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Annual Prize and Award Insert see inside

Strong Physics Lineup at Dallas March Meeting

The APS March Meeting, the largest annual physics meeting in the country, will take place from March 21 through 25 at the Dallas Convention Center in Dallas, Texas. Physicists from across the globe will present more than 7,000 papers with over 100 invited sessions and 550 sessions total. More than 7,500 scientists are expected to show up to share the most cutting edge developments in areas including condensed matter, computational physics, chemical and biological physics, new materials, polymers and fluids. A number of sessions will also look to explore the role of physics in different segments of society, including its role in industry, national security, human dynamics, sustainable energy and energy storage.

Nobel Prize Session

The Nobel Prize Session (U1), on Wednesday March 23 at 5:45 p.m., is titled "Graphene: Materials in the Flatland", and will feature 2010 Nobel laureate Konstantin Novoselov.

Superconductivity Turns 100

2011 marks the 100th anniversary of the discovery of superconductivity. To commemorate this milestone, numerous sessions at the meeting are devoted to the past, present and future of super conductivity. The Kavli Foundation is sponsoring two special symposia: "Nobelist Perspectives on 100 Years of Superconductivity" (session J3) and "Superconductivity Centennial: Future Research Developments" (session Q2). Taking a look back, session B3 will retell the story of the phenomenon from its discovery to the first high temperature superconductors. The Industrial Physics Forum (AIP) in conjunction with the APS Forum on Industrial and Applied Physics will hold sessions highlighting industrial applications of superconductivity including in electronics and the electrical grid, medical imaging, astrophysical detectors and sensitive magnetic field detectors (sessions 1A, 1B and A5).

Topological Insulators Keep Getting Hotter

A world powered by spintronics is getting closer as research into topological insulators keeps moving forward. One of the fastest growing fields of condensed matter research, topological insulators are a class of materials in which electrons flow along the surface almost without resistance, while the inside remains an insulator. More than a dozen sessions will focus on this exciting new field. Researchers at

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New Access Policy Includes Full Reuse Rights

Starting on February 15, APS began a new initiative allowing authors the option to retain copyright and remove access restrictions for papers published in most APS journals. For a fee, authors are able to make their papers open access and available via the Creative Commons Attribution 3.0 license, building upon the current Free-to-Read program. Articles published under this new option can be read without a subscription and reused freely without asking permission.

"This initiative will leave copyright for the articles with the authors. It will allow others to reuse the articles in any way they want, as long as they maintain proper attribution to the original articles," said APS Treasurer/Publisher Joseph Serene. "We want to be as generous as we can be, as long as that generosity doesn't have a negative effect on the revenue that allows us to produce high-quality journals."

The "Free to Read" program allowed anyone free access to read the involved articles, following the payment of a fee (by any interested person). The new initiative, which supersedes "Free to Read," is different: authors can purchase an agreement that not only allows anyone to read their article, but also, via the Creative Commons License, to freely reuse any part of the article so long as it's appropriately cited. APS journals

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***APS News* Interviews John Holdren - see page 5**

APS Releases Report on Energy-Critical Elements

By Michael Lucibella

The US government needs to do more to secure supply lines of uncommon elements critical to the nation's future energy technologies, according to a new study, which highlighted elements that are not currently produced in large quantities, but play major roles in emerging energy production and transmission technology. The report, *Energy Critical Elements: Securing Materials for Emerging Technologies* was conducted by APS's Panel on Public Affairs and the Materials Research Society's Government Affairs Committee. The report was accepted by the

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Photo by Mary Catherine Adams

Robert Jaffe (left) answers a question about energy-critical elements at a press conference held Feb. 18 as part of the AAAS annual meeting in Washington, DC. Another member of the report committee,Thomas E. Graedel of Yale (right), also answered questions at the conference.

Six Programs Get Outreach Mini-Grants

Last Fall, the APS outreach department launched a mini-grant program to promote creative outreach activities by APS members, and called for proposals. In February, after all the entries were evaluated by the APS Committee on Informing the Public, the recipients were announced. Altogether six programs were funded, out of more than 100 proposals received. Each successful program will receive up to $10,000 to support its activities.

"The idea of the mini-grant program is to help APS members start their own outreach projects," said Becky Thompson, head of public outreach at APS.

"This time we looked for proposals that were innovative and different," Thompson said. "A lot of times when you think of outreach, you think of demo shows and we wanted to get away from that." Thompson also added that the committee was looking especially at proposals that use the media to reach out to more than just students in elementary school.

One of the successful proposals, by Ixlan Communications and the University of Texas at El Paso, is for their "Hispanic Physics Radio Education Project." The program will produce a series of one- and two-minute long radio stories about physics in both English and Spanish. They will distribute the pieces to English and Spanish language radio stations in markets across the country, as well as post the stories

PROGRAMS continued on page 6

Science Funding on the Table as President, Congress Battle Over Budget

The future of federal support for scientific research is intimately tied to the debate over the federal budget. Two competing documents, the proposed continuing resolution to fund the government for the rest of the 2011 fiscal year, and the President's 2012 budget proposal, have embroiled the White House and Congressional Republicans in a fight about the future of the federal budget. The debate carries with it serious implications for the future of federally funded scientific research in the United States.

Congress never passed a budget for fiscal year 2011 and has been funding the government under a continuing resolution at roughly 2010 levels. The current resolution expires on March 4, at which time Congress will have to pass some form of legislation either funding the government for the rest of the year, or another temporary extension.

On February 14, President Obama submitted his budget proposal for 2012. At 4:30 a.m. on February 19, the House passed H.R.-1, its budget proposal for the rest of the year which outlined about $60 billion in cuts to the federal budget for 2011 compared to 2010 levels.

After March 4 one of two things will likely happen. Either Congress will adopt a new continuing resolution to fund the government for the rest of the year, likely with significant cuts from 2010 levels, or, if no new resolution is immediately agreed upon, the federal government could shut down until a new resolution is adopted.

The cuts contained in the Appropriations Committee's proposal for the rest of fiscal 2011 (i.e., until September 30) have implications for the future of federally supported science. The National Institute of Health and National Science Foundation would both lose about 10 percent of their budgets. The National Institute for Standards and Technology would be cut by almost 20 percent while the Department of Energy's Office of Science would be facing cuts of nearly 30 percent.

Michael Lubell, APS director of public affairs, said that the effect of this on scientific research in the United States would be devastating. The cuts at NSF would truncate the number of grants they'd be able to award for the rest of the year. At DOE, layoffs and program shutdowns at national labs would be likely. In addition construction at Jefferson Lab, ITER and the Na-

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DAMOP Sorters Meet

Photo by Mary Catherine Adams

On February 11, 23 physicists convened at APS headquarters to sort over 900 abstracts that had been submitted for the 42nd annual meeting of the Division of Atomic, Molecular and Optical Physics, to be held June 13-17 in Atlanta. Here, Trey Porto (l) and Paul Julienne (c), both of the National Institute of Standards and Technology, and Emily Edwards (r) of the University of Maryland read through abstracts while Chris Monroe (l), from the University of Maryland, and Tom Weinacht (r), from Stony Brook University, talk in the background.

Members in the Media

"How are we going to feel if they find it at the LHC? The Tevatron had the capacity to give us complementary information."

***Lisa Randall**, Harvard, on the hunt for the Higgs boson and the upcoming shutdown of the Tevatron,* The New York Times*, January 17, 2011.*

"I always knew it would be a long shot to run three additional years."

***Robert Rosner**, Fermilab, on the decision to shut down the Tevatron,* The New York Times*, January 17, 2011.*

"All great accelerators have an end…Any disappointment at the closing of the Tevatron is tempered by my wonderful memories of my time at Fermilab, when the Tevatron was cranking out discoveries and it was the center of the high-energy physics world."

***Edward "Rocky" Kolb**, University of Chicago,* U.S. News and World Report*, January 20, 2011.*

"I think this is a very neat piece of work…but I think it's important to see it as a piece of a big puzzle. Our mecca is to build a quantum computer that could have thousands of qubits; here we have only a few."

***Raymond Laflamme**, University of Waterloo, on a new technique to develop quantum qbits,* The New York Times*, January 20, 2011.*

"We're hoping to start taking it underground (by) summer."

***Robert Svoboda**, University of California, Davis, referring to detectors in the Homestake Mine that are searching for dark matter,* The Columbus Dispatch*, January 23, 2011.*

"Neutrinos are really pretty strange particles when you get down to it…They're almost nothing at all, because they have almost no mass and no electric charge... They're just little wisps of almost nothing."

***John Conway**, University of California, Davis,* The PBS NewsHour*, January 25, 2011.*

"We are due. Forget Yogi Bear. Forget Old Faithful. It's sitting on top of a sleeping giant."

***Michio Kaku**, City College of New York, on the super-volcano beneath Yellowstone National Park,* CNN*, January 27, 2011.*

"This work represents a quantum jump forward in the complexity and function of circuits built from the bottom up, and thus demonstrates that this bottom-up paradigm–which is distinct from the way commercial circuits are built today–can yield nanoprocessors and other integrated systems of the future."

***Charles Lieber,** Harvard University, on making computer chips out of nanowires,* BBCNews.com*, February 10, 2011.*

"I think the most remarkable thing about ice, in my opinion at least, is that it occurs in many, many, many different forms. Most solids occur in typically one or maybe two or three different forms, and ice has approximately 15 different crystal forms, as well as two forms that are called amorphous, which means without any shape at all."

***Eugene Stanley**, Boston University,* NPR*, February 11, 2011.*

"We want to have something that's not changing, so that we can have a stable system of measurement."

***Peter J. Mohr**, NIST, on why the international standard for the mass of a kilogram needs to be changed,* The New York Times*, February 12, 2011.*

"A real monopole would be a magnetic charge that would exist in a vacuum…What they have is a complicated condensed matter system."

***Michael Bonitz,** Universitaet Kiel, on recent research in magnetricity,* U.S. News and World Report*, February 14, 2011.*

"Around a spinning black hole, space and time behave in such an odd way; space becomes time, time becomes space, and the whole space-time is actually dragged around the black hole, becomes twisted around the black hole."

***Bo Y. Thide**, Swedish Institute of Space Physics,* BBCNews.com*, February 14, 2011.*

This Month in Physics History

March 16, 1699: William Chaloner, counterfeiter, hanged

Sir Isaac Newton's stellar scientific accomplishments are well-known: his *Principia* and *Opticks* laid the foundation for modern physics. Less frequently discussed are his later years, starting with his acceptance in 1696 of the position of warden for the Royal Mint. During his tenure, he oversaw the recoinage of England's currency, and relentlessly pursued counterfeiters, including one of the most successful: William Chaloner.

This was a period when hand-struck silver coins minted before 1662 were often "clipped" around the edges for silver shavings, reducing their weight, and hence their value as legal tender, especially in foreign countries. Since the value of the silver was greater than the currency itself, it also presented a strong temptation for melting down the coins and selling them abroad, giving rise to an arbitrage market.

Coins produced in later mintings had milled edges to prevent clipping, but this merely fostered a thriving counterfeit black market. The most common counterfeiting methods were casting coins out of fake molds, and stamping them from counterfeit dies. Newton estimated that as many as 20% of the coins collected during the great recoinage were counterfeit. It was a crime punishable by death since it was considered to be high treason: convicted counterfeiters were hanged, drawn and quartered.

The son of a weaver in Warwickshire, Chaloner was born in the mid-1650s. He proved to be trouble from the start. His frustrated parents couldn't control him, and eventually apprenticed him to a nailmaker in the town of Birmingham. As it happened, the city also had a thriving counterfeit coining industry. Chaloner proved a quick study, and soon became an expert in forging groats (about four pennies).

He had larger ambitions, however, and migrated to London in the 1680s, intending to find honest work. The Craftsmen's Guild system that dominated London at that time prevented him from doing so, and he found himself peddling fake tin watches instead. Chaloner next tried his hand at being a soothsayer and "doctor," catering to lovelorn women and those looking to recover stolen property. He was successful enough at the latter to marry and set up a fairly respectable household, fathering several children. But it seems his knack for finding stolen items stemmed from the fact that he committed the robberies in the first place. Once this proclivity came to light, he was forced to flee his home.

Chaloner first appeared in the public record in 1690, arrested for burglary. By then he was working as a japanner, acquiring skills in gilding to further his counterfeiting career. Soon he was a member of one of the many coining groups working out of London at the time. A goldsmith named Patrick Coffey taught Chaloner the finer points of molding milled edges, and he partnered with a master engraver and printer named Thomas Taylor, who made the dies. Once the counterfeit coins had been minted–usually guineas or French pistoles–another conspirator named Thomas Holloway, with the help of his wife, passed the coins to local crooks, who put them into circulation.

By all accounts, Chaloner was highly skilled and successful as a counterfeiter, purchasing a large house in Knightsbridge, hiring a carriage, and donning all the outward trappings of a respectable gentleman. He was "the most accomplished counterfeiter in the kingdom… so nice an artist of dies that it galled him to spoil their perfection by use," wrote Sir John Craig in *Newton at the Mint* (1946). In this guise, he offered his services to the Royal Mint to inspect their coining processes and advise the Mint on how to better combat counterfeiting–gaining valuable insider information on their methods in the process, the better to forge his own coins. It was a brazen scheme that fortunately failed.

Chaloner might yet have escaped punishment for his crimes had it not been for Newton, who took his role with the Royal Mint very seriously. Newton prowled the bars and taverns in the seedier sections of London in disguise, gathering evidence against those engaged in counterfeiting. He became a justice of the peace so that he could personally conduct more than 100 cross examinations of witnesses and suspects, successfully prosecuting 28 such criminals.

Newton first arrested Chaloner for counterfeiting in September 1697 and confined him to Newgate Prison, but Chaloner called on his high-ranking cohorts to win an acquittal, and he was released. Undeterred, Newton set about building an airtight case against Chaloner. A year and a half later, Newton arrested him again, having collected far more damning evidence based on the testimony of eight key witnesses, several of whom were former partners in crime. There were two indictments: one for coining French pistoles in 1692, and another for forging crowns in 1698. Always wily, Chaloner first pretended to be mad, and then, during his trial, accused the assembled witnesses of lying to avoid being prosecuted too.

Chaloner's arguments were for naught: the jury convicted him of high treason after only a few minutes' deliberation, and he was sentenced the following day by the presiding judge, Sir Salathiel Lovell for execution two weeks hence. During that time, he wrote to Newton several times, alternately accusing him and begging for leniency. "I shall be murdered unless you save me. O I hope God will move your heart with mercy pitty to do this thing for me," he lamented in his final letter, but the scientist was unmoved. On March 16, 1699, Chaloner was hanged.

As for Newton, he became president of the Royal Society in 1703, and was knighted by Queen Anne in 1705, the second scientist to be so honored, following Sir Francis Bacon. A lifelong bachelor, he became increasingly eccentric in later life, possibly due to mercury poisoning stemming from his investigations into alchemy. He died in his sleep in London on March 31, 1727, and was buried in Westminster Abbey.

Further Reading

Levenson, Thomas. *Newton and the Counterfeiter.* New York: Faber & Faber, 2009.

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Education Corner

A column on educational programs and publications

New Educational Offerings on APS Website

The APS website features a trove of new education content for physics faculty, researchers, and educators:

Ethics Case Study Guides

The APS recently produced a discussion and activity guide to accompany a set of ethics case studies that were developed by the APS Task Force on Ethics Education. The guides are intended to help ethics educators lead research ethics training and seminars. You can download teacher and student editions at www.aps.org/programs/education/ethics

Research Mentor Training Seminar Guide

APS and the University of Wisconsin-Madison recently completed a guide for a Physics Research Mentor Training Seminar. The seminar is intended for faculty, postdocs, and graduate students who mentor others as part of their work. The manual is available at www.aps.org/programs/education/undergrad/faculty. See also the related article in this issue.

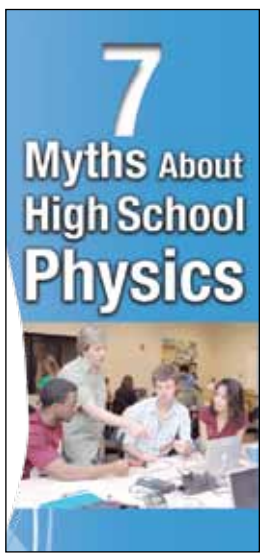
SPIN-UP Report

In 2003, the *Strategic Programs for Innovations in Undergraduate Physics (SPIN-UP)* report came out, describing common features of departments with thriving programs. APS now features the report and more recent developments in undergraduate physics at www.aps.org/programs/education/undergrad/faculty/spinup

Physics Education Research Speakers Database

If you're looking for a speaker to give a physics education research (PER)-related colloquium or talk, you can search the APS PER Speakers Database. Talks are sorted by intended audience, topic, and level, and can also be searched by keywords. If you have a PER-related talk, you can also add it to the database, which is at www.aps.org/programs/education/speakers

7 Myths About High School Physics



APS, along with the American Association of Physics Teachers (AAPT) and the Society of Physics Students (SPS), recently published a brochure entitled *7 Myths About High School Physics*. This brochure addresses common misconceptions that high school physics teachers encounter when trying to recruit students to their program. Copies of the brochure were included with the February edition of *The Physics Teacher,* which reaches over 8,000 high school physics teachers, in the hope that these teachers will use the brochure to begin conversations with counselors, parents, and students about the benefit of taking physics. The brochure includes information and statistics on careers that involve physics, college admissions, physicist salaries, and more. You can download or request copies of the brochure at www.aps.org/programs/education/posters.cfm

Undergraduate Research Week

On November 16, 2010, the US House of Representatives designated the week of April 11, 2011 as "Undergraduate Research Week." The measure, House Resolution 1654, was championed by Representative Rush Holt of New Jersey, a physicist and former assistant director of the Princeton Plasma Physics Laboratory, and a longtime supporter of undergraduate research. During consideration of the resolution, Rep. Holt and other supporters spoke of the importance of undergraduate research in spurring future US innovation. Rep. Holt said, "Around the country, thousands of students at hundreds of colleges and universities are involved in undergraduate research experiences that will shape the future trajectories of their lives and careers, yet we would benefit if thousands more were involved."

APS also supports expanding the number of research experiences for undergraduates in physics. Ted Hodapp, Director of Education and Diversity at APS, says, "Undergraduate research is one of the best ways to help students fully appreciate the excitement of *doing* science. The APS Committee on Education recently recognized this by endorsing a statement calling for research experiences to be available for all students."

The Committee's 2009 statement is available at www.aps.org/programs/education/upload/undergrad_research_statement.pdf

More information about House Resolution 1654 is available at www.govtrack.us/congress/bill.xpd?bill=hr111-1654

Robert Noyce Scholarship Program Solicitation

The National Science Foundation's (NSF) Robert Noyce Teacher Scholarship Program is the number one source of dedicated scholarship support for future science and math teachers. Since its inception in 2002, it has funded 413 institutions, which have collectively awarded over 3,600 scholarships of up to $15,000 per year. Proposals for the next round of funding for both Noyce Scholarships and NSF Teaching Fellowships/Master Teaching Fellowships are due by March 23. For more information, see www.nsfnoyce.org .

APS Launches Exchange Program with Brazil

APS, in conjunction with the Sociedade Brasileira de Física (SBF), has announced a new exchange program for professors and graduate students. Up to five physics professors and ten graduate students per year from each country will be able to use the new program to travel between the two nations.

The two societies have each set aside $50,000 to help pay travel expenses for physicists interested in participating in a scientific and cultural exchange between the two countries. It is the first time that the APS has partnered directly with another society for such an exchange program.

"The program will permit physics professors from either Brazil or the US to go to the other country to give a lecture series," said Michele Irwin, APS's international programs administrator. She added that the exchange program's aim was "to give both students and professors the opportunity to experience other cultures and experience science in other cultures."

Physics professors can apply for up to $4,000 in travel grants to either teach a short course or deliver a physics lecture series abroad. A "visiting" professor along with his or her "host" university will submit a joint proposal to participate in the Professorship/Lecture Program.

The options for graduate students interested in participating are more open, as they can come up with their own program ideas. Students will develop their own proposals with their Brazilian or US hosts, who will likely be a professor in the same field of study in the host country. Up to $3,000 will be awarded to each student to use towards attending a short-course or summer institute, temporary lab work, visiting with a professor or research group.

A committee of representatives from both APS and SBF will review submitted proposals and choose the winning candidates. US awardees will be funded through the APS while Brazilian awardees will be funded through the SBF.

The first deadline for applications is April 30th this year. More information about the application requirements can be found on the website of the APS Office of International Affairs.

The new Brazil program is based on the similar India exchange program APS started in the fall of 2008. The India exchange program, coordinated with the Indo-US Science and Tech Forum, has turned out to be quite popular, with 16 professors and 24 grad students having participated so far.

Organizers of the Brazil exchange program expect it to be similarly popular with physicists in both the United States and Brazil. Irwin said that the APS has been making an effort to develop contacts and programs with countries with developing economies. She added also that the APS Committee on International Scientific Affairs is also looking at different ideas for possible future programs with China.

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APS Executive Board at its meeting in early February.

"We're trying to adapt to a world where energy independence is an increasingly important political concern. Getting away from fossil fuels and carbon use is another strong priority. The technology that has been developed to lead us away from these dependencies relies on these unusual chemical elements," said Robert Jaffe, a physicist at MIT and chair of the committee that wrote the report.

The report recommended that the federal government, spearheaded by the Office of Science and Technology Policy, do more to collect and disseminate information on the supply chain of hard-to-acquire "energy critical elements" and support more research into their production and reprocessing. The report said also, however, that, except for helium, it was not economically practicable to maintain stockpiles of energy critical elements. The report reiterated APS's 1995 Helium Statement which recommended that the United States, along with other countries, maintain a helium reserve.

Most of the recommendations in the report are slated to be part of a bill introduced by Sen. Mark Udall (D-Colo.). As *APS News* goes to press, the bill has not yet been introduced, but is likely to be proposed by the last week of February. Previous bills have addressed energy critical elements, but these new recommendations emphasize information sharing, research and recycling, rather than past approaches like mining and stockpiling.

"We really feel that this is not a partisan issue. The main recommendations don't bear the label of being either liberal or conservative. They typically deal with well established roles of the government like gathering and disseminating information," Jaffe said, adding also that all of the proposals are budget neutral and would not cost the federal government additional money.

Jaffe said that there's no single easy way to address the issues facing the supply of these energy critical elements, and a wide range of efforts is needed. "This is a very high level, strongly coupled set of problems that require an effort that goes across many different disciplines in both the public and private sector," Jaffe said. "The lifecycle of these materials is very complex and it touches on many aspects of our economy."

All together the study identified 29 elements critical to emerging energy technologies that are rare, difficult to mine or unavailable in the United States. Examples of such elements are indium, tellurium and germanium, all of which are important to the manufacturing of photovoltaic cells. Unfortunately, there are several problems with the supply lines for these elements. Tellurium is quite rare in Earth's crust, and is only produced as a byproduct of the refinement of copper and zinc ores. Sources of indium, though less rare, are found mostly outside of the United States, causing domestic industries to rely heavily on imports. Germanium is less rare than silver, but there are no geologic processes that concentrate the element into veins that can be mined economically.

"You're going to need vast amounts of these materials," Jaffe said, "There's a huge mismatch in what is going to be needed and what is being produced."

The study group came up with several suggestions to better secure supplies of these energy critical elements. For elements such as tellurium, gallium and indium, which are the byproducts of the refinement of more profitable metals, greater effort can be made to save the energy critical elements that are co-produced. Only a small fraction of the tellurium created by the refinement of copper is retained, and the report recommends finding an economic incentive for copper producers to save more of the element.

The report also says that a better job could be done recycling energy critical elements. Almost none of the selenium, also used in photovoltaic cells, is recycled. However it highlighted lithium, a critical ingredient to rechargeable batteries, as a possible model for more recycling. The report notes that while the amount of lithium currently being recycled is small, it has been growing because of greater demand for lithium-ion batteries.

Lithium is also an element possibly susceptible to geopolitical forces. Right now worldwide lithium production is dominated by three South American countries, Chile, Bolivia and Argentina. The report states that while importing critical elements is not inherently risky, supply lines are more easily jeopardized when limited to a small number of sources. There is a firm in the United States investigating possible refinement from the mineral hectorite, but production has not yet begun.

The report singled out helium as a unique element. It has many uses in cryogenics and because of its chemical and nuclear inertness it is critical for many nuclear reactor designs. The authors of the report recommended that the US helium reserve be maintained and replenished as helium is captured during the extraction of natural gas.

Jaffe said that the course he teaches at MIT, the Physics of Energy, was a major inspiration for the report. When researching photovoltaic cells, fluorescent lights and wind turbines, "I kept encountering the names of elements I only know from the old Tom Lehrer song."

Letters

APS Should Engage in Climate Change Debate

Thomas Wolfram and Sam Werner argue that the APS "should limit its activities and publications to scientific matters and avoid societal and political issues altogether." In response I would argue that global climate change IS a scientific matter–one that also possesses enormous societal implications, complicated by contentious political issues.

We live in an era of heavily funded think tanks, many of which become dedicated to an anti-science agenda whenever studies indicate an adverse effect on business as usual; e.g., global warming, the health effects of smoking, ozone depletion, acid rain, etc. As a counterbalance, it is essential that the relevant scientific societies such as the APS, ACS and AGU, take a public stand when the science is highly relevant to our long-term well-being. The scientific societies include our most knowledgeable individuals in these specific areas, whose research message needs to be transmitted to the public. When there is general accord among their respective memberships (about 90% in the case of global climate change), the scientific societies are a legitimate and perhaps the only vehicle for delivering their concerns to the public. Otherwise, those with the financial resources will control the debate, regardless of their scientific expertise.

So I applaud the actions of the APS Council for its statement on global climate change. The only perplexing issue for me is the question of why such a large component of the global climate change dissenters are old geezers such as myself (PhD 1961), who are no longer active in basic research. Where did I go wrong?

Vic Viola
Golden, CO

Physicists Need to Speak Out

Concerning the letter "APS should stick to Scientific Matters" [*APS News*, January 2011]: apparently, some physicists, Thomas Wolfram and Sam Werner among them, believe that climate change is a purely political matter.

I do not believe that this represents the views of the majority of physicists or APS members. Climate change, nuclear energy, anti-missile defense, and others are subjects where physicists, and APS members in general, have a special competence and should not hesitate to speak out.

Henry Blumenfeld
Gif-sur-Yvette, France

Societal Engagement is a Positive Step

APS has been taken to task in some letters for its stance on scientific issues that affect society, currently highlighted by the politically charged issue of climate change. While acknowledging the duty of individual scientists to be involved in issues that have a social and political dimension, some members believe APS should confine itself to a scientific ivory tower. A drift of the Society from a scientific agenda in the 1960s to a socially relevant agenda today has been cited specifically.

In my view, that drift is an appropriate reflection of the growing awareness of the American public during the past half-century to societal and environmental issues and how science impacts those spheres in which we live. Certainly such issues are also debated within the political arena, but I do not fear that the APS leadership is prone to political demagoguery on matters of science.

The opposite has been the case. The valuable Office of Technology Assessment was abolished by Congress in 1995 to prevent authoritative, unbiased knowledge of science and technology from challenging political agendas.

That being said, identifying members who formulate statements for the Society may be a positive step to achieve greater transparency.

Jim Stoffels
Richland WA

Need for Funding Distorts APS Mission

Confirmation of your own observations is always pleasant to see; in science, a necessity. The joint letter submitted by APS Fellows Wolfram and Thomas last month was thus very gratifying. And it sparked the question as to why the APS has evolved into a "social club" as opposed to (or in conjunction with) a premiere scientific organization. The answer would appear to lie in the need in the physics community for public funding. Public funding is certainly facilitated when the organization "toes the line" on social issues. The situation reflects the ultimate quid pro quo, or in some circles it may be called prostitution. When the APS focuses on social issues to facilitate funding, the question of organizational ethics should at least be acknowledged because the organization should focus all of its resources on physics without peripheral and circular arguments regarding "diversity" or any other social issue. Great intellects, regardless of ethnicity or gender, or any other barrier, can do great things in the field of physics if they so desire. Madame Curie, Lise Meitner and a host of others did.

John E. Rhoads
Wichita Falls, TX

Scientists Responsible for Effects of Their Work

Regarding the incorrect reporting on *Fox News* in connection with an APS member's resignation: I am writing because of the responses that defended the behavior of *Fox News*, and that suggested that scientists should just stick to scientific matters.

I could not disagree more. First of all, I wholeheartedly agree with the actions of the APS Council and its current statement regarding the Climate Change issue. Also, it is clear to me (and I assume to most fair and balanced members) that if *Fox News* wished to clear up the erroneous reporting, inviting the APS President to explain the situation and restate the APS position on Climate Change would have been the obvious right thing to do. Apparently, they don't agree.

That there are APS members who cannot even agree on this is very surprising to me. That there are members who believe that scientists should stick to science, strikes me as both a very simplistic idea to have and a cowardly attitude by some working in the scientific community. As a physics student at the University of Heidelberg, I had many a German physics professor who would remind us that we must take at least some responsibility for the work that we as scientists produce. We have a responsibility to try to improve the well-being of mankind and not to help destroy either human beings or the environment in which we live. Sure, we all have to make a living, but we also have to look at ourselves in the mirror each day, and explain what we have done, and why.

I have been increasingly disturbed by the anti-science atmosphere in our country, particularly within the last 10 years (which has been well documented by e.g. the Union of Concerned Scientists). But I was even more surprised, while attending the New England APS meetings, to find many speakers presenting amateurish and fringe ideas about Climate Change with a political bias, while no reasonable mainstream views on Climate Change were being presented as a counterpoint. Mainstream scientists have to be out there vigorously defending their scientific findings against politics and corporate interests. Otherwise, in this political climate we, the scientific community, will lose the support and attention of the general public, something we cannot afford to do.

Either you care about the potential of science to help solve problems and improve the world, or you don't. Unfortunately, unless we sometimes dirty your hands with politics, we shall lose support for science in this country, and that includes losing support for funding basic research and innovation. Of course, if that happens those with their heads in the sand might find themselves unemployed.

Peter Somssich
Portsmouth, NH

Member Actually Reads APS Constitution

Robert Levine in his 4 December letter about establishing a Topical Group on the Physics of Climate states that "The Topical Group (TG) Petition was conducted in accordance with Article VIII, Section 1 of the APS Constitution http://aps.org/about/governance/constitution.cfm, under which two hundred or more APS members may petition the Council to establish a TG. Two documents are required for the TG to be considered and established, an Area of Interest statement and Bylaws."

This caused me to read the APS Constitution, which contrary to Levine's implication neither requires the Council to establish the TG based on a petition, nor grants the petitioners the right to have their Area of Interest statement and Bylaws automatically approved by the Council. In fact the Constitution requires that the Council consult with all Divisions and Topical Groups before approving any new Topical Group. While it is silent about consulting with the broad membership, there is nothing forbidding this, and given the availability of email, doing so in my judgment was prudent. With respect to Bylaws, again, the Constitution places "ultimate legal and fiscal responsibility" for TG in the Council and requires the Council to review and approve or disapprove all Bylaws. Draft Bylaws submitted by petition are not privileged.

My sense of this is that petitioners may ask the Council to establish a new unit of the society, but they are not the constituting body, that before the Council approve the creation of a new TG, the entire membership of the Society shall be offered a choice to join to gauge interest and gather information, that the Council is free and it is indeed prudent for the Council to appoint an ad hoc committee to draft Bylaws and and Area of Interest statement, and finally, that the ad hoc committee, as a creation of the Council would be wise to take the documents of the petitioners into account but should solicit information from the Divisions and other units as well as the broader membership.

However, there is an underlying serious issue that the Council and the ad hoc committee should consider. Topical Groups are to be set up to "to advance and diffuse the knowledge of a specific subject or subfield of physics." On the other hand, a Forum is an organization to advance and diffuse knowledge regarding the interrelation of physics with matters not exclusively in physics. This appears to better fit the physics of climate, which shares important aspects with many other sciences, including meteorology, geology, geophysics, chemistry, ecology, etc.

Joshua Halpern
Washington DC

Evidence of "Scotch Tape" Use Proliferates

The "'scotch tape" technique for thinning crystals was in use in the late 1950s and 1960s in the UK, where the tape was called sellotape. We used it to thin crystals of molybdenite for optical absorption measurements, see the Frindt and Yoffe paper; *Proc Roy Soc* **273A**, 89 (1963), where the work began in the end of 1959 by R.F. Frindt, who was my research student then. Frindt at Simon Fraser University developed the procedure further on, and in 1966 showed he could obtain single crystals of MoS_2 several molecular layers thick; see *J Appl Phys* **37**, 1928, (1966). Since then single layer samples have been prepared many times, and most recently a single layer transistor formed using molybdenite has been described by Radisavljevic et al in *Nature Technology Letters* published online 30 Jan 2011.

A. D. Yoffe
Cambridge, UK

Back Page Leaves Unfortunate Impression

I was disappointed to see a great arrogance of science expressed in the Back Page article [*APS News,* January 2011] by Sheila Tobias: "... the problems an able science teacher presents his or her students are not like (elementary) mathematic problems yielding to a single right answer, but are more like puzzles inviting discussion and dissent." While certainly correct, Tobias gives the impression that this point does not apply to literature, history and other subjects. Such an attitude impedes making common cause with teachers in other areas, which is likely to be a more successful approach to many problems in education, including those referred to in the article.

Terry Goldman
Los Alamos, NM

Pulsed Van de Graaff Proved a Useful Tool

The excellent review of the history of the Van de Graaff generator and its role in the history of physics in the February number of *APS News* warrants some extension.

The generator was of course admirably adapted to the acceleration of charged particles. But with the discovery of the neutron by Chadwick in 1932, it soon acquired an enhanced role both as a source of neutrons and as a tool for spectroscopic investigation of neutrons produced in nuclear reactions.

It soon proved useful in both roles. The interaction of energetic hydrogen isotopes became a standard means of production of monoenergetic neutrons in the laboratory, and in the early sixties pulsing of the output of the Van de Graaff made it an admirable means of measuring neutron energies in

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President Will Mount Vigorous Defense of Science Funding, Says Advisor Holdren

Physicist John Holdren became Science Advisor to President Barack Obama in 2009. He serves as Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST). Holdren holds degrees in aerospace engineering and theoretical plasma physics from MIT and Stanford, and prior to his appointment was Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy at Harvard University's Kennedy School of Government, as well as professor in Harvard's Department of Earth and Planetary Sciences, and Director of the independent, nonprofit Woods Hole Research Center. This interview was conducted by *APS News* reporter Alaina G. Levine on February 18 at the American Association for the Advancement of Science Annual Meeting in Washington, DC.

Q: House Republicans want to make huge cuts to funding for scientific research in FY2011, but President Obama's proposed budget for FY2012 increases funding for scientific research significantly. Can you go into some detail regarding how high a priority science and scientific funding is for the President? And how hard will it be to fight for this?

A: There are two questions embedded there. The first one is the easiest–how high a priority this is for the President. It is a very high priority for him because he understands that science, technology, and innovation are the keys to our economic future, which obviously is so important, as well as keys to our environmental future, to our energy future, our national security. He said very aptly when he was speaking in North Carolina about this issue a couple of weeks ago that if you're worried about your airplane being overloaded, you shouldn't throw your engine overboard to make it lighter, and he was referring to the fact that science, technology and innovation have been the engine of our economic growth over the last 50 years. The largest part of our economic growth has been due to science, technology and innovation and their applications in the marketplace, in the factories, in the fields, so the President doesn't want to throw the engine overboard. He's been very clear. I don't think any president has ever talked as much or as enthusiastically or as knowledgably about science, technology and innovation as this President has, and one can't doubt the priority it is for him when you look at the task that he has faced in keeping the budget flat, frozen in the discretionary, non-defense part of the budget which is about 12.5% of the total budget, and everybody's trying to take the cuts out of that little segment. It's going to be a challenge to argue with the Congress about this. But I am optimistic, because I think betting against this President when he's determined is probably not a good bet, and he's not going to give up on his commitment and understanding of the importance of investing in science and technology.

Q: Whatever happens, you feel and the President feels that the nation's scientific enterprises –the NSF, national labs, NASA and so forth - will emerge in good shape this fiscal year?

A: We are determined to make this happen. That's our proposal and we plan to defend it vigorously.

Q: What can the physics community do to help you and the President prevail?

A: I think one of the things that is important for scientists of all disciplines, not just the physicists, is to become more engaged in making the case. It seems self-serving and self-interested for scientists to talk about how important science is, [but] we really need to do it and we need to make the case in terms of specific stories of ways in which advances that people have been involved in or know about in science have led to improvements in the quality of life, led to new products, new businesses, new jobs. And of course I am not suggesting that physicists should stop talking about the plain excitement of science and the expansion of knowledge, because that's very important too. We understand it's not only about solving practical problems that the country faces today, but it's partly about who we are as human beings that we want to understand ourselves, the Universe around us, our place in it, and in fact, part of the interesting stories that need to be told are how we inspire more young people to go into science and math and engineering by talking about the excitement of discovery.

We need to get more kids excited about science and math and interested, and in fact the PCAST report on this subject had as its subtitle "Inspiration and Preparation." Those are the two fundamental ingredients–we have to get better at inspiring kids and preparing kids.

Q: The President is requesting no funding for the Deep Underground Science and Engineering Laboratory, or DUSEL, in the former Homestake gold mine in Lead, South Dakota, Is DUSEL part of the President's priorities? Will it ever be built?

A: The National Science Board recommended against NSF's continuing participation in DUSEL, which is obviously causing some consternation in the other governmental sponsor, the DOE. The DOE, however, still is engaged in DUSEL and there is funding for DUSEL over the year ahead so DUSEL is not going away in this budget, but the NSF's participation is; I don't want to quite say "going away" because I believe in the last week an agreement has been reached between NSF and DOE where NSF is going to contribute a bit of money to the continuing pumping that is needed to get the water out of there. [*Ed. Note:* APS News *has confirmed that NSF will allocate about $4 M for this purpose.*] I think it's fair to say that the DOE will be thinking about the best path for DUSEL over the next year, but DUSEL is

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APS Develops Mentor Training Guide

By Gabriel Popkin

A new publication will help physics researchers enhance their mentoring skills, thereby improving the research experience for the next generation of physicists. In collaboration with staff members from the Wisconsin Center for Education Research (WCER) at the University of Wisconsin-Madison, APS has developed a guide for facilitating a training seminar to be given to physics faculty, postdocs, and graduate students who are in mentorship roles.

This publication is part of a series of guides developed by WCER staff members, who reported in a 2006 *Science* article that research mentors who have undergone training communicate more effectively with their mentees, and are more likely to engage mentees in discussions on topics such as diversity and student expectations. According to the article, undergraduates report having better experiences with trained mentors than with mentors who had not received training.

The physics guide was prepared by a team consisting of two faculty members, a postdoc, and a graduate student from the physics community, as well as two staff members from WCER, who were supported by the National Science Foundation-funded Center for the Integration of Research, Teaching and Learning Network. This team was convened by Monica Plisch, the Assistant Director of Education at APS, who found out about the seminar series during a visit to the university.

"I immediately realized that these resources could benefit the physics community," Plisch says. The physics guide fills a gap in the Wisconsin series, which previously included mentor training manuals for math, chemistry, and astrophysics researchers, but not physicists.

The guide includes themes such as establishing expectations, maintaining effective communication, addressing diversity, and dealing with ethical issues. Within each topic, the guide provides learning objectives, suggested activities and assignments, and case studies for discussion, along with discussion guides. The manual also includes a broader set of mentoring-related resources for facilitators.

"The team that put the physics manual together made some adaptations that enhanced the curriculum overall," said Christine Pfund, a WCER staff member who led the development of previous subject guides, and was involved in the preparation of the physics guide. "We're now planning to go back and add some of these features to our existing guides."

Cathy Mader, a physics professor at Hope College who led the effort to revise the guide for physics researchers, said that leaders of Research Experience for Undergraduates (REU) programs strongly supported the development of the physics guide. "Just as professors are expected to teach without any pedagogy training, we expect them to mentor without any formal mentorship training," Mader says. "This new resource will help physicists develop the

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Letters (continued)

the MeV range by their time-of-flight.

It should be noted that the conversion of the dc beam of the conventional Van de Graaff to operation as a source of ion bursts of nanosecond duration is also to be credited to Robert J. Van de Graaff. In a 1952 paper to the Denver December Meeting of the APS, he described an ingenious system of ion beam deflection in combination with a special magnet to condense ion bursts of ten nanosecond duration to less than one nanosecond (1).

Many such systems soon became operational in low-energy nuclear physics laboratories around the world and provided a rich source of data on the interaction of neutrons in the MeV range, of importance to theories of nuclear reactions, and to neutron applications to problems of nuclear reactor design for energy and military uses.

[1]. L. Cranberg, R. A. Fernald, F. S. Hahn and E. F. Shrader, *Nuclear Instruments and Methods* **12**, (1961) 335-340.

Lawrence Cranberg
Austin, TX

Morning Coffee

by Michael S. Lubell, APS Director of Public Affairs

For me, morning without coffee is like breathing without oxygen. It's a killer. Much the same can be said about the House budget plans for science that Republicans are pressing as a prerequisite for keeping the government functioning for the balance of the fiscal year.

It's not that Republicans have it in for science. It's not even that Messrs. Boehner–the House Speaker from Ohio's 8th District whose lachrymose spigots always seem to malfunction–and Eric Cantor–the Majority Leader from Virginia's 7th District whose high ambitions complement his intellectual acumen–want to cripple the federal government and the technology-driven American economy. It's simply that elections have consequences.

Two years ago, just three days after Barack Obama's Administration opened for business, Cantor, who was then the GOP Whip, attended a White House meeting with congressional leaders from both parties. Armed with a to-do list for the economy, Cantor made his case for small business tax cuts. Obama, whose economic team had its own ideas about how to get the American economy back on track, rejected Cantor's proposals, punctuating his rebuff with this bit of chest thumping: "Elections have consequences, and at the end of the day, I won."

Scroll forward two years, and it's Republican swagger that is grabbing at the reins of overreach. It's not Boehner or Cantor, per se, but rather the House Republican Study Committee (RSC) that is driving the GOP agenda, and, if reports from the Hill are correct, driving Boehner and Cantor bonkers. The RSC espouses conservative social and economic values, that some observers argue go well beyond the historical bounds of Republican tradition.

But, beefed up by the election of dozens of Tea Party adherents, the RSC has become a potent force within the House simply by virtue of its numbers; 175 of the 242 Republicans in the 112th Congress belong to it. And they are not shy about denouncing federal programs and federal spending that do not fit the mold of a constitutionally limited government, which within their ideology must properly focus only on "a strong national defense, protection of individual and property rights and preservation of traditional family values." For many members of the RSC, science is just one more example of the federal government run amok.

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Bygone Years

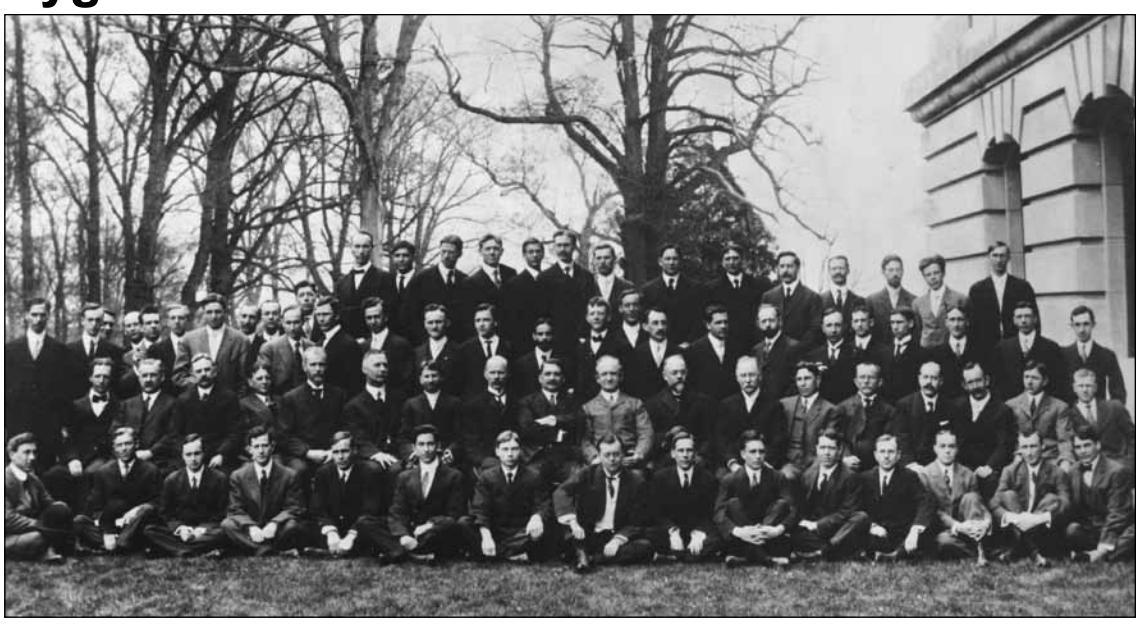

Photo prepared by Mary Catherine Adams

While cleaning out an old storage area, we happened on this photograph from the APS spring meeting in 1910, held at the campus of the National Bureau of Standards in Washington, DC. There are 74 people in the picture, none of whom we can identify (for those who wish to try, a larger version of the picture is available online on the *APS News* website). Society membership stood at roughly 500, so allowing for attendees who may not have made the picture, the meeting drew between 15 and 20% of the membership, about what the March Meeting does today. The NBS hosted many APS meetings over the years, annually from 1907 to 1941, and again from 1948 to 1965. In that year, NBS moved from Washington to Gaithersburg, MD, leaving APS to find other venues for its meetings.

One can learn several things about the effects of the passage of time from this picture. For one thing, it's been a long time since all the attendees at an APS general meeting could be assembled for a single group photo. For another, it's been a long time since the attendees at an APS meeting were uniformly white and male. And finally, it's been a long time since the expected attire for meeting attendees was a suit, white shirt, and tie.

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tional Synchrotron Light Source would be suspended.

"In the process American science, at least in terms of major facility usage, comes to a screeching halt," Lubell said.

Patrick Clemins, director of the R&D Budget and Policy Program at the American Association for the Advancement of Science, said that, taken as a whole, scientific research is on balance not in as terrible shape as it could be.

"When you look at the total cuts…research and development looks better than average," Clemins said, adding that research and development makes up about 12 percent of the federal nonmilitary discretionary budget, but comprises only about 5 percent of the cuts.

"The Republican leaders, John Boehner, Eric Cantor, Paul Ryan and so forth, are not intent on shutting the government down… they would probably admit that they don't want to harm American science. They understand the importance of it," Lubell said. "They have to pay attention to the majority of the Republican conference."

Adding to the uncertainty about the future of science funding is the proposed 2012 budget released by the President. In it, the budget for numerous research programs gets significant increases, despite cuts in other governmental programs.

"The 2012 budget is the exact opposite side of the coin at least in terms of nondefense research and development," Clemins said.

All together the President's proposed budget calls for a 6.5 percent increase for research and development compared to 2010, largely in areas where Congressional Republicans are proposing cuts. This includes a 16 percent bump to the NSF budget, a 9 percent increase in the Department of Energy's Office of Science and nearly a 50 percent increase to NIST's budget.

The uncertainty comes in because the 2012 budget will be greatly influenced by whatever funding levels are finally approved for 2011. The continuing resolution will likely pass the Republican controlled House largely intact, the Democratic led Senate will likely raise objections to the deep cuts, and the final budget will fall somewhere in the middle.

The severity of the final cuts will play a major role in determining a baseline for the 2012 budget debate to follow. If Republicans are successful in getting the deep cuts into the final budget, it will be difficult for the President and Democrats to raise funding to the proposed levels in 2012.

Lubell said that because the 2011 budget isn't settled, he sees the President's budget more as a political move to reaffirm his support of science and research among voters. Lubell is skeptical that the increases in the 2012 budget will pass in anything resembling their current form.

"It's pretty clear that Congress won't accept them, so why do that?" Lubell said. "[The 2012 budget] is a statement of the administration's priorities. The President made it very clear that among his high priorities are science and education…The fact that his 2012 budget maintains support for those areas is no surprise."

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as downloadable podcasts that can be accessed by the general public and educators.

"The main idea is that Hispanics don't have too many role models to get inspired about studying science," said Jorge Lopez, a professor at the University of Texas at El Paso. "It's going to be composed of capsules that will be distributed to many radio stations showcasing Hispanic scientists and telling what they do."

Lopez has done work with Spanish language radio programs in the past. For 15 years, he helped produce "Universo," a radio segment for Spanish radio about space and astronomy.

Another program is the "Full Body Physics Project" which incorporates videogame systems in teaching physics to a youth audience. The team will develop a videogame where understanding the physics of the universe is critical to beating the game. Each environment of the game would be modeled around a physics concept, such as electricity, mechanics, aerodynamics and even nanoscale assembly. The videogame will operate on Microsoft Xbox 360 Kinect, one of the best-selling consoles currently available. The game will be freely distributed through the console's online marketplace, providing access to more than 20 million registered users.

Other programs include a contest called "Flip for Physics," which give students flip cameras to interview researchers and produce a short video based on that interview. The students selected with the best entries will win the flip cameras. Another contest, "The Science of Every Day Materials," will distribute kits with raw materials for students to use their ingenuity to create their own science fair projects based on the physics of fluids and granular materials. The winning projects will then go on display at the Springfield Science Museum in Massachusetts. The "Einstein on your iPhone" project will produce a series of video podcasts showing how the technology in a mobile phone can trace its roots to basic research.

The first APS grants for outreach were awarded in 2005 during the World Year of Physics, celebrating the centennial anniversary of "Einstein's Miracle Year." The program was revived in 2010 for LaserFest, celebrating the 50th anniversary of the first working laser, and is now a pilot program with funding for the next three years.

Information about all 6 of the grant recipients can be found on the APS website for the public, PhysicsCentral, www.physicscentral.com.

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continue to have "hybrid" access policies, as some of the articles will be open access while others won't. The decision to implement the new initiative comes after a careful study of its potential effect on journal income. The fee to take advantage of the new initiative is $1700 for *Physical Review A-E* and $2700 for *Physical Review Letters*. Authors are not required to participate in the program and papers that have not had the license purchased for them will be subject to the journals' standard copyright policies.

"We've been thinking about it for a long time and the time finally came and we decided we should do it," said APS Editor in Chief Gene Sprouse. "A few years ago quite a few authors talked with us about derivative works; they wanted to reuse parts of their articles." Sprouse added that several scientific agencies, especially in Europe, require papers to be published under free and open access agreements.

Two years ago APS started allowing authors to reuse portions of their articles for derivative works. The policy allows authors to reuse 50 percent or less from a published article. If authors choose the new open access option for an article, they and anyone else will, via the Creative Commons license, be able to reuse any portion of that article for any purpose, as long as the original work is cited.

Creative Commons is a nonprofit corporation that provides free licensing agreements to content authors, artists, and other content providers. The Creative Commons Attribution 3.0 license gives anyone the right to freely access, distribute, and adapt the papers as long as the original work is properly credited. The Attribution 3.0 license, also known as CC-BY 3.0, is the most generous license for readers and other users.

APS has been moving to incorporate more free and open-access policies into its journals. *Physical Review Special Topics–Accelerators and Beams* and *Physical Review Special Topics–Physics Education Research* started as free access journals, and converted to fully open access journals with the adoption of the new initiative. Articles published in *Physical Review X*, APS's newest journal [see story in the February *APS News*, available online], will also be open access and published under the terms of the CC-BY 3.0 license. In addition, and as a part of a special agreement with CERN, experimental LHC papers are being published similarly.

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Viewed through such a lens, it's no mystery that the $100 billion in cuts to civilian discretionary programs that the RSC has demanded from the balance of the current fiscal year does not grant science a waiver. And it's no mystery that Boehner and Cantor have agreed to advance that agenda. If they don't march in lockstep with the RSC, they could lose their leadership positions.

President Obama was right: elections do indeed have consequences. Boehner and Cantor know it, and if scientists haven't yet recognized it, the coming months will drive the point home.

But as the President's fiscal year 2012 budget request demonstrates, we're far from a science Armageddon. Although the White House plan for the coming year is austere by comparison with recent big-spending budgets, it checks a high-priority box for research and education. As the debates over deficit reduction, taxes and spending unfold over the coming months, it is at least comforting to know that the current resident of the White House is committed to sustaining the momentum established for science by his Republican predecessor, George W. Bush, in his 2006 American Competitiveness Initiative.

But as Tea Party extremists have begun to dig deep trenches, it is possible the ensuing budget battles will sweep away the non-partisan ground that science has traditionally occupied. And if it does, we will all be worse off. We will lose economically and intellectually. We will lose jobs and high-tech manufacturing. We will lose our leadership in discovery and innovation. And at a time when other nations are getting ready to eat our technological lunch, we will be serving it to them on a fine set of china. It's enough to cause nightmares.

But if we wake up soon enough, we'll still find the morning coffee brewing, and we'll be able to meet the challenges of another day.

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skills they need as research mentors."

Good mentorship is also broadly recognized as being important to increasing the diversity of the physics community. Vanderbilt University physics professor David Ernst plans to use the guide to give workshops at events such as meetings of the National Society of Black Physicists and the National Society of Hispanic Physicists, as well as at his own university, which is a partner in the Fisk-Vanderbilt Masters-to-PhD Bridge Program. Ernst, who was also part of the preparation team, says, "This guide will be a nice way to help physics faculty understand their crucial role in preparing future researchers."

The training guide will be available on the APS website at www.aps.org/programs/education/undergrad/faculty as well as on the University of Wisconsin's website at http://researchmentortraining.org.

In addition, APS staff members are organizing workshops entitled "Improving Your Skills as a Research Mentor" at this year's March and April Meetings. More information and registration are available on the meeting websites.

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in its budget. Our hope is that we are going to get Congress to appropriate these monies.

Q: The Tevatron at Fermilab is scheduled to be shut down. Can you speculate what could happen to Fermilab in the future? Will it become a lab without a mission?

A: The Tevatron has done wonderful things, we've learned a huge amount from the Tevatron, but it no longer looks like the most efficacious way to find the Higgs and I have to say we made a lot of tough choices in this budget. There are a lot of things that are clearly worthy that we would have wanted to fund in times that were fiscally not quite as constrained. People should not assume that things we had to cut or reduce we cut or reduced because we thought they were lousy ideas, but we had to make very tough choices between higher and lower priorities and the fact that in this fiscal environment we were able to do as much as we were for fundamental science as well as applied science I think is quite remarkable. But I'm not happy about some of the things we had to cut.

Q: What are the prospects for Senate ratification of the Comprehensive Test Ban Treaty? What kind of a priority is this for the President?

A: Clearly we felt we needed to get the New START agreement ratified before we could go to the Senate with the CTBT. I believe and the President believes that getting the CTBT ratified is important. There is always a process of determining how many major issues one can manage with the Congress at one time, and I suspect that the focus in the very immediate future is going to continue to be on the budgets, but I am confident that we will go to the Senate with the Comprehensive Test Ban Treaty and that we'll do it when we're in a position to be confident of getting the votes.

Q: The issue of Cap and Trade seems to be dead with the current Congress. What is the President's plan to reduce carbon emissions in the US and how does he intend to implement it?

A: We believe that putting a price on greenhouse gas emissions is one of the most effective ways to get onto the trajectory we need to reduce those emissions over time. Doing it with a price on carbon emissions is a market-oriented solution–it creates incentives for the ingenuity that's out there in the private sector to develop the most cost-effective ways to reduce emissions. We think there ought to be bipartisan support for reducing greenhouse gas emissions in these market-based ways, but we obviously failed to get that support in the last Congress. The circumstances in the last Congress were more favorable to getting such legislation through than in this Congress, so one has to assume that the likelihood of getting such legislation through in the next two years is pretty low. We will do everything else we can to address the climate change challenge both on the mitigation side and on the adaptation side, but we're probably not going to have the benefit of a price on carbon in the next two years. After that, predictions about the future are difficult. An optimist in this domain might believe that after 2012 we will have a Congress more amenable to doing this. I think there are pretty good reasons to believe that the willingness to do what makes sense will go up over time. One of those reasons is that unfortunately the symptoms of damage from climate change are highly likely to continue to increase and that means over time more and more people will become more convinced of the need to act and to act in a perhaps more vigorous way than what we're already doing. We're doing a lot already with clean energy technology, and various policies and technologies to increase the efficiency of energy use, and we can do a lot beyond the trajectory we need to be in the next two years without having the price on carbon, but ultimately were going to need it.

Q: In regards to the US position on the world stage of science and our loss of preeminence: I know you and the President are establishing many educational programs that perhaps in the long term can help restore the US reputation as the scientific leader. How else can we stem the tide of Americans not being considered the top scientists or science students?

A: That's a complicated question. Number one, the United States is still the world leader in many domains of science and we still get far more than our share of Nobel Prizes. We are still doing fantastic scientific research in a wide range of domains. Our universities, and particularly our great research universities, are the best in the world. Students from the countries that we worry about being ahead of us, flock to the United States to go to our universities and they do it for good reason, so we should not overstate the predicament. We need to do better in science, technology, engineering, and math education, and we need to do it for at least three reasons. One reason, of course, is that we want to inspire and educate the next generation of Nobel Prize and National Medal of Science [winners]. But we also need to lift our game in STEM education in order to have the technology-savvy workforce that the 21st century is demanding, and we need to have the science-savvy citizenry that is essential to a well-functioning democracy where more and more of the policy issues that are before the public and before their representatives have science and technology content. So there are a lot of reasons that we need to lift our game in STEM education, not just the idea that we have to be number one in Nobel Prizes. But again I'm optimistic. There's a tremendous amount of creativity and ingenuity in this country, and as we improve our capacities in STEM education, we're going to inspire more kids to go into these fields and more of them are going to turn out to be superstars and ultimately we're going to do well.

ANNOUNCEMENTS

The Weimer award is open to any female plasma scientist who received her PhD within the ten-year period prior to April 1, 2011. Nominations are active for one selection cycle (three years).

The award consists of $2,000 and funds for travel to the annual meeting where the award is to be presented. The recipient will be invited to give a talk at the Division's annual meeting.

To nominate a candidate, send the following to **women@aps.org**:

- *A letter evaluating the nominee's qualifications and identifying the specific work to be recognized*
- *A biographical sketch*
- *A list of the most important publications*
- *At least two, but no more than four, seconding letters*

Deadline is April 1, 2011.

www.apsdpp.org/prizes_awards/katherine_weimer.php

Division of PLASMA PHYSICS

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MIT (Session J35.08, J35.10 and J35.12) will explain how they plan on using photons to probe the flow of electrons through the materials. Kesong Yang of Duke University will talk about 40 new materials discovered to be topological insulators (session X32.05).

The Graphene Scene

Graphene's prominence in recent years was emphasized when Andre Geim and Konstantin Novoselov won the Nobel Prize for physics in 2010. Scientific research into the two-dimensional sheets of carbon, and related carbon nanotubes, has been going strong since it was first isolated six years ago. At this year's meeting, Ming Xu of the Technology Research Association for Single Wall Carbon Nanotubes and the National Institute of Advanced Industrial Science and Technology in Tsukuba, Japan, will discuss a new rubber-like material made of carbon nanotubes that retains its elasticity over temperatures ranging from nearly -200 C to 1000 C. In lab tests, researchers dipped the material into liquid nitrogen and burned it with a butane torch without any appreciable effect (session B28.07). In addition, session B37 "Focus Session: Graphene Growth, Characterization, and Devices: Devices and Contacts" will feature a talk by Walt de Heer giving an overview of the promise of graphene, as well as the announcement of new devices and applications for graphene, including radio frequency transistors, logic inverters, and flexible transparent field emission devices.

Finding the Purest Germanium

Dongming Mei of the University of South Dakota will describe a method to grow germanium crystals deep in the underground tunnels of the planned DUSEL experiment in Lead, South Dakota. Though more abundant in Earth's crust than silver, germanium is difficult to find in any appreciable quantity because there's no geologic process that concentrates the element into minable veins. Mei's team will show how to identify impurities in the fully grown crystals that will be used to hunt for evidence of dark matter, neutrinos and cosmic rays (session A11.12). The germanium crystals, which can be up to several pounds, will be part of detectors that register when the kinetic energy of a particle hits a germanium nucleus.

X-Ray Archeology

Three physicists from Cornell University have developed a technique using X-rays to see eroded or obscured writing on ancient artifacts (session W21.13). X-ray fluorescence highlights chemical traces left behind by the tools of ancient artisans, even if the markings themselves are gone. The technique holds much promise for future archeological work as it doesn't require any special sample environment to work in, doesn't damage the artifacts and can be used on any-sized object. Recently the team has started using X-ray fluorescence to investigate ancient Mayan relics and has already revealed previously obscured writing on a number of artifacts.

Ghost Lasers in the Sky

A team of researchers at Texas A&M University, with help from collaborators at Princeton and the University of Arizona, are developing a laser system that can sample pollutants in the upper atmosphere from the ground (sessions W45.13 and W45.14). The system starts out by shooting pulses of two different colored lasers into the sky in rapid succession. Because different wavelengths of light travel at slightly different speeds in a medium like air, the longer wavelength pulse will overtake the shorter wavelength pulse and excite the air molecules when it does. This sends a laser-like pulse, a "backwards-emitting pulse," back down the beam line. The team can then spectroscopically analyze this backwards beam created by the excited air molecules.

Teeny Tiny Antennae

The world's smallest antenna has been created by researchers at the Institute of Photonic Sciences in Barcelona. Built out of nano-sized rods, the tiny antennas redirect photons emitted by quantum dots. The team announced its first workable model in August 2010, and now has created a variety of different nano-antennas that could be used to detect signals from biological molecules or to act as connections in future quantum computers (session B32.04).

How Much of an Impact Can One Scientist Have?

Alexander Petersen and Eugene Stanley of Boston University have come up with a new technique to gauge the scientific impact of a physicist (session B14.04). The two researchers looked at the careers of 200 scientists, ranging from assistant professors to Nobel laureates, and found a surprising statistical regularity in careers, which can be modeled. With their "beta-index," which looks in part at the number of publications by a scientist and the number of times they have been cited, Petersen and Stanley say they can quantify how popular a scientist's papers are, and track his or her career development.

The Back Page

What I found in Yongbyon and Why It Matters

Siegfried S. Hecker

On November 12, 2010, during my most recent visit to the Yongbyon nuclear complex, North Korean scientists showed me and my Stanford University colleagues, John W. Lewis and Robert Carlin, a small, recently completed, industrial-scale uranium-enrichment facility and an experimental light-water reactor (LWR) under construction. Although I had long ago concluded that North Korea has a uranium enrichment program, despite Pyongyang's vehement denials, I was stunned by the sight of 2,000 centrifuges in two cascade halls and an ultramodern control room.

These findings raise troubling questions about how North Korea's program got this far and the nature of the threat it poses. Moreover, in the wake of recent military altercations between the two Koreas, what we saw highlights the necessity of a careful review of what we know about the nation's nuclear program–and what we don't–so we can prevent a further nuclear buildup and forestall the potential export of fissile materials and technology.

Unlike what was widely reported in the news media, we did not discover secret North Korean facilities. Pyongyang showed them to us because it wanted the world to know, and it chose us to report its nuclear advances because they trusted us to do so accurately. This trust came from a long association with North Korea's diplomats and professionals through non-official, non-governmental (Track II) visits.

I made my first visit to North Korea in January 2004 at the request of Lewis, who had a long relationship with North Korea. We were invited at the time because Pyongyang wanted to show that they had reprocessed the spent fuel that had been stored, per agreement, under international safeguards for eight years. Yongbyon technical specialists showed us key nuclear facilities that had been frozen during the U.S.–North Korea Agreed Framework, but restarted because of a 2002 altercation with the Bush administration that prompted Pyongyang to withdraw from the Nuclear Nonproliferation Treaty. Their goal was to send a message to Washington that they had the bomb; they went so far as to show me and let me hold a sealed glass jar with a 200-gram plutonium metal sample. Since then, I have returned to North Korea each year–seven visits in all, including four to Yongbyon – and Pyonyang used my most recent visit to tell the world about its LWR and enrichment program.

Pyongyang has seriously pursued LWRs for more than 25 years. In 1985, it struck a deal with Moscow to provide two LWRs, but the deal fell through with the demise of the Soviet Union. The 1994 Agreed Framework was an attempt to replace its indigenous gas-graphite reactors with LWRs, which are good for electricity but less suitable for bombs. Shortly after the North's April 2009, long-range rocket launch and the predictable UN condemnation that followed, Pyongyang announced it would build its own LWR. In November, our Foreign Ministry host told us "no one believed us when we announced this in 2009, including you, Dr. Hecker."

Pyongyang's interest in building LWRs for electricity represents a major shift in its nuclear strategy, and I believe this interest is genuine. Pyongyang appears prepared to abandon its plutonium program by shutting down its 5 Megawatt-electric (MWe) gas-graphite reactor, give up on external assistance for an LWR, and proceed with its own program, beginning with the small, experimental 25 to 30 MWe reactor before proceeding with larger power reactors. Although it is technically possible that the LWR will be used to produce bomb-grade plutonium, such a scenario is unlikely. Plutonium from an LWR is much less suitable for bombs than the plutonium already produced in the 5 MWe reactor. If Pyongyang wanted more plutonium bomb fuel, it would simply restart that reactor, not build an LWR. Yet construction of the experimental LWR raises different concerns: can they do it safely, and will the enrichment program lead to additional weapons or export? The answers to both questions are troubling.

I have serious concerns about the design and whether North Korea can operate an LWR safely. I was told that a new team of young engineers, rather than their experienced gas-graphite reactor engineers, designed the LWR. To our knowledge, Yongbyon specialists have no experience in dealing with key LWR design and safety issues. For example, many of the reactor components, such as the pressure vessel and steam generator, require radiation-resistant steels and stringent fabrication and welding specifications so as to withstand intense, long-term radiation environments. The rest of the world has developed strong technical and regulatory links to deal with these challenges, particularly after the Three-Mile Island accident. North Korea has never been part of such collaborations. Moreover, we found they

have little experience with uranium oxide fuels and Zircaloy cladding materials, which are typical for LWRs. We found the concrete work for the reactor of most immediate concern. The foundation appeared insufficiently robust and the containment shell was being poured in small sections from a small concrete mixer, not in keeping with nuclear-grade concrete pouring requirements. These concerns will increase dramatically if Pyongyang proceeds with plans for larger power reactors. Operating LWRs with inadequate construction and operational safety standards and practices poses risks beyond the North's borders.

I am also concerned that North Korea's enrichment program might lead to the development of additional weapons or the export of fissile materials. What we saw at the Yongbyon enrichment facility points to Pyongyang's interest in highly-enriched uranium (HEU), which can be produced with slightly reconfigured centrifuge cascades and used as bomb fuel. As we entered the newly renovated building, the chief process engineer told us "we did not want to show you this facility, but our superiors told us to do so." From the second-floor control room we were amazed at the sight of three rows of pairs of centrifuges in the high-bay halls extending 50 meters in both directions. In the modern control room with blinking LEDs and flat-panel monitors, we were told that 2,000 centrifuges in six cascades were operating, producing low-enriched uranium (LEU) for the LWR under construction. We were hurried past the control room and through what they called the recovery room, which allowed us to see some of the uranium hexafluoride gas handling systems and tanks. Because of the hurried pace and limited access, we are not certain that the centrifuges were operational, but what we saw was not inconsistent with a partially or fully operational facility. I was able to get the chief process engineer to tell us enough to conclude that the centrifuges are of a second-generation, P-2, design with a capacity of 4 separative work units (SWUs)/year per machine. The 8,000 SWU/year total capacity is sufficient to produce approximately 2 tons of LEU/year, consistent with the requirements of the small LWR, but could also be reconfigured to make roughly one bomb's worth of HEU/year. We know that North Korea has indigenous uranium ore and all of the chemical know-how and equipment to make the necessary feed material. But, I believe that North Korea is not able to produce key high-performance materials and components domestically to build 2,000 centrifuges.

This is significant because it gives us insight into how Pyongyang got this far–and what they might plan to do next. At Yongbyon, we were told that construction of the centrifuge facility began in April 2009 and that it was completed days before we arrived. But what we saw demonstrates without a doubt that Pyongyang has pursued enrichment for many years. The claim that they just started the centrifuge program for their new LWR program is not credible. In retrospect, over the years there has been plenty of evidence, but no smoking gun, of Pyongyang's uranium enrichment efforts. Former Pakistani President Pervez Musharraf claimed in his memoir that A.Q. Khan, the father of the Pakistani bomb, delivered 20 P1 and four P2 centrifuges to North Korea about 10 years ago. Concurrently, North Korea operated an extraordinarily far-reaching illicit international network through which it procured specialty materials such as high-strength aluminum, maraging steel, and specialty epoxy, along with components such as ring magnets, bearings, vacuum pumps, valves, and flow meters. Prior to his 2004 house arrest in Pakistan, Kahn not only supplied North Korea with a centrifuge starter kit, centrifuge controls, and software, but also trained some of the country's technical specialists at the Khan Research Laboratories.

Now that we have the smoking gun, I believe that Pyongyang combined its own centrifuge experience, which most likely began in the 1980s, with reciprocal visits of Khan's specialists to North Korean facilities, which provided the hands-on training to help Pyongyang master centrifuge operations in a relatively short time. I believe that North Korean specialists built the centrifuges and successfully incorporated them into working cascades in a clandestine facility of unknown size that served as the prototype for the Yongbyon plant. The clandestine facility was almost certainly dedicated to making HEU for bomb fuel rather than LEU for reactors because the gas-graphite reactor in use before Pyongyang decided to build an LWR uses natural uranium fuel, which does not require enrichment.

How does the revelation of uranium enrichment change the security risk? Pyongyang already had the bomb, but not much of a nuclear arsenal. A 25-year pursuit of the plutonium route to the bomb, interrupted by the Agreed Framework and some of the Six-Party agreements, yielded a plutonium inventory of roughly 24 to 42 kilograms. Following the termination of the Agreed Framework in late 2002, Pyongyang built plutonium bombs and demonstrated the first one in 2006. Pyongyang's continued attempts through the Six-Party process to bargain for an LWR were unsuccessful. In 2009, it greeted the Obama administration with a long-range rocket launch, a second nuclear test and a different reality– it would keep the roughly four to eight nuclear weapons that we estimate it has and it will build its own LWRs.

Pyongyang can ratchet up the current nuclear threat if it greatly expands HEU production at undisclosed sites, increases the size of its nuclear arsenal substantially, or conducts more tests to enhance its sophistication. Increased centrifuge capacity also heightens the export threat. Hence, the immediate response by the international community should be to limit Pyongyang's nuclear buildup. Pyongyang's categorical denial of any enrichment activities during a time when they surely existed will make diplomatic reengagement more problematic. Yet there are few options but to reengage. Whereas the long-term objective remains denuclearization of the Korean peninsula, we must first prevent Pyongyang from expanding its arsenal or exporting its nuclear technologies.

Specifically, I advocate what I call the three no's: No more bombs, no better bombs (which means no nuclear testing), and no export, in return for one yes–U.S. willingness to seriously address Pyongyang's fundamental security concerns. Since our ability to monitor uranium enrichment is limited, it would require greater cooperation from Pyongyang and a more intrusive inspection regime to have adequate confidence that it is not producing HEU clandestinely. Likewise, the export threat is much greater because HEU has a weak radiation signature and is difficult to detect. Preventing exports requires close cooperation from the international community, especially from China. So far, no one has been able to figure out how to convince Beijing that Pyongyang's nuclear program seriously threatens what China says it wants to preserve–peace and security in Northeast Asia and the world at large.

For the one yes, we do not really know what Pyongyang wants, but it surely will seek in exchange for cooperation on the nuclear front normalization of relations with the United States, along with energy and economic aid. An appropriate starting point might be a policy based along the lines of the October 2000 Joint Communiqué between Washington and Pyongyang, which stated that neither government would have hostile intent toward the other and confirmed the commitment of both to make every effort to build a new relationship free from past enmity. We can also be sure that the right to have LWRs will be on Pyongyang's list. But it will not be possible to accept uranium enrichment without much greater cooperation and transparency in North Korea

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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