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Physics and Technology Forefronts
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Signing Launches International Program

Photo by Ken Cole

On July 9 at APS headquarters in College Park, MD, APS and the Indo-US Science and Technology Forum (IUSSTF) agreed to begin a program that will sponsor exchanges of physicists between the US and India, at various career levels. Signing the memorandum of understanding are IUSSTF Executive Director Arabinda Mitra (left) and APS Executive Officer Judy Franz (right). Standing guard are Kamal Kant Dwivedi (left), Science and Technology Counselor at the Embassy of India in Washington, and Amy Flatten (right), APS Director of International Affairs. The IUSSTF was established in 2000 for the purpose of promoting Indo-US bilateral collaborations in science, technology, and related disciplines.

The APS-IUSSTF program is comprised of two components, one for professors and another for graduate students. At the faculty level, the program will fund physicists in India or the US wishing to visit overseas to teach short courses or provide a "physics lecture series" at a US or Indian university. Up to 3 awardees from each country (six total) will be selected each year, with each award being up to $4000.

At the student level, up to ten awardees will be selected each year.

The memorandum specifies a 7:3 ratio of US to Indian students, as the United States already hosts many graduate students from India, while far fewer US students have gained similar first-hand experience with India. Students will submit proposals for a visit in collaboration with their advisor as well as a professor at an institution in the host country. Awards will typically be in the $3000 range.

IUSSTF will fund the awards, whereas APS will defray operational costs, and provide staff to administer the program and manage the disbursement of funds. Program details will be available on the International Affairs page of the APS web site, www.aps.org, later this year.

APS Board Calls for Doubling Number of Physics Bachelors

APS has gone on record as favoring the doubling of the number of physics majors at US colleges and universities. At its June meeting, the Executive Board endorsed the following statement: "We advocate doubling the number of bachelor degrees in physics, to address critical national needs including K-12 education, economic competitiveness, energy, security, and an informed electorate."

A similar goal has also been endorsed by the American Association of Physics Teachers.

The statement does not precisely define what doubling means. As the graph shows, after peaking in the early 1960's, the percentage of physics majors has gone into decline, reaching a nadir of about 3800 majors in 1999. In recent years, there has been a turnaround, with the number of majors in 2006 reaching about 5400. One suggested realization of the doubling concept is to reach 10,000 majors within less than a decade. Given the rate of increase since 1999, this number would not be attained until 2023. To regain the same percentage as the peak in the 1960's would require 15,000 majors today.

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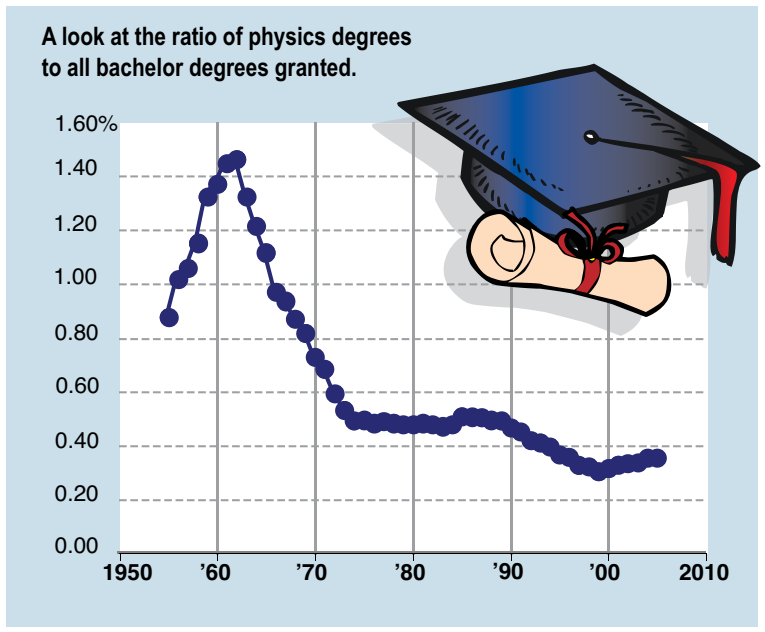

Source: AIP Statistical Research Center

APS Staff

APS Honors 26 Minority Scholars in 2007-2008

The APS Committee on Minorities has selected 26 students for the 2007-2008 Scholarship for Minority Undergraduate Physics Majors.

Each new minority scholar receives $2,000, and the scholarship may be renewed once, for $3,000. This year the committee selected 18 new scholars and 8 renewals. The scholarship may be used for tuition, room and board, and educational materials. Each minority scholar is paired with a mentor at his or her university, and physics departments that host a minority scholar each receive $500 for programs to encourage minority students.

The scholarship is open to any African-American, Hispanic American, or Native American US citizen or permanent resident who is majoring or planning to major in physics, and who is a high school senior, college freshman, or sophomore.

New minority scholar Iara Cury has spent the past two summers doing research in astrophysics. Now beginning her junior year at Yale, Cury is originally from Brazil. She and her parents, who are both biologists, moved to California about seven years ago. Cury has always been interested in science and math, and her teachers and professors have been encouraging, she says. After her freshman year in college, she approached professor Meg Urry and asked for a summer research project. Urry was busy, so she sent Cury to Chile to work with Paulina Lira of the Universidad de Chile. Cury, who had little experience in astronomy at the time, quickly jumped into the project, which involved infrared spectroscopy of high redshift active galactic nuclei.

This summer, Cury is working at the Harvard-Smithsonian Center for Astrophysics, where her research focuses on microlensing, a type of gravitational lensing. Cury plans to go to graduate school and earn a PhD in astrophysics,

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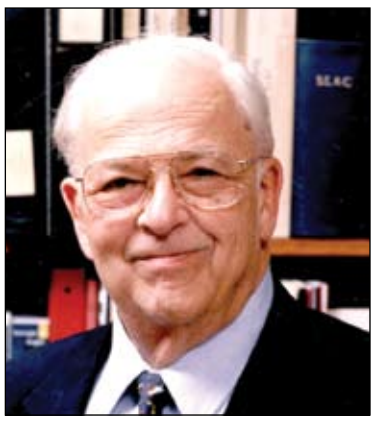
Richter to Chair APS Energy Efficiency Study

Former APS President and Nobel Laureate Burton Richter will chair a newly-established APS study group charged with producing a report on energy efficiency. The study will focus primarily on buildings (commercial and residential, including appliances) and transportation (primarily cars and trucks). Buildings and transportation account for more than 70% of total domestic carbon emissions.

According to the study group charge, "Improving energy efficiency is the simplest and least costly means available to reduce US oil consumption and carbon emissions, but the US is not doing enough to capitalize on energy efficiency either at home or in the products it exports. Improving energy efficiency must be one part of a portfolio of approaches for treating the US "oil addiction" and reducing its output of greenhouse gases."

"First on everyone's list, whether you're concerned about global warming or energy supply security, should be conservation and efficiency," said Richter.



"The APS did a seminal study on efficiency in 1975," he said. "It's been a long time, and the APS is coming back to the efficiency issue. This study will review where we are, and hopes to define the most promising areas of development for the future."

The study group will address the following questions: 1) What gains in energy efficiency are technically feasible, and over what periods of time? 2) What basic and applied research, development and demonstration need to be conducted and/or funded by government and industry to achieve the technically feasible gains in energy efficiency? 3) What changes in government programs are needed to accomplish that research, development and demonstration, and what changes in government policy are needed to facilitate the success of new energy-efficient technologies in the marketplace?

Energy-efficiency is "clearly an area where we can get the greatest gains most quickly for the least cost," said study group vice chair David Goldston, who formerly served as staff director of the House Science Committee. Energy has been an important topic in the news and in

RICHTER continued on page 7

Blewett Scholarship Awarded to Archana Dubey

By Katherine McAlpine

India to Albany, Albany to Austin, Austin to Orlando! While the life of Archana Dubey has taken her across the world and around the US, the frequent changes in scenery have impeded her academic career. Her current institution, the University of Central Florida, has offered as much support as possible for her research endeavors, but she wants to do more. The Hildred M. Blewett Scholarship, recently awarded to her through APS, will help her cut a wider path through the thickets of theoretical physics.

The scholarship, a grant of up to $45,000, was created from money left to APS by Hildred M. Blewett with the purpose of advancing the research careers of women in physics. Specifically, it is intended to jumpstart the work of women whose research has been interrupted for reasons concerned with family.

While all of the candidates clearly had excellent research credentials and plans, Dubey stood out in her perseverance through three career interruptions, the baby, and two moves for her husband's job changes, said Peter Sheldon, a member of the committee that selected Dubey for the Blewett Scholarship. She had great support from the institution where she is trying to get some research going, and it seemed clear that the scholarship would help her to establish herself there.

Born in Rajasthan, India, Dubey completed most of her doctoral work at Bhavnagar University. Towards the end, she married and moved to Albany, NY. "While I was able to finish my PhD work remotely, continuation of further work became cumbersome if not impossible," she said.

BLEWETT continued on page 5

Members in the Media

"If either of these ice sheets were to disintegrate, it would destroy coastal civilization as we know it,"

***Michael Oppenheimer**, Princeton University, on the Greenland and west Antarctic ice sheets,* Washington Post*, July 16, 2007*

"There are some things that chemistry can't do on its own. The additional design flexibility with introducing structure as well as chemistry into the equation enables you to reach properties that just haven't been accessible before."

***John Pendry**, Imperial College London, on metamaterials,* The New York Times*, June 12, 2007*

"I'm not crazy. I don't know if this experiment will work, but I can't see why it won't. People are skeptical about this, but I think we can learn something, even if it fails."

***John Cramer**, University of Washington, on a proposed time travel experiment,* Seattle Post Intelligencerx;*, June 11, 2007*

"It's a lot like looking for an ivory-billed woodpecker."

***Dick Loveless**, University of Wisconsin-Madison, on hunting for the Higgs particle,* Wired*, June 18, 2007*

"The trouble is that rocks are made out of the same stuff as the fossils and the two are not always distinguishable."

***Jim Siegwarth**, NIST, on a fossil hunt,* Pittsburgh Post Gazette*, June 24, 2007*

"I'm doing fine; I'm doing wonderful considering it was just a week ago I got a new kidney. I had just turned 66, and I had just taken phased retirement, so this was a nice present."

***Chuck Brown**, Fermilab, on receiving a new kidney,* Kane County Chronicle*, June 20, 2007*

"The shock wave would have spread across the whole continent. This event was large enough to directly kill most everything instantly. Those that survived would have found their food sources devastated, their water polluted, all kinds of things that would have made it difficult to go on much longer."

***Richard Firestone**, Lawrence Berkeley National Lab, on the possibility that a comet may have killed off the wooly mammoths,* Washington Post*, June 11, 2007*

MEMBERS continued on page 5

Workshop Teaches Policy Fellows About Political Campaigns

About 40 current and former AAAS science and technology policy fellows, including congressional fellows sponsored by APS, got some practical advice on how to run a campaign for public office at a workshop in July in Washington, DC.

Fellows are typically PhD-level scientists who spend a year involved with science policy by working either on Capitol Hill or in the Executive Branch. The workshop was designed to give participants an introduction to political campaigns. Some of the participants had worked on a campaign, but few had run for office themselves.

The workshop was organized by Scientists and Engineers for America, a recently formed organization that aims to help scientists and engineers run for public offices. "Policy makers don't know science. Scientists and Engineers for America was formed to address this at the root–namely the election," said SEA director Mike Brown at the workshop.

Speakers at the workshop included professional campaign managers, pollsters, and former AAAS policy fellows who have run for office. They discussed the basics of running a campaign in races ranging in size from local offices to President of the United States.

Dean Levitan, a campaign manager with MSHC Partners, said that having a written campaign plan and a realistic budget is essential. "A campaign is like a business," he said.

Workshop participants were somewhat surprised to learn that a candidate must spend a lot of time making phone calls to raise money, often as much as 40 hours a week. Levitan also suggested spending 75% of campaign funds on paid media and direct voter contact, keeping in mind how many votes each expenditure can be expected to bring in. For instance, trinkets and yard signs bring visibility to a campaign, but don't bring in many votes.

Small campaigns, such for school board seats or other local offices, may cost only about $1000, and may require only one campaign staff person, namely the candidate himself or

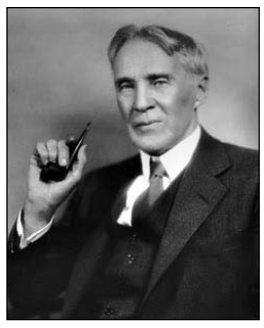
WORKSHOP continued on page 3

This Month in Physics History

September 1904: Robert Wood debunks N-rays

Shortly after the discovery of X-rays in 1895, there was a flurry of research activity in the area, with many scientists expecting more similar discoveries. So when another new type of radiation was reported in 1903, it generated a lot of excitement before it was proved false in September 1904.

The first claimed discovery of the new type of radiation was made by René Prosper Blondlot, a physicist at the University of Nancy in France. Blondlot, a respected scientist and member of the French Academy of Sciences, had been experimenting with the polarization of X-rays when he found what he thought was a different type of radiation. In the spring of 1903, Blondlot published his first report on the new rays in the *Proceedings of the French Academy* (the *Comptes Rendus*). He called the new rays N-rays, with N standing for Nancy, his hometown. The N-ray discovery was something of a matter of national pride for the French, since X-rays had been discovered by Wilhelm Conrad Roentgen, a German.



Robert Wood

Blondlot used various kinds of apparatus to observe the rays, which were purportedly just barely detectable. In his first experiments, he detected the rays through slight variations in the brightness of a small electric spark when the rays fell on it. Later, he used screens with a phosphorescent coating, which would supposedly glow slightly brighter when hit by N-rays. He thought the new rays were also a form of light, and found that they could be polarized, reflected, and refracted.

Within months of Blondlot's first announcement, many scientists–mostly French scientists, but a few others as well–would claim to have seen the rays. Hundreds of papers were soon published on the topic, including 26 papers by Blondlot himself.

Soon various properties of the N-rays were "discovered." For instance, the rays were found to go through wood and metals, but were blocked by water. They were emitted by the sun, gas burners, and metals, but not wood, and could be stored in a brick.

Other scientists proposed applications of the mysterious radiation. For instance, Augustin Charpentier, a professor of medical physics at the University of Nancy, reported that the rays were emitted by rabbits and frogs, and the human brain, muscles, and nerves. He predicted that N-rays, like X-rays, could be useful for medical imaging, to see the outline of internal organs. Another N-ray researcher, Jean Becquerel, son of Henri Becquerel who discovered radioactivity, claimed that N-rays could be transmitted over a wire.

These scientists seem to have genuinely believed in their claimed observations, but many other scientists found they could not replicate the results. In fact, they could not see any evidence of N-rays at all. Blondlot and others N-ray believers argued that those who couldn't see the rays simply didn't have sufficiently sensitive eyes to detect the effects of N-rays, which were supposedly just at the limits of visibility.

The physics community was divided on the issue. One physicist who had been unable to detect the N-rays in his own lab was Robert Wood, of Johns Hopkins University. Wood, who did research on optics and electromagnetism, was known for his diverse interests and his enjoyment of pranks.

In the summer of 1904, Wood was sent to France to observe Blondlot's experiments, in hopes of clearing up the matter.

Blondlot and his assistants set up several of their demonstrations for Wood. In the most well known demonstration, Blondlot showed how N-rays could be spread out into a spectrum by an aluminum prism. Blondlot claimed to detect this spectrum by noting a slight increase in brightness at some points along a phosphorescent strip. Wood could see no evidence of the N-ray spectrum.

The experiments had to be done in a darkened room, which gave Wood the opportunity to play a trick: unseen by Blondlot and his assistant, Wood removed the crucial prism from the apparatus. He then asked Blondlot to repeat the observations of the N-ray spectrum.

Not knowing the prism had been removed, Blondlot continued to insist he saw the very same pattern he had claimed to see when the prism was in place.

After several similar demonstrations, Wood was completely convinced that Blondlot and others were imagining the phenomenon.

On September 22, 1904, Wood sent off a letter to *Nature* describing his visit to Blondlot's lab, and his conclusion that N-rays were non-existent. "After spending three hours or more in witnessing various experiments, I am not only unable to report a single observation which appeared to indicate the existence of the rays, but left with a very firm conviction that the few experimenters who have obtained positive results have been in some way deluded," he wrote in his report to *Nature*. Although Wood didn't mention Blondlot by name in the article, anyone reading it would have known whose experiments it referred to.

Wood's report was published in the September 29, 1904 issue of *Nature*. Within months, almost no one believed in N-rays anymore. The issue was considered resolved. Blondlot, however, refused to admit he had been in error, and kept working on N-rays for years after others had given up on them.

The story of N-rays, which fooled many respectable scientists, has been used ever since as a cautionary tale of how easy it is to deceive oneself into seeing something that is not really there.

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Washington Dispatch

A bi-monthly update from the APS Office of Public Affairs

ISSUE: Science Research Budgets

Congress began to mark up its twelve spending bills for fiscal year 2008 (FY 08) in May and, so far, has funded science research above the President's request levels. (See table below.)

Although Congress might be able to pass all the FY 08 bills before the September 30th deadline, as the Democratic leadership has promised, President Bush has pledged to veto civilian spending bills that exceed his budget levels. Since enough conservative House Republicans have already staked out positions supporting the President, veto overrides are very unlikely. As a result, FY 08 spending plans are uncertain at this time.

Account	FY05 ($B)	FY06 ($B)	FY07 ($B)	FY08 ($B)		
				Request	House	Senate
DOE Office of Science	3.57(a)	3.47[a]	3.8	4.4 (+15.8 %)	4.52 (+18.9 %)	4.50(+18.3%)
DOE Renewables	--	1.16	1.46	1.23 (-15.6 %)	1.90 (+30 %)	1.71 (+17%)
NSF	5.48	5.59	5.92	6.43 (+8.8 %)	6.51 (+9.9 %)	6.55(+10.6%)
NIST Core[c]	0.40[a]	0.44[a]	0.49	0.60[a](+20%)	0.63 (+28%)	0.65 (+32%)
STRS	0.37[a]	0.39[a]	0.43	0.50 (+16%)	0.50 (+16%)	0.52 (+21%)
CRF	0.03	0.05	0.06	0.09 (+59.3 %)	0.13 (+120%)	0.15 (+154%)
NIST ATP	0.14	0.079	0.079	0 (-100 %)	0.09 (+14%)	0.10 (+27%)
DOD 6.1	1.49	1.47	1.54	1.42 (-7.8 %)	--	--
DOD 6.2	4.79	5.17	5.21	4.36 (-16.3 %)	--	--
NASA Science	5.50	5.25	5.25	5.52 (NA)[b]	--	5.66 (+3.5%)

(a)–Adjusted for Congressionally Mandated Programs (or Earmarks) (b)–New budget structure; comparison with previous years is not appropriate. (c)–NIST Core contains both NIST STRS and NIST CRF.

NIST Acronyms: STRS–Scientific and Technical Research; CRF–Construction of Research Facilities; ATP–Advanced Technology Program

Details of NASA Science are expected in mid-July; however, the Senate Commerce, Justice, Science and Related Agencies subcommittee approved a spending level of $5.66 billion. The bill is awaiting full Appropriations Committee action.

Before reaching the President's desk for consideration, spending bills progress as follows: in each chamber, passage by appropriations subcommittee, passage by full committee, passage on floor of the chamber; if House and Senate versions differ, passage by conference committee followed by passage in each chamber.

To track the progress of the appropriations bills, visit http://www.aaas.org/spp/rd/approp08.htm or go to http://www.aps.org/policy/issues/research-funding/index.cfm

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ISSUE: Washington Office Media Update

The Washington Office assisted with the following: in Indiana, a TV spot featuring a Purdue researcher developing cellulosic ethanol appeared on the FOX affiliate in June. Three letters to the editor praising Chairman Peter Visclosky (D-IN) for his support of science in the House Energy & Water Appropriations Subcommittee appeared in two newspapers in his district–The Times of Northwest Indiana and the Post-Tribune. Don Koetke of Valparaiso and Bruce Bunker and Wayne Mitchell of the Notre Dame were the authors.

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Log on to the APS Web site (http://www.aps.org/public_affairs) for more information.

WORKSHOP continued from page 2

herself.

Joe Trippi, who managed Howard Dean's 2004 campaign, talked about the advantages and challenges of running for office in the internet age. "We're now moving to an era where you have to be who you are," he said. Trippi believes voters would welcome someone from a different perspective, such as a scientist. "More and more the problems we have are not likely to be solved by the standard group of politicians," he said. If a candidate has clear positions on issues, the internet can be very useful in bring in campaign contributions.

The group also heard form pollster Anna Greenberg on crafting a message. "Your message has to be simple," she said. You can't assume people know anything, and you have to repeat your message many times before people hear it, she advised.

Scientific credentials can put distance between the scientist-candidate and the voters, she said, but communicating directly with voters and connecting the message to their lives can help overcome that distance. "It's very important to be respectful of other people's worldviews," she added.

Representative Rush Holt (D-NJ), a former APS congressional fellow and one of the two physicists in Congress, also offered some advice on being a scientist running for office. At first, in his campaign, he had tried not to over-emphasize his science background, but he soon found that he could make it work to his advantage. "I've managed to talk about science in a way that didn't paint me as an egghead," he said. Holt said he believes he won his seat by raising a lot of money early in the campaign, by working hard, and by a particularly effective television ad.

He said that scientific aspects of some issues are ignored because Members of Congress are afraid of science. "They are reflecting their constituents. That is the public attitude," he said.

A discussion by former AAAS science and technology policy fellows who had run for office also yielded some pieces of advice. For instance, Doug Meckes, a veterinarian who ran for and served on the Board of Commissioners in Apex, North Carolina, said it's helpful to be active in the community. "I had great name recognition. I'd been taking care of everybody's animals," he said. David Westerling, a civil engineer who was elected Town Moderator in Harvard, Massachusetts, added, "You've got to get involved with the local party. You're not going to win without their support."

After the workshop, SEA director Mike Brown called the event a "great success," and said that feedback had been "overwhelmingly supportive." Participants asked many good questions during the workshop, and several have followed up with SEA since the workshop to learn more about potentially running for office. Brown says SEA hopes to hold similar events in the future.

INTERNATIONAL News

...from the APS Office of International Affairs

A Physicist at the U.S. Department of State

by James A. Harrington

Throughout my professional career as a physicist working in industry and academia, I was always curious about the role scientists play in shaping public policy. It often seemed to me that for the most part scientists were marginalized and that physicists played only a small role in policy decisions. I wondered to what extent scientists were involved in foreign policy decisions and if a scientist working at the Department of State could make a difference. I was fortunate to have the opportunity to experience firsthand the interaction between science and foreign policy as a Jefferson Science Fellow at the Department of State. I felt that working as a physicist at State would enable me to become involved with at least a few of the many issues that are important to the physics community, such as non-proliferation, climate control, and the control of US technology.

In 1999, the Secretary of State asked the National Research Council for suggestions on how it could better deal with foreign policy issues involving science, technology, and health. The report issued by the NRC, entitled *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State*, stated the pressing need for more scientists and engineers within the Department of State. To address this need, George Atkinson, Science Advisor to the Secretary of State, initiated the Jefferson Science Fellowship (JSF) program in 2004 to bring tenured faculty members from US academic institutions to work at State for one year. I worked as a JS Fellow from August, 2005 through August, 2006. That year there were 5 JSFs with backgrounds in physics, chemistry, material science, and environmental engineering. The only requirements for a JSF, in addition to being a US citizen, are that the institution must sign a memorandum of understanding with the Department of State agreeing to pay the salary for the fellow while on leave. Living expenses and a small travel grant are provided by the MacArthur Foundation and the Carnegie Corporation. The JSF program is a wonderful opportunity for senior level faculty to work as science advisors within a wide variety of State's bureaus and offices. More general information on the JSF program may be found at http://www7.nationalacademies.org/jefferson/.

When the Fellows arrive at State, we interview staff members from across a broad range of policy areas. During my year, some fellows were attached to the African and Korean bureaus while others found opportunities within the Office of Information and Research, where they largely studied emerging technologies. I spent my year helping to advise the Bureau of International Security and Nonproliferation on export control of high technology goods. Specifically, I worked as a technical advisor in the Office of Conventional Arms and Threat Reduction (CATR) engaged in international negotiations that establish export control regulations related to cutting-edge dual-use goods and technologies. Dual-use goods are those that have both military and non-military applications. The controls are established by the 40 countries making up the Wassenaar Arrangement (WA) which meets in Vienna, Austria three times each year (see www.wassenaar.org for more details on the WA). During my year I have been exposed to controls for many of the goods and associated technologies covered in the WA including advanced materials, materials processing, electronics, computers, telecommunications, sensors and lasers, navigation and avionics, marine, and propulsion. Clearly it is not possible to have the background depth to work effectively in all of these categories, so I concentrated on the new controls proposed for detectors, lasers, and superconductors.

While the Department of State is the lead WA negotiator for the US, the determination of whether an item should be controlled or not is a joint effort between State and the Department of Defense and the Department of Commerce. Defense is normally quite conservative when it comes to releasing control of items that may be used by the non-WA countries for military purposes. Commerce, however, has to be concerned with security as well as keeping US industry competitive abroad. An excellent example of the dichotomy between Defense and Commerce is the control of low-light level detectors that may be used in night vision equipment. Defense wishes to control these sensitive infrared detectors and associated cameras while Commerce does not want to restrict the sale of low-light level cameras used for scientific purposes. One of my duties has been to help structure export controls that will decontrol non-military cameras yet prevent unlicensed sale of the new breed of highly sensitive detectors.

I was asked to chair the international technical working group on lasers. Lasers have been controlled for years in terms of the type of laser, but a new laser proposal would virtually rewrite the existing controls in terms of performance parameters rather than a specific laser type. My general background in lasers helped me work with the US and international delegations to refine the controls on lasers. The final proposal from our technical working group was presented to the Experts Group of the WA last September and it was approved. During the final negotiations leading up to the approval process at the WA, I learned that the new laser controls were not only based on science but also strongly influenced by policy and economic considerations. For example, one of the most difficult parts of the new laser proposal was the control of the rapidly emerging fiber laser technology. The final control on the output power of single-mode (SM) fiber lasers was determined by the military's need to control powers well below 100 W yet still have the fiber lasers meet the commercial, non-military applications which require much more power.

During my tenure at State I was fortunate to work with so many scientists, engineers, and policy personnel from the Departments of State, Defense, and Commerce as well as those from industry. I learned the difficulty in arriving at controls which do not overly hinder commercial applications but at the same time protect our military from the proliferation and sale of high technology outside of the 40 WA countries. One of the advantages of the JSF program is the possibility to continue the relationship with State after the fellowship year is over. I am continuing my work on export control as chair of the international working group on low-light level sensors and cameras. Working with State has enabled me to see first hand the importance of science in the development of a sound foreign policy. Clearly there is an important role for a scientist at State, yet I have learned that even though the science may be straightforward the path to achieving the final export controls is often filled with diplomatic potholes. But this just makes this job all the more interesting.

James A. Harrington is Professor of Material Science and Engineering at Rutgers University. He is an optical physicist whose research interests are in the area of specialty fiber optics including infrared fibers and photonic bandgap waveguides.

Letters

Collins is an Honorable Man

I read with great disappointment the Back Page article by P. D. Zimmerman in the June 2007 issue of *APS News*. My disappointment is less with Zimmerman than with the editors of *APS News* for allowing this sort of article to appear. The article is a criticism of "the hafnium project". Zimmerman focuses on a PRL published by Carl Collins's group [***Ed. note**: Collins is a professor at the University of Texas, Dallas*]. Last I checked PRL was a refereed journal. Does this mean that everything published there is correct? Of course not; just as not everything rejected is bad. However, the blind refereeing system is the best system we've got to print good science while winnowing out the junk. I certainly don't know if Collins's PRL work is correct: I didn't do the experiments. However, I do know that Collins is an honorable man; a man who will not fudge the data; a man of his word. If the conclusions Collins draws from his experiments are incorrect, this should come out in other refereed articles. If his data are somehow flawed, due to some contaminating effect that he has not considered, then that will also come out. Let the scientific method triumph, not the exalted priesthood who may, or may not, have an axe to grind. So much for Zimmerman's thinly disguised attack. But what of the *APS News* editors' decision? Are they actually encouraging a move away from the peer review system? I hope that they will consider very carefully the message they send to scientists if they allow future attack narratives to be published.

Brett D. DePaola
Manhattan, KS

***Editor's note**: In the January* Physics Today*, former presidential science advisor Jack Gibbons reviewed the book* Imaginary Weapons *by Sharon Weinberger about the Hafnium bomb. Here is his opinion, taken from that review: "Weinberger's story is about the government's pursuit of an allegedly new kind of powerful weapon envisaged by scientist Carl Collins, who hyped the results of a bad 1998 experiment and, over the course of several years, doggedly sold his dream to people in the defense community for untold money. It was, at best, a case of selling 'snake oil '."*

Wind Power is at Best a Supplement

The letters by Fritz de Wette, Russell Dreyfus, and Alfred Cavello in *APS News* in May and July concerned the feasibility of wind power. Depending on one's expectations for wind power, the glass may be regarded as half full, or well under half empty. If one hopes that wind power can be a useful supplement (~<10%) for conventional power generation, the glass could well be half full. There are tens of Gigawatts (GW) of wind power installed in Europe, around 10 GW in the USA, and several GW elsewhere in the world.

However if one expects wind power to be a large component of our electrical power generation, the glass is well beyond half empty. This installed capability typically delivers only a small fraction of its potential, due to the sporadic nature of the source. Dreyfus mentions that lots of steady wind power is available below 40 degrees south, as if transporting this power to 40 degrees north is a minor detail.

Cavello mentions several paper studies from the 1990's (and one from 2007) showing that large scale wind power is feasible. There has now been a great deal of experience with wind power, however, and this mostly belies the rosy potential. Both Cavello and de Wette mention the EON-Netz experience in Germany. Due to the sporadic nature of wind power, when it is delivered to the grid, the power plants must be ready to turn on again quickly, so they still use power in a spinning reserve mode (like a car idling at a stop light). Also the grid can only accept about 10% of its power from such a sporadic source before the grid itself goes unstable. Hence as more wind power capability is installed, a smaller and smaller fraction can be delivered to the grid. Less than 30% of EON-Netz' capability can be delivered to the grid. We could imagine new types of electric grids, but the world has trillions of dollars invested in the existing grids, and they will not be readily replaced. Both EON-Netz and Hydro Quebec are only able to deliver wind power at all because of very large state subsidies.

The country that has made the largest commitment to wind power is Denmark. This has been costly for the Danes, but they have been unable to decommission a single thermal power plant, and they will be unable to meet their 2010 Kyoto requirements for CO_2 reduction. I have studied this issue [1,2] and have concluded that while fossil fuel and renewables have their place, mankind's best hope to power civilization, without destructive climate change, in the next half century or century, is the breeding of nuclear fuel by fusion or fission.

1. M. Hoffert et al, Advanced Technology Paths for Global Climate Stability, Energy for a Greenhouse Planet, *Science*, 298, 981, 2002

2. W. Manheimer, Can Fusion and Fission Breeding Help Civilization Survive?, *Journal of Fusion Energy*, 25, 121, 2006

Wallace Manheimer
Camden, ME

And Those Caissons Go Floating Along

Peter Zimmerman's Back Page article about Hafnium bombs and pigeon research (*APS News*, June 2007) reminded me of a research contract that was let by the US Army R&D unit in Dayton, Ohio around 1959 or 1960. The contract was to study possible ways of canceling or shielding the force of gravity. Varian Associates, in Palo Alto, California where I was working at the time, accepted the contract, not because they thought it made any sense, but because they hoped that it could be redirected into research in other fields that would be meaningful to the Army and possibly useful to them.

I was given the unpleasant task of dealing with the Army contract originator, who would come out west every few months to find out what progress had been made in the contract work (zero, of course). He refused to have the contract redirected out of gravity and after a year or so complained to his superiors about the lack of diligence on the part of Varian. At that time, fall 1961, I left Varian for other reasons. I pity my successor who had to handle the contract details afterward.

Arnold L. Bloom
Menlo Park, CA

Creationist View Not Presented

I believe that there is an inappropriate lack of evenhandedness in the front-page article in the July *APS News* headlined "Creation Museum Draws Scientific Fire".

After a description of the new Museum in Kentucky, the article goes on for many paragraphs of criticism. I work as a research physicist, and I am a firm believer that the theory of evolution best explains a wide variety of data, but it was quite striking to me that there is not a single quote from anyone associated with this Museum, commenting on the issues raised in the article.

I believe that this lack of evenhandedness does not reflect well on *APS News*; it suggests that you do not believe that people reading this publication have the ability or the desire to analyze the issue if it includes a viewpoint counter to that dominant in the physics community.

Neil Zimmerman
Gaithersburg, MD

Our Children Will Not Be Us

Two articles in the July *APS News* attracted my attention: Parker J. Palmer's Back Page, and the page 1 story on scientific criticism of the new Creationist Museum. Palmer describes an authoritarian teaching method: "Listen to what I say, sit down, shut up, make notes on it and feed it back to me at the end of the term." He speaks of this as a form of violence. Indeed. Yet, without this, no one will learn from the past! With too much of it, knowledge will not increase. A balance is needed. The supporters of the Museum and its detractors are all people of the authoritarian bent. But there is another way of viewing the existence of the Museum and its effects–one implied in Palmer's remarks.

The Book of Genesis, which forms the basis for the museum's presentation, is a keyhole into how people thought more than 6000 years ago. Children are likely to learn from it things that neither the creators nor the detractors of the museum expect. And this is true of all instruction. Our children are not going to be us.

The weather conditions described in Genesis before the flood suggest an unvarying warm surface temperature, mist rather than rain, and long-lived people perhaps due to low exposure to radiation. One could speculate that Earth once had a water corona. Bunk says the authoritarian mind, but the imaginative mind would create a model, test the possibility, and learn ideas he or she could apply to Venus.

It is likely that those doing absurd experiments will be the ones to make discoveries. The environment that will produce these people is probably one in which people can go to museums that question what they learn in school.

J. W. Lane
Talahassee, FL

Objectivism and Reduction are Pillars of Learning

With regard to the Back Page article in the July 2007 *APS News* by Parker Palmer: I'm glad that Palmer has found a personal philosophy that he finds fulfilling. But like many who find such a philosophy, he then takes on an evangelical mission to convert the rest of us. Palmer states, "[O]ne key to non-violence is avoiding the arrogance of believing that I know how others should live their lives." He then spends the rest of the article doing exactly that: telling us how we should put our educational and professional lives in better order.

He describes the various ways "violence" (as defined by him in very broad terms) is done in the academic community. He mentions "brutalization" of a graduate student without telling us how that student was brutalized. Now, to be sure, I have known faculty who view students as little more than convenient tools in their own careers. However, I suspect that Palmer has something larger in mind, as he goes on to assault what he views as "initiation rites," general lecture format, academic competition, and also argument through attacking another's weak points in their presentation.

Recalling my own graduate days, I would probably have agreed with Palmer that I was being "brutalized" by the "initiation rite" of having to take four days of six-hour exams called prelims; and the months of studying that preceded those exams. A year or two later I realized it was at that point I truly became a physicist. I only wish I knew as much physics now as I did when I took them. Those "brutalizing" exams were life-changing.

Competition brings out the best in new ideas. Given the recent Duke study on grade inflation, it seems we may need to move back to even more competition in academia as A's have become so plentiful that they hold no meaning. My own institution gave latin honors to 47% of this year's senior class. Is this what Palmer wants: everyone is excellent and thus the term loses all meaning?

When I submit a paper for publication I expect the reviewer to attack the weak points of my argument. Isn't that their job? How can I improve or learn anything if someone doesn't point out my "weakest link," as Palmer would have us refrain from doing?

Finally, Palmer disparages what I consider to be the main pillars of classic liberal learning: objectivism and reduction. This is what my older colleagues in the humanities and social sciences used to call "the dispassionate search for knowledge." He deplores his own learning about the Holocaust that was done by facts and figures. I can only wish it were still the same. A recent survey by the American Council of Trustees and Alumni (http://www.goacta.org/publications/Reports/VanishingShakespeare.pdf) shows only 15 out of 70 colleges and universities now require Shakespeare for their English majors. If your institution is like mine, the English curriculum now consists of minor works that supplement a faculty member's preferred political outlook. Objectivism and reduction are long gone from the humanities and social sciences, and it seems Palmer would like us to do away with them also in physics.

It is obvious that Palmer is not very well-acquainted with how physics is actually done when he asks, "What physicist, or astronomer, or chemist ever got anywhere by trying to reduce the amazing phenomena he or she is working with to the convenient frames that work for his or her own mind..?" That seems to contradict everything I've ever learned about how I, or most other physicists, do physics. Don't we always try to reduce a complex phenomenon to a more simple model that we can begin to understand "for our own minds"? We then commit the sin of objectivism by testing that "reduced" model. Poor Newton, and Einstein. They tried to understand some phenomena by putting them in terms of models that worked in their minds, never knowing that they were disrespecting the "otherness."

Michael Monce
New London, Connecticut

zero gravity

The Lighter Side of Science

The Case of the Missing Time

By Gaetan Damberg-Ott

When she burst into my office, I knew she meant business. Killer on the loose, killer body: this dame had a case that was right up my alley. Between her sobbing I got some bare details of the case. Husband dead, high speed trains, this case didn't sound like a cakewalk. Then again, you don't come to Bull Tracer with the easy ones. I'm a Private Eye; says so on the door.

I told the dame to take a seat, and give me the facts. Seems her husband was some big honcho, import-export if you catch my drift, and had been sent to sleep with the fishes so to speak. His most recent trip had taken a turn for the worse, and now he had turned up dead. At noon yesterday he had boarded his train. High speed train. The dame said this train was faster than a speeding bullet, I didn't take it literally 'till she told me that the thing traveled at three-fifths the speed of light. I'm no Einstein but that's fast. At 1:15 p.m. she was supposed to meet him at the station. Instead, as she stood there waiting for him the train roared past the station, and at that instant she saw a gun flash. At the next station the train stopped, and she found the guy dead. Gun shot. And she'd seen it happen.

Guns don't make me nervous but numbers do. I took a sip of whiskey and asked the dame if we had any other clues. Turns out the kingpin is a paranoid guy, guess you gotta be in that business, and required every person who entered his cabin to sign in to the registry outside his door. Case closed, I told the dame: match the guy who was signed in at the moment she saw him killed. This femme was all worked up for nothing, as long as we had the registry we got the guy.

Not so easy, she told me. Turns out the dame wasn't just a pretty package, she'd already tried that. The train left at 12 p.m., and at 1:15 p.m. she saw him killed. Hour and fifteen by my watch. When she got in the train, she looked at the registry, but no one was signed in at 1:15. Looks like our killer is no wiseguy, and my one lead had turned sour.

All these times and numbers were making my head hurt. I needed a drink and I knew where to find one. I hustled her out the door and told her we were going for a walk. The dame worried it wouldn't be safe out. I told her my sidekick was coming with. I keep him at my side, and he sure kicks. We headed down to The Quantum Shift, a little watering hole I like to call home.

The place is always crawling with physicists. Not my crowd, but my bookie's never heard of the place so I put up with 'em. She grabbed a table in the back; I grabbed a drink. I needed to get the juices flowing. I decided to go back over the case with the dame. 12 p.m. train leaves, 1:15 he's shot. Yet no one was signed into the registry at the time of the shot. She assured me that everyone had to sign it before they could enter. This dame was more persuasive than a loaded .38, so I believed her. It was like fifteen minutes was missing. Where did that time go?

I decided to find Marie. We had a history, but I needed answers. She studies falling bodies; I study dead ones. She tried to dodge me when she caught sight of me but I cornered her. "I ain't here to rehash the past, hon; I'm here for something else. Namely time. It's missing. I need some answers and I need them now," I muttered. "You missing some time Bull?" she asked. "Yeah. Fifteen minutes," I told her, "Any idea how you can get rid of time?" "Well you can't get rid of time, but you can have differences in time."

I didn't follow. Time was time. How can it change without being lost? Marie could always tell when I was lost. In no time she was explaining that in different reference frames, time can move at different speeds. I thought she might be on to something. I didn't follow the whole reference frame-thing, but I was cold out on leads. "So this could account for the fifteen minutes?" I asked. She went on to list more Greek letters than a frat boy, something about gamma and time dilation. I told her my eyes were going to dilate if she didn't slow down.

"Time moves more slowly if you are moving faster," she said. "How slowly time moves depends on how fast you are going relative to the speed of light. The speed of light is the benchmark for most of my line of work." The speed of a bullet was the benchmark in my line of work, but suddenly it was making more sense in my head. It seemed the registry didn't match up 'cause the time on the train was different than the time of the dame watching. What for her was an hour and fifteen elapsed, was less for them on the train. Could this be where my time had gone?

"How much time would I lose going at three-fifths the speed of light for an hour and fifteen?" I demanded. "You don't lose time, it just moves at a different speed" she mumbled again. I wasn't in any mood for the details, I needed this case solved, and fast. "What would a clock on the train read at the time of the shot?" "Well…" and she proceeded to scribble numbers on a napkin…

$$\gamma = \frac{c}{\sqrt{c^2 - v^2}}$$ is the equation,

now the train moved at .6c so:

$$\gamma = \frac{c}{\sqrt{c^2 - .36c^2}}$$ which will…

I couldn't tell what made me more uncomfortable: all these numbers or being around Marie again. I wasn't in the mood to find out. "Time's up Marie. I need answers, not numbers." "1.25!" she yelled. "That's gamma!" I didn't know what the hell gamma was or meant, but she seemed to think it was important. "What time did he get shot at then?" I demanded. "Well, 75/1.25=60, so at 1 p.m. he was shot, according to the time frame of the train," announced Marie proudly.

You had to give it to the gal, she performed well under pressure. We'd cracked the case. The dame seemed thrilled. While she had seen him shot at 1:15 p.m., on the train the event occurred at 1 p.m. according to their frame of reference. The guy who was signed in at 1 p.m. knocked off our guy. Numbers ain't my game, but then again I don't pick my cases. Plus, the dame paid me handsomely for my troubles, and the sight of greenbacks snapping into my hand made my worries slip out the door. "Bout time for me to slip out the door," I thought to myself, glancing at my watch. It was 4 a.m. Now that's time dilation I'm more familiar with. Who knew who'd walk into my office tomorrow, but for now I needed some sleep. Another case closed for Bull Tracer.

Gaetan Damberg-Ott is a graduating international relations major at Carleton College..

Letters continued

Driving By the Seat of Your Pants

While I would wholeheartedly agree that, as reported in the July *APS News*, the best NASCAR drivers, like all good race drivers, are "intuitive physicists", Dr. Leslie-Pelecky is incorrect in asserting that "the key to maintaining that precarious balance is maintaining, as much as possible, the same amount of force on all four tires." Race cars are not rigid bodies; weight transfer occurs during the application of any acceleration, thereby increasing the loading of the front tires under braking, the rears under acceleration (for a rear wheel drive car), and the outsides under cornering. What we race drivers concern ourselves with is maintaining slip angles within the limits and effecting weight transfer as smoothly as possible within the constraint of minimizing our lap times. This is done largely with the help of our inner ears and the seats of our pants.

Stephen Schiff
Middleburg, VA

Editor's Note: *We apologize for possibly misrepresenting what Diandra Leslie-Pelecky said Here is a clarification in her own words: "The important thing is for the forces on all four tires to be equal to each other as much as possible. They can be 200 lbs or 2000 lbs, as long as they are similar on all four tires. The way it is written in the article, the reader can interpret it as saying that the actual amount of force on each wheel doesn't change–when it obviously must."*

BLEWETT SCHOLARSHIP continued from page 1

In Albany, she first met Tara Prasad Das, who introduced her to theoretical investigations of electronic structures. She landed a postdoctoral position at Rensselaer Polytechnic Institute in Troy, NY; however, she put her research on hold to focus on her first child.

In the meantime, she and her husband moved to Austin, Texas. Here, she made new contacts by taking classes and collaborating with professors. She again engaged in research activities with Texas State University during her fifteen-month stay in Austin.

Dubey has now lived in Orlando for six years. She worked in various capacities for the Department of Physics of the University of Central Florida, leading to a lectureship. Talat Rahman, chair of the physics department at the University of Central Florida, became a mentor to her.

Dubey has focused her research activities on theoretical physics over the last two and half years. This discipline gives her the freedom to do research at any time from any location, and she possesses the diligence to put this freedom to good use. She expects to enhance her research repertoire with projects funded through the Blewett Scholarship.

Her interest lies in understanding the atomic and electronic structures of hemoglobin molecules. Found in red blood cells, hemoglobin binds oxygen and carries it to other cells through the circulatory system.

Her work may have medical value in the future. This very basic understanding of these essential elements of life has the potential to be the basis of future developments of diagnostic techniques as well as cure diseases related to blood, Dubey explained.

Current theory says that the electrons in oxyhemoglobin should be in a singlet state with their spins anti-aligned. However, experiments involving bulk amounts of oxyhemoglobin demonstrate a response to magnetic fields which would not occur if the electron spins cancelled.

Dubey believes the first excited state of oxyhemoglobin is a spin-aligned triplet state. She also believes that relatively little energy is required for an electron to be promoted to the first excited state. This way, statistical fluctuations in energy among oxyhemoglobin molecules at room temperature would allow for some of them to have electrons in the triplet state, accounting for the observed response to magnetic fields.

She will investigate this hypothesis through first principles calculation of the energy of ground and first excited states. She will test the ground state calculations against experimental data taken through Mössbauer spectroscopy to confirm that her methods are sound. Then, she will calculate the energy required to promote an electron from the ground to first excited state.

Through Boltzmann statistics, she will determine if this energy is small enough to produce significant amounts of triplet-state oxyhemoglobin at room temperature. Finally, she will examine the features of the triplet state through muon spin resonance, comparing with experimental research.

In the course of this work, she looks forward to hiring a graduate student, attending national and international conferences, and making new contacts in the interdisciplinary field of theoretical biophysics. It will be her first time hiring graduate students, and her standards reflect those that she set for herself. "I would like a student to have determination, drive, integrity, and desire," Dubey articulated. "I believe if there is passion for something, it happens without effort."

Receiving the award with a sense of accomplishment, Dubey is also very grateful to those who helped her along the way. "I want to take this opportunity to thank APS for providing me the opportunity to establish my credentials, Professor Das and Professor Rahman's unconditional support and mentorship for my growth, and my daughter, Shikha, who usually gets the short end of every deal for being my best partner and counselor in the times of need," she said.

By aiding in the advancement of her career at such a critical time, the Blewett scholarship will help Dubey fulfill her dream of conducting physics research for years to come.

MEMBERS IN THE MEDIA continued from page 2

"It's hard to find anybody in fusion who didn't want to save the planet."

Christine Celata*, Lawrence Berkeley National Laboratory, on the potential for fusion power to serve as "peaceful power for the poor,"* San Francisco Chronicle*, June 26, 2007*

"Our view is we did the best we could and we didn't come out on top, so our job is to support our colleagues in South Dakota now."

Wick Haxton*, University of Washington, on NSF's decision to locate the deep underground laboratory at the Homestake Mine in South Dakota,* Associated Press*, July 11, 2007*

"You can go over it with a truck and not break it–you will crumble the outside (of the shell) but not the (nacre) inside…If you understand how it forms, you could think of reproducing it ... a so-called 'biomimetic' material."

Pupa Gilbert*, University of Wisconsin-Madison, on studying the structure of mother-of-pearl (nacre),* UPI*, July 3, 2007*

"There is no reason to believe our students are inherently unsafe going to that country. We should go. This should not be politics. The Iranian people are going to welcome us."

Paul Stanley*, Beloit College, on taking the US team to the International Physics Olympiad in Iran, channel3000.com, July 3, 2007*

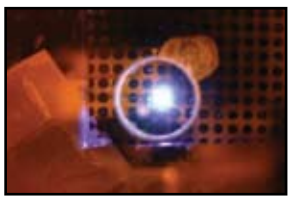
"It's important to mentally engage students in what you're teaching. We're way too focused on facts and rote memorization and not on learning the process of doing science."

Eric Mazur*, Harvard University,* The New York Times*, July 17, 2007*

PHYSICS AND TECHNOLOGY FOREFRONTS

Waiting in the Wings: OLED-Based Sensors Advance Towards Commercialization

A new sensor platform has the potential to revolutionize the science and technology of chemical and biological sensors, ultimately leading to very cheap, disposable microarrays of sensors. The key ingredient: organic light-emitting diodes (OLEDs), according to Joseph Shinar, a condensed matter physicist at Iowa State University (ISU). Together with Ruth Shinar, a Senior Scientist at the Microelectronics Research Center of ISU, he is developing structurally integrated OLED-based luminescent sensors for numerous potential applications, such as monitoring inorganic gases and biological compounds and organisms.



The Shinars' lab has helped blaze a path for the commercialization of OLED technology in general over the years, and since 2000 or so, he has turned his attention to integrating an OLED light source with luminescent chemical and biological sensors, receiving his first patent in 2001. "Integration and miniaturization of photoluminescence (PL)-based chemical and biological sensors is highly desirable, as it is the first step towards the development of field-deployable PL-based sensor arrays that could be used for simultaneous analyses of multiple analytes in a single sample, including organisms," says Shinar.

Conventional PL-based sensors use lasers or inorganic light-emitting diodes (LEDs) as light sources, but they are not easily integrated with the other sensor components, and the resulting devices are consequently expensive. OLEDs enable a uniquely simple integration, and consequently have the potential to be more versatile, flexible and cost-effective, and enable high-density microarrays with hundreds of sensors on a single chip. OLED-based sensors have advanced to the point that they are an important part of a new conference on organic electronics-based sensors, chaired by Ruth Shinar and George Malliaras of Cornell University, that will convene at the annual SPIE meeting this year in San Diego, August 26-30.

OLEDs function like inorganic LEDs: they are solid state devices mounted on a substrate of clear plastic, glass or foil. Typically, there is a transparent anode layer that injects "holes," and a cathode layer that injects electrons when a forward bias is applied across the device. Sandwiched between the anode and cathode layers are hole- and electron-transporting layers, and between them, the emissive layer. The emissive layer emits light when a forward voltage is applied; the color of the light depends on the type of organic molecule used.

The Shinars' OLED-based sensor has a sandwich structure that typically includes the sensing element (usually a thin film), the thin OLED light source, and the photodetector (PD) that responds to the sensor's PL. Individually addressable OLED pixels and a sensor film are fabricated on opposite sides of a common substrate (e.g, glass slide) or on different substrates that are attached back-to-back, generating a compact module with a thickness determined by that of the substrate. As the OLED light source (typically pulsed) excites the sensor film, the latter luminesces. In the presence of an analyte of interest, the PL changes, depending on the analyte's concentration in the sample, and the PD, typically positioned behind the OLED light source, detects that change. The latter's placement is an important enabling design, known as back-detection geometry. In this geometry, light passes through the gaps between the OLED pixels and is recorded by the PD below, making it easier to handle the analyte. In the other "front-detection" geometry, the PD is placed on top, with the OLED light source at the bottom and the sensing element in between.

The OLED/sensing element integration also paves the way for the next step in the development process: integrating additionally the PD. Such a device would be more compact, and would permit the development of an array of PL-based sensors that could be driven by an array of OLED pixels and tracked by an array of thin film-based PDs. Ultimately, the Shinars envision that the entire device would be the size of a silver dollar.

On Display

OLED technology is already big business, with a market estimated at $1.4 billion. That is expected to increase to $10.9 billion by 2012. The technology has found its way into the small screens in cell phones, PDAs, digital cameras, and portable music players. To date, OLEDs are not being used in full sized flat panel displays (apart from demonstration prototypes), such as computer monitors or television screens, although several companies are investing heavily developing the technology to do so, including Kodak, Sony, Dupont, and Universal Display Corporation.

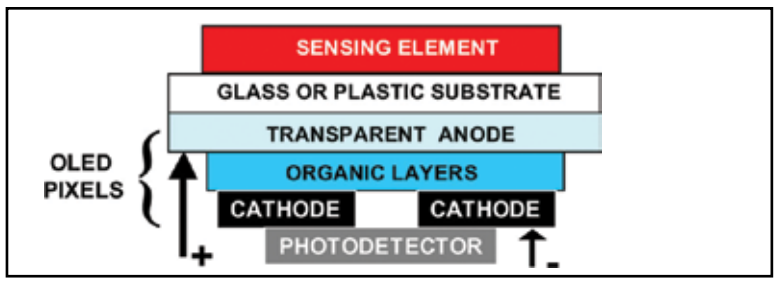
OLEDs offer several advantages for full-sized display applications. For instance, OLEDs do not require a backlight, thereby drawing less power and able to operate longer on the same battery charge. Since the OLED pixels emit light directly, they have a greater range of colors, brightness and viewing angle than with LCDs even if the viewing angle is shifted as much as 90 degrees from the axis perpendicular to the display.

Furthermore, they are thinner, lighter and more flexible. In fact, polymers OLEDs can be printed on any suitable substrate using inkjet printer technology, including flexible plastics, making OLEDs ideal for future technologies like roll-up displays, or even displays embedded in clothing. Other future applications include OLED-based heads-up displays, car dashboards, billboards, and home and office solid state lighting.

However, because they are organic, OLEDs degrade over time, and they do so at different rates, depending on their composition. They still cost more to produce, and are easily damaged by exposure to water. Much of the applied research being done in this area is focused on extending OLED lifetimes and improving the manufacturing processes to make them more competitive with standard LED technology.

Sensory Overload

The Shinars face many of the same technical challenges with their sensor technology as those faced by the display industry, most notably extending the lifetime of OLEDs. The challenge is a bit different than for display technologies, where the OLEDs must function at a medium brightness for a long period of time, or for solid state lighting, where they must function continually at more than ten times the brightness of display monitors. OLED-based sensors fall somewhere in between: they must have longer lifetimes for high brightness, but the brightness only needs to be high during the pulse, and the OLED only needs to last about a year. "We're not there yet, but we're very close," says Shinar.



The Shinars have good reason to be optimistic, having already secured one patent and filed two more on their integrated sensor platform technology. They have formed their own start-up company, Integrated Sensor Technologies, Inc. (ISTI), with two Small Business Innovation Research Phase I grants. The first grant was from the National Institutes of Health to develop a gas phase oxygen sensor for monitoring oxygen levels in, e.g., surgery requiring general anesthesia and in the homes of patients with respiratory conditions–an enormous potential market. However, such a sensor requires FDA approval, which is a lengthy and costly process. Therefore, the first commercial product to hit the market will most likely be a dissolved oxygen sensor, which is the focus of the second grant, from the National Science Foundation (NSF). Such a sensor would be especially useful to wastewater treatment facilities, which need it in order to maintain an adequate dissolved oxygen level and thus cut the electricity use by as much as 40%.

There are more potential applications further on the horizon, because the technology can be so easily tailored to suit many different needs. For instance, there is a multi-analyte sensor under development capable of simultaneously detecting glucose, alcohol, and lactate levels, of interest to the sports industry. Additionally, the sensors could be used for high-throughput drug discovery, or for point-of-care medical testing.

NSF also awarded an exploratory grant for the Shinars' research at ISU to develop an OLED-based sensor to detect anthrax, while an OLED-based sensor for hydrazine, a very toxic substance, was developed in a NASA-funded project. The Shinars' hydrazine sensor is so sensitive, that it can detect levels of hydrazine that are 80 times lower than the OSHA regulations currently require (< 10 parts per billion over 8 hours of exposure).

And because most of the prototype sensor components are so cheap, apart from the PD, when production is scaled up to mass market volumes, the price could be very low, with most of the cost stemming from the PD array. "A whole new paradigm in sensor technology could emerge from this very basic idea of integrating the very low-cost OLED light source with the photoluminescent sensor in this uniquely simple design," says Shinar.

House S&T Committee Explores Globalization and the US High-Tech Workforce

How is globalization affecting US high-tech workers? What steps should the government take to ensure sufficient jobs and a robust high-tech workforce in the future? What are the roles of community colleges and industry in producing highly-skilled employees for technical and manufacturing jobs? The House Science and Technology Committee addressed these issues in two recent hearings.

Witnesses at the first hearing indicated that not enough is yet known about the consequences of offshoring high-tech jobs. They were united in opposition to protectionist policies, arguing that the US instead should take actions to support a flexible and creative environment for innovation. The second hearing highlighted the fact that many highly-skilled manufacturing jobs are still available in the US, but employers face difficulties finding qualified people to fill them and community colleges are having trouble attracting students to technology training programs.

In what Chairman Bart Gordon (D-TN) called "the first in a series of fact-finding explorations," the full committee on June 12 heard from experts in economics and international R&D. The number of jobs that can be done electronically, and thus are vulnerable to being relocated, is "destined to increase greatly," according to Alan Blinder, Director of Princeton's Center for Economic Policy Studies. Globalization will not lead to mass US unemployment, he noted; it will also create jobs in the US, but he warned that more Americans may need to find personal service jobs.

Thomas Duesterberg, President and CEO of the Manufacturers Alliance/MAPI, testified that US multinational companies, even as they increase employment among foreign affiliates, also generate employment growth in the US that "equals or exceeds" that of other US companies.

Alfred P. Sloan Foundation President Ralph Gomory warned that the old theories of free trade assumed that production capabilities are fixed. If those are now mobile, he said, it will lead to "a whole new ball game."

All four witnesses were adamantly against trade barriers and protectionist policies; Blinder called protectionism "a loser's game."

In addition, the federal government should take steps to "ameliorate the downsides" of globalization, as Blinder put it, including addressing the costs of health insurance, litigation and regulatory burdens, ensuring sufficient unemployment insurance and worker retraining, tackling budget and trade deficits and the national savings rate, and addressing the undervaluation of certain Asian currencies and intellectual property theft.

Some of these same themes arose in a June 19 hearing of the Research and Science Education Subcommittee. According to the hearing charter, as manufacturing jobs have become more specialized, companies are reporting difficulties in finding workers with the necessary skills. Chairman Brian Baird (D-WA) cited a National Association of Manufacturers survey indicating that "80 percent of respondents report difficulties in finding qualified people to run their production processes and serve as technicians."

The witnesses described how community colleges and other two-year institutions, in partnership with industry, frequently fill the role of training high-tech production and technical workers. Community colleges often rely on local businesses to provide information on their needs and develop appropriate curricula, and in many cases an industry advisory board oversees the training programs, provides feedback, and ensures that courses remain current. In addition to oversight of curricula, witnesses

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ANNOUNCEMENTS

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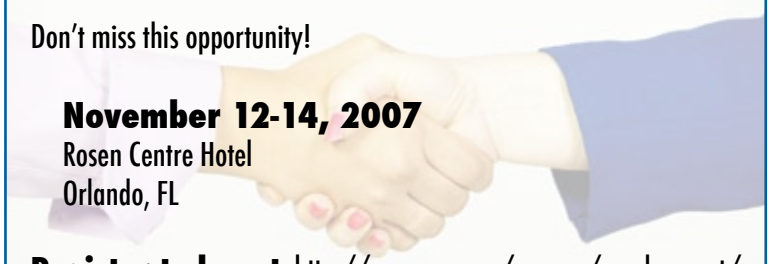

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APS Director of Education and Diversity Ted Hodapp stresses that the doubling refers to undergraduate majors, not PhD's. "There is a dramatic shortage of high-school physics teachers," he says, a problem that APS is already working on via its PhysTEC and PTEC programs. Hodapp expects that doubling the number of physics majors will significantly increase the pool of new physics teachers.

Another issue that Hodapp points to is what he calls the "woeful underrepresentation" of women and minorities among physics majors. One of the goals of the doubling initiative is an increase in the fraction of both women and under-represented minorities who major in physics.

Currently, about 300 physics majors and minors receive certification to teach physics each year. APS Committee on Education chair Michael Marder estimates that about 700 more per year would be needed to address the physics teacher shortage. "If we do not accomplish this, then poor and minority students will continue to get less than the educational opportunities they deserve," he says.

The best way to increase the number of physics majors is to make the major more welcoming, says Marder. "Probably the most effective strategy will be creating degree plans for physics majors that do not require them to settle on physics as freshmen if they want to finish their degree in 4 years, and creating supportive communities within physics departments for future physics teachers."

"I think we are most likely to meet this goal if it is part of a general change in attitude in physics departments so that the undergraduate degree is not exclusively aimed at people continuing on to graduate school in physics, but also is attractive for students interested in other careers," says Marder.

Increasing the number of physics majors is important for other reasons as well, says Marder. "More and more, the influence of the discipline depends on how many majors it has. I'm worried that the physics community will lose resources" if it does not attract more majors.

"The increase does not come without risk, since physics has retained status and influence for a long time in the US by holding to exceedingly high standards. However I think the risk is worth taking," says Marder.

The language accompanying the statement notes that "physics majors successfully pursue and are qualified for a wide range of careers, and we support a much broader recognition of this by faculty and employers." *APS News* is in the midst of a series of articles, under the banner "Profiles in Versatility", that highlight physics majors (and in some cases PhD's) who have gone on to a variety of careers. The first three articles appeared in the April, June and July *APS News* (all available online), and more will appear in future issues.

American Institute of Physics

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This Fellowship is open to all qualified members of APS and other AIP Member Societies, of all ages and career levels. By sponsoring at least one Fellow a year in the State Department, this program benefits the government, the science community, and the individual Fellows.

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- AIP Member Society membership
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Applicants should possess interest or experience in scientific or technical aspects of foreign policy.

Application deadline: November 1, 2007

For more information, please see: http://www.aip.org/gov/sdf. html.

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stated that businesses could also offer internships, guest speakers, equipment donations, job placement for graduates, and marketing and recruitment efforts.

In echoes of the previous hearing, Stephen Fonash, Director of the Center for Nanotechnology Education and Utilization at the Pennsylvania State University, said that the US must "innovate or perish," and Monica Poindexter, Associate Director for Corporate Diversity and College Programs at Genentech, Inc., questioned whether the US education system was ready for the 21st century. Baird and other subcommittee members mused that perhaps the allocation of H1-B visas should reward businesses that play an active role in attracting students to, and helping educate them in, high-tech careers.

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

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: Random matrices and chaos in nuclear spectra

T. Papenbrock and H.A. Weidenmüller

Quantum systems are called chaotic if the statistical properties of their eigenvalue spectrum are in accordance with predictions from random-matrix theory (RMT). It is shown in this Colloquium (i) that predictions of RMT often agree well with spectroscopic data in atomic nuclei, and (ii) how this success of RMT–or equivalently the existence of chaos–can be reconciled with the known dynamical features of spherical nuclei which are described by the shell-model plus a residual nucleon-nucleon interaction. The matrix elements of the residual interaction are thereby taken to be random variables which form a so-called two-body random ensemble. Chaos in nuclear structure is then a generic feature of the ensemble with properties which partly differ from those of standard RMT.

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Congress recently, but few studies have focused on the technical aspects of the research and development needed to improve efficiency, he said. This is a natural area for APS to make contribution.

Energy efficiency research is an area that has been under-funded, said Goldston. The study group, which includes experts on buildings and transportation, will look at what areas of research and development we most need to focus on, and will provide a prioritized research agenda.

Changes in policy are also necessary, said Goldston. "That said, there's a lot we can do with the research, so that will be our primary focus" in this study, he said.

The study will be designed to be useful to both policymakers and researchers, and will include technical detail as well as a short policy supplement. The target release date for the completed study is summer 2008.

The APS has a long-standing interest in energy issues. In 2000, the Council approved a statement saying that, "The Council of the American Physical Society believes that the use of renewable energy sources, the adoption of new ways of producing and using fossil fuels, increased consideration of safe and cost effective uses of nuclear power, and the introduction of energy-efficient technologies can, over time, promote the United States' energy security and reduce stress on the world's environment.… we urge the adoption of policies that promote efficiency and innovation throughout the energy system, including conservation and the development of alternatives to fossil fuels."

Richter received the Nobel Prize in 1976, and served as APS President in 1994. He is the Director Emeritus of SLAC, and has also chaired the Physics Policy Committee of the APS. Goldston left the Science Committee of the US House of Representatives last year, and is now scholar in residence at Princeton University's Woodrow Wilson School of Public and International Affairs.

The other study group members are: George Crabtree, Argonne National Laboratory; Leon Glicksman, MIT; David Goldstein, Natural Resources Defense Council; David Greene, Oak Ridge National Laboratory; Daniel Kammen, University of California, Berkeley; Richard G. Newell, Duke University; Maxine Savitz, The Advisory Group (a consulting group); Daniel Sperling, University of California, Davis.

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and eventually she wants to be a researcher or professor. "I would attribute all my success to hard work, and none of it to any special talent," she said.

The counterintuitive nature of quantum mechanics attracted minority scholar Gabriel Mendoza to physics. Mendoza, who will be a freshman at Caltech this fall, was inspired to study physics after reading books on quantum mechanics and quantum field theory. He is also interested in quantum computation, and has already begun work in that area: while in high school, he did an independent research project that involved the creation of quantum distributed and cluster algorithms. This summer Mendoza is working on quantum information theory at Caltech's Institute for Quantum Information (IQI). At Caltech, Mendoza plans to major in physics and computer science, and after graduate school, he hopes to "help engineer the computers of the future."

Minority scholar Ana Brown, a sophomore at Stanford University from Arlington, Virginia, is concentrating on biophysics. During her senior year in high school, she worked at the Naval Research Lab. This summer, she's working at the National Institutes of Health.

Growing up, she always enjoyed math and science, and her father, an engineer, encouraged her interest. She excelled in math, and likes physics, because "physics for me is math, but applied to real world situations," she said.

Brown plans to focus on biophysics in order to help solve energy and environmental problems. "I really love nature, and I care about the environment and I want to spend time working to preserve it. I feel like I can do that and also pursue my passion for physics and math through biophysics," she said. Brown hopes to earn a PhD in biophysics, and then go into academia. In addition to schoolwork, Brown plays on Stanford's women's Ultimate Frisbee team, one of the top teams in the country.

Christophe Schmitz, a minority scholar and freshman at Vassar College, is interested in using physics for engineering. In high school, Schmitz found his physics courses most interesting, and as he says, "I always was a mathematics kind of guy." He hopes to go to graduate school after completing his bachelor's degree in physics, and is considering studying mechanical or electrical engineering. In particular, "building bridges sounds great to me and I would be intrigued to do so," he said.

More information about the scholarship can be found at http://www.aps.org/programs/minorities/honors/scholarship/index.cfm

New scholarships

DeEricka Aiken
Ana Brown
Rolando Capote
Iara Cury
Maria Garzon
Elizabeth Henderson
Montinique McEachern
Maximo Menchaca
Gabriel Mendoza
Maxwell Murialdo
Franklin Orndorff-Plunkett
Micahel Salerno
Laura Salguero
Christophe Schmitz
Brendon Sullivan
Irene Toro Martinez
Jaime Varela
Erik Verlage

Renewal scholarships

Eduardo Hariton
Tamela Maciel
Amanda McCoy
Alexander Robel
Jessica Saiz
Aaron Sampson
Malachi Tatum
John Matte

The Back Page

Reflections on the APS and the Evolution of Physics

By John J. Hopfield

As a graduate student I once got into an argument with a chemist about the nature of physicists. I had always thought of physicists as very broad scientists. In my (then young) experience, most physics professors I had known were capable of teaching any undergraduate course in physics. Undergraduate students were in turn responsible for the entire available undergraduate course offering in physics. In chemistry, by contrast, undergraduates specialized, and your typical physical chemistry professor could not possibly be assigned to teach, say, organic chemistry, even at the introductory level.

I attributed this difference to the breadth of physicists. My chemist friend utterly disagreed. The difference, he maintained, was that physics was a young and a narrow science, a science so narrow that the intellect of one person could span it. Chemistry had developed more fully, was a more mature science, and was now so rich and broad that it could no longer be meaningfully spanned by a single individual.

As a field of knowledge expands, and its number of practitioners increases, a point of instability is reached at which the enterprise splits into multiple components. The split may be complete, or leave some connective bridge, but either way the knowledge and the scientists become isolated to sub-compartments to better pursue the subject.

I have watched this going on since the first APS meeting I attended in January 1958, in New York. There were talks from all corners of physics. And prior to 1953, the APS apparently felt no use was to be served by singling out one researcher or accomplishment with a prize. There were invited talks given by the luminaries of the various corners of physics, but no prizes.

As physics began to be larger than the span of single individuals, and as the number of physicists working in an area became so large that no one personally knew all the major contributors even to his/her own field, let alone to physics as a whole, this was no longer the case. My theory of scholarly prizes and awards is that they serve a social function within a science, by pointing to role models and particularly valuable contributions within a group that has become so large and fractionated that it is no longer completely obvious to any one individual who the major players are, and why. This function does not exist when the enterprise is small and unfractionated. The first APS Prize, the Oliver E. Buckley Prize in Solid State Physics, was created in 1953.

Physics is now far larger–the number of papers at the March Meeting has grown by a factor of 10–and there are now over 30 prizes and awards. The symptom that the field is maturing and fragmenting is seen in the rather specific nature of the prizes and awards, which are carefully allocated to subfields of physics. It is a posture now very similar to that of chemistry and the American Chemical Society.

The subspecialization has become so strong that instead of going to hear a set of diverse people talking about truly prizeworthy science, physics proles prefer to attend sessions devoted to their subspecialty. Physics is becoming more mature, becoming fragmented, becoming larger, with a more complex sociology that comes spontaneously with increased size. Prizes and awards are now an established and significant part of our culture. At a larger scale, the same fragmentation is seen in the creation of new divisions, fora, and topical groups of the APS.

If maturing means fragmentation and specialization, what (nontrivial) problems does this create for the APS and for physics? I tend to look at such issues by going back to first principles, asking what is the organization for. I take its major purpose as the facilitation and encouragement of physics research, with emphasis on the US scene. As such, it runs meetings, publishes journals, lobbies government, presents a variety of advice and services to its members. How will this maturation and fragmentation affect the APS?

Publishing. When I first joined the APS in 1956, I did so in order to subscribe to the *Physical Review*. Nowadays very few of our members subscribe. The maturation in publishing began with the realization that as physics fragmented, there was more scope for specialty journals to compete with our major flagship. So the *Physical Review* was split into multiple parts. That someone could subscribe to only a sub-part, was a direct reaction to specialization.

The digital world has enhanced this ability to specialize in what we are exposed to. In this day of electronics, hardly anyone has a volume of *Phys Rev X* in hand. Articles are read on the screen, or printed out, one at a time. The nominal paper publication with articles grouped together is no longer really relevant to the reader. It is thus no longer necessary to proliferate more and more specialty journals to compete. What is important is a refereeing system that can succeed in obtaining highly authoritative and useful referee reports for papers from any corner of physics. For this we rely on the fact that the excellent refereeing culture of physics has continued in spite of the maturation of the field, and we rely on the superb organization of the APS editorial office.

The same electronic technology that solves this problem of specialization creates Web competition such as arXiv. How and from whom we will get our scientific literature information 10 to 20 years from now is a rather open question for all fields of science, maturing or not.

Lobbying and the Government Support of Physical Science. Federal support of physics, at the time of my first APS meeting in 1958, was dominantly motivated by the past success of physics discoveries in the military sphere. The NSF was new and relatively small. GE, Westinghouse, ATT, Union Carbide, Ford, GM, and RCA had credible long-term research laboratories. They felt that a long-term investment was necessary to be able to find and develop ideas from physics into their future products. The highest corners of the executive branch were very concerned about physics and the national defense. There was no real problem in 1958 about getting good physics policy advice understood by the government, or in getting good physicists to give it.

In 2006, the NRC report, *Rising Above the Gathering Storm,* chaired by Norm Augustine, had as its major conclusion that the failure of the US to adequately support the physical sciences over the past 20 years is going to have a major negative effect on the economic situation of the US. This failure results from both the decreasing of the funding per university scientist available from the federal government and the near collapse of long-term industrial research in the physical sciences. The US economy rests very heavily on leadership in civilian technological innovation, and the report documents that this leadership is imperiled by the current support climate.

In 1958, the APS really did not need to lobby Congress or the administration. In contrast, the APS is now an organization that devotes a considerable effort to lobbying Congress and the executive branch. It took a huge lobbying effort to get the competitiveness initiative to even obtain a high level hearing in the executive branch, and more effort yet to get it included in the 2006 state of the union address. The APS can be proud of its contribution to getting the program put forward by the Augustine committee into legislation.

The recent basis for arguing for funding for physical science was in support of the US as an economic power, through the technological innovation that depends on advances in physical science. But our effort must go beyond those parts of physical science that are obviously and directly tied to economic impact. Our advocacy of support must also be for those areas and aspects that are less directly tied, those parts of physical science that are iffy and longer-term, and for the entire intellectual enterprise as being an inseparable whole.

Why should physics be supported by the average US citizen to the tune of many billion dollars a year? Why should it have more support than philosophy, art, music, or literature? It is the historical record of the contribution of advances in physics to human well-being, to the economy of the world, and to defense that explain this difference, and justify believing that this should continue to be the case.

If we are to continue to be funded at such a level, we owe it to the world that a significant fraction, the larger part, of our requests for federal funding be plausibly relatable to human well-being on the timescale of one to five decades. It is increasingly obvious that this well-being is conditioned on bringing the atmospheric greenhouse problem under control. Unfortunately, it has been relatively easy to do interesting physics involved with weaponry. It has been less easy, less sexy, to try to find good physics in areas such as energy conservation. In my more pessimistic moments, I recall the closing refrain of T. S. Eliot's "The Hollow Men:"

This is the way the world ends
This is the way the world ends
This is the way the world ends
Not with a bang but a whimper.

The United States has legitimate worries about nuclear proliferation, nuclear deterrence, and terrorist attack. But I believe physics has been worrying too much about "bang" when "whimper" is steadily, stealthily approaching. The world would be better served if physics became more oriented toward issues in electricity generation, storage, conservation, CO_2 and related problems.

While the chief reason for strong physical science funding in the 1950's may have been the potential weapons of military competition rather than the weapons of innovations and economic competition, there is a very important common feature to the way that we have asked for governmental support in the two eras. The rising tide must float all boats, and while the maturing of physics has somewhat loosened the ties between the boats, all boats are still somewhat rafted together. The preservation of physics as a single entity depends on these ties between sub-disciplines.

Meetings. The maturing of physics into sub-disciplines and the immense advances in communications technology have appreciably changed the structure and content of our meetings. In the late 1950s, the dominating purpose was to be able publish and communicate a new result. ArXiv or other equivalents now allow me to do this without going to a meeting, so general meetings no longer serve as a significant publication tool.

The number of more specialized divisional and special topics meetings has increased—physicists do still want to get together; we are not entirely antisocial animals. Some of the slack of the demise of national general APS meetings has been taken up by successful section meetings. However, the evolution of meetings, and the demise of significant general meetings, is a symptom of the maturing and fractionating of our science and indeed is a contributor to its fractionization.

A task force on the future of the April Meeting, chaired by Chris Quigg, reported to the APS Council in 2006. I had been afraid that their report might have led to the demise of this meeting. Instead, it reported on a meeting that was still vibrant and somewhat diverse, and described several mechanisms and experiments designed to keep it so. I look forward to the implementation of these ideas.

What is physics? To me–growing up with a father and mother both of whom were physicists–physics was not subject matter. The atom, the troposphere, the nucleus, a piece of glass, the washing machine, my bicycle, the phonograph, a magnet–these were all incidentally the subject matter. The central idea was that the world is understandable, that you should be able to take anything apart, understand the relationships between its constituents, do experiments, and on that basis be able to develop a quantitative understanding of its behavior. Physics was a point of view that the world around us is, with effort, ingenuity, and adequate resources, understandable in a predictive and reasonably quantitative fashion. Being a physicist is a dedication to a quest for this kind of understanding.

When my interests in such a science turned from crystalline solids to biological matter in 1970, most physicists took that as leaving physics. To me it was merely changing from the physics of crystalline matter to the physics of biological matter. Some 30 years later I was elected APS vice president. That is a testimonial to the idea that physics is a point of view about the world, that diverse kinds of subject matter will come and go, but that it is the quest for a physicist's kind of understanding about the world that unites us as physicists, and will continue to do so.

Physics has many times had to make a choice between striving to keep a new component, a teenage child as it were, within the fold, or to send it out into the wilderness as a separate discipline. I am gratified that many–perhaps most–physicists now view the physics of complex systems in general, and biological physics in particular, as members of the family.

John Hopfield is the Howard A. Prior Professor of Molecular Biology at Princeton University. He served as APS President in 2006.

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