APS NEWS

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The Envelope Must be REALLY Big

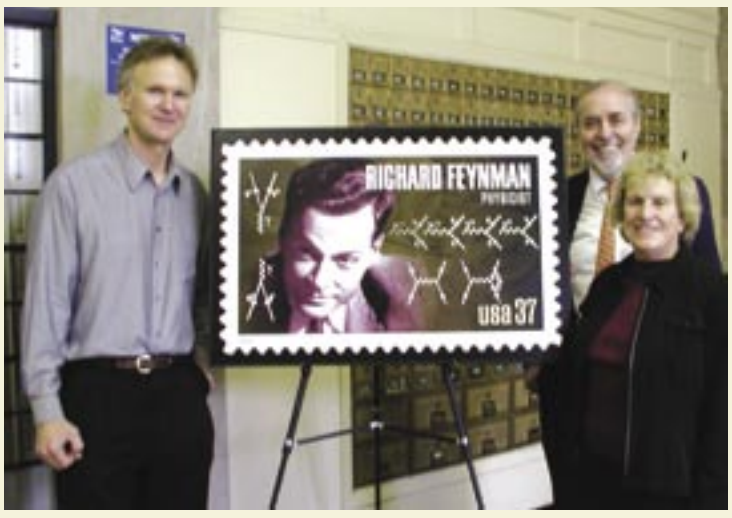

Photo credit: Adrienne Klein

May 11 is the birthday of the late Richard Feynman, physicist extraordinaire, and in his honor on that date the US Post Office issued the stamp pictured here. The scene is the post office in Far Rockaway in the borough of Queens, New York, where Feynman grew up, and surrounding the humungous stamp are (l to r), Ralph Leighton, who co-authored "Surely You're Joking, Mr. Feynman" and various other books with Feynman, Brian Schwartz of the Graduate Center of the City University of New York, who worked with Leighton to get the stamp approved, and Feynman's sister, physicist Joan Feynman.

New APS Open-Access Online Journal Features Physics Education Research

By Ernie Tretkoff

A new online-only APS journal, *Physical Review Special Topics-Physics Education Research*, will provide a place for researchers in the rapidly growing field of physics education research to publish articles on the teaching and learning of physics. The journal began accepting submissions in May.

The APS is journal is co-sponsored by the American Association of Physics Teachers and the APS Forum on Education.

"Physics education research is a bit outside where our other journals have led, but it is an important element in the Physical Society," said Martin Blume, APS Editor-in-Chief.

In 1999 the APS Council passed a statement supporting physics education research as a valuable topic for research in physics departments.

PRST-PER will be edited by Robert Beichner, a physics education researcher at North Carolina State University. Beichner, a recently elected APS fellow who has worked in physics education research for years, emphasized how quickly the field has been growing recently. For instance, said Beichner, over the past six years, an average of ten new faculty hires in physics education research have been made per year. "The physics education research field is growing very rapidly," he said, "Most of this work is done by physicists in physics departments."

But with the rapid expansion of the field, it has often been hard to find places to publish this type of research, said Beichner. "I've been working in the field for a long time, and I know how difficult it is to get things published." Physics education researchers need a recognized journal in which to publish their work.

Until now, the primary place

See Online Journal on page 7

APS Report Tackles Proliferation Resistance and Nuclear Power

By Ernie Tretkoff

For the first time in several decades, the US is seriously considering building new nuclear power plants. This change in attitude towards nuclear power prompted the APS Panel on Public Affairs to organize a study group to examine steps the US can take to enhance the proliferation resistance of nuclear power systems. The Nuclear Energy Study Group recently released their report, entitled "Nuclear Power and Proliferation Resistance: Securing Benefits, Limiting Risks."

Global electricity demand is expected to grow by more than 50% by 2025. Nuclear power could meet a substantial portion of that demand, without carbon dioxide emissions. Environmentalists, who in the past had opposed nuclear power, are starting to change their minds because of concerns about global warming, and the US is considering building new nuclear power plants.

"For the last few years there has been increasing positive international and national attitude about the future of nuclear energy," said Roger Hagengruber, chair of the study group.

The APS has long been in favor of nuclear energy, and in 1993 the Council passed a statement supporting the development of nuclear energy as one alternative to fossil fuels.

However, the use of nuclear energy increases the danger of nuclear weapons proliferation, because nuclear power technology overlaps with nuclear weapons technology.

"Nuclear power cannot be made 'proliferation proof.' However, numerous steps can be taken–and must be taken–to make it as 'proliferation-resistant' as reasonably possible. This is an urgent global security problem," says the report. "No single diplomatic, military, economic, institutional, or technical initiative alone will be able to fully deal with this proliferation challenge."

The study group dealt only with proliferation, not with other concerns about nuclear power, said

See Proliferation on page 4

How Green was New Jersey

PhysicsQuest Winners Collect Grand Prize at Institute in Princeton

By Richard M. Todaro

What do: the World Year of Physics 2005 celebration… a contest grand prize trip to New Jersey…a teacher and nine of her 9th grade students from Iowa…an enormous linden tree in New Jersey…a secret treasure…and an exploding hydrogen-filled balloon…have in common? All of them figured into the APS-sponsored PhysicsQuest contest grand prize trip to the Institute for Advanced Study in Princeton on May 20-22.

Julie Mooney and her class of nine 9th graders from St. Albert Catholic Schools in Council Bluffs, Iowa were the grand

See PhysicsQuest Winners on page 3

Photo credit: James Riordon

The winning Physics class meets at the Institute of Advanced Study with John Bahcall (center), Richard Black Professor of Natural Sciences and the retiring President-elect of APS (see election preview item on this page). In the front row of the picture are (l to r): Emily Oliver, Lacey Stogdill, Danielle Cain, John Bahcall, Amanda Burkey, Morgan Wickersham and Julie Mooney. In the back row are: John Avey, Zachary Butcher, Kelsey Mooney, bubblegum-chewing Michael Hoffmann, and Randy Schmitz.

High School Students Measure New Value for Earth's Radius to Celebrate World Physics Year

Has the radius of Earth mysteriously grown by about 3%? According to data taken by 183 high-school classes participating in a World Year of Physics project, "Measure the Earth with Shadows", the radius of Earth is 6563 km, compared to the accepted value for the mean radius of 6371 km.

Of course, no one is claiming the size of Earth has actually changed. "Most of the data submitted was remarkably good," said Jennifer Fischer, the APS project leader. "It is nice to see that measurements taken by so many groups, sometimes in less than ideal conditions, came so close to the right answer."

The data were submitted by high school classes all around the US, as well as some in Canada and Mexico, working in pairs. Each pair measured the angle of the sun, in the same way that the Greek philosopher Eratosthenes did more than 2000 years ago in Alexandria, Egypt–by comparing the length of an object to the length of its shadow, measured at local noon.

Eratosthenes made his measurement on the summer solstice, and had the additional knowledge that on that day the sun was directly overhead at a location a known distance south of Alexandria, on the Tropic of Cancer. This enabled him

See Earth's Radius on page 3

Andrew Blum gives some pointers to students in his high-school class in Clinton, Mississippi as they work on the Eratosthenes project.

APS ELECTION PREVIEW INSIDE

The APS election for Society-wide positions is underway. Voting opened on June 15 and will close on September 1. Biographies of the candidates appear on pages 6 and 7.

This year the election is somewhat unusual, because members are being asked to vote not only for Vice President but also for President Elect. John Bahcall, the current President Elect, decided that he would not be able to serve as President in 2006 because his health has put restrictions on his ability to travel widely. He very much regrets this. The current APS Vice President, John Hopfield, will serve as President in 2006.

Members with valid email addresses should be looking for a message containing their own personal ID that will enable them to vote on the web. Paper ballots will be mailed to members without such addresses, or upon request.

Highlights

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Making the Case for University Research
By Norman R. Augustine

Members in the Media

"Until we have independent studies that converge on a single answer, the doubters will prevail, and the fine structure constant will continue to be regarded as well, constant."

–Stephen Maran, American Astronomical Society, on the possibility that the fine structure constant has changed over time, San Francisco Chronicle, May 9, 2005

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"We take biodegradable vegetable matter–paper, twigs, sawdust, waste from bakeries, cafeterias and flower shops and supermarkets–grind it up in water with a little acid and heat, and on the other end we get a product we can sell to industry or turn into P-Series fuel."

–Stephen Paul, Princeton University, on his garbage-based fuel, the Palm Beach Post, May 8, 2005

✶✶✶

"It has a very smooth ride. When the electric engine is on, it's completely silent. And the turning radius also is very good."

–Olivier Gayou, Jefferson Lab, on his car, a Toyota Prius, the Virginian-Pilot, May 12, 2005

✶✶✶

"I'm not absolutely sure that hydrogen will ever be exactly the same as gasoline. People might have to relax a little bit and refuel a little more often to save the planet."

–Anne Dillon, National Renewable Energy Laboratory, on hydrogen power, Wired, May 16, 2005

✶✶✶

"The great thing about being in a male-dominated field is that when you go to a conference, there's no waiting line at the ladies' room."

–Frances Hellman, UC Berkeley, on being a woman in physics, San Francisco Chronicle, May 17, 2005

✶✶✶

"The issue isn't: Do you support nuclear? The issue should be: Do you support massive subsidies to the tune of billions of dollars for nuclear power? The answer is no."

–Thomas Cochran, Natural Resources Defense Council, on proposed subsidies for nuclear power, The New York Times, May 15, 2005

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"The signature of Bose-Einstein condensation in those images could not be more clear. It's very unambiguous. As a scientist, you live to see those kinds of things."

–Randall Hulet, Rice University, Rocky Mountain News, May 28, 2005

See Members in the Media on page 4

INSIDE THE BELTWAY:

Washington Analysis and Opinion

Michael S. Lubell

The Sky, The Sky Is Falling. I Must Go Tell the King.

by Michael S. Lubell, APS Director of Public Affairs

Honesty does pay off, even in Washington–sometimes. Case in point: the President's Fiscal Year 2006 budget request for science at the Department of Energy, which Ray Orbach, the Director of the DOE Office of Science, was frank enough to admit last February would wreak havoc with university research programs and facilities operations.

Three months later, the House of Representatives responded by substituting a 1.5 percent increase for the 4.5 percent cut the White House had proposed. And Orbach still has his job.

Three years ago, Mike Parker, who was then Assistant Secretary of the Army for Civil Works, tried the same gambit with the presidential budget request for the Army Corps of Engineers. Under questioning by the Senate Budget committee, Parker, a former Republican congressman from Mississippi, admitted to his ex-colleagues on the Hill that the White House budget plan for Fiscal Year 2003 would force the Corps to cancel $190 million in already contracted projects.

Parker not only didn't get all the money he was seeking, he lost his job. Of course, he had to contend with an unsympathetic boss, Secretary of Defense Donald Rumsfeld, no pussycat he, who felt he had been badly undercut.

Ray Orbach was more fortunate–some might argue, more savvy. His boss, Sam Bodman, had inherited the DOE science budget when he took the job of Secretary of Energy in February. As a former MIT professor of chemical engineering and a venture capitalist, he wasn't

See Inside the Beltway on page 7

This Month in Physics History

Einstein's Biggest Blunder

Once upon a time, physicists believed the cosmos was static and unchanging, a celestial clockwork mechanism that would run forever. But a puzzling paradox cropped up when Isaac Newton formulated his law of universal gravitation in the 1600s. According to Newton, each star in the universe ought to be attracted towards every other star. They should not remain motionless, at a constant distance from each other, but should all fall together to some central point. Newton admitted as much in a letter to Richard Bentley, a leading Cambridge philosopher of the time. Yet it never occurred to any scientist from the late 1600s through the early 20th century that the universe might be evolving with time.

Shortly after formulating his theory of general relativity, Einstein collaborated in 1917 with the Dutch astronomer Willem de Sitter to demonstrate that his equations could be used to describe a highly simplified universe. This model was adapted by other scientists to describe the actual universe, but they quickly ran headlong into a version of Bentley's paradox. The calculations indicated that the universe was changing with time.

Prevailing scientific opinion held that the universe was static, so Einstein introduced a mathematical "fudge factor" into his equations, known as the cosmological constant, or *lambda*. It implied the existence of a repulsive force pervading space that counteracts the gravitational attraction holding matter together. This balanced out the "push" and "pull" so that the universe would indeed be static.

Perhaps Einstein should have trusted his instincts. Twelve years later, Edwin Hubble was studying distant galaxies and noticed an intriguing effect in the light they emitted: it had a pronounced "shift" toward the red end of the electromagnetic spectrum. Hubble reasoned that this could only be happening if the light were traveling across space that is expanding. Einstein's original equations had been correct, and there was no need for a cosmological constant. The cosmos was indeed still expanding. Einstein denounced *lambda* as his "greatest blunder."

Einstein and de Sitter.

Hubble's discovery changed the Big Picture of how the universe will end. The attractive force of gravity would slow down the rate of expansion. Scientists spent the next 70 years trying to measure that rate. If they knew how the rate of expansion was changing over time, they could deduce the shape of the universe. And its shape was believed to determine its fate.

The more matter there is, the stronger the pull of gravity, and the more space will curve – making it more likely that the current expansion will halt and the universe will be "closed," i.e. will collapse back in on itself in a "Big Crunch." If there's not enough matter, the pull of gravity will gradually weaken as galaxies move farther apart, and the universe will be "open," i.e. will expand forever with essentially no end. Scientists believed the universe was flat, i.e. on the border between open and closed, so the expansion would slow down indefinitely, but without recollapsing.

Just as physicists were getting comfortable with this idea, the story took an unexpected turn. In 1998, two separate teams of physicists measured the change in the universe's expansion rate, using distant supernovae as mileposts. When Hubble made his 1929 measurements, the farthest red-shifted galaxies were roughly 6 million light years away. If expansion was now slowing under the influence of gravity, supernovae in the most distant galaxies should appear brighter and closer than their red shifts would suggest. Instead, at high red shifts, the most distant supernovae are dimmer. The expansion of the universe is speeding up.

It's a testament to Einstein's genius that even his blunders prove to be significant. *Lambda* implied the existence of a repulsive form of gravity, and such a thing appears to be the driving force behind cosmic acceleration: it's called dark energy. If dark matter gives rise to the gravity that holds the universe together, then dark energy is the counter-force pushing the universe apart. As the universe continued to expand, the dark matter density, and hence the gravitational pull, decreased until it was less than that of the dark energy. So instead of the expected slow-down in the expansion rate, the now-dominant dark energy began pushing the universe apart at ever-faster rates.

The simplest example of repulsive gravity can be found in the quantum vacuum, which is teeming with virtual particles that wink in and out of existence. But the numbers don't add up. The quantum vacuum contains far too much energy density: roughly 10^{120} times too much. So the universe should be accelerating much faster than it is. An alternative theory proposes that the universe may be filled with an even more exotic, evolving form of dark energy dubbed "quintessence."

The dark energy could be the result of the influence of unseen extra dimensions predicted by string theory. Alternatively, in 2004, scientists at the University of Washington proposed that the dark energy could be due to neutrinos interacting with hypothetical particles called "accelerons." Or perhaps there is no such thing as dark energy, and general relativity is not an accurate description of gravity after all.

Thanks to cosmic acceleration, the shape of the universe will no longer determine its ultimate fate. Instead, its fate rests on whether the dark energy is constant or changing. All the observations to date indicate that the dark energy is constant. If so, the acceleration will continue indefinitely, and matter will grow farther and farther apart. Within a hundred billion years, we will only be able to see a few hundred galaxies, compared to the hundreds of billions we can see today.

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On the Firing Line

Photo credit: U.S. Department of Energy, Oak Ridge National Laboratory

Einstein-in-the-City, a World Year of Physics outreach event, was held on May 18 at World's Fair Park in Knoxville in conjunction with the biennial DPB/Particle Accelerator Conference. The panelists, who fielded questions from the audience, are (seated, l to r) Maury Tigner (Cornell University), Norbert Holtkamp (Spallation Neutron Source), Michael Turner (University of Chicago/NSF), and Carlo Rubbia (University of Pavia). The moderator (standing) is Bill Madia, former director of Oak Ridge National Laboratory. Questions included: "What would Einstein ask tonight?", "What does physics have to say about evolution?", "Was Einstein ever wrong?", and "What is Bell's theorem and why should I care about it?".

Job Satisfaction High Among Recent Physics PhD's

By Ernie Tretkoff

A recent American Institute of Physics study on the initial employment of physics degree recipients in 2001 and 2002 found that most were satisfied with their physics degree and their initial employment situation. The study surveyed bachelor's, master's, and doctoral degree recipients six months after receiving their degrees in 2001 and 2002.

Those two years represented "the seventh and eighth straight year of declining physics doctorate production" in this country, the report says. In 2001, 1157 physics PhDs were produced, and in 2002, 1095 students earned a physics PhD. More recent data indicates that the number of first year graduate students has been going up in the past few years, so it is expected that the number of new PhDs will soon begin to turn around. In 2001 and 2002 about 50% of PhD degrees went to foreign students, and of those, only about 15% left the US after receiving their degrees.

In 2002 the proportion of new physics PhDs taking postdoctoral positions rose for the second consecutive year. Over half (53%) of the new physics PhDs who responded to the survey took postdocs. Another 6% accepted some other temporary position, and 39% were in a potentially permanent position six months after receiving their degree. Only 2% of these recent PhD recipients reported being unemployed.

Slightly less than 20% of the new PhDs with potentially permanent positions indicated that their employment was not directly related to physics. 40% said their employment was "somewhat" related to physics, and 41% said they were employed primarily in physics. Among the non-physics jobs, work in areas such as engineering, computer software, business or finance were the most common. Of those employed outside of physics, the most common reason cited was a change of interests, followed by pay and promotional opportunities; less than 10% indicated they couldn't find employment in physics.

Most respondents, even those employed outside of physics, felt that their physics PhD was an appropriate background for their position. "While obtaining a PhD they gain analytical and problem-solving abilities, advanced math, software and laboratory skills, as well as a basic understanding of the fundamental principles of science. Thus PhD physicists are excellent candidates for a broad range of positions," says the report.

Overall, physics PhDs who responded were satisfied with their employment and training. 88% of respondents said they would still get a PhD in physics if they were given the opportunity to do it again. "This high satisfaction with their degree choice was true for respondents in temporary as well as permanent positions, and equally for women as well as men," the report states.

The AIP study also reported on bachelor's and masters degree recipients from 2001 and 2002. Unlike PhDs, physics bachelor's degree production increased significantly in these years and in fact continued to rise thereafter. In 2001, 4091 students earned bachelor's degrees and in 2002, 4305 students earned bachelor's degrees. About half of physics bachelors went directly to graduate school (30% in physics or astronomy, 20% in other fields), as had been the case for many years.

According to the report, the private sector "continues to be the dominant employer," but its share is shrinking, as fewer graduates took computer-related jobs in 2001 and 2002 than during the high-tech boom of the late 1990s, and more graduates accepted positions in government and high school teaching. "On the whole, people are moving away from the private sector," said Casey Langer, one of the report's authors.

Most bachelor's degree recipients were pleased with their decision to study physics. 85% of those surveyed said they would major in physics if they had to do it again, even though fewer people (59%) indicated satisfaction with the job market and their career options. This high satisfaction with their degree in physics is similar to what has been found in past years, said Langer. "I think it's the nature of physics that people who go into it are likely to be happy," said Langer.

The report can be found at http://www.aip.org/statistics.

PhysicsQuest Winners *from page 1*

prize winners of the PhysicsQuest, a World Year of Physics 2005 educational project aimed at 5th to 9th graders across the United States. They were randomly chosen from among the 87 classes who submitted correct results in time for the April 22 contest deadline.

Mooney, two other chaperones, and her group of nine students flew to New Jersey to collect the PhysicsQuest "secret treasure" in person at the appointed time and location somewhere on the grounds of the Institute for Advanced Study in Princeton, N.J.

Arranged as a treasure hunt, PhysicsQuest was a set of four experiments designed to promote awareness of basic physical principles in the areas of harmonic motion, the diffraction of laser light, magnetism, and soap bubble configurations on a wire frame.

It was made possible by financial support from the National Science Foundation, the Department of Energy's Office of Science, and Cadmus Communications.

Though the Institute grounds sprawl over 800 acres of forest and fields, the treasure spot was beneath an enormous linden tree near the back of Fuld Hall, the Institute's central building.

Revealed at the 2 o'clock hour on May 21, the treasure consisted of a 5-inch reflecting Meade telescope with automatic drive for the class, and iPod Shuffles for each student.

This was the first time ever in New Jersey for Mooney, her husband Greg, fellow teacher Randy Schmitz, and her students, including her daughter Kelsey, who has her mom as a teacher in two classes.

"There are so many trees and lots to see," said 15-year old Michael Hoffmann. He contrasted the leafy suburban landscape of central New Jersey to the open rural spaces around Walnut, Iowa, where he lives and where his grandfather owns and operates a family farm 10 miles outside of town.

Like his classmates, Hoffmann volunteered to do the PhysicsQuest experiments before and after classes. He was seeking extra credit, and personal circumstances allowed him to come in early and stay late on the two consecutive days it took to do the experiments.

The group was treated to a physics show by David Maiullo from the physics and astronomy department of nearby Rutgers University.

Maiullo's traveling physics road show "Dave's Dazzling Demo" is an hour-long, occasionally dramatic presentation of a variety of physical phenomena. The show featured demonstrations of buoyancy (with a bowling ball floating in water), sound waves (using a series of gas-fed flames in a perforated pipe), air pressure (pumping air from an oil barrel until it implosively decompressed), and conservation of momentum (using a cart, a fire extinguisher, and Maiullo himself).

After exploding a hydrogen-filled balloon with a flame, Mauillo pointed out how close Princeton is to Lakehurst, N.J., site of the Hindenburg disaster in 1937.

Following the visit to the Institute, the group spent the afternoon at the Six Flags Great Adventure amusement park.

EARTH'S RADIUS *from page 1*

to compute the Earth's radius. In the current experiment, each pair of high schools used the known north-south distance between them and the angle of the sun at each location to determine the radius.

For various reasons, about one-sixth of the schools were unable to work with their assigned partner school, but they did the measurement anyway, on the vernal equinox, using the knowledge that the sun is directly overhead at the equator on that date.

"The Eratosthenes Project really gets kids to think in a special way," Fischer said. "Most kids learn in school that the Earth is round, but they never really picture it in their heads as if they were in outer space. This project forces you to imagine the solar system as if looking down on it from the outside. Learning to think imaginatively and creatively like this is an important part of physics."

Rebecca Messer, a physics teacher in Northfield, Minnesota, wrote in an email "My students were thrilled to be part of this experiment and were very diligent in their measurements. We ran 5 stations; they each used a level to plant their dowel and to level the horizontal when they measured the shadow lengths."

The class of physics teacher Brent McDonough in Edmonton, Alberta, had two US partners, one in Henderson, Nevada and the other in Calexico, California. "We had a great time working with all three schools and have even exchanged email photos of each class and posted them on our school website with a report of the project," McDonough said.

The project's influence has spread to the southern hemisphere. An Argentine physicist, Silvia Ponce Dawson, writes "I've found the Eratosthenes project that you've launched on the occasion of the World Year of Physics really fascinating and I would like to have it done in my country too." As a first step, she has translated the APS teacher's guide for the project into Spanish.

Participating students each received a World Year of Physics pin, and their classes received a commemorative certificate. More details of the project, including the teacher's guide and a map showing the distribution of participating US schools, can be found on the World Year of Physics website at http://www.physics2005.org/events/eratosthenes/index.html.

2005 US Physics Olympiad Team Honored

Twenty-four of the most talented physics students from high schools around the country came to the nation's capitol in May. These students had competed against hundreds of their peers to earn a place on the 2005 US Physics Team.

While participating in a week-long training camp at the University of Maryland, the Team members were honored with a "Tribute to the US Physics Team 2005" ceremony on Capitol Hill. The May 18 ceremony was sponsored by the American Institute of Physics (AIP) and the American Association of Physics Teachers (AAPT). It was co-hosted by Reps. Vern Ehlers (R-MI) and Rush Holt (D-NJ), the two physicists in Congress. In conjunction with the ceremony, Ehlers also placed a statement in the Congressional Record congratulating the Team.

This year's international competition will be held in Salamanca, Spain, from July 3 to 12. At the end of the training camp, the top five highest scoring students were chosen to represent the US at the 2005 International Physics Olympiad. The members of the traveling Team are: Timothy Credo, Illinois Math and Science Academy, Aurora, IL; Nickolas Fortino, Phillips Academy, Andover, MA, Menyoung Lee, Thomas Jefferson HS for Science and Technology, Alexandria, VA; Eric Mecklenburg, Hawken School, Gates Mills, OH; Daniel Whalen, Phillips Academy, Andover, MA; *Alternate*: William Throwe, Shoreham-Wading River HS, Shoreham, NY.

Since 1986, AAPT and AIP, with support from APS and other societies, have recruited, selected, and trained teams to compete in the International Physics Olympiad. The US Team has enjoyed great success over the years, bringing home two gold, two silver, and one bronze medals from the 2004 Olympiad in Pohang, Korea.

CORRECTION

The Back Page article of the May *APS News*, entitled "Einstein, Ethics and the Atomic Bomb" contained an error which was introduced in the editing process, and was not the fault of the author, Patricia Rife.

A sentence which should have read "Elections in Germany brought Adolf Hitler into the position of Chancellor, approved by President Hindenburg, to lead the Third Reich," appeared in print as "Adolf Hitler was elected Chancellor and approved by President Kaiser Wilhelm to lead the Third Reich."

APS News regrets the error, and apologizes both to our readers and to Dr. Rife. The complete version of Dr. Rife's article, which was too long for the printed version, appears on the web at http://www.aps.org/apsnews/0505/050523.cfm.

zero gravity
The Lighter Side of Science

The Second Law of Thermodynamics

Ed. Note: In its May issue, the magazine ***Physics Today*** *broke new ground by deliberately printing a work of fiction, a short story entitled "The Second Law of Thermodynamics" by the well-known writer and physicist Alan Lightman. Not to be outdone, or at least not to be caught bringing up the rear by more than a couple of months,* ***APS News*** *is proud to present its own work of total fiction, a short dramatic piece which, curiously enough, is also entitled "The Second Law of Thermodynamics." It is based on the following, real, quotations:*

"The second law has the same degree of truth as the statement that, if you throw a tumblerful of water into the sea, you cannot get the same tumblerful of water out again."

–James Clerk Maxwell, letter to J. W. Strutt

"James, you're beginning to enjoy yourself. It is time we go home."

–Katherine Maxwell (attributed)

The scene is a seaside resort in the west of Scotland. Walking by the shore are the physicist James Clerk Maxwell and his wife Katherine. The time is the early 1870's, and it is a glorious Scottish summer day.

Katherine: Och, James, 'tis a bonnie day, is it not? I think that bright spot in the clouds is where the sun must be, and this morning's fierce rain has given way to a nice torrential downpour.

James: Yes, it's too bad the wind is so strong, or I'd put up the umbrella. Well, a wee dram makes the weather fine, I always say. *(Reaches into his pocket for a flask).*

Katherine: James, James, put that away. It ill becomes a Christian gentleman to drink so early in the day.

James: But it's good to the last drop, as we Maxwells have it. Besides, I've just been reading another paper by that Austrian fellow, Ludwig Boltzmann. I tell you, Katherine, it's enough to drive anyone to drink. He writes these fearful long papers and at the end of it you can't be sure what he's saying. Is the law of entropy derivable from mechanics or is it not? Is it a statistical statement, or is it not? He claims to prove a theorem, but I call it the H-theorem, for "hot air".

Katherine: Well, I'll tell you what I think. Give me that whisky. I'm going to pour it into the ocean, and then see if you can drink any of it. (Pours the whisky into the sea).

James: *(lunges forward)* Katherine! My angel! What are you doing?

Katherine: *(sarcastically)* Here's a tumbler, James. See if you can dip it in the ocean and get that evil drink back again. So much for your demon whisky!

James: I believe the term is "demon rum," Katherine. But wait a minute, my brilliant impetuous bride! If I understand right, your wee experiment here is a perfect illustration of the second law of thermodynamics.

Katherine: I'll bet you say that to all the lassies.

James: No, no. I did say something once about the *first* law of thermodynamics in the heat of the moment, but it didn't work out. The second law is neither more nor less true than the statement that if I pour a tumblerful of liquid into the sea I can't get the same tumblerful out again. Unless, of course, I have a demon with a quick hand and a sharp eye, who can let the water go by and only catch the molecules of whisky.

Katherine: Well I hope you have such a demon, James, because that's the only way you're going to get yourself any more whisky.

James: Yes, my sweet. *(Gives a sudden start.)* Ooh! The wind is getting stronger now, and it's blowing up inside my kilt.

Katherine: James, you're beginning to enjoy yourself. It is time we go home.

They exit, arm in arm, stage left.

MEMBERS IN THE MEDIA *from page 2*

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"It was an expedient attempt to solve a problem. What they got is ineffective, wasteful and expensive to maintain."

–Philip J. Wyatt, on the monitoring equipment for biological weapons that was installed in some cities in a hurry after the start of the Iraq war, The New York Times, May 8, 2005

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Massive particles such as protons are built of quarks and gluons, which have zero mass (unless they are moving). Mass is far from conserved."

–Frank Wilczek, MIT, giving examples of things taught in basic physics classes that aren't exactly correct, such as conservation of mass, The Wall Street Journal, June 3, 2005

Viewpoint...

Encouraging Women in Physics is Based on Rudimentary Sense of Fairness

By Gary White

Ed. Note: The following Viewpoint is a rebuttal of a letter in the April ***APS News****. For those who missed the letter when it first appeared, it is available on the web at http://www.aps.org/apsnews/0405/040508.cfm.*

I read Andrew Warden's letter and laughed out loud, but then felt a little guilty about it. I like off-color humor as much as the next guy, and appropriately, it was April Fool's Day, but still, it seemed ungallant not to refute his ridicule of the Committee on the Status of Women in Physics (CSWP).

Warden's letter seemed carefully crafted not only to entertain, but also to disguise the hopelessly weak logic underpinning the stated case, so I felt compelled to write.

With tongue-sort-of-in-cheek, Warden advocated establishing a committee parallel to CSWP, a 'CSRP,' devoted to luring Republicans into physics, seeing as how they are so woefully underrepresented in the physics community. Lurking among some amusing physics/political humor about conservative forces and parity violation, and some entertaining stereotypes of Democrats and Republicans, is the subversive crux of his message. In explaining why APS should initiate a Republican recruitment committee, he trots out his main argument–physics best not deprive itself of half the pool of potential colleagues just because of their political leanings if it wants to survive–the expand-the-pool-or-die argument. The fallacious next step that the silver-tongued Warden would lure you to make is clear–if you don't buy this argument for Republicans, then you shouldn't buy it for woman and minorities.

Just because the expand-the-pool-or-die argument is occasionally used to make the case for the existence of CSWP, it does not mean that, in physics, the distinction between Republicans and Democrats is parallel to the distinction between female and male. The expand-the-pool-or-die argument has its place, especially when talking to those who are not swayed by issues of fairness. It is certainly not the only argument for CSWP, though, nor is it the most compelling in my mind.

I would say that the chief argument for the existence of CSWP and for the analogous Committee on Minorities, COM, is based on a rudimentary sense of fairness, and it goes like this:

There have been hundreds of years of worldwide discrimination–legalized, establishment-approved, and even physicist-sanctioned discrimination–against females and ethnic/racial minorities entering most any scholarly endeavor…arguably more than a thousand years of affirmative action for white males, to loosely quote Debra Rolison's remarks from her recent invited talk at the April APS meeting. This situation has begun to change only recently, say in the past few decades, and only in some parts of the world. And unlike being Republican or Democrat, one does not generally get to choose one's gender or race or ethnicity, nor can one hide any of these traits very easily.

"But wait," some argue, "by establishing CSWP, one is committing the same kind of violation, discriminating against men instead of women. Isn't this an example of the pendulum swinging too far in the opposite direction?"

No.

The pendulum has perhaps slowed down, but it has not even changed direction, much less come anywhere close to returning to equilibrium. In today's society, conclusive evidence of continued bias against women and racial/ethnic minorities is easy to obtain. As an illustration, unintentional and unrecognized bias is prevalent, even among groups of women and racial/ethnic minorities themselves and even among groups that consider themselves immune to bias (see the work by Greenwald, et al, on the Implicit Association Test, for example). As another example, see the 1999 commentary by Nancy Hopkins on the admission by MIT administration of gender bias in the MIT School of Science–http://chronicle.com/colloquy/99/genderbias/background.htm, as well as the subsequent posts.

In conclusion, gender/racial inequities in physics are not remotely analogous to those that might be related to political beliefs; in fact, in this context, the Republican/Democrat divide, should it actually exist, is more like the great boxers/briefs schism of 1994.

Gary White is Director, Society of Physics Students, Sigma Pi Sigma Director, and Assistant Director of Education at the American Institute of Physics

Andrew Warden replies: Gary White states that "…unlike being Republican or Democrat, one does not generally get to choose one's gender…", and therefore it is wrong to discriminate against women. This implies, however, that it is all right to discriminate against Republicans, because they could have chosen to be Democrats. I'm afraid that, in the case of politics if not of gender, Dr. White has allowed his biases to overwhelm his rudimentary sense of fairness.

PROLIFERATION RESISTANCE *from page 1*

Hagengruber, "We felt the greatest risk was not cost or safety, but proliferation."

Nuclear reactors now provide about 20% of electric power in the US. Worldwide, 30 new nuclear plants were under construction in March 2005, with 20 of them in Asia. Many countries have expressed interest in nuclear power. "As evidenced by the current situation in Iran, technological advances and institutional changes are required to avoid proliferation by countries taking advantage of a global spread of nuclear power," says the report. It is important to make sure safeguards are in place, whether the US pursues nuclear power or not.

The report therefore recommends, as a high priority in the near term, significantly strengthening the federal Technical Safeguards R&D program. Technical safeguards technology is intended to deter or detect theft or diversion. Environmental sample analysis and surveillance analysis have proved effective, but "for technical safeguards to remain functional at containing theft, diversion, and breakout, they must advance at least as quickly as a proliferator's techniques and potential opportunities," the report says.

The report recommends increasing resources for safeguards technology development, identifying near-term technology goals, formulating a technology roadmap, and improving interagency coordination. "Revitalizing Safeguards R&D is the most significant technical investment that can enhance the proliferation resistance of nuclear power within the next five years," the report says. The report lists some specific objectives for development of safeguards technology.

In the longer term, as the next generation of nuclear reactors is developed, it is essential to incorporate proliferation-resistance into the design, the report says. "Processes, designs, and initiatives that might be attractive on the basis of cost, performance, and other considerations should not be pursued if they are not proliferation-resistant," states the report. New reactors should be built to continuously monitor for any misuse. It is also essential to develop and strengthen international collaborations on key proliferation-resistant technologies, the report states.

The report also advises against reprocessing spent fuel at the present time, saying there is no urgent need to do so. The US does not currently reprocess spent nuclear fuel. Reprocessing could reduce waste, and would make it possible to produce more energy from the original uranium, but reprocessing spent fuel has inherent proliferation risks because it leads to separated plutonium, which can be used directly for nuclear weapons. On the other hand, if not reprocessed, stored fuel emits intense radiation, which deters theft, says the report. In order to make possible further study, the report recommends delaying any decision on whether to reprocess fuel.

All of the report's recommendations are intended to be practical suggestions that can realistically be implemented, said Hagengruber. "Our goal was to arrive at a consensus that also had reasonable and executable actions. Otherwise you get great recommendations, but nothing will happen. We were very careful to select executable options," he said. So far, he said, the report has met positive response from policy makers.

The full report can be found at http://www.aps.org/public_affairs/proliferation-resistance.

Atom Chips, Attosecond Lasers Featured at 2005 DAMOP Meeting

New progress in "atom chips," studies of X-ray emissions in our solar system, and a town meeting to discuss the future of the field were among the highlights of the 36th annual meeting of the APS Division of Atomic, Molecular and Optical Physics (AMO), held May 17-21 in Lincoln, Nebraska.

Among the special events was an Einstein Centennial Symposium to celebrate the World Year of Physics, and a performance by "storysmith" Susan Marie Frontczak dramatizing the life of Marie Curie. Presidential Science Advisor Jack Marburger delivered the Friday evening banquet keynote address, and several of the University of Nebraska-Lincoln's laboratories devoted to AMO physics were open for tours on Thursday evening.

Interferometer on a Chip. Scientists at the University of Colorado and JILA have succeeded in building an atom Michelson interferometer on a single "atom chip," according to Dana Z.Anderson. The chip uses lithographically patterned conductors and external magnetic fields to produce and guide a Bose-Einstein condensate.

High-Order Harmonics. According to Margaret Murnane of the University of Colorado/JILA, high-order harmonic generation (HHG) provides a useful source of coherent, ultrafast light in the extreme UV region of the spectrum. In HHG an intense laser pulse is focused into a medium, and the nonlinear interaction between the laser light and the atoms creates higher-order harmonics, resulting in a coherent, low-divergence beam.

Murnane and her colleagues have shown that by combining phase matching, quasi-phase matching, and pulse compression in a single gas-filled waveguide, they can shift the phase-matching region in large atoms to significantly higher energies. The technique has useful applications in ultrafast atomic and molecular dynamics, coherent control of electron dynamics, lithography, high-resolution imaging, site-specific spectroscopy, and bio-microscopy.

Gravity Probe B. Last April, the Gravity Probe B satellite was launched, designed to perform a high-precision test of the general theory of relativity. The instrument is currently making measurements of the precession rates of the four mechanical gyroscopes relative to the guide star, IM Pegasi. Its motion in turn is being measured relative to extragalactic reference sources. According to Stanford University's G.M. Keiser, combining these two references will enable physicists to determine the precession rate of the gyroscopes relative to the extragalactic reference sources, which can in turn be compared with the geodetic and frame-dragging precession rates predicted by the general theory of relativity.

The X-Ray Factor. Many objects in our solar system emit X-rays, most notably the Sun, Venus, Earth, Mars, Jupiter, and comets. Thomas Cravens focused on X-ray emissions from the aurora of Jupiter, particularly the first observations of the planet by the Chandra X- Ray Observatory, which revealed a powerful X-ray aurora in the polar caps. He believes it is explained by energetic heavy ion precipitation, either on open field lines connecting to the solar wind, or on closed field lines reaching to the planet's outer magnetosphere.

NASA/GSFC's Timothy Kallman has analyzed recent observations of X-ray spectra in nebulae surrounding hot stars and in active galaxies. It has long been known that photoionization and photoabsorption play a dominant role in determining the state of a gas in such systems, but Kallman concluded that these processes are also dominant in highly ionized gas near compact objects.

Town Meeting. Ten years after the last comprehensive assessment of the AMO field, there have been numerous significant advances that are giving rise to profound changes in AMO physics and its applications. A panel has been formed to conduct a new study, co-chaired by Philip Bucksbaum and Robert A. Eisenstein. Both men were on hand at the DAMOP meeting for Friday evening's Town Meeting open-microphone panel discussion.

Northwest Section Holds Spring Meeting

The APS Northwest Section held its spring meeting on May 13-14 at the University of Victoria.

Among the technical highlights was a talk by Montana State University's Neil Cornish on recent results from the Wilkinson Microwave Anisotropy Probe (WMAP).

Al Meldrum of the University of Alberta discussed the potential of silicon nanoclusters. These nanocomposites emit a broad luminescence spectrum in the red to near infrared. Meldrum's group has been able to "tune" the emission spectrum to specific colors in the visible and near infrared.

Dean Karlen (University of Victoria and TRIUMF) discussed plans for the International Linear Collider, which the worldwide particle physics community has agreed should be a linear electron-positron collider operating at the center-of-mass energy of 500 GeV.

Another talk focused on the design and scientific potential of the Gamma-ray Large Area Space Telescope (GLAST), to be launched into low earth orbit in 2007. It will scan the sky for gamma-ray bursts and analyze their spectra.

Among the education-related topics was Oregon State University's John Gardner's presentation on his experiences teaching physics to blind and dyslexic students. Gardner demonstrated several new computer technologies that permit students with print disabilities direct access to electronic materials.

Finally, to mark the World Year of Physics, Andrea Damascelli of the University of British Columbia discussed the legacy of Einstein's Nobel-Prize-winning work on the photoelectric effect, which marked the beginning of photoelectric spectroscopy.

A special Friday evening reception and banquet featured a presentation by Inge and Werner Israel on the unwritten letters between Einstein and his first wife, Mileva.

APS Joins Other Organizations in Calling for Visa Reforms

A group of 40 academic, scientific and engineering organizations have joined together in a newly-released statement that, while recommending improvements to the visa application process for foreign students and scientists, also acknowledges the reforms that have already taken place. The APS and four other member societies of the American Institute of Physics–the American Association of Physics Teachers, the American Astronomical Society, and American Geophysical Union, and the Optical Society of America–all signed the May 18 statement.

"Despite significant recent improvements to the US visa system," the statement says, "considerable barriers remain that continue to fuel the misperception that our country does not welcome these international visitors, who contribute immensely to our nation's economy, national security, and higher education and scientific enterprises." The statement, which is directed at the White House and the State Department, expresses "gratitude and support for the changes that have been made" and recommends "additional improvements, so that America can continue to compete for and welcome the world's best minds and talents."

The federal government tightened restrictions on foreign students and scientists applying for visas in the wake of the September 11, 2001 terrorist attacks. These tighter restrictions, coupled with insufficient staff and technology to handle the increased workload, led to severe delays and backlogs in visa applications, and, according to many reports, have fostered a perception that the US does not welcome international students and scholars.

The new statement recommends extending the validity of the type of security check entitled Visas Mantis; allowing students and scientists to at least begin a visa revalidation process before leaving the country; renegotiating visa reciprocity agreements; developing a national strategy to promote scientific exchange and study in the US; and emphasizing student applicants' "academic intent and financial means to complete a course of study" rather than "their ability to demonstrate evidence of a residence and employment in their home country." Additionally, it opposes the requirement of export licenses for foreign students and scientists using equipment that is needed "to conduct unclassified, fundamental research."

The full text of the statement is available at http://www.aau.edu/homeland/05VisaStatement.pdf

–Courtesy of FYI, the American Institute of Physics Bulletin of Science Policy News (http://aip.org/fyi).

Ask the Ethicist

Publication Déjà vu

Dear Jordan,

As an APS member, I would like to have your opinion and guidance concerning an apparent misconduct in publication practice by one of our physics faculty.

APS established publication standard requires that "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."

This faculty member has patently published research papers in different journals on practically the same experimental data. In some cases, one paper has several coauthors. Thus, by rearranging the title somewhat, there would be another paper by a lesser number of coauthors or just himself as a single author. Worse yet, there was never any cross-referencing among them although some data were published three times.

Resume padding by this seasoned physicist has actually resulted in his reaching higher administrative positions and getting undeserved rewards.

Sincerely,
Name withheld

Jordan Moiers replies:

Dear Name withheld,

You are absolutely right that it is unethical to intentionally leave out relevant citations. It seems pretty clear that the omissions are intentional. It is also unethical to incompletely list coauthors, or to add unqualified authors.

However, your colleague's citation and authorship shenanigans are overshadowed by a greater transgression. At best, correcting citation lists and authorship would lead to a published erratum for each paper in question.

The larger issue is publication of duplicate research data. Scholarly journals are venues for new and original work. In many cases, it's appropriate to publish a short synopsis of research and results in a journal such as Physical Review Letters or in the rapids section of some other journal, and follow it up with the subsequent publication of a complete description of the work. The second paper would, of course, include the same data published in the first paper. (It would also include a citation for the initial letter or rapid paper.) In fact, PRL authors are strongly encouraged to follow up their letters with another paper in one of the full-length Physical Review journals.

As you point out, if your colleague is not citing his own papers then it appears that he is not following this accepted practice, but is instead hiding the connection between essentially identical papers in order to pad his resume.

If journal editors learn that a submitted paper has been published somewhere previously it will be rejected out of hand. If they discover the duplication after the paper has already made it into print, it could warrant a retraction.

You should contact the editors at the journals that have published the duplicate papers and make them aware of the situation. If I were you, I would do it anonymously to avoid repercussions within your department. There's no reason for you to get involved beyond that –the papers should speak for themselves.

I'm not sure it's worth worrying about the authorship issue. If there is something amiss, the other authors should be the ones to bring it up. No doubt, they will be hearing from journal editors soon enough anyway. I'd be willing to bet the omitted authors will be happy they were left off, if the papers are retracted due to duplication of earlier works. The citation problem will take care of itself once the duplicates are retracted.

2005 APS General Election Preview

It's that time of year again, when APS members have the opportunity to elect next year's leadership from a slate of candidates selected by the APS Nominating Committee. Brief biographical descriptions for each candidate can be found below. Those elected will begin their terms on 1 January 2006. This year, in addition to electing the usual positions–Vice President, Chair-Elect of the Nominating Committee, two General Councillors and an International Councillor–members will elect a President-Elect, since the current APS President-Elect, John Bahcall, will be unable to fulfill his tenure due to health reasons. The current APS Vice President, John Hopfield, will serve as President in 2006. All votes must be entered by Noon, Central Daylight Time, September 1, 2005. Full biographical information and candidates' statements can be found at www.aps.org/exec/election2005.

FOR PRESIDENT-ELECT

RICHARD HAZELTINE
University of Texas, Austin

Hazeltine is a physics professor at the University of Texas at Austin. A graduate of Harvard College (A.B., 1964) and the University of Michigan (Ph.D., 1968), he spent two years at the Institute for Advanced Study in Princeton before joining the University of Texas in 1971. In 1980 he helped establish the Institute for Fusion Studies at Texas, and served for ten years, beginning in 1991, as Institute Director. As a theoretical plasma physicist, Hazeltine has worked in transport theory, plasma stability theory and nonlinear fluid modeling. His scientific interests extend from basic plasma physics and plasma confinement to such topics as nonlinear dynamics, astrophysics and the theory of fluctuations. He is co-author of the books Plasma Confinement (1992) and The Framework of Plasma Physics (1999). His teaching has won an Excellence Award from the University of Texas. He has been chair of the APS Division of Plasma Physics, as well as an APS Divisional Councilor. Previously on the editorial boards of *Physical Review* and *The Physics of Fluids*, Hazeltine served some 8 years as an associate editor of *Reviews of Modern Physics*.

LEO P. KADANOFF
University of Chicago

Kadanoff received his AB, MA, and PhD from Harvard in Physics, and followed up with a postdoc in Copenhagen. He taught at the University of Illinois (1962-1969), Brown University (1969-1978), and then moved to the University of Chicago where he is presently John D. and Catherine T. MacArthur Professor of Physics and Mathematics, Emeritus. He has served as vice-president of the Urbana Chapter of the NAACP, as a member of both the Board of Governors of Argonne National Laboratory and the Board of Physics and Astronomy of the National Research Council (US), and twice as Director of the University of Chicago Materials Lab. Kadanoff has won the APS Buckley and Onsager Prizes, the National Medal of Science (US), and la Grande Médaille d'Or of the French Academy of Sciences. His theoretical work has focused on condensed matter and statistical physics, and he helped establish the scaling and universality basis of phase transition theory.

FOR VICE PRESIDENT

ARTHUR BIENENSTOCK
Stanford University

Bienenstock received his BS and MS in physics from the Polytechnic Institute of Brooklyn in 1955 and 1957, respectively, and his Ph.D. in applied physics from Harvard in 1962. After an NSF Postdoctoral Fellowship, he joined Harvard's Division of Engineering and Applied Physics in 1963. He joined Stanford University's Materials Science and Applied Physics Departments in 1967. In 1978, he took on the Stanford Synchrotron Radiation Laboratory directorship and held that position through the summer of 1997. In November, 1997 he was confirmed as the Associate Director for Science of the White House Office of Science and Technology Policy (OSTP) and remained in that position until 2001. Bienenstock's early research is primarily solid-state theory, focusing on symmetry theory, vibrational and electronic states in crystalline solids and order-disorder phenomena. Subsequently, he turned to the physical properties of amorphous materials, with a focus on determining atomic arrangements. Bienenstock served as an APS general councilor, on the APS Committee on Applications of Physics, on the Audit Committee, on the Panel on Public Affairs, and as chair of the Ethics Committee.

ROBERTO PECCEI
University of California, Los Angeles

Peccei is the Vice Chancellor for Research at the University of California at Los Angeles (UCLA). Peccei obtained a B.S. from MIT in 1962, an M.S. from NYU in 1964 and a Ph.D. from MIT in 1969. After a brief period of postdoctoral work at the University of Washington, he joined the faculty of Stanford University in 1971. In 1978, he became a staff member of the Max Planck Institute in Munich, Germany. He joined the DESY Laboratory in Hamburg, Germany, as the Head of the Theoretical Group in 1984. He returned to the US in 1989, as a faculty member of the Department of Physics at UCLA. Soon thereafter, he became Chair of the Department, a position he held until becoming Dean of the Division of Physical Sciences of the College of Letters and Sciences in November 1993. Peccei is a theoretical particle physicist whose principal interests lie in the area of electroweak interactions and in the interface between high energy physics and cosmology. He is probably best known for his work on CP Violation. The so-called, Peccei-Quinn symmetry predicts the existence of axions, which could be the source of the dark matter in the Universe. He is presently interested in neutrino models of dark energy. He chaired the APS Division of Particles and Fields in 1989-90, and served on the APS Council from 1998 to 2001.

FOR CHAIR-ELECT, NOMINATING COMMITTEE

ERIC D. ISAACS
Argonne National Laboratory & University of Chicago

Isaacs is the Director of the Center for Nanoscale Materials at Argonne National Laboratory and Professor of Physics in the James Franck Institute at the University of Chicago. He received his PhD from Massachusetts Institute of Technology in 1988 in the area of magnetic semiconductors and was a post-doc at Bell Laboratories (1988-1990) studying magnetism and superconductivity, mostly with synchrotron-based x-ray techniques. During his 13-year tenure at Bell Laboratories he was a Member of Technical Staff (1990 – 2000), Director of the Materials Physics Research Department (2000-2001) and Director of the Semiconductor Physics Department (2001-2003). He has served on the APS Division of Materials Physics (2002-2005). His current research centers on studies of novel electronic and magnetic materials with a particular focus on creating images of new phenomena in reciprocal and real space at the nanoscale.

MARGARET MURNANE
JILA & University of Colorado

Murnane is a Fellow of JILA and is a member of the faculty in the Department of Physics at the University of Colorado. She received her B.S and M.S. degrees from University College Cork, Ireland, and her Ph.D. degree in physics from the University of California at Berkeley in 1989. She remained at Berkeley for one year as a postdoctoral fellow, before joining the faculty at Washington State University in 1990. In 1996, Murnane moved to the University of Michigan, and in 1999 she moved to the University of Colorado. Murnane's research interests have been in ultrafast optical science. She served as Chair of the APS Committee on the Status of Women in Physics in 2004, and currently coordinates the CSWP Site Visit program. She has served on the APS Council and Executive Committees, as well as on the Executive Committees of the APS Divisions of Laser Science and Atomic, Molecular and Optical Physics.

FOR GENERAL COUNCILLOR

CHRISTINA BACK
General Atomics

Back is an experimental physicist with expertise in the study of radiation in high energy density plasmas. She received her B. S. in Physics from Yale in 1984 and earned her Ph.D. in plasma physics from the University of Florida in 1989. Her thesis work led to the first measurement of resonance fluorescence in a laser-produced plasma. Following her Ph.D. she worked in France at the Ecole Polytechnique for two years and was also a visiting scientist at the UK Rutherford-Appleton Laboratory. In 1992 she joined Lawrence Livermore National Laboratory. This year, she became the Center Head of High Energy Density Physics Targets and Research at General Atomics. Her publications include significant contributions to the study of high efficiency x-ray production, opacity, hohlraum physics, and spectroscopic diagnostics. Back currently serves on the APS Division of Plasma Physics Executive Committee.

OLIVER K. BAKER
Jefferson Laboratory & Hampton University

PHOTO NOT AVAILABLE

Baker is an Endowed University Professor of Physics at Hampton University and, jointly, a Staff Member in the Physics Division at Jefferson Lab. His current research interests include studies of proposed Exotic Physics phenomena, specifically extra dimensions, at the energy frontier in ATLAS at the Large Hadron Collider, and precision studies of nuclear and particle systems with strangeness degrees of freedom at Jefferson Lab. He is the Director of the NSF-funded Physics Frontier Center in particle and nuclear physics at Hampton University. He has won several awards for his research success, including the APS Edward Bouchet Award. He has served on the Nuclear Science Advisory Committee and the High Energy Physics Advisory Panel, as well as on the Quarks to the Cosmos Committee that produced the report "The Quantum Universe" in 2004. Baker received his B.S. in Physics from MIT (1981), and his Ph.D. in Physics from Stanford University (1987). He is a Fellow of the Southeastern Universities Research Association and the National Society of Black Physicists.

GARY FELDMAN
Harvard University

Feldman, Baird Professor of Science at Harvard University, is an experimental particle physicist with primary current interest in neutrino physics. He was Chair of the Harvard Physics Department from 1994 to 1997. Feldman received his B.S. degree in physics from the University of Chicago in 1964 and his Ph.D. degree from Harvard University in 1971. After graduating, he joined the staff

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2005 ELECTION *from page 6*

of the Stanford Linear Accelerator Center. His research at SLAC was primarily in the physics of electron-positron annihilation with the Mark I and II experiments, where he was fortunate to be able to participate in the many discoveries of the "November Revolution." In 1990, Feldman joined the faculty of Harvard University and turned his attention to the study of neutrino oscillations. He is currently the cospokesperson of the NO collaboration, which is proposing a large off-axis detector for the NuMI beamline at Fermilab. Feldman has served on the Department of Energy's High Energy Advisory Panel. He chaired the APS Division of Particles and Fields in 1992.

WENDELL T. HILL, III
University of Maryland, College Park

Hill holds the rank of Professor at the University of Maryland, College Park, with appointments in the Institute for Physical Science and Technology and the Department of Physics. He received a B.A. in physics from the University of California, Irvine, in 1974 and a Ph.D. in physics from Stanford University in 1980. He is a guest worker at NIST, where he was a postdoc before joining the faculty of the University of Maryland in 1982. His current investigations are centered around ultrafast dynamics, coherent control, strong-field laser-matter interaction, atom optics and quantum information. He leads the first group to combine ultrashort pulses and coincidence imaging with position-sensitive detectors to extract correlated ejection details previously not possible. Most recently, his group has demonstrated an all-optical atom switch to transfer atoms between two different guides. Hill was a member of the Executive Committee of the APS Division of Laser Science, the APS Committee on Minorities, and chaired the Nomination Committee for the APS Division of Atomic, Molecular and Optical Physics.

FOR INTERNATIONAL COUNCILLOR

ALBRECHT WAGNER
Deutsches Elektronen-Synchrotron, DESY, and University of Hamburg

Wagner did his undergraduate studies in Munich and received his doctoral degree in physics in 1971 from Heidelberg University with work done at an experiment at CERN. During his scientific career he worked from 1973-1974 at the Lawrence Berkeley National Laboratory, USA. He did research from 1975 until 1986 at DESY, and from 1986 until 1999 at CERN. In 1984 he became full professor at the University of Heidelberg. In 1991 he was offered a professorship at the University of Hamburg and at the same time was appointed Director of Research at DESY. He is chair of the board of the TESLA Collaboration which works on superconducting accelerator development. Wagner's own research is in elementary particle physics, with a main emphasis on the study of the electro-weak and strong forces. His second field of interest is the development of detectors, with an emphasis on gaseous detectors and fast electronics.

AMNON AHARONY
Tel Aviv & Ben Gurion Universities

Aharony is the Moyses Nussenzveig Professor of Statistical physics at Tel Aviv University, Israel, where he has been professor of physics since 1975. He is also a visiting professor at Ben Gurion University and an adjunct professor at the University of Oslo, Norway. He received his B.Sc. in physics and mathematics (1963) and his M. Sc. in nuclear physics (1964) from the Hebrew University and his Ph.D. in high energy physics (1971) from Tel Aviv University. He then switched to statistical physics, and was a post-doc at Cornell (1972-4), Harvard, UCSD, and Bell Labs (1974-5). In 2005 he will be a visiting professor at the University of Tokyo. He is also a frequent visitor at universities and research institutes in Germany. Aharony is a theoretical condensed matter physicist, with contributions to critical phenomena, magnetism, liquid crystals, disordered systems, percolation, electron localization, and mesoscopic physics. Aharony was the chairperson of the IUPAP Commission on Statistical Physics and a member of the IUPAP Commission on Magnetism. He has been a member of the editorial board of several international journals, including Physical Review E.

ONLINE JOURNAL *from page 1*

to publish physics education research articles has been the *American Journal of Physics*, which is published by AAPT. But the AJP, which mainly publishes pedagogical articles, rather than primary research, isn't large enough to handle all the new physics education research articles that need to be published.

PRST-PER will have the same peer review process and high standards as the other *Physical Review* journals. The well-known quality of the *Physical Review* journals should help enhance the status of the physics education research field, said Beichner.

The journal will publish a range of experimental and theoretical research on the teaching and learning of physics, including review articles, replication studies, descriptions of new assessment tools, presentation of research techniques, and methodology comparisons or critiques.

The new journal will be published online only, and expects to initially publish about 50 articles a year. PRST-PER will be distributed free of charge, financed by publication charges. Authors or their institutions will be asked to pay a per-article charge of $700, plus a length-dependent charge of $80 per 125 lines. Authors who cannot pay these charges can request a fee waiver. As a special incentive, manuscripts submitted in 2005 will have the $700 charge waived.

This "open-access" model, in which the author pays the publication charges, makes sense especially when the authors and the readers of the journal aren't necessarily the same people. For instance, some high school teachers might want to read some of the articles in PRST-PER, said Blume. "It is important that it be open access," he said, "Many educators will want to see this. Everyone who needs it should have access."

INSIDE THE BELTWAY *from page 2*

too fond of the proposed spending plan either.

But it didn't hurt that the House Appropriations Subcommittee for Energy and Water Projects has David Hobson (R-OH) as chairman and Peter Visclosky (D-IN) as ranking member. Both of them are big boosters of science.

And it probably didn't hurt that APS members had flooded Capitol Hill with more than six thousand letters beginning in March, and that hundreds of scientists had roamed the corridors of power during a series of congressional visits beginning in January.

The core programs at the National Institute of Standards and Technology didn't fare as well, even though Frank Wolf, who chairs the new House Appropriations Subcommittee for Science, State, Justice and Commerce, is one of the true research and innovation champions on Capitol Hill.

The message Wolf had received from the Commerce Department was that the presidential budget had provided the NIST labs with a 10 percent boost. So a small trimming of the request for the labs in order to better fund the Manufacturing Extension program that the White House had proposed to cut seemed a reasonable approach. It would have been, but for the large shortfall in the closeout costs for the Advanced Technology Program that the Administration had somehow forgotten to mention. Absent remedial action by the Senate, NIST could wind up in the minus column.

Let's be honest, though, Congress faces a daunting job, trying to fund programs with money it doesn't have. The truth is that the United States treasury is in desperate need of disaster relief.

The real budget deficit this year will be about $600 billion, the balance of trade deficit will reach $700 billion, and the national debt, within four years, will climb to about half the gross domestic product, with China holding a good fraction of the outstanding IOU's. Social Security will be paying out more than it will be bringing in within a dozen years, and Medicare could be on life support even sooner. Chicken Little is right to be scared.

Today, as a percentage of the Gross Domestic Product, the federal treasury is collecting less than at any time in the post World War II era. The culprit is the 2001 tax cuts that are about to become permanent. They have left a $500 billion hole that wishful thinking and discretionary budget trimming cannot possibly fill.

The only solution is to increase taxes and cut entitlements. But both political parties have learned their lessons well. Whoever blinks first and utters the "T" word loses: the Republicans sacrificed the Senate in 1986 after the Reagan increase and the White House in 1992 after the Bush increase, and the Democrats gave up the House and the Senate in 1994 following the Clinton increase. And whoever suggests cutting back on Social Security and Medicare will be out of office in an instant.

So where does that leave research? Well, in a $2.4 trillion budget, it will only take about $2 billion of additional spending to keep the science level of effort constant. That's really not too much to pay to secure our nation's future, even when the sky seems to be falling.

ANNOUNCEMENTS

AAPT Executive Officer Applications and Nominations Sought

The American Association of Physics Teachers (AAPT) seeks an experienced physicist to serve as its Executive Officer. The position requires a leader with an entrepreneurial flair and a broad vision of physics education who is also a skillful manager. The AAPT Executive Officer works in concert with the AAPT Executive Board to support the members of the organization in improving physics teaching at all levels. A candidate should have taught physics and be familiar with the physics teaching community and the issues it faces. As an important representative of this community, the AAPT Executive Officer needs the skills and background to build effective alliances and to interact productively with physicists of all kinds and with leaders of other scientific and educational organizations, federal government officials, funding agencies, and the public. The Executive Officer heads the office of the AAPT located in the American Center for Physics in College Park, Maryland.

The review of applicants will commence on October 1, 2005 and continue until the position is filled. Interested persons should send a resume and cover letter by email to the Search Committee at eosearch@aapt.org. Nominations are welcome and should also be sent to that email address. Questions and inquiries should be addressed to the chair of the search committee, Ken Heller, School of Physics and Astronomy, University of Minnesota, at heller@physics.umn.edu. More information about the AAPT can be found at http://www.aapt.org/. AAPT is an Equal Opportunity/Affirmative Action Employer.

New Membership Directory Feature

APS Members may now search the Online Member Directory by institution. Please visit http://www.aps.org/memb/enter-directory.cfm to login to the Member Directory. From there you will see the original single member search and the new "Search by Affiliation" option.

An email request was sent to all members during the last year to verify the accuracy of all affiliation linking that we have on record. Please note that not all members have provided affiliation information and may not be listed in the institutional directory. If you have a correction to a listing, please contact a membership representative at membership@aps.org or 301-209-3280 for assistance.

Thank You.

The APS Membership Department

The Back Page

Making the Case for University Research

By Norman R. Augustine

The role of research universities in underpinning our nation's standard of living is of pivotal importance. However, too often it is taken for granted that our universities will more or less automatically continue to generate the breakthroughs that have fueled our economy for many years. Dan Goldin told me when he was administrator of NASA that he had received a complaint from a disgruntled citizen who inquired, "Why do we need meteorological satellites? We have the weather channel."

It was my privilege during the late 1990s to serve as a member of the Hart-Rudman Commission on National Security. Our final report stated, in part, that " . . . the US government seriously under-funded basic science research in recent years . . . If we do not invest heavily and wisely in rebuilding [research and education], America will be incapable of maintaining its global position long into the 20th century."

The other primary finding stated that a major direct attack against American citizens on American soil with heretofore unimagined casualties was likely, and that a National Homeland Security Agency should be established with Cabinet status to address that threat. Our prediction proved to be all too accurate. Unfortunately, the tragedy of 9/11 occurred before any of our Commission's principal recommendations were implemented. But it is *not* too late to address the health of our basic scientific research enterprise, which is principally harbored in the nation's universities.

I was responsible for a firm whose future existence was heavily dependent upon the competitive margin that could be generated by the 62,000 engineers and scientists with whom I worked. And I was well aware of studies that had shown that over 50% of the jobs created in America during the last half century could be directly attributed to investments in science and technology. Most of our own company's sales were derived from products that did not even exist a few years earlier. In the case of another firm, Intel, nearly 90% of all the products they sell in any given year did not exist a year earlier. Even a consumer products firm such as Procter and Gamble has been described by its former CEO as fundamentally an R&D enterprise.

I was deeply troubled that many of the corporate boards on which I served were increasingly being called upon to approve proposals to relocate factories outside the US. It was almost certainly in the best interest of our shareholders, and, ultimately, of our remaining employees, to conduct more and more of our manufacturing operations in such places as Asia, India and Mexico. I recently visited a factory in Vietnam where the wrap-rate was about twenty-five cents per hour, far less than most American firms pay simply for medical insurance for their employees.

The trend to relocate abroad did not stop with factories. I soon learned that we could hire eleven engineers in India for the cost of *one* in the US. We could hire even more in Russia–and these too were highly-qualified engineers, many educated in the US. Soon we were being asked to approve moving our design teams and software production abroad. More recently, our research laboratories have joined the exodus.

Today, America's companies find themselves in a marketplace without borders–or, at the very least, with borders that are extremely permeable. And it is quite clear that we are unable to compete in this global marketplace on the basis of favorable domestic labor costs. Only one acceptable choice remains: to be among the world's foremost innovators. The underpinning of innovation is research, particularly in science and technology, which is increasingly becoming the relatively exclusive province of our nation's universities. This is where the breakthroughs, the "Big Bangs" that have profound impacts, are produced. The consequences of neglect, although severe, are often not suffered for a number of years. Further, a trend of neglect is not easily reversed–as some great scholar once noted, you can't produce pigs by running the sausage machine backwards.

One might reasonably ask why, if in the last dozen years, inflation-adjusted research and development conducted in America has increased by two-thirds, one should be alarmed about the health of the nation's research enterprise. Furthermore, the industrial sector seems to have been picking up the slack in R&D growth. In fact, industry R&D spending surpassed government spending in 1980, and now comprises more than double the amount of funds that the government appropriates to this purpose.

However, almost all the increase in government research spending has been devoted to the biosciences. And while pursuing this laudable course, investment in the physical sciences, mathematics and engineering has been badly neglected. In the physical sciences, federal research spending has been roughly flat as measured in constant-purchasing power, while funding in mathematics and engineering has only slightly surpassed inflation. Correspondingly, the number of Bachelors degrees awarded by US universities in these fields since 1985 has dropped by 11%, 28% and 21%, respectively. Undergraduate students seem to be keenly aware of where the jobs are to be found.

While overall industry-funded R&D has increased markedly, these monies have largely been devoted to *development* activities as opposed to research. Even those funds which have been devoted to research are increasingly focused upon applied rather than basic research. Current indicators of this trend include the diminished status of such renowned institutions as Bell Labs or the closing several years ago of Martin Marietta's corporate research laboratory.

Several years ago, when I was with Martin Marietta, we concluded that it had an unusually rich set of opportunities that could be reaped by increased investment in applied research. We called a special meeting in New York of Wall Street analysts so our president could describe our exciting plans in detail. But upon completion of his presentation, the audience literally ran from the room and *sold* our stock.

The price of our stock plummeted the next day and continued to decline gradually for another 18 months as we persisted in our strategy. I particularly recall the remarks of one analyst who told us, "Everyone knows it takes 10 or 15 years for investments in research to pay off–but your shareholders, on average, only own your stock for a little over a year before they sell it. The benefits of your research, if there are any, may be of interest to the great-grandchildren of your shareholders–but today's shareholders shouldn't be asked to foot the bill for it. Our fund doesn't invest in companies with such *short-sighted* (emphasis added) management."

But if industry is to abdicate its responsibility to feed the front-end of the innovation machine, who then is to do so? A case can be made that the support of generic, broadly-applicable, high-payoff and often risky research is an appropriate province of our government. This has in fact been widely and beneficially recognized for many years and has resulted in the creation of such agencies as the NSF, NIH and DARPA and the DOE science program.

The problem resides in the inadequacy of resources being made available for research in the so-called "hard sciences". Flat federal funding of the physical sciences, in constant dollars, has taken place as we have become increasingly dependent on science and technology for jobs, healthcare, energy and national security. In effect, we have created a huge "inverted pyramid" of jobs, corporations and technology which to a large extent is supported, rather precariously, at its fulcrum by a program of university research.

The bottom line is that in the last two decades, the US share of global exports has fallen from 30% to 17%, while those of Asia, excluding Japan, grew from 7% to 27%. For the first time in memory, the US now has a negative trade balance *for high-technology products*–and the jobs associated therewith are fast becoming one of our major exports.

These were some of the considerations that prompted me to begin attempts to call increased attention to our nation's under-investment in university research. It became abundantly evident in my role as a relatively neutral party that, although I found America's academe broadly and highly respected for its scholarly excellence, its researchers were often resented by the very officials who have a say in the allocation of federal research funds. I also found a certain unspoken reluctance by some legislators to support institutions which they view as elitist; institutions whose tuition, even after scholarships, grows at a rate considerably exceeding the growth in income of the general populace–and which rejects the sons and daughters of the Washington *cognoscenti* at a rate which does not go unobserved. And, finally, I would gratuitously note that when scientists, as a group, take public positions on contentious subjects having at best marginal relationships to science, it rarely endears them to all members of the political establishment.

I further discovered that relationships within the nation's research community itself in many instances make last year's Los Angeles Lakers appear to be Miss Congeniality. On several occasions, after having made an impassioned plea for university research funding, I would learn that my footsteps had been followed by groups of scientists wherein the physicists argued that any new money should be spent on physics and certainly not on chemistry; but the physicists then argued among themselves whether new money should be spent on particle physics or astrophysics; and the experimentalists asserted that new funds should certainly not be wasted on theoreticians.

The result of this cacophony was that many members of Congress, perhaps understandably, tended to throw up their hands: If the experts can't agree on how money should be spent, and the members don't have the time, or perhaps even inclination, to learn the difference between a boson and a lepton, it is best that the money simply be spent on highways.

It is my belief that were industry and our universities to work more closely together in explaining the importance of fundamental research, a much broader acceptance of the notion might be realized. Similarly, an increase in industry funding of research performed at our universities would benefit both parties. A program of tax credits for companies that do so would provide additional incentives.

I recognize that it is difficult to obtain government support in today's challenging funding climate for pursuits that do not produce a rather clear, direct impact on the quality of life of the average citizen. My first suggestion is to adopt, wherever possible, pragmatic arguments when making the case for increasing the nation's spending on academic research. Relate such spending to the creation of jobs, the enhancement of health, the assurance of physical security, and so forth. I conclude this with a sense of sadness, because I believe that the search for knowledge has merit in its own right. If we cannot afford to study the origin of the dinosaur because it may not create jobs, not even for dinosaurs, does that also suggest that we should not take time to watch Shakespeare performed, listen to Beethoven's works, or cheer Roger Clemens' fastball? On the other hand, when this connectivity is convincingly demonstrated, the nation's policy makers appear to be willing, even eager, to invest.

My second suggestion is that some degree of internal consensus be established within the academic community as to priorities for allocating resources. At a minimum a "truce" is needed whereby the various interested partisans make their cases without attacking those of others.

Third, spokespersons need to be enlisted in the cause who are independent of our research universities and do not suffer the appearance of being self-serving. This accounts for the remarkable success groups of citizens concerned with various diseases have had in doubling the NIH budget in recent years.

Fourth, successes achieved from our government's investment in research need to be broadly publicized and publicly attributed to government support. Few people seem to recognize the important role physics, chemistry, engineering and mathematics play in underpinning health research; for example, the contribution of robotics, computers and mathematics in deciphering the human genome, or the role of mathematics and engineering in modern non-intrusive imaging techniques. Even fewer seem to be aware of studies such as the one that concluded that research conducted at MIT alone had in recent years generated over 4,000 companies and created over a million jobs.

Finally, I recommend communicating the old fashioned way: *face-to-face* contacts with individual members of Congress, the administration and the media. It is also important to visit the members in their home district, where they have more time to devote to longer-term issues. Including respected local citizens in these visits amplifies the impact of the message being conveyed.

The bad news is that our nation's investment in research in the physical sciences and engineering is only about one-tenth of one percent of the nation's GDP. But the good news is that major proportionate increases can therefore be achieved with relatively modest overall impact on the federal budget. For example, the federal research effort in engineering, math and the physical sciences could be *doubled* by increasing the gasoline tax by a dime per gallon. For perspective, the entire research budget in all these fields is less than the amount by which healthcare costs in America *increase* every two months. There is enormous leverage available for research to recover increased investment.

I would like to close with a poem attributed to Richard Hodgetts that, to my mind, captures the intense competitiveness of the global marketplace.

Every morning in Africa a gazelle wakes up.

It knows it must outrun the fastest lion or it will be killed.

Every morning in Africa a lion wakes up.

It knows it must outrun the slowest gazelle or it will starve.

It doesn't matter whether you're a lion or a gazelle–when the sun comes up, you'd better be running.

Norman R. Augustine is the retired Chairman and CEO of the Lockheed Martin Corporation and former Under Secretary of the Army. This article is adapted from his April 19, 2005 lecture before the Association of American Universities.

The full text of the lecture can be found at http://www.aau.edu/resuniv/Augustine–04-19-05.pdf.