IN THIS ISSUE:
SPRING 2003
HONORS
INSERT

APS NEWS

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Physicists Head to Austin for APS March Meeting

The biggest physics meeting of the year, the APS March Meeting, rumbles into Austin, Texas during the week of March 3-7, 2003, featuring an estimated record 5735 talks in a broad range of fields, including materials and condensed matter physics, biological physics, atomic, molecular and optical physics, computational physics, instrumentation, and many others.

The meeting is also traditionally a showcase for the kind of applied physics that forms the backbone of modern technology in all its diverse forms: computing, displays, lighting, photon-based and wireless communications, global positioning, smart materials, medical imaging, automated study of biological molecules, sensing and scanning, printing, the mixing of powders and fluids, and early cancer detection.

In addition, there will be sessions on various nontechnical topics—such as the history of physics, international physics, physics education, and current issues such as homeland security and scientific ethics —as well as numerous special events [See sidebar, page 6]. A broad-brush sampling of some program highlights follows; more extensive reporting on specific events at the meeting will appear in future issues of *APS News*.

MAGNETIC REFRIGERATORS

Magnetic refrigerators, in which the switching on and off of a strong magnetic field drives the refrigeration process, have in the past been hampered by the need for extremely large magnetic fields and often didn't work at room temperature. Four groups report on new magnetic refrigerators that operate with one tenth of previous field strength at usable temperatures. One group finds a 12° Celsius cooling effect and achieves temperatures below freezing. [Session K7]

CARBON NANOTUBES

Carbon nanotubes are now a huge focus of research and development with applications arising in diverse areas. They are being studied as ultrasensitive sensors of gas molecules in the environment, as optical sensors, as mechanical sensors, and as the basis for electronic devices.

At the March Meeting, one can hear results on the nanotube version of transistors, the basic element of electronics. Nanotubes can also emit x-rays suitable for medical use, and are useful for nanoextraction, as nanowicks, and for better microscopy. [Sessions B27, N26, K26, V26]

HOMELAND SECURITY

Forefront physics research has contributed to vital technology used in national defense. A special session features scientists from four national labs and talks on nuclear testing negotiations, providing necessary technical means of verifying treaty components, and the development of large-area detectors for monitoring or searching for weapons-grade materials and high explosives. Among the speakers is C. Paul Robinson of Sandia, this year's recipient of the George E. Pake Prize. [Session P2]

THAT'S ENTERTAINMENT!

Physics principles can be used for fun and profit in elucidating many aspects of everyday life. Conversely, some of the more glamorous aspects of mass culture can be used to help teach physics, as evidenced by a special session on physics in comics, baseball and Hollywood.

The three speakers are James Kakalios (University of Minnesota) who teaches a course in the "sci-

See MARCH MEETING *on page 6*

Severe Visa Problems Threaten Research Collaborations

By Pamela Zerbinos

In late September of last year, a graduate student studying physics at Columbia University went home to China for a three-week vacation. But she ran into some problems at the consulate, and ended up stuck there for more than six weeks — and she's one of the lucky ones.

The 27-year-old student, Shaohua Fu, works on the D-Zero experiment at Fermilab, and has been studying in the United States since August of 1998. Her work at D-Zero is not sensitive, she hasn't had any visa problems before, and she did everything she was supposed to do. She applied for an F1 visa at the Chengdu Consulate General, in southwestern China, two days after her arrival. As a returning student, she didn't need an interview.

"I was scheduled to pick up my visa on Oct. 7," she said. "But when I went there, I got my materials back with no visa, but a piece of paper informing me that I needed an interview." She booked an interview two days later.

"At the interview, the visa officer told me that because I was pursing a PhD in physics, he was not authorized to determine whether to give me a visa, and that my case must be submitted to Washington for a security check." This, she was told, would take three months. She was sent home to wait, without her passport, which prevented her from traveling in China.

"My supervisor [at D-Zero] and the secretary of my physics department both wrote letters explaining my student status and my research area. But I didn't know where they should send the letters. The consulate wouldn't tell me the address my case had been sent to, and they wouldn't reply to the faxes sent by the physics department."

With nothing to do except wait, Fu went home. She went

See VISA *page 5*

Scientific Societies Join Forces To Urge for Funding Increases

Just after the new year, 32 scientific societies banded together to jointly send a letter to President Bush, calling on him to "reverse the decline in science and engineering support that threatens our status as the world's leader in these areas, placing our nation at great future risk." The letter cites the Bush Administration's stated top policy priorities for the coming year — national security and job creation—and notes that "achieving them will require continued advances in science and technology across disciplines. The federal government must take steps to strengthen its support of science and engineering research, many aspects of which have suffered significant declines for more than a decade."

The genesis of the letter dates to late last year, when Michael Lubell, APS director of public affairs, spoke with colleagues at several other professional societies about their mutual concerns regarding the discrepancy between rhetoric from the Bush Administration on the need for increased federal funding for the physical sciences and engineering, and the actual funding levels in the FY 2001/FY2002 presidential budget requests. "We found that there was little in either budget that suggested the kind of attention the administration said needed to be paid," says Lubell.

See SOCIETIES page 3

Photo Credit: Jessica Clark

Physics First

Standing in front of the spectacular APS booth at the January meeting of the American Association of Physics Teachers in Austin, Texas, Kim Bess (center), Director of Science and Educational Technology at the San Diego City Schools, explains the virtues of teaching physics first (i.e. before chemistry and biology). Listening raptly are Kevin Aylesworth (left) and Fred Stein of the APS Department of Education and Outreach.

President Signs NSF Authorization Bill; White House Suppresses the Evidence

On December 19, President Bush signed the NSF Authorization Bill, and the White House made a big deal out of it. But then they seemed to change their mind.

The bill, passed by Congress in the "lame duck" session after the November elections, authorizes funding levels that would double the National Science Foundation budget by 2007, and contains other provisions that will have significant impact on operations at NSF. To dramatize the importance of this legislation, key members of Congress and the heads of several scientific societies, among them Bill Brinkman of APS, were invited to the White House to witness the signing.

At the ceremony, President Bush reportedly made a strong statement in support of science. Pictures were taken. Scientists and legislators alike left with a real feeling of accomplishment.

Here at *APS News*, we called our contact at the Office of Science and Technology Policy, and were promised pictures of Presidents Bush with Brinkman as soon as they became available. A month went by, the deadline for our February issue came and went, and still we waited. As this is being written, the deadline for our March issue looms and there is no sign that the pictures will ever be released.

Apparently all such pictures have to be cleared, exactly by whom we don't know, and exactly why we don't know. It is unlikely that there could be any security implications to them. Maybe they need to be inspected to be sure that the President (Bush, that is) is not caught with an unbecoming expression on his face.

See NSF page 4

Highlights

One Last Look:

Notable S&T Quotations from 2002

"I want to state clearly at this point that, despite its apparent impracticality, the administration values discovery-oriented science, and aims to continue to support the grand quest for knowledge about the universe at the largest and smallest scales."
—OSTP Director John Marburger at a meeting of the American Astronomical Society.

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"In absolute terms the science and technology [budget request] numbers have grown as well. Would we have liked to have gone faster? Of course."
—DOD Comptroller Dov Zakheim on the Administration's FY 2003 Defense Department request.

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"The Congress, led by this Committee, will have to show its mettle and provide an infusion of cash for the rest of the research budget, even in these strained times."
—House Science Committee Chairman Sherwood Boehlert (R-NY).

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"While these projects don't sound very relevant to the daily existence of most Americans, the downstream impact of projects like these is pretty significant."
—DOE Undersecretary Robert Card on nuclear and high energy physics research.

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"What I've come to understand is that in science and technology, few things could actually be bigger than nanotechnology."
—Rep. Boehlert.

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"I think you need to raise your visibility . . . [the] public perception is not as great as it should be."
—Rep. Rodney Frelinghuysen (R-NJ) to NSF officials.

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"Some believe NASA has lost its focus and that the pioneering spirit, the excitement of NASA's mission is gone. But believe me, that spirit is alive and well. We intend to nourish it."
—NASA Administrator Sean O'Keefe.

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"The Department's scientific inquiries and modeling clearly demonstrate that a repository at Yucca Mountain can meet the EPA's standards for protecting the health and safety of our citizens."
—Energy Secretary Spencer Abraham.

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"Nevada considers the Yucca Mountain project to be the product of extremely bad science, extremely bad law, and extremely bad public policy."
—Nevada Governor Kenny Guinn.

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"I find this really disturbing."
—Senator Barbara Mikulski (D-MD) on the FY 2003 NSF request.

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"I'm disappointed that the Administration has not demonstrated the same level of support for NSF as we have."
—Senator Christopher Bond (R-MO)

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"Understanding the actual return on our federal investment dollar is all the more essential in the current environment, when we need to ensure that national security needs are fully met. We cannot afford to increase funding for all programs."
—OMB Comptroller Mark Everson at a hearing on the evaluation of R&D programs.

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"Without adequate research into the underlying fields of physics and chemistry, advances in biology and medicine will stall."
— Rep. Connie Morella (R-MD).

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"We get a huge return on the money that we invest in research, and we will determine today what kind of a world our children will live in."
—Rep. Gill Gutknecht (R-MN) during House consideration of NSF "doubling" bill.

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"No one lab will have supremacy."
—Senator Pete Domenici (R-NM) on the role of national labs in the new Department of Homeland Security.

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"I just don't want to be second in the world."
—Office of Science Director Ray Orbach to high energy physics advisory panel.

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"America's technological prowess is unequaled in the world today — which is why, despite our economic slowdown and the financial burdens of prosecuting the war against terrorism and ensuring our collective defense, we still have the strongest, most vibrant economy on the planet."
—Senator Joseph Lieberman (D-CT).

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"It always pays to be mindful of the fact—especially in the wake of the September 11 events—that there is a strong and tight linkage between our national security and the level of science and technology proficiency in America."
—Rep. John Larson (D-CT).

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"International tests place our students in the bottom third of in-

See QUOTES *on page 5*

This Month in Physics History

March 13, 1781: Herschel Discovers Uranus

Frederick William Herschel began life modestly as one of three children in a German family of musicians, but eventually became one of the most notable observers in the history of astronomy. Best known for his discovery of the planet Uranus, it was Herschel's systematic survey of the sky that turned out to be one of his most important accomplishments, resulting in a catalogue of nebulae that increased those then known from about 100 to 2500.

Born in Hanover, Germany, in 1738, Herschel served briefly in the German military but fled to England at age 19 with the help of his father, earning a living first as a military bandmaster, and then as an organist and music teacher at the Octagon Chapel in Bath, England. He later began composing military music, symphonies and choral works, and performing, proving to be quite successful as a musician. In his leisure he devoted himself to the study of foreign languages, philosophy and mathematics.

However, as he matured, Herschel developed an avid interest in astronomy when he read Smith's *Compleat System of Opticks* and Ferguson's *Astronomy*. He initially rented a small reflecting telescope to observe the heavens. Since he lacked the funds to purchase a larger telescope, he decided to build his own, with the help of his brother and sister, Alexander and Caroline, who had since joined him in England. This ultimately led to the construction of his largest telescope, a 48-inch reflector. But most of his recorded observations were made with his 20-foot reflecting telescope. The large reflecting telescopes that he constructed, including one with a 40-foot focal length, far surpassed in size those of his contemporaries.

Herschel's skill at devising his own instruments helped ensure his success as an astronomer. His first major discoveries were that Mars and Jupiter exhibit axial rotation. But on March 13, 1781, while scanning the skies with a 7-inch reflecting telescope in an attempt to determine stellar parallax, Herschel observed an unusual disk-shaped object, which he initially thought was a comet. For the next few months he continued making observations and calculations, and discovered that the object's orbit was fairly circular and lay well beyond the orbit of the planet Saturn. He concluded that it was, in fact, a planet, which the astronomical community eventually named Uranus, after the mythological god of the skies. His discovery—the first new planet discovered since Antiquity—brought immediate celebrity and earned him a pension of 200 pounds a year and a knighthood from King George III, who also made him "king's astronomer." This enabled Herschel to devote himself full-time to astronomy.

Frederick Herschel

Herschel's subsequent observations and discoveries were numerous. While Caroline turned her attention increasingly to comets, he observed sunspots and confirmed the gaseous nature of the sun, and later discovered two moons of Jupiter and two moons of Uranus. But his principal work centered on stars, particularly the movement of the solar system through space, and evidence that binary stars move around a common center of gravity. Herschel made one of the first attempts to measure the sun's motion through the galaxy using nearby stars, providing an important step in the gradual acceptance in the astronomical community that the Sun was not, in fact, the center of the universe. He also anticipated the work of Laplace with his development of an evolutionary theory of the universe in which, starting from a uniform "initial state," stars form and clump into nebulae. And he discovered more than 1000 binary stars.

But by far Herschel's most ambitious undertaking was an attempt to determine the structure of the Milky Way galaxy using a technique he called "star gauging": making sample counts of the stars in the field of view of his telescope. His increasingly large and powerful telescopes allowed him to resolve many of the mysterious "nebulae" into clusters of faint stars. Because his instruments lacked clock drives to keep them trained on the moving sky, his method of observation was to train his telescope on a point on the meridian and watch what crossed the field of view in a thin strip of the visible sky. He did this while standing on a ladder, calling out descriptions of whatever he saw to his sister Caroline. As the nights progressed, he would change the position of the telescope to observe another thin strip of sky, and so forth.

With Caroline's help, Herschel was ultimately able to observe all of the sky visible in Great Britain over a period of about 20 years, during which he methodically catalogued the faint patches of light now known as nebulae. After his death in 1822, Herschel's son, John, took his father's instrument to South Africa where he was able to survey the southern sky, publishing *The General Catalogue of Nebulae* in 1864, which was later revised and enlarged in 1888 by L.E. Dreyer as *The New General Catalogue of Nebulae*. Even today most non-stellar objects are still known by their General Catalogue (NCG) numbers. Herschel concluded from his star counts that the Milky Way galaxy was shaped like a disk, marked by many irregularities, and that the sun was located near its center. Later studies, of course, confirmed Herschel's deduction of shape, but found that the Sun is not near the center, and that the system is considerably larger than Herschel supposed.

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Number Six

Giant Magnetoresistance of (001)Fe/(001)Cr Magnetic Superlattices,

(M. N. Baibich, J. M. Broto, A. Fert, F. Nguyen Van Dau, F. Petroff, P. Eitenne, G. Creuset, A. Friederich, and J. Chazelas, Phys. Rev. Lett. 61 (1988) 2472), 2455 citations

This is the fifth in a series of articles by James Riordon. The first article appeared in the November 2002 issue. The articles will be archived under "Special Features" on the *APS News* online web site.

Mario Baibich recalls that the study of magnetism was generally considered to be a dead end in the 1980's. "Many a friend tried to talk me out of concentrating on this subject," says Baibich. In fact, the field was only in a temporary lull, and the sixth most-cited *Physical Review Letter* that the Brazilian physicist coauthored while working as a postdoc with a group of researchers in France was just the thing to perk it up. The discovery of giant magnetoresistance (GMR) turned the study of layered magnetic structures into one of the most dynamic, and profitable, fields in physics in the last quarter century.

GMR is the dramatic variation in the resistivity of multilayered thin film structures that occurs with application of a magnetic field. The applied field changes the relative orientations of magnetic regions in some of the layers. When the fields in adjacent layers are aligned, electrons with spins oriented parallel to the fields (up electrons) pass easily from one layer to another, and antiparallel (down) electrons are strongly scattered, leading to low resistivity for up electrons. If adjacent regions have antiparallel fields, both spin up and spin down electrons are strongly scattered, and the resistivity is high for all electrons. It is the spin-based explanation for GMR that has led to the use of the term "spin valve" for various GMR devices.

Magnetic sensors and the read heads in high density computer storage media are among the common devices to benefit from GMR, and nonvolatile, low-power, high-density magnetic random access memory (MRAM) may soon replace dynamic random access memory (DRAM) in personal computers. Arguably, the most promising GMR-derived applications are still in their infancy; spin-selective active devices, such as transistors, are only now being perfected, but they have already inspired a new term in the scientific nomenclature: spintronics. Potentially, spin-selective components may even offer a practical avenue to much-hyped optical and quantum computers.

Albert Fert, a coauthor on the *PRL* paper and the group leader who headed up the GMR research at the time, points out that the initial discovery of GMR as well as the subsequent commercial success of related technology is a shining example of the benefits that can result from collaborations between academia and industry. "In the middle eighties," explains Fert, "I realized that progress in the technology for the fabrication of thin multilayers had reached the point that it was possible to exploit my previous fundamental works on spin-dependent transport and obtain novel effects in artificial nanostructures." Inspired by the discovery two years earlier of antiferromagnetic coupling between iron layers separated by a thin layer of chromium by Peter Grunberg and coworkers at the Jülich Research Center in Germany, Fert approached Thompson-CSF (now the Thales Corporation), and arranged for the fabrication of more elaborate multilayer superlattices with the company's new molecular beam epitaxy machine.

Although Fert, Baibich, and their colleagues fully expected to see spin dependent conduction effects, the magnitude of the effect was startling. "To tell you the truth," says Baibich, "after the first experiment I took apart the whole system to check for possible short circuits." The researchers had expected to see effects on the order of a few percent, but instead saw the resistance drop by a factor of two." As [our coauthor] Jean Marc Broto said at the time," recalls Baibich, "we could have used a multimeter to measure the effect!"

"I knew from my work on iron-based alloys that the couple iron-chromium was a good system for spin dependent conduction effects," adds Fert, "but I was afraid of the possible drawbacks of the interface roughness to blur the spin dependence. It was a good surprise to see magnetoresistance at so high a level. Our luck was that, finally, the GMR was not requiring interfaces of very high quality."

Due to the relatively modest size of the research community involved in the study of magnetic thin films at the time, says Fert, the paper was initially slow to accumulate citations. "Since that time, with the present extension of the field of spintronics, the community is much larger and GMR is often referred to as the first example of exploitation of spin in transport devices." In part due to the discovery of GMR and the snowballing popularity of the 1988 *PRL*, Fert was able to create a new laboratory. He continues his work in the field as a group leader in charge of spintronics research at the Unité Mixte de Physique at Orsay, a joint laboratory of the French National Center of Scienific Research (CNRS) and the Thales company in association with the Université Paris-Sud.

Baibich is now back in his native Brazil at the Universidade Federal do Rio Grande do Sul, where he is primarily looking into other ways of testing spin-selective scattering. In reflecting on the extraordinary success of the GMR paper and the many scientific advances it spawned, Baibich has one final thought on the advice his friends gave him suggesting he find something more fruitful to study than magnetism. "Perhaps the greater lesson is that we will never know everything about any subject," says Baibich, "and that good science should be the criterion to judge."

INSIDE THE BELTWAY:
A Washington Analysis

The Costs of War Put Science Under Stress

By Michael S. Lubell, APS Director of Public Affairs

From Washington to Boise, from London to Karachi, the air hangs heavy with the smell of war. Swift on the heels of Al Qaeda's 9/11 attack, even before America struck back against the Taliban in Afghanistan, White House military hawks had persuaded the President to adopt the doctrine of preemptive war. In September, Congress gave its blessing to the first application of the Bush Doctrine: regime change in Iraq.

Today, the United States is deployed to fight wars on two fronts, at home—against terrorism, and abroad, against deemed threats in Iraq and possibly North Korea. To date, 150,000 troops have been sent to the Middle East, about as many reservists have been called up and a Department of Homeland Security has been created that consolidates the activities of 22 agencies under the rubric of a gigantic new federal bureaucracy.

None of this comes cheap, and the pain it is causing comes at a time when the stock market is in the tank, business is shedding jobs at a rate of more than 100,000 a month and states and municipalities are awash in red ink. In two years, the nation has gone from surpluses that economists had forecast would total $5 trillion over ten years to deficits that are now projected to extend as far as the eye can see, amounting to more than $1.3 trillion dollars in the next decade, alone. That could balloon to almost $3 trillion dollars if Congress gives the President the new tax cuts he has proposed.

The impact on American science is likely to be substantial. Its effects on federal research budgets, workforce composition and international collaborations are already being felt. In Fiscal Year 2002, the federal government ran a deficit of $159 billion. And Mitch Daniels, Director of the Office of Management and Budget, now forecasts a $200 billion shortfall for Fiscal year 2003 and at least $300 billion for 2004. Against this backdrop it is little wonder that the 108th Congress began to trim back in February the increases for research that the 107th Congress had proposed for Fiscal Year 2003 last fall.

Doubling the National Science Foundation budget, as called for in the 2002 NSF Authorization Act, overwhelming passed by the House and Senate in November and signed by the President in December, now seems little more than wishful thinking. The Department of Energy's Office of Science, which had expected to see its programs grow modestly in Fiscal Year 2003, is now preparing for belt tightening, with little hope for relief anytime soon. And in the Department of Defense, the 6.1 Programs that fund basic research are coming under increasing pressure, as DOD copes with the transformation demands the Administration has placed on it in a time of war.

The science workforce is also facing transformation issues. For more than a decade, American students have shunned the physical sciences and engineering. In most of these disciplines, foreign nationals now account for more than half of freshly minted advanced degrees. Even in the life sciences, non-citizens represent a large fraction of the American workforce. The National Institutes of Health, according to a January 20th report in the Wall Street Journal, has more foreign nationals on staff than Americans.

See BELTWAY *on page 4*

SOCIETIES *from page 1*

To call attention to this discrepancy, a working group was formed with representatives from the APS, the American Chemical Society, the American Astronomical Society, the American Mathematical Society, the American Society for Biochemistry and Molecular biology, and the IEEE to draft the letter. That draft was then circulated to numerous scientific societies, revised, and recirculated. Despite the short time frame and the holiday season, 32 societies ultimately agreed to sign the letter. And Lubell believes that the letter was perfectly timed: negotiations on the FY2004 science budgets were not resolved until January 13th. "So the letter was sent just when [the Office of Management and Budget] was making its hard decisions," he says.

"We felt we had a compelling case," says Lubell, pointing to a recent draft report, "Assessing the U.S. R&D Investment" by PCAST, and the RAND report, "Federal Investment in R&D." Both reports are cited in the letter and both point out the harm that a continued downward trend in federal funding for the physical sciences and engineering would have, both on research and the future S&T workforce. Continued reductions, the letter states, "would make it difficult to maintain an appropriate balance of funding for individual investigators and large projects, for core programs and initiatives, for universities and national laboratories, and for major equipment or instrumentation and research operations."

However, despite the president's signature on H.R. 4664, the NSF Authorization Act, FY2004 funding levels for the agency in draft appropriations legislation currently in conference are significantly lower than specified in that bill, according to Lubell. The NSF is slated for a 10% increase in research funding and a 6.5% increase overall, compared to the 15% research increase and 10-14% increase for the agency overall contained in H.R. 4664. Other agencies, particularly the Department of Energy, fare even worse. [*See* **BELTWAY**, *page 3*]

Assessing the impact of the January 3 letter to President Bush is difficult, but Lubell believes the letter was certainly noticed, and that it is critical for the scientific community to continue to voice its concerns — even though, with a Republican-controlled Congress beholden to the White House, some feel such efforts would be moot. "If we don't express our point of view, who will?" Lubell contends. "If we're silent, it will suggest that we agree with what is being done. In my judgment, that would be not only inappropriate for the scientific community, but also makes for bad government. Leaders need to hear a diversity of opinion. They will ultimately make their own choices, but we must give them input."

The complete text of the letter can be viewed online at www.aps.org/apsnews.

LETTERS

BNL Proud Of Davis

I was pleased to read your extensive and informative write up of the 2002 Physics Nobel Prizes in your December 2002 issue.

We at Brookhaven National Laboratory have been especially excited about the award to Ray Davis because he was a BNL employee (in the Chemistry Department) from the start of his scientific career until his retirement, and his prize-winning work on the detection of solar neutrinos was initiated and pursued for the most part while he was at BNL with funding from DOE.

I was thus dismayed to find not a single reference to BNL in the entire description of Davis' experiment and would like to set the record straight (although most physicists undoubtedly already associate Davis with BNL).

Peter Paul
Brookhaven National Laboratory

My B-Field Is Bigger Than Yours

The first sentence of the article on the DPP meeting (front page January 2003 *APS News*) asked, "Where can you find the strongest magnetic fields on Earth?" The answer is, in close approaches of high-energy heavy muclei. Magnetic fields of 2 x 10^{20} Gauss are found midway between two 500 TeV lead nuclei passing with a center to center distance of 20 fm. This will occur with the LHC (Linear Hadron Collider) at CERN when it becomes operational in a few years. The magnetic field generated by the heavy ions is about a trillion times the laser generated field described in the article.

Edwin Norbeck
Iowa City, IA

Knee-Jerk Rejection Wrong

James Felten's rabid dismissal of Anna Mayo's point of view on Teller because her choice of political persuasion appears to be what he calls "leftist" reminds me of the way some schools of feminism reject most of classical and modern physics because the choice of social persuasion of the authors appears to be what they call "sexist".

It's so easy to close a mind, but in our business we are supposed to be dedicated to opening them.

Patricia Schwarz
Pasadena, California

Under 30?
Good at Physics?
Win a New Car!!!
(or the equivalent)

See the Call for Nominations for

THE GEORGE E. VALLEY JR. PRIZE OF THE APS

in the Prizes and Awards insert.

First Came The Grasshopper

I enjoyed the "Circa January 1961: Lorenz and the Butterfly Effect" piece in the January 2003 issue of *APS News*. Unfortunately, the article perpetuates the myth that the term "Butterfly Effect" came about because the Lorenz attractor has, with some imaginative effort, the shape of a butterfly.

The actual story is much more interesting. Some of the details are given in Ed Lorenz's book *The Essence of Chaos* (U. Washington Press, 1996).

I recently learned that the "butterfly effect" was, in fact, predated by nearly 70 years in a book review published in *The Physical Review*.

The late Prof. Al McLennan of Lehigh University, knowing of my interest in nonlinear dynamics, alerted me to the review of Pierre Duhem's *Traité Élementaire de Méchanique Chimique fondée sur la Thermodynamique* (1897) written by Prof. W. S. Franklin of Lehigh.

The review appeared in *Phys. Rev.* ***6,*** *170-175 (1898)*. Discussing the sensitivity of the atmosphere to small perturbations, Franklin writes:

"Long range detailed weather prediction is therefore impossible, and the only detailed prediction which is possible is the inference of the ultimate trend and character of a storm from observations of its early stages; and the accuracy of this prediction is subject to the condition that the flight of a grasshopper in Montana may turn a storm aside from Philadelphia to New York!"

It seems as if the notion of "sensitive dependence on initial conditions," the hallmark of chaos, has been in the air (so to speak) for some time and that insects have been the creatures of choice for vivid metaphors for these effects.

Robert C. Hilborn
Amherst, MA

Specify What Each Author Did

The recent debates about authorship of scientific papers have been thoughtful, and led me to think of one possible innovation. What if a journal were to require a short paragraph at the end of the paper, where acknowledgments are usually given, which specified the nature of the contribution of each author?

I think it might be very useful to tenure committees and funding agencies to know that a postdoc carried out the major measurements and wrote the manuscript, while a grad student characterized the samples, which were provided by a collaborator, and the professor secured the funding for the research.

Readers would know exactly whom to call with specific questions, and meeting organizers would know which author should be invited to present the work. This would certainly be a more valuable use of space than the author pictures and bios published by some journals.

Kristl B. Hathaway
Deale, Maryland

APS Prejudiced And Cowardly

Re."APS Council Approves Statement Protesting Boycott of Israeli Scientists", *APS News*, January 2003: Bravo to the APS for taking a strong stand for academic freedom. It was particularly heartening to read in the statement "*Bona fide scholars pursuing academic activities should be free to do so without hindrance*".

As such, I will eagerly look forward to a similar protest by the American Physical Society over the closing, by military force, of two leading Palestinian Universities on January 15 by the Israeli military in the Occupied Palestinian West Bank. By shutting down the Islamic University and the Polytechnic Institute in Hebron, Israel is doing far worse than refusing to speak to Palestinian academics. It is destroying the very structure of Palestinian academia by force.

Unless I see a similar protest by the APS at Israel's destruction of Palestinian academic institutions, I will have no choice but to see the APS as prejudiced, cowardly, politically motived and totally unworthy of my continued membership.

Isaac Boxx
Austin, TX.

Ed. Note: *For the record, the APS statement (See* http://www.aps.org/statements/02.5.html *) takes no position on the Israeli-Palestinian conflict. It asserts, however, that regardless of one's views on this conflict, it is wrong for those in the academic community to boycott Israeli science and scientists.*

Engineers May Drop Physics Requirement

On one slow day in July a polite young engineering professor came to my office to discuss teaching physics to engineers. The conversation began with a concern that his students did not understand vector cross products very well and an offer to supplement what we teach with some engineering examples. He was quite nice. Then he asked what our physics faculty would think about moving physics to the second year so he could teach statics to engineering students in their first semester. His course would include Newton's Laws and energy conservation. I explained some problems with doing that and he seemed satisfied, especially when I asked to look at the material he wanted me to use. However he was not quite done. And after a pleasant interlude he asked how many of the physics faculty at our university do research in classical mechanics. None, I thoughtfully replied. He pointed out that some of his colleagues in engineering are actively working on statics and dynamics, and commented that our engineering students might find some of their research interesting. Remaining topics, such as quantum mechanics, could in his view, be given in a second year physics course. He was kind enough not to explicitly say that these engineering students are not even in our college of arts and sciences, or that engineers active in mechanics may be better qualified to teach mechanics to engineers.

The accreditation of courses in engineering physics in the US is now done by an accreditation board for engineering and technology (ABET). The rules have changed. Specific courses are no longer required for a BS in engineering. Instead a list of goals is developed, including familiar topics such as problem solving together with new topics such as professional development. These goals are somewhat flexible and vary from university to university. Schools of engineering are now free to find new and better ways to teach their students. At many universities such as ours, retention of students (together with their tuition) and financial self-sufficiency of individual schools ("each tub on its own bottom") provide rational for implementation of change. Our school of engineering would like direct contact between engineering students and faculty in the freshman year so that student commitment to engineering can be strengthened. Our school of engineering may also question why they should send money to math and science that can be spent within engineering to build engineering.

In many physics departments across the country enrollments in introductory physics courses include large numbers of engineering students. Faculty positions are to some extend tied to the demand for teaching. If the demand is reduced, eventually the number of positions in (and the influence of) physics may also be reduced.

Jim McGuire
Tulane University

Diffusion In Biological Membranes Related To DLA

I enjoyed James Riordon's reminiscences of Tom Witten and Len Sanders' *PRL* on "Diffusion Limited Aggregation" (*APS News*, December 2002).

There's a similar earlier 2D example from biological membranes, to which I was introduced on sabbatical in Jon Singer's laboratory at the University of California at San Diego, stimulated by a basic paper by Frye and Edidin [*Journal of Cell Science* 7, 319 (1970)].

We Monte-Carlo modelled the mobility of "particles" in membranes as a simple diffusion, and let particles remain together upon contact. The resulting pictures are similar to those in the letter.

We spent a fascinating half-day with Benoit Mandelbrot, exploring connections with fractals, but were too limited in computing power to pursue this. Diffusion in biological membranes is still an active field.

Paul Meakin, with whom we discussed early on our problem *vis-a-vis* diffusion limited aggregation, has nicely noted in "Fractals, Scaling, and Growth Far From Equilibrium", *Cambridge University Press*, (1998) why there was not more connection between the diffusion limited aggregation and biophysical communities .

Leonard Finegold
Philadelphia, PA

Examples Reflect Ideology

In the January 2003 issue, Brian Cluggish states in his letter that, "The Bush administration needs to base its actions on sound science, regardless of ideology."

I fully agree, but have to laugh at the examples he refers to. It is obvious that his openly biased position wants an administration to base its actions on sound (liberal) ideology, regardless of science.

Bill Morrey
Palm City, Florida

NSF *from page 1*

A second possibility occurs to us: President Brinkman is a tall man, significantly bigger than President Bush. The picture of them together might make Bush look small. If that's the problem, we are hoping for another opportunity in 2003; our new President, Myriam Sarachik, has many admirable qualities, including the foresight to stand barely more than five feet tall.

Will President Sarachik get to meet President Bush? And will the White House have the courage to release a picture of them together? We'll keep you posted.

BELTWAY *from page 3*

As a nation of immigrants, the United States has reaped huge benefits from the influx of foreign workers. Science has been no exception. And until recently, policy makers who expressed concern about the risks of a foreign-dominated science workforce, found their apprehensions subject to accusations of jingoism.

Today, all that has changed. New security regulations make it difficult, if not impossible, for scientists from "sensitive countries" to obtain study or work visas. National laboratories, especially those involved in defense research, have erected high, if not insurmountable, barriers for scientists from China, Russia, Pakistan and a host of Arab countries.

Even many prominent visitors have to wait for up to six months to obtain permission to attend conferences in the United States. The international collaborative nature of science, a hallmark of the last half century, is coming under great stress. Such are the costs of war for American science. They may be necessary, but they will leave the enterprise much weakened.

VISA *from page 1*

online and found hundreds of other Chinese students with the same problem. One Internet newsgroup, "Student Visa for Chinese", has almost 300 members, and provides a place for them to trade stories, tips, information and encouragement.

Finally, she got a call on Nov. 14, saying her visa was ready.

"That was a pleasant surprise," she said. "I was expecting three months. After all this, I still think I am lucky."

Others haven't been so lucky. Another D-Zero graduate student, Zhong-Min Wang, who is enrolled in the State University of New York at Stony Brook, has been stuck in China since last July. Other D-Zero students and scientists from Vietnam, India and Russia have also run into difficulties, and in October of last year the collaboration was short 14 scientists.

Gerald Blazey, experiment co-spokesman, said they started noticing the problem during the summer of 2002.

"There was one case in particular that really brought the problem home to us," he said. "Some of our front-end electronics had fairly sophisticated programs that had been written and maintained by our Russian collaborators, and a problem developed that was causing inefficiencies in data collection. The individual who could fix it was stuck in Russia until his visa problem could be cleared up." Fortunately, D-Zero was able to get help from the Fermilab computing division.

The D-Zero collaboration consists of 600 scientists from 75 institutions in 50 countries. Half the scientists are not U.S. citizens, and a significant number of graduate students are foreign nationals. According to experiment co-spokesman John Womersley, there are 200 scientists at Fermilab working on D-Zero at any given time.

"There has been a relatively large number of collaborators who did not anticipate delays in getting visas processed," said Womersley. "These are all kinds of people—new graduate students, people who have been here many times before, people enrolled in PhD classes at American universities, and others from our collaborating institutions overseas. We can communicate with them by e-mail, but they're simply not allowed to enter the country. And for a lot of the tasks to do with operating the detector and developing the software and doing the analysis, they need to be here, they need to be able to visit and talk with people."

"If the larger visa issue isn't solved," said Blazey, "we will have trouble maintaining efficient operations. We'll have to divert money and personnel to deal with the systems traditionally our foreign collaborators handled."

Another danger is that institutions from the countries and regions having the most trouble—China, Russia, southeast Asia and the Middle East—will withdraw from the collaborations, leaving personnel and funding gaps that will be very difficult to fill domestically.

In October 2002, Blazey and three other D-Zero officials sent a letter to Secretary of State Colin Powell and Secretary of Energy Spencer Abraham to highlight the difficulties the collaboration was having, and included a list of the 14 scientists having trouble.

The President of APS has also sent letters highlighting the problem—both at D-Zero and in the physics community in general—to Secretaries Powell and Abraham, as well as CIA director George Tenet, Attorney General John Ashcroft and Homeland Security Director Tom Ridge.

Since then, there has been a small amount of progress at D-Zero. "We haven't done a new census," said Womersley, "but there has been some progress on a few of the cases mentioned in the letter. On the other hand, I think an equal number of people have probably made it on to the list."

Fermilab is not the only place having difficulty. A 2002 APS survey of 79 PhD-granting physics departments revealed serious problems, particularly among smaller schools. Southern Methodist University, which has a small but high-quality program, had zero entering students this year because their two foreign admittees were not granted visas. "One more year of this, and we'll close down the program," said the SMU spokesman who filled out the survey.

Temple University, in Philadelphia, lost half its first-year graduate students due to visa problems. Other universities said that in the future, they will make fewer offers to international students, because they can't afford the possibility that the students will be unable to come at the last minute. Most of those expressed displeasure at the loss of talent and diversity this policy change would cause their programs.

"One of the things that frustrates people here," said Womersley, "is that the people having visa problems are the groups of people who would naturally be most accepting of the United States. The US is presenting a very bad public face to people who are influential and educated and who would be its natural friend. It creates a bad feeling, and these are the people who need to be wooed."

Womersley also mentioned a 1952 CBS documentary, made for the 10-year anniversary of Enrico Fermi's historic self-sustaining nuclear reaction. At the end of the show, the host, Edward R. Morrow, "made a very forceful argument about how all of these guys were foreigners who'd been welcomed into this country and produced nuclear technology when it was needed. It sent a very timely message."

APS is ready and willing to help individual scientists having difficulties with visas; Email: international@aps.org *or call any one of the APS International Affairs staff: Irving Lerch, (301) 209-3236; Michele Irwin, (301) 209-3237; or Jackie Beamon-Kiene (301) 209-3239.*

QUOTES *from page 2*

dustrialized nations in their performance in science, and dead last among those nations in high school physics."

—Rep. Vernon Ehlers (R-MI)

✶✶✶

"The priorities of the nation drastically changed in a matter of a few hours."

—OSTP Director Marburger.

✶✶✶

"It's a big deal."

—Commerce Secretary Don Evans on global climate change.

✶✶✶

"It has become very tough."

— DOE Office of Science Director Ray Orbach discussing the budget for his office.

✶✶✶

"Where the rubber meets the road, we have to stop talking and invest, with real money, in the science and engineering enterprise that will guarantee the health, economic viability, and security of our future."

—Senator Ernest Hollings (D-SC)

✶✶✶

—Compiled by FYI Staff, American Institute of Physics

zero gravity

The Lighter Side of Science

Physics Songs For the Technically Inclined

They might not make the Top 40 pop charts, but physics songs are a great deal of fun. More than 250 of them can be found online— many with online recordings — and are catalogued and organized at www.PhysicsSongs.org. A sampling is below:

The Snell's Law Song

Tune: Sweet Betsy from Pike (traditional)
Words: Marian McKenzie and Walter F. Smith

Come and listen and learn, I've a story to tell,
I sing of the genius of Willebord Snell
A mathematician who lived long ago
In the Netherlands where the Rhine river does flow.

He set for his mind occupations of worth,
Improved navigation and measured the Earth.
He gave us the sine law, that wonderful guy,
And he made more precise calculations of pi.

Chorus:
Singin' n1 sine theta-sub-1, hey, hey, hey,
Equals n2 sine theta-sub-2, hip hooray!

His greatest feat came in Sixteen Twenty-One,
When optics as science was really begun.
While flashes of lightning illumined his page,
He wrote down Snell's law, his great gift to the age.

So if you wear glasses or like to fry ants,
Be grateful your lenses were not made by chance.
Astronomers hail him with each newfound star.
Microscopists toast him from each sleazy bar.
(*Chorus*)
Now some credit Harriot, others Descartes,
Both studied refraction, and both were real smart.
But we prefer Willebrod van Roijen Snell —
He laid down the law, and he did it darn well.
(*Chorus*)

And here is one of the earliest physics songs, written by James Clerk Maxwell, a parody of the poem *"Comin' Through the Rye"* by Robert Burns:**

** *Dialect translations*: "gin" = "if"; "ilka" = "every"; "ane" = "one"; "hae" = "have"; "a" = "all"; "ken" = "know"; "waur" = "worse".

Gin a body meet a body
Flyin' through the air.
Gin a body hit a body,
Will it fly? And where?

Ilka impact has its measure,
Ne'er a ane hae I,
Yet a' the 'ads they measure me,
Or, at least, they try.

Gin a body meet a body
Altogether free,
How they travel afterwards
We do not always see.
Ilka problem has its method
By analytics high;
For me, I ken na ane o' them,
But what the waur am I?

Finally, many physics songs are about research and the life of the researcher. Below is the final stanza from a song called "Placement," recorded in 1974 by Professor Arthur Roberts and other members of the physics department at the University of Iowa. The song concerns the career choices facing physicists after World War II, with words and original music written by Roberts.

The time is for decision;
Well, this is my position:
I don't wanna play
For pay from RCA,
I don't wanna work for Bell Labs,
I ain't been contemplatin'
Locatin' out in Dayton.
Ditto ditto Naval Ord Labs.
I don't wanna work for Westinghouse,
They ain't got no sex appeal.
I don't like the universities,
They ain't got no checks appeal!
I don't get apoplectic
For General Electric,
I don't care for NRL.
I don't wanna work for anyone,
Everyone can go to... the Watson Labs.
Ain't no place I wanna go — exceptin' fishin',
Fishin's what I wanna do — and not uranium,
Fishin's what I wanna do.

—Submitted by Walter F. Smith

Physics in Films

While you're watching the latest movie hero fly through space or speed through the streets to bring lawbreakers to justice, Costas Efthimiou may be noting if the hero or villain's breaking the laws of physics.

Efthimiou teaches physics at the University of Central Florida in Orlando. He's found the actions and reactions of today's action flicks can be great teaching tools for physics-phobic students.

"They come to class the first day and they always ask is it going to be hard is it going to have a lot of calculations and formulas?"

Efthimiou's approach is filling his classes. He says between two classes last fall about 600 students learned serious physics with some Hollywood flair.

The professor's formula for reducing those fears was to look to the movies as physics demonstrations in unreal life. "For example, we used 'Speed 2'," he says, "That gave us the opportunity to discuss acceleration, deceleration and motion in general."

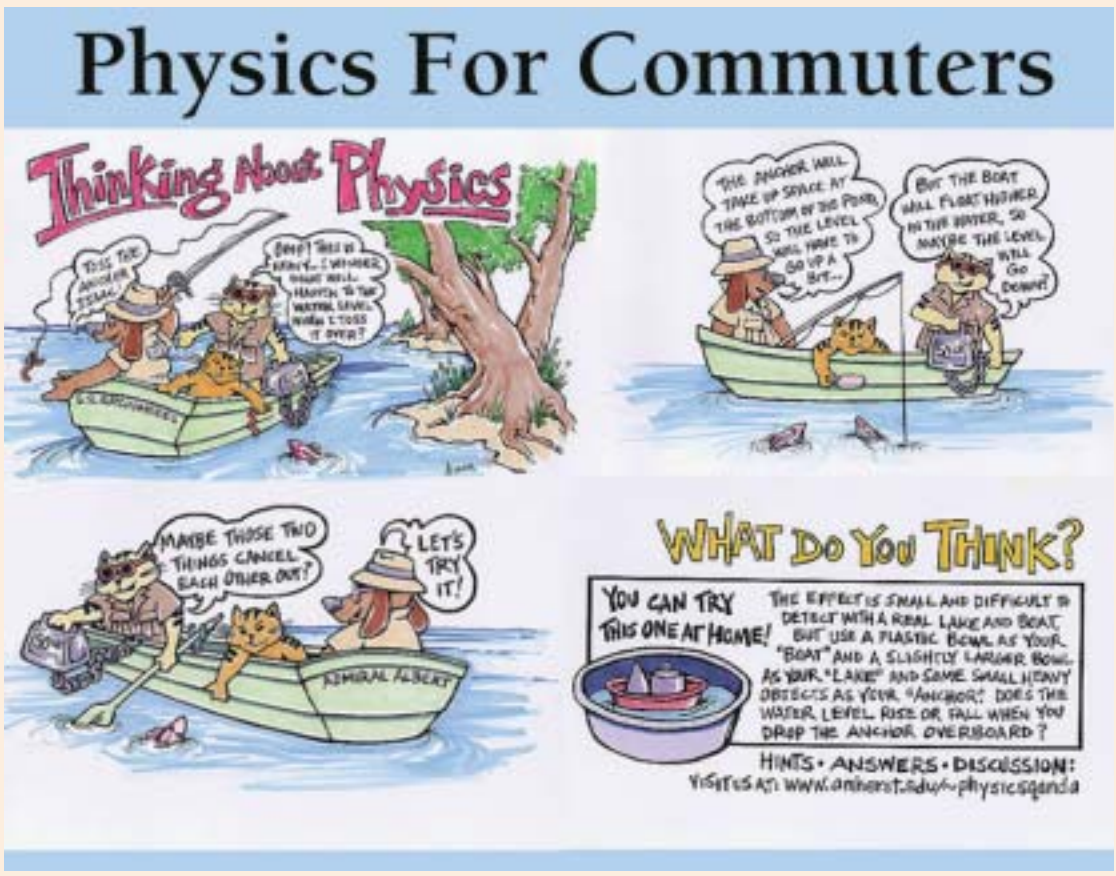
The Sylvester Stallone cop thriller "Tango and Cash" helped show how electricity behaves when the heroes dangled from a power line without getting shocked. (They weren't grounded.) The hyper-kinetic actions of Arnold Schwartzenegger in "Eraser" offered lessons in momentum, conservation of momentum, free fall, and weightlessness. "Armageddon" offered lessons in motion, astronomy and rockets, but for real science, Efthimiou prefers the other "killer rock" film of that year: "Deep Impact".

Efthimiou says when a comet collides with Earth in 'Deep Impact', "They have a very nice sequence of tidal effects; but the students don't like that movie as well as 'Armageddon.' They love 'Armageddon.' "

His theory is a more heroic plot line trumped sound science in the students' affections. Armageddon's heroes managed to keep the asteroid from hitting Earth. In 'Deep Impact' the comet did hit.

Debunking Hollywood's science mistakes can offer valuable lessons too but some of the most accurate science is in a film 35 years old: Stanley Kubrick's "2001". In that film rockets are silent (sound can't travel in the vacuum of space), and a spinning segment of the spacecraft uses centrifugal force as a realistic way to achieve artificial gravity.

— Inside Science News Service



Some guys are sitting in a boat on a lake. They throw an anchor overboard. Does the level of the lake rise, fall, or stay the same?

Illustrated in cartoon format, his physics question is now appearing on placards inside buses operated in the Amherst area by UMass Transit. The placards—there will soon be five more with different questions—are the brain-children of Robert Romer, a retired Amherst College physics professor. The artist is Bruce Aller of Upton, formerly of Amherst.

"All my life I have been trying to get people of various ages to think about physics and to enjoy doing so, so this is just a continuation of that mission," Romer said.

There is even an experiment you can try at home to find the answer to the anchor question. That's posted on a special web site, www.amherst.edu/~physicsqanda.

UMass Transit is donating space for the placards. "I think it's great," said Allan E. Byam, UMass Transit manager. "I'm very interested to see how many hits his Web site gets. It's nice to have some positive stuff up on the bus, instead of just (placards saying) 'Don't eat on the bus' and 'Report hate crimes' and such."

Romer said his colleague at the Massachusetts Institute of Technology, John King, instigated the overall "grandiose hopeful" plan of putting such thought-provoking questions on playgrounds, matchbook covers and other places besides buses.

"He invited me to collaborate with him, the assumption being that since both of us are 'retired', we have lots of time, a common misconception," Romer said.

Romer hopes his web site will get lots of hits, so he can demonstrate interest and seek outside funds for more ambitious venues like the Boston and New York City subway systems.

—Reprinted with permission from an article by Kay Moran in the Daily Hampshire Gazette, Northampton, MA.

NSBP Calls for Hearings on Discrimination at DOE Labs

In January, the National Society of Black Physicists called for hearings on the May 2002 GAO report regarding discrimination, employment and equal opportunity oversight at the DOE National Labs, "DOE Weapons Laboratories: Actions Needed to Strengthen EEO Oversight" (GAO-02-391).

The report was prepared at the request of Representatives Eddie Bernice Johnson (D-TX) and David Wu (D-OR), members of the House Science Committee in the 107th Congress.

The GAO report discusses a number of EEO concerns at the DOE weapons labs. These include compensation, promotion and work environment differences. While the GAO report analyzes several job categories, NSBP is mostly interested in the professional scientific workforce that is at the core of the labs' enterprises.

In May 2002, *APS NEWS* published an article written by Keith Jackson, President of NSBP, entitled "The Status of the African-American Physicist in the DOE National Laboratories."

This article reports the results of a survey on the number of African-American physicists employed at all the DOE national labs. The results of the survey show that African-American PhD physicists are less than 0.4% of the PhD physicists employed at the DOE labs, compared to a 3% representation among American born physicists.

"Our central issue is the underutilization of and the apparent paucity of opportunities for African-American physicists at the DOE labs," the NSBP said in its press release. "The fact is that the DOE labs have not been inventive and aggressive in recruiting domestic African-American and Hispanic-

See NSBP *on page 7*

MARCH MEETING *from page 1*

ence of comic books," [See profile, *Physics Today*, November 2002]; Robert Adair (Yale University) who has written a book on the physics of baseball; and the author of *The Physics of Star Trek*, Lawrence Krauss (Case Western Reserve University), talking about physics in movies and on TV. [Session 3A]

MISCONDUCT IN PHYSICS

Recent evidence of professional misconduct in two different areas of physics has caused the community to think deeply about such issues. In November 2002, the APS Council approved new statements of professional ethics and revised its "Guidelines for Professional Conduct". [See *APS News*, January 2003].

A panel session, including members of the Lucent and Berkeley review committees, confronts these issues, with time allowed for audience participation. The session, chaired by APS President Myriam Sarachik (CCNY), includes panelists Malcolm Beasley (Stanford), Pierre Hohenberg (Yale), Arthur Bienenstock (Stanford), and George Trilling (Lawrence Berkeley National Laboratory). [Session U1]

DREAMS FOR THE FUTURE OF PHYSICS

This is an exciting time to be a physicist, as technological advances revolutionize many subfields and even promise to spin off new ones. In session F1, chaired by Marvin Cohen, APS Vice President, Frank Wilczek (MIT) contends that it is becoming increasingly clear that the standard model of particle physics is incomplete. The Large Hadron Collider under construction at CERN will provide a chance to observe many new phenomena predicted by non-standard model physics. Wilczek also tackles the future of nuclear physics, which lies with QCD and opens the possibility of understanding matter at extreme temperatures such as those found in the Big Bang.

According to Michael Turner (University of Chicago and Fermilab), these new possibilities have deep ties to astrophysics and cosmology, a field which will try to answer questions about dark matter, cosmic rays, black holes and dark energy.

In biophysics, says Albert Libchaber (Rockefeller University), there is an apparent conflict between the search for universality in physics and the search for intricate details in biology.

Steve Girvin (Yale University) explains how progress in condensed matter physics has been driving new technology, which has in turn been advancing the field even further and increasing its relevance to other fields, particularly elementary particle physics.

Advances in accelerator technology could lead to experimental tests of string theory by observing supersymmetric particles or extra dimensions, according to David Gross (UCSB). [Session F1]

NEW DISCOVERIES IN THE RNA WORLD

Which molecule is responsible for the origin of life? An increasingly popular candidate is RNA. Like DNA, RNA is made from four molecular "bases" that can carry genetic instructions. Like proteins, RNA can fold into enzyme-like molecules that catalyze important biochemical activities.

At the meeting, researchers present intriguing findings on the folding properties of RNA. Ranjan Mukhopadhyay and his colleagues at NEC Laboratories in New Jersey have found that a typical RNA sequence with its 4-letter code folds more predictably and stably than would a hypothetical RNA sequence based on 2- and 6-letter alphabets. If early life was indeed RNA-based, Mukhopadhyay says, nature may have chosen a 4-letter genetic code because of RNA's folding properties.

Ralf Bundschuh (Ohio State University) and Terence Hwa (UC-San Diego) have found that RNA, under certain conditions, can become "glassy," meaning that a given RNA sequence can fold into random, rather than pre-determined, structures. Exploring how different organisms produce the same RNA structures from different sequences, Erik Schultes (Whitehead Institute of MIT) will discuss experimental evidence of "neutral networks," harmless changes in RNA sequence that still produce the same folds in an RNA molecule. [Session G10]

STORING AND PROCESSING INFORMATION WITH ULTRA-SLOW LIGHT

Following on from slowing and stopping light in ultra-cold gas clouds, Zachary Dutton (National Institute of Standards and Technology) and Lene Hau (Harvard University) show how a Bose-Einstein condensate (BEC) can store and process optical information. This may be the first step toward quantum computation in BECs. Other researchers present the latest results on trapping arrays of BECs for use in quantum information processing. [Sessions H4, K34.004]

SOLAR CELLS

The production of electricity with solar cells has of late been increasing at a rate of 40% per year, higher even than for wind-powered technology. The key to sustaining this growth is through increasing the efficiency of the cells (the ratio of usable electricity to sunlight) and using cheaper and more manageable materials.

The March Meeting features the latest word on photovoltaic research. Allan Barnett (AstroPower, Inc.), CEO of the largest company dealing exclusively with photovoltaic products, provides an introduction to the subject.

Other speakers describe how plastic solar cells can be integrated into clothing and power mobile phones, and report on new 2nd-generation devices and on the process by which 3rd-generation materials will be winnowed. [Session A8]

RISK ANALYTICS

Evan Picoult earned a PhD in particle physics but his interests and the job market took him in a different direction. He became interested in neurobiology and psychology, then got an MBA and went into finance theory. He now works at Citicorp in the field of risk analytics, the study of the value and risk associated with financial contracts.

More than an art but less than a science, risk analytics bears some resemblance to physics, relying as it does on equations and modeled from statistics and probability

March Meeting Special Events

Sunday, March 2
1:30 pm - 5:30 pm
Workshop on the Role of Physicists in Countering Bioterrorism
3:00 pm - 6:00 pm
Career Workshop

Monday, March 3
7:00 am - 9:00 am
CSWP/FIAP Breakfast
5:15 pm - 6:15 pm
Awards Program
6:15 pm - 7:30 pm
Welcome Reception
7:30 pm
Dream for the Future of Physics: Where are We? Where are We Going?

Tuesday, March 4
8:30 am - 3:45 pm
High School Teachers' Day
2:00 pm - 3:00 pm
Panel Discussion with PR/PRL Editors
5:00 pm - 7:00 pm
Current Status on Funding Opportunities in the NSF Division of Materials Research
5:30 pm - 6:30 pm
Student Reception
6:00 pm - 8:00 pm
Alumni Reunions

Wednesday, March 5
12:30 pm - 2:00 pm
Students Lunch with the Experts
3:00 pm - 5:30 pm
CSWP Panel Discussion: Women in Physics — Title IX and Institutional Policies
7:30 pm
Professional Conduct: What Can We Learn From Recent Events?

BACKPAGE *from page 8*

The university brought its enormous prestige and significant clout to bear on lab governance. Its prestige continues to be a magnet to attract the best and the brightest. It has also used its impressive convening power to help us enlist advisors from its world-class faculty and from industry or government. The university's tradition of freedom of expression has enriched the national debate about nuclear weapons over the years. Its clout has in the past helped to buffer the labs from the vagaries of political pressures, regardless of what political party was in power at the federal or the state level.

At the time I became director, the university had managed the lab for 43 years. It was clear that it was in it for the long term. This continuity was important because the turnover of government personnel with nuclear weapons responsibility was substantial. For example, my tenure as director overlapped that of four secretaries of the Department of Energy—all of them political appointees with greatly varying backgrounds and views on nuclear weapons. Hence, we viewed ourselves as the corporate memory and as possessing full "cradle-to-grave" responsibility for nuclear weapons.

The university managed the delicate balance between competition and cooperation between the Los Alamos and Lawrence Livermore labs. Under the university umbrella we had an intense rivalry, but it was one for ideas (as well as for prestige, of course) and not for contractor profits. I developed a deep appreciation for the importance of two labs operated by one contractor.

The university has been criticized in the past for not providing sufficient oversight of the labs. However, over the past 10 years, the university has increased its presence and influence on operations significantly. It created a President's Council of advisors with representatives from industry and a vice president for laboratory management. Together with the DOE, it developed a performance-based contract that includes measures for world-class operations as well as science. The president and the regents encouraged me to reach out to industry to bring the latest tools for improving quality and productivity to the lab. However, the erosion of the GOCO partnership and a lack of support from the DOE handicapped our productivity initiatives in the mid-1990s.

So, as we address the UC contract today, we should focus not only on how to fix the immediate business operations problems at Los Alamos, but also how to revitalize the partnership between the government and the contractors. Over the years, the DOE has modified the contract to progressively eliminate many of the features that made stewardship successful. It has become increasingly difficult to nurture world-class science, to take a public-service approach, to deal with the risks of nuclear operations, to provide a buffer from political pressures, and to provide the continuity necessary for stewardship. In February 1995, the Task Force on Alternative Futures for the Department of Energy Laboratories, chaired by Bob Galvin, former CEO of Motorola, lamented the steady erosion of the GOCO partnership. The Task Force made it clear that the broken system of governance was a major contributor to diminished effectiveness and productivity at the laboratories, and that both DOE and Congress must shoulder some of the blame. I believe that the erosion in the partnership has become more acute since 1995.

Hence, fixing business practices at Los Alamos is necessary, but not sufficient. The very basis of the partnership between the DOE and its laboratory contractors must be restructured to provide effective nuclear weapons stewardship.

Siegfried S. Hecker,
Senior Fellow,
Los Alamos National Laboratory

NSBP *from page 6*

American scientific talent."

The labs' research programs have substantial scientific interaction with non-US institutions, but formal scientific interactions between domestic Historically Black Colleges and Universities (HBCU) and Hispanic-Serving Institutions (HSI) schools are rare.

Furthermore, many STEM jobs are in sectors like aerospace, electronics and biotechnology, where the United States can expect fierce competition from the very countries that supply our foreign workforce. These countries will increasingly retain their high tech workers as internal opportunities grow. The DOE labs are currently rich training grounds for foreign scientists, and this is undoubtedly leading to growth in the middle class in overseas economies.

However, NSBP feels that there is an unfilled commitment to training of domestic scientists by the DOE labs, especially African-American and Hispanic-American scientists.

"The US is fast approaching the point where it cannot depend on immigration to fulfill its science, technology, engineering and mathematics (STEM) human capital needs," the release continued. "The concurrency of the problems of homeland security, the war on terrorism and the looming retirements of experienced scientists compels action by Congress and the Administration... Hearings on this GAO report is an appropriate and necessary first step for the Congress to assure the American people of diversity, equity, security and excellence at the DOE national labs."

SESAME Project Now Open

The SESAME Project (Synchrotron-light for Experimental Science and Applications in the Middle East) became official in January with the formation of the SESAME Council, composed of representatives of the seven founding member states: Bahrain, Egypt, Iran, Israel, Jordan, Palestine, and Turkey. To be constructed in Alaan, Jordan, the facility will house the upgraded BESSY I light source that has been donated by the German government, Shown here are King Abdullah of Jordan (left) and Herwig Schopper, a former Director-General of CERN who is the President of the SESAME Council, at the occasion of the groundbreaking ceremony at the SESAME site.

MARCH MEETING *from page 6*

theory, but one must always keep in mind that the human element in finance can trump equations in some transactions.

Other topics at the session are credit risk models, theory of risk management, and basic methodological issues and numerical methods for the practical implementation of risk calculations for financial derivatives. [Session L1]

VIEWING BIOMOLECULES BENEATH THE SURFACE

In research that can provide new insights into gene expression and the molecular mechanisms of disease, Vasilis Ntziachristos (Harvard Medical School and Massachusetts General Hospital) describes a non-invasive method for three-dimensionally resolving tiny amounts of fluorescent molecules buried centimeters deep in living tissue.

Called fluorescent molecular tomography (FMT), the technique shines light through tissue and uses a CCD camera to detect fluorescent markers and measure optical properties of tissue. By shining the light at several angles, Ntziachristos and colleagues can build 3D "tomographic" maps of the concentrations of fluorescent molecules. [Session P10.004]

LEFT-HANDED MATERIALS

Steps toward the "perfect lens" and lenses that bend microwave beams the opposite way to normal lenses have been taken by an MIT/Harvard collaboration. Much debate has surrounded whether or not these theoretically possible devices could actually be created but these experimental results put part of that debate to rest. Passing the microwaves through a slab of "left-handed material" (LHM), as these devices are known, results in a focused spot of microwave power, something that would not happen from normal right-handed materials.

Other researchers from the University of Utah suggest that LHMs can be used for a new 3D imaging process. A Naval Research Laboratory scientist moves to the microscale to discuss the possibilities for incorporating LHMs into electronics and the new types of electronic devices that will be possible. [Session K22]

IMPACT CRATER FORMATION

Although scientists can't do full-scale experiments with asteroids and planets, they can study impact craters through scaled models that explain what happens in the planetary arena. UCLA physicists have experimentally studied how the size of a crater depends on the impact object, a vital piece of information in understanding past impact events. The shapes of craters also provides information about an impact and Memorial University of Newfoundland physicists have developed a sequence of crater shapes that identify the energy of impact. [Session A13]

CARBON NANOTUBES

Carbon nanotubes are now a huge focus of research and development with applications arising in diverse areas. They are being studied as ultrasensitive sensors of gas molecules in the environment, as optical sensors, as mechanical sensors, and as the basis for electronic devices.

At the March Meeting, one can hear results on the nanotube version of transistors, the basic element of electronics. Nanotubes can also emit x-rays suitable for medical use, and are useful for nanoextraction, as nanowicks, and for better microscopy. [Sessions B27, N26, K26, V26]

ULTRAFAST LASER PULSES FOR CLEANER AIR

Modern cars often use catalytic converters to remove carbon monoxide from exhaust fumes. However, understanding the process of the catalysis is challenging because it happens on a small physical scale over very brief periods. New techniques involving ultrafast laser pulses have been used to observe the chemical reaction happening and could lead to better technologies for cleaner air. [A11.006]

CAN YOU HEAR ME NOW?

Increasing the information capacity of communications systems requires an increase in "bandwidth". The current state-of-the-art 40 GHz bandwidth can't be pushed much higher using conventional choices of materials, so researchers are exploring high band-width options. Mark Lee (Bell Laboratories) describes how the properties of polymers as electro-optic devices allow bandwidths in the 150 to 200 GHz range with signals still measurable as high as 1.6 THz (=1600 GHz). [Session N18]

HIGHER-RESOLUTION OPTICAL MEDICAL IMAGING

Conventional medical imaging techniques, such as MRI and CT scans, can only see anatomical features as small as 0.1-1 millimeter. Far better resolution is required for diagnosing many medical conditions, including some important warning signs of heart disease and the early stages of numerous cancers. In many cases, it is important to see details less than 20 microns in size.

Towards these ends, Nicusor Iftimia (Harvard Medical School) presents a host of high-resolution imaging techniques that employ fiber optics and light. The wavelengths of near-infrared and visible light, in the micron range and below, enable imaging of structures on those size scales. [Session P10]

SINGLE-MOLECULE BIOPHYSICS

Biology is a fruitful arena for physicists hoping to study fundamental science or to apply known physics principles in new ways.

One example of this is the use of nanotechnology in exploring and mimicking the behavior of cells. Cells are complex systems with outer membranes separating them from a wider environment and an inner membrane surrounding the cell nucleus.

Daniel Branton (Harvard) and his colleagues have created an artificial membrane consisting of silicon-nitride substrate with a nanopore only nm in diameter. Since DNA molecules are slightly negative in charge, they can be gently pulled through the pore using a positive voltage differential.

Furthermore, since the chemical base units which help to form the backbone of DNA cause the conductivity of the pore to change in a characteristic way, it is possible to map the bases as they go through. This method shows great prospect of speeding up the genome sequencing process. [Session A10]

OUT OF AFRICA

Physicists in African universities are confronted with daunting challenges in their efforts to train students and conduct research, according to Kennedy Reed (Lawrence Livermore National Laboratory), this year's recipient of the APS Wheatley Award for his work in that region. He outlines recent efforts at developing the scientific infrastructure in Sub-Saharan Africa, as well as efforts to encourage scientific links between physicists in the US and those in Africa.

Other speakers discuss fostering new partnerships between the U.S. and African physics communities, the economic and technological development of African countries, and new initiatives by the NSF and other agencies to promote materials physics in the southern regions of the continent. [Session H2]

START ME UP

"In the late 1990s, it seemed that any two graduate students and their dog could start and grow a high-tech company," says Cyrus Taylor (Case Western Reserve University), a featured speaker at a Thursday afternoon session on educating physics entrepreneurs.

But with the collapse of the Internet and telecommunications sectors, the challenges facing new start-up firms have greatly increased. Taylor offers his keys to survive and even to thrive in this new environment.

He is joined by Dennis Hamill (Nanotechnologies Inc.), who gives the small company perspective on moving a unique technology toward a commercial success, and Mark Zou (USA Instruments), who reveals how he took his fledgling company from humble beginnings to one of the country's 500 fastest-growing private companies. [Session X6]

The Back Page

The University and the Laboratory: Can the Marriage Be Saved?

Editor's Note: *In early January, the University of California, which manages Los Alamos National Laboratory for the US Department of Energy, announced the resignation of the laboratory director and his top deputy, in the wake of allegations of financial mismanagement and attempts to cover it up. This episode followed earlier problems including the Wen Ho Lee affair [APS News, April 2000 and July 2002 (see archives at apsnews online)].*

As we go to press, the Department of Energy is reviewing the role of the University of California, which has been involved in the management of the Laboratory since 1943. In light of these events, APS News *asked several prominent members of the Los Alamos and University of California communities for comment on the relationship of the two institutions. What follow are their own personal opinions; their affiliations are noted for identification purposes only.*

Keep Issues in Perspective

I came to Los Alamos as a young researcher, inspired by the prospect of putting to use in molecular biophysics some of the remarkable technologies that weapons physics had created. I became part of a community that valued science and technology in service to a nation. Several years ago, I started directing my efforts toward helping to strengthen and build capability at Los Alamos for a strong national defense against biological weapons. After September 11 the anthrax letters raised the nation's awareness of the importance such a capability and, luckily, the University of California's weapons physics laboratories, Los Alamos and Lawrence Livermore, were already working on the problem. We had developed capabilities in bio-surveillance and microbial forensics and were already active in transferring them to law enforcement and public health agencies. And the labs have made many other contributions after September 11.

Today, the University of California's management of Los Alamos is the focus of severe public criticism for flawed business practices. The UC leadership has stepped forward and is aggressively taking ownership and implementing drastic changes to correct the problems. I hope and trust that the progress that we make in the next few months will be considered in the light of a deep understanding of what the UC stewardship of the weapons physics labs has given this country, and, moreover, with an understanding of what is being asked of us as we look to our future.

The 60-year association of the weapons physics laboratories with the University of California has given the nation a nuclear deterrence that uses weapons that are strategic, minimize the use of nuclear materials, and provide the needed diversity for a strong defense. These labs were pivotal in creating the world's safest nuclear stockpile, and along the way established the safe limits for radiation workers used broadly through out industry today. By doing research into the health effects of the by-products of weapons research and production, we sowed the seeds for, and then participated in, one of the greatest accomplishments of 20th Century biology, the Human Genome Project.

One cannot ignore or underestimate the UC management and the strong academic values of these laboratories in determining these outcomes. It was no quirk of history that brought the greatest academic leaders together in 1943, under the direction of a UC professor, to achieve what seemed impossible; a nuclear bomb that would end a bloody, global conflict. They achieved their goal. After the war they asked the critical, hard questions about what to do with the power they had created. It was in the greatest tradition of intellectual freedom that Robert Oppenheimer engaged in a national debate and set the world on a course for nuclear arms control.

Today we are asked to maintain a safe and reliable nuclear stockpile without testing, to provide technology for treaty verification and non-proliferation, and to urgently address the terrorist threat from nuclear, chemical and biological weapons. It is perilous to think that this mission can be supported without the ability to attract and retain the highest quality scientists from academia, and to partner them with the best of the engineering laboratories and industry for what are some of the greatest science and technology challenges we face. The University of California has the required breadth and depth of capability to attract a critical part of the needed community, including those of us who began our careers thinking of things as seemingly unrelated to a nation's defense as the beauties of life's molecules, and who found inspiration in applying our abilities to a strong, science based national defense. May we all keep perspective as the current issues are addressed.

Jill Trewhella
Bioscience Division Leader, Los Alamos National Laboratory

Actions of a Few Shouldn't Derail Lab's Mission

It may well be that those who are considering transferring the contract to manage the Los Alamos National Laboratory to another entity do not appreciate the critical role played by having the same contractor managing both the Livermore National Laboratory [LLNL] and the Los Alamos National Laboratory [LANL]. These two laboratories have the responsibility for maintaining the integrity of our nation's—one might even say the free world's—nuclear deterrent. This to date is being done without the indisputable benefits of nuclear testing as was done in the past. In order to carry out this vital role it is absolutely necessary that the two laboratories interact very closely. This requires a continuous exchange of individuals, exchange and clarification of extremely complex computer codes, and the unrestricted exchange and use of very sophisticated facilities and equipment. Under the present single management structure this has been accomplished with remarkable success.

Those who are raising questions with regard to non-technical management issues at the LANL must agree that the science and defense work has been and is carried out in an exemplary manner. In no small measure this is due to the flexibility of facilities use and personnel exchange under the University of California management structure.

Compared with recent Washington D.C. government credit card abuse the events at the LANL are small events. Material unaccounted for at the LANL compared with the loss of firearms and personal computers by the FBI alone are insignificant.

One must be concerned as to what the real initiative is in considering separating the LANL management from the University. Clearly there is internal management restructuring required at the LANL and it has and is being done. This is a simple and clearcut management issue.

If Washington makes the move to place our nation's only nuclear weapons laboratories under separate contract managers, our nuclear deterrent may suffer a very serious setback.

Considerations of how personnel can be exchanged, facilities and codes shared, and how objective cooperation will be carried out will be a management nightmare. Unfortunately those who will make the final decision may to date have little or no appreciation of the details or expertise required to maintain our nuclear deterrent in these very sensitive times.

Hopefully they will educate themselves as to the real advantage and necessity of having a single contract manager for these two laboratories and will take only those crucial measures required to overhall the strictly administrative structure at the LANL.

The recent few stupid actions and lack of integrity by a few individuals at the LANL should not be allowed to cripple the activities of these two laboratories which have to date so well served our nation in their role of maintaing our nuclear deterrent.

Harold M.Agnew
Director of the LANL 1970-79

Press Coverage Ignores Science

Recently-uncovered cases of purchasing fraud, lax inventory controls, and—most seriously—firing of two investigators at Los Alamos National Laboratory have led the Secretary of Energy to consider ending the contract with the University of California to manage LANL. Unfortunately none of the extensive press coverage that I have seen mentions the high quality of the science and technology conducted at this laboratory—quality fostered throughout the almost sixty years of the contract by UC. Let me describe some of the ways in which UC management has fostered quality and has given scientific leadership:

1. UC has insisted that the science done at LANL, at its sister national security laboratory Lawrence Livermore National Laboratory (LLNL), and at the Lawrence Berkeley National Laboratory (LBNL) be of the same high quality as that done on its campuses. This is monitored every year by an outside peer review committee for each division of each laboratory.

2. UC has fostered a climate of openness and free exchange of ideas, to the maximum extent consistent with protection of classified information. Effective security and quality science are both necessary for the national security laboratories to carry out their missions.

3. Staff members at LANL and LLNL assure me that being a part of the UC strongly enhances their ability to recruit talented scientists.

4. UC has consistently emphasized the need for a strong science base at the national security laboratories. Given the inadequate budgets of the current era, there is great pressure to turn all attention to meeting short-term deliverables. Constant vigilance is required to maintain the science base on which the continuing effectiveness of the labs—and therefore our national security— depends.

The challenge of maintaining the nuclear stockpile without nuclear testing has placed new demands on the quality of science and technology at LANL and LLNL. Underground testing to maintain confidence has been replaced by more refined computer simulations based on improved theoretical and experimental physics and chemistry. Greater fundamental understanding based on laboratory-scale experiments has maintained confidence in the stockpile without the need for explosions with nuclear yield. But meeting future challenges requires the strengthened—rather than weakened—science base which UC management is, I believe, best qualified to foster.

William R. Frazer
Senior Vice President, Emeritus, University of California

The Jack, Not the Wrecking Ball

Over many years, under management by the University of California (UC), Los Alamos National Laboratory has developed an unmatched set of capabilities, and physical and human capital, for sowing, growing, and reaping scientific discovery and development. Los Alamos contributes across the entire technology spectrum, from basic scientific discovery to the actual manufacture of components that relate to its nuclear weapons, global threat reduction, and energy missions. We (with our sister lab at Livermore) are unique in the US national technology portfolio in the breadth of what we are tasked to accomplish; and there are unusual management challenges that go with that breadth.

Some of the American public has lost confidence in UC's ability to manage business systems at Los Alamos. Pete Nanos, the lab's interim laboratory director, has the perspective of both a Princeton PhD in physics and a distinguished technical career in the Navy. As a vice admiral, he commanded the Navy's high-tech acquisition organization, NAVSEA. He said recently, "My challenge is to jack up the science and replace all the management and business controls on the bottom, then gently set the science back down on a new foundation."

Nanos, and the rest of us in UC and Lab management, must respond to the loss of public confidence. If we don't fix things, and if the management contract passes from UC to a more industrially minded organization, then an irreplacable national capability will almost certainly be lost.

Like a university, Los Alamos adds new knowledge to the world stock; like industry, it applies that knowledge and delivers to its sponsors and customers. Unlike either, it is a highly integrated institution for the "tech transfer" that happens in the middle. Industry in general (and defense industry in particular) reprocesses, develops, and repackages scientific capital. Only rarely does it create or discover; it acquires and applies.

Attempting to describe abstractly the kind of institution that can best manage Los Alamos, we quickly see that we are describing, in essence, UC: It should be a great, distributed university system, among whose multiple campuses and research centers can be found world leadership in virtually every field of science and engineering. It should have a history of close interactions with high-tech industry, and a tradition of public service to the nation. It should have demonstrated performance as an incubator for new discovery and invention, and have the kind of intellectual credentials that will attract the next generation of outstanding scientists and engineers to its labs. It should provide means for cross-fertilization and mobility to and from its multiple labs and campuses at multiple career levels (student, postdoc, staff member, faculty).

At Los Alamos, the first-line technical managers are Group Leaders, (about 200 in number). These scientists and engineers are the pivot points at which the institutional balance between basic and applied programs, and also between scientific and operational imperatives, are established. What they tell us is that UC management of Los Alamos is not a distant technicality, but something that affects their ability to do their jobs, in hiring, in demanding intellectual honesty and independence, and in developing essential collaborations with the rest of the U.S. scientific community.

Imagine replacing these creative, committed managers with ones whose first loyalty is to a corporate structure or to a strictly operational "bottom line". Now, imagine the damage that would be done to the inventiveness and productivity of the Lab's scientists and engineers, and thereby to the nation.

Yes, Los Alamos must (and will) improve its business and operational practices. But better to do this under revitalized UC management, by "gently jacking up and then setting down the science," than by bringing in the management equivalent of the bulldozer and wrecking ball.

William H. Press
Deputy Director for Science and Technology, Los Alamos National Laboratory

Successful Stewardship Requires an Effective Partnership

The current concerns about business practices at the Los Alamos National Laboratory have brought into question what the University of California brings to the management of the Los Alamos and Lawrence Livermore national laboratories. I offer my thoughts based on nearly twelve years as director of the Los Alamos National Laboratory, from 1986 to 1997.

The single greatest responsibility of these laboratories is nuclear weapons stewardship. Nuclear weapons remain in the supreme national interest. Effective stewardship requires that we continue to attract the best and the brightest, and because stewardship is an inherently governmental function, it also requires a special contractual relationship between the government and the contractor. An innovative partnership known as the GOCO (government-owned, contractor-operated), established during the Manhattan Project, became the cornerstone of successful stewardship.

Successful stewardship requires not only an effective contractor, but also an effective partnership. Today's focus is on the contractor. Clearly, Los Alamos must do better in its business practices. UC president, Richard Atkinson, and interim director, Pete Nanos, are dedicated to fixing these problems and to regaining public confidence. I believe that this is also the time to fix the steady erosion of the partnership that reduces productivity at the laboratories and threatens effective stewardship.

The most important contribution of the university in the management of the labs has been to create and nurture the environment required for effective stewardship. During the first month of my directorship, Fred Reines, chair of the UC Advisory Committee, made it clear that he expected me to uphold the tradition of world-class science at the lab. This tradition is key to creativity and innovation. David Gardner, then UC president, underscored the importance of intellectual freedom and intellectual integrity, which are especially important in a highly classified environment.

By example of its own tradition of public service, the University instilled in me and in our staff the importance of public service. The president and the regents expected me to discharge my responsibilities to place the national interest above all. They never forced me to choose between the interests of the University and the State of California on the one hand and the U.S. Government on the other. It is in this spirit that the lab directors have signed the annual nuclear weapons certification letter, have testified in Congress about their concerns related to nuclear safety and nuclear testing, and have engaged their counterparts in Russia to help improve the security of Russia's stockpile of nuclear materials.

See BACKPAGE *on page 7*