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APS Selects 26 as 2002-2003 Minority Scholarship Recipients

The APS has awarded Corporate Minority Scholarships to 26 students who are majoring or planning to major in physics. Since its inception in 1980, the program has helped more than 290 minority students pursue physics degrees. Fifteen new scholars and eleven renewal scholars were selected. Each new scholarship consists of $2,000, which may be renewed once, and each renewal scholarship consists of $3,000.

A member of the Cherokee tribe, Corporate Scholar John Lamberson graduated in the top 10% of his class at Cascia Preparatory School in Tulsa, OK. He became increasingly interested in physics and astronomy throughout high school, and most recently developed a fascination with superstring theory and multidimensional analysis. His interests also include music. For his "Career Exploration" senior project, Lamberson worked in a local music store, organizing the warehouse area and sharing his love of music with the customers. He will be a freshman at Tulsa University this fall, and hopes to eventually become an engineer or a high energy physicist, working at SLAC or the future Large Hadron Collider.

Corporate Scholar Gabriel Mitchell has always been interested in astronomy and space exploration and hopes to one day hold a research position in the aerospace industry. As a junior at McNavy High School in Oregon, he completed a special research project involving planning for robotic planetary space probes, analyzing several factors that contribute to the cost and success rate of robotic space exploration, and designing a simulation program to track and optimize several critical factors. He presented his results in two talks at statewide research symposia.

This year Mitchell is continuing his simulation modeling work by focusing specifically on trajectory issues. He is also pursuing an entirely separate study in another class, working with a Willamette University professor to analyze DNA fragments in ancient grain samples from the Middle East in an attempt to quantify the extent of grain trading between distant regions. He will be a freshman at Oregon State University this fall.

Born in Cameroon, Corporate Scholar Anita Ngatchou is entering her junior year at Rutgers University. Her interest in physics dates back to her childhood, where she exhibited a natural curiosity for how things worked, constantly taking apart her electronic toys and radios. Initially a chemistry major, she switched to physics her sophomore year, and hopes to

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New Scholarships

- Daniel Garcia
- Micah Hawkins
- Gabriel Armas-Cordona
- Jon Lamberson
- Gabriel Mitchell
- Anita Ngatchou
- Daniel Noval
- Joshua Reeves
- Manuel Reyes
- Dione Rossiter
- Alyse Rothrock
- Matthew Sievert
- Tonia Venters
- Jerry Vigil
- Elspeth Whetten

Renewal Scholarships

- Jose Banuelos
- Ryan Camacho
- Joy Chavez
- Monique Cook
- Sharon Doku
- Tyeisha Hughes
- Lydia Kwateng
- Bernice McPherson
- Matthew Pena
- Marcos Vicente
- Kendrick Walker

Tannenbaum is New APS Congressional Fellow

A young high-energy physicist from California is the new APS Congressional Fellow. Benn Tannenbaum, a postdoctoral fellow at the University of California, Los Angeles, will spend the next year broadening his Congressional experience through direct involvement with the legislative and political processes. The APS Congressional Science Fellowship program is intended to provide a public service by making individuals with scientific knowledge and skills available to members of Congress. In turn, the program enables the physics community to communicate more effectively with its representatives in Congress.

Tannenbaum grew up with parents who were both chemists,

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Societies Honor Physics Olympiad Team

After a week of grueling physics exams, lab experiments and classroom work, five students have been selected as winners of the 2002 Physics Olympiad.

For 2002, due to concerns about international travel, the Physics Team did not compete in the international Olympiad, held this year in Indonesia. Instead, the top five team members were presented with awards and scholarships at a June 7 ceremony cosponsored by AIP, AAPT, and NASA's Office of Space Science in Washington DC.


Photo by Bernard Khoury

The top five students hold their computer-based laboratories to go with the calculator contributed by Texas Instruments They also received an award of $2,000 each.

The winning students are (shown left to right in the photograph): Steven Byrnes: Junior, Roxbury Latin School, Boston, Massachusetts; Sean Markan: Senior, Roxbury Latin School, Boston, Massachusetts; Benjamin Schwartz: Senior, Staples High School, Westport, Connecticut; David Simmons-Duffin: Senior, Shaker Heights High School, Shaker Heights, Ohio; and Pavel Batrachenko: Junior, John Marshall High School, Rochester, Minnesota. Since 1986, the AIP and the AAPT, with support from other societies, have recruited, selected, and trained teams to compete in the International Physics Olympiad.

At the awards ceremony, the students heard from astronaut John Grunsfeld and several federal officials, including Norman Neureiter, the Science and Technology Adviser to the Secretary of State. "You're not going to Indonesia this year," Neureiter said, "but you are in fact starting your trip out into a world of science, and automatically with

See OLYMPIAD on page 5

Department Chairs Confer, Drop In On Congress


Photo by Bernard Khoury

One hundred eleven physics department chairs from around the country convened at APS headquarters in early June for the biennial Physics Department Chairs' Conference sponsored by APS and the American Association of Physics Teachers (AAPT). The conference focused on education and outreach, with talks ranging from how to increase the number of physics majors to how to prepare future high-school physics teachers. Shown in the photo is David Hertzog of the University of Illinois who spoke about his department's program to teach re-

See CHAIRS on page 7

INSIDE THE BELTWAY:
A Washington Analysis

Leaders of Industry Fall From Political Grace

By Michael S. Lubell, APS Director of Public Affairs

The "golden parachute" and the "poison pill" are taking on new meanings. Once identified with the financial machinery designed to protect the interests of corporate executives, the terms are singularly germane to the politics of the here and now.

Democrats hope to use corporate abuse as the "golden parachute" that will take them to victory in November. And Republicans recognize that continuing to cozy up to corporate America is the "poison pill" that could make the Democrats' dreams come true. The message to the titans of industry: "Don't call us, we'll call you."

Remember the time when GE, Xerox, and Lucent-Bell Laboratories were kings of the technology mountain? They were the fount of scientific discovery, the trailblazers of innovation and the engines of the American economy. Breathing their names opened doors to the corridors of power. No more.

They lost their luster as the Edens of basic research years ago. Now their fall from scientific grace has a new partner: an ignominious fall from political grace.

Along with Enron, Worldcom, Halliburton, Quest, Tyco, and Adelphia, these bastions of the American economy have been more than tainted by allegations of executive malfeasance and misfeasance. So strong is the belief that their corporate leaders raped and pillaged investors and employees, alike, that no politician of sane mind will entertain for even one minute the thought of sitting at a table with any of them—at least for now. And since no one can predict which megacorp will next come a cropper, CEO's as a species are on the venomous list, so far as public office-holders are concerned.

But memories are short. It wasn't too long ago that academia was struggling to rebuild its image. As the decade of the 1990's opened, Donald Kennedy, former

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Highlights

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The Back Page:
Marcelo Alonso on The Current State of Physics in Cuba: A Personal Perspective.

Members in the Media

"There are some people out there saying to the public, 'Buy my thing and you'll be safe.' It's just not true."
—Richard Garwin, Council on Foreign Relations, on the utility of home radiation detection devices, ABCNews.com, June 4, 2002

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"I don't think it's really possible to throw Einstein's theory out entirely, because it certainly holds to a fantastic degree of precision."
—Alan Kostelecky, Indiana University, on whether atomic clocks on the space station might overturn relativity, CNN, June 5, 2002

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"This is the most marvelous sandbox of physics that we can play in for a long time to come."
—Stirling Colgate, Los Alamos, on building a model of a black hole in the laboratory, AP, June 6, 2002

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"This is going to Congress. It's going to be changed in some detail and probably improved. You can't do all the preliminary work ahead of time."
—Michael May, Stanford University, on the establishment of the Department of Homeland Security, USA Today, June 10, 2002

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"The image is saying that somehow we only form stars in a very small part of that galaxy."
—Rodger Thompson, University of Arizona, on new results from the infrared camera on the Hubble Space Telescope, Newsday, June 11, 2002

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"If someone were trying to find radioactive materials to scare people with, a vulnerable area would be medical schools."
—Allen Sessoms, Harvard University, LA Times, June 12, 2002

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"The physics we've learned is so different than the normal big things that we're used to... it really isn't communicated well until you get into college."
—Franz Gross, William & Mary, on new results about the neutron from Jefferson Lab, Hampton Roads Daily Press, June 8, 2002

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"We're having a hard time convincing students they ought to do push-ups and eat bran flakes for breakfast instead of cotton candy. It's a general trend that students don't want to take anything harder than they have to in order to be successful (but) that's just human nature."
—Jerry Woodall, Yale University, on the difficulty of recruiting students in engineering, UPI, June 13, 2002

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"There is nothing I can think of that would make a nuclear test necessary."
—Bruce Goodwin, Livermore National Laboratory, Contra Costa Times, June 15, 2002

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"Condensed-matter physics is like fine wine—you have to develop a taste for it."
—Marvin L. Cohen, University of California at Berkeley, UPI, June 15, 2002

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"I figured if I got a Ph.D. in physics, people couldn't make dumb-blonde jokes anymore."
—Tina Kaarsberg, House of Representatives Science Committee, The National Journal, June 22, 2002

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Meeting of the Board

Photo by Allen Goldman

The APS Executive Board held its June meeting in Annapolis, Maryland. Members of the board adjourned for dinner to Cantler's Riverside Inn, where a good, if messy, time was had by all.

This Month in Physics History

August 1946: The Moore School Lectures

It's difficult to believe, in this Internet age of laptop and handheld personal computers, that such machines and the ideas from which they developed were once strenuously resisted, and even scientists and engineers were slow to grasp the implications of the technology. Among the influential occurrences that helped change that mindset was a series of 48 lectures held from July 8 to August 31, 1946, at the University of Pennsylvania's Moore School of Electrical Engineering. With speakers drawn from all facets of the field of computation, the lectures were designed to disseminate the current knowledge and progress in electronic computation, in which the Moore School was preeminent. The ideas presented during the Moore School lectures profoundly influenced the direction of computer development for many years afterwards.

By the 1940s, the Moore School had become the center for the development of electronic computation during World War II in response to urgent military needs. During the national emergency, the school's differential analyzer — the most sophisticated computing instrument available for scientific use at the time—was in constant use working out ballistic tables, although it was originally used to study nonlinear and varying parameter differential equations. In fact, the Moore School became something of an extension of the Army's Ballistic Research Laboratory (BRL), replacing human beings with handheld calculators. A trajectory that could take up to 40 hours to calculate using a desktop calculator could be computed in 30 minutes or so on the differential analyzer.

The need to even further speed the calculation and improve the accuracy of the firing and bombing tables resulted in the unveiling, in February of 1946, of the Electronic Numerical Integrator and Computer (ENIAC), the world's first operational, general purpose, electronic digital computer. ENIAC had no moving mechanical parts associated with the high-speed computational aspects of the machine. In fact, the only mechanical elements in the final system were external to the calculator itself: an IBM card reader for input, a card punch for output, and the associated relays. All prior machines had relied on such parts to perform their calculations, thus limiting their compactness and reliability, as well as the speed with which operations were executed.

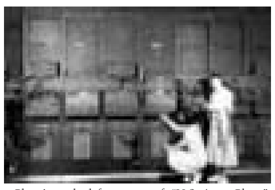
By today's standards, ENIAC was a monster with 18,000 vacuum tubes, but it was the prototype from which most other modern computers evolved. It could perform 5,000 additions or subtractions or 360 multiplications of two 10-digit decimal numbers in one second. Its impact on the generation of firing tables was obvious. A skilled person with a desk calculator could compute a 60-second trajectory in about 20 hours. The Bush differential analyzer at the Moore School could produce the same result in 15 minutes, but the ENIAC required only 30 seconds.

However, ENIAC had one critical shortcoming: the lack of internally stored program capability. The Moore School researchers began developing preliminary designs for the Electronic Discrete Variable Computer (EDVAC). Around 1944, one of the most innovative scientists of the 20th century, John L. von Neumann, became a frequent visitor to the Moore School and eagerly joined discussions about the new and improved machine that would store its "instructions" in an internal memory system. In June 1945, he produced the first draft of a report on the EDVAC, recognized today as a seminal document in computer history.

Disputes over patent rights, among other issues, eventually led to von Neumann's disassociation with EDVAC's development team, but he nevertheless was on hand for the 1946 lecture series, entitled "Theory and Techniques for the Design of Electronic Digital Computers". The Moore School lectures featured talks by some of the biggest names in the field. Officially, 28 people from both sides of the Atlantic attended, but many others attended at least one lecture. Most expected the sessions to focus on ENIAC, but many speakers discussed designs and concepts for EDVAC. Together with von Neumann's paper, the Moore School lectures circulated enough information about EDVAC that its design became the basis for several later machines.

Meanwhile, in 1948, ENIAC was reassembled and converted into an internally stored-fixed program computer through the use of converter code. Many other improvements were made in ensuing years, including an independent motor-electricity generator set to provide steady, reliable power, a high-speed electronic shifter, and a 100-word static magnetic core memory developed by Burroughs Corporation. Until it was retired in 1955, ENIAC ran successfully for a total of 80,223 hours of operation. In addition to ballistics, applications included weather prediction, atomic energy calculations, cosmic ray studies, thermal ignition, random number studies, and wind tunnel design.

While ENIAC as built was never copied, and its influence on the logic and circuitry of succeeding machines is minimal, its development and the interactions among people associated with it critically impacted future generations of computers.



Photo's on the left courtesy of: "U.S. Army Photo", from M. Weik, "The ENIAC Story". Photo above courtesy of: "U.S. Army Photo", from the archives of the ARL Technical Library.

Photo on the Left: A technician changes a tube "Replacing a bad tube meant checking among ENIAC's 19,000 possibilities." Photo on the right: Two women wiring the right side of the ENIAC with a new program, in the "pre-von Neumann" day.

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Viewpoint...

Odds Are Stacked When Science Tries To Debate Pseudoscience

By Lawrence M. Krauss

I vividly remember the first time I was hijacked on the radio. I had agreed to participate in a debate for a Florida radio program that specialized in alien visits and UFO sightings. My better judgment suggested that I should be wary. But I thought if I kept my focus purely on the physics challenges involved in space travel, I might be able to persuade some listeners to be skeptical of the claims that aliens were regularly visiting, abducting and experimenting with our fellow earthlings.

I should have known better. After 45 minutes defending myself against the claim that I was close-minded, when I argued that science did in fact impose constraints on what is possible, and politely responding to demands that I must first scrupulously review all the specific claims of alien sightings before I could possibly have the temerity to make general statements about plausibility or implausibility, I felt that any uninformed listeners who might have been waiting to be swayed probably found themselves merely confused at the end of the show.

In a debate that confronts the results of science with pseudoscience, from alien abductions and crop circles on one hand to the health benefits of weak magnetic fields or young earth creationism on the other, the odds are stacked against science.

Part of the problem is uniquely American. We in the United States are constantly regaled by stories about the limitless possibilities open to those with know-how and a spirit of enterprise. Combine that with a public that perceives the limits of science as targets that are constantly being overcome, and the suggestion that anything is absolutely impossible seems like an affront. Indeed, modern technology has made the seemingly impossible almost ordinary. How often have I heard the cry from an audience, Yeah, but 300 years ago people would have said it would be impossible to fly! Although true, the problem with that assertion is that 300 years ago people did not know enough about the laws of physics to make the assertion, so the claim would have been improper. Had they made a simpler claim like, 300 years from now, if you drop this cannonball off the Tower of Pisa, it will fall down, they would have been right.

Although it is probably true that there is far more that we do not know about nature than that we do know, we do know something! We know that balls, when dropped, fall down. We do know that Earth is round and not flat. We do know how electromagnetism works, and we do know that Earth is billions of years old, not thousands. We may not know how spacecraft of the future will be propelled, whether matter-antimatter drives will be built or even if time travel is possible. But we do know, absolutely, how much on-board fuel will be needed to speed up a substantial spacecraft to near the speed of light: an enormous amount, probably enough to power all of human civilization at the present time for perhaps a decade.

As difficult as debating ultimate limits of the possible may be, there is another debate that is even harder to win. But it is a debate that may be even more important. It is a debate on the fairness of science. The reason for the difficulty is simple. Science is not fair. All ideas are not treated equally. Only those that have satisfied the test of experiment or can be tested by experiment have any currency. Beautiful ideas, elegant ideas and even sacrosanct notions are not immune from termination by the chilling knife edge of experimental data.

In Ohio, a debate is raging over whether to teach intelligent design alongside evolution in high school biology classes. Intelligent design is based on the belief that life is too complicated to explain by natural causes alone and that some intelligence, ultimately some divine intelligence, must have created the original life forms on earth or guided their development. Proponents of that idea suggest that including it in the curriculum is simply a question of fairness. If a significant number of people do not believe that evolution provides an adequate explanation of the origin of species, they argue, then it is only fair to present both sides of the argument in a high school science class.

But at least half of Americans polled in a recent survey by the National Science Foundation did not know that Earth orbits the Sun, and that it takes a year to do so. Does this mean we should teach that Earth is the center of the universe? Of course not. It merely means that we are not doing a very good job informing the public about physics. Science is not a democratic process. It does not proceed by majority rule and it does not accept notions that

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Demand for Boycott of Israeli Science Stirs Controversy

The political turmoil in the Middle East has begun to spill over into the scientific community. Petitions have been circulating, mostly in Europe, calling for scientists to boycott Israeli scientific institutions. One such petition (see http://www.pjpo.org) is headlined: "University Professors call for European boycott of research and cultural links with Israel." Counter-petitions opposing the boycott have also been circulating. For a rundown of activity on both sides, see http://euroisrael.huji.ac.il/news.html.

In its June 7 issue, *Science* published an editorial condemning a European biologist who refused to share experimental material with an Israeli colleague on political grounds. This followed an editorial in *Nature* on May 2 with the headline "Don't Boycott Israel's Scientists."

At press time, *APS News* knows of no evidence of Israeli physicists suffering directly from a boycott, although many of them have expressed deep apprehension. While not addressing this issue specifically, APS has taken positions at various times in the past on similar issues regarding the international nature of science. For example, in 1989 the APS Council passed a statement on "the International Nature of Physics and International Cooperation", the preamble of which reads:

"In consideration of the international dimensions of science and the need of scientists of all nations to maintain professional contact with colleagues at home and abroad, the American Physical Society has adopted the following statement on The International Nature of Physics and International Physics Cooperation:

Science belongs to all humanity and transcends national boundaries. As in the past, science can serve as a bridge for mutual understanding across political and ideological divisions and as a vehicle for the enhancement of peace. In particular, APS believes that it is important at this time to strive for more open dialogue among scientists to enhance international cooperation."

The full text of this and other APS statements can be found on the Web at http://www.aps.org/statements/ .

APS Fellows Win Four National Medals of Science, 1 Technology

President Bush awarded four National Medals of Science and one National Medal of Technology to fellows of the APS in a White House ceremony on June 12. The medals are the country's highest award for lifetime achievement in science and technology.

–**Andreas Acrivos** of the City College of the City University of New York and professor emeritus of chemical engineering at Stanford University was awarded a National Medal of Science for his contributions to the modern theory of fluid mechanics and convective heat and mass transfer.

–**Marvin L. Cohen** of the University of California, Berkeley, and Lawrence Berkeley National Lab, won the medal for his work in solid state physics.

–**Ernest R. Davidson** of Indiana University was honored for work that led to the field of computational quantum chemistry.

–**Raymond Davis** of the University of Pennsylvania and Brookhaven won the award for first measuring the solar neutrino flux and creating the field of neutrino astronomy.

–**Jerry M. Woodall** won a National Medal of Technology for his research on and development of compound semiconductor heterojunction materials and devices.

A total of fifteen medals of science and five medals of technology were awarded this year. Other winners included Harold Varmus, a 1989 Noble Laureate who studied the genetic origins of cancer, and Arun Netravali of Lucent Technologies.

The National Science Foundation administers the National Medal of Science, which was established by Congress for the White House in 1959. The National Medal of Technology was established in 1980.

SCHOLARSHIP, *from page 1*

pursue graduate studies in biophysics. That interest was sparked by a summer research internship, during which Ngatchou assisted Rutgers professor John Gagliardi in a study of microscale electrostatics in mitosis, and found the use of physics principles to explain biological phenomena particularly interesting.

A competitive classical pianist by the time she reached junior high school, Corporate Scholar Elspeth Whetten began seriously pursuing physics studies when her musical career was sidelined by a serious bout of carpal tunnel syndrome, requiring surgery and a year of physical therapy. Her high school science teacher fostered her interest by loaning her physics books, and she proceeded to take as many math and science courses as she could, electing to major in physics once she reached the University of Utah. Now entering her sophomore year, Whetten spent part of this past winter as a research assistant to UU professor Kai Martens, helping to measure the quantum efficiency of a photomultiplier tube. She hopes to eventually earn a PhD in physics.

The APS scholarship program operates under the auspices of the APS Committee on Minorities in Physics, and is supported by funds allocated from the APS Campaign for Physics. Scholarships are awarded to African-American, Hispanic American and Native American students who are high school seniors, college freshmen or sophomores. The selection committee especially encourages =applications from students enrolled in institutions with historically Black, Hispanic or Native American enrollment. After being selected, each scholar is matched with an accomplished physicist to act as a mentor.

For applications for the 2003-2004 competition, contact Arlene Modeste Knowles at knowles@aps.org. Information can be found at http://www.aps.org/educ/com/index.html.

Hamre Commission Takes Hard Look at Security Mismanagement at Weapons Labs

By Desirée Scorcia

The Commission on Science and Security, charged with studying security in DOE weapons laboratories, has released a report identifying problems with the labs' current security structure. John Hamre, former Deputy Secretary of Defense and President and CEO of the Center of Strategic and International Studies (CSIS), chaired the commission, which was established in October 2000 by then Secretary of Energy Bill Richardson.

The weapons labs are managed independently of DOE's Office of Science, which funds physics research at universities and other national labs.

The report, issued last spring, says "DOE's policies and practices risk undermining its security and compromising its science and technology programs." It cites "management dysfunction" and "woefully inadequate" investments in security and counter-intelligence technology, among other problems.

"It is critical to understand that excellence in science and sound security are not mutually exclusive objectives," Hamre said in a press release. "The laboratories in the Department of Energy are national treasures, but they are obviously targets of foreign espionage and need to be better secured against that threat. They are also at risk because of inappropriate and ineffective security solutions from the past that are now undermining the creative environment we need in these institutions to meet our national objectives."

One major problem identified in the report is that the DOE's "continuing management dysfunction impairs its ability to carry out its science and security missions." As a consequence, security policy lacks clarity, consistency, and strategic planning.

To solve this problem, the commission recommends that the DOE clarify the security responsibilities of each employee, trim excess management, and establish a security budget that is controlled by laboratory directors.

Collaboration between the science and security communities is also "badly damaged," the commission found. These communities also disagree about which research requires protection and how best to provide it. To rectify this situation, the commission recommends integrating science and security by making the laboratory director both chief scientist and security director of his lab.

The report went on to recommend tailoring security to the risks unique to each research project, investing in new, hi-tech security measures such as b=iometric identification systems to replace the current, paper-based system, and increasing cyber security in all of the labs.

LETTERS

APS Statement Draws Fire

I wish to express my strong reservations concerning the APS statement on DOD basic research (*APS NEWS* June 2002).

Support of basic research should be based primarily on the desire to discover more about nature and our universe. Emphasizing applications tends to undercut some science at the frontiers of knowledge such as cosmology and elementary particle physics. I remember with embarrassment the attempts of a Texas congressman to describe the wonderful applications to arise from the SSC; they only served to hasten the demise of that frontier accelerator project.

It is important and correct to emphasize that all the wonderful applications of science in our modern world have as a foundation the results of basic research. The examples that we should point to are those that can benefit all of mankind. Unfortunately it is hard to say whether applications that augment U.S. military power are more of a benefit or a danger to mankind.

In conclusion, for moral reasons as well as to achieve the results we desire, we should refrain from defending basic research in physics on the basis of military applications.

Lincoln Wolfenstein
Pittsburgh, PA

We are disappointed that the APS Council, at the April meeting, adopted a resolution on military spending. Whether you agree or disagree with the content of the resolution, you may agree that it seems inappropriate for the Council to speak out on this subject on behalf of the entire membership.

Would it not have been more appropriate for those influential leaders of the Society to make known their views on weaponry as individuals?

And better for the organization as a whole to keep its focus on advancing and diffusing knowledge of the physical world?

Nina Byers
Santa Monica, California
Kenneth Ford
Philadelphia, Pennsylvania

Scientists Toy with Origami As A Solution

Fold the paper in half and then fold it in half again and eventually that piece of paper will be transformed into an airplane, a hat, or a peace crane. Origami—the ancient Japanese tradition of paper folding—has long been recognized as an art, but now origami is providing the answers to real world problems in mathematics, engineering, and astronomy, proving that origami is more than just child's play.

"Origami helps in the study of mathematics and science in many ways," says Martin Kruskal, a mathematician at Rutgers University, "Using origami anyone can become a scientific experimenter with no fuss." Kruskal found that origami is simpler to develop than most scientific theories and a lot easier to apply.

With his experience tackling a variety of puzzles that range from designing a folding telescope, called Eyeglass, that is easily deployed in space to the careful folding of an air bag to protect passengers, Robert J. Lang, an engineering consultant, explains the basic geometric concepts used to solve a broad class of origami folding challenges. Lang teaches scientists how to apply origami to their work. "One basic technique is how to pack circles that don't overlap into a square, also known as 'circle-packing,' " says Lang. As result of his research, Lang has propelled the art of origami into tools used for applied mathematics and engineering.

Expanding the realm of origami applications, Jeremy Shafer, an origamist with the Bay Area Rapid Folders, shows scientists how to design their own origami models as an exercise in problem solving. "It's all about coming up with a good folding challenge," says Shafer, "After that, it's about experimenting with different base shapes, devising a strategy, coming up with a working model, and then evolving it toward perfection."

Eric Demaine, assistant professor in electrical engineering and computer science at Massachusetts Institute of Technology is fascinated by the mathematical and computer science problems that develop naturally in origami. For example, what shapes can be made if a square piece of paper is folded flat, and then cut? "Our team has proved that with one straight cut, a butterfly, swan or just about any other shape can be made," say Demaine, revealing that one carefully calculated cut, can open up a multitude of possibilities.

"For many years, I have thought that science and the arts really are just opposite sides of the same coin," says Patricia Wang-Iverson, senior associate for Research for Better Schools and organizer of the session, "People only seem to see the tedium and hard work of science, but don't see the creativity and beauty as they do in a great work of art." Maybe the answers to solving real-world problems of mathematics and science may have been tucked away in the hidden in the folds of origami all along.

— Inside Science News Service

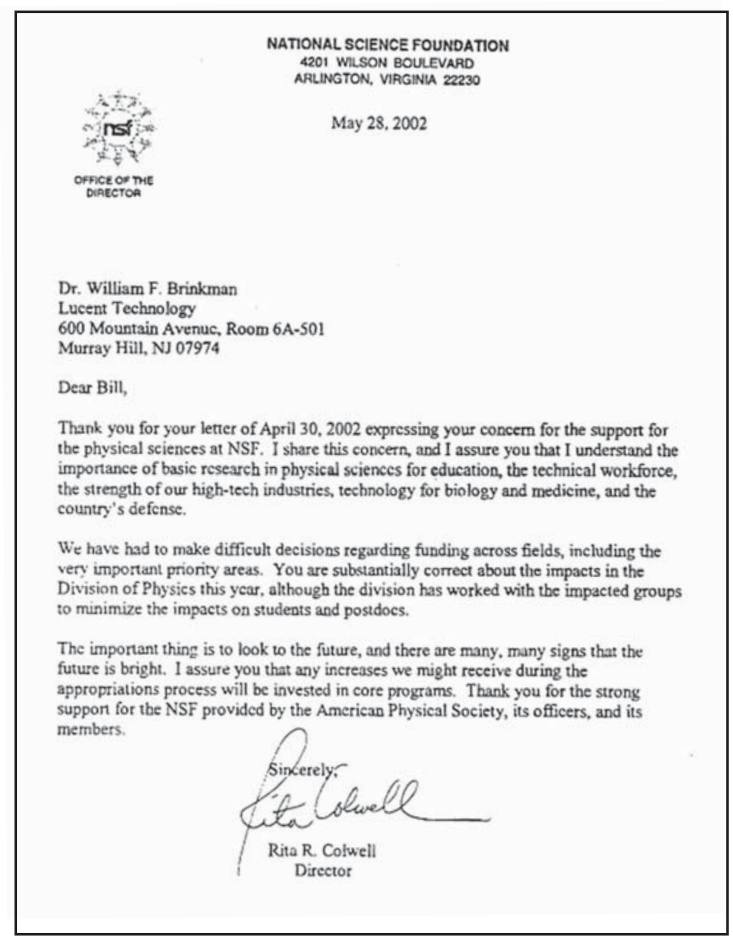
APS Lobbyists Work the Hill While Brinkman and Colwell Correspond

In response to severe cuts to core programs in the physical sciences at NSF, the APS has been working especially hard in the past few months, both within the administration and on Capitol Hill, to help turn the situation around.

APS lobbying efforts, spearheaded by Senior Science Policy Fellow Steve Pierson, focused on gaining support for a "Dear Colleague" letter in the House of Representatives, in which members of Congress asked their colleagues on the relevant appropriations committee to raise the NSF budget by 15% this year. By calling more than 160 Congressional offices, and personally visiting more than 75, Pierson and others in the APS Washington office led the effort that ultimately resulted in 131 members signing the letter. The appropriation for NSF will not be passed for another month or two, but in a related development, on June 5 the House overwhelmingly passed a bill that authorized a 15% increase for NSF for each of the next 3 years. [Authorization bills set policy and priorities, but the actual budget numbers are determined by the appropriation bills].

Meanwhile, on April 30, APS President Bill Brinkman wrote to NSF Director Rita R. Colwell, noting the support that APS has traditionally given the NSF. He pointed out that, in addition to its direct lobbying activity, last year APS helped with more than 2,500 letters to Congress from physicists on behalf of NSF, and this year that total has already been surpassed. Brinkman went on to detail the cuts that NSF-supported research groups had suffered, citing as examples the 23% cut that the University of Chicago particle physics group received, and 11% at Michigan State. "I strongly urge you to work toward increasing the physical sciences budget in the next years if some of the increases that you are hoping for are realized," he told the NSF Director.

Colwell replied in a letter to Brinkman dated May 28. The text of her letter is below.



NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

OFFICE OF THE DIRECTOR

May 28, 2002

Dr. William F. Brinkman
Lucent Technology
600 Mountain Avenue, Room 6A-501
Murray Hill, NJ 07974

Dear Bill,

Thank you for your letter of April 30, 2002 expressing your concern for the support for the physical sciences at NSF. I share this concern, and I assure you that I understand the importance of basic research in physical sciences for education, the technical workforce, the strength of our high-tech industries, technology for biology and medicine, and the country's defense.

We have had to make difficult decisions regarding funding across fields, including the very important priority areas. You are substantially correct about the impacts in the Division of Physics this year, although the division has worked with the impacted groups to minimize the impacts on students and postdocs.

The important thing is to look to the future, and there are many, many signs that the future is bright. I assure you that any increases we might receive during the appropriations process will be invested in core programs. Thank you for the strong support for the NSF provided by the American Physical Society, its officers, and its members.

Sincerely,

Rita R. Colwell
Director

FELLOW, *from page 1*

from whom he received a firm grounding in math and science. He earned his BS in physics from Grinnell College in Iowa in 1990 and decided to pursue graduate studies, earning his master's degree from Michigan State University in 1993. He completed his PhD at the University of New Mexico four years later, with a thesis on the search for charging-neutralino production using the CDF detector at Fermilab's Tevatron collider.

Tannenbaum's interest in the public policy aspects of science began when he was a graduate student. He helped found the Graduate Student Association at Fermilab, which acted as a liaison between the graduate students and the lab's Directorate.

As the CDF representative on the Association, Tannenbaum traveled to Washington, DC to meet with funding and policy agencies, as well as science aides to Congressmen. He currently chairs Fermilab's User's Executive Committee— which acts as a liaison between the users and the directorate of the lab, as well as representing their interests in Washington—and is an active member of ArmsNet, a subgroup of the Union of Concerned Scientists that focuses specifically on arms control issues, including national missile defense. He even helped prepare a position paper in April 2001 for Senator Dianne Feinstein (D-CA), which led to proposed legislation requiring a sound scientific rationale for any NMD spending.

Tannenbaum is also a strong advocate of increasing scientific literacy. While at Michigan State, he helped found Science Theater, an NSF-sponsored group that designed demonstrations to interest students and the general public in science and physics. The group has performed at schools, at local malls, and for girl scout troops, and in 1993 received the AAAS Award for Public Understanding of Science and Technology.

Benn Tannenbaum

Given his extensive background in public policy, it isn't surprising that Tannenbaum eventually sought out a Congressional fellowship, where he hopes his skills and experience as a physicist, communicator and teacher will prove useful. "These are tumultuous times for our country, and I believe that scientists have a special obligation to society," he says. "It is our responsibility to keep both our government and the general public informed as to what science can and cannot do to protect our nation." He initially identified technology transfer, science funding and world scientific leadership as the areas he would most like to focus on as a fellow, but in light of last year's terrorist attacks, he has expanded that list to include foreign relations and intelligence and other national security issues. "These are rather complex, disparate tasks," he admits. "But they all require a scientist who can work with politicians to design equitable solutions."

In September, Tannenbaum will join nearly 100 other Congressional fellows from other scientific societies for a special orientation session sponsored by the AAAS, followed by an intensive interviewing process to decide where he will spend his fellowship year. As of now, he is keeping an open mind as to whether he will choose to work in a Congressional office or on the staff of a Congressional committee.

Viewpoint...

Letters Reveal New Insights Into the Bohr-Heisenberg Meeting

By Frederick Seitz

The final public release earlier this year of several drafts of a letter that Niels Bohr wrote to Werner Heisenberg in the mid-1950s, but never sent, gives us a somewhat deeper insight into the meeting between the two that took place in Copenhagen in September, 1941. Germany was then at the height of its period of military success, having occupied most of Europe, defeated France, and driven the British Army off the continent. The US was still technically neutral and the destructive bombardment of Pearl Harbor lay several months ahead. Denmark had been forcibly occupied, so Bohr could not help but be apprehensive about the visitors from an enemy country, in spite of what had previously been a deeply friendly professional relationship.

While we do not know full details about their discussions, the record makes it clear that Heisenberg brought up — in what appears to be a heavy-handed way — two issues that were guaranteed to raise Bohr's ire. Since German victory in the war now seemed assured, Heisenberg suggested that Bohr takes steps to promote friendly relations between Denmark and Germany. Bohr could only have been incensed at the proposal. He was a very loyal Dane, a notable distinguished father-figure in his country, and he well knew that his fellow citizens were outraged by the German occupation. The notion that Bohr would support any official form of friendly relationship was simply beyond comprehension under the circumstances. On the more personal side, Bohr was partly Jewish and must have despised the German leadership for promoting the anti-Semitic Nuremberg Laws.

In a similar manner, Heisenberg stated that he and a group of colleagues were in the process of developing a nuclear chain reaction based on the fission of uranium. If we can trust Bohr's memory a decade and a half later, Heisenberg implied that he had a fairly complete understanding of the steps needed to achieve such a reaction, but would not go into details. He also stated that work of this kind would ultimately lead to the development of some form of nuclear bomb that would probably play a crucial role in bringing the war to an end if they succeeded. He could not at that time have realized how fully prescient he was, since the Pacific war was far away and the US was not yet engaged. Clearly such an admission would have angered Bohr at least as much as the proposal that he cooperate with the existing German government.

What are we to make of this, beyond concluding that Heisenberg proved to be a poor diplomat during the visit and, in fact, behaved much like the proverbial bull in a china shop? It is likely that the first proposal to Bohr, suggesting that he take the lead in developing cultural links with German counterparts, was the primary goal of the visit as contrived in the diplomatic offices in Berlin, and was made a condition for permission to visit Denmark. Had Heisenberg possessed more sensitive feelings regarding Bohr's special position as a leading Danish citizen, he would have refused, realizing that it would only pour salt in an open wound and severely damage what had once been a warm, valuable friendship.

Perhaps the key to the situation lies in Heisenberg's personal pride at that moment, both in German military prowess and what he viewed as the significant strides he was making on the road to releasing high levels of nuclear energy. Had Hitler not come to power, and had political and economic affairs in Germany stabilized, Heisenberg's intellectual life would undoubtedly have continued to be centered in physics and the academic world. However, he came from a patriotic family and felt very strongly that he should do his best to preserve what he could from the shambles in his intellectual world created once Hitler came to power. He also felt a patriotic duty as a German citizen to take his place in military service and related matters.

Yet Heisenberg faced many difficult confrontations with German government leaders on matters of socio-ethical policies. A small group of physicists who were highly supportive of Hitler designated him a "White Jew" in the official press of the Nazi Party for giving lectures on Einstein's theory of relativity. This caused the government to carry out an in-depth investigation of his status, making him a marked individual. One wonders if his willingness to cooperate with the government by carrying out "cultural missions" in the occupied countries before and during the war stemmed from the hope that he could regain some degree of credibility with officialdom and exert positive influence on behalf of the scientific community.

He did have opportunities to escape, particularly in the summer of 1939, when he came to the US to lecture at the University of Michigan summer school. There he met his good friend Enrico Fermi, who had just succeeded in emigrating from Italy with his family. Fermi implored him to remain in the US, where he would enjoy a top-flight position, emphasizing that Heisenberg could never accomplish anything significant back in Germany, because those now in charge of the government had no appreciation for his ideals and goals. Heisenberg, in turn, stated that he felt an obligation to try and save something out of the wreckage that was emerging in his country. Moreover, he would have had to

See BOHR-HEISENBERG *on page 7*

Proposed New Department Complicates Outlook for Visas

By Desirée Scorcia

As a result of last fall's terrorist attacks and a growing fear that the US borders are poorly guarded, the federal government is instigating major changes in the way visa applications are screened and foreign students are tracked in the US. Many of these changes have the academic community worried that the benefits of free, international collaboration will be devalued and science and technology will suffer.

The uncertainty began last October, when President Bush signed the USA PATRIOT Act (Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism) into law. It ordered the creation of an interagency panel to screen long-term visa applications and prevent possible terrorists from entering the country. The situation got more complicated when the president announced his intention to build a new Department of Homeland Defense, which could dramatically change the distribution of authority over border controls.

The White House Office of Science and Technology Policy (OSTP) and the State Department designed the Interagency Panel on Advanced Science and Security (IPASS) without any knowledge of Bush's plan to propose the new Department of Homeland Defense. The new department will oversee intelligence and law enforcement and will control the borders, duties that now belong to the INS and the Department of Justice.

"The Homeland Security Department won't affect how IPASS works," says Wendy Hall, senior policy analyst at the OSTP. "It's still going to work as we intended earlier, and it should be operational in a short time."

Under the present system, INS consular officials, many of whom have little or no science training, hold all of the responsibility for visa issuance in foreign embassies. Often, they need help distinguishing science that merely sounds like a threat to national security from science that might pose a real risk. While the permanent panel is being set up, an interim panel is issuing these advisories.

If IPASS works as envisioned by the OSTP, the consular officials will refer suspicious-looking visa applications to IPASS. While no firm guidelines are set, OSTP says it will probably look carefully at applicants from terrorist-sponsoring countries and those who wish to study in fields "uniquely available" in the US or its closest allies.

Many in the scientific and academic communities were alarmed by the idea of a panel to screen science visas and feared stringent restrictions might prevent those with honest intentions from entering the US. The OSTP is aware of this concern.

"From its inception, we have been seeking input from those in academic and science community," said Kathryn Harrington, communications director at OSTP. "We met with representatives from that community, let them know about IPASS, and asked for their thoughts and feelings."

President Bush's science advisor and OSTP director John Marburger said the panel expects to review 2,000 of nearly 200,000 science student visa applications the INS processes each year. He also confirmed that the panel would be strictly advisory, and the final authority to issue visas would remain with the counselor official who initially submitted the application for review. "Hopefully, it will have a very

See VISAS *on page 7*

OLYMPIAD, *from page 1*

that you're joining an international world, a world which will cross borders. And I guarantee as you go out into that world, you're going to have a lot of international experiences. Physics is perhaps the most universal of sciences today. Electrons travel with the same speed and the same spin no matter what language is spoken, no matter what borders they cross."

The Physics Team also received a 'behind-the-scenes' tour of the Smithsonian Air and Space Museum. Following the awards ceremony, students enjoyed a private viewing of "Space Shuttle 3-D" at the Museum's IMAX theater.

Speaking Out In Support of Science Education Funding

In conjunction with the US Olympiad Team's visit to the nation's capital, AIP and AAPT sent a brief policy statement to Congress, also endorsed by the APS, the Optical Society of America, the American Astronomical Society, and the Acoustical Society of America. Members of Congress were invited to join in "celebrating the achievements of these US Physics Team students" by supporting full funding for federal programs to improve K-12 science and math education.

In the Education Department, specific funding for science and math education reform is provided through the Math and Science Partnerships program. This program was established and authorized at $450 million annually in the "No Child Left Behind" bill (now Public Law 107-110), but only received $12.5 million in FY 2002. Another $12.5 million has been requested for FY 2003. This will not be enough for the program to reach high-need school districts in all states, as it was intended to do. NSF also has its own version of Math and Science Partnerships. The NSF Partnerships, which are merit-based awards to develop model reform programs, received $160 million in FY 2002; $200 million has been requested for the coming year. A bill to authorize this program at $200 million per year was passed by the House (H.R. 1858), but the companion bill (S. 1262) has not yet passed in the Senate.

The text of the statement follows:

"We urge Congress to support K-12 science and math education, particularly programs that enable professional development for teachers and preparation of new teachers, by funding the Math and Science Partnership programs at the levels called for in authorizing legislation:

$450 million for the Department of Education Partnerships in P.L. 107-110, and

$200 million for the NSF Partnerships in the House-passed H.R. 1858."

News Item: American Physics Olympics Team Decides Not to Compete in Indonesia

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PHYSICS AND TECHNOLOGY FOREFRONTS

Photonic Crystals

By E. Yablonovitch

Photonic crystals are the *electromagnetic* analog of semiconductor crystals. They are artificial crystal structures that do for electromagnetic waves what semiconductor crystals do for electron waves. In today's world, electronic semiconductors are the basis for the micro-electronic, telecommunications, and computer industries. We are just now beginning to understand the exciting potential of their electromagnetic cousins for tomorrow's world.

The powerful analogy between photonic and semiconductor crystals has unleashed the collective scientific imagination of many creative physicists, engendering a profusion of synthetic electromagnetic crystal structures. These usually have an electromagnetic bandgap, a band of frequencies in which electromagnetic waves are forbidden. Various 2-dimensional and 3-dimensional photonic crystal structures have now been conceived for application in high capacity optical fibers, color pigments, and especially nano-photonic integrated circuits that might be included in standard microchips.

A Little History

In electronic semiconductor crystals, electron waves scatter off the layers or rows of atoms. Bumping into periodic row after periodic row of atoms, the back-scattering is reinforced if the electron wavelength matches the spacing of successive layers. Venturing off in different directions, the electron waves meet other layers of atoms. No matter which direction they go, they just can't get through if their wavelengths roughly match the layer spacings. The result is the celebrated forbidden bandgap of electronic semiconductors like silicon.

While it took thousands of years of metallurgy and materials science to discover and bring to perfection electronic semiconductor crystals, photonic crystals are in principle more accessible. Since electromagnetic waves appear equally well at all wavelengths from giant radio waves to tiny gamma rays, artificial electromagnetic crystal structures can be made with any convenient row spacing and size.

Only human imagination limits the crystal design and structure—we are no longer restricted to real material crystals that grow in nature. Yet initially there was no assurance that any particular design would actually produce a forbidden photonic bandgap. Ultimately the search for the first electromagnetic bandgap crystal would take four years, and involve the participation of numerous experimentalists and theorists who had no idea in advance whether a true photonic bandgap could ever even exist.

The absence of early empirical success was compounded by the problems that faced theorists. Electromagnetic waves are vectors like electric fields. It therefore took time for theorists to retool their band structure computer programs to accept vector waves. Several groups that undertook this task, including M. Leung of Polytechnic University, and K.M. Ho, C.T. Chan and C.M. Soukoulis of Iowa State University, began to make valuable predictions. The Iowa State group discovered that the diamond structure would indeed produce a real bandgap. Diamond structure is a form of face-centered-cubic (fcc) in which two atoms, instead of one, are inscribed into each unit cell. The form of diamond structure that was most effective, giving the widest photonic bandgap, consisted of only the dielectric rods ("valence bonds") between the atoms, which were allowed to shrink simply to points.

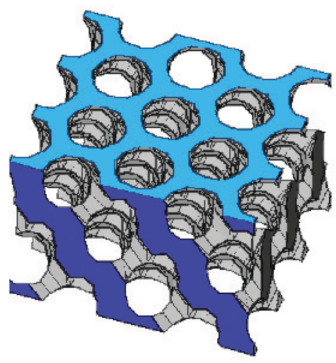

Figure 1: The first photonic crystal was formed by drilling three intersecting arrays of holes into a block of ceramic material. Each array is angled 35° into the plane, producing a structure now called Yablonovite. The pattern of 6mm-diameter holes blocks radio waves from 13 to 16 GHz.

There was also the question of whether the required refractive index might be unattainable in real materials, but the calculations showed that a refractive index of as little as 1.87 was enough in a diamond structure. As there are many optical materials available with refractive indices of up to 3.5, it seemed feasible that photonic bandgaps could be successfully made from real existing materials.

But theoretical searches for photonic bandgaps in fcc structures were at first elusive. Initially, only a pseudo-gap emerged between the 2nd and 3rd bands but eventually, at a little higher frequency, a bandgap emerged[2] between the 8th and 9th bands in fcc structures. Later, contrary to all expectations, H.S. Sozuer, J.W. Haus, and R. Inguva found that a bandgap, albeit a small one, could exist even in a simple cubic "scaffold" structure.

Some Real Life Photonic Crystals

Nature already makes photonic crystals, in the sparkling gem opal, and in the colors of butterfly wings. These have photonic band structures though not full photonic bandgaps. A complete bandgap seems to have eluded nature—it seems to require too much refractive index contrast. Nevertheless, an incomplete bandgap can still be very useful. Novel forms of synthetic opal can be self-assembled in titanium dioxide particles, the white pigment used in paint and to make printer paper white. Coherent scattering of light can give more whiteness for less titanium dioxide. One day we may find photonic crystals all around us on painted walls and in the stacks of documents that clutter our work desks!

While a perfect 3-dimensional structure is needed to block all waves in all directions, we have learned that 2-dimensional photonic crystals might be even more valuable. Two-dimensional photonic crystals come in many forms, since there is considerable freedom in handling the 3rd dimension. If the 3rd dimension is stretched out long and narrow, photonic crystals provide a new method for confining light in optical communications fibers, as first introduced by J. C. Knight, J. Broeng, T. A. Birks, and Philip St. J. Russell of Bath University. Normally light is trapped in optical fibers by total internal reflection in a high refractive index region at the core of the fiber. In contrast, bandgap confinement allows the core to have a lower refractive index, indeed to consist of an empty hole. These "holey" fibers allow new freedom in fiber design that can be valuable even when photonic bandgap confinement is absent. It is predicted that holey fibers may carry up to 100 times the information of conventional telecommunications fibers, potentially with such low losses that optical amplifiers and repeaters would be unnecessary.

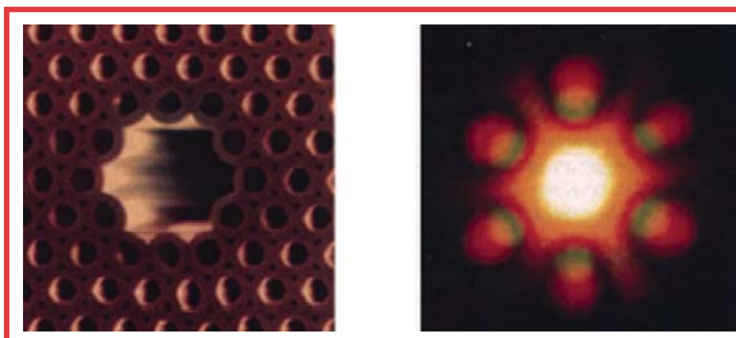

Figure 2: Left: the cladding of several hundred capillary tubes confines light to the central hole which is about 15 microns in diameter. Right: the pattern of colors shows that the optical confinement of a bandgap fiber depends strongly on wavelength.

Images courtesy of University of Bath, UK.

A photonic crystal is often most functional when an artificial defect is introduced, similar to doping in a conventional electronic semiconductor. Added dielectric material is equivalent to "donor" doping, and deleted dielectric material is equivalent to "acceptor" doping.

An example of this is the thin film 2-dimensional hexagonal-array photonic crystal. John Joannopoulos, Shanhui Fan and Pierre Villeneuve of MIT and E. F. Schubert of Boston University did some of the first calculations on thin-film 2-dimensional slab photonic crystals. Such thin films were not thought to be useful for trapping light, since they are completely open, top and bottom. Nonetheless, they are intriguing in that they could be easily patterned by standard integrated circuit production methods. When one of the holes is left plugged up, the result is a "donor" cavity, a local electromagnetic mode in a region with an otherwise forbidden bandgap.

Surprisingly, these 2-dimensional cavities can be very effective for trapping light, in spite of being open top and bottom. Indeed O. Painter, R.K. Lee, A. Scherer, A. Yariv, J.D. O'Brien, P.D. Dapkus, and I. Kim at Cal Tech and USC have recently fabricated the tiniest lasers ever from them. These 2-dimensional photonic crystal thin films can be readily patterned into optical circuits that would represent the ultimate limit of optoelectronic miniaturization. Many researchers believe that these types of photonic crystal integrated circuits stand ready to extend the integrated circuit revolution into the domain of high bandwidth optical signals, following the same miniaturization trajectory as conventional electronic integrated circuits.

From the ultimate miniaturization of tiny optical waves, we go to macroscopic radio waves. Can the concept of an electromagnetic bandgap be useful for radio waves? (Given their long wavelength they should be called "electromagnetic crystals" rather than "photonic crystals") For example a cellular telephone often uses radio waves that are 35cm long in free space. The corresponding electromagnetic crystal consisting of multiple periods would have to be even larger than that and not very practical for carrying around. Here the common electrical circuit of inductors and capacitors ("LC-circuit") rescues us. An LC-circuit can confine an electromagnetic wave to a small volume and arrays of LC circuits can behave as photonic crystals, controlling long electromagnetic waves, even though the whole array can be smaller than one free space wavelength.

This simple concept has led to a series of innovative new ideas in electromagnetics. For example, using arrays of LC-circuits, David Smith, Willie J. Padilla, D. C. Vier, S. C. Nemat-Nasser and Shelley Schultz of UCSD have created the first "left handed" materials, in which the group velocity and phase velocity are opposite!

Meanwhile, M.C.K. Wiltshire, J.B. Pendry, I.R. Young, D.J. Larkman, D.J. Gilderdale, and J.V. Hajnal of Imperial College have used LC electromagnetic bandgap arrays for manipulating the radio magnetic fields used in medical magnetic resonance imaging and D. Sievenpiper, Z. Lijun, R.F.J. Broas, N.G. Alexopolous, and E. Yablonovitch have used LC resonator arrays for controlling radio antennas.

It appears likely that these circuit concepts can be extended right back up to optical frequencies, where they emerge as so-called "plasmons", the optical frequency currents that can flow on metallic surfaces. Such ultra-miniature LC circuit arrays, smaller than an optical wavelength, may eventually represent the ultimate end point of photonic crystal miniaturization.

Eli Yablonovitch is professor of electrical engineering at the University of California, Los Angeles. He is a Fellow of the APS.

APS E-Board Passes Resolution on Perpetual Motion Machines

The APS Executive Board approved a resolution at its June 2002 meeting in Annapolis, MD, affirming the fraudulent nature of claims of perpetual motion machines.

The resolution was deemed necessary because of a recent increase in patent applications for such devices. Robert Park, APS Director of Public Information and author of the weekly electronic newsletter "What's New," reported that the US Patent Office has received several patent applications for perpetual motion machines during the first six months of this year alone. [Park's 2000 book, *Voodoo Science*, devoted considerable space to the phenomenon of such devices throughout history.] The text of the APS resolution follows.

The Executive Board of the American Physical Society is concerned that in this period of unprecedented scientific advance, misguided or fraudulent claims of perpetual motion machines and other sources of unlimited free energy are proliferating. Such devices directly violate the most fundamental laws of nature, laws that have guided the scientific progress that is transforming our world.

ANNOUNCEMENTS

The Science Centers Partners Program

The Science Centers were established by international agreements beginning in 1992, as a nonproliferation effort to provide peaceful research opportunities to weapons scientists and engineers in the Newly Independent States (NIS) of the Former Soviet Union.

The International Science and Technology Center (Moscow) and the Science and Technology Center of Ukraine (STCU) are intergovernmental bodies with the following nations as member states: the United States, Russia, Ukraine, Japan, the European Union, Kazakhstan, Belarus, Georgia, Uzbekistan, Armenia, the Kyrgyz Republic, Norway, and the Republic of Korea. Total member state funding has exceeded $400 million in over 1600 projects and involving over 35,000 former weapons scientists.

The Partners Program at the Science Centers provides opportunities for private industry, scientific institutions and other governmental or non-governmental organizations to fund research at NIS institutions.

Moreover, the Program has been established so as to mitigate the risks of funding research in the region by providing a protective infrastructure and using the Science Centers to monitor and oversee the projects. The Program provides specific benefits:

* **Tax and customs exemptions**
* **Protection of intellectual property rights**
* **Confidentiality and protection of proprietary information**
* **A legally binding project agreement**
* **Expedited project approvals and implementation**
* **Advance host-country government concurrence on projects**

To request Partner status, interested candidates need only to submit a letter to the Department of State. Becoming a Partner costs nothing and does not obligate an organization to fund a project. Scientists and institutes working in the program are engaged in R&D projects involving chemistry, material science, information and telecommunications, air, space and surface transportation, biotechnology, environmental science and more. Depending on their own R&D objectives, interested candidates may choose to fund a project that has already been registered at one of the Centers, or may work with an appropriate NIS institute to custom-design a project. Many well-known U.S. businesses have recognized the depth of scientific talent in the NIS and have chosen to participate in the Partners Program, including Boeing, General Electric, 3M, Procter & Gamble, Dow, Dupont, General Atomics, and Air Products and Chemicals.

To apply, please contact: Mr. Andy Hood, Science Centers Partners Program, U.S. Department of State, NP/PTR, Room 2428, 2201 C Street, N.W., Washington, DC 20520

Call for nominations for 2003 APS Committee members.

The Committee on Committees is asking for your help in suggesting names to replace those rotating off various committees at the end of this year.

There is an interactive web page through which nominations can be submitted. You will find the page at: http://www.aps.org/exec/COCnoms.html

Please submit as many names of qualified people as you would like. You should provide a short biographical summary and a brief explanation of what you feel they would be able to contribute to the committee for which you are nominating them. Self nominations are always welcome.

There is still time to vote in the APS Election. Vote by September 1, 2002 at http://www.gosbs.com/apselection/LOGIN.APS

VISAS, *from page 5*

minimal impact on the flow of students and scholars to this country," said Vic Johnson, a public policy director at NAFSA: Association of International Educators.

But APS members are already reporting unusual problems obtaining short-term visas for their colleagues abroad.

Joseph Birman, a physics professor at City College and City University of New York, said that three senior Russian scientists he had invited to a conference in Boston were unable to attend because their visas were not processed in time. Birman added that while many physicists understand the importance of applying for visas as soon as possible, it can be impossible to invite foreign colleagues and offer them a guaranteed travel allowance any sooner than two months before the conference begins.

"A number of people pointed out that it makes foreigners not want to come to the states," he said. "I'm really concerned that important conferences might not be held here in the future, because who needs this kind of hassle?"

CHAIRS, *from page 1*

search and communication skills to undergraduates. On June 7, in a special session, conference participants heard from Presidential Science Advisor Jack Marburger and Director of the Department of Energy's Office of Science Raymond Orbach.

Several of those who attended the conference took advantage of being in the nation's capital and spent one day visiting with their Congressional representatives. The visits were organized by the APS Office of Public Affairs, and participants were provided with briefing materials and other information to assist them in conveying their interests to Congress. They predominantly focused on the issue of improved funding for science research through the NSF and the DOE Office of Science. In particular, they asked senators to support the Senate version of the recently approved House resolution [H.R. 4664] that authorizes the doubling of NSF's funding over the next five years [See *APS NEWS*, July 2002]. For the Office of Science, department chairs lobbied on behalf of a 17% increase in funding.

Chris Stanton, who chairs the physics department at the University of Florida, talked to staffers for both of his senators and his Congressional representative, and found them to be professional, educated about the issues, and receptive to his input. "The physical sciences need to do a better job getting their message across to Congress," he says. "It's easy to assume someone else will do it, and the APS Washington office has been doing a terrific job, but I think it's important enough that we department chairs/members should begin assuming responsibility for it ourselves."

Robert Jacobsen, acting physics department chair at the University of California, Berkeley, admits to some strong skepticism about the potential impact of participating in Congressional visits. OPA staffers pointed out that as few as eight visiting constituents is considered significant contact for any Congressional office. And it quickly became clear to Jacobsen that the staffers welcomed his input.

Besides being skeptical, Jacobsen admits he was a bit nervous about dealing with a Congressional office for the first time. "I had impressions of grand old men in suits, and I don't even own a suit. But nobody I talked to was over 25," he says. He compared the experience to a college seminar in which the students "are genuinely interested in the subject, but they don't have time to do lots of homework."

APS members who would like to arrange a visit with their Congressional representatives should contact the APS Office of Public Affairs, 202-662-8700, opa@aps.org.

BOHR-HEISENBERG, *from page 3*

leave his family behind, since it would have been impossible to gain permission to take them abroad at that late date. Restrictions on foreign travel had become very tight. Furthermore, he may well have thought that he might be called upon by the US to help develop a nuclear bomb that would threaten his homeland.

Fermi not only had some 15 years of experience living under a dictatorship led by individuals with the same mentality as the Nazi leaders, but had by nature or acquisition developed appropriate "street smarts" that enabled him to understand exactly what was at stake. Heisenberg possessed neither the experience nor the gifts of insight that Fermi did. He was guided by a code, probably closely related to that of his patriotic family, which demanded that he go back and support his country and possibly save some of the residual scientific structure in Germany. The result was a disaster for which he paid a great personal price. He accomplished essentially nothing except perhaps to keep a small group of scientists sufficiently engaged in practical work to remain free of army service, although late in life he devoted much time and effort to science and public policy, particularly with regard to the changing course of the German educational system in the mid 1960s.

Events took a very different turn from that which Heisenberg anticipated in September of 1941. He emerged from the war a very chastened individual. During Heisenberg's visit to Fermi in the US shortly after the end of World War II, a graduate student remarked, "It's hard to believe that guy ever did anything important." Fermi admonished him sharply, saying, "You should have seen him at the peak of his creative period."

During the course of a long and distinguished physics career, Frederick Seitz was President of the APS in 1961, President of the N.ational Academy of Sciences from 1965 to 1968, and President of Rockefeller University from 1968 to 1978.

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have already been disproven by experiment.

Intelligent design makes assertions that cannot be tested by experiment. Those assertions that can be tested, say about blood clotting or the claimed irreducible complexity of various components of cells, seem to have thus far failed those tests. So intelligent design does not belong in a science class. End of story. Nevertheless, recently the Ohio State School Board felt it necessary to run a hearing on evolution vs. intelligent design in a debate format, with two proponents of evolution to face off against two advocates of intelligent design in Columbus.

One might think that I would know better than to agree to participate in such a debate. But I did, because I felt the education of schoolchildren in Ohio was so important. Nevertheless, I tried to learn from my earlier mistakes. Merely having a debate inevitably suggests that each side has some credibility. As a result, opponents of the scientific method like creationists try very hard to appear in debates with scientists. Merely being on the same stage represents a victory!

I made sure that I emphasized this intrinsic inequity in my opening remarks in Columbus, and it colored much of the subsequent discussion, as well as the later reporting of the event. I do not know whether it was sufficient to let listeners focus on whether there was really anything worth debating in the first place. But it at least allowed for that possibility.

In the meantime, for those scientists who find themselves thrust in such public debates, I have found at least one useful tool. When debating UFO experts, ask them whether they believe in Young Earth Creationism. When debating young earth creationists, ask them whether they believe in alien UFO's. When they say no, ask why. Their answers will inevitably shed light on the weakness of their own positions.

Of course, as has once happened to me, you might find yourself debating a UFO-believing creationist. But you can't win them all. My hope is that you can win at least some of the time.

Lawrence M. Krauss is chairman of the physics department at Case Western Reserve University and the author of the bestselling book, The Physics of Star Trek. *His most recent book,* Atom: An Odyssey from the Big Bang to Life on Earth…and Beyond, *was published in Spring 2001.*

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BELTWAY, *from page 1*

president of Stanford University, stood accused of paying for a university yacht with federal research dollars. And in 1994, Nobelist David Baltimore, former President of Rockefeller University, was forced to resign his post under the cloud of alleged falsified research that he had published with MIT collaborator Thereza Imanishi-Kari.

Back then, if you were an academic scientist, you often had a fair bit of explaining to do before Washington officialdom welcomed you in. Three years ago, the national laboratories also took a hit, following the indictment of Los Alamos physicist Wen Ho Lee on charges of espionage. So it's no surprise that industrial leaders had the ear of the White House throughout the 1990's when it came to matters of science and technology.

Today, the tables are turned. Policy makers increasingly are viewing the universities and the national laboratories as crucial players in the war on terrorism. Add to this their role in fighting disease, promoting economic growth and training the 21st century workforce, and you have a case that officials at both ends of Pennsylvania Avenue find compelling. This year's congressional action underscores just how compelling the case is.

Assisted by a member of the science community, congressional advocates moved the National Science Foundation doubling bill through the House of Representatives in June. The bill, H.R. 4664, cleared the House by an overwhelming margin of 397 to 25. And President Bush is expected to sign the legislation into law following Senate action. (It certainly didn't hurt that APS members sent more than 4,000 letters to the Hill while the bill was pending.)

Similar legislation for the DOE Office of Science is still under consideration, but the outcome is less certain. It is tied up by the comprehensive energy bill, H.R. 4, that contains several controversial provisions, among them oil drilling in Alaska and electricity regulations upon which House and Senate conferees have strong differences.

It's not clear whether the political parties will want to enter the November elections bashing each other over the failure to pass an energy bill or whether they will see it in their self interest to excise the controversial portions and claim joint victory on the rest. But it's clear that industry's ability to influence the outcome is diminishing with every revelation of corporate abuse.

THE BACK PAGE

Engaging Cuban Physicists Through the APS/CPS Partnership

By Irving Lerch

In his reflections on Cuban physics below, Marcelo Alonso urges APS to take steps to promote interactions between Cuban and US physicists. As an introduction to Marcelo's essay, this note will summarize past and current activities.

After a prolonged period of political estrangement, we have actively engaged colleagues in Cuba in a number of collaborations over the past two years. In many ways, this joint effort mirrors the APS policy of engagement pursued during the Cold War with the physics communities of the USSR and China. But scientific communications with the Soviet Union and China were not hampered by extraordinary legal impediments such as the economic embargo levied against Cuba in 1960. Nonetheless, this past April, more than 30 US medical physicists participated in an international congress in Havana (International Conference in Medical Physics, April 8-10, 2002) and many more are expected to attend the VIII Inter-American Conference on Physics Education to be convened July 7-11, 2003, in Havana.

The policy that underlies this relationship was enunciated by the APS Council in 1989 with a "Statement on the International Nature of Physics and International Cooperation," which, while advocating the rights of physicists, strongly promoted open international exchange (see http://www.aps.org/statements/89.2.html).

With not much more than 11 million people on an island smaller than Pennsylvania, Cuban physicists were little in number, known to colleagues in Latin America and the Soviet Bloc, but practically unnoticed in the US.

In the early '90s, during Ernest Henley's Presidency, the APS made a commitment to invigorate its ties with colleagues in Latin America and embarked on a series of initiatives to include the organization of joint Canadian-Mexican-US physics meetings called CAM(Canadian Association of Physicists, American Physical Society, Sociedad Mexicana de Física). These, in turn, led to regular meetings with the Federation of Latin American Physical Societies, a consortium of 17 national physical societies.

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It rapidly became clear that notwithstanding Cuba's size, the island's intellectual community was a major presence in Latin American science. Cuban physicists often took up residence in the universities and labs of the larger countries of Latin America, Spain, France and Russia. And gradually, growing numbers of Cuban students and scholars began coming to the US.

At the April, 2000, APS meeting in Long Beach, California, the President of the Cuban Physical Society, Victor Luis Fajer Avila, was invited to attend a discussion on future APS/CPS collaborations with the officers of the Society and an agreement was made to organize joint meetings in Cuba. In May, a Reciprocal Member Agreement was signed by the two societies exchanging some privileges. By the following year, the two societies had agreed to hold joint meetings on medical physics and physics education and both Bernd Crasemann (then Chair of the Committee on International Scientific Affairs), and I participated in an international conference in Havana in early June, 2000, and met with the Board of CPS and officers of the Cuban Academy of Sciences. At these meetings we finalized the procedures to be used to facilitate accelerated contacts between the two communities.

To limit the impact of the embargo, we agreed to exploit that portion of US law that promoted intellectual and cultural exchange sponsored by international organizations of which both Cuba and the US were members (although the law specifies that the organization may not have its headquarters in either country). Thus IUPAP sponsorship—to include the sponsorship of most of the other international disciplinary unions—was a viable means for promoting scientific relationships.

The success of the medical physics conference (supported by the International Union of Physics and Engineering Sciences in Medicine and the International Organization for Medical Physics) prompted the Brazilian physics community to offer to host a second meeting and it is likely that the series will continue. Since the Inter-American Conference was due to be convened in 2003, the Council of the conference readily accepted Cuba's offer to hold the next meeting in Havana (and the organizers have applied to IUPAP for sponsorship). But we have not been nearly as successful in meeting Marcelo's other demand that a way be found to increase Cuban participation in APS meetings. Funding continues to be a significant obstacle.

I was first scheduled to arrive in Cuba on October 28, 1962, by parachute from a C123 troop transport. History intervened and made me wait almost 4 decades.

It was well worth the wait.

Irving Lerch is Director of International for the APS.

The Current State of Physics in Cuba: A Personal Perspective

By Marcelo Alonso

After 40 years of absence I returned twice to Cuba, in January and December of 2000, to participate as a guest lecturer in two international scientific meetings. The first dealt with Physics Education, and the second with current issues related to Quantum Mechanics. In addition to a few participants from Europe, US and Latin America, the two meetings were well attended by Cuban physicists.

International meetings are very useful for Cuban physicists, whose travel possibilities are limited unless financed by foreign sources, and thus offer them the opportunity to interact with foreign colleagues. For me the meetings were very helpful because I could talk at length with several Cuban physicists, allowing me to get first-hand information about physics education and research. Both have changed during my absence. Prior to 1959 there were three official universities, Habana, Central and Oriente, and one private, Villanueva. Now there are several official universities, polytechnic institutes and pedagogical institutes, so higher education is much more diversified. Only two universities in Cuba offer a degree in physics: the University of Habana, in Habana, and the University of Oriente, in Santiago, although other universities offer physics courses for students of Chemistry, Engineering, Biology, etc.

On both occasions I was able to visit the University of Habana, where I had been professor of Theoretical Physics until 1960. The main campus, on a hill, with neoclassical architecture, remains the same except that the use of some buildings has changed because the academic structure of the University has also changed. Unfortunately the buildings are not well maintained, but that is a general problem in Cuba.

I found that since my time the physics curriculum in the University of Habana has been reorganized substantially and the academic staff expanded considerably. The Faculty of Physics, headed by a Dean, consists of three Departments: General Physics, Theoretical Physics, and Applied Physics, with a total academic staff of 69 persons with about 40 holding a PhD. The Faculty offers a 5-year "licenciado" which has a level between bachelors and masters degrees in the US. Beginning with the third year, students must work in some laboratory, and at the end of the 5th year students must submit a thesis in order to obtain their diploma. Masters and PhD. degrees are also offered, that are to a great extent comparable to the US. At least a Masters degree is required to teach in a University. My general impression is that the physics students (currently about 100) and the staff are very well prepared, in spite of severe limitations in resources (equipment and library).

> *"An important difference with the US is that ALL students when they finish secondary (high) school have taken physics."*

In many cases students can take graduate courses or do their Masters or PhD. thesis in some of the research institutes that operate under the Academy of Sciences, such as the Institute for Cybernetics, Applied Mathematics and Physics (ICIMAF) and the Advanced Institute for Nuclear Science and Technology (ISCTN) that offers 5-years "licenciado" and PhD degrees in Nuclear Physics and in Nuclear Engineering.

In addition to the two universities and research centers offering advanced physics degrees, there are 16 Higher Pedagogical Institutes that offer a 5-years "licenciado" degree in Education with specialization in Physics Education. This degree is required to teach physics in secondary schools, although university physics students must take courses on the pedagogy of physics, just in case they decide to teach.

Marcelo Alonso

After graduation a student must work up to two years in some government research center or equivalent (social work). In addition to the physics courses, students must take courses with social and political content, a tradition inherited from former Soviet universities.

During the period of Soviet influence in Cuba, from the early 60's until the demise of the Soviet Union, many Cuban scientists were trained in Russian centers, mostly in Moscow and St. Petersburg (formerly Leningrad), as well as in some East European countries, such as Hungary. The Cuban scientific establishment was patterned after the Soviet organization of science, with universities and technological institutes providing mainly scientific and engineering education, and most of research done in specialized governmental institutes operating under the Cuban Academy of Sciences, the Ministry of Science, Technology and Environment, or other government agencies. This structure still exists.

In a centrally planned and operated economy as is the Cuban system, all job opportunities are in governmental institutions. To be considered for a position (research and teaching) in a university, the "licenciados" in Physics must have graduated with an average of at least 4.0 points out of 5.0, and must take advanced courses related to pedagogy in the areas in which they will teach. Cuban physicists work in research centers of the Ministry of Science, Technology and Environment and other government agencies, in hospitals and biomedical research centers, and in industrial and technical services. The main fields in which Cuban physicists work are (1) optics, lasers and spectroscopy, (2) condensed matter and materials physics, (3) electronics and computation, (4) non-conventional energies, mostly solar, (5) biophysics and medical physics, (6) geosciences, (7) theoretical physics (complex systems, cybernetics, particle physics, field theory, etc.) , (8) nuclear physics, (9) teaching, and (10) physics education research at all levels. In some instances it is a combination of fields.

Currently there are in Cuba about 1600 physicists, of which about 180 are PhD's, and about 700 are engaged in research. The Cuban Physical Society has about 500 members, and publishes the Cuban Journal of Physics, three issues per year. Other technical journals, some of popular nature as "Energy and You" (Energia y Tu) published by CubaSolar and "Nucleus" published by the ISCTN, are available. Beside research, physics education at all levels receives special attention and several semi-popular journals have that orientation.

An important difference with the US is that ALL students when they finish secondary (high) school have taken physics. In elementary school students start taking science courses, with some physics content, in the third grade. However physics as an "obligatory" course for secondary (high) school students is taught in grades 7 through 12. All physics teachers in secondary schools must be "licenciados" in Physics Education, graduated from a Higher Pedagogical Institute. Thus in spite of possible deficiencies in laboratory and computing equipment, secondary (high) school graduates are much better prepared in physics (as well as in mathematics and other subjects) than their counterparts in the US.

If I am asked what is the best way to help physicists in Cuba, I would recommend as the first priority to establish a modest fund to invite Cuban physicists to attend conferences and seminars in the US, and to teach one semester courses or work with a research group in US academic institutions. Considering how inexpensive travel is between Miami and Havana ($300 round trip) I assume that the amount needed per individual physicist would be of the order of $2,000 to $5,000 depending on the place and length of stay. Organizing seminars in Cuba, in which US physicists would participate, is my other priority. I hope very much that funds for these two purposes can be found.

Marcelo Alonso is Principal Research Scientist (retired) at the Florida Institute of Technology in Melbourne, Florida. He has served as the Director of Science and Technology for the Organization of American States. A somewhat expanded version of this article will be published in the 2002 newsletter of the APS Forum on International Physics later this year.

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.