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TechTalk
SERVING THE MIT COMMUNITY

Geobiologist Newman follows a rocky road

New HHMI investigator sees clues to life in ancient rocks

Anne Trafton
News Office

When most people look at a rock, they see a lifeless slab. When Dianne Newman looks at one, she sees clues to the history of life on Earth — and potential answers to some of today's medical mysteries.

"You have to look at what we have today and use it to figure out what happened long ago," says Newman, a professor of biology at MIT. "In studying Earth's history, it's very common to look at ancient rocks to infer something about the processes that led to their formation."

Newman, a geobiologist who joined MIT's faculty last year after seven years at Caltech, studies the co-evolution of life and Earth. By focusing on traces left behind by bacteria billions of years ago, she hopes to learn something about ancient Earth and its life forms.

Her work has also led down an unexpected path. She's studying how certain types of anaerobic bacteria thrive in the human body, which could one day help treat infections.

Earlier this year, Newman was named a Howard Hughes Medical Institute investigator, an award that provides unrestricted funding to top researchers to explore topics that may take many years to reach fruition.

Past and present

Geobiologists such as Newman take two complementary approaches to studying ancient Earth and its microbes. One is to analyze rocks containing fossilized deposits of organic and inorganic material; another is to probe the metabolism of modern bacteria.

The second approach is based on the idea that fundamental processes such as cellular metabolism are conserved over time, even billions of years. Half of Newman's laboratory focuses on cyanobacteria and purple bacteria, phototrophic organisms that are assumed to be metabolically not much different from their ancestors that lived billions of years ago.

> *You have to look at what we have today and use it to figure out what happened long ago.*
>
> **Dianne Newman**
> **biology professor**

AP PHOTO

HHMI investigator Dianne Newman

Cyanobacteria are believed to be the first life forms to produce oxygen from water by photosynthesis — a critical step in making Earth hospitable to life that depends on oxygen. Purple bacteria, on the other hand, grow photosynthetically on substrates other than water and do not produce oxygen.

A few years ago, she and her students isolated a type of modern bacterium, known as Rhodopseudomonas palustris, that performs photosynthesis using ferrous iron, with rust as a byproduct. Similar bacteria are thought to have existed billions of years ago.

"It's great that we can still find and study those bacteria with such bizarre metabolisms," Newman says. "We hope that they will provide us with important clues that will allow us to better interpret the evolution of life in the ancient rock record."

Such bacteria leave behind minerals, which, over time, turn into deposits of iron in rocks such as the one Newman has in her office — a smooth dark sphere with jagged red markings.

That specimen, found in South Africa, is about 2.4 billion years old, but such rocks can range from 3.8 billion to less than 1 billion years old. She hopes to discover how iron deposits were formed during different time periods, which could reveal the composition of the Earth's

▶Please see NEWMAN, **PAGE 7**

Hockfield to testify on need for energy research

Speaking to Congressional committee Wednesday

MIT President Susan Hockfield will argue for a sharp increase in federal funding for energy-related research during a pair of visits to Washington in the coming week.

On Wednesday, Sept. 10, Hockfield will testify before the House Select Committee on Energy Independence and Global Warming, which is chaired by Massachusetts Congressman Edward Markey. The committee was created last year to address issues related to the urgent challenges of oil dependence and climate change.

Check the News Office web site for up-to-date information at
web.mit.edu/newsoffice

The hearing will be webcast on the committee's web site at http://globalwarming.house.gov starting at 10 a.m.

A week after her appearance on Capitol Hill, Hockfield will be back in Washington for a press conference on energy at the National Press Club, along with energy industry leaders and the director of a national laboratory. The four speakers will again be calling for increased investment in basic energy research.

Hockfield's testimony is an outgrowth of the MIT Energy Initiative (MITEI), an ambitious, Institute-wide effort to provide an objective analysis of the policies and technologies that will transform the energy landscape.

For updated coverage of Hockfield's testimony, please visit the MIT News Office web site at web.mit.edu/newsoffice.

Two of a kind: O'Bryant students get set for four years at MIT

Stephanie Schorow
News Office correspondent

When Alban Cobi, 18, and Bruno Piazzarolo, 17, started their senior year at the John D. O'Bryant School of Math & Science in the Roxbury section of Boston, they really wanted to go to MIT — but neither was counting on it.

The two students understood just how tough it was to get accepted at MIT and that no student from their school had been admitted in recent memory. So they decided to apply and not be too disappointed if they didn't get in.

Thus, when Cobi and then Piazzarolo got the news in the spring that both were accepted to the Class of 2012, it was — in the parlance of high school — an "Omigod" exalted moment.

"I love the school so much I knew I had to come here," said Cobi, during his first week on campus. "Part of it is MIT's great name. And now, as I come to orientation, I like the people here. It's very diverse. We have people from all these countries and states — I think anyone can fit in here."

For the past several years, MIT has had a close relationship with the O'Bryant School, coordinated by Professor J. Kim Vandiver, dean for undergraduate research. It is one of many efforts MIT is making to help prepare high school students for rigorous education in math and science.

For Piazzarolo and Cobi, the preparation paid off.

Piazzarolo got the news of his acceptance via cell phone while in a Best Buy. "I was really excited — it was somewhat of a shock," he said.

The two teenagers were instant celebrities at O'Bryant, the former Boston Technical High School, and one of the examination schools in the

▶Please see O'BRYANT, **PAGE 7**

PHOTO / **PATRICK GILLOOLY**

Bruno Piazzarolo, 17, and Alban Cobi, 18, will be attending MIT after graduating from the John D. O'Bryant School of Math & Science in Roxbury, which has close ties to MIT.

Former MIT Corporation Chairman Alexander d'Arbeloff

D'Arbeloff remembrance set for Oct. 17

The MIT community will honor the life and legacy of former MIT Corporation Chairman Alexander Vladimir d'Arbeloff '49 during a remembrance gathering at 3:30 p.m. on Oct. 17 in Kresge Auditorium.

D'Arbeloff, a visionary entrepreneur who co-founded Boston-based high-tech company Teradyne, died on July 8 at age 80.

As the eighth chairman of the MIT Corporation, d'Arbeloff provided crucial leadership during the Calculated Risks, Creative Revolutions fundraising campaign, which had a transformative effect on the Institute — from the physical campus to its research agenda. The campaign ushered in cutting-edge facilities such as the Al and Barrie Zesiger Sports and Fitness Center and the Ray and Maria Stata Center and also sparked a new emphasis on the intersection between the life sciences and engineering at MIT.

With his wife, Brit SM '61, d'Arbeloff created the Fund for Excellence in MIT Education to support teaching innovations in science and engineering. The pair also supported a professorship in the MIT Department of Mechanical Engineering and established the d'Arbeloff Lab in the Department of Mechanical Engineering.

In 1960, d'Arbeloff co-founded Teradyne Inc. with Nick DeWolf — a former MIT classmate whom he had met when they had to line up alphabetically during an ROTC class. During his tenure as president and CEO of Teradyne, which manufactures automatic test equipment and interconnection systems for the electronics and telecommunications industries, the company's annual sales rose from $13 million to more than $1 billion.

In 1997, he was named chairman of the MIT Corporation, having served as a member since 1989. At the time, he said he was aware of the differences between academia and the business world but preferred to focus on the common ground they shared.

Memorial gifts may be made to the d'Arbeloff Fund for Excellence in Education. Checks to MIT can be mailed to the MIT Office of Memorial Gifts, 600 Memorial Drive, W98-500, Cambridge, MA 02139-4307. Questions may be directed to Bonny Kellermann at bonnyk@mit.edu; 617-253-9722.

To read more about Alex d'Arbeloff's life, please visit the MIT News Office web site at web.mit.edu/newsoffice/2008/obit-darbeloff-0709.html.

Manalis wins new NIH grant

EUREKA program seeks to unleash revolutionary science

Scott Manalis, associate professor of biological and mechanical engineering, has been awarded a new grant from the National Institutes of Health to promote investigation of novel, unconventional hypotheses.

The NIH last week announced it will award $42.2 million to 38 research projects under the new grant program, called EUREKA (Exceptional, Unconventional Research Enabling Knowledge Acceleration).

Scott Manalis

"EUREKA projects promise remarkable outcomes that could revolutionize science," said NIH Director Elias A. Zerhouni. "The program reflects NIH's commitment to supporting potentially transformative research, even if it carries a greater than usual degree of scientific risk."

Manalis, who is also a member of the David H. Koch Institute for Integrative Cancer Research at MIT and the MIT Media Lab, said he plans to use the funding, approximately $200,000 per year for four years, to develop a microsystem for cell sizing.

Manalis says the sizing system could help answer the question of how cells control their size. Such work could help shed light on how cancer develops, and could potentially be used to evaluate the effectiveness of cancer drugs.

The system is based on a mass sensing technology recently developed in the Manalis laboratory that can weigh mammalian cells with a precision of one part in 10,000.

The cell-sizing project grew out of a collaboration with biologists Paul Jorgensen and Marc Kirschner of Harvard Medical School, who worked with Manalis and his students to develop approaches for studying mammalian cells with the mass sensing technology.

The Manalis laboratory originally developed the mass sensor for immunoassays. "We never planned to weigh cells," he said. "It has been exciting for us to find an application in cell biology."

Lonsdale to head MIT Haystack Observatory

Colin J. Lonsdale, a noted radio astronomer and the principal investigator of the Murchison Widefield Array (MWA) project, will become director of the Haystack Observatory, effective Sept. 1.

Claude Canizares, vice president for research and associate provost, announced Lonsdale's appointment and noted that he "brings great scientific, technical and managerial strengths to the directorship, as well as a long history of contributions to the observatory and to the wider radio astronomy community."

Colin J. Lonsdale

Lonsdale succeeds Joseph Salah, who was the director of the observatory from 1983 to 2006, and Alan R. Whitney, who has been serving as interim director.

Lonsdale is a 1978 graduate of St. Andrews University, Scotland. He received a PhD from the University of Manchester in 1981 following thesis research conducted at Nuffield Radio Astronomy Labs, Jodrell Bank, England, on observations of extragalactic radio sources. Following work at Pennsylvania State University, he joined the research staff at Haystack in 1986. In recent years, he has served as principal research scientist and in 2006 became an assistant director at Haystack.

Lonsdale's most recent work has been as principal investigator of the Murchison Widefield Array, an innovative new radio array with powerful capabilities for radio astronomy and heliospheric science at frequencies from 80 to 300 megahertz, optimized for extremely wide fields of view and unprecedented sensitivity at those frequencies.

The MWA is located in Western Australia. Alan Whitney has been appointed the project director for the MWA.

MIT Haystack Observatory is an interdisciplinary research center engaged in radio astronomy, geodesy, upper atmospheric physics and radar applications. The facility is located in Westford, Mass.

AWARDS&HONORS

Langer wins Millennium Technology Prize

In June, MIT Institute Professor Robert Langer won the Millennium Technology Prize, the world's largest award for technology innovation.

Langer was chosen "for his inventions and development of innovative biomaterials for controlled drug release and tissue regeneration that have saved and improved the lives of millions of people," according to Technology Academy Finland, which gives the award every other year.

The award goes to developers of a technology that "significantly improves the quality of human life, today and in the future." Winners receive 800,000 euros, or about $1.2 million.

Tarja Halonen, president of Finland, handed Langer the prize and the trophy at an award ceremony in Helsinki.

Langer will also be speaking on Thursday, Sept. 25, as part of the Molecules That Matter Lecture Series put on by the Chemical Heritage Foundation. The series will showcase scientific objects and artistic reactions to 10 organic molecules that transformed the twentieth century.

Roberts selected for world forum

Ed Roberts, the David Sarnoff Professor of Management of Technology and chairman of the MIT Entrepreneurship Center, has been selected to participate in the World Economic Forum's Global Agenda Council on Promoting Entrepreneurship, which includes "the most innovative and relevant leaders to capture the best knowledge on each key issue and integrate it into global collaboration and decision-making processes."

MIT Sloan professors named fellows

John Hauser, the Kirin Professor of Marketing, and Institute Professor John Little were elected as inaugural fellows of the INFORMS Society of Marketing Science at the 30th Annual Marketing Science Conference in Vancouver, BC. The 10 Fellows Awards were given in recognition of significant, long-term contributions in research, education and service to the Society of Marketing Science's efforts.

Students juggle to a win

Jacob Sharpe '11 and Nate Sharpe '09 won first place in the International Juggling Association Teams Competition with their duo Diabolo routine. The brothers, well known around MIT for bringing in the gold at various talent shows across campus, broke away from their summer commitments to make time for the competition.

Architectural team takes first in London

SODA, a team of architects at MIT, in collaboration with SPArc at the MIT Design Laboratory, won first prize of the International Architectural Competition "London 2008" organized by Arquitectum in collaboration with the Architectural Association of London. The competition "Adaptable Architecture Gallery" called for a mobile design for an architecture gallery, floating and itinerating through the Thames River in London.

Students win Dan David Prizes

James Saenz, a graduate student in the Department of Earth Atmospheric and Planetary Sciences, and Nicholas Buchanan, a graduate student in the Program in Science, Technology, and Society, were named recipients of the Dan David Prize for young scholars. Saenz won for "Developing a Molecular Proxy for Marine Cyanobacteria"; Buchanan on "Negotiating Nature: Expertise and Environment Along the Klamath River."

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NEWS IN BRIEF

Nominations Open for Doherty Professorship

Nominations are now open for the Doherty Professorship in Ocean Utilization. All nontenured MIT faculty members from any Institute department are eligible. Endowed by the Henry L. and Grace Doherty Charitable Foundation, the two-year chair opens the way for promising, nontenured professors to undertake marine-related research that will further innovative uses of the ocean's resources. Deadline is Nov. 7.

The person appointed to the Chair will receive $25,000 per year for two years, beginning July 1, 2009. Please contact Kathy de Zengotita for more information, Room E38-300, 617-253-7042, kdez@mit.edu.

Endicott House garden sale starts today

The Endicott House fall garden sale will be held today, Wednesday, Sept. 10, and tomorrow, Sept. 11, from 9 a.m.-3 p.m. Today's sale (on McDermott Court, between Walker Memorial and Building 54), features many hardy chrysanthemums and houseplants. Tomorrow's sale, which is geared more toward students, will include a variety of houseplants and gift items. The second sale will be in the Edgerton House courtyard, 143 Albany St. Staff from Endicott House (with help from the MIT Gardeners' Group) will also provide advice to new gardeners.

Jacks to accept award from EHS

Tyler Jacks, director of the Koch Institute for Integrative Cancer Research at MIT, will be presented an award by the Environment, Health and Safety Office on Sept. 12, at 10:30 a.m., in recognition of the Koch Institute's outstanding EHS performance. Criteria used to select awardees included such requirements as timely completion and maintenance of required EHS training by all personnel requiring training and completion of EHS inspections.

Class project gets gold star from Google

'Locale' will let Android cell phones adjust to surroundings

A team of MIT students walked away from their spring-semester course with a lot more than an A and six credits: They just won a $275,000 top prize from Google for the application they developed for the company's new open-source Android cell-phone system.

The application, called "Locale," lets a cell phone automatically adjust its settings according to its location — for example, silencing the ringer when it detects that it's at the office or in a lecture hall.

Locale was developed by students in a class called "Building mobile applications with Android" (6.087), taught by Hal Abelson, the Class of 1922 Professor of Computer Science and Engineering in the Department of Electrical Engineering and Computer Science. The class is being offered again this fall, but this time is extending to cover two other cell-phone systems in addition to Google's Android: Nokia and Windows Mobile.

Engineers from Google, Nokia and Microsoft will also work with students in the class to help them develop their concepts. One of the important aspects of this hands-on class, Abelson says, is "to give the students the experience of working with really experienced professionals" as they refine their applications. Professor Alex (Sandy) Pentland of the Media Lab and Eric Klopfer of the Department of Urban Studies and Planning will be co-teaching the class with Abelson. Andrew Yu of MIT's IS&T will also be working with the teams.

Two of the students who developed Locale, Carter Jernigan and Jasper Lin, graduated this June with degrees in computer science and are now working as software engineers. Christina Wright is also a recent graduate in computer science. And Clare Bayley is a junior, majoring in computer science. Jennifer Shu, a recent MIT graduate in computer science who works as a software engineer, was added to the team to help them perfect the product.

The team's application was one of 10 Google selected for the top prizes on Aug. 29, out of 50 finalists that were chosen from hundreds of entries. In addition to the cash prize, each of the winning applications will now be included with every new Android phone. The first such phones are expected to be released before the end of the year. Ten other teams won $100,000 each.

PHOTO COURTESY OF THE LOCALE TEAM

A cell phone showing how Locale, a program created by MIT students for Google's Android phone platform, works.

OBITUARIES

Former professor, MIT alumnus Hammer dies at 60

Michael Hammer, a research affiliate with MIT's Engineering Systems Division who also previously taught as a professor of computer science and was a lecturer in the MIT Sloan School of Management, died Wednesday after collapsing from apparent cranial bleeding last month. He was 60.

Hammer received an SB (1968), SM (1970) and PhD (1973) from MIT and was the president of Hammer and Company, a business education and research firm focused on cutting-edge issues in operations, organization and management.

After graduating from the Institute, he became an assistant, then associate, professor of computer science at MIT. He was the associate director for the Laboratory for Computer Science, one of the precursors to the Computer Science and Artificial Intelligence Laboratory.

In 1987, he began working full time as a management consultant, an endeavor he characterized as "research and teaching the theory and practice of why and how enterprises do (and don't do) good work." It was this work that informed and inspired the international best-seller, "Reengineering the Corporation."

Hammer was also named by Time magazine to its first list of America's 25 most influential individuals. An engineer by training, Hammer focused on the operational nuts and bolts of business.

Hammer's relentless pursuit of "why?" drove his entire career. "My modus operandi is simple," he once wrote, "though not always easy to carry out. I take nothing at face value. I approach all business issues and practices with the same skepticism: Why?"

PHOTOS / **PATRICK GILLOOLY**

pi + pi = welcome to MIT

Phi Kappa Theta members Matt Fitzgerald '10, center, and Victor Vazquez '10, right, hit Jacob Bredthauer '11 with a pie during the Philanthropy Carnival at MIT on Monday, Aug. 25. The event was part of orientation for MIT's Class of 2012.

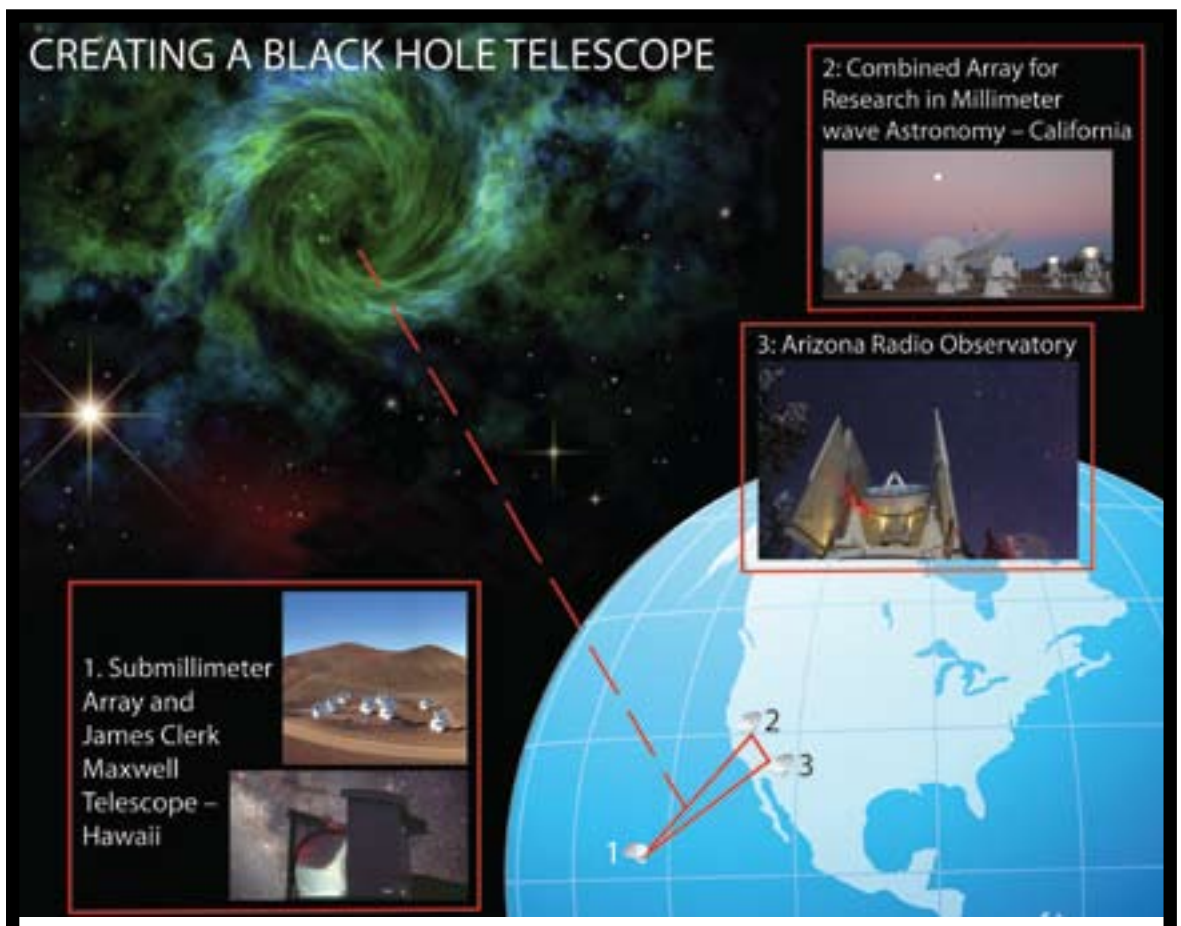
AWARDS &HONORS

MIT sending two to participate in U.S. Frontiers of Engineering Symposium

Stephen J. Uftring, assistant leader of the Missile Defense Elements Group at Lincoln Laboratory, and Christopher Schuh, an associate professor in the Department of Materials Science and Engineering, have been selected to take part in the National Academy of Engineering's 2008 U.S. Frontiers of Engineering Symposium, which brings together engineers who are performing exceptional research and technical work.

John Howard Dellinger Medal awarded to Haystack Observatory professor

Professor Alan Ernest E. Rogers, of MIT's Haystack Observatory, was recently honored with the John Howard Dellinger Medal, which is given out by the International Union of Radio Science. Rogers was cited for "his outstanding contributions to instrumentation in radio astronomy and its use to make fundamental discoveries about interstellar masers, superluminal expansion of quasars, deuterium abundance in the galaxy, and plate tectonics."



GRAPHIC / **SHEP DOELEMAN, PATRICK GILLOOLY**

Four radio observatories in Hawaii, Arizona and California linked to create a 2,800-mile-wide virtual telescope.

New virtual telescope zooms in on Milky Way's super-massive black hole

David Chandler
News Office

An international team, led by astronomers at the MIT Haystack Observatory, has obtained the closest views ever of what is believed to be a super-massive black hole at the center of the Milky Way galaxy.

The astronomers linked together radio dishes in Hawaii, Arizona and California to create a virtual telescope more than 2,800 miles across that is capable of seeing details more than 1,000 times finer than the Hubble Space Telescope. The cosmic target of the observations was the source known as Sagittarius A* ("A-star"), long thought to mark the position of a black hole whose mass is 4 million times that of the sun. Though Sagittarius A* was discovered three decades ago, the new observations for the first time have an angular resolution, or ability to observe small details, that is matched to the size of the black hole "event horizon" — the region inside of which nothing, including light, can ever escape.

The concept of black holes, objects so dense that their gravitational pull prevents anything including light itself from ever escaping their grasp, has long been hypothesized, but their existence has not yet been proved conclusively. Astronomers study black holes by detecting the light emitted by matter that heats up as it is pulled closer to the event horizon. By measuring the size of this glowing region at the Milky Way center, the new observations have revealed the highest density yet for the concentration of matter at the center of our galaxy, which "is important new evidence supporting the existence of black holes," said Sheperd Doeleman of MIT, lead author of the study that will be published in the Sept. 4 issue of the journal Nature.

"This technique gives us an unmatched view of the region near the Milky Way's central black hole," Doeleman said. "The new observations have a resolution equivalent to being able to see, from Earth, a baseball on the surface of the moon."

The key to making these observations is a technique called very long baseline interferometry, or VLBI, which links simultaneous observations from several radio telescopes that can be thousands of miles apart. The signals from these radio dishes are combined to create a "virtual" telescope with the same resolving power as a single telescope as large as the distance between the participating dishes. As a result, VLBI can reveal exquisitely sharp details. To create the continent-sized telescope, the team developed and installed special equipment at four observatories: the Arizona Radio Observatory's Submillimeter Telescope (ARO-SMT) of the University of Arizona, the Combined Array for Research in Millimeter-wave Astronomy (CARMA) in California, and both the James Clerk Maxwell Telescope (JCMT) and the Submillimeter Array (SMA) in Hawaii.

> *This technique gives us an unmatched view of the region near the Milky Way's central black hole*
>
> **Sheperd Doeleman**
> **Research scientist,**
> **MIT Haystack Observatory**

The new observations were done using very short radio waves of 1.3 millimeters wavelength, which can penetrate the fog of interstellar gas that blurs observations at longer wavelengths. Like a distant light seen through a dense mist, longer-wavelength views of the Galactic Center are dimmed and distorted. "The short wavelength observations, combined with the large distances between the radio observatories, is what makes this virtual telescope uniquely suited to study the black hole," said Lucy Ziurys, director of the Arizona Radio Observatory and a co-author of the study.

Though it takes light more than 25,000 years to reach us from the center of the Milky Way, the team measured the size of Sagittarius A* to be only one-third the Earth-sun distance — a trip that light would make in only three minutes. The astronomers concluded that the source of the radiation likely originates in either a disk of matter swirling in toward the black hole, or a high-speed jet of matter being ejected by the black hole. "Future observations that create even larger virtual telescopes will be able to pinpoint exactly what makes Sagittarius A* light up," Doeleman said. "Most galaxies are now thought to have black holes at their centers, but because Sagittarius A* is in our own galaxy, it is our best chance to observe what's happening at an event horizon."

"This pioneering paper demonstrates that such observations are feasible," commented theorist Avi Loeb of Harvard University, who was not a member of the discovery team. "It opens up a new window for probing the structure of space and time near a black hole and testing Einstein's theory of gravity."

Total recall

MIT researchers: human memory capacity much bigger than previously thought

Anne Trafton
News Office

In recent years, demonstrations of memory's failures have convinced many scientists that human memory does not store the details of our experiences. However, a new study from MIT cognitive neuroscientists may overturn this widespread belief: They have shown that given the right setting, the human brain can record an amazing amount of information.

In the study, the results of which could have implications for artificial intelligence and for understanding memory disorders, people viewed thousands of objects over five hours. Remarkably, afterward they were able to remember each object in great detail.

"Visual long-term memory capacity is much higher than previously believed and shown," said Aude Oliva, associate professor of brain and cognitive sciences and senior author of a paper describing the work, which will appear in the Proceedings of the National Academy of Sciences the week of Sept. 8.

Co-authors include MIT graduate students Timothy Brady and Talia Konkle, and George Alvarez, a former postdoctoral associate in brain and cognitive sciences and current assistant professor of psychology at Harvard University.

PHOTO / **PATRICK GILLOOLY**

Associate professor of brain and cognitive sciences Aude Oliva

Oliva and her students showed subjects nearly 3,000 images, one at a time, for three seconds each. In tests the same day, they were shown pairs of images and asked to select the exact image they had seen earlier.

Subjects were tested with three types of pairings: two totally different objects; an object and a different example of the same type of object (e.g., two different remote controls); and an object and a slightly altered version (e.g., a cup that is either full or half-full).

Against all expectations, subjects' recall rates on the three types of memory tests were 92 percent, 88 percent and 87 percent, respectively. "To give just one example, this means that after having seen thousands of objects, subjects didn't just remember which cabinet they had seen, but also that the cabinet door was slightly open," Brady said.

While a previous study from the 1970s showed that people could remember many individual images, scientists assumed that people could only remember abstract descriptions of the images (for example, "a photo of a wedding"), but not details about each one.

The new results suggest that visual capacity is several orders of magnitude higher than the older study implied.

Traditional models of vision theorize that details necessarily slip away as visual input travels from the eyes to higher processing centers in the brain. The new results may prompt neuroscientists to revise those models to account for how people remembered so many details, Konkle said.

Previous studies had never found that we could hold so many details in memory, in part because they didn't look for it.

However, the researchers believe that multiple factors play a critical role in how well people remember details. For instance, it makes a huge difference if people are motivated to pay attention to detail, which they were in this study.

Second, it helps if the objects viewed are familiar. The images used in this study were all everyday items such as remote controls, dollar bills and loaves of bread. The results would likely be different if subjects were asked to remember details of abstract artworks, Oliva said. In future studies, the team hopes to explore factors that affect the level of detail at which memories are encoded.

These results establish a new bound on the size of human memory, and give credence to artificial intelligence approaches that depend primarily on a large memory capacity. The research also has implications for diagnosing memory disorders using more sensitive tests of what is remembered and what is forgotten.

The research was funded by the National Science Foundation, the National Institutes of Health, a National Defense Science and Engineering Graduate Fellowship, and a National Research Service Award.

For a demo of the study or more information, see http://cvcl.mit.edu/MM/.

IMAGE COURTESY OF THE COMPUTATIONAL VISUAL COGNITION LABORATORY

Examples of some of the images used in the researchers' study.

MIT probe could aid quantum computing

Gregory P. Hamill
MIT Lincoln Laboratory

MIT researchers may have found a way to overcome a key barrier to the advent of super-fast quantum computers, which could be powerful tools for applications such as code breaking.

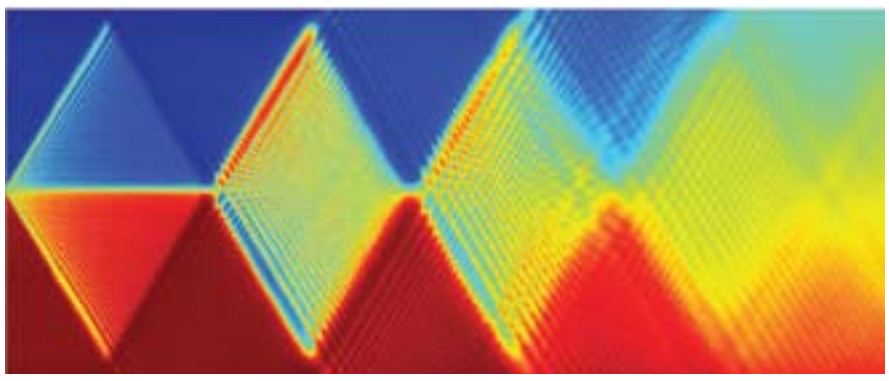


IMAGE COURTESY OF LINCOLN LABORATORY

The colorful patterns formed by the response of superconducting 'artificial atoms' to a new probe called amplitude spectroscopy serve as an identifying fingerprint for a given atom.

Ever since Nobel Prize-winning physicist Richard Feynman first proposed the theory of quantum computing more than two decades ago, researchers have been working to build such a device.

One approach involves superconducting devices that, when cooled to temperatures of nearly absolute zero (-459 degrees F, -273 degrees C), can be made to behave like artificial atoms — nanometer-scale "boxes" in which the electrons are forced to exist at specific, discrete energy levels (picture an elevator that can stop at the floors of a building but not in between). But traditional scientific techniques for characterizing — and therefore better understanding — atoms and molecules do not necessarily translate easily to artificial atoms, said William Oliver of MIT Lincoln Laboratory's Analog Device Technology Group and MIT's Research Laboratory for Electronics (RLE).

In the Sept. 4 issue of Nature, Oliver and colleagues have reported a technique that could fill that gap. Oliver's co-authors are lead author David Berns, a graduate student in physics and RLE; Mark Rudner, also a graduate student in physics; Sergio Valenzuela, a research affiliate at MIT's Francis Bitter Magnet Laboratory; Karl Berggren, the Emanuel E. Landsman Career Development Associate Professor in the Department of Electrical Engineering and Computer Science (EECS); Professor Leonid Levitov of physics; and EECS Professor Terry Orlando. The work is a hallmark of the increased collaboration between researchers on the MIT campus and at Lincoln Laboratory.

Characterizing energy levels is fundamental to the understanding and engineering of any atomic-scale device. Ever since Isaac Newton showed that sunlight could be dispersed into a continuous color spectrum, each color representing a different energy, this has been done through analysis of how an atom responds to different frequencies of light and other electromagnetic radiation — a technique known generally as spectroscopy.

But artificial atoms have energy levels that correspond to a very wide swath of frequencies, ranging from tens to hundreds of gigahertz. That makes standard spectroscopy costly and difficult to apply. "The application of frequency spectroscopy over a broad band is not universally straightforward," Oliver said.

The MIT team developed a complementary approach called amplitude spectroscopy that provides a way to characterize quantum entities over extraordinarily broad frequency ranges. This procedure is "particularly relevant for studying the properties of artificial atoms," Oliver said.

Better knowledge of these superconducting structures could hasten the development of a quantum computer. Each artificial atom could function as a "qubit," or quantum bit, which can be in multiple energy states at once. That means it would not be simply a one or a zero (like the electronic switches in a conventional computer) but rather in a sort of hazy combination of both states (it's akin to the famous paradox of Schroedinger's quantum cat, which is considered to be both alive and dead at the same time until an observation is made, simultaneously creating and revealing its true condition). This odd behavior, inherent to the quantum nature of materials at the atomic level, is what gives quantum computing such promise as a paradigm-busting advance.

Amplitude spectroscopy gleans information about a superconducting artificial atom by probing its response to a single, fixed frequency that is strategically chosen to be, as Oliver puts it, "benign." This probe pushes the atom through its energy-state transitions. In fact, the atoms can be made to jump between energy bands at practically unlimited rates by adjusting the amplitude of the fixed-frequency source.

The radiation emitted by the artificial atom in response to this probe exhibits interference patterns. These patterns, which Oliver calls "spectroscopy diamonds" because of their striking geometric regularity, serve as fingerprints of the artificial atom's energy spectrum.

MIT zooms in on malaria-infected cells

Work could aid in diagnostics, drug testing

Anne Trafton
News Office

In work that could lead to new ways of detecting and treating malaria, MIT researchers have used two advanced microscopy techniques to show in unprecedented detail how the malaria parasite attacks red blood cells.

The researchers' images show red blood cell membranes becoming less flexible, which causes the cells to clump as they try to navigate tiny blood vessels. They also show the destruction of hemoglobin, the critical molecule that red blood cells use to carry oxygen.

The images are made possible by microscopy techniques that reveal tiny vibrations in red blood cell membranes.

"By studying the way the cell membrane vibrations progressively change as the malaria parasite matures inside the cell, we can study the changes in its mechanical, elastic and dynamic properties," said Michael Feld, director of MIT's George Harrison Spectroscopy Laboratory and a professor of physics.

Feld and Subra Suresh, dean of MIT's School of Engineering, are senior authors of a paper on the work to be published in the Proceedings of the National Academy of Sciences the week of Sept. 1.

The study establishes the first experimental connection between cell membrane vibration and the pathological state of a living cell.

"You can establish a measurement of membrane-fluctuation changes as a function of the gradual progression from a healthy state to a severely pathological state," said Suresh, who has appointments in materials science and engineering, biological engineering, mechanical engineering and the Harvard-MIT Division of Health Sciences and Technology.

It has been known for more than a century that red blood cell membranes continuously undulate. These vibrations are difficult to study because the measurements involved are so tiny (nanometer, or billionth of a meter, scale), and occur in just microseconds.

Suresh and colleagues have previously shown that the cell membranes of red blood cells invaded by the malaria parasite lose their elasticity, as proteins transported from the parasite attach to the membranes and make them significantly stiffer.

In the new paper, the researchers describe using a technique called diffraction phase microscopy to image living cells over the first 48 hours of malaria parasite maturation. They showed that infection reduces elasticity and decreases the vibration frequency of the cell membrane.

The team also used a technique called tomographic phase microscopy, which was developed in Feld's laboratory and is based on the same concept as a CT scan: To create a 3-D image, the researchers combine about 100 two-dimensional images taken from different angles. Those images are produced with a technique known as interferometry, in which a light wave passing through a cell is compared with a reference wave that doesn't pass through it.

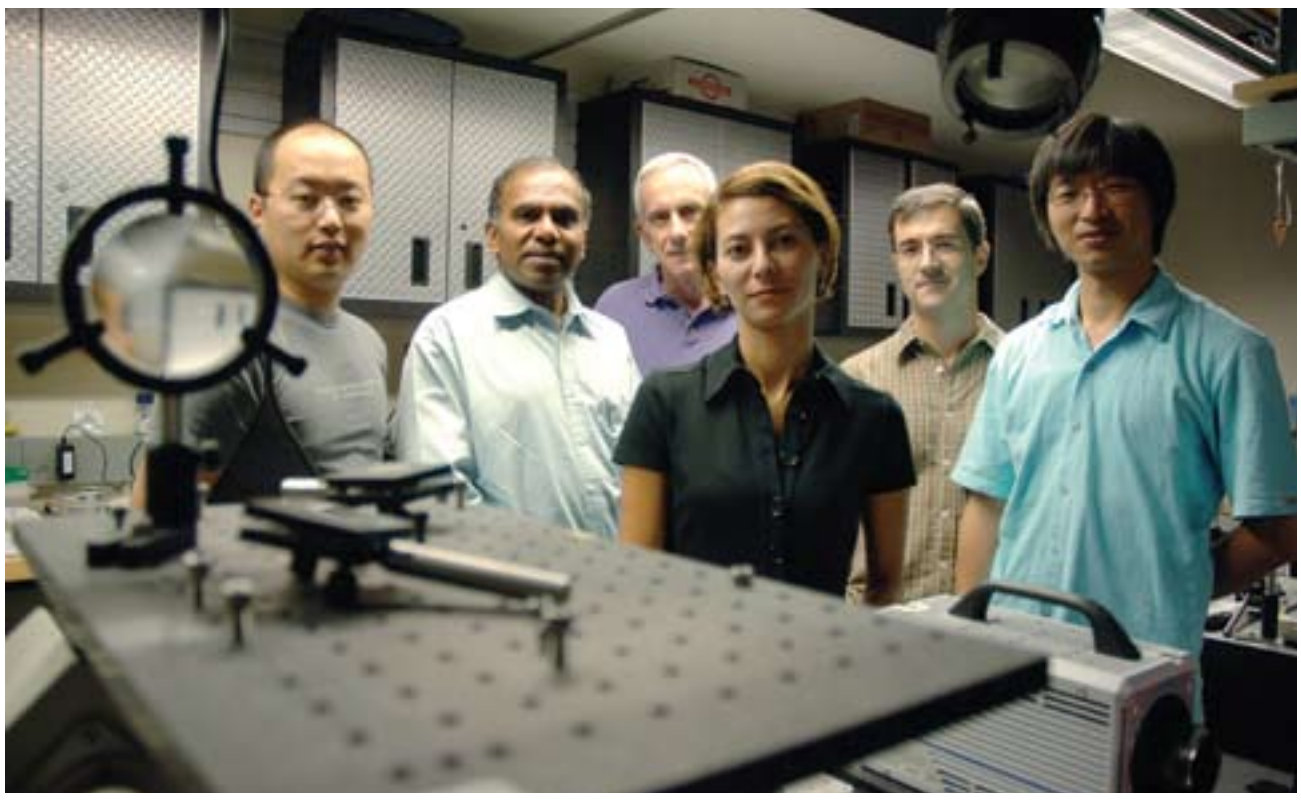


PHOTO / **PATRICK GILLOOLY**

From left, graduate student YongKeun Park, School of Engineering Dean Subra Suresh, Professor Michael Feld, and postdocs Monica Diez-Silva, George Lykotrafitis and Wonshik Choi stand in the Spectroscopy Laboratory.

The technique allowed them to study changes in the refractive index of a cell, which is a measure of how much the speed of light is reduced as it passes through the material.

Images generated by tomographic phase microscopy revealed the degradation of hemoglobin as the malaria parasite interacted with the cell.

In the future, the microscopy technology could be used to develop a diagnostic tool to detect human diseases by measuring cell membrane properties. It could also be used to test the efficacy of potential drugs.

The current project got underway about two years ago, after Suresh gave a talk at the Spectroscopy Laboratory on his work studying the mechanical stiffness of malaria-infected red blood cells. Feld and his colleagues were already working on microscopy techniques to visualize red blood cells, so the groups decided to collaborate.

"This project brought physics, engineering, materials science and cell biology all to bear on a problem of infectious disease," said Suresh.

Lead authors of the paper are YongKeun Park, a graduate student in the Harvard-MIT Division of Health Sciences and Technology, and Monica Diez-Silva, a microbiologist trained at Institut Pasteur and currently a postdoctoral fellow in the Department of Materials Science and Engineering (DMSE). Other authors are Gabriel Popescu, now at the University of Illinois at Urbana-Champaign; George Lykotrafitis, a DMSE postdoctoral fellow; and Wonshik Choi, a postdoctoral associate in the Spectroscopy Lab.

This work was funded by the National Center for Research Resources of the National Institutes of Health, the National Science Foundation, and the Singapore-MIT Alliance for Research and Technology Center.

PHOTO / **L. BARRY HETHERINGTON**

What's new at MIT

New Dean for Student Life Chris Colombo stands in front of the new Ashdown House during a picnic to introduce both to the MIT community.

Kinney named director of arts initiatives

Leila Kinney will become director of arts initiatives, effective Oct. 1, Associate Provost Philip S. Khoury announced this week.

Currently working as administrator for academic programs in comparative media studies, Kinney will work with the associate provost, the Office of the Arts, the MIT Museum, the List Visual Arts Center and the Creative Arts Council to advance the arts agenda at MIT in the areas of strategic planning, communications, resource development and cross-school collaborations.

"Leila Kinney already commands the respect and admiration of the many faculty and staff in the MIT arts community who collaborated with her when she was a faculty member and most recently as a member of the Creative Arts Council," Khoury said. "I am delighted she accepted to become director of arts initiatives, and I look forward to working closely with her for the higher good of MIT's outstanding arts institutions and programs."

Kinney is an art historian with experience in both the School of Humanities, Arts, and Social Sciences and the School of Architecture and Planning at MIT. In her current position, Kinney coordinates a thriving graduate, postdoctoral and visiting scholars program and guided the recent approval by the Institute of the bachelor of science degree in comparative media, the first interdisciplinary undergraduate degree established at the Institute.

Previously on the faculty in the history, theory and criticism section of the Department of Architecture, she specialized in modern art, with an emphasis on media in transition, arts institutions and artists' engagement with mass culture. Her publications have focused on early modernist painters, world fairs, hybrid artistic genres and new visual technologies in the 19th century. She also taught in the Program in Women's Studies and served on search committees for the Visual Arts Program and the List Visual Arts Center. For the College Art Association, Kinney worked on new media communications; she established its first web site, co-founded its electronic reviews journal, http://caareviews.org, and facilitated its advocacy for fair use of digital imagery.

"MIT offers unparalleled circumstances for artistic discovery and creativity," Kinney said. "Where else can one find creations such as a Sol LeWitt floor in the physics building, a sonic chandelier in the music library, a digitally controlled water pavilion and an electronic archive of Shakespeare performances alongside exquisite performances of both classical and original music, dance and theater by renowned faculty and over 50 student groups? MIT students are famously gifted in science, technology, engineering and math, and at the same time extraordinarily active in the arts. It is a distinctive aesthetic environment."

Kinney received a BA from Agnes Scott College with highest honors in English literature and art history and an MA from Yale University in history of art. She succeeds Lori Gross, who became associate provost for the arts and culture at Harvard University in July.

Broad Institute receives unprecedented $400m endowment

Less than five years into a 10-year groundbreaking experiment in philanthropy and science, the results are in. The Broad Institute of MIT and Harvard, launched in 2004 to test how effective interinstitutional collaboration could be in propelling biomedical progress, has been declared a resounding success and will now become a permanent institution within the biomedical landscape.

At a Sept. 4 celebration, the Broad Institute of MIT and Harvard received an unprecedented gift from its philanthropic founding partners, Eli and Edythe L. Broad: a $400 million endowment intended to establish the Broad Institute of MIT and Harvard as a permanent biomedical research organization. The Broads announced their gift at a ceremony featuring speeches by Gov. Deval Patrick of Massachusetts, MIT President Susan Hockfield, Harvard President Drew Gilpin Faust, Nobel-winning former MIT professor and Caltech President Emeritus David Baltimore, and MIT Professor of Biology and Broad Institute Director Eric Lander.

PHOTO / **LEN RUBENSTEIN**

From left to right, Broad Institute Director Eric Lander, MIT President Susan Hockfield, Harvard President Drew Gilpin Faust, Eli and Edythe Broad, Massachusetts Gov. Deval Patrick and Nobel laureate David Baltimore of Caltech announce the Broad's $400 million gift.

The endowment brings the Broads' total commitment to $600 million. The gift is a testament to the success of the institute's research collaboration, which spans the entire MIT and Harvard communities, including the 17 Harvard-affiliated teaching hospitals. This collaboration aims to accelerate the pace of scientific progress and make data and tools rapidly and freely available. In its short history, the Broad Institute's accomplishments include cataloging and identifying genetic risk factors for diseases such as type 2 diabetes and autism; discovering new therapeutic targets for cancer, malaria, and other diseases; and applying genomic tools to better understand and treat human pathogens such as tuberculosis.

"Of all of our philanthropy, the Broad Institute has been the investment that has yielded the greatest returns," said Eli Broad, founder of The Eli and Edythe Broad Foundation. "This truly is a new way of doing science, and the Institute's unique collaborative model for scientific research has resulted in remarkable accomplishments in a very short period of time. Although this is a large gift — the largest that we have ever made — it is only a fraction of what will be needed to unlock the enormous promise of biomedical research at MIT and Harvard. We are counting on others to step forward as partners in the next phase of this grand experiment. We are convinced that the genomics and biomedical work being conducted here by the world's best and brightest scientists will ultimately lead to the cure and even the prevention of diseases."

The Broads' $600 million commitment is the largest to support biomedical research at a university anywhere in the world. With the new endowment, the Broad Institute will transition to a permanent, nonprofit 510(c)(3) organization with both Harvard and MIT still at the heart of it, continuing to help govern the institute.

"Eli and Edythe Broad are true visionaries," said Lander. "They made an enormous bet in 2004. Their bet has paid off more handsomely than any of us imagined. It has unleashed the creative potential of a remarkable community of scientists. And it has defined a new model for how scientists and institutions can work together."

"Cambridge and Boston are world-renowned for their creative, scientific minds and unrivaled biomedical community, and the Broad Institute is uniquely positioned to realize the full potential of these intellectual resources," said Hockfield. "We are profoundly grateful to Eli and Edythe Broad for their generosity and vision, and look forward to continuing our many collaborative research efforts through the Broad Institute and defining the future of the field."

"To fully realize the benefits of the genomic sciences, scientific research must transcend the boundaries of disciplines, departments and even institutions," said Faust. "Through their continued philanthropy, the Broads have made that transcendence possible. I am grateful for their support of this important work and look forward to continuing our partnership with the Broad Institute."

New MISTI initiative to fund faculty research worldwide

MIT International Science and Technology Initiatives (MISTI) has unveiled new funding for international collaboration — MISTI Global Seed Funds — which supports faculty research worldwide and encourages student participation.

Globalization makes international research and collaboration key to scientific and technological advance. Global issues such as health, environment, energy and security cannot be addressed effectively without international cooperation. Increasingly, scientists, managers and engineers participate in research networks across the world. Such networks are critical for advancing knowledge, theory and practical application. MISTI seeks to build global learning in all fields at MIT through its new seed funds. The funding aligns with the Institute's effort to enhance its reach in international education and research.

Proposals are welcome from faculty and research scientists in all disciplines at MIT. The application deadline is Oct. 20, and the application form is available on the MISTI web site at web.mit.edu/misti/faculty/seed.html.

The seed funds cover a variety of expenses, including exploratory field research, workshop materials and instrument costs. Salary cannot be covered. Each proposal is eligible for up to $20,000 in funding. Research and collaboration can take place anywhere in the world on any topic. For all projects, up to $10,000 in additional funding is available for undergraduate and graduate student participation.

MISTI country programs also offer five country-specific seed funds. Opportunities for faculty interested in collaborative research involving France, India, Italy, Japan or Spain are available.

CLASSIFIED ADS

Members of the MIT community may submit one ad each issue. Ads should be 30 words maximum; they will be edited. Submit by e-mail to ttads@mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Wednesday the week before publication.

FOR SALE

Rollerblades: Rollerblade brand, model VTX5000, women's size 7, in excellent condition. $25, negotiable. Call 617-253-0731

Student trundle bed with finished pine sides. Two beds and mattresses, including cover and bolsters. $125. Black metal computer cart and matching desk chair with wheels. $35. Call 781-395-5924

Whip-it! professional cream whipper, which is BRAND NEW. A highly durable Swiss made whipped cream dispensers that instantly transforms cream into a whipped topping. 1/2 liter size. Includes two decorating tips and cleaning brush. $25. Call Cheryl at 617-258-5673 or cheryl@mit.edu.

Pegasus brushed nickel kitchen faucet with side spray. Model 481-670F. Excellent condition. $50. Call Cheryl 617-258-5673 or cheryl@mit.edu.

Apple 23" monitor flat panel TFT-LCD cinema HD display, 1920x1200 resolution. Refurbished, ½ price: $450. 617-489-3161.

HOUSING

Seeking graduate student to exchange household services for free room/board; third floor single in desirable location 20 minutes from Harvard Square. Valid driver's license required; must shop and prepare evening meal. 617-547-7138.

The 'art' of real estate finance

New Compton exhibition eyes links between money, buildings

A new Compton Gallery exhibition opening this week, presented by the Center for Advanced Visual Studies and the MIT Museum, explores possible relationships between finance and buildings through an installation of models, videos, photographs and drawings.

"Red Lines, Death Vows, Foreclosures, Risk Structures: Architectures of Finance from the Great Depression to the Sub-Prime Meltdown," an exhibition by designer Damon Rich and the Center for Urban Pedagogy (CUP), immerses visitors in a landscape of pulsating capital and city buildings. The immense head of a pioneering real estate appraiser gazes over a field of floor-mounted house portraits. A jagged, free-standing graph of the 20th century's prime rate reflects a flickering neon sign advertising the process of block busting. A paired set of projected videos features interviews with mortgage stakeholders, including financiers, anti-foreclosure counselors and government regulators — and their voices haunt the gallery.

"Red Lines" aims to support a broader, richer conversation about how society finances its living environments and how the financial decisions of individuals have impacted families, communities and businesses. Through public programs, contributions to the curriculum at MIT, and off-site works such as the educational video, Predatory Tales, produced with Lawrence Community Works of Lawrence, Mass., "Red Lines" provides multiple sites where new dialogues about these crucial topics can begin.

During his year-long residence at MIT's Center for Advanced Visual Studies (CAVS), guest curator Damon Rich, designer and founder of CUP, studied the fundamentals of real estate markets: property law, proformas, appraisal, mortgages, and more. Working with MIT students and volunteers, he traveled to Washington to visit and interview representatives of the Mortgage Bankers Association and the Comptroller of the Currency. In Chicago, Rich and Meg Rotzel of CAVS created a video with the National Training and Information Center about the anti-redlining movement of the 1970s and the democratic reforms it brought to banking. In Boston, Rich spent time with mortgage brokers as they relaxed after work in bars and restaurants. These interviews, photographs, napkin sketches and yellowed clippings provide the material for the work in the exhibition.

This exhibition is supported by the National Endowment for the Arts, the Graham Foundation, the LEF Foundation, the New York State Council for the Arts and the Loeb Fellowship of the Harvard Graduate School of Design.

"Red Lines" runs from Sept. 10 to Dec. 21. Admission is free and open to the public. For more information, contact Meg Rotzel, MIT Center for Advanced Visual Studies, 617-253-4415 or mrotzel@mit.edu.

Weather cycles

MIT group gears up for climate change awareness ride

Patrick Gillooly
News Office

A group of MIT-affiliated cyclists hope to fuel themselves from New York to Washington in a few weeks to raise awareness — and money — for climate change initiatives.

The nine graduate students, researchers and friends are all planning to take part in Climate Ride 2008, a five-day, 320-mile ride from the Big Apple to the nation's capital that symbolizes the nation's need to get out of the car.

"Bicycling is a perfect event," said team member John Reilly, a senior lecturer in the MIT Sloan School of Management. "If everyone used their bikes to get to work, do errands, then we'd be a happier, healthier place."

And weaving through the numerous cities and towns on their way to Washington should help generate buzz for ideology, said Engineering Systems Division graduate student Travis Franck, another team member.

"I hope that awareness about climate change issues increases because of the publicity we get riding through different communities," he said. "I think that the notion that cycling is an alternative to cars is an important aspect of climate change awareness."

Reilly and Franck's fellow cyclists include Center for Global Change Science postdoc Noelle Selin, graduate students Valerie Karplus and Katherine Potter, and Wade Franck, Elke Hodson, Tina Huang and Daniel Meredith. Together, they plan to ride as the team "Greenhouse Gamblers," which refers to the research done by members of the team in the MIT Global Change Program to understand the risks of climate change.

PHOTO / **PATRICK GILLOOLY**

Travis Franck, John Reilly, Valerie Karplus and Noelle Selin, all of the Center for Global Change Science at MIT, pose with their bicycles on Memorial Drive.

For several of the team members, the 320-mile trek isn't much more than an average week in the saddle. Reilly and Franck both ride their bicycles to MIT every day; Reilly puts in almost 115 miles a week and for Franck "60 miles a day is not bad."

With this experience, the major hurdle won't be completing the ride, but raising enough money to participate in it. With about two weeks until the ride, which runs from Sept. 20-24, the team has raised almost $8,500. They're just under halfway to their goal of $20,250.

"We are making progress but we need to get more donations," Reilly said. "I don't know if we'll be the lead team, but hopefully we can at least win as the best fundraising team."

A link to the team's fundraising web site can be found at web.mit.edu/global-change/www/climateride08.html. Those interested in donating can either give to a specific team member or donate to the team as a whole.

Additionally, the team will be hosting a fundraising event at the Muddy Charles Pub next Tuesday evening, Sept. 16. Door prizes and raffle prizes will be given out, including two weeklong stays at a cabin in Bethal, Maine, near the Sunday River ski resort.

NEWMAN: Geobiologist follows a rocky road

Continued from **Page 1**

atmosphere at each time.

To that end, she is studying the modern rust-producing bacteria to determine how iron travels through the cell during photosynthesis, to understand the cellular machinery that processes it, in the hope that this will explain the deposits on rocks.

"Dianne's current work, using sophisticated molecular methods to unravel the biosynthesis and physiological roles of molecules that we know can be preserved in rocks over billion-year timescales, underpins geochemical approaches to solving the same problem," says Roger Summons, an MIT professor of earth, atmospheric and planetary sciences.

From Earth to human body

Newman's work, which originally focused on the bacterial metabolisms that affected the chemistry of the environment, may also shed light on how bacteria thrive in the human body. Body wounds often have little oxygen, so the types of bacteria that invade such tissues could be metabolically similar to bacteria that lived on ancient Earth.

"Thinking like geoscientists can help us think about the environment within a wound," she says.

Her lab is studying a bacterium called P. aeruginosa, which often infects the lungs of cystic fibrosis patients and is also found in burn wounds.

P. aeruginosa can survive in environments in the absence of oxygen, and evidence from Newman's lab suggests that a compound called phenazine might be involved in the process. If so, phenazine-processing machinery could become a potential target for drugs to treat P. aeruginosa infections, Newman says.

"We have a long way to go before being able to test this idea, but the hope is that if survival in the lung is influenced by phenazine — or some other electron-shuttling molecule or molecules — tampering with phenazine trafficking might be a potential way to make antibiotics more effective," she says.

O'BRYANT: Two students embark on new MIT-related journey

Continued from **Page 1**

greater Boston area. "It's really good for our school," Piazzarolo said.

Michael Sullivan, O'Bryant director of science and technology, said that while it was doubtful that the pair are the very first in the school's 100-year history to go to MIT, they were certainly the first to do so in many years. "We're trying to establish a much stronger relationship with MIT," he said.

Cobi credits his favorite teacher, physics instructor Steve Fernandez '88, for encouraging him to apply. And when his Spanish teacher found out he had been accepted, she had tears of joy in her eyes.

Fernandez told him, "You're going to have a very fun four years but a lot of hard work," Cobi said.

> *I was really excited — it was somewhat of a shock.*
>
> **Bruno Piazzarolo '12**

Both Cobi and Piazzarolo are the children of immigrants who came to the United States in pursuit of "the American dream," as Cobi put it. Cobi was born in Albania, and his parents moved to Boston about 10 years ago. "My parents knew that America was a better country for education," he said.

Piazzarolo's parents hail from Brazil, and Piazzarolo, who was born in Boston, spent some years there before settling with his parents in Brighton.

His interest in attending MIT stemmed from his participation in the FIRST robotics competition, where he was encouraged by Edward Moriarty, a technical instructor in the Edgerton Center. At O'Bryant, both he and Cobi took Advanced Placement physics, calculus and chemistry and Cobi even took AP history, even though he admits he hated history (but now has respect for the subject).

Piazzarolo plans to concentrate on mechanical engineering ("Ultimately, I want to do something with cars; I'm not sure what yet," he said), while Cobi has become intrigued with ocean engineering. Cobi also hopes to get on the ping-pong and sailing team while Piazzarolo is aiming for soccer.

Piazzarolo's pre-enrollment jitters have been calmed somewhat by learning about all the support systems available for students. He is reassured that MIT seems ready to help out as long as he's prepared to dig in. And he's happy that classmate Cobi will also be there. "We won't feel alone — we can help each other out," Cobi said.

PHOTO / **PATRICK GILLOOLY**

Bruno Piazzarolo, 17, and Alban Cobi, 18, will be attending MIT after graduating from the John D. O'Bryant School of Math & Science in Roxbury, which has close ties to MIT.

How I spent my SUMMER VACATION

Whether it was public service in South Dakota, an internship in Israel or Lincoln Laboratory, MIT students didn't just lounge around after classes ended last spring. Here's a sampling of what some MIT students did over the last three months.

LEXINGTON

Some students traded sunglasses for safety glasses as they participated in internships at Lincoln Laboratory, which offered summer programs for students from across the nation. The laboratory routinely hires summer students through the MIT VI-A MEng Thesis Program and MIT's graduate and undergraduate research programs.

PHOTO COURTESY OF LINCOLN LAB

MIT student Pei-Lan Hsu probing grapheme transistors during her internship at Lincoln Laboratory.

This summer, more than 100 interns performed hands-on engineering at Lincoln Laboratory while addressing problems critical to national security.

"This internship is an eye-opener," says Pei-Lan Hsu, a graduate student in the Department of Electrical Engineering and Computer Science. Hsu is doing thesis research in the Advanced Silicon Technology Group in her third summer at Lincoln Lab. "I'm learning how to be an engineer that gets things done — knowing when to be exact and when to approximate. I've also realized how much I still have to learn."

Internships help students bring about an understanding of a field. "Sometimes students have a good intern experience but decide it's not what they want to do; this is as useful as the internship that furthers you in your chosen field," said Gary Hackett, Lincoln Laboratory's College recruiting program coordinator.

Often, the internship develops into post-graduation employment. Hackett says, "Internships are mutually beneficial — they can view us as a potential employer and we can view them as a potential employee," Hackett said.

Through these programs, students contribute critical thinking in real time, in real life, while complementing their course of study.

ISRAEL

Ammar Ammar, a senior in electrical engineering and computer science, spent his summer working on YouTube at Google Tel Aviv in Israel as a part of MIT-Israel, the newest MISTI program.

Having lived most of his life in the region, Ammar was aware of the reputation of the Israeli technology sector and wanted to learn more about Israeli culture, politics and society.

The MIT-Israel Program carefully matches MIT students with internship opportunities in Israel, so for Ammar, who likes to design and build software systems and enjoys traveling and seeing new places, the Google internship was perfect. While there, he learned a lot about Google infrastructure, had the unique opportunity to advance professionally, meet Israelis and tour the country.

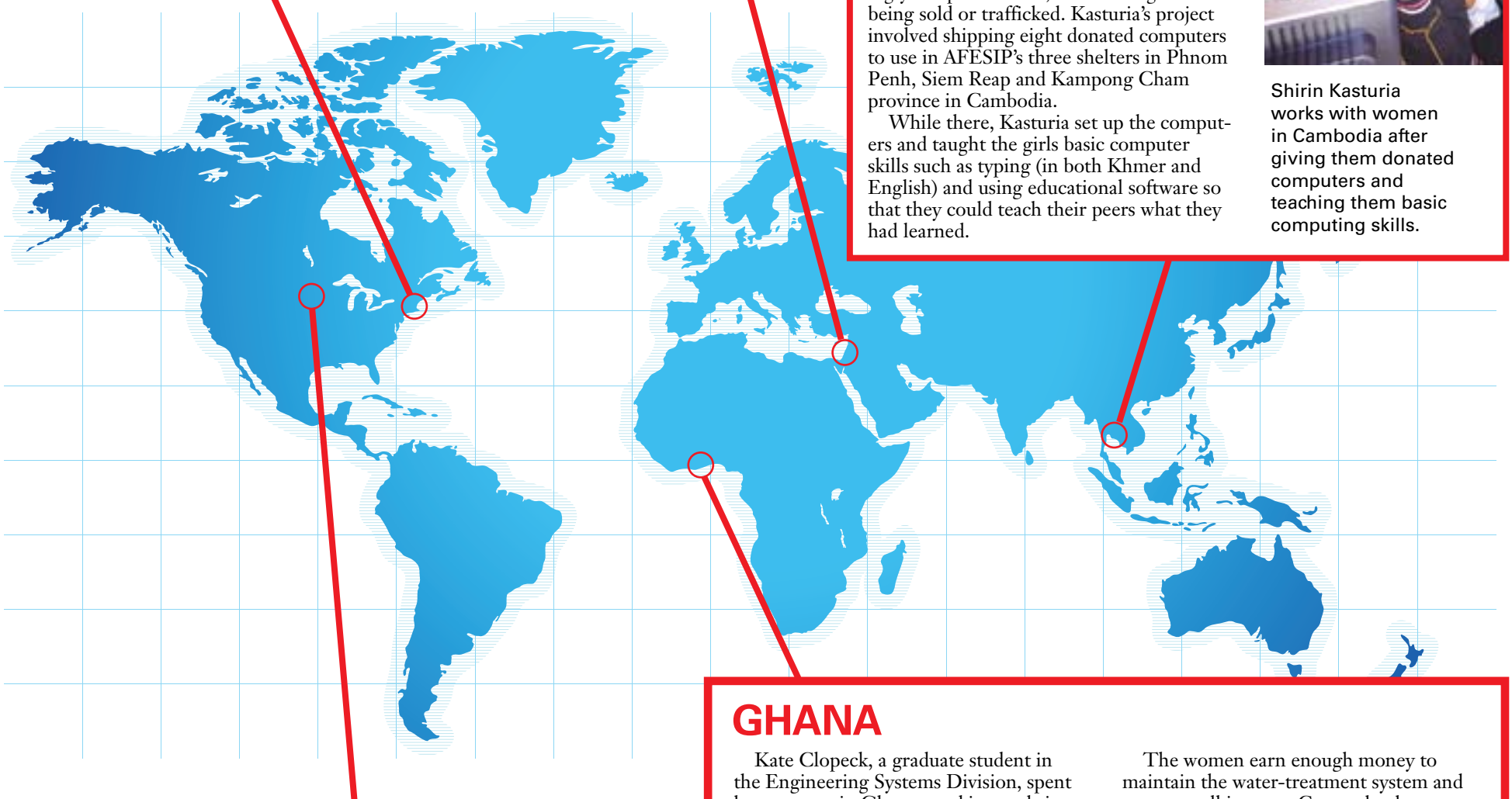
"The MISTI preparation gave me a strong background to understand the Israeli society and help me be successful in my internship. They really worked with me to find an internship that would be a right fit."

CAMBODIA

Junior Shirin Kasturia spent six weeks this summer in Cambodia working with AFESIP, an organization that provides shelter, protection, basic education and vocational training for women and children who have been rescued from human trafficking for sexual exploitation, have willingly left prostitution, or are at high risk of being sold or trafficked. Kasturia's project involved shipping eight donated computers to use in AFESIP's three shelters in Phnom Penh, Siem Reap and Kampong Cham province in Cambodia.

While there, Kasturia set up the computers and taught the girls basic computer skills such as typing (in both Khmer and English) and using educational software so that they could teach their peers what they had learned.

Shirin Kasturia works with women in Cambodia after giving them donated computers and teaching them basic computing skills.



SOUTH DAKOTA

Allison Brown '08 and Kendra Johnson '09 worked for the Environmental Protection Program of the Oglala Sioux Tribe on Pine Ridge Reservation in South Dakota. The tribal government faces a tremendous challenge in maintaining infrastructure and providing services to 26,000 inhabitants of the reservation, which is larger in area than the states of Delaware and Rhode Island combined and contains some of the poorest counties in the country.

Johnson and Brown worked to develop the capacity of Oglala Lakota College, the tribe's community college, to process water quality samples for the tribe. In addition, Allison collaborated with Stephan Schweig, a mechanical engineering student from Germany, to assist the tribe's efforts to develop renewable energy capacity on the reservation. Kendra worked together with the Environmental Protection Program staff to begin developing a watershed management plan for two small grassland streams: Wounded Knee Creek and Porcupine Creek. They are in the process of setting up a project for next year's interns to help a community build its own wind turbine from old car parts, scrap metal and other common, inexpensive materials.

More information is available on Johnson's blog at http://kendradey.blogspot.com/search/label/Pine%20Ridge%20Reservation

GHANA

Kate Clopeck, a graduate student in the Engineering Systems Division, spent her summer in Ghana, working on bringing fresh water to the masses through two different projects.

For the first project, Clopeck worked with Vanessa Green MEng '08 to implement a community water-treatment system in Kasaligu, a rural village in Northern Ghana. "We distributed safe storage containers to the 200 households in the villages and then trained two local women to clean enough water for the entire village," Clopeck said. "These women then sold the clean water to the other members of their community for 5 peswas (about 5 cents) for each 20-liter safe-storage container."

The women earn enough money to maintain the water-treatment system and earn a small income. Currently, the system is still running and the MIT students continue to advise the team leadership and monitor the project's success.

Clopeck's second project was the evaluation of Pure Home Water, a small nonprofit that sells ceramic water filters in northern Ghana. She surveyed 221 of Pure Home Water's customers to determine if they were still using the water filter, and if not, why they had stopped. She plans to publish her findings in her master's thesis.

More images of Clopeck's work can be seen at http://picasaweb.google.com/kate.clopeck

Kate Clopeck checks the turbidity of water of the Kakpagayelli dugout in Ghana.