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TechTalk
SERVING THE MIT COMMUNITY

Reactivated gene shrinks tumors, MIT study finds

Anne Trafton
News Office

Many cancers arise due to defects in genes that normally suppress tumor growth. Now, for the first time, MIT researchers have shown that re-activating one of those genes in mice can cause tumors to shrink or disappear.

The study offers evidence that the tumor suppressor gene p53 is a promising target for human cancer drugs.

"If we can find drugs that restore p53 function in human tumors in which this pathway is blocked, they may be effective cancer treatments," said David Kirsch of MIT's Center for Cancer Research and Harvard Medical School, one of the lead co-authors of the paper.

The study appeared in the Jan. 25 issue of Nature. It was conducted in the laboratory of Tyler Jacks, director of the Center for Cancer Research, the David H. Koch Professor of Biology and a Howard Hughes Medical Institute investigator.

P53 has long been known to play a critical role in the development of many tumors—it is mutated in more than 50 percent of human cancers. Researchers have identified a few compounds that restore p53 function, but until now, it has not been known whether such activity would actually reverse tumor growth in primary tumors.

The new MIT study shows that re-activating p53 in mouse tumors dramatically reduces the size of the tumors, in some cases by 100 percent.

"This study provides critical genetic evidence that continuous repression of a tumor suppressor gene is required for a tumor to survive," said Andrea Ventura, an Italian postdoctoral associate in the Center for Cancer Research and first author of the paper.

In normal cells, p53 controls the cell cycle. In other words, when functioning properly, it activates DNA repair mechanisms and prevents cells with damaged DNA from dividing. If DNA damage is irreparable, p53 induces the cell to destroy itself by undergoing apoptosis, or programmed cell death.

When p53 is turned off by mutation or deletion, cells are much more likely to become cancerous, because they will divide uncontrollably even when DNA is damaged.

In this study, the researchers used engineered mice that had the gene for p53

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U.N. paper: Human activity fuels global warming

Anne Trafton
News Office

Last week's release of a widely anticipated international report on global warming coincides with a growing clamor within the United States to reduce greenhouse gas emissions and prevent the potentially devastating consequences of global climate change.

"There's more interest in this now than at any time in the last 20 years," says Ronald Prinn, TEPCO Professor of Atmospheric Sciences at MIT, who was a lead author of the report issued by the Intergovernmental Panel on Climate Change (IPCC).

Ronald Prinn

The report issued Feb. 2 in Paris, a 21-page summary of a much longer study on the science behind climate change, concludes there is a greater than 90 percent chance that greenhouse gases from human activity are responsible for most of the steadily rising average global temperatures observed in the past 50 years.

"There's clear evidence that greenhouse gases have been increasing by very large amounts since preindustrial times, and the vast majority of these increases are due to human activity," said Prinn, whose specific task on the panel was to assess this issue.

This is the fourth climate report issued by the IPCC since it was established by the U.N. in 1988. Prinn, who is the director of MIT's Center for Global Change Science, was one of more than 100 lead authors for the three-year study, which involved climate researchers from around the world.

For the first time, the IPCC provides

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PHOTO / **DONNA COVENEY**

Molding light waves

An MIT team, including postdoc Peter Rakich (above), has developed a novel way to add the power and speed of light waves to traditional electronics. See story on page 5.

Microwaves designed for missile detection improve breast cancer treatment

Elizabeth Thomson
News Office

A breast cancer treatment based on MIT research originally intended for detecting missiles is documented in a new book by Alan J. Fenn, an MIT researcher and inventor of the technique.

The book, "Breast Cancer Treatment by Focused Microwave Thermotherapy" (Jones and Bartlett Publishers, 2007), includes a discussion of promising results from the latest clinical trials of the therapy.

Treating cancer with heat is not a new idea, but "researchers were having trouble using it to treat tumors deep within the body," said Fenn. Further, it's difficult to deliver the heat only to cancer cells with-

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Team develops nanoparticles for chemo delivery

New particles mimic platelets

Elizabeth Dougherty
Harvard-MIT Division of Health Sciences and Technology

On a quest to modernize cancer treatment and diagnosis, an MIT professor and her colleagues have created new nanoparticles that mimic blood platelets. The team wants to use these new multifunctional particles to carry out different medical missions inside the body, from imaging to drug delivery.

Sangeeta Bhatia

After years of research, "we still treat cancer with surgery, radiation and chemotherapy," said Sangeeta Bhatia, an associate professor in MIT's Department of Electrical Engineering and Computer Science and the Harvard-MIT Division of Health Sciences and Technology. "People are now starting to think more in terms of 'Fantastic Voyage,' that sci-fi movie where they miniaturized a surgical team and injected it into someone."

The National Cancer Institute has recognized the value of Bhatia's work and has awarded her a grant to continue this line of research. Bhatia and collaborators Michael J. Sailor, chemist and materials scientist at the University of California at San Diego, and Erkki Ruoslahti, tumor biologist at the Burnham Institute for Medical Research, will receive $4.3 million in funding over five years.

The grant will allow the team to continue work on promising nanoparticle solutions that, while not quite miniature surgical teams, do have the potential to help identify tumors and deliver chemotherapy locally.

One solution already underway involves

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UPOP 5th anniversary honors alumni service

Nancy DuVergne Smith
MIT Alumni Association

Each January, about two dozen tech-savvy alumni return to campus to help teach two weeklong boot camps, the intensive training at the core of the Undergraduate Practice Opportunities Program (UPOP). The alumni volunteers work with more than 250 engineering sophomores who are developing business and interpersonal skills they will take to internships next summer and, later, into professional life.

To celebrate UPOP's fifth anniversary and honor its major sponsors, program leaders created the Desh and Jaishree Deshpande UPOP Service Award. Three volunteers, each with more than 1,000 hours of UPOP service, received the first awards Feb. 2. Two alumni, Paul Edelman '78 and Mark Herschberg '95, have volunteered as teaching assistants since the program's founding. Edelman, managing director of Edelman & Associates, an executive search firm serving high-tech industries, has worked in organization development for AT&T and startups. Herschberg, a consultant for New York area startups, has managed engineering departments and worked in fields as diverse as financial modeling and online video space. A third service award went to Susan Luperfoy, an artificial intelligence expert who directed Akamai's data analysis and reporting department. The honorees have participated in boot camps and career development events, hosted summer interns and mentored students.

More than 110 alumni have participated as UPOP volunteers and many more have served as internship sponsors. Volunteer Steve Levy '86, president and CEO of the MacGregor Group, a software company providing trade order management and financial network services, says students can use UPOP to learn about the dynamics of working with teams of people. For him, the ability to communicate is the most essential skill that young professionals can acquire. UPOP uses boardroom strategy sessions and mock interviews to teach effective communication. "You want to have a really clear picture of what the customer needs, what the company's doing and how you're going to fulfill your part," he says.

Another 2007 alumni volunteer, Lee Brettman '69, CEO and director of Dynogen Pharmaceuticals, encourages students to expand their understanding of people different from themselves. He expanded his own intellectual horizons by earning S.B. degrees in biology and Russian literature. His advice to UPOP students: "It's not just what you know, it's how you communicate with people, how you work with people and how you are able to understand where they are coming from."

To learn more about UPOP, visit web.mit.edu/engineering/upop/.

PHOTO / **TAMI JEAN SHINKAWA**

Paul Edelman '78 receives the first Desh and Jaishree Deshpande UPOP Service Award from the Deshpandes.

Professor fasts over tenure process

On Monday, Feb. 5, Associate Professor James L. Sherley began a fast on campus to protest both the decision not to promote him to tenure and the outcome of his previous grievance process.

In an e-mail to the community, Vice President for Institute Affairs and Secretary of the MIT Corporation Kirk D. Kolenbrander expressed concern for the well-being of Sherley and his family. Noting that President Susan Hockfield and Provost L. Rafael Reif had encouraged Sherley to seek other means to voice his concerns, he stated that MIT would uphold Sherley's right to express his views in a manner that did not disrupt the work of the Institute.

In addressing a gathering of colleagues, family and friends outside Hockfield's office on Monday, Sherley expressed his hope that the administration would put in place processes by which to recognize and redress racism, when it occurs.

Kolenbrander urged members of the community to continue to speak and act in the "spirit of mutual respect and dialogue that marks the Institute at its best." The situation raises "complex issues for many in our extended community," he wrote. To read the full text of Kolenbrander's message, please go to web.mit.edu/newsoffice/2007/letter-kolenbrander.html.

In another message sent on Feb. 5, Chancellor Phillip L. Clay asked that students respect both Sherley's right to disagree publicly and one another's views about Sherley's statements. Clay also announced that opportunities would be available soon to discuss the tenure process and related matters.

Reif outlined the process by which Sherley's tenure case had been reviewed in a Jan. 29 message to the faculty. In it he affirmed that fairness and integrity in academic processes are of "fundamental concern to the Institute." To read his complete statement, please go to web.mit.edu/provost/letters/letter01292007.html.

Walter A. Backofen, pioneer of superplasticity, dies at 80

Walter Alan Backofen, retired professor of metallurgy and materials science, died at his Marblehead home on Dec. 2. He was 80.

Backofen taught at MIT for 25 years, retiring in 1975. He designed new courses and a new laboratory and became recognized for bridging theory and practice over a wide range of real-life problems—from automotive stampings to orthopedic implants and the Star Wars defense shield.

A paper he wrote in 1964 on "superplasticity" identified the ability of metals, temporarily given a near nano-size grain structure, to behave like silly putty. That paper was recognized for its seminal influence on a now-burgeoning global industry at an International Conference on Superplasticity held in Chengdu, China, in June 2006.

Born in Rockville, Conn., on Dec. 8, 1925, he graduated as valedictorian from Rockville High School in June 1943, entered MIT within days, and soon enlisted in the U.S. Navy. In February 1946 he graduated from MIT with an ensign's commission and bachelor's degree in metallurgy.

By September 1946, he was back at MIT as a graduate student and instructor in the Department of Metallurgy. In 1950 he married Elizabeth "Lib" Wood Warren of Orange, Mass., and received his doctorate with an appointment as assistant professor in the Department of Metallurgy.

Backofen belonged to the American Institute of Mining and Metallurgical Engineers and the American Society for Metals and Materials, and was elected to membership in Tau Beta Pi and Sigma Xi. He was the first in his field to receive its three principal achievement awards: for teaching (Bradley Stoughton Award, 1958), research (Howe Medal, 1964) and professional leadership (Campbell Lecturer, 1973). He was a popular speaker in his profession and a pioneering popular-science lecturer on live television for Channel 2 of Boston's first broadcast from the roller skating rink across Mass. Ave. from MIT.

During a sabbatical at Dartmouth College, he wrote a book on his technical specialty, deformation processing, in a systems-analysis context that redefined an ancient field for modern times.

In partnership with his wife, he started Hill Farm, where they raised apples, blueberries and Christmas trees, in East Plainfield, N.H. They also ran an American art and antiques business and founded the Lord Timothy Dexter Press, devoted to exploring New Hampshire history.

He is survived by his wife; a brother, Albert H. Backofen of Greenfield, Mass.; and two foster sisters, Dolores Hoermann of Rockville, Conn., and Lois Shelly of Belleaire, Fla.

There will be no services. His ashes will be scattered at Hill Farm.

Contributions in his memory may be made to the Upper Valley Humane Society, 300 Old Route 10, Enfield, NH 03748, or the Dartmouth College Library System.

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Continued from Page 1

using nanoparticles for cancer imaging. By slipping through tiny gaps that exist in fast-growing tumor blood vessels and then sticking together, the particles create masses with enough of a magnetic signal to be detectable by a magnetic resonance imaging (MRI) machine. "This might allow for noninvasive imaging of fast-growing cancer 'hot spots' in tumors," said Bhatia. The team will continue this research by testing the imaging capabilities in animal models.

Another solution, described in the Jan. 16 issue of the Proceedings of the National Academy of Sciences, is a novel "homing" nanoparticle that mimics blood platelets. Platelets flow freely in the blood and act only when needed, by keying in on injured blood vessels and accumulating there to form clots. Similarly, these new nanoparticles key in on a unique feature of tumor blood vessels.

Ruoslahti had identified that the lining of tumor vessels contains a meshwork of clotted plasma proteins not found in other tissues. He also identified a peptide that binds to this meshwork. By attaching this peptide to nanoparticles, the team created a particle that targets tumors but not other tissues. When injected into the bloodstream of mice with tumors, the peptide sticks to the tumor's clotted mesh.

An unexpected feature of the nanoparticles is that they clump together and, in turn, induce more clumping. This helps to amplify the effects of the particles. "One

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Jensen will head Chem.E.

Professor Klavs Jensen has been named head of the Department of Chemical Engineering, effective Feb. 1.

Jensen, the Lammot DuPont Professor of Chemical Engineering, "is a noted chemical engineering researcher and educator," said Thomas Magnanti, dean of engineering, in announcing the appointment.

Jensen has made "important contributions to a wide variety of arenas, including microfabrication and testing and integration of microfluidics. He is well known for his pioneering research on 'chemical processes on a chip.' He has also investigated and taught broadly in areas such as materials synthesis and processing, and multiscale simulation of reactive processes," Magnanti said.

Jensen's honors include membership in the National Academy of Engineering; appointment as a fellow of the Royal Society on Chemistry (London); an honorary doctorate from the Danish Technical University; and the distinguished Colborn Award from the American Institute of Chemical Engineers.

Magnanti thanked outgoing department head Robert C. Armstrong, the Chevron Professor of Chemical Engineering, "for his simply outstanding service.... The department has thrived over the past 10 (almost 11) years under his superb leadership. It has been a privilege to work closely with Bob."

—Elizabeth Thomson

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

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

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Editor
Sarah H. Wright

Photojournalist
Donna Coveney

Production
Anne Trafton

News Office Staff

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New microchip sieve speeds biomolecule sorting

A new MIT microchip system promises to speed up the separation and sorting of biomolecules such as proteins. The work is important because it could help scientists better detect certain molecules associated with diseases, potentially leading to earlier diagnoses or treatments.

The microchip system has an extremely tiny sieve structure built into it that can sort through continuous streams of biological fluids and separate proteins accurately by size. Conventional separation methods employ gels, which are slower and more labor-intensive to process. The new microchip system could sort proteins in minutes, as compared to the hours necessary for gel-based systems.

The MIT team's results appeared in the Feb. 5 issue of Nature Nanotechnology.

The new technology is an advance from a one-dimensional sieve structure reported by the same MIT group last year. The key to this new advance, called an anisotropic nanofluidic sieving structure, is that the researchers have designed the anisotropic sieve in two orthogonal dimensions (at a right angle), which enables rapid continuous-flow separation of the biological sample. This allows continuous isolation and harvesting of subsets of biomolecules that researchers want to study. And that increases the probability of detecting even the smallest number of molecules in the sample.

"With this technology we can isolate interesting proteins faster and more efficiently. And because it can process such small biologically relevant entities, it has the potential to be used as a generic molecular sieving structure for a more complex, integrated biomolecule preparation and analysis system," said Jongyoon Han, the Karl Van Tassel Associate Professor of Electrical Engineering and associate professor of biological engineering at MIT and head of the MIT team.

Han's coauthors of the Nature Nanotechnology paper are co-lead authors Jianping Fu, a Ph.D. candidate in the Department of Mechanical Engineering, and Reto B. Schoch, a postdoctoral associate in the Research Laboratory of Electronics (RLE). Additional authors are Anna Stevens, a postdoctoral associate in the Harvard-MIT Division of Health Sciences and Technology, and Professor Steven Tannenbaum of MIT's Biological Engineering Division.

Han noted that until the late 1990s, most advances in biological laboratory equipment were aimed at the Human Genome Project and discoveries related to DNA, which are larger molecules compared to proteins. However, because of the vital role proteins play in almost all biological processes, researchers began to focus their attention on proteins. But one obstacle has been the lack of good laboratory tools with which to prepare biological samples to analyze proteins, said Han, who also has affiliations in MIT's RLE, Computational and Systems Biology Initiative, Center for Materials Science and Engineering and Microsystems Technology Laboratories.

"I shifted my attention from DNA into the area of protein separation around 2002 with the shift to proteomics (the study of proteins)," Han said. "But the field was using decades-old gel electrophoresis technology. There is a big gap in the need for technology in this area."

Han and Fu therefore devised the anisotropic sieve

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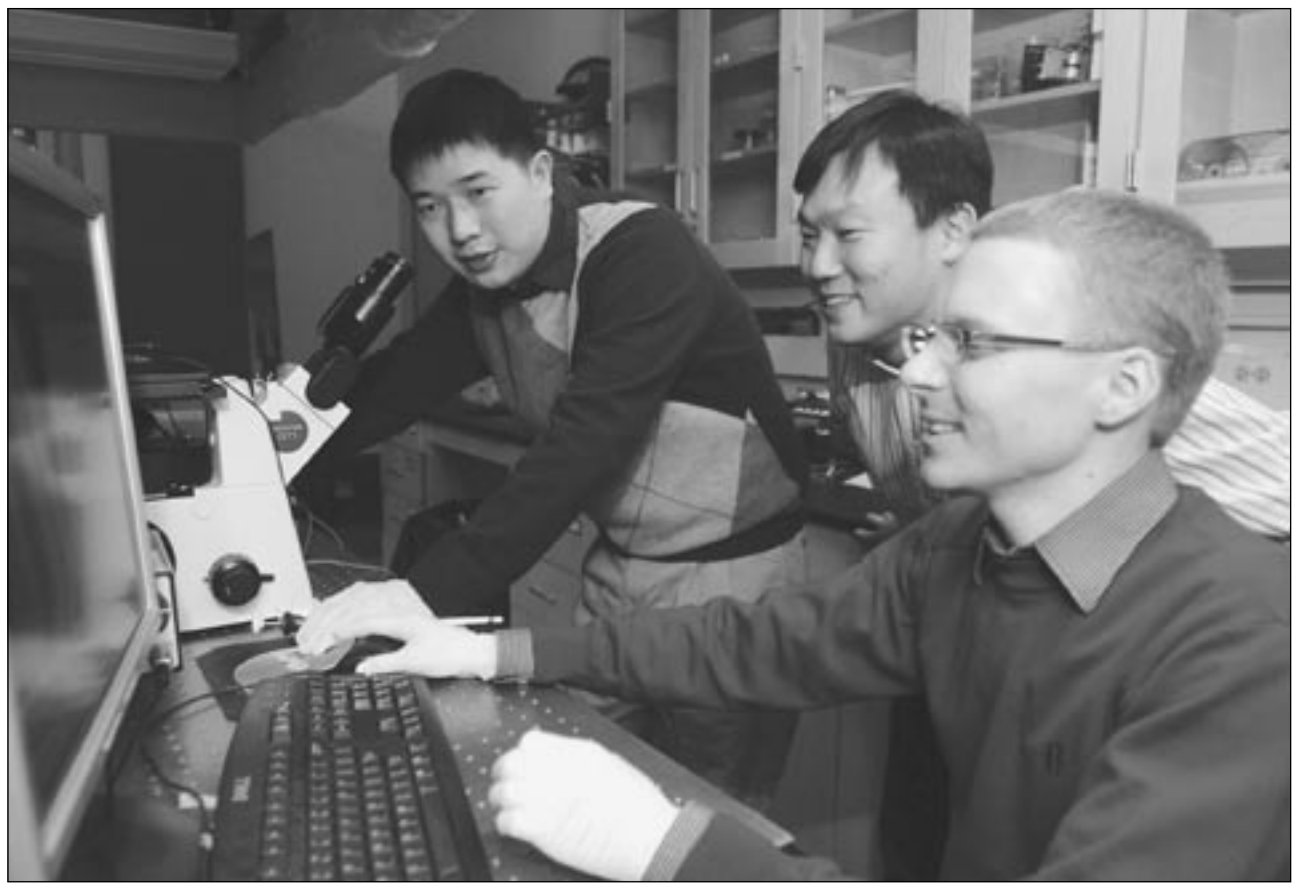

PHOTO / **DONNA COVENEY**

Graduate student Jianping Fu, left, Professor Jongyoon Han and postdoctoral associate Reto Schoch have developed a microchip that can sort proteins in the lab by passing them through a tiny sieve.

Mrowka receives Veblen geometry prize

Professor of mathematics Tomasz Mrowka received the 2007 Oswald Veblen Prize in Geometry, one of the highest honors in the field of geometry, on Jan. 6.

Mrowka shares the award with Harvard University professor Peter Kronheimer. The American Mathematics Society honored the pair "for their joint contributions to both three- and four-dimensional topology through the development of deep analytical techniques and applications."

Tomasz Mrowka

Mrowka received the award, which is given every three years, at the annual meeting of the American Mathematics Society in New Orleans.

Mrowka said of winning the award: "The list of past Veblen prize winners contains many of my mathematical heroes and teachers. To be included in this list is a singular honor."

The award citation specifically mentions three papers Mrowka and Kronheimer wrote together in the past 13 years. One of the papers deals with Donaldson's polynomial invariants, which have been used to prove a variety of results about the topology and geometry and four-manifolds.

That paper, published in 1995, "gives a conceptual framework and an organizing principle for some of the disparate observations and calculations of Donaldson invariants that had been made earlier … and it has been the point of departure and the motivating example for important further developments, most spectacularly for Witten's introduction of the so-called Seiberg-Witten invariants," according to the award citation.

The second paper proves the so-called "Thom conjecture" and was one of the first deep applications of the then brand new Seiberg-Witten equations to four-dimensional topology.

In a third paper published in 2004, Mrowka and Kronheimer used their earlier development of Seiberg-Witten monopole Floer homology to prove the Property P conjecture for knots. "The proof is a beautiful work of synthesis which draws upon advances made in the fields of gauge theory, symplectic and contact geometry, and foliations over the past 20 years," reads the citation.

Mrowka joined the MIT faculty in 1996. He served as chair of the Graduate Student Committee from 1999 to 2002 and has chaired the Pure Mathematics Committee since 2004. He is also on the editorial boards of several mathematics journals.

He received the S.B. in mathematics from MIT in 1983 and the Ph.D. from the University of California at Berkeley in 1988. He taught at Stanford, Caltech and Harvard before coming to MIT.

In 1993 he received an Alfred P. Sloan Research Fellowship and a National Young Investigator Award.

Seager wins Warner Prize from AAS

Sara Seager, the Ellen Swallow Richards Associate Professor in the Department of Earth, Atmospheric and Planetary Sciences, has won the 2007 Helen B. Warner Prize from the American Astronomical Society (AAS).

The Warner Prize is normally awarded annually for a significant contribution to observational or theoretical astronomy during the five years preceding the award.

It is given to an astronomer who is not yet 36 years of age in the year designated for the award or is within eight years of receipt of the Ph.D. degree. The recipient must be a resident of North America or a member of a North American institution, stationed abroad.

Seager received the prize for developing "fundamental techniques for understanding, analyzing, and finding the atmospheres of extrasolar planets," according to the AAS.

Previous recipients of the Helen B. Warner Prize include Riccardo Giacconi, Allan R. Sandage and Maarten Schmidt.

PBS' 'Living Weapon' film features CIS expert on U.S. biological weapons program

Stephanie Schorow
News Office Correspondent

Decades before President Bush began railing against Iraq's weapons of mass destruction, the United States had its own top-secret program to develop biological weapons of mass destruction.

From 1943 to 1969, U.S. scientists worked with pathogens such as anthrax and tularemia, seeking to develop deadly bioweapons that experts say were meant for the mass slaughter of enemy civilians as well as enemy combatants.

The time is now ripe for a re-examination of this program, say these experts, including Jeanne Guillemin, senior advisor in MIT's Security Studies Program and author of "Biological Weapons: From the Invention of State-Sponsored Programs to Contemporary Bioterrorism" (2005).

Jeanne Guillemin

Guillemin was among those featured in a PBS documentary on biological weapons, "American Experience: The Living Weapon," which aired Monday, Feb. 5, on WGBH 2. The documentary looks at the years of secret testing, animal experiments and top-level, closed-door meetings as American scientists attempted to turn some of the world's most potent germs into devastating weapons. First driven by fears that Nazi Germany was developing the bioweapons, then by Cold War agendas, U.S. military researchers raced to develop methods of dispersing lethal diseases in bombs and sprays. They even conducted open-air tests (with harmless bacteria) on major American cities to make sure the systems would work. The program was ended in 1969 by President Richard Nixon.

Guillemin, trained as a sociologist and anthropologist, has spent years studying issues of medicine, infectious disease and biological weapons. Her 1999 book, "Anthrax: The Investigation of a Deadly Outbreak," documents a 1979 bioweapons accident in Russia; she's currently researching the 1934-1945 Japanese biological warfare program in Manchuria. Guillemin praised the new documentary for its timeliness and use of film footage and visuals to graphically highlight the ethical pitfalls of biological weapons.

Q: Many of the points of the documentary have been reported before. Why is it important to revisit the issues now? Are there any parallels to today?

A: I think the interest in having an overview of the history of biological weapons has been building since the end of the Cold War. Before the demise of the Soviet Union in 1992, and before the discovery of Iraq's chemical and biological programs, we in the United States were not really in a position to look back at our own program in any reflective or critical way. With a war that began on the premise that there were nuclear, chemical and biological weapons in Iraq, we have even more of a responsibility to consider our own role in creating threats and ask, "What have we as a nation been doing for the last 80 years or so in developing weapons of mass destruction?"

We are also positioned very well now to consider the problem of secrecy in government. We have seen increasing government secrecy since 2000 and especially after 9/11, in the name of national security. The history of biological weapons offers an example of an extremely dangerous secret program—the details of which were not known to members of Congress or to the public. We are in a very good position historically to look back and evaluate what were we doing in creating weapons that kill civilians. That was the point of these weapons, that they be a corollary to nuclear weapons for the mass murder of enemy civilians. That was the Cold War agenda.

Q: It is interesting that Richard Nixon stopped the program. Does that give us any reason to reevaluate Richard Nixon?

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Storing CO_2 below ground may prevent polluting above

Denise Brehm
Civil and Environmental Engineering

A new analysis led by an MIT scientist describes a mechanism for capturing carbon dioxide emissions from a power plant and injecting the gas into the ground, where it would be trapped naturally as tiny bubbles and safely stored in briny porous rock.

This means that it may be possible for a power plant to be built in an appropriate location and have all its carbon dioxide emissions captured and injected underground throughout the life of the power plant, and then safely stored over centuries and even millennia. The carbon dioxide eventually will dissolve in the brine and a fraction will adhere to the rock in the form of minerals such as iron and magnesium carbonates.

Carbon dioxide is one of the primary greenhouse gases contributing to global warming. Studies have shown that reducing carbon dioxide emissions or capturing and storing the emissions underground in a process called sequestration is vital to the health of our planet. But one of the biggest risks of any sequestration project is the potential leak of the injected gas back into the atmosphere through abandoned wells or underground cracks.

In a paper published in a recent issue of Water Resources Research, MIT Professor Ruben Juanes and co-authors assert that injected carbon dioxide will likely not flow back up to the surface and into the atmosphere, as many researchers fear.

"We have shown that this is a much safer way of disposing of CO_2 than previously believed, because a large portion—maybe all—of the CO_2 will be trapped in small blobs in the briny aquifer," said Juanes, a professor of civil and environmental engineering. "Based on experiments and on the physics of flow and transport, we know that the flow of the CO_2 is subject to a safety mechanism that will prevent it from rising up to the top just beneath the geologic cap."

Researchers have considered the possibility of sequestering CO_2 beneath the Earth's surface in at least three types of geologic formations: depleted oil and gas fields, unminable coal seams and deep saline aquifers. Juanes' research dealt with the third category—porous rock formations bearing brackish water that are ubiquitous underground.

The study shows that carbon dioxide could be compressed as it leaves the power plant and injected through a well deep underground into a natural sublayer consisting of porous rock, such as sandstone or limestone, saturated with saltwater. Because of its buoyancy, the injected gas

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downside of nanotechnology is that you shrink everything, including the cargo," said Bhatia. "You need particles to accumulate for them to be effective."

The assembly of these new particles concentrates them in a way that may improve on the tumor imaging capabilities the team described earlier. These particles also have the potential to be used as a means to cause clots big enough to choke off the blood supply to the tumor or to deliver drugs directly into the tumor.

But there are challenges ahead. For one, the team must verify that these particles only accumulate where they are desired. Also, they need better ways to keep the nanoparticles in the bloodstream. The body naturally clears these foreign bodies through the liver and spleen.

The team devised a means to temporarily disable this natural clearing system. They created a "decoy" particle that saturates this clearing system temporarily, allowing the active nanoparticles time to accumulate in the tumor tissue. These decoys, however, were toxic to some mice and also disable a system that normally protects the body, leaving it vulnerable to other invaders.

This challenge dovetails nicely with Bhatia's other work. Not only does she have expertise in liver functions, she directs the facility at the MIT Center for Cancer and Nanotechnology Excellence that analyzes new materials for toxicity and is working to standardize the guidelines for nanomaterial toxicity.

"We need to be able to understand the whole system better to be able to move the field forward," she said.

In addition to Sailor and Ruoslahti, Bhatia's co-authors on the recent PNAS paper are Dmitri Simberg, Tasmia Duza, Markus Essler, Jan Pilch, Lianglin Zhang and Austin M. Derfus, all from lead author Ruoslahti's laboratories at the University of California at Santa Barbara; Robert M. Hoffman, Ji Ho Park and Austin M. Derfus of the University of California at San Diego; and Meng Yang and Robert M. Hoffman of AntiCancer Inc.

The research was supported by the National Cancer Institute and the National Institutes of Health.

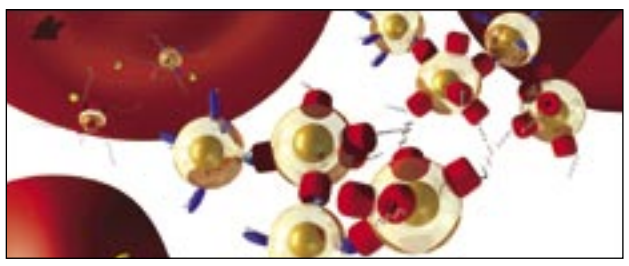

IMAGE COURTESY / **GEOFFREY VON MALTZAHN, HARVARD-MIT DIVISION OF HEALTH SCIENCES AND TECHNOLOGY**

Sangeeta Bhatia and colleagues imagine a hypothetical system that uses their multifunctional nanoparticles to attack breast cancer. Two types of nanoparticles, with magnetic cores and different types of targeting receptors in red and blue, might cluster in the tumor blood vessels and provide both imaging and drug therapy; or they might bind to one another to choke off the blood supply to the tumor.

PHOTO / **DONNA COVENEY**

Andrea Ventura, an MIT postdoctoral associate, works in the lab at the Center for Cancer Research. He and his colleagues have shown that by reactivating a certain gene, tumors in mice can be drastically reduced in size.

GENE

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turned off. But they also included a genetic "switch" that allowed the researchers to turn p53 back on after tumors developed.

Once the switch was activated, p53 appeared in the tumor cells and the majority of the tumors shrank between 40 and 100 percent.

The researchers looked at two different types of cancer—lymphomas and sarcomas. In lymphomas, or cancers of the white blood cells, the cancer cells underwent apoptosis within one or two days of the p53 reactivation.

In contrast, sarcomas (which affect connective tissues) did not undergo apoptosis but went into a state of senescence, or no growth. Those tumors took longer to shrink but the senescent tumor cells were eventually cleared away.

The researchers are not sure why these two cancers are affected in different ways, but they have started trying to figure it out by identifying the other genes that are activated in each type of tumor when p53 turns back on.

The study also revealed that turning on p53 has no damaging effects in normal cells. The researchers had worried that p53 would kill normal cells because it had never been expressed in those cells.

"This means you can design drugs that restore p53 and you don't have to worry too much about toxic side effects," said Ventura.

Possible therapeutic approaches to turn on p53 in human cancer cells include small molecules that restore mutated p53 proteins to a functional state, as well as gene therapy techniques that introduce a new copy of the p53 gene into tumor cells. One class of potential drugs now under investigation, known as nutlins, acts by interfering with MDM2, an enzyme that keeps p53 levels low.

In follow-up studies, the MIT researchers are looking at other types of cancer, such as epithelial (skin) cancer, in their mouse model, and they plan to see if the same approach will also work for tumor suppressors other than p53.

This research was funded by the Howard Hughes Medical Institute, the National Cancer Institute, the American Italian Cancer Research Foundation and the Leaf Fund.

Other MIT authors on the paper are Laura Lintault, (a research affiliate in the Center for Cancer Research), Jamie Newman (graduate student in biology), former MIT postdocs Margaret McLaughlin (Novartis), David Tuveson (Cambridge Research Institute, U.K.) and Jan Grimm (Memorial Sloan Kettering Cancer Center), Elizabeth Reczek (a former graduate student in Jack's lab, now a postdoctoral fellow at Brigham and Women's Hospital) and Ralph Weissleder (Harvard Medical School).

Physicist recommends U.S. develop 'portfolio of fuels, electricity and efficiency'

Deborah Halber
News Office Correspondent

President Bush called on fuel makers to produce 35 billion gallons of alternative fuels a year by 2017. That's not going to happen using corn as the basis for ethanol, said Ernest J. Moniz, director of the MIT Energy Initiative.

Moniz, the Cecil and Ida Green Professor of Physics, spoke Wednesday, Jan. 24, at an IAP event on "Energy, Security and Environment."

As part of the broad energy picture facing the United States and the world today, Moniz described the potential consequences of the predicted doubling of energy use in the next half-century. This doubling will take place, he said, even as we continue to improve efficiency.

A lot of the growth will occur in countries with emerging economies, where currently more than a billion people have no access to electricity.

The increased demand for energy will lead to even more concerns about security. "In every projection, dependence on Middle East oil will increase going forward," Moniz said. And oil itself will not go away as a fuel source, although fossil fuels will make up an increasingly small percentage of the overall energy picture.

Ernest J. Moniz

We need to address energy sources, energy security and climate change to accomplish a "major transformation of the energy system," he said. Behavioral changes, new technologies and government policies will be crucial for a workable solution, he said.

Moniz said that Bush's emphasis on change in the transportation fuels market is reasonable: The market is currently almost entirely dependent on oil. "If we have a more elastic market and more (nonpolluting) options for running vehicles," both security and environmental issues will improve, he said.

The environmental imperative is serious. The atmosphere is currently carrying 750 gigatons of carbon and at the current rate of increasing energy use, we will get to atmospheric overload—with alarming consequences—in 50 years. "The bottom line is, simple arithmetic tells you it's a 50-year problem…to look beyond 50 years, you've given up the game on the climate side," Moniz said. "Fifty years is also the timescale for turning over the infrastructure so that we can stay where we are in CO_2 emissions while meeting much greater demand."

To do this, a combination of alternative energies will

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‘Optics on a chip’ could revolutionize telecommunications

Deborah Halber
News Office Correspondent

In work that could lead to completely new devices, systems and applications in computing and telecommunications, MIT researchers are bringing the long-sought goal of “optics on a chip” one step closer to market.

In the January 2007 inaugural issue of Nature Photonics, the team reports a novel way to integrate photonic circuitry on a silicon chip. Adding the power and speed of light waves to traditional electronics could achieve system performance inconceivable by electronic means alone.

The MIT invention will enable such integrated devices to be mass-manufactured for the first time. Depending on the growth of the telecom industry, the new devices could be in demand within five years, said co-author Erich P. Ippen, the Elihu Thomson Professor of Electrical Engineering and professor of physics.

The new technology will also enable supercomputers on a chip with unique high-speed capabilities for signal processing, spectroscopy and remote testing, among other fields.

“This breakthrough allows inter- and intra-chip communications networks that solve the wiring problems of today’s computer chips and computer architectures,” said Franz X. Kaertner, a professor of electrical engineering and computer science.

In addition to Ippen and Kaertner, other members of the MIT team are Tymon Barwicz (Ph.D. 2005), Michael Watts (Ph.D. 2005), graduate student Milos Popovic, postdoc Peter Rakich, and Henry I. Smith, professor of electrical engineering and co-director of MIT’s Nanostructures Laboratory.

Molding light waves

Microphotonics technology aims to “mold” the flow of light. By using two different materials that refract light differently, such as silicon and its oxides, photons can be trapped within a miniscule hall of mirrors, giving them unique properties.

The stumbling block has been that microphotonics devices are sensitive to the polarization of light.

Light waves moving through optical fibers can be arbitrarily polarized to be vertical or horizontal, and microphotonic circuits don’t work well with that kind of random input. This has meant that devices used in photonic subsystems and optical communication networks, for instance, couldn’t connect to the outside world without often having to be assembled piecemeal and painstakingly by hand.

Like polarizing sunglasses, which use vertical polarizers to block the horizontally oriented light reflected from flat surfaces such as roads or water, the MIT method of integrating optics on a chip involves separating the two orientations of polarized light waves.

Splitting the difference

The MIT researchers’ innovative solution involves splitting the light emanating from an optic fiber into two arms—one with horizontally polarized beams and one with vertical beams—in an integrated, on-chip fashion.

Setting these two at right angles to one another, the researchers rotated the polarization of one of the arms, also in an integrated way. The beams from the two arms, now oriented the same way, then pass through identical sets of polarization-sensitive photonic structures and out the other side of the chip, where the split beams are rejoined.

“These results represent a breakthrough in permitting the processing and switching of arbitrarily polarized input light signals in tightly confined and densely integrated photonic circuitry,” said Ippen. The innovation means that optical components can be integrated onto a single silicon chip and mass-produced, cutting costs and boosting performance and complexity.

The advantage in integrating optics with silicon technology is that silicon fabrication technology “is already highly developed and promises precise and reproducible processing of densely integrated circuits,” Kaertner said. “The prospect of integrating the photonic circuitry directly on silicon electronic chips is ultimately also an important driver.”

In addition to offering a breakthrough in polarization, the MIT chip also contains first-of-their-kind components in materials meeting telecommunications specifications.

“Our results illustrate the importance of academic research in nanofabrication and academia’s role in breaking new pathways for the industry to follow,” Smith said. “Creating these devices was only possible due to the unique nanofabrication facilities at MIT, enabling fabrication with extraordinary precision.”

This work was supported by Pirelli Labs in Milan, Italy, and made use of MIT’s Nanostructures Laboratory and MIT’s Scanning Electron Beam Lithography Facility, both within the Research Laboratory of Electronics.

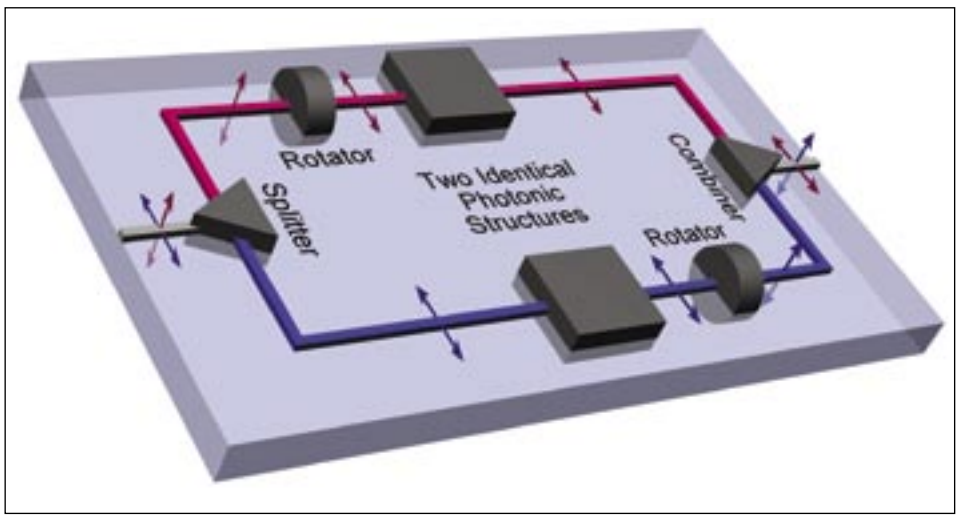

IMAGE COURTESY / **TYMON BARWICZ, MIT**

Illustration of MIT’s solution to polarization sensitivity, which until now prohibited most real-world applications of ‘optics on a chip.’

Initiative launched to assess minority faculty issues

Provost L. Rafael Reif and President Susan Hockfield have announced that MIT will undertake a comprehensive, rigorous and systematic study of the effects that race may have in the hiring, advancement and experience of underrepresented minority faculty at MIT.

The president and provost will consult broadly with the MIT faculty and community in framing plans for the new initiative.

In a Jan. 29 letter announcing the initiative, Reif told the faculty that he and Hockfield are “deeply committed to removing barriers that may exist for underrepresented minority faculty members.”

L. Rafael Reif

Hockfield, writing to the Institute community on Feb. 2, noted that these are “issues of concern to higher education nationwide,” and said, “We owe it to our students and community to take a position of leadership on this issue.”

Hockfield pointed to the diversity of new arrivals to the faculty and of this year’s freshman class as evidence that “concerted institutional efforts can make a difference.”

Reif noted that he has discussed these issues with many members of the faculty since becoming provost. The new initiative will build on the efforts to date of committees on minority faculty recruitment and retention he appointed a year ago.

In developing plans for the new venture, the Institute will draw on the example offered by its pioneering work on gender equity, which Hockfield noted has had “lasting national and international impact.”

Postdocs’ series explores hype and hope of a hydrogen economy

Stephanie Schorow
News Office Correspondent

The pint-sized model car sitting on a classroom table in Building E13 encapsulates the title of the four-part IAP seminar held in January: “Hydrogen: Hype or Hope?”

Francesca Baletto

Hydrogen car model

Caetano Rodrigues Miranda

The model car, built from a kit by the seminar presenters, MIT postdoctoral associates Caetano Rodrigues Miranda and Francesca Baletto, runs on hydrogen and represents the promise of a hydrogen-based economy, with its lure of pollution-free, renewable energy.

On the other hand, the car will run maybe five minutes at a time. The days of a hydrogen-powered automobile that will rival today’s gas-guzzlers are years in the future.

Yet, whether we like it or not, hydrogen may prove to be a boon to an energy-starved world, because, as Miranda and Baletto’s seminar made clear, “the end of oil is coming soon.” Crude oil, which supplies 37.7 percent of the world’s energy, has only about 41 years of reserves left. Natural gas (19.5 percent) has 63 years of reserves and coal (21.4 percent) has 218, according to the pair.

Miranda is studying material for hydrogen storage and amorphous systems for photovoltaic applications in the group of Gerbrand Ceder, professor of materials science and engineering; Baletto is looking at key processes in catalysis, energy storage and environmentally hazardous chemical reactions in the Quasiamore research group of Nicola Marzari, associate professor of computational materials science. Together, they explored the technical challenges of a hydrogen economy, which include hydrogen production, fuel cell design, storage, distribution and transportation.

The pair provided a glimpse of a tantalizing vision of the future, with a short film on the H2PIA project, a planned community in Denmark where citizens produce and store their own hydrogen fuel, running homes and cars on renewable, pollution-free energy. “It is possible to transform this into reality,” Miranda said.

However, Baletto noted, the very first step of a hydrogen economy—obtaining hydrogen—requires energy that has to be “clean.” While hydrogen is plentiful in the form of water, the process of hydrolysis—which separates the hydrogen from oxygen—is currently done with gas- and coal-powered processes that produce carbon dioxide and other pollutants. For hydrogen energy to be “clean,” hydrolysis must run on renewable energy sources, such as solar or wind power. It’s “green hydrogen

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Page 6

MICROCHIP

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that is embedded into a silicon chip. A biological sample containing different proteins is placed in a sample reservoir above the chip. The sample is then run through the sieve of the chip continuously. The chip is designed with a network of microfluidic channels surrounding the sieve, and the anisotropy (directional property) in the sieve causes proteins of different sizes to follow distinct migration trajectories, leading to efficient continuous-flow separation. The current sieve has an array of nanofluidic filters of about 55 nanometers, or billionths of a meter, wide.

“The proteins to be sorted are forced to take two orthogonal paths. Each path is engineered with different sieving characters. When proteins of different sizes are injected into the sieve under applied electric fields, they will separate into different streams based on size,” Han explained. At the bottom of the chip the separated proteins are collected in individual chambers. Scientists then can test the proteins.

While other scientists have used similar continuous flow techniques to separate large molecules like long DNA, the MIT team succeeded with the tinier proteins. “This is the first time physiologically relevant molecules like proteins have been separated in such a manner,” said Han. “We can separate the molecules in about a minute with the current device versus hours for gels.”

Another advantage of the microchip is that it can have so many different pore sizes, and unlike gels, it is possible to design an exact pore size to increase the separation accuracy. That in turn can help researchers look for so-called biomarkers, or proteins that can reveal that disease is present, and thus help researchers develop diagnostics and treatments for the disease. “Sample preparation is critical in detecting more biomarker signals,” said Han.

Funding came from the National Science Foundation, the National Institutes of Health and the Singapore-MIT Alliance.

Lauffenburger wins 2007 Galletti award

Professor Douglas Lauffenburger, head of the Biological Engineering Division, has won the 2007 Pierre Galletti Award from the American Institute for Medical and Biological Engineering.

The Galletti award, AIMBE's highest honor, recognizes an individual's "contributions to public awareness of medical and biological engineering, and to the promotion of the national interest in science, engineering and education."

Lauffenburger was cited "for training a generation of bioengineering faculty, establishing an innovative biological engineering program at MIT, writing a seminal text on receptors and exemplary service to bioengineering societies."

Lauffenburger will receive the award in late February at the President's Dinner at the National Academy of Science.

Geltner named 'most influential' researcher

David Geltner, director of the MIT Center for Real Estate, has been named the most influential researcher in the real estate field from 2000 to 2004, an honor that reflects his long-term productivity investigating topics of interest to the real estate community.

The study, based on the number of times an author's work was referenced by others, was published in the Fall 2006 issue of Real Estate Economics (REE), recognized as the leading journal in the real estate field. The REE study also ranked MIT as the second most influential research institution in the field, based on the number of citations referencing its researchers. The University of California at Berkeley was ranked first.

The publication of the study coincides with the second edition of Geltner's "Commercial Real Estate Analysis and Investments," co-authored with Norman G. Miller, Jim Clayton and Piet Eichholtz (Thomson South-Western, 2007).

Geltner and Miller are also the authors of "Real Estate Principles for the New Economy" (Thomson South-Western, February 2004).

GLOBAL WARMING

Continued from **Page 1**

extensive evidence of the regional signals of climate change, including rising continental-scale temperatures, rising sea levels, shrinking of Arctic summer sea ice and decrease in snow cover in the Northern Hemisphere. It also offers predictions for how rising temperatures will affect the planet in decades to come.

Taken as a whole, the report presents a strong case that the United States, which is responsible for about 25 percent of global greenhouse gas emissions, should take much more vigorous steps to curb its emissions along with the other major emitters around the world, Prinn said.

"Overall, the scientific evidence for human influence on climate has strengthened significantly in the past half-dozen years, and the case for decreasing greenhouse gas emissions is significantly more compelling than it was six years ago," he said.

Greenhouse gases, which include methane, nitrous oxide, ozone, chlorofluorocarbons and their replacements (hydrofluorocarbons) as well as the better-known carbon dioxide, trap infrared radiation in the Earth's atmosphere, inhibiting the planet's cooling capability. Burning of fossil fuels is a major contributor to greenhouse gas emissions, but agricultural activities and deforestation also contribute.

"It's not just the highly industrialized nations that are involved here," Prinn said. "To some degree, every person on the planet is responsible, but some are much more responsible than others."

There is now a near-universal scientific consensus that human activity is driving climate change, but 10 years ago, Prinn himself was not convinced that that was the case. But, as the evidence mounted, Prinn concluded that the changes were too great to be explained by natural climate variations.

Other highlights of the report:

• While global temperatures have risen significantly, the rise is less than expected from the greenhouse gases alone, because of the cooling effect of sulfate aerosols, another type of pollutant caused by fossil fuel combustion. Efforts already underway to reduce those aerosols, which cause acid rain and are harmful to human health, could lead to greater future warming.

• For the first time, the IPCC has placed odds on the accuracy of its climate predictions: The report offers several different greenhouse gas emissions scenarios and, for each one, predicts the likelihood of a certain temperature increase—for example, a two-thirds chance that global temperatures will rise 2.4 to 6.4 degrees Celsius for one high-emissions scenario.

Those odds will help policy-makers decide how much effort is needed to lessen or adapt to the potential impacts of climate change, according to Prinn.

"I'm very pleased because this has been a quest by the climate researchers at the Center for Global Change Science and the Joint Program on the Science and Policy of Global Change at MIT for more than a decade," he said. "In order to help make policy decisions, scientists have got to provide the uncertainties on their key numbers."

In recent weeks, several climate change bills have been introduced in Congress, and Prinn anticipates that he and other MIT researchers will be asked to testify on the scientific, technological and economic aspects of the proposed legislation.

In late November, Prinn spoke to a group of 36 newly elected members of Congress at Harvard's Kennedy School of Government. The representatives were very interested in the topic of global warming, he said.

In addition to reducing emissions, the world should also be thinking about the need to prepare for and adapt to the effects of climate change, Prinn said. For example, it may not be wise to build new infrastructure in coastal areas that may be inundated with rising waters, he said. The IPCC report emphasizes that we are already committed to future warming due simply to the greenhouse gases already in the atmosphere.

Later this year, the IPCC will issue two more reports. One focuses on possible mitigation strategies, while the other will address the impact of climate change on global ecosystems and economies.

BIOWEAPONS

Continued from **Page 3**

A: In many ways Nixon was able to do things because he was a hawk. His agenda, which was very much influenced by Henry Kissinger, was to make sure that Europe was not the battleground between the United States and the Soviet Union. He was able to accomplish a great deal because he was perceived as tough and he was also under pressure to eliminate chemical weapons use in Vietnam.

Q: Why was no one within the program "thinking rationally"?

A: The U.S. program was extremely secret—there was virtually no oversight. One of the lessons for today is if you're going to have heavy investment in military innovations aimed at civilians, you need oversight from agencies and Congress and you need public awareness and debate. Things can happen in secret that you could not believe. Afterwards one wonders, "What happened to the moral compass there? How can these scientists sleep at night?" And the answer is very simple: They worked within a closed moral order, they never questioned outside the particular goals of the technological innovation they were dealing with. And they felt patriotic.

Q: Is there any justification for creating nonlethal biological weapons, in which people just get sick, not die?

A: No. To begin, there's a problem with the term "nonlethal" when lethality can actually occur. It depends very much who the object of the attack is. We develop a notion of a nonlethal biological or chemical weapon based on the physical reactions of a sturdy 22-year-old.

Q: Realistically, is there anything else the United States should be doing to protect us against a biological weapons attack?

A: The best protection is a strong public health system, coupled with international efforts to increase transparency. We need to protect our population against health threats from any source. We also need to include as many nations as possible, including developing countries, within a normative legal framework, with treaties and technological sharing that fosters trust and openness among nations and networks of scientists.

The real danger now is that innovations in biotechnology could be used for hostile purposes. That is a clear possibility and a threat that our lead scientists should be addressing.

FUELS

Continued from **Page 4**

have to be developed. Electricity use in residential and commercial buildings is a big number, so "carbon-free" electricity is a goal. This can be achieved to some extent through burning coal and sequestering the released carbon, nuclear energy and photovoltaics.

The problem is that on a small scale, all these technologies, as well as President Bush's call for ethanol, are attractive and promising. On the large scale necessary to make a dent in energy needs, they get more problematic. Biofuels, for instance, will take a huge number of acres devoted to growing switchgrass or other plants conducive to efficient conversion from cellulose to fuel, plus a lot of water and fertilizer.

"This question of scale is critical," Moniz said. "We each have nice fuzzy technologies we love. It's easy to love them when they're small. It becomes harder to love them when you grow them. When biofuels were small, water supply didn't matter. The same is true of carbon sequestration. There's no silver bullet. We're going to get there only by having a portfolio of fuels, electricity and efficiency."

HYDROGEN

Continued from **Page 5**

versus black hydrogen," she explained.

The model car, for example, uses a solar panel to separate hydrogen from oxygen.

Also, while hydrogen power does not produce carbon dioxide—the chief culprit in global warming—as a byproduct, it does produce water vapor which, Miranda noted, is also a greenhouse gas.

Other design challenges for a hydrogen economy include:

• Storage issues: Liquefied hydrogen has lower energy density per volume than gasoline. "Huge storage tanks are needed for very small cars," Baletto said.

• Fuel cells: Hydrogen fuel cells, while efficient, nonpolluting and silent, are complex to operate, expensive and have low durability, said Miranda.

• Storage of hydrogen in a solid form: This requires material that is strong enough to capture hydrogen atoms but weak enough to release the hydrogen when energy is needed.

A hydrogen economy would require massive changes in infrastructure, including the creation of hydrogen filling stations. Refueling a hydrogen car may take up to an hour—not an attractive option for today's drivers.

Thus, is hydrogen more hype than hope?

Miranda is optimistic—he tends to favor a "Hollywood ending," as he put it. His native Brazil, he noted, has been able to switch to more use of ethanol instead of gasoline after the government heavily subsidized ethanol's use and distribution. Now it's a free market. Hydrogen is "the best candidate for replacing oil in the long term," he said.

Baletto, however, opts for a more "European movie ending," in which obstacles take much longer to sort out and problems remain. "Hydrogen is a possibility we have to explore. In any case, we have to start to change the way to produce energy."

The Three Mile Island crisis–was it a failure of science or spin?

Stephanie Schorow
News Office Correspondent

Since 1979, the words "Three Mile Island" have been synonymous with the words "nuclear disaster." But does a careful analysis of the timeline, aftermath and media coverage reveal that the accident at the Three Mile Island Nuclear Generating Station was really a public relations disaster and not a technical failure?

That was the provocative question posed by Andrew Kadak, professor of the practice of nuclear engineering, in his Jan. 22 two-part IAP seminar about five crucial days in March 1979 at the plant near Harrisburg, Pa.

In the morning session of "Three Mile Island—Colossal Failure or Colossal Success?" Kadak concluded there were failures all around—except for the most important aspect: The melted nuclear core was contained and any radiation released was minimal. Kadak's arguments met with lively opposition, as session participants zeroed in on technical glitches.

Just as lively was the afternoon session on "Three Mile Island Communications—Good, Bad or Ugly?" in which Kadak discussed the role of local reporters, the plant spokesperson, members of the Nuclear Regulatory Commission and Pennsylvania Gov. Dick Thornburgh.

Kadak set the framework for analysis by identifying four aspects of "failure": technical, financial, perception and consequences.

One of the key technical issues in running a nuclear plant is managing heat: radiation decay means that 7 percent of full heat continues even after the plant is "shut down," he explained. The nuclear core has to be covered with water at all times.

On March 28, through a series of errors around 4 a.m.—including a valve that was supposed to close but didn't and a known leak that led operators to conclude high temperatures readings were false—water escaped from the core, which began heating up without a way to remove the heat. Within a matter of minutes, things went from bad to worse as operators continued to believe water was circulating through the core and they had a "bottled-up system."

By 7 a.m. a site emergency was called; by 7:30 a.m. a general emergency was called, amid concerns that a hydrogen bubble had formed in the core. It had not, Kadak said, although months later, cleanup crews were astonished to see how much of the core had actually melted.

Reports that radiation had been released—later found to be inaccurate—led Gov. Thornburgh to order a partial evacuation. A plant spokesperson, technically skilled but inexperienced in media relations, gave the impression of a cover-up. Eventually a visit to the plant by then President Jimmy Carter, who had studied nuclear physics, helped calm the public and the cleanup process began.

As a result of the Three Mile Island incident, nuclear plant construction was halted throughout the United States, "killing the nuclear industry for 30 years," Kadak said, and many became convinced nuclear energy was unsafe. Yet Kadak said, despite ominous newspaper photos, radiation was "contained"—the supreme goal of the design. Could that not be considered a success?

Not to Miklos Porkolab, MIT physics professor and director of the Plasma Science and Fusion Center. "I would say they were damn lucky," he said. "It reminds me of my Pontiac." That is, everything has failed at one time or another.

The bottom line: No one was killed in the accident and subsequent studies have turned up no conclusive evidence of health problems. Three Mile Island could have been a huge disaster; because of safety protocols, it was not, Kadak concluded. The real hero, he argued, was Gov. Thornburgh, who took the attitude, "I'm not going to do anything until I get the facts."

Seuss fans unite for 'Cat in the Hat'

Ruth Walker
News Office Correspondent

Most people standing up to give a literary reading announce the title of the work they are about to share with their audience.

Not so Professor Henry Jenkins at MIT's 17th annual "Salute to Dr. Seuss."

When he stood up before the capacity crowd in Room 4-237 on Jan. 29 and opened a copy of "The Cat in the Hat," he just plunged in.

He knew that virtually every one of his listeners would recognize the story. He knew most of them would be able to picture the unforgettable Seuss illustrations.

And he knew that some would have to restrain themselves from reciting along with him as he read.

The "Salute to Dr. Seuss" is a campus tradition going back to 1991, the year Theodore S. Geisel (Dr. Seuss) died. Jenkins, director of the MIT Comparative Media Studies Program and the Peter de Florez Professor of Humanities, inaugurated and has sustained the event each year.

Seuss, the creator of the fantastic tale of the cat who drops in on a couple of children while their mother is out, clearly had a home in the hearts of the MIT community. Jenkins added, "In a place like this, full of imagination and creativity, it's not surprising that Geisel's work should resonate so."

Jenkins located Seuss at the intersection of some important trends in pop culture, politics and child-rearing.

Geisel adopted his famous pseudonym as a student at Dartmouth. Banned from writing for "The Jack-O-Lantern," the campus humor magazine, he simply renamed himself "Dr. Seuss" and started writing again.

Early on, Seuss focused on pseudo-scientific discussions of such weighty issues as "How warm is 'luke'?" and "How big is a nook?" (The concern here is that one's breakfast nook may actually be only big enough to qualify as a "cranny.")

But Seuss was not uninterested in the important issues of life. He was a lifelong political progressive and outspoken anti-Fascist. He contributed to the progressive magazine "PM." During World War II, Geisel served in the U.S. Army and worked with Frank Capra on the "Why We Fight" films commissioned by the U.S. government.

Dr. Seuss was also an important voice in the 20th-century debate on child-rearing, according to Jenkins. Dr. Spock urged parents to trust themselves and their own instincts as to what was right for their children. Dr. Seuss urged parents to trust their children. This was Seuss' "permissive streak," Jenkins said. Children who were listened to, whose imagination was celebrated, would grow up to be the kind of democratic citizens the world needed, in Dr. Seuss' view.

The IAP program concluded, as the "Salute" has always done, with a showing of the 1953 live-action movie musical, "The 5,000 Fingers of Dr. T." It's apparently well on its way to cult status, at least at MIT. The film, for which Dr. Seuss provided story, screenplay and lyrics, might be thought of as "Leave It to Beaver" meets "The Wizard of Oz," by way of Marlene Dietrich and "The Blue Angel," with nods to Gene Kelly and "Lassie."

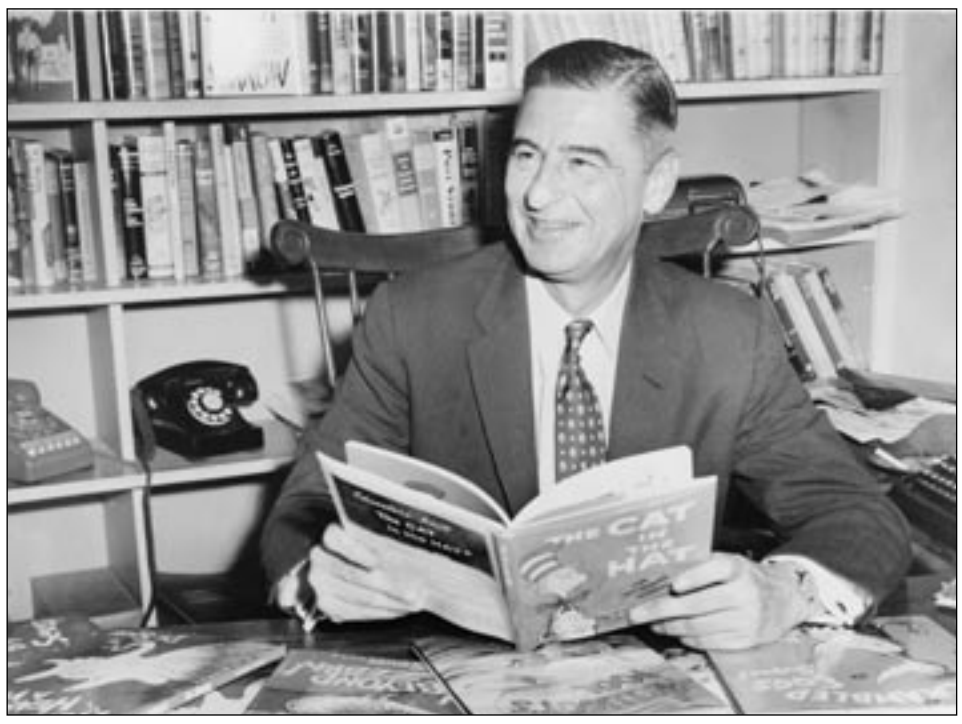

PHOTO / **AL RAVENNA, NEW YORK WORLD TELEGRAM & SUN**

Ted Geisel (Dr. Seuss) in 1957.

Hynes named scientific governor of U.K. charity

Professor Richard O. Hynes has been named scientific governor of the United Kingdom's largest charity, the Wellcome Trust, effective Jan. 1.

Hynes, the Daniel K. Ludwig Professor for Cancer Research at the Center for Cancer Research (CCR) and a faculty member in the Department of Biology, is also a Howard Hughes Medical Institute investigator. He has served as head of both the department and the CCR.

Richard O. Hynes

"With $1 billion annual spend [sic] in science to improve human and animal health, it's great that the Wellcome Trust can bring on board a pre-eminent U.S. scientist who will strengthen our global perspective," said Bill Castell, chair of the Wellcome Trust.

Hynes' research concerns the molecular basis of cell adhesion and its involvement in cell behavior, including contributions to human disease. From his childhood, Hynes gravitated towards science. He chose science as a natural career and never looked back.

He once commented, "Science is intellectually exciting and entertaining. It's good to be employed to play at what you do."

Hynes received a B.A. and M.A. in biochemistry from the University of Cambridge and the Ph.D. in biology from MIT in 1971. After doing postdoctoral work at the Imperial Cancer Research Fund Laboratories in London, where he initiated his early work on cell adhesion, he returned to MIT as a founding faculty member of the Center for Cancer Research.

MIT Sloan hosts sports managers at conference on role of analytics

J.P. Ricciardi, senior vice president of baseball operations and general manager of the Toronto Blue Jays, and Jamie McCourt, president of the Los Angeles Dodgers, are slated to serve as keynote speakers at a pioneering conference to explore the increasing role of analytics in the sports industry.

Bill James, senior baseball operations advisor for the Boston Red Sox and author of "The Bill James Baseball Abstract," will also be featured in the conference, which is sponsored by the MIT Sloan Entertainment, Media & Sports Club and will be held Saturday, Feb. 10, from 8:30 a.m. to 5 p.m. at MIT.

Daryl Morey (M.B.A. 2000), former instructor of the analytical sports management course at MIT Sloan, is conference co-chair. The daylong event will bring together national sports industry leaders who are already "integrating an analytical approach into their personnel decisions and business operations. In the sports industry, competitive advantage is critical. Our goal is to provide a unique opportunity to meet and learn from top sports industry leaders who are creating advantage by using these methods," Morey said.

Morey, who is assistant general manager of the Houston Rockets and a former Boston Celtics senior vice president of operations, noted that conference participants will also include Rich Gotham, chief operations officer of the Boston Celtics; Peter Chiarelli, general manager of the Boston Bruins; Mark Waller, senior vice president of NFL International; and Jessica Gelman, conference co-chair and director of new business development and operational initiatives for the New England Patriots.

Participants will explore such key questions as: Why are some sports teams and leagues more successful than others? How does quantitative analysis factor into personnel decisions such as drafting players and making trades? How should teams determine the optimal ticket pricing strategy? Will rule changes be introduced to counter the pace of technology improvements?

McCourt, an MIT Sloan alum, described the Sloan sports business conference as an "important step in showcasing the role of M.B.A.s and the use of analytics in the industry. As (the L.A. Dodgers') president, I believe that hiring the right people with the necessary analytical skill set combined with excellent interpersonal skills will result in a winning team for fans and profitability for the franchise."

Moderators for the conference will include prominent sports journalists such as Darren Rovell of CNBC; Michael Schrage of the Washington Post; John Hollinger of ESPN.com; Rob Neyer of ESPN.com; and Shira Springer of the Boston Globe.

For more information or to register for the MIT Sloan Sports Business Conference, please visit www.sloansportsconference.com/. For more information on the MIT Sloan Entertainment, Media & Sports Club, please visit sloanems.org.

The conference is also sponsored by Stratbridge, a supplier of sports industry technology for teams in the NBA and NHL; the Parthenon Group, a boutique provider of sports industry management consulting; and yOOnew, an online marketplace for futures contracts.

PHOTO COURTESY / **MIT ALUMNI ASSOCIATION**

Daryl Morey (M.B.A. 2000), assistant general manager of the Houston Rockets.

IAP opens the institute of medieval clothing technology

Robin H. Ray
News Office Correspondent

Technologies don't have to be complex to be effective. Nor do they need to be complex to be difficult to master. These were among the lessons made clear to students during the first-ever Independent Activities Period class in making clothes the very old-fashioned way.

"The Distaff Arts: Medieval Clothing Technology," taught jointly by Anne McCants, professor of history, history graduate Miranda Knutson and Margo Collett, administrative assistant to the history faculty chair, introduced participants to the whole range of ancient fiber technologies, from washing, carding, dyeing and spinning fleece, to weaving and constructing simple garments.

The course, held in the basement of the Tang Center, paired well with one that McCants has taught for several years—"Old Food: Ancient and Medieval Cooking." Both are in some sense spinoffs (no pun intended) from her popular MIT course, "Medieval Economic History in Comparative Perspective." In the distaff arts course, refreshments consisted of old foods: handmade butter and olive oil drizzled over focaccia and wheat-berry bread, made with a sourdough starter that McCants first incubated in Berkeley, Calif., in 1985.

Standing in a kitchen pungent with the smell of wet sheep fleece, McCants explained that the IAP class sprung from discussions she has had over the years with students in her medieval economics classes about the nature of human capital and the problem of defining skilled versus unskilled labor. Students are inclined to dismiss tasks like spinning and weaving as unskilled and therefore fungible. If it's repetitive, they seem to think, it must be unskilled. "But if you think of something like hip-replacement surgery," said McCants, "you can see that repetitiveness of a task is not a marker of something being skilled or unskilled." At the same time, she noted, students find it difficult to comprehend that textiles could make up a significant share of a person's wealth in medieval society, that something like a shirt could be a precious possession to be itemized in one's will.

In fact, she explained in a later e-mail, textiles were "the engine of urbanization, economic growth (of the high medieval variety—think Gothic cathedrals, etc.), long-distance trade (to China and back), and significant technological change, in this case mostly wind and water mill technologies." Moreover, textiles and their precious value were intimately connected with the women who made them. In "Beowulf," which McCants teaches every year in a spring seminar, feuds are settled by "the giving of gifts, often in the form of gold, or women, or women's work—and all three put together in many cases." This is a hard sell to the students, however. "They can't see textiles as the cutting-edge technologies of their day, and they don't think of these things as luxury goods," she observed.

Until, that is, they try their own hands at the spinning wheel, or attempt to figure out the complex geometry of weaving using a waist loom. Said one student weaver in frustration, "I think I'm doing the exact same thing every time, and yet I'm getting these mysterious stripe things."

Many MIT staffers from a variety of departments lent their expertise to the project, which was aided by grant money from the Class of '51 Fund for Excellence in Education. Collett has extensive experience in knitting, spinning and dyeing, and intervened frequently to untangle a jammed spinning wheel or demonstrate the proper use of the Lazy Kate, a simple but ingenious tool for winding spun yarn into skeins. Valarie Poitier, assistant to the dean of student life, helped guide the weaving segments. "I have a 6-foot-by-8-foot loom in my living room," she explained matter-of-factly.

Knutson, who has made the mastery of textile technology her focus since graduating from MIT last year, moved from group to group, offering advice and occasionally turning for help to the pile of books she had accumulated over months of research, with titles like "The Medieval Tailor's Assistant." "I tried hard to find instructions for card-weaving online," said Knutson, noting that everything she found was inadequate or incomplete. "Google has failed; the library has won."

Many of the students chose to undertake the IAP distaff arts course because it looked like fun. "It's a nice change from soldering," said Finale Doshi, a second-year graduate student in robotics. Other students were veterans of McCants' medieval economics class, drawn to the clothing technology class both by the subject matter and by McCants herself. "She's a great professor," said Jeremy Hurwitz, who was making himself a hooded cloak using a pattern of great antiquity and simplicity.

Christine McEvilly, a history major who intends to pursue graduate study in intellectual history of the early modern period, reported that on the first day of the medieval economics class, McCants brought in a jar of milk. Students took turns shaking the jar until the butter separated: a vivid demonstration that sometimes the simplest technology makes the most sense for getting a task done under a given set of circumstances. "This is what people did on a daily basis," said McEvilly as she carefully carded wool that had been dyed bright purple with indigo and madder. "You need to know how people lived to know how they thought."

PHOTO / **DONNA COVENEY**

Valarie Poitier, of the office of the dean for student life, spins at an IAP class taught by Anne McCants of history on the technology of clothes-making in 15th-century Europe.

TREATMENT

Continued from Page 1

out overheating normal tissue.

The microwaves in the new technique heat—and kill—cells containing high amounts of water and ions, or electrically charged atoms. Cancer cells typically have a high content of both, while healthy breast tissue contains much less. The outpatient procedure uses a single tiny needle probe to sense and measure parameters during treatment. Side effects appear to be minimal.

The first clinical study of the treatment involved 75 patients with early-stage breast cancer. Of the 34 patients who received the treatment prior to lumpectomy, none had viable cancer cells remaining at the surgical margins. Of the 41 patients who had a lumpectomy but did not receive the MIT treatment, four had cancer cells at the surgical margins.

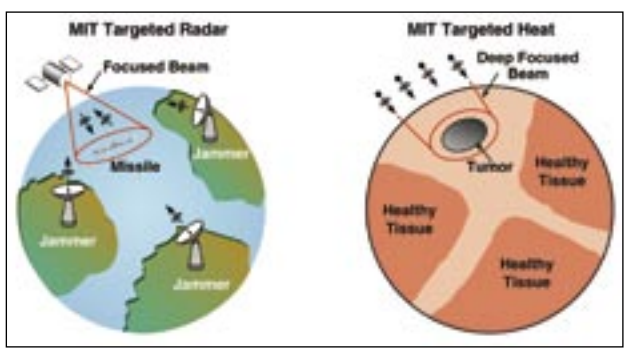

IMAGE COURTESY / **LINCOLN LABORATORY**

The image at left shows the process of detecting and destroying an enemy missile using MIT targeted radar. Microwave energy is fixed on a missile while simultaneously nullifying enemy jammers. On the right, microwave energy is aimed at a cancerous tumor with a deep, focused beam while simultaneously nullifying any energy that would overheat surrounding healthy tissue.

This result is important for two reasons. First, additional breast surgery is often recommended for patients with cancer cells close to the edge of the lumpectomy surgical margin. Second, there is a higher risk of local recurrence of the breast cancer when cancer cells are found at the surgical margins. Fenn noted that all patients in both arms of the study received postoperative radiation therapy to reduce the risk of local recurrence.

Also presented in the new book are preliminary results for a study of the treatment in combination with preoperative chemotherapy for breast cancer patients with large tumors. "In this small feasibility study of 28 patients, one of the principal objectives was to increase tumor shrinkage with the combined use of focused microwave thermotherapy and preoperative chemotherapy," Fenn said.

In this study tumors shrunk by approximately 50 percent more in women treated with both the MIT technique and chemotherapy, versus women treated with chemotherapy alone.

The results of both clinical studies will be presented at the 17th Annual National Interdisciplinary Breast Center Conference in Las Vegas, from Feb. 25 to 28.

Another larger clinical study for patients with large breast cancer tumors is expected to begin later this year at six institutions in the United States and Canada.

Other potential clinical studies for treating recurrent breast cancer, ductal carcinoma in situ and benign breast lesions with the MIT thermotherapy treatment, as well as its use to enhance antiestrogen therapy for breast cancer prevention, are also described in the book.

Celsion (Canada) Ltd. exclusively licenses the technology from MIT. The company developed the clinical thermotherapy system and is funding the clinical studies. The Air Force funded Fenn's original radar research at MIT Lincoln Laboratory.

CO_2

Continued from Page 4

will form a plume and begin to rise through the permeable rock. Once the injection stops, the plume will continue to rise, but saltwater will close around the back of the gas plume. The saltwater and CO_2 will juggle for position while flowing through the tiny pores in the rock. Because the rock's surface attracts water, the water will cling to the inner surface of the pores. These wet layers will swell, causing the pores to narrow and constrict the flow of carbon dioxide until the once-continuous plume of gas breaks into small bubbles or blobs, which will remain trapped in the pore space.

"As it rises, the CO_2 plume leaves a trail of immobile, disconnected blobs, which will remain trapped in the pore space of the rock, until they slowly dissolve and, on an even larger timescale, react with rock minerals," said Juanes. "It is a good example of how a process that occurs at the microscopic scale affects the overall pattern of the flow at the geologic scale."

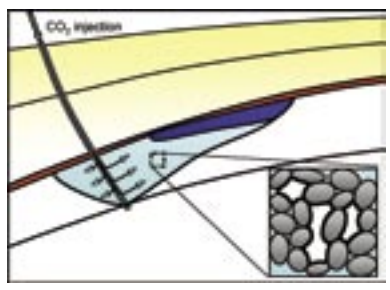

IMAGE / **RUBEN JUANES**

Carbon dioxide could be injected underground into the briny porous rock below. Most of the CO_2 gas would be immobilized (light blue), trapped as small bubbles (white) in the pore space of the rock (gray). Only a small portion of the CO_2 (dark blue) will continue to flow up towards the impermeable layer of caprock (yellow).

Other co-authors are Martin Blunt of Imperial College London and Franklin Orr Jr. of Stanford University. The work was funded by industrial affiliates of the Petroleum Research Institute at Stanford.