APS NEWS
June 2004
Volume 13, No. 6
A Publication of The American Physical Society http://www.aps.org/apsnews

International Physics Community Joins Forces for 2005 World Conference in South Africa

As part of the celebration of the World Year of Physics 2005, UNESCO, ICTP, IUPAP and the South African Institute of Physics (SAIP) will sponsor a World Conference on Physics and Sustainable Development, to be held October 31-November 2, 2005, in Durban, South Africa. The APS will be a co-sponsor and help with the organization.

The conference will review the contributions that physics has made to society in the past, and formulate a plan for the contributions that it can and should make in the future. The conference is partially a follow-up to a broader United Nations World Summit on Sustainable Development held in Johannesburg in the summer of 2002. Four themes have been chosen: physics and economic development; physics and health; energy and the environment; and physics education.

Several international conferences have been scheduled for 2004 on these topics, and will serve as preparatory meetings for the 2005 World Conference—the first time the international physics community will focus its collective attention on these themes, and the interplay between them.

Attendance of about 500 people is anticipated. Conference organizers are particularly eager to attract participants from Africa, Asia, Latin America, and the Middle East, as well as from more developed countries, and the organizers hope to be able to provide travel grants for as many as half of the attendees.

"Physics has contributed greatly to the health and economic well being of people around the world. However, the contributions have not led to equal progress in all parts of the world," said APS Director of International Affairs Amy Flatten.

See SOUTH AFRICA *on page 5*

APS Council Approves Statements on Subordinates and on Referencing

At its April meeting, Council continued its involvement with ethical issues. Two additional statements relating to ethics were passed, one on the treatment of subordinates, and one on proper referencing practices in journal articles. The statement on subordinates is posted on the APS web site at http://www.aps.org/statements/. The statement on referencing appears there also as a supplement to Statement 02.2: Guidelines for Professional Conduct.

The texts of these two statements follow.

Statement on Treatment of Subordinates

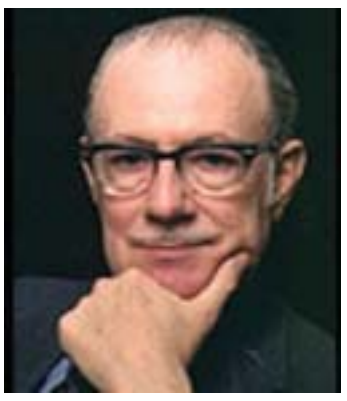
Subordinates should be treated with respect and with concern for their well-being. Supervisors have the responsibility to facilitate the research, educational, and professional development of subordinates, to provide a safe, supportive working environment and fair compensation, and to promote the timely advance of graduate students and young researchers to the next stage of career development. In addition, supervisors should ensure that subordinates know how to appeal decisions without fear of retribution.

Contributions of subordinates should be properly acknowl-

See COUNCIL *on page 7*

APS Council Honors George Pake

At its April meeting, the APS Council passed a memorial resolution on the March 4 death of esteemed physicist George Pake:



The Council of the American Physical Society notes with great sadness the death of George E. Pake (1924-2004). A pioneer in the field of nuclear magnetic resonance, his early work helped establish it as a powerful tool to study condensed matter systems important in physics, chemistry, and biology.

Shortly after he began his scientific career, his common sense, wisdom, fairness, and perceptive insight into human relations, combined with his scientific brilliance, led him to be called upon to assume responsibilities of leadership, a circumstance that persisted for the rest of his career.

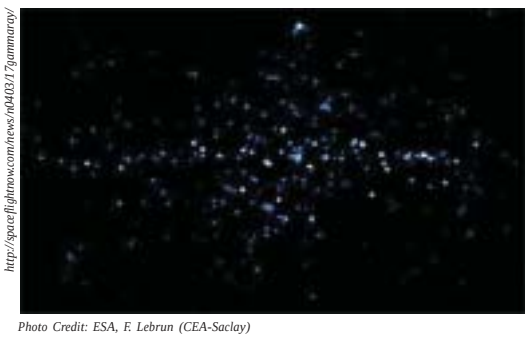
He served with distinction as a leader in the academic world (at Washington University in St. Louis), the professional world (chairing the Pake Report on the Status of Physics for the National Academy of Sciences, and serving as APS president), and the public world (serving on the President's Science and Advisory Committee).

As the founding director of the Xerox Palo Alto Research Center, he assembled and led a research laboratory imbued with a vibrant spirit that has had a profound effect on industrial research and played a decisive role in the creation of the modern computer.

The American Physical Society has commemorated his manifold contributions by establishment of the George E. Pake Prize. The APS Council expresses deep sympathy to his wife, children, grandchildren, and many friends.

Integral Looks at the Cosmos Through Gamma Glasses

Scientists have opened a new window in the study of the formation of elements in the universe with a new space-based gamma ray telescope called INTEGRAL (INTErnational Gamma Ray Astrophysics Laboratory), launched by the European Space Agency in 2002. At the APS April meeting, researchers on the collaboration reported on the scientific highlights to date of the project.



http://spaceflightnow.com/news/n0403/17gammarcpy/

Photo Credit: ESA, F. Lebrun (CEA-Saclay)

The central regions of the Milky Way as seen by Integral in gamma rays. The brightest 91 objects in this image were classified by Integral as individual sources, while the others appear too faint to be properly characterized at this stage.

Gamma ray photons are a million times more energetic than those of visible light, and can pass through matter with hardly any interaction. Even more powerful than X-rays, they are nonetheless blocked by Earth's atmosphere. Hence, gamma ray astronomy is largely space-based.

Positron annihilation is one source of gamma rays in the universe. Gamma rays are often created in the radioactive decays of short-lived elements inside such cosmic sources as supernovae and novae. Other sources include pulsars and microquasars.

Launched in October 2002, Integral uses two specially designed gamma ray telescopes to register these elusive rays. One provides the sharpest images of the gamma ray sky ever seen and the other measures the energies of the gamma rays with unprecedented accuracy. The telescopes work in tandem with an X-ray monitor and an optical camera. According to Roland Diehl of the Max Planck Society in Garching, Germany, this is the first time

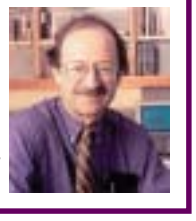
See GAMMA *on page 3*

Crushing a Light Bulb

At the High School Physics Teachers' Day in Denver on May 3, Cindi Allmendinger and Andrew Zwick examine the filaments of three-way bulbs to understand how the bulbs are wired. This activity was presented by Larry Woolf, whose contributions to the APS Teachers' Days are supported by the General Atomics Sciences Education Foundation.

Photo Credit: Edward Lee

Highlights



Innovation Task Force Unveils New Advocacy Campaign

On April 20, at a press conference in Washington, DC, leaders from industry and academia unveiled an advocacy campaign to illustrate the importance of basic research to the future of American innovation, economic growth, and job creation.

Targeted at policy makers and the general public, the initiative will seek to reverse a decline in federal investment in basic research in the physical sciences and engineering through paid advertising and traditional lobbying and outreach to policy makers on Capitol Hill.

The new initiative is sponsored by the Task Force on the Future of American Innovation, which includes the APS and 13 other organizations associated with business and academia. Specifically, the task force is calling on the federal government to grow the budgets of key research agencies by 10-12% per year over the next five to seven years. These agencies include the National Institute for Standards and Technology, the National Science Foundation, the Department of Energy's Department of Science, and the Department of Defense's Research Accounts.

Basic research in the US over the last few decades has led to breakthrough technologies that have spawned entirely new industries. Notable examples include lasers, the integrated circuit, fiber optics, the Internet, and global imaging systems.

Such innovations in turn create jobs; the semiconductor industry alone has created 226,000 jobs with worldwide sales of $166 billion. Basic research at American universities has created 4,000 spin-off companies with an estimated 1.1 million employees and annual worldwide sales of $232 billion. And according to Robert Shaw, a Nobel laureate in economics, at least 50% of the nation's economic growth over the last 50 years has come from technological innovation.

Yet US federal investment in basic research continues to decline. While the GDP nearly doubled from $6 trillion in 1980 to $12 trillion today, federal investment in R&D in the physical and mathematical sciences and engineering plummeted 37%. President Bush's FY05 budget request continues the trend of previous administrations. The overall research

See TASK FORCE *on page 4*

Members in the Media

"I wore short skirts and had long, blond hair. People would say: 'You don't look like a physicist.' Well, what did they want me to do, grow a beard?"
—Helen Quinn, SLAC, on being a woman in physics, Los Angeles Times, April 11, 2004

✶✶✶

"Who will be the next generation of scientists and engineers? How can we even discuss preparing for human exploration to the moon and Mars without discussing who will do the science to get us there?"
—Shirley Ann Jackson, Rensselaer Polytechnic Institute, on women and minorities in physical science, Los Angeles Times, April 11, 2004

✶✶✶

"There's still probably only 30 black women with physics PhDs in the whole country. But it's not just minorities. Whether they're black, brown, yellow, green, Americans just aren't going into physics."
—Arlene Maclin, Norfolk State University, Los Angeles Times, April 11, 2004

✶✶✶

"Since ordinary sonoluminescence delivers so much energy at pressures of only one or two atmospheres, you could hope that at 1,000 atmospheres, you'd be in fusion territory— if the temperature also scaled up. But that's a really big 'if.'"
—Seth Putterman, UCLA, on sonofusion, Business Week, March 29, 2004

✶✶✶

"You would never have thought it possible to pick up an atom and actually move it a few atomic diameters away. It is equivalent to reaching out to the planets and being able to touch a planet and move it from one orbit to another."
—Joseph Stroscio, NIST, on nanotech, CNN.com, April 15, 2004

✶✶✶

"Anybody who does credit card transactions across the Internet—sorry, you've been had, because somebody will be listening and they just stole your credit card number,"
—Carl Williams, NIST, on security problems quantum computers may cause, Dallas Morning News, April 26, 2004

✶✶✶

"If there were no neutrinos, the sun and the stars wouldn't shine. There would be no Earth, no moon, no us. Without them, we wouldn't be here."
—Boris Kayser, Fermilab, Detroit Free Press, April 28, 2004

✶✶✶

"Mainline fusion people were skeptical from the beginning. To be honest, support for cold fusion was mostly driven by the popular press."
—Thomas O'Neil, UCSD, The San Diego Union-Tribune, April 28, 2004

✶✶✶

"Nobody understands string theory well enough to derive observational consequences."
—Steven Carlip, UC Davis, Christian Science Monitor, May 6, 2004

✶✶✶

"A radiological weapon is not a weapon of mass destruction. It is primarily a weapon of economic and psychological disruption. After the panic from a dirty-bomb attack subsides, public refusal to return to contaminated urban areas could cause severe economic damage."
—Jaime Yassif, Federation of American Scientists, Rocky Mountain News (Denver, CO), May 3, 2004

Denver Fellows Have a Party

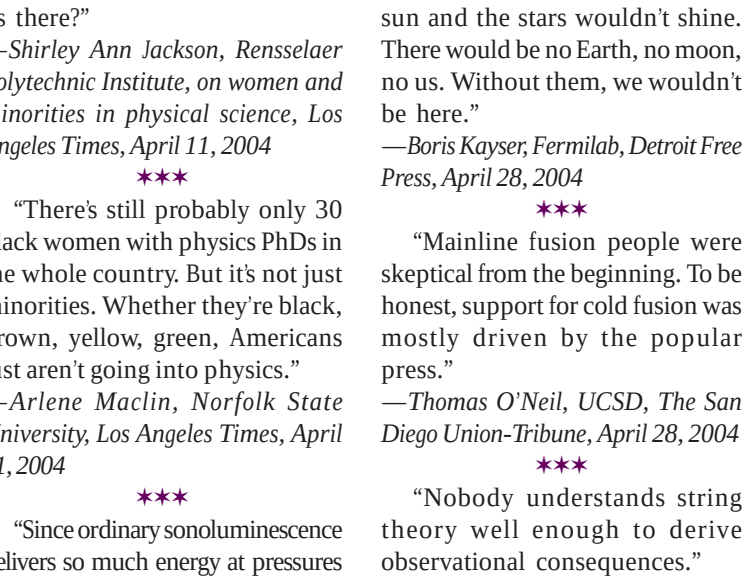


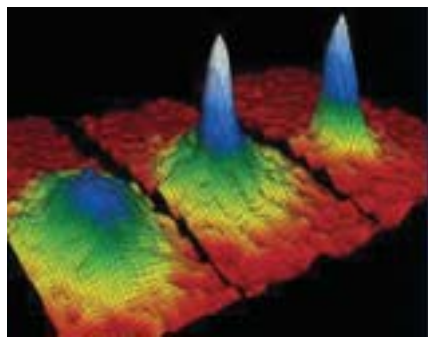
Photo Credit: Alan Chodos

Shown here are Denver area APS Fellows (l to r) William Fairbank, William Ford, Branka Ladanyi and Carl Patton, with Jeanne Patton (right), enjoying the Fellows' reception held in conjunction with the meeting of the APS Executive Board on April 28.

This Month in Physics History

Making Superatoms

June 5, 1995: First Bose Einstein Condensate



The density of the atomic cloud is shown, with temperature decreasing from left to right. The high peak, the Bose-Einstein condensate, emerges above the other atoms. The picture is from the JILA laboratory.

Sometimes it can take awhile for experiment to catch up with theory in physics. Predicted in the 1920s, it would be 75 years before the actual creation of the first Bose Einstein condensate (BEC) in the laboratory. That achievement established an entirely new branch of atomic physics that continues to provide a treasure trove of new scientific discoveries, since it enables scientists to study the strange and extremely small world of quantum physics as if they were looking through a giant magnifying glass.

The BEC phenomenon was first predicted by Satyendra Bose and Albert Einstein: when a given number of identical Bose particles approach each other sufficiently closely, and move sufficiently slowly, they will collectively convert to the lowest energy state: a BEC. This occurs when atoms are chilled to very low temperatures. The wavelike nature of atoms allows them to spread out and even overlap. If the density is high enough, and the temperature low enough (mere billionths of degrees above absolute zero), the atoms will behave like the photons in a laser: they will be in a coherent state and constitute a single "super atom."

JILA's Carl Wieman (University of Colorado, Boulder) and Eric Cornell (NIST) first started searching for a BEC around 1990 with a combination laser and magnetic cooling apparatus. Wieman pioneered the use of $200 diode lasers (the same type used in CD players) instead of the $150,000 lasers other groups were using. His approach was initially met with skepticism by his colleagues, but when he began to report real progress, several other groups joined the race to achieve the first BEC. Beginning with rubidium gas atoms at room temperature, the JILA team first slowed the rubidium and captured it in a trap created by laser light. This cooled the atoms to about 10 millionths of a degree above absolute zero—still far too hot to produce a BEC.

Once trapped, the lasers are turned off and the atoms are held in place by a magnetic field. The atoms are further cooled in the magnetic trap by selecting the hottest atoms and kicking them out of the trap. Then came the tricky part: trapping a sufficiently high density of atoms at temperatures that were cold enough to produce a BEC. To do this, Wieman and his colleagues had to devise a time-averaged orbiting potential trap (an improvement to the standard magnetic trap).

The world's first BEC was achieved at 10:54 AM on June 5, 1995 in a laboratory at JILA, a joint institute of University of Colorado, Boulder, and NIST. The BEC was formed inside a carrot sized glass cell, and made visible by a video camera; it measured only about 20 microns in diameter, or about one fifth the thickness of a sheet of paper. The result was a BEC of about 2,000 rubidium atoms that lasted for 15–20 seconds. Shortly thereafter, Wolfgang Ketterle also achieved a BEC in his laboratory at MIT.

Today, scientists can produce condensates of much greater numbers of atoms that can last as long as three full minutes, and they continue to glean intriguing new insights into this unusual form of matter. By September 2001, over three dozen other laboratories had replicated the discovery. In 1997, MIT researchers developed an atom laser based on BECs that was able to drip single atoms downward from a micro spout, and in February 1999, a team at Harvard University used a BEC to slow down light to just 38 MPH by shining a laser beam through the condensate. Two years later the team announced that it had briefly brought light to a complete stop.

In March 1999, scientists at the NIST facility in Gaitherburg, MD, nudged super cold atoms into a beam to create a device that shoots out streams of atoms in any direction.

The breakthrough could lead to a new technique for making very small computer chips, or to construct nanodevices one atom at a time.

On June 18, 1999, JILA researchers used the technique to achieve the first Fermi degenerate gas of atoms. A group of German researchers demonstrated in 2001 that BECs can be created and manipulated using so-called atom chips, an achievement that could form the basis of integrated "atom circuits" based on the motion of atoms rather than electrons.

And in December 2002, physicists in Innsbruck created the first BEC out of cesium atoms, which are the basis of atomic clocks and also play a key role in certain metrological applications, including measurements of the electric dipole moment of the electron.

The Colorado group is now experimenting with this new form of matter by manipulating it in new and different ways. In July 2001, he and his colleagues were able to make a BEC shrink, which was followed by a tiny explosion similar in some ways to a microscopic supernova. So they dubbed it a "Bosenova."

About half of the original atoms appear to vanish in the process. They cooled the matter to 3 billionths of a degree above absolute zero—the lowest temperature ever achieved to date.

Cornell, Ketterle and Wieman shared the 2001 Nobel Prize in physics for their accomplishment. Their joint discovery of the BEC is "going to bring revolutionary applications in such fields as precision measurement and nanotechnology," the citation from the Royal Swedish Academy of Sciences said. The apparatus used by the JILA team is now part of the permanent collection of the Smithsonian Institute in Washington, DC.

APS NEWS
Series II, Vol. 13, No. 06
June 2004

Coden: ANWSEN ISSN: 1058-8132

Editor ..... Alan Chodos
Associate Editor ..... Jennifer Ouellette
Special Publications Manager ..... Elizabeth Buchan-Higgins
Design and Production ..... Stephanie Jankowski
Forefronts Editor ..... Neville Connell
Proofreader ..... Edward Lee

APS News (ISSN: 1058-8132) is published 11X yearly, monthly, except the August/September issue, by the American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, (301) 209-3200. It contains news of the Society and of its Divisions, Topical Groups, Sections and Forums; advance information on meetings of the Society; and reports to the Society by its committees and task forces, as well as opinions.

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding *APS News* should be directed to: Editor, *APS News*, One Physics Ellipse, College Park, MD 20740-3844, E-mail: letters@aps.org.

Subscriptions: *APS News* is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $15. Nonmembers: Subscription rates are available at http://librarians.aps.org/institutional.html.

Subscription orders, renewals and address changes should be addressed as follows: For APS Members—Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org. For Nonmembers—Circulation and Fulfillment Division, American Institute of Physics, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication. Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to *APS News*, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

QuarkNet Brings Research Experience to the High School Classroom

By Ernie Tretkoff

High school teachers around the country are participating in particle physics research, changing their teaching styles, and integrating high-energy physics into their lessons, thanks to the QuarkNet program at Fermilab, which has been running since 1999.

"We think it's really one of the most valuable physics education programs that we have," said Judy Jackson, head of public affairs at Fermilab, "It brings so many different players into the mix. It's a great way of bringing in people from a wide geographic area."

Here's how the QuarkNet program works: First, after a weeklong orientation at Fermilab, selected high school teachers spend a summer doing research with a physicist-mentor from a local university or laboratory. The teachers might work on experiments at CERN or Fermilab, or at their mentor's lab.

After their research summer, the teachers try to integrate some of what they learned into their classroom. Rather than teaching a separate unit on particle physics, many teachers find they can integrate particle physics into lessons on basic concepts such as conservation of momentum and energy.

Also during the school year following their research summer, the QuarkNet teachers, along with their mentors, develop a three-week research-based program for up to ten more "associate" teachers. The following summer, the lead teachers and their mentors present their three-week program at their QuarkNet center, the university or lab where the mentor researchers work.

"Our goal in essence is to help teachers learn how scientists work, and look at the way they can bring those work skills into their classroom so that their students begin to model research in the classroom," said Marge Bardeen, manager of the Fermilab education office and spokesperson for QuarkNet. QuarkNet also aims to get teachers a more "inquiry-based" approach that involves hands-on projects rather than the traditional lecture format. Several teachers have indeed changed the way they teach.

For example, Jeff Dilks, a teacher in Iowa, conducted an experiment with his high school class, and found that he had meaningless data. Before QuarkNet, he would have just moved on to the next topic, but instead he realized that scientists wouldn't do that. So the next day, he had the students think about how they could change the experiment to improve the data. The class reran the experiment and got better results.

Photo Credit: LeRoy Castle

The young woman in the photo is Erin McCamish, and she is holding an optical decoder unit for the CMS hadron calorimeter that she assembled. The summer this picture was taken, she was a student at Lake Shore High School in Stevensville, MI. Now she is at the University of Michigan studying physics.

Dilks also found that the QuarkNet program has earned him, and his subject, new respect at his school. " There's a new interest in what's going on in physics. Administrators ask what I'm doing. Secretaries provide me with newsclippings. Physics has a much higher profile around my school," he said.

Another QuarkNet teacher, Deborah Roudebush of northern Virginia, designed her entire physics class around the theme of the search for the Higgs boson. She taught the standard high school physics topics, but always introduced the concepts in the context of how they would apply in the search for the Higgs.

The physics researchers also benefit from the QuarkNet program. Randy Ruchti, a Project Principal Investigator and QuarkNet mentor, appreciated the chance to expand his research group to include the teachers, and he said he learned a lot from them. "First of all, I've learned that among the difficulties teachers face, many are teaching to a test, so there is very little time to do any inquiry." Ruchti participates in the program because he believes that "practicing scientists have an obligation to reach down to attract young people into science."

Ruchti also said QuarkNet is working to include more traditionally underrepresented groups, especially by attracting teachers who work in inner city schools.

Since QuarkNet began in 1999, nearly 500 high school teachers have participated in the program, either as lead teachers or associate teachers. About 50 centers are now operating across the country. The program plans to expand to include about 60 centers, and will reach over 700 teachers. Some of the centers that have been operating for several years are now expanding to include several high school students in a summer of research at the center. One of the reasons the program has been so successful, said Bardeen, is that it is run by a staff of teachers. "I always feel it's important to put teachers in leadership positions," she said, "They have not only the understanding of what teachers face in the classroom, but they also have credibility."

GAMMA *from page 1*

scientists have routinely been able to take several different measurements concurrently. This capability is expected to allow a clearer identification of the gamma ray sources.

Diehl reported that thus far the collaboration has observed one gamma ray burst per month during its first six months of operation.

The researchers have discovered ten new gamma ray transient sources, and have been able to produce the first map of parts of the galactic plane, based on the gamma rays emitted by decaying atomic nuclei.

It is hoped that Integral will also shed light on such mysteries as how black holes interact with their surroundings; supernova explosions and their role in forming chemical elements; and the specific nature of powerful gamma ray bursts.

zero gravity
The Lighter Side of Science

A Brief Encounter with a Facilities Manual

Editor's Note: *Abstracts submitted for the APS April Meeting are organized into sessions according to topic each year by a volunteer sorting committee. But this year our sorters were flummoxed by a submission that just didn't seem to fit in anywhere. We didn't want to let it slip through the cracks. So in the interests of furthering the scientific debate on the incomprehensibility of astronomical instrument user's manuals, we reproduce it here.*

.

ABSTRACT: Large astronomy labs that make some time available to the general astronomical community normally provide instruction manuals for the main telescopes and related instrumentation. As a rule, these are prepared by the person who developed the apparatus and already knows a great deal about it.

Unfortunately, this is not always true of the first-time user. We report a novice observer's interaction with a short extract from a typical manual.

STEP 12: Backstep Reticulator

Happily the reticulator—unlike many of the other instruments—carries its name upon its face and thus is easy to identify. It is a black near-cube about a foot and a half (0.5 m) high, attached by cables to three of the possible four nearest neighbor boxes, and to five of the possible 16 nearest neighbors.

On its face are 12 dials in two rows, three switches, and two screens, apparently intended to display alphanumeric information, and one square presumably intended for graphical information. Both are currently dark, showing no data.

Alas, none of the dials is labeled "*backstepper.*" In fact, none are labeled, except a small left-hand dial in the top row, which bears a small gummed paper sticker sternly declaring, "*These are logarithmic units. The possible settings are A, B, C, D, E and K1.*"

The dial is set at D, which seems to be as good a logarithm as any.

The switch near the rectangular screen is held firmly down by a piece of adhesive tape with faint blue lettering, admonishing the would-be user with an incomprehensible warning: *"Do not atempt (sic) to rotate reticulator slit unless you have been checked out by JCM."*

With fading hopes and dangling participles, further enlightenment is sought from the primary instruction sheet, where an earlier observer has penciled the remark, "*Reticulator must be on before backstepping.*"

Novice observer backsteps on tiptoe out of the control room all the way to the parking lot and heads for home.

Once home, high priority is given to the task of revising *curriculum vitae* to describe primary research interest as theoretical astrophysics rather than observational astronomy.

—*Virginia Trimble*

Laser Science, Quantum Optics Featured at 2004 CLEO/IQEC Conference

Breakthroughs in NASA technologies, medical imaging, and homeland security technology were among the highlights at the 2004 Conference on Lasers and Electro-Optics/International Quantum Electronics Conference (CLEO/IQEC) - a leading conference showcasing new results in laser science, quantum optics, and related fields—which took place May 16-21 in San Francisco, California. The meeting was jointly sponsored by the APS, the Optical Society of America, and the Institute of Electrical and Electronics Engineers/Lasers and Electro-Optics Society.

The featured plenary session explored the history of the maser and future applications for technology; presentations on optics and photonics in bioscience; and optical metrology. There was also a joint symposium celebrating the 50th anniversary of the invention of the maser.

SEEING THE BREATH OF DISEASE. Equipped with the latest advances in optics, researchers are setting their sights on carbonyl sulfide (COS), a molecule that has importance in both the atmosphere and in medicine. Currently, diagnosing lung-transplant rejection requires a biopsy. A non-invasive breath diagnosis would be very desirable, but detecting the typically parts-per-billion levels of the molecule in patients is very challenging. Gerard Wysocki and his colleagues at Rice University have built a new detection system that can detect the COS molecule at very low levels.

The centerpiece of the system is a quantum cascade laser, a device that generates laser light in a part of the spectrum known as the mid-infrared. COS molecules absorb light in a unique part of the mid-infrared spectrum and thereby can reveal their molecular "fingerprint." In the setup, a patient first exhales some breath into a small gas cell. Then, the cascade laser shines precisely tuned infrared light through the cell. COS molecules absorb light in the exact part of the spectrum where the laser is tuned. The detection system records the amount of absorption, and this determines the concentration of the molecules in the breath. The researchers have performed some preliminary tests of the system in human breath samples. Having demonstrated a sensitivity of a part per billion, they are hoping to build a prototype medical device with their technology. Such a system would be reasonably priced for a hospital, at about $30,000.

CATCHING DEFECTS IN SPACE SHUTTLE FOAM. Investigators believe the Space Shuttle Columbia disaster resulted from loosened fuel-tank insulation foam hitting a shuttle wing at high speeds. However, it has been difficult to inspect shuttle foam without damaging it or the fuel tank that it protects. X.-C. Zhang of Rensselaer Polytechnic Institute and his colleagues, in collaboration with scientists from NASA Langley Research Center and Lockheed Martin Space Systems, have used terahertz radiation - a form of light in the far infrared part of the spectrum—to detect small defects in samples of space shuttle foam. If shuttle launches are to continue, this technique could help NASA examine the insulating foam prior to shuttle liftoffs.

In their experiment, the researchers tested four foam samples. They looked for two types of foam defects: air bubbles (called "voids") and de-lams, which are separations between layers of foam or between a layer of foam and the aluminum fuel-tank base. Scanning the foam with terahertz waves, the researchers could catch both types of defects. Recently, NASA has announced that terahertz imaging has been

See CLEO/IQEC *on page 6*

LETTERS

Stronger Stand Needed on Evolution

I have just read the *APS News* for April, 2004 and was interested in the article "APS Helps Local Organizers in State Battles on Evolution" beginning on page 5.

Particularly, the sentence on page 6 caught my eye: *"Though evolution is a topic in biology, not physics, it's an issue that all scientists can get involved in."*

The debate involves more than just biologists and geologists. Creationists, relying on a literal interpretation of scripture, estimate the age of the earth at little more than 6,000 years. This does violence to the considerable evidence from physics and astronomy of a much older earth, namely 4.5 billion years, and an even older universe, 13.7 billion years.

Moreover, anyone who has had the misfortune of being drawn into a debate with creationists will recognize the lengths they will go to distort information about the magnetic field of the earth (they assume a uniform decrease in B without the well-documented oscillations), and entropy.

The sentence in the article, though true, is too weak. This is an issue that is crucial to physicists and astronomers. I applaud the APS for taking a leadership role in this discussion.

Mary Lu Larsen
Towson, MD

Suppression of Thought is Alarming

Evolution is clearly evident everywhere in our environment, but I believe that true understanding demands that one start at the beginning and try to comprehend the cause of the universe, as well as the cause of its evolutionary changes over the 13.7×10^9 years of its existence. Students should be encouraged to think for themselves, to remain open minded, and to examine any explanation that is not shown to be fallacious.

It is incomprehensible to me that something has suddenly appeared without cause from nothing in a "big bang," and has spontaneously evolved in complexity over millions of years without intelligent direction from a "point" into the immense universe now observed.

In light of the second law of thermodynamics, it is equally incomprehensible that intelligent life has evolved spontaneously. One might expect that the course of evolution would be toward entropy—increased disorder—and chaos, rather than toward increased order, regularity and life.

Stephen Weinberg's testimony for suppressing any view other than evolution is perplexing. I believe that we should suppress nothing relevant, but instead encourage thoughtful students to decide complex matters for themselves on the basis of credible evidence.

Before "creationism" is dismissed with derision, a more plausible cause of the existence of the universe should be proposed and justified. Let us not abandon causality to defend atheism. I, for one, am not "fearful of intelligent design." I am more alarmed about suppression of thought.

William G. Pettus
Monroe, Virginia

Sleep-Retardant Column OK with Her

Since you printed two negative letters regarding the Zero Gravity column "The Sleep-Retardant Properties of My Ex-Girlfriend" [February *APS News*], I assume that's predominantly what you received. Technically, I'm neither a subscriber nor a physicist. (I read my husband's copy of *APS News*.)

Perhaps I'm missing some nuances or subtleties they teach in quantum mechanics or particle theory, however, as an economist and a woman, all I can say is, lighten up! This was a darling column which I passed on to the stats teacher at our high school. I seriously doubt it will discourage any of the girls from continuing in math or encourage any of the couples to sleep together. But it might help them learn some basic principles of statistics. (Nothing motivates quite like wanting to get the joke.)

Marlys Stapelbroek
North Tustin, CA

Orodruinium: the Story Continues

The April "Zero Gravity" was incomplete in its consideration of the optical properties of Orodruinium. There is another exemption from invisibility in addition to cited case of D. L. Sauron. The additional exemption is T. Bombadil who surprised F. Baggins by not vanishing when he put on the ring. T. Bombadil also detected and 'saw through' whatever optical obscurity Orodruinium produces. This was demonstrated when F. Baggins put on the ring and tried to walk away. T. Bombadil's reaction was "Where be you a-going? Old Tom Bombadil's not as blind as that yet." Perhaps T. Bombadil's vision covers wavelengths not accessible to others.

Larry Crooks
Richmond, CA

Who Sponsors Bob Park?

As an acute reader of Bob Park's "What's New" email column I notice that the rejoinder about not being the opinions of the APS, "but they should be", no longer appears—only the University of Maryland.

In the past I have found Park's material to be a bit contentious, if generally correct. Recently I have found that I am in even stronger agreement with everything he writes.

We are living in times when the iconoclastic opinions of one who might be considered a maverick sound more and more like simple truth (of course, in my opinion). I find myself very pleased that APS continues to sponsor his provocative and useful column, and am equally happy that he longer needs that awkward rejoinder.

Benjamin Bederson
New York, NY

Editor's Note: *Indeed, the awkward rejoinder no longer appears, but neither does the APS name as a sponsor. The University of Maryland has become the primary sponsor of "What's New". This should give Bob Park broad leeway to continue to express opinions in a column that has entertained many of us over the years.*

Senators Sign Letter Calling for More DOE Funding

In an unprecedented move, 55 senators signed a bipartisan letter to Energy and Water Development Appropriations Subcommittee Chairman Pete Domenici (R-NM) and Ranking Member Harry Reid (D-NV), urging them to increase the budget for the Department of Energy's Office of Science by 10% over that requested by the Bush Administration.

With this letter, more than half of the Senate is now on record for substantially higher funding for the Office of Science.

The letter highlighted the importance of the Office of Science-funded research to energy, technology, and the country's economic future, while lamenting its essentially flat budget since 1990.

"The nation must have a balanced investment to maintain the overall health of science and technology research," the letter said. "Recent funding increases for the National Institutes of Health and the National Science Foundation cannot compensate for the need to invest in the physical sciences, upon which all other science is based."

This demonstration of support for the Office of Science, which many lament is often lost within the larger DOE structure, is a significant turnaround for that office.

A year ago, a similar letter had 39 signatories. Active constituent interest and diligent senatorial staff work was important in increasing the number of senators signing this letter. The APS played a very active role in this effort.

A pdf copy of the full text of the letter, with the signatures of the 55 senators, can be viewed at http://www.aps.org/public_affairs/index.cfm

— Richard M. Jones
American Institute of Physics

TASK FORCE *from page 1*

budget would be down 1.8%, apart from a 0.6% increase for the Department of Health and Human Services. Two days after the announcement, the American Association for the Advancement of Science issued an analysis showing that the proposed Bush Administration's budget for the next five years would cut funding for basic research at 21 of 24 federal agencies.

At the press conference, Deborah Wince-Smith, president of the Council on Competitiveness, said that America's technological leadership faces greater competition from abroad as developing economies increase the number of PhDs in engineering and physical sciences and create new incentives for scientists and engineers to work outside the US. Other nations are rapidly replicating the structural advantages that historically have made the US the center of innovation: investing in education and job skills; building modern network infrastructures; financing new ventures; and opening their markets to global trade.

As a result, the US is fast approaching a "tipping point" at which 30 years of declining or flat federal research could have dire consequences for scientific discovery and innovation. "These changes demand that we rethink our approach to innovation," said Wince-Smith. "We need to reevaluate the policies, programs and institutes that were designed for a world in which innovation was linear and US leadership was unrivaled. In today's global marketplace, innovation is essential for economic security and American prosperity."

Hence the launch of the advocacy campaign, whose primary message is, "Don't flatline our innovation future by underfunding basic and applied research," according to Craig Barrett, CEO of Intel Corporation and chairman of the Computer Systems Policy Project. "We can choose to continue to invest in the industries of the 19th century and allow innovation to atrophy, or we can build on our past strengths and go forward to maintain our competitiveness."

Barrett pointed out that while the government has focused increasingly on the growing problem of outsourcing in industry, there has been almost no corresponding discussion regarding funding of basic research. Asked whether perhaps industry could pick up the slack, Barrett said that Intel alone spends $5 billion on product development R&D—more than the entire US government spends on basic research—and also spends an additional $100 million on research and education.

"America's universities and their researchers are the world's most prolific engines of innovation," said Nils Hasselmo, president of the Association of American Universities. "Investments in university research make America work and are vital to our security. They also provide indispensable hands-on research opportunities for the scientists of tomorrow. We understand current federal budget restraints. But research is the foundation of future economic growth and security."

Richard Smalley, a professor at Rice University and winner of the 1996 Nobel Prize in Chemistry for the discovery of buckyballs, reiterated Hasselmo's comments about the importance of universities to innovation, noting that his own field of buckyballs and carbon nanotubes has propelled the development of nanotechnology. Smalley himself cofounded Carbon Nanotechnologies Inc. in 2000. "Our work-force is not flatlining, it's in decay. The US has been on a downward slide in supporting physical sciences and engineering for more than a decade," he said. "We've been living off the successes of the past. If we don't change course, we will leave our children a very poor legacy."

In addition to the APS, the current members of the Task Force on the Future of American Innovation include the American Chemical Society, the Alliance for Science & Technology Research in America (ASTRA), the Computer Systems Policy Project, the Council on Competitiveness, Intel Corporation, Hewlett Packard, IBM, the National Association of Manufacturers, the Science Coalition, the Semiconductor Industry Association, and Texas Instruments.

Photo Credit: James Riordon

Photo Credit: Steve Pierson

(Top photo): Richard Smalley speaks at the press conference announcing the advocacy campaign, while Craig Barrett of Intel and Deborah Wince-Smith of the Council on Competitiveness look on. (Bottom photo): APS President Helen Quinn with Richard Smalley at the press conference.

Readers Bash Beltway Column

Editor's Note: *As a registered lobbying organization, the APS advocates for increased support for science, and for other public positions expressed in statements of the APS Council. These activities are strictly non-partisan: we never lobby for particular candidates or parties. Likewise, "Inside the Beltway", appearing bi-monthly in* APS News, *provides non-partisan analysis and commentary on the Washington scene by the APS Director of Public Affairs, Michael S. Lubell. Sometimes, however, readers take issue with not only Lubell's analysis but also his impartiality. The April column generated a particularly voluminous and vociferous batch of letters. We reprint excerpts from four of them here, along with a reply from Lubell.*

When did *APS News* become a megaphone for the Democratic Party and other assorted Bush bashers? Michael Lubell turned the April issue into a shallow propaganda sheet with his "Inside the Beltway" column. A thoughtful analysis of Washington trends would indeed serve the interests of APS members, but Lubell's "analysis" is a thinly veiled partisan attack, filled with jabs at the Bush administration but with little else in the way of facts or opinions of anyone other than himself. You can find much of the same at www.democrats.org.

This banal "analysis" isn't worth the paper and ink spent on it. If *APS News* can't tell the difference between sober analysis and partisan Bush bashing, then maybe it shouldn't publish political articles at all.

Thomas Karr
Linthicum, Maryland


INSIDE THE BELTWAY:
A Washington Analysis

Cracks Begin to Show in the GOP Fortress

✶✶✶

I am sick and tired of Mike Lubell practicing partisan politics of any flavor on my nickel. The APS should not be using membership revenue to pay for this. Perhaps the Society should spin off its political arm so that only those who choose to support it may do so. The Office of Public Affairs should be independent of an organization that's supposedly devoted to physics.

Art Blair
Madison, Wisconsin

✶✶✶

I usually value highly the information I get from *APS News*, but when I looked at the April 2004 issue, I thought I was looking at the *Washington Post*. Mike Lubell's column, "Cracks Begin to Show in the GOP Fortress," is an unabashed political screed, and I hope it is not an indication that in this political year, *APS News* has become an organ of a specific political party. The Beltway column is little more but a not so subtle attack on the Republican Party. If Lubell can't refrain from this, or if he can't find material that is pertinent to the mission of the APS, I suggest the *APS News* editor find someone who can.

Lawrence Johnston
Moscow, Idaho

✶✶✶

Regarding Mike Lubell's article, "Cracks begin to show in the GOP fortress," I was surprised and dismayed to see such a combative attitude in the pages of *APS News*. I am informed that Karl Rove first "addressed a captive audience," and then that he had "no compelling response" to questions from Congressman Vern Ehlers about job losses. It appears I have no need to know what that response actually was.

I am cynically accustomed to this patronizing attitude in the mainstream press, but in an APS publication, I expect to be given the facts so that I may determine for myself whether they are "compelling" or not. None of us would publish a paper with only analysis and no data. I am very disappointed in this article.

Sabrina Chase
Kirkland, Washington

✶✶✶

Michael Lubell Replies:

Having been excoriated last month for dissing the Democrats, I am much bemused by the reaction this month to my latest column. Much of what the letter writers conclude is in their own eyes. For the record, I am not a highly partisan Democrat. My political views are without a doubt considerably to the right of the majority of APS members, but I do my best not to reveal them. Apparently I succeeded all too well this time.

My point in the column was that the GOP—which had remarkable achievements last year and had the Democrats off balance—was suffering a change in fortunes. With control of both houses in Congress and the White House, all of which they were managing with political aplomb, Republicans were believed to be a veritable fortress as 2004 opened. That has not proved to be the case. And it has enormous potential consequences for R&D funding, which now accounts for 15% of the total discretionary budget, including defense and homeland security.

With the Republicans put on the deficit ropes by Democratic critics, the outlook for science is not good. Anyone who doubts me should personally ask members of the Republican leadership, or any of the budget appropriators. I have spoken to quite a few of them, and that's what they are saying. I haven't yet spoken to the Democrats, but perhaps I should, and report that information in my next column. That way, I can maintain a certain degree of political neutrality.

Ask the Ethicist

Editor's Note: *Please send ethical questions for Jordan Moiers or comments to: ethics@aps.org, or by mail to Jordan Moiers, c/o APS News, One Physics Ellipse, College Park, MD 20740. Contributors should identify themselves, but their names and addresses will be held strictly confidential unless they request otherwise.*

The opinions expressed in this column are not necessarily those of either the APS or APS News.

✶✶✶

"At my previous postdoc position I worked on a research project inspired by a discussion with a senior collaborator, and then was carried out exclusively by myself. I presented the work at a conference, with myself, the senior collaborator, and another collaborator as authors. After the conference I wrote a proceeding paper, which my collaborators reviewed. We also published an article in a journal.

Months later, while by browsing the Internet, I discovered that my senior collaborator was giving a talk at another conference about the research we had done. When I asked if he would submit a paper on the work he presented to a journal, the answer was "yes." I asked to review the manuscript before it was sent out, but I did not receive a copy until after it was submitted. The first surprise was that the author list had changed. Instead of being listed first on the paper with my collaborators' names following, I was listed second and my senior collaborator was first. In addition, two more coauthors were included. The new coauthors knew nothing about the project and had not been informed that they were listed on the manuscript.

To make matters worse, the new manuscript was nearly identical to the one published earlier, only five sentences were different out of seven pages. I contacted my collaborator and asked him to either withdraw the paper or remove my name. The paper has not been withdrawn. I am not sure if my name has been removed.

Should the publication of the manuscript be stopped completely? After all it is a copy of a different paper. Should I contact the editors of the journal? Clearly my senior collaborator did not like me pointing out the unethical behavior, which may have repercussions along my career. How should I handle this situation? If I contact the journal, I might have more problems with my collaborator.

(Name and address withheld)

Jordan Moiers replies:

Yes, you should contact the journal. Scholarly journals are venues for new and original research. According to APS Editor-in-Chief Martin Blume, submitted papers that are duplicates of published work are rejected out of hand. A published journal paper that is found to be a duplication is retracted.

It's understandable that you are concerned about the impact on your career that might result from offending your senior coauthor by raising the issue with the journal, but if there is existing evidence of double publication, in the form of a previously published work, no one needs know that you blew the whistle on your colleagues. In fact, all you have to do is contact the journal editors, perhaps via an anonymous phone call, and point out the smoking gun of the existing paper in the literature. If you feel the need to identify yourself, there is no reason that the editors would have to alert your coauthors to the source of their information. At least as far as the *Physical Review* is concerned, Blume informs us that the editors would be happy to maintain your anonymity.

With regard to author priority and coauthor qualifications—in this case, those are higher order issues compared to double publication. Only the initial paper has any legitimacy at all, if the subsequent ones are merely duplicates of the first. As my Grandma used to say, "There's no point in worrying about the state of the drapes, if the roof is caving in."

Help on Ethics Needed

The recent APS Task Force on Professional Ethics recommended that APS work with physics departments to improve education on ethical issues that affect the physics community. If you have experience or interest in developing materials to help students understand and confront such issues and would be willing to help with this task, please contact Ken Cole, Special Assistant to the Executive Officer, at cole@aps.org.

Closing In on the Mysterious Dark Matter?

Initial data from the Cryogenic Dark Matter Search (CDMS II) was reported at the APS April meeting in Denver. This underground observatory in Northern Minnesota has provided unprecedented sensitivity into the search for so-called Weakly Interacting Massive Particles (WIMPs). Should evidence of WIMPs be observed, it could answer the dual mystery of both the dark matter problem and supersymmetry.

The CDMS II team practices "underground astronomy" with particle detectors located nearly half a mile below Earth's surface in a former iron mine. Earth's crust blocks cosmic rays and the background particles they produce. Made of germanium and silicon crystals, the detectors are chilled to within one-tenth of a degree of absolute zero. They are capable of measuring both the charge and vibration produced by particle interactions within the crystals.

The detectors are now able to look for signals just one-fourth as intense as any seen before, and the team expects to improve sensitivity by a factor of 20 over the next few years. WIMPs will signal their presence by releasing less charge than most background particles produce for the same amount of vibration.

A WIMP, which carries no charge, is expected to have roughly one hundred times the mass of a proton. Yet WIMPs are able to slip through ordinary matter while barely leaving a trace. The presence of dark matter in the universe is detected through its gravitational effects, from the growth of structure in the early universe to the stability of galaxies today. Dark matter cannot be made of the ordinary matter forming objects in the visible universe, and constitutes as much as seven times more total mass than ordinary matter. WIMPs are a strong contender for dark matter.

The nature of dark matter is fundamental to our understanding of the formation of the universe. With the CDMS II collaboration, either the dominant mass of the universe will be discovered, or a large number of supersymmetric models will be excluded as possibilities.

WIMPs might be the as-yet-unobserved subatomic particles called neutralinos. That would provide strong evidence for supersymmetry, which predicts that every known particle has a supersymmetric partner with complementary properties, although no such partners have been observed to date. Many supersymmetry models predict that the lightest such particle, called the neutralino, has a mass of about 100 times that of the proton.

SOUTH AFRICA *from page 1*

For example, most East African countries have research programs in renewable energy. Certain donors have helped initiate such programs in response to the region's needs (and its many sunny days). But the research efforts have been uncoordinated, so despite the 20-year effort, 80% of African households are still without electricity.

"Unless a coordinated program is created to apply the region's physics expertise, renewable energy may continue to be an interesting research topic with little prospect of contributing to economic development," said Flatten.

Among the hoped-for results of the 2005 World Conference is the establishment of new international partnerships. More than 200 such partnerships were launched at the 2004 World Summit.

"Developing scientific capacity requires more than just educating graduate students and postdocs in the developed world and returning them to their home nations," she said. "It requires partnerships of policy makers, scientists and industrialists from both developing and developed nations, for jointly executed, action-oriented projects."

APS, AAPT Appoint Joint Task Force on Graduate Education

Together with the American Association of Physics Teachers (AAPT), the APS has appointed a new Joint Task Force on Graduate Education in Physics. Chaired by Boston University's David Campbell, the task force will examine current trends in physics research and education that may be contributing to the fragmentation of the physics community.

The task force is charged with examining and summarizing directions in graduate education in physics, with special emphasis on doctoral programs.

It will identify special challenges and problems facing graduate education in physics, and recommend appropriate actions for APS, AAPT, and/or PhD-granting universities to take in response to these issues.

"The physics community has not reviewed its graduate education programs for ten years," said APS Executive Officer Judy Franz about the rationale for forming the task force. "We hope that the task force will be able to suggest positive steps to help graduate students learn physics that will enhance their understanding of the interconnections between different fields; prepare them to apply physics in a variety of fields or disciplines; and foster their appreciation of the breadth of physics."

The other task force members are: Renee Diehl, Penn State University;

J.D. Garcia, University of Arizona;

James Gates, University of Maryland, College Park;

Michael Paesler, North Carolina State University;

Peter Jung, Ohio University;

Joel Fajans, University of California, Berkeley;

Allen Goldman, University of Minnesota; and

Tom Appelquist, Yale University.

CLEO/IQEC *from page 3*

selected as one of two technologies for inspecting the insulation foam for any future shuttle launches.

INVESTIGATING MERCURY'S SURFACE AND INTERIOR. How will scientists measure the topography of Mercury? Developers of the Mercury Laser Altimeter answer this question as the spacecraft is readied for launch in August 2004. Once the spacecraft begins orbiting this hot and dense planet, the laser altimeter will transmit laser pulses towards the planet's surface and four large cones will collect the photons reflected off Mercury's surface. The topography of the planet is determined from the laser pulse time-of-flight and the spacecraft orbit position data. The innovative 4-cone receiver optics design helps maintain focus under large and rapid temperature change as the spacecraft travels from the dark and cold side of Mercury to the sunny and hot side.

Understanding Mercury, one of the most extreme rocky planets, will help us understand Earth's topography, development, magnetic field and interaction with the sun.

REAL-TIME IMAGING OF HUMAN SKIN WITH TINY 2-D SCANNER. A team of researchers from the University of California, Los Angeles, and the Massachusetts Institute of Technology, has built a tiny endoscopic scanner, only 5.5 millimeters across.The scanner combines a 2-D scanning mirror, measuring only 1 millimeter in diameter, with optical coherence tomography. With a resolution of 5 micrometers, this endoscope can scan living tissues and provide real time 3-D images.

Tests at MIT were able to scan live human skin in real-time, capturing up to 20 frames per second, with 5-micrometer axial image resolution. The scanner has a very high resonant frequency and can scan areas quickly.

NEW LIGHT FROM GALLIUM ARSENIDE. Nonlinear optics continues to provide many scientifically interesting and technologically useful effects.

Konstantin Vodopyanov of Stanford and his colleagues have built a new nonlinear-optics device, based on gallium arsenide (GaAs), capable of producing high-power light for numerous applications including many items on the homeland security wish list. Light that enters the material can be efficiently converted into a wide range of different colors (wavelengths). However, to achieve these effects, researchers have to construct specially tailored crystal structures of GaAs. By combining two layer-by-layer crystal growth techniques known as molecular beam epitaxy and hydride vapor phase epitaxy, the researchers have built the first GaAs structure that operates as an optical parametric oscillator (OPO).

OPOs convert single-color laser light into any of a very wide range of new wavelengths. The new device can produce wavelengths in the entire "fingerprint" region of common molecules (2-17 microns). This is crucial for detecting a wide variety of drugs and explosives.

A GaAs OPO can generate powerful infrared light that aircraft can potentially employ to divert heat-seeking missiles. Moreover, the GaAs OPO can potentially generate the far-infrared light suitable for terahertz imaging at airport security as well as trace gas detection. Another benefit is that GaAs devices are likely to be reasonably priced, as the material has been widely studied. However, fabrication techniques, such as hydride vapor phase epitaxy, need to be developed futher to help bring many of these applications to real world use.

— Compiled by Philip Schewe and Ben Stein, American Institute of Physics

INSIDE THE BELTWAY:

Washington Analysis and Opinion

Physics in the Headlines But Not in the Usual Way

By Michael S. Lubell, APS Director of Public Affairs

Michael S. Lubell

Suddenly physics, more precisely the physical sciences, math and engineering—but that's too much of a mouthful, so I'll stick with physics—is back on the agenda of politicians, policy makers, industrial leaders and the media.

It's not the discoveries and the Nobel prizes of the last few years that are creating the buzz, though they haven't hurt. Rather, it's the growing recognition in the circles that count that the nation really does depend on physics discoveries to stimulate the economy, enhance security and improve the health of the populace. And further that the physics enterprise is under significant stress from two decades of federal neglect, growing competition from abroad, and a tangle of education and workforce problems, which, left untreated, will seriously compromise the future of America.

Why the issue is suddenly gaining traction is a story in itself, one that would take too many words to tell in this column. Suffice to say that the threat is real and that physics advocates—many of them readers of "Inside the Beltway," I trust—have been able to break through the political cacophony and journalistic prejudice that usually relegate science and science policy to the back benches and the back pages.

A few examples deserve mention.

•Dateline, March 17, 2004, *Wall Street Journal*: **Competitive Edge of U.S. Is at Stake in the R&D Arena**.

•Dateline, Washington, March 29, 2004, *C SPAN*, "Washington Journal," Former Lockheed/Martin CEO Norman Augustine: **Can Science Save U.S. Jobs?**

•Dateline, Washington, April 8, 2004, *Roll Call*, "Pennsylvania Avenue," by Morton M. Kondracke: **Kerry, Congress Should Fight Bush Science Cuts**.

•On stage at the National Press Club, April 20, 2004, Intel CEO Craig Barrett, Association of American Universities President Nils Hasselmo, High Voltage Engineering CEO Russ Shade, Nobel Laureate Richard Smalley and Council of Competitiveness President Deborah Wince-Smith: **Task Force on the Future of Innovation Launches Advocacy Campaign to Illustrate the Importance of Basic Research**.

•29th Annual AAAS Forum on Science and Technology Policy, Washington, DC, April 22, 2004, Senate Minority Leader Thomas A. Daschle: "Today, we stand at a pivotal moment. For all our past successes, there are disturbing signs that America's dominant position in the scientific world is being shaken."

•Dateline, April 27, 2004, *USA Today*, "Editorial/Opinion," **Intel CEO: Let's End Political Games and Compete**.

•Dateline, Washington, April 28, 2004, *Roll Call*, Task Force on the Future of Innovation Ad: **Economics 101 Innovation is America's Economic Heartbeat, Don't Flat Line Our Future!**

•Dateline, May 3, 2004, *The New York Times*, William J. Broad: **U.S. Is Losing Its Dominance in the Sciences**.

•Dateline, May 5, 2004, *The New York Times*, William J. Broad: **National Science Panel Warns of Too Few New Scientists**.

•Dateline, May 7, 2004, *The New York Times*, "Editorial": **Losing Our Technical Dominance**.

•Factoid, Washington, DC, May 11, 2004: 56 Senators Sign Letters to Energy and Water Appropriators Calling for 10% Increase in DOE Office of Science Budget.

The federal government may be swimming in red ink, but apparently some opinion makers don't think it's worth sacrificing our future by shortchanging the physical sciences, mathematics and engineering. I agree. If you do too, "Speak out!"

Two-Day Los Alamos Event to Honor Oppenheimer

J. Robert Oppenheimer (photo courtesy of the National Archives)

In honor of the centennial of the birth of J. Robert Oppenheimer, and to recognize the preservation of the Manhattan Project history at Los Alamos, a two-day public event will be held June 25 and 26 in Los Alamos.

Born on April 22, 1904, Oppenheimer was the first director of the Los Alamos laboratory, and the technical director of the Manhattan Project that developed the atomic bomb during World War II.

The event, organized by the Atomic Heritage Foundation, the Los Alamos Historical Society and Los Alamos National Laboratory, includes tours, speeches, a dedication of the Oppenheimer house, and a reception and dinner.

"We need to be rooted in this history and be proud of it. We think this will be a really good event, and we want to get everybody there," said Cindy Kelly, president of the Atomic Heritage Foundation, a nonprofit organization dedicated to preserving the history of the Manhattan Project and the Atomic Age.

Kelly said the organization is planning to offer tours to some of the Manhattan Project sites, including some sites not normally accessible to the public. (For security reasons, these tours require advance reservations). "The majority of people who've lived in Los Alamos all their lives have never seen these properties that we're restoring," she added.

On Friday afternoon, New Mexico Senators Pete Domenici and Jeff Bingaman will dedicate the house where Oppenheimer and his family lived. The house was recently acquired by the Los Alamos Historical Society. After the dedication, a reception and dinner will be held at Fuller Lodge, once the center of social life for the Manhattan Project community at Los Alamos.

Saturday's program features an all-day symposium on "Oppenheimer and the Manhattan Project" at the Smith Civic Auditorium in Los Alamos.

One of the speakers will be Ed Gerjuoy of the University of Pittsburgh, a former APS Council member and currently Chair of the APS Committee on the International Freedom of Scientists (CIFS). He was one of Oppenheimer's last PhD students at Berkeley before Oppenheimer left for Los Alamos.

Other speakers include historian Richard Rhodes, author of *The Making of the Atomic Bomb*, several other historians and authors of forthcoming books on Oppenheimer, and Manhattan Project veterans who knew Oppenheimer.

For more information on the program, or to purchase tickets for any of the events, visit http://www.atomicheritage.org.

ANNOUNCEMENTS

DIRECTOR OF EDUCATION AND OUTREACH PROGRAMS

The American Physical Society (APS) is seeking applications and nominations for the position of Director of Education and Outreach Programs to replace Fred Stein, who plans to retire in September. The person selected will play the leadership role in all APS education programs, including a major program to improve the physics education of K-12 teachers (PhysTEC), and will work closely with the Committee on Education and the Forum on Education. In addition, he or she will work with the Committee on the Status of Women in Physics and the Committee on Minorities in Physics in efforts to increase the number of women and minorities with careers in physics. An excellent staff is available to help with these programs.

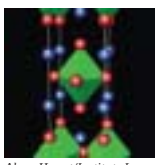
Qualifications for the position include a PhD in physics or a related field, familiarity with the physics research and education communities, experience in managing large projects, some experience in working with teacher education programs, and excellent interpersonal and communication skills.

For consideration, send a cover letter, resume, and professional references to Judy Franz, APS Executive Officer, franz@aps.org, by June 15.

Physical Review Focus http://focus.aps.org

Down-to-earth accounts of hot research from the *Physical Review* journals—ideal for college physics majors and researchers interested in work outside their specialty. Write to **join-focus@lists.apsmsgs.org** to get weekly e-mail updates.

Some recent *Focus* stories:



Alan Hewat/Institut Laue-Langevin

Ghost of SuperConductivity on a Fall Day
Magnetic measurements hint at vestiges of superconductivity near room temperature—far too warm for the full superconducting phenomenon to exist.

P. Shipman/Univ. of Arizona

Cactus Patterns Buckle Up
Computer simulations demonstrate that the forces in a growing plant can lead to spiral patterns with special mathematical relationships.

Lawrence Berkeley National Laboratory

***Landmarks:* The First Million-Volt Accelerator**
In 1932, the invention of the cyclotron marked the start of modern particle physics.

Now Appearing in RMP: Recently Posted Reviews and Colloquia

You will find the following in the online edition of Reviews of Modern Physics at http://rmp.aps.org.

Spintronics: fundamentals and applications
—Igor Zutic, Jaroslav Fabian, and S. Das Sarma
Spintronics is an emerging field devoted to the generation and detection of quantum spin polarization, its control and transport. Rather than operating on the charge currents of conventional electronics, spintronic devices utilize spin currents. Recent advances in materials, experimental techniques, and theory are leading to a rapid development of both the basic science of spintronics and its commercial applications. This comprehensive review describes that progress, including the fundamental theory and the promising technologies for spintronic devices.

Also Recently Posted:
The current-phase relation in Josephson junctions
—A. A. Golubov, M. Yu Kupriyanov, and E. Ilíchev

New Job Web Site for APS

If you're looking to fill or find a job, the new APS Online Job Center at **http://careers.aps.org** is your one-stop shop. Jobseekers and employers alike will find the APS Job Center, which now receives over a million hits from 20,000 unique visitors monthly, to be an invaluable resource.

The APS Job Center contains hundreds of new jobs posted monthly and offers a database of thousands of resumes. It covers all physics fields plus related fields such as materials science, computing, biology, chemistry, and engineering.

EMPLOYERS

Whether you're an HR manager or a member of technical staff looking to hire, you can take advantage of valuable services for a low cost.

For example, you can:

- Post multiple job descriptions
- Receive job applications online
- Track how often your job is viewed
- Fill out an employer profile section, which allows company information to appear at the bottom of each ad you post.
- Create automatic resume alerts—when the perfect person for the job posts her resume
- Search the resume database by keyword and geographic location to find someone ideal for the position

JOBSEEKERS

Jobseekers have access to a variety of services that take the hassle out of finding a job that's tailored to their skills.

As a job seeker you can:

- Create your online profile once and allow prospective employers to find you, or
- Maintain confidentiality until you are ready to apply for a position
- Search jobs by multiple criteria
- Apply for jobs directly online to save time and paper
- Store multiple copies of resumes for different kinds of jobs
- Create automatic job alerts—you'll be contacted as soon as your dream job is posted.

If you have any questions about any of these services, please contact us at **jobs@aps.org.**

COUNCIL *from page 1*

edged in publications, presentations, and performance appraisals. In particular, subordinates who have made significant contributions to the concept, design, execution, or interpretation of a research study should be afforded the opportunity of authorship of resulting publications, consistent with APS Guidelines for Professional Conduct.

Supervisors and/or other senior scientists should not be listed on papers of subordinates unless they have also contributed significantly to the concept, design, execution or interpretation of the research study.

Mentoring of students, postdoctoral researchers, and employees with respect to intellectual development, professional and ethical standards, and career guidance, is a core responsibility for supervisors. Periodic communication of constructive performance appraisals is essential.

These guidelines apply equally for subordinates in permanent positions and for those in temporary or visiting positions.

✶✶✶

Statement on Referencing Guidelines

Authors have an obligation to their colleagues and the physics community to include a set of references that communicates the precedents, sources, and context of the reported work. Proper referencing gives credit to those whose research has informed or led to the work in question, helps to avoid duplication of effort, and increases the value of a paper by guiding the reader to related materials. It is the responsibility of authors to have surveyed prior work in the area and to include relevant references.

Proper and complete referencing is an essential part of any physics research publication. Deliberate omission of a pertinent author or reference is unethical and unacceptable.

BACK PAGE *from page 8*

disciplines to intersect in unexpected ways, and public interest in science continues to grow.

Still, we have a great deal to worry about. Enlarging budget deficits threaten to constrict future budgets for science, immigration policies and practices may deflect new talent to other countries, and inappropriate attacks on peer review and a failure to separate religion from science can undermine the delicate balance between scientific independence and governmental oversight. And we may not be moving fast enough to promote science and its uses in the developing world, and to provide open access to scientific findings through the Internet. Effective collaboration between science and government seems to me one of the few rational ways to find our path in a largely irrational and increasingly dangerous world. I hope that an accounting of these concerns can ultimately help to strengthen our traditional relationship.

Harold Varmus is president and chief executive officer of the Memorial Sloan-Kettering Cancer Center, and former director of the National Institutes of Health. This article is adapted from his Carey Lecture, delivered at the American Association for the Advancement of Science Policy Meeting on April 22, 2004. The full text of his speech can be found at http://www.mskcc.org/mskcc/html/19743.cfm

Butterflies, Tornadoes, and Time Travel

Very few people are afraid of butterflies… but maybe more should be. The movie *The Butterfly Effect* (which opened in theaters nationwide on January 23) may not include any nefarious insects, but it is based in part on a concept from chaos theory that suggests that something as subtle as the flap of a butterfly's wings in Brazil could trigger a tornado in Texas.

The term "butterfly effect" was coined by meteorologist Edward Lorenz, who discovered in the 1960's that tiny, butterfly-scale changes to the starting point of his computer weather models resulted in anything from sunny skies to violent storms—with no way to predict in advance what the outcome might be.

In the movie *The Butterfly Effect*, actor Ashton Kutchner plays a man who has found a way to travel back in time to his youth. Each time he returns to his childhood, he makes minuscule changes that radically alter his life in the present, inevitably leading to (you guessed it) terrifying results.

Human time travel is a purely fictional concept, but according to Rutgers biophysicist Troy Shinbrot, the idea that small changes can lead to dramatically different outcomes is firmly rooted in the physics of chaos theory, at least for some systems.

"If you're willing to suspend your disbelief long enough to accept the possibility of time travel," says Shinbrot, "then, yes, the movie sounds like it has a reasonably plausible premise, from a physics point of view."

Shinbrot should know—his PhD dissertation at the University of Maryland was based on groundbreaking butterfly effect experiments.

Scriptwriters, it seems, have found that the butterfly effect is a useful tool for establishing dramatic tension.

For scientists like Shinbrot, it can be a useful tool for manipulating chaotic systems. In fact, Shinbrot's dissertation was part of an effort to learn how to make small adjustments to a chaotic system to choose the system's outcome.

"NASA currently directs trajectories of spacecraft using the butterfly effect," says Shinbrot. "The first example that I know of was the International Cometary Explorer. They used the fact that the butterfly effect applies to trajectories in the solar system. With tiny amounts of hydrazine fuel, they created little puffs that steered the spacecraft halfway across the solar system to meet up with comet Giacobini-Zinner That's how they achieved the first ever scientific cometary encounter."

In order to make use of the butterfly effect, NASA scientists must study highly accurate models of satellites in the solar system.

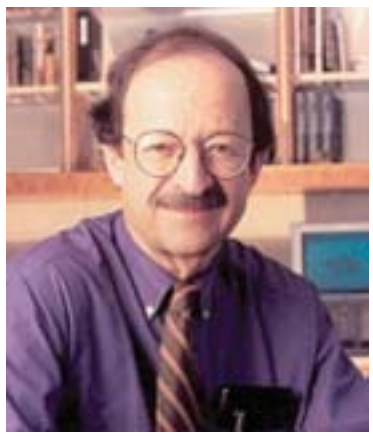
As for the adventures Kutchner faces in *The Butterfly Effect*, says Shinbrot, "If he had a better model for the system that is his life, perhaps he could have chosen better outcomes. But then the movie wouldn't be very interesting."

—Adapted from Physicscentral.com

The Back Page

Science, Government, and the Public Interest

By Harold Varmus



Harold Varmus

The relationship between science and government has not always been as richly textured as it is now. Historically, science, like philosophy and the arts, was generally either pursued as an avocation by the wealthy or financed by wealthy patrons, who might or might not also have political power. More recently, the patron was often one of the new philanthropic foundations. Following the industrial revolution, as commerce learned to use the fruits of science in the 19th and 20th centuries, increasing levels of support also came from the industrial sector, often with the intention of producing something of value to the investor, not necessarily knowledge for the general public.

The extraordinary characteristic of governmental involvement in science is its most prominent purpose: to create knowledge that advances public welfare. To achieve this goal, science and government need to be mutually supportive. In its simplest form, the government pays scientists to make discoveries that lead among other things to practical inventions, economic prosperity, and better health—all of which are in the public interest. The relationship depends on trust between the two parties and allegiance to rules that are often unspoken and not legislated, but worth trying to state here.

To get what it needs and wants from scientists, the government needs to ensure reasonable levels of financial support for scientific work; organize agencies that can deploy the funds in a fair, equitable, and productive fashion; pay attention to the supply of scientific workers; observe sympathetically the physical and functional components of the scientific infrastructure; listen to the advice scientists offer to the government on many issues; and exercise wise oversight—neither careless nor draconian—of the agencies and institutions that spend public money, keeping an eye on priorities, on the distribution and use of scientific findings, and on scientific integrity and fiscal accountability.

In turn, the scientific community needs to honor the government's fiscal commitment. This is achieved by individuals and their institutions through the hard work of doing science; communication of research findings; the education and training of new scientists; the pursuit of useful applications of new knowledge; an enthusiasm for providing nonpartisan advice about scientific knowledge that informs policy making; and a willingness to be subjected to competitive review by peers and to administrative and legislative oversight by government.

1. Financing Research

At this time in our history, the vast majority of scientific work performed in academia and government is absolutely dependent on the availability of government funds. It is essential that the national treasury be equipped to sustain the vitality of American science. The darkest cloud on the horizon of the marriage of government and science is the rapidly growing budget deficit—a product of expanding costs of mandatory programs, an expensive war in Iraq, and dramatic reductions in revenues by ill-timed tax cuts. In an amazingly rich country like ours, with an annual gross product of about $10 trillion, it would seem a simple matter to have enough set aside to insure that all the major sciences are growing at the kinds of rates we consider healthy for other components of our economy. This is especially so when leading economists agree that public investments in science have a rate of return unmatched in any other area. But the Federal deficit that now yawns before us threatens essentially all sciences with not just an absence of growth, but possibly a reduction in support over the next several years. It is time to reassert the depth of our relationship and to redefine its fiscal requirements, continuing to reward accomplishment and preserve competition, while providing stability.

2. Immigration Practices

The availability of long term resources for the scientific enterprise is among the factors required to insure a steady supply of new talent for science in the public domain. A second factor is the training environment—the schools and universities and lab-based programs that we use to interest students in science and to teach them to become good scientists. We continue to do a good job in biology and computer science, but we don't do so well in engineering, physics, and mathematics. And test scores show that we are mediocre in teaching the scientifically ungifted or the disinclined, those who eventually become the general public.

The third factor is our capacity to attract talented and ambitious young scientists from abroad. Enlightened immigration is a long-standing source of both pride and outstanding scientists. (Bruce Alberts reported in his annual Presidential Address to the NAS this year that fully a quarter of current members of the NAS were born abroad.) But there are signs that practices affecting visas for students and scientific visitors have recently veered out of balance. The GAO reported last year that the average time for issuing visas is longer than two months, although the State Department has claimed that visa delays have been reduced recently in response to such complaints. Still, students and postdoctoral fellows report treatment that is annoying, insulting, and humiliating. One possible consequence is described in a recent report from the Council of Graduate Schools: a decline this year of about one-third in applications for graduate training, especially from China, Korea, India and several other countries.

Certainly, the scientific community has a responsibility to recognize legitimate concerns about terrorism; they will and should have an effect on procedures and policies that govern travel and immigration. But the government must formulate a reasonable defense; fears of terrorism must not be allowed to erode our ability to attract talent to our shores.

3. Independence of Peer Review

The contract between government and science has worked well in the US in large part because the scientific community has made an enormous commitment to police the quality of grants that are awarded and papers that are published in leading journals through expert peer review. We in the scientific community assume that the near-sanctity of peer review is widely accepted. But peer review is fragile. Two things threaten it. One is a decline in funding that can lower success rates to the point at which the review mechanism cannot make credible decisions between what should and should not be supported. In this situation, review criteria are corrupted—innovation gives way to mere feasibility—and older established scientists are given opportunities that belong to younger untested ones.

The other threat is more immediate and more distressing: an effort to undermine peer review through poorly informed political action. On July 11, 2003, Rep. Toomey of Pennsylvania rose on the floor of the House of Representatives to propose an unusual amendment to the NIH spending bill: four NIH grants would be stripped of their funds because he had determined from the abstracts that they were inappropriate for funding. Fortunately, the allies of science came to our aid, and the Toomey Amendment was defeated—but by a mere two votes.

This worrisome episode tells us that there is a festering wound in the relationship of science and government. We as scientists and the science agencies need to describe our review processes with greater clarity and in wider venues to insure an appreciation of them.

4. Separating Religion and Science

The quality of science in the US depends substantially on our history as a basically secular country. Yet, ironically, as recent immigration trends have made our country much more diverse culturally, ethnically, and spiritually, we have not become more securely secular. Instead, an increasingly dogmatic faith-based element has invaded government and politics, undermining the evidence-based approaches to problems that most scientists would like their governments to use. In crucial situations, this can produce important mistakes with disastrous consequences—even well beyond the usual confines of science, as in trying to find "weapons of mass destruction" that we know must exist in "evil" countries, rather than looking for evidence that they do.

Arguments based on the contention that spending tax dollars to do certain research might offend the sensibilities or beliefs of taxpayers, threaten to replace another kind of moral argument based on the idea that spending tax dollars to do certain research might produce benefits, especially health benefits, for many diverse people in our complex society.

Consider two examples: The strong tilt in this Administration towards abstinence programs and away from more realistic programs that use contraceptive devises, like condoms, to prevent the spread of HIV and other sexually transmitted agents, here and even abroad. And, second, the policies that now govern stem cell and human embryo research, that give heavy weight to the moral rights of a tiny cluster of undifferentiated cells at the expense of full fledged adult citizens who could benefit from such research. These policies are now driving most of this work to the private sector, to a few wealthy non-profit institutions, and, most troubling for our nation's future in science, to new players like South Korea or to our traditional competitors like Great Britain.

This is not an argument to deny ethical considerations their role in deciding how to conduct government-supported science. But this role needs to be exercised in the context of a balanced, non-doctrinaire approach in which the ethical consequences of research are also fully considered for application in an increasingly pluralistic society.

5. Globalizing Science

The US government generally understands its role as the major supporter of the scientific work that benefits our citizens and our economy. But it has been slower to understand the global impact of the public goods that science generates and the beneficial effects of US support for science in other countries, including the poorest countries. We now achieve our best effects internationally by training foreigners who return home and also by permitting widespread use of knowledge that we produce here and place in the public domain. But I envision a much more extensive program with more expansive goals. I believe that we can "globalize science" in a way that builds sounder societies, links scientific communities, and produces knowledge with regional or national, as well as world-wide, importance.

My enthusiasm for building science in the developing world is based on several things—the belief that science can improve lives in those countries; the fact that the opportunities to become a scientist are severely limited there; the desire to counter the damage we are doing to our international reputation for beneficent leadership by our actions in Iraq and elsewhere; and the experience of seeing American dollars for science at work in one of the poorest places in the world, Bamako, Mali. There, efforts by USAID and NIAID have created a strong Center for Malaria Research and Training that is a source of local health improvements, recruitments of Malians to medical science, national pride, and internationally respected science. We need more Bamako's.

6. Disseminating Scientific Knowledge

Our government is spending billions of the public's tax dollars to generate knowledge meant to be public goods. Yet the scientific community has not done as much as is now possible to optimize the dissemination, storage, retrieval, and use of that knowledge. The government has an obvious vested interest, on behalf of its citizens, to see this happen. But too it has not yet moved vigorously to encourage the use of its own technology—the Internet—to make the work it pays for immediately and freely available to everyone, everywhere, stored in and retrieved from digital libraries. This dream of freely accessible public knowledge has been around for a long time, long before the digital age. In 1836, the head of the British Library said: "I want a poor student to have the same means of indulging his learned curiosity, of following his rational pursuits, of consulting the same authorities, of fathoming the most intricate inquiry as the richest man in the kingdom." We now have the technical tools to make this vision a reality. [**Ed. note:** *Information about open access publication in biology and medicine can be found at www.plos.org].*

Since the end of World War II, the US government has forged a remarkable partnership with the US scientific community. This is both the best and worst of times for this partnership. We continue to lead the world in scientific discovery, our research universities are still unmatched in other countries, new findings and new technologies are bringing different

See BACK PAGE *on page 7*

APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org.