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Richter Argues for DOE's Office of Science Before Senate Committee

By Susan Ginsberg

Burton Richter, chair of the APS Physics Policy Committee, testified in late July before the Senate Energy and Natural Resources Subcommittee on Energy on the role that the Department of Energy's Office of Science plays in fostering basic scientific research. Richter served as APS president in 1994 and is director emeritus of the Stanford Linear Accelerator Center.

Referring to the Office of Science as "the brightest star in the Department of Energy," Chairman Lamar Alexander (R-TN) opened the hearing with a call for a stronger investment in the physical sciences, specifically for the research conducted by the Office of Science.

Alexander pointed out that the Office of Science is the nation's largest supporter of basic science research in the physical sciences and that the office is a "key sponsor of research at our universities and national laboratories… [which] perform the basic research that leads to the technologies of tomorrow and educate our next generation of scientists."

Picking up on Alexander's theme, Richter put the spotlight on the successes of the Office of Science. He listed the huge computer simulations being run at the Lawrence Berkeley Laboratory, the impact of synchrotron light source research, the Human Genome Project and accelerator research results, as well as pointing to advances in fusion energy research and climate change research. "It is easy to spend money, but harder to spend it well," said Richter. "A close look finds that DOE's science funding has been well-spent indeed."

Richter pushed for increased funding for Office of Science research, saying that economic growth depends on science and technology advances.

"Industry relies on government-funded research for the work that will be behind the 'next big thing,' " Richter said. As the "last big thing" becomes a commodity, its production moves offshore, and therefore, said Richter, "the US economy needs the next big thing. DOE's programs in such areas as nanotechnology, quantum computing, or perhaps something that has not yet emerged clearly, may supply it."

Richter took a grim view of the current funding problems. "The present situation is bad for the nation's science, is bad for the nation's economy and is bad for the nation's security," he said.

Alexander then asked Richter what the federal government is uniquely suited to do that the private sector could not.

See **RICHTER** *on page 6*

APS, AAS, AMS Honor Three with 2003 Public Service Awards

In July, Senator Pete V. Domenici, Representative Sherwood Boehlert and Representative Alan Mollohan received the 2003 Public Service Award from the American Astronomical Society (AAS), the American Mathematical Society (AMS) and the American Physical Society (APS).

Photo Credits: Jessica Clark

Representatives Sherwood Boehlert (R-NY) and Alan Mollohan (D-WV) receive their awards at a special ceremony on Capitol Hill. The third recipient, Senator Pete Domenici (R-NM), was unable to be present at the ceremony.

The Public Service Award is given annually to recognize a public figure for his or her sustained and exceptional contributions to public policies that foster support for research, education, and industrial innovation in the physical sciences and mathematics.

See **AWARDS** *on page 3*

Here Comes... the World Year of Physics

You may well be asking yourself, what's that logo in the upper-right corner of this page? Ask no more. It's a reminder that the World Year of Physics is only a little over a year away, and it's a call to action for the physics community to take part in a unique opportunity for public outreach.

The year 2005 will feature events, exhibits and other physics-related activities worldwide. The APS is spearheading US participation, which ideally will involve the entire physics community in a collective effort to inform and excite the public about their field.

Last fall [*APS News*, December 2002] we reported that, following an initiative of the European Physical Society (EPS), the International Union of Pure and Applied Physics (IUPAP) passed a resolution declaring 2005 to be the World Year of Physics. The choice of 2005 commemorates the centennial of Einstein's "year of miracles" in 1905, when he created the special theory of relativity, postulated the existence of the photon, and used Brownian motion to demonstrate the reality of atoms and to estimate their size.

In the year since the IUPAP resolution, the APS has been hard at work on its plans for coordinating the American activities associated with WYP 2005, under the general theme of "Einstein in the 21st Century." A preliminary web site,

See **WORLD** *on page 5*

US Team Wins First Place Honors at 34th International Physics Olympiad

Photo Credit: Mary Mogee

Victorious members of the US Physics team line up with their medals on display. Left to right they are Daniel Gulotta, Chintan Hossain, Pavel Batrachenko, Emily Russell, and Immanuel Buder.

Representatives of the US Physics Team placed first out of 54 countries at the 34th annual International Physics Olympiad in Taipei, Taiwan, sweeping the competition with five medals and four special prizes yesterday for their knowledge of topics such as special relativity and properties of laser diodes. This is the first time a US student has taken the top honor since 1989, and the first time in the competition's history that the US team has been the top-ranking country.

The awards were presented at the closing ceremonies on August 10. The Olympiad was originally scheduled for late July, but concerns about SARS delayed the competition. Pavel Batrachenko of Marshall High School in Rochester, MN, took top honors in the 238-student competition, which began on August 2. He also received one of the two prizes for the best score in experiment, tying with Thaned Pruttivarasin from Thailand. Daniel Gulotta, Illinois Math & Science Academy, Aurora, IL, received a prize for the best score in theory. Emily Russell from Choate Rosemary Hall in Wallingford, CT, received a prize as the best female participant.

"We're ecstatic about the success of the team—they worked really hard and they deserve it," said Bernard Khoury, executive

See **OLYMPIAD** *on page 6*

APS Sponsors Second Conference on Opportunities for Physicists in Biology

The APS plans to hold a second topical conference on "Opportunities in Biology for Physicists" in San Diego, CA, from January 30 to February 1, 2004.

The conference will be aimed predominantly at graduate students and postdocs in physics who are considering applying the methods of physics to biological topics. However, all those who are interested in entering the broad interdisciplinary area will be welcome if space is available. The conference is not aimed at those who already work in the field of biological physics or biophysics, and will not be a place where scientists come to present their own new research.

In 2001, the APS Executive Board decided that it would be advantageous to organize a different kind of meeting, a topical conference on an emerging field, that would prepare physicists for future opportunities.

As a result of this decision, a conference was organized focusing on the interface between physics and biology and aimed at early career physicists who were interested in exploring the possibilities of entering this exciting field.

That first conference was held in Boston September 27-29, 2002 (*see APS NEWS*, November 2002), and was very well received. A follow-up survey revealed a great deal of interest in a second workshop. Robert Austin, Princeton, and Herb Levine, UCSD, co-chair the Steering Committee for the second conference which consists of outstanding researchers who work in the interface area between physics and biology.

"Rapid strides are occurring in biology, where enormous technical and conceptual progress has

See **BIOLOGY** *on page 7*

Highlights

Photo Credit: Mark McCarty

Members in the Media

Ed. Note: *Because of space pressure, Members in the Media has not appeared since the June issue. The quotes below are from May and June; we didn't want to let the good ones slip away even if they are not the most recent.*

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"There could be wild and crazy solutions to this problem."

—Rick Smalley, Rice University, on using nanotechnology to solve the energy crisis, Houston Chronicle, May 4, 2003

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"The issue is not testing or developing new designs; it's deciding if you want to package one so it can penetrate deeper without destroying itself by detonating."

—Sidney Drell, SLAC, on researching low-yield weapons, Washington Post, May 5, 2003

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"There are almost no public funds. And because of the condition of the stock market, it's very difficult to come up with private funds."

—Christopher McKee, UC Berkeley, on trying to keep the physics department healthy, San Francisco Chronicle, May 2, 2003

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"If you want to be really good at science, if you're really serious, it's a 60- to 80-hour-a-week job. You don't want distractions. You want quiet. This is a good place to do science."

—Rick Nebel, Los Alamos, Mother Jones, May 1, 2003

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"Science isn't just another subject. We aren't talking about populating one sector, the high-tech sector [with employees], we are talking about the health of our economy overall."

—Rush Holt, Member of Congress, National Journal, May 7, 2003

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"The main message is we have to be a bit modest and listen to what the local people say. We don't seem to be doing very well with modesty lately."

—Freeman Dyson, Institute for Advanced Study, on using technology to help people, Portland Oregonian, May 7, 2003

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"It is as surprising as thinking the Earth was round and finding it flat."

—John Ralston, University of Kansas, on the discovery that protons have different shapes, Dallas Morning News, May 3, 2003

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"Imagine there's this dance hall that you're not allowed into, but you know that everyone inside is having a great time. You know that inside there's a beautifully elaborate dance going on. It's all choreographed and the dancers are whirling around and switching partners. Now imagine that it's your job to try and figure out what that dance is without going into the dance hall."

—Matthew Fisher, Kavli Institute for Theoretical Physics, on doing physics research, Santa Barbara Daily Nexus, May 16, 2003

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"We got a lot of calls from nuclear experts and they said, 'Are you guys nuts? Why did you do that?' But we also got a lot of calls from our relatives and friends, who said, 'I feel so much better after having seen that.' The experts assume that people are starting with a blank slate. But the reality is they are starting with the assumption that tens of thousands of people will die."

—Michael Levi, Federation of American Scientists, on the making of a PBS documentary about dirty bombs that included an estimate of radioactive contamination, USA Today, May 15, 2003

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"I have probably thought about physics every day for the past 50 years."

—Marvin Cohen, UC Berkeley, The Economist, June 19, 2003

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And finally, some comments by Janet Conrad, of Columbia University, from the profile of her in the *New Yorker*, June 2, 2003:

"I remember standing there and looking at the northern lights, and it was so neat that something so remote, so very far away, could be creating something so beautiful right in front of my eyes."

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"Electronics really isn't that different from cooking or sewing. There's a certain set of rules that you follow, a certain set of parameters. You may want to try variations on a theme, but, once you know your patterns, it's pretty easy."

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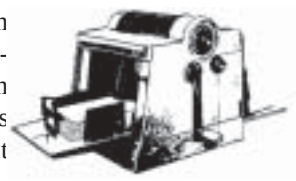
"It's really bad when the waitress at the airport starts to know you."

On meeting her husband, who teaches in New Mexico, at Chicago's O'Hare Airport for dinner.

This Month in Physics History

October 22, 1938: Invention of xerography



Sometimes it takes extraordinary patience, perseverance, and belief in oneself before the usefulness of an invention is finally realized. Take the case of physicist Chester Carlson, who invented the xerographic process, thereby launching what is today a multi-billion dollar industry. But for several years after patenting his process, Carlson could find no company interested in xerography. It was the invention that nobody wanted.

He developed much of his patience and perseverance during an especially difficult childhood. Born in Seattle, WA, in 1906, Carlson was the only child of an itinerant barber and grew up in southern California. By age 14 he was working after school and weekends for a local printer to support the family, since his father was crippled from arthritis. His mother succumbed to tuberculosis when he was 17. Always fascinated by graphic arts and chemistry, Carlson didn't let his humble roots deter him from finishing high school and working his way through a nearby junior college, earning a degree in chemistry. He then attended Caltech, graduating two years later with a degree in physics.

Unfortunately, Carlson entered the job market in the midst of the Depression, applying to 82 firms before landing a job as a research engineer at Bell Telephone Laboratories in New York City. His success was short lived and he was soon laid off because of the deepening Depression, finally securing a position with an electronics firm, P.R. Mallory & Co. He studied law at night at the New York Law School, and eventually became manager of the company's patent department. Despite the security of a steady job in uncertain times, Carlson was dissatisfied and restless, and devoted his leisure hours to the pursuit of invention.

Around this time, he noticed that there never seemed to be enough copies of patent specifications around the office, and no quick or practical means of obtaining more copies. There were only two options: either send the patents out to be photographed, or laboriously type new ones, both of which were costly and time consuming. Carlson conceived of a device that would accept a document and make copies of it in seconds, researched various imaging processes at the New York Public Library, and eventually lit on the then little-known field of photoconductivity, specifically the research of Hungarian physicist Paul Selenyi. Carlson combined two fundamental concepts: materials with opposite electrical charges attract one another, and some materials conduct electricity better after being exposed to light.

Carlson began conducting experiments in the kitchen of his apartment in Queens, eventually developing the fundamental principles of what he called "electrophotography", later known as xerography. His theory was that if the image of an original photograph or document were projected onto a photoconductive surface, current would only flow in the areas that light hit upon, and not in the areas of darkness, *i.e.*, the print. If he could get dry particles to stick to a charged plate in a pattern corresponding to an image shining on the plate, he could make "dry reproduction" work. After filing a patent application in October 1937, he set up a small lab in Astoria and hired a lab assistant, a German refugee named Otto Kornei.

It was there that the first xerographic copy was made on October 22, 1938. The two men prepared a sulfur coating on a zinc plate, and Kornei printed a notation in India ink on a glass microscopic slide: "10-22-38 Astoria." They pulled down the shade to darken the room, then rubbed the sulfur surface vigorously with a handkerchief to apply an electrostatic charge. The slide was laid on the surface, and the two pieces were placed under a bright incandescent lamp for a few seconds. The slide was then removed and lycopodium powder was sprinkled on the sulfur surface, then blown off. What was left on the surface was a near-perfect duplicate in powder of the same notation on the glass slide. After repeating the experiment several times to reassure themselves the process worked, the men made permanent copies by transferring the powder images to wax paper and heating the sheets to melt the wax.

Carlson shopped his invention around for several years trying to find a company to develop it into a useful product, and was turned down by more than 20 companies, as well as the National Inventors Council. "How difficult it was to convince anyone that my tiny plates and rough image held the key to a tremendous new industry," Carlson later recalled. Finally, in 1944, Battelle Memorial Institute, a nonprofit research organization, signed a royalty agreement with Carlson and began to develop the process. Three years later, Battelle made an agreement with a small photo paper company called Haloid (later to be known as Xerox), giving Haloid the right to develop a xerographic machine.

Twenty-one years after Carlson made the first xerographic copy in his modest Queens laboratory, the first office copier was unveiled in 1959. The Xerox 914 copier could make copies quickly at the touch of a button on plain paper, and was a phenomenal success.

Today, xerography is the foundation stone of the worldwide copying industry, and Carlson ended his years as a wealthy and much-honored man. But he remained both humble and generous, giving away $100 million of his personal fortune to charity before his death.

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Viewpoint...

The Truth About Missile Defense: Will Science Make A Difference?

By Philip E. Coyle

In political Washington, one can get the impression that everything is "spin", that there are no real truths. In the news media different views are aired and debated, but one view is said to be no better than another, and certainly political views cannot be proven the way we learn mathematical proofs in school.

By contrast, the American Physical Society released a comprehensive study of the scientific feasibility of boost-phase missile defense. Two years in the making, the study takes no policy position on whether the United States should pursue ballistic missile defense. Also, the report only examines the technical feasibility of one approach to missile defense, namely shooting down enemy missiles in their *boost-phase*, that is, within the first two to four minutes after launch. Nevertheless, the APS report should be required reading for Members of Congress and other decision makers interested in missile defense, pro or con.

With scientific and mathematical rigor, the report examines those aspects of boost-phase missile defense that are feasible and those that are not. The report also identifies those aspects that while theoretically possible are so unlikely as to be fantasy.

The authors of this report, co-chaired by physicists Frederick Lamb and Daniel Kleppner, are a "Who's Who" of eminent scientists in the fields of relevance—physics, precision guidance, high power lasers, and aerodynamics—in short, "Rocket Science." The authors have bent over backward to maintain balance, spending months checking every word and sentence for proper and accurate meaning.

Critics of missile defense looking for a slam-dunk to quickly shoot down funding for the boost-phase option may be disappointed. Physicists won't say something is impossible unless it violates the basic laws of physics, and the authors stick to the facts. But proponents for missile defense should read the report carefully.

With respect to interceptors or lasers fired from platforms on land, sea, or air, the study shows that for boost-phase missile defense to work, the defender must be close to the enemy missile before launch. Also the defender must have a fast interceptor, faster than any US missile in existence.

As a result, boost-phase missile defense from such platforms is not feasible with any known technology against large countries such as China, Russia or Iran. Technically, boost-phase missile defense from land, sea or air is possible against Iraq, a smaller country than Iran, but can require basing defenders in nearby countries that might not approve, such as Syria or Turkey.

North Korea, a small narrow country, accessible to the Untied States from the sea on two sides and from South Korea on a third, is tractable for land, sea or air based boost-phase missile defenses, but even then it would take quick reaction, split-second timing, and tight operational readiness.

Proponents of space-based missile defenses may see some hope in this report since interceptors or lasers orbiting in space are not constrained by geographic boundaries. From space, boost-phase missile defense is technically possible against large countries like Russia or China so long as the orbiting defenders can reach the enemy missiles in time. Here the issue is that the world is round. Missile defense attack satellites on the wrong side of the Earth can't reach an enemy missile in time. One solution is to have enough missile defense platforms on orbit so that at least one is in the right place at the right time, that is, when an enemy missile is launched. As with land, sea or air based interceptors, space-based interceptors also must be very fast to reach enemy missiles in time. This means many platforms in space, perhaps hundreds or thousands depending on the sophistication and dispersal of the enemy threat.

In particular, the APS study explains, during the decade or more it could take the United States to develop boost-phase missile defenses against liquid fueled enemy rockets, US opponents could develop the technology of solid propellant rocket boosters. Enemy missiles using faster burning solid propellant fuel would stress the defenses even more, compress the time available for intercept to less than three minutes, and effectively negate operationally practical boost-phase missile defense from land, sea, air, or space.

With respect to missile defense weapons in space, the APS study lays out the facts about boost-phase missile defense from space in a straightforward and readable manner. Now the United States and the international community must grapple with the policy and arms control implications.

Should the United States introduce orbiting weapons with attack capabilities, and should we spend billions to place missile defense satellites in space that could be obsolete before they were fielded? And can such systems be effective, reliable and dependable even against liquid fueled enemy rockets? These are policy and engineering questions intentionally not addressed in the APS study. But apart from the policy and arms control issues raised by placing attack weapons in space, the number of satellites required and the costs of the overall system are daunting. US taxpayers will have to consider whether an arms buildup in space is worth the price.

Here the APS study provides the technical facts, not the policy answers. But for the truth about boost-phase missile defense, the APS report is unshakeable and solid. It is a report that can and should make a difference. Whether it will make a difference will depend on whether the Administration and the US Congress read this important new scientific study, and then whether they acknowledge or ignore the facts in it.

Philip E. Coyle was Assistant Secretary of Defense for Test and Evaluation from 1994 to 2001, and is a Senior Advisor at the Center for Defense Information

AWARDS *from page 1*

Each of this year's three recipients has been a strong supporter of science in the 108th Congress. But Arthur Jaffe, past president of the AMS, noted, "While every Member of Congress shares this view of science, only a handful of Members put science near the top of their list of priorities. Today we recognize three such visionary leaders, and thank them."

This year, as Chair of the Senate Energy and Natural Resources Committee, Domenici ensured that authorization language for the Department of Energy included high levels of funding for basic science research.

"Senator Domenici is one of the Senate's strongest champions for Science in Congress," said APS President-elect Helen Quinn, who presented the award to him. "He deserves our thanks for his contributions to science policy issues."

Joseph A. Burns, AAS senior vice president, presented the award to Science Committee Chairman Boehlert, whom he praised for laboring "enthusiastically, both publicly and privately, for a strengthened and rationally funded national science policy.

"Boehlert's contributions as a cheerleader for the science community cannot be understated," Burns said, but he stressed that Boehlert also helped the community understand politics and Washington. "He tells us the facts of life and provides tough-minded advice."

Mollohan, minority leader of the VA-HUD and Independent Agencies subcommittee, has worked tirelessly on behalf of the National Science Foundation and the National Aeronautics and Space Administration.

"Alan Mollohan's behind-the-scenes work has been instrumental in the recent budget increases of the NSF," said Jaffe as he presented Mr. Mollohan his award. "Because of his long-standing interest in science, technology, and education, Congressman Mollohan has supported many initiatives to improve the teaching and learning of mathematics, science, and technology."

Prior awardees include: James T. Walsh and Barbara Mikulski (2002), Vernon Ehlers and Neal Lane (2001) and William Frist, Joseph I. Lieberman, and Harold Varmus (2000).

Media Give Widespread Coverage to APS Missile-Defense Study

As reported last month in APS News, in July the APS released its long-awaited study on boost-phase missile defense. Media coverage of the report was both broad and long-lasting. Some excerpts from that coverage follow.

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An extensive study by a national group of scientists raised serious doubts yesterday about the likely effectiveness of some weapons that President Bush is pursuing in his drive to develop a system for defending the United States against ballistic missile attack.

Washington Post, July 16

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Timing is the fatal flaw in long-range missile defences that target ballistic missiles during their vulnerable launch phase, says a report from the American Physical Society.

New Scientist, July 15

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A key component of the US National Missile Defense plan is a pipe dream, according to a new study by the American Physical Society.

ScienceNOW

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"The objective [of the report] was to let you draw your own conclusions," says former APS president William Brinkman. "But the conclusions are fairly clear to anyone who wants to look."

ScienceNOW, July 15

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The report may not change many minds on this partisan topic, but it will inform the debate over whether to catch missiles as they take off, says Philip Coyle, senior adviser to the Center for Defense Information in Washington DC. "This study is the first honest-to-God assessment of what's scientifically possible," he says.

Nature, July 17

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Coyle says scientists in the Missile Defense Agency never talk about these difficulties publicly. They refused to again today. The agency issued only a short three-sentence statement. It said a review of boost phase will be done in September. It concluded, quote, "We continue to believe that boost phase technology has great potential for playing a vital role in a layered missile defense."

David Kestenbaum, National Public Radio, July 16

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It's unlikely, however, that such findings will slow the administration's push to deploy this and related missile defense systems. For it has pursued missile defense with the same disregard for allies, facts and predictions of trouble that it has the rest of its foreign policy.

The Courier-Journal (Louisville, KY), July 18 (Editorial)

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"MDA is confident we are headed in the right direction," the agency said in a statement. "We continue to believe that boost-phase technology has great potential for playing a vital role in a layered missile defense."

Aerospace Daily, July 18

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The Missile Defense Agency, or MDA, which has been examining concepts for boost-phase intercept for more than a decade, said in a statement it has not had the time to "digest" the study.

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"We're in the process right now of beginning to look into that [study] ourselves," said retired Air Force Lt. Gen. Patrick Caruana, vice president of Missile Defense for Northrop Grumman at a briefing Wednesday. "I will tell you, as an example, the Missile Defense Agency is going to look at that study in a lot more detail and provide a solution."

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The Missile Defense Agency spokesman said in a statement the agency is "confident we are headed in the right direction. There will be another assessment of boost-phase viability in December of this year, before any investments are made in a development activity."

Defense Week, July 28

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India's hope of acquiring an effective defensive umbrella from the US could be folded as experts feel there is a "fatal flaw" in the long range missile defense system.

The Times of India, August 6

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It may be no coincidence that the Pentagon suspended work on BPI shortly after the release of a massive, technically detailed study by the American Physical Society—one of the world's preeminent physics organizations—which concludes that boost-phase intercept is a lot more complicated than anyone has previously grasped.

Slate, August 7

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Three weeks ago, the Pentagon quietly announced that it has suspended the space-based intercept component of their National Missile Defence (NMD) program due to technological difficulties....It's surely no coincidence that the suspension was announced shortly after the release of a damning study on NMD by the American Physical Society, the professional association for US physicists. The authors focused only on the science and technological feasibility of NMD, leaving the policy and politics to others.

Toronto Globe & Mail, August 22

LETTERS

Back Page Rife With Errors and Exaggerations

Motivated chiefly by a sense of duty, we respond to the July 2003 "Back Page" article by G.W. Bracey, "Farsighted or Foolish...". While Bracey flails at many targets, ranging from a Sandia Report of 1990 to the inaccessibility of some Japanese schools, his injudicious piece is chiefly directed at the 20-year-old Report, "A Nation At Risk". A proper response would require far more space than is given us, so we must merely hint at a very few of his errors and exaggerations.

1) He writes: "the Report's recommendations were banal. They called for nothing new, only for more of the same...". This is blatantly contrary to the five strong recommendations in the Report, one of the results of 1 1/2 years of intense work of the 18 members of the National Commission, the large supporting staff of the US Department of Education,16 site visits, 40 reports commissioned from experts (and published on the ERIC System), and testimonies and presentations from no less than 290 experts on education. Far from being banal and not new, one of the major recommendations requested a vast strenghtening of the academic program in high schools, to counter the then increasing trend by which over 40% of the students had migrated from vocational and academic to "general" tracks that led them nowhere. And happily, not long after the Report was published, chiefly thanks to courageous governors, a large number of states did increase attention to academic programs substantionally.

2) Bracey states that "the recommendations were based on a veritable treasury of slanted, spun, and distorted statistics." Elsewhere: "A Nation At Risk fabricated its case...", and later, "without merit".

Here, two points are to be made. What Bracey tries to convey, with little and selected evidence, is itself contradictory: At one end he claims the students' performance was much better than the Report found, but at the other end he opines that in view of the nation's unrest and turmoils in the previous two decades, "it would have been a miracle if test scores had not fallen."

The other point is that such pungent, ad hominem attacks on the Commission, in language probably unique in *APS News*, questions the competence and seriousness of such Commission members as Glenn Seaborg, the presidents of several universities, a former governor, school principals, experts on education, and all the others who signed that unanimous Report.

3) Bracey makes the mistaken claim that the Report firmly tied educational reform to a "prediction of national economic collapse". But in the Report, such consideration was minor. Rather it called specifically and at length for a reform that would upgrade "the intellectual, moral, and spiritual strengths of our people, which knit together the very fabric of our society", for the sake of maintaining a functioning, free, democratic citizenry.

Much more needs to be said. If readers are interested in some of the various recent retrospective comments on the Report, they might consult a fairly balanced collection of what the Report did and did not achieve, in over a dozen essays by top educational scholars, edited by David T. Gordon, A Nation Transformed (2003), which also contains a reprint of the Report itself; or the essay, "An Insider's View of 'A Nation At Risk'," in the April 25, 2003 issue of the Chronicle of Higher Education.

Gerald Holton
Cambridge, MA

William O.Baker
Murray Hill, NJ

Krauss Reveals True Motives

I am astounded that *APS News* found it proper to reprint the *New York Times* article of L.M. Krauss. (*APS News*, June 2003). Krauss hates Bush, his Administration, and the utterances of government agencies if they differ from his social or ethical preferences. This is perfectly unobjectionable, and Krauss had his say in the *NYT*.

What I resent is that he vents his political condemnation by disingenuously representing the perceived failures as if they would be somehow connected to, or on a par with, the recently discovered cheatings in physics research.

Of course, Krauss gives away his true motivation by the following paragraph of his article (italicized in *APS News*): "scientists have a special ethical responsibility at this particular time to question our government's actions."

Clearly, the emphasis is on "this particular time".

Paul Roman
Ludenhausen, Germany

Beckham's Bend Badly Explained

I read the article "The Physics behind 'Bend it like Beckham' " in the July 2003 *APS News*.

This article repeats an explanation often given to nontechnical audiences about how lift is generated by airfoils and rotating spheres. However, the explanation has a serious flaw.

The article explains how the force on an object (ball or airfoil) is due to a combination of the force due to the pressure difference on the two sides of the object and the force due to the bending of the wake.

This is untrue.

At a microscopic level, the force on the object comes from the air molecules hitting it and changing their momentum. This is by definition pressure.

Since there is no action at a distance, the pressure distribution over the object accounts for all of the force on the object.

In a macroscopic continuum fluids picture, the force on the object is equal to the change in momentum of the fluid per unit time. The deflection of the wake is

See **LETTERS** *on page 7*

Main Claim Not Substantiated

After wading through the "Farsighted or Foolish" Back Page (*APS News*, July 2003), I finally figured out that the entire point was the last two sentences:

"It's called 'No Child Left Behind'. It's a weapon of mass destruction and the target is the public school system."

I only wish the author had spent the other 95% of the column inches allotted to him explaining his basis for making those statements, which at least relates to the future we can affect instead of critiquing the past 20 years of history about which we can do little.

David J. Ritchie
Naperville, Il

Bring Sanity Back to Educational Policy

The article by Prof. Gerald W. Bracey was most sobering and I am pleased that he made the effort to point out how easily well-meaning people, including myself, can be herded into accepting results influenced by political ideology. A law must exist stating that when one chooses to follow the wrong path, the outcomes will never be better and inevitably will be much worse.

My concern on how one interprets test results to evaluate a person's ability began some three decades ago when I participated in evaluating fellowship applications for the Ford Foundation. At the time, I asked a psychologist specializing in testing how much value could be placed on the results of a single comprehensive test. He replied that such a test was equivalent to raising thoroughbred racing horses, i.e., if speed in a horse is all one desires, one should keep interbreeding them. That view was expressed long before the concept of multiple intelligences made news.

A few years ago, I started to question anew the use of student test results to evaluate schools. I find that school district superintendents attempt to make their mark by claiming progress in test results. These in turn are used to reward schools in compliance.

This approach is moving along the wrong path, and things do indeed get worse: the implied directive has caused teachers to be blamed and even summarily ousted from years of teaching for sharing test questions before tests are officially given.

The challenge faced by teachers under the new edict understandably tempts them to push the envelope to comply, perhaps motivated also by their frustration with inane policy.

What adds insult to injury is that superintendents themselves are rewarded by school district councils for the presumed success.

I would hope that the enlightenment such as provided by Prof. Bracey will help inform the public and return some sanity to our nation's educational policy...and very soon.

J. V. Martinez
Bethesda, MD

Back Page Not Appropriate

I am writing to protest the inclusion of the article "Farsighted or Foolish? The 20th Anniversary of a Nation at Risk" in the July issue of *APS News*.

This article comments on the report of the College Board's investigative panel where the panel ascribes "most of the decline to changes in who was taking the test—more minorities, more women, more students with mediocre high school records, more students from low-income families."

The article states that "All of those demographic changes are associated with lower scores on any test. It would have been very suspicious if the scores had not declined."

I find it highly inappropriate to include such an article in *APS News*.

Nora Thornber
Somerville, NJ

"A Nation at Risk" Far from Banal

Mr. Bracey's "Back Page" article (APS News, July 2003) about *A Nation At Risk* presents a highly distorted view of the report. While there is some merit in Bracey's argument that the link between the American public education system and the decline in the competitiveness of American industry in the 1960's and 1970's was tenuous, the report as a whole cannot be dismissed so easily. It correctly identified many of the problems that existed in K-12 education at the time, and far from being banal, the remedies that it suggested were reasonable when compared to the problems. Indeed, it was one of the first reports to focus on the relatively poor quality of academic preparation of credential candidates. Many of the problems that first were identified in *A Nation At Risk* remain today.

Though I would agree with Bracey that many ideologues take delight in trashing public education, one should not assume that all of those who are critical of various aspects of public education wish the enterprise ill.

Mark H. Shapiro
Fullerton, CA

Questionable that Physicists have "Known Sin"

J. Robert Oppenheimer's oft-quoted line that physicists have "known sin" for having developed the atomic bomb implies a number of highly questionable propositions. [See "This Month in Physics History," *APS News*, July 2003.] One is that the decision to build the bomb was made by physicists. It was in fact the decision of popularly elected officials charged with national policy-making responsibility, and that meant President Franklin D. Roosevelt, a non-physicist.

I have yet to hear anyone accuse FDR of being a sinner for having made that decision. The decision was prompted by fear that Hitler might, and in fact was trying to develop such a weapon. Had he succeeded ahead of us, the real sinners would have been those who opposed our bomb, for western civilization would have suffered its worst setback in history.

The decision to use the bomb was Harry Truman's, not that of any physicist. To imply otherwise is self-aggrandizement by physicists, and if there is sin, that is one. No wonder Truman threw Oppenheimer out of his office, and told his staff not to let that (expletive deleted) back again.

If there is a Judgment Day when we are all called to account for our sins, the physicists of the atomic era who will deserve to fare the worst will be the members of Hitler's Uranium Club, who labored to put atomic bombs in the hands of history's worst tyrant.

Lawrence Cranberg
City, TX

Restricting Information is Nonsensical

I write to protest two examples of the closing off of information.

As an APS member, I believe that the APS can and should readily do something about the first and that it should be acting to stop the nonsense about the second.

First: At the *APS News* online site I read "The Current Issue is protected by password and is for APS members only." Really? This publication should be freely available to all, consistent with the APS' declared aim of fostering the dissemination of knowledge of physics. I find the same limitations at *Physics Today* (AIP's organ) but have been informed that the limitation there is substantially in response to the APS! Not a good idea in these days of "declining support for the physics enterprise." The same applies to many APS/AIP publications. Open up the information on the web.

Second: In tracking down the literature for the article in July's *APS News* on the Trinity test, I find that Los Alamos National Laboratory has shut off public web access to many, if not most, of its early publications. Thus, on clicking for a copy of the pdf version of Bainbridge's report on the test, I find "Access restricted to selected government agencies." A lot of people have seen that report already. Whom is LANL kidding?

By the way, I first noticed a severe limitation in the utility of the LANL library site after the Wen Ho Lee circus of four years ago. A very wide range of information and reports suddenly disappeared. LANL seems never to have recovered and is evidently still trying to cover its confusion and/or incompetence by restricting access to reports long gone into the public domain. Everybody knows the big secret: the Trinity test worked. Anyone who is really concerned can probably find those reports elsewhere, but why waste everybody else's time?

D.H. McNeill
Pittsburgh, PA

HEPAP Meeting Emphasizes Prioritizing Large Scale Facilities

Trends toward large-scale facilities in many fields of science, and how to prioritize and pay for them, were among the topics discussed at a two day meeting of DOE's High Energy Physics Advisory Panel (HEPAP) in July. Participants also discussed the importance of high-performance computing, and the impact on the high energy physics (HEP) program of last year's National Research Council report on the intersection of physics and astronomy, "From Quarks to the Cosmos."

Ray Orbach, director of DOE's Office of Science, discussed his attempts to prioritize a wish list of facilities across the Office's programs in a 20-year plan. Orbach said that both his office and NSF are attempting to prioritize research across fields, and while it is a difficult task, "somebody has to make a decision." He admitted, though, that "in some cases it was simply impossible to decide on the scientific merit between various projects."

Regarding future funding for high energy physics, Orbach said that "the issue of expectations and accomplishment is terribly important." Recognition of the quality and importance of the HEP program's performance has been demonstrated by the fact that appropriators in both the House and Senate have recommended "augmentations" above the President's request. "I can't impress on you enough the importance of credibility," he said. "We have to remain credible, or people will lose confidence in us." Orbach also described his office's difficulties with the international aspects of programs like the International Thermonuclear Experimental Reactor and the Large Hadron Collider (LHC).While the schedule for completing the LHC has slipped by at least two years to 2007, the US detectors were on budget and on schedule for completion in 2005.

"Most of our time is spent worrying about large-scale facilities," said Patrick Looney, OSTP Assistant Director for Physical Sciences and Engineering. He noted that some existing facilities are underutilized, some redundant, and many need upgrades. At the same time, traditional fields are requesting significant new investments for facilities, while facing increased competition from fields that have not relied on large facilities in the past. Looney estimated that the total cost of the many recommended facilities "exceeds optimistic budget projections by more than a factor of two."

Given the stiff competition for funding, how do appropriators decide which areas they should be investing in? Looney advocated a uniform policy for making the case for a facility to OSTP and OMB — a policy that would address the project's consistency with agency missions and national goals, coordination with other federal agencies, and impacts on other fields of science. His advice: "Don't tell us what you want to build; tell us what you want to do." Looney also reported that a panel of the National Science and Technology Council was looking into the issue of large-scale facilities, while another was developing recommendations, based on the "Quarks to the Cosmos" report, on interagency research at the intersection of physics and astronomy.

Finally, Robin Staffin, who heads the high energy physics program at the Office of Science, emphasized the need to develop consensus on the future of high energy physics, and the importance of communicating that vision to the public and to policymakers. "It's easy to believe we are not a special interest," he said, but to policymakers who deal with a wide variety of programs, "I'm sure we sound like a special interest. We need to communicate ourselves as an important social, economic and intellectual resource." In his remarks, Staffin also commented that "globalization is an important new criteria for how decisions will be made," and he noted that while the issue of evaluating program performance "is not going away," the choice of appropriate performance measures "is largely up to us."

In a related meeting, the multinational collaboration to build the International Thermonuclear Experimental Reactor (ITER), and the project's impact on the domestic fusion program, was a main topic of discussion at a July 31 - August 1 meeting of the Fusion Energy Sciences Advisory Committee.

N. Anne Davies, the director of DOE's Fusion Energy Sciences (FES) program, described the current status of the FY 2004 appropriations process and her efforts to develop a financial plan for the year in the absence of a final appropriations bill. Using the lower of the House and Senate appropriators' recommendations ($257.3 million, equal to the request), Davies warned, "We will not be able to do all of what Congress told us to do." Her guiding principles for the FY 2004 financial plan include supporting ITER transitional arrangements; partially restoring cuts to other international collaborations; increasing the level of facility operations over FY 2003; and minimizing personnel disruptions.

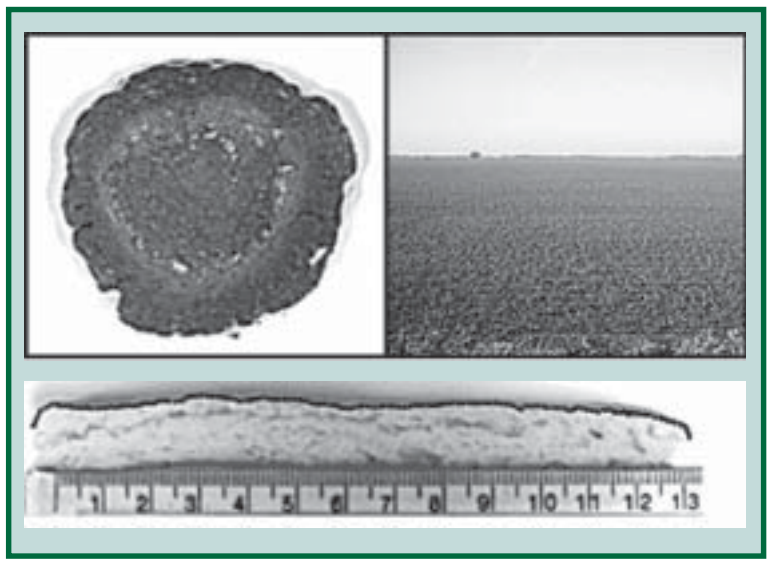
Davies said that the budget request for FES was premised on emphasizing the activities necessary to support ITER participation, while delaying or postponing longer-term efforts. However, she noted that both the House and Senate appropriations committee reports raised concerns about the imbalance between ITER and the domestic fusion program.

Orbach told the committee that the promise of fusion "has made an impression on the Secretary of Energy and the White House.... There is momentum here," he declared. The ITER negotiations are "more important than just ITER," Orbach remarked. They are "setting the framework" for future collaborations and, "as a consequence, if something goes wrong...if we are unable to bring it to conclusion...it will have ramifications far beyond fusion."

Across the US scientific enterprise, "we have tremendous numbers of facilities that exist, and more that are being proposed," said Looney, who offered his own personal suggestions for investment criteria, including whether the facility addresses important scientific questions; how it impacts other efforts in the field and other fields of science; whether there is coordination and collaboration both domestically and internationally; whether the planning is realistic; and how the program is performing with current funds. "My feeling," he said, "is that we are in danger of saturating our available budgets with low-priority, redundant, and uncoordinated activities."

zero gravity
The Lighter Side of Science

Scientists Prove Kansas Flatter than a Pancake



While driving across the American Midwest, it is common to hear travelers remark, "This state is as flat as a pancake." To scientists at Texas State University and Arizona State University, respectively, this adage seems to qualitatively capture some characteristic of a topographic geodetic survey.

The obvious question "How flat is a pancake" sparked their analytical interest, and they set out to find the "flatness" of both a pancake and one particular state: Kansas.

Their findings have been published in the *Annals of Improbable Research* (AIR) [*See link at end.*]

Kansans have always fondly claimed that their state, in the heart of America's Great Plains, is "as flat as a pancake." Using modern analytical techniques, geographers Mark Fonstad, William Pugatch, and Brandon Vogt measured the flatness of Kansas, and contrasted it with the flatness of a pancake.

Their results demonstrate that, of the two, Kansas is considerably flatter. [It may also be of significance that the town of Liberal, Kansas, hosts the annual "International Pancake Day" festival.]

Barring the acquisition of either a Kansas-sized pancake or a pancake-sized Kansas, mathematical techniques were needed to do a proper comparison.

The scientists compared the two surfaces—Kansas and the pancake—using special geographic information software. Topographic elevation data for Kansas was taken from a digital scale model prepared by the United States Geological Survey.

The pancake was purchased from an International House of Pancakes. "The importance of this research dictated that we not be daunted by the 'No Food or Drink' sign posted in the microscopy room," write the authors.

One common method of quantifying "flatness" in geodesy is the "flattening" ratio. The length of an ellipse's (or arc's) semimajor axis (a) is compared with its measured semiminor axis (b) using the formula for flattening. A perfectly flat surface will have a flattening of one, whereas an ellipsoid with equal axis lengths will have no flattening, and f will equal zero. For example, the earth is slightly flattened at the poles due to the earth 's rotation, making its semimajor axis slightly longer than its semiminor axis, giving a global *f* of 0.00335.

How flat is Kansas, compared to a pancake? Fonstad, Pugatch, and Vogt explain that:

Mathematically, a value of 1.000 would indicate perfect, platonic flatness. The calculated flatness of the pancake transect is approximately 0.957, which is pretty flat, but far from perfectly flat.

After many hours of programming work, we were able to estimate that Kansas's flatness is approximately 0.9997. That degree of flatness might be described, mathematically, as "damn flat."

For the complete online article, see http://www.improbable.com/airchives/paperair/volume9/v9i3/kansas.html

WORLD *from page 1*

www.physics2005.org, has been set up, where people can register to receive information as it becomes available. The site will keep track of and coordinate WYP projects around the country, including several that will be organized by the APS, with help from the NSF, the DOE, and NASA.

Many of the projects are aimed at students at various levels, and APS is working with its sister societies, the American Association of Physics Teachers (AAPT) and the American Institute of Physics (AIP) in organizing them. If funding becomes available, there will be a poster contest for elementary school children, a challenging "physics quest" for middle-schoolers, and, at the high-school level, a project to measure the radius of the Earth involving partner schools in different parts of the country (or perhaps in other countries) working cooperatively. In addition, about 20 "physics on the road" teams, based at universities and science museums, will bring demonstrations and hands-on activities to schools all across the US. APS is also planning to work with science museums nationwide to encourage them to mount special physics exhibits in celebration of 2005.

Recently APS has e-mailed chairs of all the physics departments in the US, bringing the World Year of Physics to their attention, and suggesting that they schedule at least one event for the public, such as a public lecture or an open house, during 2005. "The World Year of Physics can only have a real impact if the whole physics community gets involved," said APS Executive Officer Judy Franz. "This is not an APS event, like our centennial four years ago. We are happy to act as coordinators, but we really hope to have extensive participation at the local level."

Efforts are underway to introduce a motion in the UN General Assembly to have it declare 2005 the International Year of Physics (as opposed to the "World Year of Physics" declared by IUPAP. The designation of an International Year requires UN approval). If successful, this declaration would raise the profile of the World Year of Physics and give it added visibility in countries around the world.

Since its introduction by the EPS, the logo has been subject to divergent views regarding its interpretation. To physicists it signifies a light cone, while to the general public, most of whom have never heard of a light cone, it most frequently is seen as an hourglass, symbolizing Einstein's profound insight into the relativity of time. The colors are probably merely decorative, but it has been suggested that, in the light cone interpretation, the future is blue because we are rushing toward it and hence it is blue-shifted, whereas we are moving away from the red-shifted past. No one has yet provided a convincing theory of the green and yellow colors of the diagonal members.

Playing with Sand Helps Scientists Study Earthquakes

Next time you're at the beach, learn some basic engineering: follow these easy experiments with sand and water to learn how geologists and house builders think about the beach's building blocks.

Sand is composed of tiny grains that react differently depending on the types of physical forces acting on them. If the grains are squeezed, stretched, shaken, or mixed with water, they respond very differently. Dry sand doesn't stick together very well, and can't make steep sandcastle walls. Adding water to sand makes it much easier to build a sandcastle. Water molecules stick together with a kind of molecular glue, called polarity, that also helps the sand grains stick.

But adding vibration changes the sandcastle's sturdiness. Try this yourself: Mix some water and sand on the beach and place a seashell or rock on top of it. Next, pound on the beach about six inches away to simulate an earthquake. If you watch the shell or rock closely, you'll see it slowly sink.

Mixing sand and water together creates what's called a thixotropic mixture: while you mix it, it acts like a fluid. In fact, the more you mix it, the runnier it seems. "When the mixture is sitting still, the combination of friction and water holds everything in place," says Robert Krampf, a geology science educator. "When you vibrate the

mixture, the grains move and you lose the friction." Then, the water acts as a lubricant instead of glue, causing the mixture to flow easily. Other thixotropic mixtures include ketchup and quicksand.

You can also dig for water on the beach. "When the level of the water in the sand is equal to the ocean and you dig a hole, you will strike water," says Krampf. Try this yourself: the further from the water's edge you are, the deeper you have to dig to reach water. Engineers have to know how far down water is located in order to dig a well.

During an earthquake, the sand and water in the soil are mixed together and compressed. As the water pressure inside the mixture rises, the ground becomes unstable. "During an earthquake, the soil, sand, and water underneath an aboveground swimming pool could turn from a solid, stable base to a heavy, thick liquid in a process called liquefaction," says Stein Sture, a professor of engineering at the University of Colorado-Boulder. "Liquefaction is strong enough to move a swimming pool."

"By knowing more about the fundamental process of earthquakes, building designs can be improved and existing structures can be made more stable," says Sture. "We now know more about the buildup of the water pressure in the ground than we knew before." Important knowledge like this begins with building castles in the sand.

— Inside Science News Service

INSIDE THE BELTWAY:
A Washington Analysis

President's Waning Popularity Emboldens Critics

By Michael S. Lubell, APS Director of Public Affairs

It doesn't rank with the San Andreas fault, but cracks are evident on the banks of the Potomac. For the first time in two years, President Bush's re-elect numbers tilted toward a Democrat, according to a Zogby poll taken in late August. In Washington, which had grown accustomed to apparent White House invincibility, this was a seismic event.

From a high of 82 percent, two weeks after 9/11, the President's approval rating has slipped to just over 50 percent, about where it was before the terrorist attacks. Administration critics on Capitol Hill, whose silence for many months had baffled and angered rank and file Democrats, have found new voice.

Howard Dean, former governor of Vermont, whose sharp denunciation of White House economic policies and the war with Iraq had earlier earned him the approbation "Darling of the Left," is suddenly main stream and is leading the Democratic pack of presidential hopefuls by a wide margin in New Hampshire, which kicks off the presidential primary season on January 27. And two of his rivals, Massachusetts Senator John Kerry and Missouri Representative Richard Gephardt, have begun to pile on with stinging criticisms of the Bush Administration's foreign and domestic policies.

Even Connecticut Senator Joseph Lieberman, Al Gore's 2000 running mate, who had stood shoulder to shoulder with the President on Iraq and on the faith-based initiative, has squared off with the White House over the environment and taxes.

But Bush's critics are not just the Democrats who are vying for a shot at the presidency in 2004. As the death toll of American troops keeps mounting in post-Saddam Iraq, some Republican heavyweights have begun to break ranks with the White House as well, over its handling of foreign affairs. Count three Senate committee chairmen among them: John Warner of Virginia—Armed Services, John McCain of Arizona—Commerce, Science and Transportation, and Richard Lugar of Indiana—Foreign Relations.

For now, GOP congressional criticism of White House domestic policies has been relatively muted. But if the tide of federal red ink grows into a tsunami, as the nonpartisan Congressional Budget Office now predicts, and if the unemployment rate proves itself strongly resistant to supply-side economics in the short term, as many Wall Street analysts say, look for Capitol Hill Republicans to distance themselves from the President as the 2004 election draws closer.

Also look for more Administration officials to exit. Earlier this year, the Bush team embarked on an economic make-over when Secretary of the Treasury Paul O'Neill and National Economic Council Chairman Lawrence B. Lindsey departed. Several months later, Glenn Hubbard, Chairman of the President's Council of Economic Advisors, left to resume his academic post at Columbia University. And in the late spring, Mitch Daniels, Director of the Office of Management and Budget, who had been a lightning rod for bipartisan congressional criticism of White House financial policies, resigned to run for governor of his home state of Indiana.

The exodus continued in June with the departure of Christie Todd Whitman, the Administrator for the Environmental Protection Agency, a New Jersey moderate who was a poor fit for a conservative White House from the outset. Her replacement, Utah Governor Mike Leavitt, is more suited to a presidential campaign that is certain to appeal to the westward-looking, right-wing core constituency of the GOP.

Although his poll numbers are sinking, don't count Bush out for 2004. With a bankroll that is expected to exceed $200 million by the time the campaign gets into high gear, the President will be a formidable adversary for even the strongest Democrat - and so far, his opposition field appears pretty weak.

So where does this leave science in the coming year, when Republicans control all branches of the federal government?

Inside the Beltway, it's no secret that President Bush is far from a techie dweeb. Unlike his 2000 opponent, Al Gore, who was the prime promoter of the Internet when he was a member of the United States Senate, Bush, according to White House cognoscenti, is downright uneasy when he's in the presence of almost any member of the scientific elite.

Still, he's a politician with a politician's thirst for elective success. And therein lies a scientific opening. With the tech workforce accounting for 10 million votes, the White House must pay attention to a standard theorem of political calculus: *don't alienate a potential voting bloc if you can possibly avoid it.*

The budgetary stars may be in perverse alignment, but the White House must have its political telescope trained on the voting populace, if it wants to prevail in 2004. And scientists could make themselves a force to be reckoned with.

RICHTER *from page 1*

"High-risk research," Richter answered. Seventy-five percent of all US patents cite research that was done with government funds as part of the basis for the patent, said Richter, and "If investment is not made in this kind of high-risk research, the engine [of invention] will run out of gas."

In response to a question about the cause of the flat funding that has plagued the Office of Science for more than a decade, Richter suggested that it could be a result of misunderstandings in Congress as to which agencies fund which research. Praising Congress for passing the NSF doubling bill last year, Richter pointed out that even doubling the NSF budget would only increase physical science funding by 15%.

Richter was further questioned on what the Office of Science could do with additional funds. Richter introduced an APS white paper into the record which gives a detailed account of opportunities being missed in the Office of Science due to lack of funds. The white paper, entitled "Securing the Future for the Department of Energy's Office of Science" can be found at http://www.aps.org/public_affairs/issues/hr34/.

Richter also mentioned the "20 Year Priority List" that should be published soon by the Office of Science.

The hearing took place on one of the last days before the August recess, on a day when the Senate Energy Policy Act was being debated on the Senate Floor. A few days after the DOE Office of Science hearing, the Senate passed a version of the Energy Policy Act virtually identical to the language passed the year before. Both the Senate version and that passed by the House include language that would authorize increases in funding for the Office of Science.

Only the Senate bill includes a provision for an additional undersecretary in the Department of Energy. This position, which has been the subject of lobbying efforts in the physical science community, would oversee the science programs at DOE and thereby give those programs higher administrative visibility.

The House has already passed its spending bill that includes the Office of Science, giving a 6.4% increase to the Office of Science.

The Senate Appropriations Subcommittee on Energy and Water passed a bill that gives only slight increases to the Office of Science, but the full Senate had not yet passed a final version of the bill when Congress went into recess.

Also testifying at the DOE Office of Science hearing were Secretary of Energy Spencer Abraham; Hermann Grunder, director, Argonne National Laboraratory; and G. Wayne Clough, president of Georgia Institute of Technology and member of the President's Council of Advisers on Science and Technology. Ray Orbach, director of the Office of Science, was on hand to answer questions.

Full testimony from all witnesses can be found at http://energy.senate.gov/hearings/witnesslist.cfm?id=880.

OLYMPIAD *from page 1*

officer of the American Association of Physics Teachers, which co-sponsored a training camp to prep the students for the international tests. "We've never had this kind of confluence of great students before. It's all the more remarkable, since the event might never have been held. The fact that they did so well speaks even better on behalf of the kids."

All five members of the US traveling team placed in the top 10%.

Batrachenko (ranked first), Gulotta (ranked 13th), and Chintan Hossain, from the Charter School of Wilmington Delaware, (ranked 19th) received gold medals.

Russell (tied for 21st place) and Immanuel Buder, from Thomas Jefferson High School, Alexandria, VA, (ranked 23rd) received silver medals. Although the competition is among individuals, an informal summary of scores showed that the US was the top-ranking country out of the fifty-four participating nations, followed by South Korea, Taiwan and Iran.

Members of the 2003 US Physics Team were selected from a group of semifinalists based on their screening exams, transcripts, and letters of recommendation. The 24 members of the team met at the University of Maryland's physics department for the training camp May 16 - 26, [*see APS NEWS, July 2003*] and from that meeting five traveling members were selected.

The traveling members met again at Cal Poly Pomona, July 27-30, for a mini-camp devoted to enhancing their laboratory skills.

ANNOUNCEMENTS

AIP STATE DEPARTMENT FELLOWSHIP

APS/AIP CONGRESSIONAL SCIENCE FELLOWSHIP

The American Physical Society and the American Institute of Physics are accepting applications for their 2003-2004 Congressional Science Fellowship programs. Fellows serve one year on the staff of a Member of Congress or congressional committee, learning the legislative process while lending scientific expertise to public policy issues. **Application deadline is January 15, 2004.** For more information, visit: http://www.aip.org/pubinfo or http://www.aps.org/public_affairs/fellow

AIP STATE DEPARTMENT SCIENCE FELLOWSHIP

The American Institute of Physics (AIP) is now accepting applications for the AIP State Department Science Fellowship. This fellowship program represents an opportunity for scientists to make a unique and substantial contribution to the nation's foreign policy. Each year, AIP sponsors one fellow to work in a bureau or office of the US State Department, becoming actively and directly involved in the foreign policy process by providing much-needed scientific and technical expertise. **Application deadline is November 1, 2003**. For more information, visit: http://www.aip.org/mgr/sdf.html

Bored? Try the new Discussion Board

The Forum on Physics and Society is inaugurating an internet "Discussion Board" to support discourse on physics and society topics that extends beyond the regular meetings of the American Physical Society.

You can reach the FPS Board via: http://www.fpsboard.org

The new report of the APS Study Group on Boost-Phase Intercept Systems for National Missile Defense, released on July 15, 2003, is the first special discussion topic.

The executive summary of the boost-phase report, and related material, are contained in a subsidiary site, which you can reach by clicking on the "executive summary and other material" link on the FPS Board.

A principal long-term purpose of the FPS Discussion Board will be to make available summaries of the talks and discussion at invited-paper sessions of particular interest from a "physics and society" point of view, and then to permit APS members who were not at the sessions (or even who were) to participate in a continuing discussion of the topics raised in these sessions.

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

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

Some *Focus* Stories:

I. Shaw & A. Plesch/Harvard Univ. for SCEC

Big Impacts of Small Tremors
Small earthquakes may trigger more aftershocks than do larger quakes, according to an analysis of California's seismic history.

X. Ji, A. Belitsky, F. Yuan/Univ. of Maryland

How the Proton Got its Spin
Mathematically-derived pictures show the structure of quarks inside a proton.

Royal Navy, Crown Copyright

Light-Speed Submarine
A seeming paradox in relativity involving a near-light-speed submarine has now been resolved.

APS Seeks New Director of International Affairs

Due to the imminent retirement of Irving Lerch, the APS is seeking a Director of International Affairs beginning January 1, 2004.

Responsibilities include: promoting international exchange and collaboration, helping build and maintain relationships with other national physical societies throughout the world, advancing APS programs in support of developing countries, and working with APS Committees on International Scientific Affairs and International Freedom of Scientists. In addition, the Director advises the APS leadership on international issues of importance to the Society.

Necessary qualifications include: a PhD in physics or a related field; expertise in seeking external funding for project support; substantial experience in the international science area including at least one of the following: living and working abroad for an extended period of time, administrative or program experience within an organization with emphasis on international scientific relations, and extensive overseas travel in connection to physics research or administration.

To apply, send a cover letter detailing your interests and expertise, curriculum vita, and contact information for three references by October 10 to Judy Franz, APS Executive Officer, franz@aps.org.

Now Appearing in RMP Recently Posted Reviews and Colloquia

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

Colloquium: Advances in atomic force microscopy
—Franz J. Giessibl
Atomic force microscopy has emerged as an important tool for the imaging of surfaces of conductors and insulators. In particular, frequency modulation atomic force microscopy carried out in a vacuum environment has allowed the imaging of insulators with true atomic resolution. This article presents the principles of atomic force microscopy, discusses the experimental challenges that must be overcome in order to achieve atomic resolution, and surveys new developments in the field.

Also Recently Posted:
Recent trends in the determination of nuclear masses
—D. Lunney, J. M. Pearson, and C. Thibault

Research Corporation Helps Young Scientists Get Going

By Pamela Zerbinos

For 90 years, young physics researchers struggling to find funding for their first projects have turned to the Research Corporation, a nonprofit philanthropic organization dedicated to supporting scientists and their work.

"Your first grant is, in many ways, very important," said Protik Majumder, who teaches physics at Williams College in Massachusetts.

Majumder proposed to use small-scale experiments to do precise measurements of thallium atoms. He received the Cottrell College Science Award, granted to faculty at undergraduate institutions, in 1994.

"It was a small grant, but it really got me off the ground and got me started. I now have had five years of support from the NSF and have received a very competitive NIST grant. Nothing convinces a skeptical grant reviewer about your potential to get things done at a small college like accomplishing your first set of research goals."

"My Research Corp. grant has a very special place in my heart," said David Tanenbaum, a Pomona College professor who won the Cottrell College Science Award (CC) in 1998. "It was very fast. I wrote it in the fall and could spend the money by the summer. It allowed me to budget and spend my start-up money much more sensibly."

In 2002, the CC Awards accounted for just under half of the $5.4 million granted by the Research Corporation. Seventy undergraduate faculty members received a total of $2.4 million.

Young faculty at PhD-granting institutions are also encouraged to apply for some of the foundation's other grants. The Cottrell Scholar (CS) program was started in 1994 in response to criticism that faculty at research institutions don't put enough emphasis on teaching; the prize, which is awarded in the amount of $75,000 and spent at the discretion of the recipient, requires both research and teaching proposals and recognizes young faculty who excel at both.

"I think the Cottrell Scholar program is a great idea to encourage faculty at research institutions to think about excellence in teaching as well as research," said Mark Moldin, a UCLA professor who won a CS Award in 1996.

"I think they have developed a wonderful cadre of young faculty that are now tenured and making decisions that will have a real impact on the balance of research and teaching. I know that my ideas on the importance of strongly integrating teaching and research have been strengthened because of my involvement with the Cottrell Scholar program."

In addition to the CC and CS awards, the foundation also sponsors the Research Innovation Award (RIA) and the Research Opportunity Award (ROA). The RIA is for first-year faculty, and the ROA for senior faculty who want to explore new experimental research.

Their final program grants the Special Opportunities in Science Award to projects that advance scientific research but fall outside other program guidelines.

It is through this program that the Research Corporation is able to fund two of the American Physical Society's awards, the Edward A. Bouchet lecture award, for a distinguished minority lecturer; and a prize for faculty research at an undergraduate institution.

The Research Corporation was founded in 1913 by Frederick G. Cottrell, who donated his patents for the electrostatic precipitator in 1912 to create the foundation. And other proceeds from Cottrell's patents have been donated to other scientists to help further their research.

BIOLOGY *from page 1*

been made in the last 10 years," says Austin about the decision to hold a second workshop. "Biology is changing from a descriptive to a quantitative and conceptually profound field. We believe that physics will make a substantial contribution to this revolution, particularly if biologists and physicists work together at this critical time."

Physicists and biologists who are leaders in their fields will be asked to give broad overviews of selected areas at the interface between physics and biology.

On the afternoon of the first day, there will be a reception, at which time there will be an opportunity for those who fund researchers in biological physics and those who hire biological physicists to meet with the participants and to display posters or provide information in other forms.

There will be a "Lunch with the Experts," available to all the student participants free of charge. Attendance will be limited to about 250 participants. "Keeping the conference small will allow the participants to interact more easily with the speakers, all of whom will be major leaders in their fields," said Franz.

A detailed schedule of talks and events will be posted as soon as it becomes available.

For more information about the "Opportunities in Biology for Physicists" workshop in San Diego, see http://www.aps.org/meet/biology-physics2/.

LETTERS *from page 4*

a change in momentum. Therefore, the deflection of the wake also accounts for all of the force on the object.

The pressure distribution and the bending of the wake are not separate effects. One is a direct consequence of the other.

You can't have a lift-generating pressure distribution without bending the flow, and vice-versa. Either one alone explains the force.
Stergios J. Papadakis
Chapel Hill, NC

The Back Page

Standing on the Knife-Edge: The Leadership Imperative

By Shirley Ann Jackson

The events of the past several months underscore just how global is the reach—and how urgent the task—of science. The war in Iraq was premised on preventing the use of advanced chemical, biological, and possibly nuclear weapons against innocent people. And, the progress of US and British forces was supported by their use of advanced weapons and technology: laser-guided missiles, remote-controlled "packbots" to see into hostile spaces, new surveillance methods, and an array of special computers.

Science and technology will continue to advance; these are not genies that go gently back into their bottles. But there is a "knife-edge" to the advancement of science. Its misuse could take us to the brink. Yet, science also can lead us toward salvation.

Science is a neutral commodity, choosing no sides, offering no judgments, rendering no opinions, except with respect to the science itself. The results of research remain neutral, until they are ascribed meaning, or significance, through application. Yet truly controversial issues lie at the juncture of science and humankind, when new knowledge is applied in ways that may have unanticipated moral or ethical implications, where safety or security risks are introduced which must be balanced against the benefits achieved.

It is up to the science and engineering community, itself, to step forward and provide leadership: solutions, clarifications, or resolutions to what seem to be either/or propositions, but which often can be solved scientifically. But the scientific approach must dovetail with policy. In this way, knife-edge questions can be defused, enabling the development of technologies that can bring prosperity, enhance security, ensure an enduring peace, and safeguard the global community.

Take nuclear science, for example. Three decades ago, France, a nation with few coal and natural gas resources and virtually no oil resources, embraced a national nuclear power policy for generating its electricity. Today, France's 57 nuclear power plants generate almost 80% of that nation's electrical power and provide several billion dollars in annual revenues from sales of surplus power to other European nations. There has never been a nuclear power accident in France, and the nation safely reprocesses much of its nuclear waste. Because its nuclear energy produces no emissions, France has the lowest rate of carbon equivalent emissions in the European Union (EU), and is predicted to have the least difficulty among EU members in meeting its greenhouse gas emission goals under the 1997 Kyoto Protocol.

The environmental benefits of nuclear power also are recognized in the US, where the modest-but-respectable 20% of US electricity generated by nuclear power represents more than three-quarters of the nation's emission-free electricity production. Beyond nuclear power, approximately 10 to 12 million nuclear medicine imaging and therapeutic procedures are performed each year in the United States.

Nuclear by-product material is used in calibration sources, radiopharm aceuticals, bone mineral analyzers, portable fluoroscopic imaging devices, brachytherapy sources and devices, gamma stereotactical surgery devices, and teletherapy units. Radioisotopes are used to identify drug-resistant strains of malaria, tuberculosis, and other diseases; radiation is used in sterilizing bone, skin, and other tissues required for tissue grafts to heal serious injuries; and nuclear techniques are used to optimize malnutrition studies. Agricultural productivity is enhanced by the development of new plant varieties through radiation-induced mutation.

But then, the US government reported last year that 1,500 radiation sources were believed lost or stolen in the US since 1996. More than half of these were never recovered. In late March, *The New York Times* reported that police in the former Soviet Republic of Tajikistan had arrested two people who were in possession of—and attempting to sell—four kilograms, or about nine pounds, of radioactive mercury. In the Republic of Georgia, over 280 "orphaned" radioactive sources— that is, sources outside of regulatory control—have been recovered since the mid-1990s. Some of these sources have lethal levels of radioactivity.

We must add concern over how nations comport themselves internationally. On the Indian subcontinent, we have India and Pakistan, in a dangerous stand-off, based on deeply rooted historical and ethnic divisions that overshadow the potentially devastating consequences of conflict between them.

Domestically, there is heightened concern over the safety and security of nuclear reactors. War in Iraq and fear of terrorist activity are fueling an intensified campaign to close the Indian Point nuclear power station, 35 miles north of New York City. The plant is in compliance with federal safety regulations, but state and local officials have declined to certify the plant's emergency plan because of fears of the release of radiation in the event of a major accident or terror attack. The area is densely populated—about 11.8 million people live within 50 miles—and its proximity to New York City makes it a potential terrorist target.

Biomedical technologies also exist on the "knife-edge" of life and death, and of policy differences. The transplantation of an electrical device into his diaphragm has enabled injured actor Christopher Reeve to breathe more easily. Yet, the nation was transfixed by the errors that occurred during a widely publicized heart/lung transplantation at Duke University Hospital this winter, which caused the death of a young Mexican woman because of the use of tissue of the wrong blood type. The incident forced hospital officials to confront some of the most troubling questions posed by our expanding biotechnology capabilities: that no matter how far biomedical science advances, doctors are still human, and the best laid plans can be confounded by the simplest of errors.

In each of these and other issues, resolution will require leadership on the knife-edge. The first leadership question is, who will do the science? Who will address the issues? Scientists and engineers comprise less than 5% of the total US civilian workforce, yet the societal, economic, and quality of life impact of their scientific discoveries and technological innovations throughout US history greatly exceeds their small number. They have given the US the world's strongest national economy, with the largest per-capita income and the highest standard of living.

Science and engineering are essential to our national economic and physical security. And yet, the cohort of scientists and engineers who have been responsible for propelling our nation to these heights of leadership, prosperity, innovation, and security, is soon to retire. Nor is it being replaced in sufficient numbers. The National Science Board's Science and Engineering Indicators 2002 find that, although the number of trained scientists and engineers in the national labor force will continue to increase for some time, the average age will rise, and retirements will increase dramatically over the next 20 years. This emerging loss is compounded because the aging cohort is not being replaced in adequate numbers. Graduate and undergraduate student populations in engineering and the physical sciences—and even in the computer sciences—are static or declining. The only positive trajectories have been in the life sciences.

In the past, we have imported the science, engineering, and technological expertise we needed. But in an era of turbulent global relationships and security concerns at home, this is beginning to be more difficult. International students and scientists have begun to choose to return home in greater numbers. Many jobs are moving overseas. Some have linkages to US companies, whose workers, living abroad, are well compensated. The economies in some third world countries are improving, creating more opportunities. At the same time, in the post September 11th environment, immigration is becoming more restrictive, especially for science and

Photo Credit: Mark McCarty

Shirley Ann Jackson

engineering students wanting to study certain technical subjects.

The good news is that we can do something. We have the talent. It resides in plain view, in the new majority comprised of young women, minority youth, and young people with disabilities—groups that, currently, are underrepresented in science, mathematics, engineering, and technology. Taken together, these groups offer what I call an "affirmative opportunity" to construct the science and engineering workforce of the future. In a dozen years (by the year 2015), our undergraduate population will expand by more than 2.6 million students. Two million of them will be students from these underrepresented groups. If these young people are willing, if they are prepared, and if they are financially able, then we will have bridged the science and engineering talent gap.

Our challenge is to make this happen. This, too, will require that we "stand on the knife-edge." Why? Because of concerns about affirmative action. The debate about affirmative action is a red herring. The future scientific prowess of the US depends upon closing the talent gap, which we can do only if we mine all the talent. But, this takes more than post-secondary education remediation strategies, or making "merit-based decisions" about university admissibility. The fight cannot begin at the college classroom door.

Like scientific research itself, building a science, mathematics, engineering, and technology workforce has a lengthy lead time. To "build" or to "craft" a scientist or an engineer, we must begin in junior high school, at the latest. It takes as much as a decade or more to construct the interest and excitement, the background and preparation, the education and experience, needed to produce a future PhD in biocatalysis, for instance, or a nuclear engineer.

Yet the systems that enable this process often depend upon a mix of government policies, political climates, and economic constructs which operate on a fast scale, but which have long-term effect. Decisions debated today, enacted tomorrow, and implemented next year combine to set the tone and create the environment that will affect us for many years to come.

Decisions in these arenas impact students, their choices, and their support. They also affect broader science literacy and support among the general public. They affect how we raise and resolve the tangled ethical issues that advancing scientific research continuously places before us. These decisions and their impact cry out for real leadership. Because this issue affects the American future so broadly, this new leadership needs to be a coalition leadership, combining the science communities, the education communities, the corporate and industrial communities, and the full spectrum of government.

A second area of leadership that I believe is critical will be to focus the energies of the scientific community on those areas in which technological solutions can make the difference in resolving knife-edge challenges. Nuclear energy, for example, is an important transition fuel for the first half of this century, reducing our dependence on oil and petroleum products, supplying our growing need for power, and helping to resolve our global climatic and environmental concerns over greenhouse gas emissions.

The third element of leadership on the knife-edge must be communication to inform public policy. Public policy is not always an ideal forum for fair debate. It is a roiling marketplace where every voice has its own agenda, and where an issue can become veiled and confused. But, it is a public marketplace for ideas, it is democratic, and it is open. The public policy arena needs the reasoned voice of science itself—scientists who have no economic interest in the outcome of a decision, scientific organizations that can use their credibility to inform public policy debates, weighing in on knife-edge issues with the voice of reason.

The scientific community has the leadership, and the fortitude, to step up to this opportunity. We cannot stand on the sidelines and allow science and its contribution to human knowledge, to technological innovation, to economy, aid, trade and security to be held hostage to fear and misinformation, special interests, or bad policy. The scientific community must take a stronger hand in formulating policy. We must bring balance to the debate, and we must advocate the role of science, and of the scientific community, in addressing the issues.

We have a lot of work to do. There is a lot at stake.

Shirley Jackson is president of Rensselaer Polytechnic Institute and president-elect of the American Association for the Advancement of Science (AAAS). She was Chairman [sic] of the Nuclear Regulatory Commission from 1995 to 1999. The above is adapted from her AAAS William D. Carey Lecture of April 10, 2003. Used with permission.

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.