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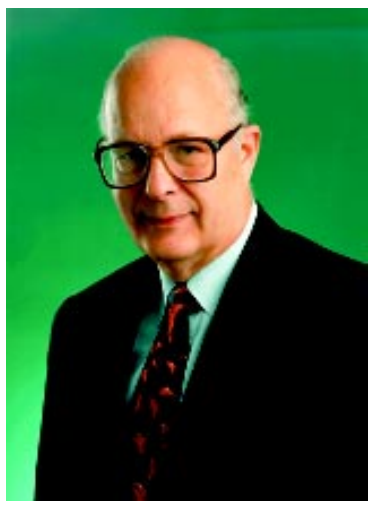
State Department's Neureiter Meets with APS Executive Board

The US State Department is poised to improve its languishing science and technology component, but it needs input and advice from the scientific community to realize its goals, according to Norman Neureiter, the newly appointed science and technology advisor to Secretary of State Madeleine Albright. Neureiter was an honored guest at a dinner for the APS Executive Board in November in Washington, DC.

"The issue is market development, to put it in corporate terms," he told the assembled Board members. "I've got to build a market inside the department for science and technology-related counsel and advice, so we can have this superconducting link between the scientific community and the heart of the State Department."

Neureiter's appointment is the result of a report by the National Research Council (NRC) released in October 1999, entitled "The Pervasive Role of Science, Technology and Health in Foreign Policy: Imperatives for the Department of State." The report was sharply critical of the absence of science and technology advice in the State Department, and Secretary of State Madeleine Albright quickly acknowledged the need for greater S&T expertise in her department. "Today there can be no question about the integral role science and technology must play in our diplomacy," she said in a May 15 memorandum outlining the Department's strategy for remedying the situation. "Whether the issue is countering weapons of mass destruction, dealing with infectious diseases, or expanding the global economy while protecting the global environment, if we are to get our international strategies right, we must get our science right."

The State Department is implementing most of the NRC's recommendations, chief among them being Neureiter's appointment as science and technology advisor to the secretary of state. Neureiter is charged with leading a Department-wide effort to ensure that science, technology and health issues are properly integrated into US foreign policy. Albright also reestablished a Science Directorate within the Bureau of Oceans, International Environment and Scientific Affairs (OES), and is requiring all regional and policy bureaus to designate a deputy assistant secretary responsible for science and technology based issues. "In a world being transformed by technology, good science is vital to good diplomacy," she said.



Norman Neureiter

Neureiter was sworn in as science and technology advisor on September 19, and since then has spent a considerable amount of time acquainting himself with a government environment that is vastly changed from that of his early years of diplomatic service. "The bureaucracy is frightful, the computer system is antiquated and the security regulations are a little suffocating," he admitted during the Executive Board dinner. "It's a difficult system in which to accomplish things."

Unlike multinational corporations, which are merging at unprecendented rates, Neureiter reports that the political world seems to be divesting into an increasing number of small independent countries, driven by ethnicity and nationalism. Simultaneously, there are major emerging global issues, such as the environment, economic challenges, and the role of the Internet, much of which are based on technology. "This is the foreign policy agenda of the 21st century, and we need people who can deal with this agenda," he said. He is already working with a science education specialist to include more science-related questions on the foreign

See NEUREITER *on page 6*

APS Establishes New Industrial Fellows Program

In partnership with several industrial research organizations, the APS and its Forum on Industrial and Applied Physics (FIAP) have created a new industrial fellowship program for APS members who are on the faculty in physics (and closely related) departments. According to James Kaufman of IBM Almaden Research Center, Chair of the FIAP Executive Committee, the program is aimed at strengthening the ties between US industry and academia, enriching the experiences of faculty members and ultimately enhancing physics education.

"It is hoped that faculty fellows will bring new skills and knowledge to the host company and help participating hosts enter new areas of research, and develop new ties with academia," says Kaufman. Several leading industrial research laboratories are already committed to participating in the program, including Bell Labs/Lucent Technologies, Dow Corning, Agilent Technologies, Ford Motor Company, IBM, Motorola, HRL Laboratories, and Schlumberger-Doll. The diverse research opportunities available at these companies include advanced electronics for communications, test and measurement, materials, compound semiconductor devices and processes, novel algorithms and code, microfludics, optics, ultrasonics, and X-ray physics, among other specialized areas.

For its part, the APS has created an on-line tool for interested industrial companies to register their participation and to post industrial fellowship opportunities. Applications from interested faculty members can be submitted on-line and screened by the APS to ensure validity. All decisions regarding fellowship offers will be made by the industrial sponsor, which will also be responsible for the salaries and expenses of participating faculty members.

For more information about the APS Faculty Industrial Fellow program and instructions on how to sign up, see http://www.aps.org/industrialfellow/index.html.

Council Authorizes Boost-Phase NMD Study

At its November 19 meeting, acting on the recommendation of a special advisory committee, the APS Council unanimously decided to sponsor a study focusing on the technical issues related to a boost-phase missile defense system. But the study will not get underway until suitable leadership can be found, and will require significant external funding as well.

The motion passed by Council reads as follows:

"That the APS go ahead with the study as proposed by the advisory committee upon:

a. identification of appropriate and willing leadership, and

b. identification of funds sufficient to support the study. If necessary, a contribution by the APS of about $50,000 would be acceptable.

This APS study will concern itself only with the technical feasibility of proposed missile defense systems. In sponsoring this study, the Society takes no position with regard to the wisdom of deployment."

A boost-phase intercept system would seek to destroy the missile during the first minute or two after launch, while the rocket engines are still turned on. The advantage of such a system is that the target is a single rocket, and not a confusing array of warheads and decoys that could be encountered by a mid-course interceptor. The disadvantage is that extremely rapid detection and response are required to effect the interception.

The advisory committee, chaired by Frederick K. Lamb of the University of Illinois, recommended a study of the boost-phase system for several reasons, among them: Basic physical principles can play a significant role in answering the relevant questions; proposals for a boost-phase system are under active consideration (see, for example the Back Page article by Senator John Kerry (D-MA) in the August/September *APS News*); and since the boost-phase option has received less scrutiny than the mid-course system, the APS study can have a greater relative impact.

The committee also recommended strongly that the study be unclassified, in part because only in this way could one hope to complete the study in time to influence the decision-making process, which the committee estimated at nine months. The committee stated its belief that "an unclassified APS study of boost-phase intercept would have a very high degree of credibility because… of the very strong reputation the APS has for conducting careful, objective, and rigorous studies of technical issues." An example is the APS study on the "Science and Technology of Directed-Energy Weapons" that was co-chaired by N. Bloembergen and C. K. N. Patel, published in 1987 (see http://www.aps.org/public_affairs/popa/list.html#ST).

Other members of the Advisory Committee on NMD in addition to Lamb were: John F. Ahearne, W. R. Frazer, Steve Koonin, Kumar C. Patel, Roberta P. Saxon, Jeremiah D. Sullivan, and, ex officio, James S. Langer, George H. Trilling, and Judy Franz.

APS April Meeting Returns to Washington, DC in 2001

The APS April meeting returns to the nation's capitol in 2001, featuring a special theme of Physics of the Universe. The meeting will run from April 28 through May 1 in Washington, DC, and will include invited and contributed sessions on a broad range of topics, including nuclear physics, astrophysics, particle physics, gravitation, international affairs, education, history, and science policy.

Chief among the program highlights is the much-anticipated initial report of the National Research Council Committee on the Physics of the Universe (CPU), entitled "Connecting Quarks to the Cosmos: Scientific Challenges for the New Century." (see *APS News*, July 2000) CPU chair Michael Turner (University of Chicago) will present the committee's Phase I report at a special session discussing the most timely opportunities in this rapidly developing and very active area of research. The session will begin the process of collecting input from the scientific community for Phase II of the committee's task, which is to evaluate and prioritize projects that address science at the intersection of physics and astronomy. Turner and other CPU members will be on hand to respond to questions and

See APRIL MEETING *on page 3*

HIGHLIGHTS

Council Passes Statements on Energy, Education and Protection from Discrimination

These can be viewed on-line at http://www.aps.org/statements (Statements numbered 00.5, 00.3 & 00.4)

Photo by Martin Blume/APS

3 ***Q&A with Trilling***
APS President George Trilling outlines goals for APS.

"Members in the Media"

Editor's Note: This is the second installment of our "Members in the Media" feature in which we highlight appearances by our members in the popular press. We welcome submissions by our readers of relevant quotations (email: letters@aps.org).

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"We could not move much from the status of uncertainty. And since the next step is so expensive, we had to stop at this point."

—Luciano Maiani, Director-General of CERN, commenting on the closing of the LEP collider without confirming the discovery of the Higgs boson, BBC News, November 8, 2000

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"It's like filling a room full of Ping-Pong balls and then driving your car through them. It's not the most effective way to stop your car, but it does work."

—Gerald Gabrielse, Harvard University, on his experiment to make anti-hydrogen, Dallas Morning News, November 6, 2000

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"At first I was a little nervous that it would turn the fans off. But I couldn't resist the chance to talk about my favorite subject. Plus, here I didn't have to grade tests or give homework."

—Tim Gay, University of Nebraska, on his Football Physics videos, shown at half-time at Nebraska home games, People Magazine, December 4, 2000

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"We have a very good understanding of our world, but we know this understanding is not final. We really want to get deep into the essence of …how nature works."

—Marcela Carena, Fermilab, on building the next generation of colliders, New York Times, November 21, 2000

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"There's at least a dozen approaches to fusion in the world right now, but each one has its flaws. What's so interesting about this is we don't have to invest a huge amount of resources. The whole experiment is a kind of convergence of 20 years of research that has found ways to move metal fast."

—Glen Wurden, Los Alamos, on "fusion in a beer can", Albuquerque Journal, November 25, 2000

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"We try to offer well-taught introductory courses, to encourage effective mentoring, and to integrate new students into departmental activities. Another component is engaging them in significant undergraduate research experiences."

—R. Steven Turley, Brigham Young University, on why BYU awarded the 2nd most bachelors degrees in physics nationwide, The Daily Universe, November 13, 2000

Latest Research in Micro-Fluidics Highlights DFD Meeting

The burgeoning field of microfluid dynamics, which holds enormous potential for commercial applications, was a major focus of the annual fall meeting of the APS Division of Fluid Dynamics (DFD), held 19-21 November 2000, in Washington DC. Micro-fluidic dynamics is a key enabling factor in the miniaturization and integration of multiple functionality for chemical analysis and synthesis in handheld microdevices, which require efficient methods for transporting ultrasmall volumes of liquid through networked arrays.

The majority of such devices combine micromechanical and electric field driven methods for controlling flow in closed channels. However, researchers at Princeton University recently introduced a non-electronic means of flow control especially well suited to the construction of a chemical reactor on the surface of an integrated circuit. The design relies on thermocapillary transport of liquid streams or droplets on a surface produced by micropatterning a self-assembled monolayer. The chemical patterning confines the flowing liquid to selected pathways bearing a streamwise thermal gradient. Eventually, the researchers hope to use micropatterned temperature fields in differential mode to route liquid along selected pathways, and in absolute mode to induce chemical reactions at electronically addressable sites

At the University of California, Berkeley, researchers have

See DFD MEETING *on page 6*

This Month in Physics History

January 28, 1986: The Challenger Explosion

On January 28, 1986, the nation eagerly awaited the launch of Space Shuttle Challenger, NASA's pride and joy, in an historic flight: its crew included high school teacher Christa McAuliffe, the first non-astronaut citizen to be launched into space. But a mere 73 seconds into the flight, Challenger made a different kind of history. As millions of Americans watched, it burst into flames, killing all seven crew members, making it the worst space disaster ever.

Image from http://www.stlcop.edu/~johnpais/challenger/challenger.html

Investigators viewing slow-motion replays of the shuttle just before the explosion witnessed a jet of flame shooting out of the side of one of the solid rocket boosters, burning straight into the side of the main fuel tank, causing it to explode. During Congressional hearings before the Rogers Commission assigned to investigate the tragedy, it was revealed that the technical problem lay with the rubber O-ring seals between the rear-most segment of the shuttle's right-hand solid rocket booster. The seals were intended to prevent hot exhaust gases from escaping, but because of a design flaw, they were dangerously sensitive to low temperatures. The night before the launch had been a cold one, and frost had formed on the O-ring in question, freezing it and making it brittle. A jet of hot gas escaped through a crack in the O-ring, piercing the main fuel tank in a fraction of a second. The liquid hydrogen and oxygen mixed and exploded, destroying the shuttle instantly.

The highlight of the Rogers Commission hearings was the testimony of Nobel-Prize-winning physicist Richard Feynman, who, frustrated by witnesses' vague answers and slow bureaucratic procedures, conducted an impromptu experiment that proved key to the investigation. He dunked a piece of the rocket booster's O-ring material into a cup of ice water, memorably demonstrating how it lost all resiliency at low temperatures and removing all doubt as to the technical cause of the explosion. In the commission's final report, Feynman accused NASA of "playing Russian roulette" with astronauts' lives.

That caustic observation was sparked by a more alarming finding of the commission: namely, that the safety reporting system at NASA was so weak that the commission termed it "silent", and that the agency's management structure suppressed pre-launch warnings that could have prevented the tragedy. Thiokol Corporation, the company that designed the O-ring, first discovered the flaw in 1977 and reported it to NASA, but the commission in charge of the shuttle project ignored the report, even after significant erosion to the O-rings was discovered during shuttle flights in 1981.

In the wake of the Challenger disaster and subsequent commission report, NASA invested $2 billion in nearly 400 improvements before the first post-Challenger shuttle flight on September 29, 1988, seeking to upgrade equipment, enlarge its safety corps, and inject new accountability into shuttle management. Of these, the most significant change was made to the solid rocket boosters: an internal metal latch was added, along with a third rubber O-ring and a reconfiguration of the insulation, each intended to prevent the escape of combustive exhaust gases from the side of the motor. And the seals were equipped with electric heaters to keep the O-rings from becoming brittle in cold temperatures and losing their sealing capability.

The shuttles were also equipped with a rudimentary escape system permitting a crew to bail out if faced with the prospect of ditching in the ocean. New latches to prevent a premature interruption in fuel flow to the main engines were installed in the fuel lines, the brakes and steering controls were improved, and a drag chute was fitted to the tail to increase control during high-speed landings. Many of the tiles protecting the shuttle from the heat of re-entry were replaced with larger, more durable insulation blankets. Finally, the mission management team responsible for overseeing the countdown, launching and flight operations now included NASA safety personnel and representatives from the major contractors involved in each flight.

NASA had the chance to prove it had learned its lesson in the summer of 1995, just prior to the scheduled August 5 mission of shuttle Endeavor. Thiokol alerted NASA that its inspectors had discovered pencil-point-sized scorch marks on nozzle O-rings recovered from two consecutive shuttle launches — evidence that hot exhaust gases had strayed dangerously within the booster nozzle. This time, NASA responded by postponing the mission until Thiokol scientists could correct the problem. Endeavor launched safely on September 7.

President Reagan, in his address to the nation the night following the Challenger tragedy, called the lost crew members "pioneers" in our continued efforts to explore and master space, and specifically addressed the nation's schoolchildren. "I know it's hard to understand that sometimes painful things like this happen. It's all a part of the process of exploration and discovery, it's all a part of taking a chance and expanding man's horizons," he said. "The future does not belong to the fainthearted. It belongs to the brave."

Birthdays for January:

1 Satyendranath Bose (1894)
8 Stephen Hawking (1942)
22 André Marie Ampère (1775)
Lev D. Landau (1908)
23 David Hilbert (1862)
Hideki Yukawa (1907)
25 J. L. Lagrange (1736)

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Trilling Outlines Challenges, Priorities for APS in a Time of Change

Editor's Note: George Trilling, Professor Emeritus at the University of California, Berkeley, and Faculty Physicist at the Lawrence Berkeley National Laboratory, assumed the APS presidency on January 1, 2001. In the following interview, he outlines his prevailing concerns and priorities for the Society as it enters the new millennium.

Q *What do you see as the primary challenge facing the Society in 2001 and beyond?*

A The APS must continue to pursue its objective of "the advancement and diffusion of the knowledge of physics" in a world in which the rapid progress of information technology leads to new challenges and new opportunities. The pursuit of the above goal requires more than communication among physicists through journals and meetings: it requires communication between the physics community and the public, and between the physics community and government officials. It also requires attention to many other issues, such as science education, international relationships, etc.

Q *How is the APS responding to the rapidly changing environment for the publication of scientific journals?*

A This was well discussed by [APS Past President] Jim Langer in the August 2000 *Physics Today*. Our journals, with a 70% input from abroad, are a premier vehicle of communication in physics. Major changes are occurring, among them the move to an all-electronic publication process to reduce costs. The Society has also undertaken the preservation of an archive (traditionally the province of librarians) as we move away from print, along with a move to a different model of pricing subscriptions: a multi-tier system based on expected average level of usage. Finally, this year saw the establishment of on-line virtual journals in specialized areas (biological physics and nanoscale science and technology). The APS journals represent our largest financial activity, and the challenge will be to keep that enterprise financially viable while maintaining quality and accessibility. Fortunately our Editor-in-Chief, Marty Blume, and Treasurer, Tom McIlrath, are doing an outstanding job in this regard.

Q *What do you see as the Society's role in terms of public policy issues?*

A First and foremost, we need to inform the public and the government of the importance of scientific research, and the necessity to support strongly a broad portfolio of programs through several funding agencies. The nation needs to invest in the research that will sustain health, security and economic prosperity in the future. Even sustaining any one area such as health, requires scientific efforts over a broad range of disciplines including physics. Unfortunately the federal support of physical science in recent years has not been as strong as needed to maintain a healthy research enterprise, and we need to try our best to rectify this situation.

We must also keep reminding government that many of the issues on which it must make decisions (such as missile defense, arms control, environmental concerns, foreign policy issues) require, for their wise resolution, considerable involvement of scientific and technical expertise. Such decisions must be based on sound science. The recent appointment of a Science and Technology Adviser to the Secretary of State is very much a step in the right direction.

Q *Physics education remains an important component of the Society's outreach activities. How is the APS expanding its efforts and involvement in this area?*

A Promoting the advancement and diffusion of the knowledge of physics includes trying to improve the quality of science education. Many members of our Society have personally involved themselves in this effort through classroom visits, participation in school boards, running in-service teacher workshops at their institutions etc. The APS Education Department has recently focused on an ambitious program aimed at the improvement of elementary and secondary school science education, to respond to two major needs: i) developing enough motivated and well-prepared graduates of our school system to ensure an adequate supply of future scientists to maintain the health of our research effort, and ii) preparing the general public for a world in which science and technology are playing an increasingly important role.

The Education Dept. under Fred Stein, in collaboration with AAPT and AIP, is developing an ambitious new initiative to improve undergraduate college courses and curricula aimed specifically at future K-12 science teachers. If successful, this program may lead not only to better trained and motivated science teachers, but also may stimulate the broadening and modernization of the general undergraduate programs for physics majors.

Q *It is also important to reach non-scientists in the general public. What is the APS doing to improve public awareness of physics?*

A APS has recently set up the physics outreach web site, physicscentral.com, which I recommend that you explore. My problem is that once I go to it I find it so much fun and spend so much time that I neglect my other duties. Its numerous elements include physics news, people in physics, physics picture of the week, links to other physics sites, physics-related books, answers to physics questions etc. This is a site that should be of interest to both physicists and to non-scientists. *Physical Review Focus* is also providing physics developments aimed at a broader public than physicists. In collaboration with AIP, APS is sponsoring TV spots on physics-related topics. Finally I should mention that public lectures and Op-Ed pieces on physics-related issues provide a means for individual members to contribute.

Q *Major changes are also occurring on a global scale. How is the Society responding to those changes, and why is its presence on the international stage important?*

A Science is of course universal, and it is natural that globalization be highly relevant to current APS affairs. About 70% of our journal articles are submitted from abroad, and about 23% of our membership is resident outside the US. We have an active Committee on International Scientific Affairs (CISA), as well as the Forum on International Physics. These have close contact with Irving Lerch, head of the APS Office of International Affairs. CISA has recently made a very useful reassessment of the Society's goals in international relations, and I strongly endorse its eloquent words: "the Society should develop, support, and advance international activities for the benefit of the global physics community, without regard to political or other extraneous factors." This includes strengthening interactions among researchers in different regions, working to change government policies that hinder international collaboration in fundamental research, assisting the organization of international meetings and workshops, working to extend worldwide access to scientific information, strengthening collaboration among physical societies in different regions, and supporting the free expression of human rights everywhere.

An important new trend is that as we seek to build new and more powerful facilities, the capital costs may go beyond what any one country or region may be willing to provide. To keep moving forward, the scientific community needs global scientific planning to develop international arrangements and international financing for the construction and operation of very large facilities, somewhat as was pioneered for the Large Hadron Collider. It is politically difficult to convince governments to contribute to projects in foreign lands, and the APS may have a useful role here.

Q *In recent years, the APS has sought to develop a policy of inclusiveness within the physics community. Why do you feel this is important?*

A We need to increase our membership to include physicists who are not presently members, especially those in industry. We also need to broaden the physicist pool by encouraging more women and minorities to go into physics. Our ability to influence policy in science or in education is in direct proportion to our numbers. Our committees need the largest possible pool of physicists who are willing to participate. The wisdom of our actions can be enhanced through the input of a larger and more diverse membership. Judy Franz and her colleagues at APS headquarters have recently formed Task Forces on Graduate Student Participation and on Physicists with Disabilities, and I believe that these will help in increasing the participation of these important groups.

Q *How do you view the role of the Society's geographical sections?*

A I am delighted that a California Section has just been formed. In this last year, our APS Constitution has been changed to give sections official voting representation on the Council even as the overall membership of the Council was being reduced. The sections have an important role helping to promote the participation of smaller colleges and universities and industrial labs in the "advancement and diffusion of the knowledge of physics". They are also well placed to make contact with and inform the local members of Congress and other public officials about the value of research and scientific education, and local school boards about educational issues.

Q *Any final thoughts?*

A I believe that it is extremely important that our members be well informed about the many activities of their Society. One of the lesser known achievements of the Task Force on the Organization of the Council was to initiate the fairly expeditious communication of Council and Executive Board minutes to all the units. The *APS News* and the APS Web Site also play a major role here. I would be highly receptive to further ideas on how to improve communication among ourselves.

Photo by Martin Blume/APS

George Trilling

TARGET ON TRILLING

- Received PhD in 1955 from California Institute of Technology.
- Assistant and associate professor of physics at the University of Michigan, 1957-1960.
- Moved to University of California, Berkeley, in 1960, chairing physics department from 1968-1972.
- Served as director of the Physics Division of Lawrence Berkeley National Laboratory, 1984-1987.
- Research focus in experimental particle physics, including studies of hadron interactions and resonances, electron-positron annihilation at high energies, and colliding beam experiments.
- Served on APS Physics Policy Committee, and as chair and divisional councilor for the APS Division of Particles and Fields.

April Meeting, *from page 1*

comments from meeting attendees during the open discussion. (For more information on the CPU study, see http://www.nationalacademies.org/bpa/projects/cpu.)

In keeping with the more general nature of the April Meeting, there are nine invited plenary lectures planned. National Public Radio's David Kestenbaum will discuss bringing physics to the public, while Fermilab's Maria Spiropulu will report on the search for extra dimensions.

Other plenary lecturers will address such topics as magnetic reconnection, CP violation in B mesons, neutrino oscillations, atom wave amplification, the Chandra project, and the Boomerang experiment.

The downtown Washington locale provides an ideal setting for several sessions related to science policy, including possible appearances by science appointees in the new administration. In addition, the APS is participating in the annual Congressional Visits Day, May 1-2, and conference attendees are encouraged to stay an extra day in Washington to participate. It is a two-day annual event that brings scientists, engineers, researchers, educators, and technology executives to DC to raise visibility and support for science, engineering, and technology. (See http://www.agiweb.org/cvd, or contact Christina Hood in APS-OPA, 202-662-8700, hood@aps.org.)

Finally, a new feature at this year's meeting is the Students Lunch with the Experts, on Monday, April 30. The April Meeting Program Committee identified a broad range of scientific topics and experts on each. The experts will host an informal discussion over a complimentary box lunch with students interested in their topic. Sign-up begins on Saturday, April 28, at 1 PM, near the APS Registration Desk, and will continue on a first-come, first-served basis until all the slots are filled.

IIASA Young Scientists Summer Program 2001:

Summer Fellowship in Austria for Advanced Doctoral Students

Each summer, the International Institute for Applied Systems Analysis (IIASA) near Vienna, Austria, hosts a selected group of advanced doctoral students from around the world in its Young Scientist's Summer Program (YSSP). These students work closely with IIASA's senior scientists on projects within the Institute's three theme areas of Natural Resources and Environment, Population and Society, and Energy and Technology. The US Committee for IIASA provides airfare and a modest living allowance for the applicants from American institutions who are selected to participate. Details and application forms are available at the IIASA Website: http://www.iiasa.ac.at/ **APPLICATION DEADLINE IS 17 JANUARY 2001**

LETTERS

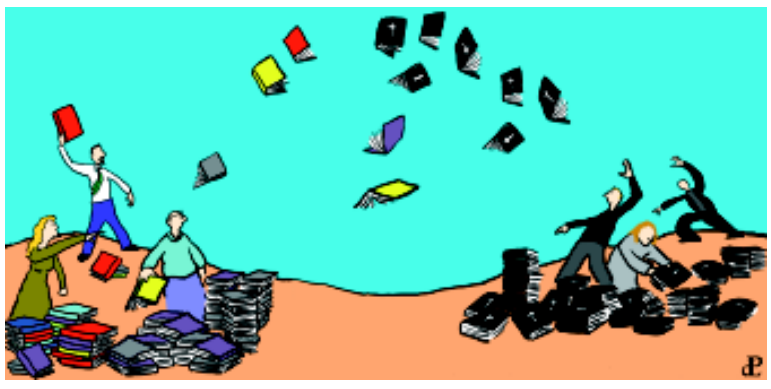
APS News Readers Respond to "Creationism Versus Physical Science"

I couldn't agree more with Stephen G. Brush's article "Creationism Versus Physical Science" (*APS News*, November 2000). As Brush points out, creationism affects not only biology but all the sciences. In fact, the infamous Kansas State Board of Education decision strips from that state's education standards not only all mention of biological evolution but also all mention of the big bang, radioactive dating, continental drift, and the age of Earth. The best response is education: teachers should include this issue in every introductory science course. Based on 30 years' experience in doing just that, I would like to recommend several pertinent topics for physics teachers.

First and foremost, teach critical thinking, including the fallacies of pseudoscience. As an irrational belief that is made to look scientific but that is not supported by scientific methods, "creation science" is a perfect example of pseudoscience. Second, teach radioactive dating as an application of nuclear physics, and present the main geological ages along with supporting radioactive and non-radioactive evidence. Third, discuss the creationists' anti-evolution argument based on the second law of thermodynamics, and the scientific reply (see Brush's article). Fourth, present big bang cosmology and the supporting evidence: the expanding universe, the three-degree background radiation, "ripples" in the background radiation, and quantitative agreement between big-bang isotope-formation predictions and observed isotope ratios in our galaxy's oldest stars. Fifth, discuss the search for and possibility of extraterrestrial life, including the hypothesis of the chemical origin of life on Earth and supporting experimental evidence. Always stress the theme of "how do we know," i.e. present lots of evidence.

I include these topics in my liberal-arts college physics course for non-scientists and can testify that, while many students disagree with some specific conclusions, nearly all students find these topics instructive, interesting, and even fascinating.

Art Hobson
Professor Emeritus of Physics
University of Arkansas



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Recently, I have found this conflict very difficult to understand. Physical Science and Creationists (indeed, religious persons of virtually every creed) agree: The Universe had a beginning. You would think that this fundamental agreement would be infinitely more significant than the relatively minor detail of just how long ago that was. It would appear, however, that Creationists are not really "Fundamentalists", as they style themselves, but rather, "Literalists", which makes all the difference.

Another example: Brush reports, "If you teach children they are descended from animals, the reasoning goes, they will assume they can behave like animals." But as he correctly points out earlier, this is the fallacy of assuming entropy increase only. What, one may ask, would the reasoning be if you teach the children that they are "ascended" from animals?

T. Goldman
Los Alamos, New Mexico

In his helpful discussion, Stephen G. Brush mentions the guilt by association between evolution and secular humanism introduced by televangelists. The televangelists I have viewed are merely objecting to the claim that evolution is an unsupervised, impersonal process (1996 Statement on Teaching Evolution of the National Association of Biology Teachers). Such a claim is a logical fallacy identified by Aristotle (350 BC). For, on the basis of evidence from the material world, evolutionists are claiming that there is no personal supervisor of evolution outside the material world. It is as though Hamlet claimed that there was no Shakespeare because he could not find Shakespeare within the confines of the play.

Finally however, in 1997, 138 years after Darwin's *Origin of Species*, the NABT deleted the two words: *unsupervised* and *impersonal* from their definition of evolution. This removal of the challenge to the supernatural should remove much of the opposition to evolution by thoughtful people.

John A. McIntyre
Texas A&M University

The notion of a Creator who brought space time and all into being is central to the book of Genesis and no scholarly exegesis can expunge that from it. Those who believe in a Creator are not all "Young Earth Creationists" as Stephen Brush implies and attacks.

Darwin meant by evolution the process whereby life arose from non-living matter and subsequently developed entirely by natural means. This is a form of scientific materialism that Freeman Dyson decries in "Science and Religion Can Work Together." (*APS News*, November 2000.) Richard Dawkins, famed author of "The Blind Watchmaker," has said that Darwin made it possible to be an "intellectually fulfilled atheist."

Scientists and teachers ought to make it clear, as Brush indicates, that evolution and cosmology are working assumptions, not established facts. Unlike physics, evolution and cosmology are sciences in the sense of forensic science. The evidence for evolutionary transition of humans from apelike ancestors is not abundant enough to conclude, beyond a reasonable doubt, that it has occurred. That is why the overwhelming majority of Americans still believe in a Creator.

The foundation of modern science was laid down by devout Christians (Galileo, Kepler, Newton, Maxwell, Planck, etc.) who studied nature to know more about its Creator. It was the extension of the evolutionary ideas of Darwin to an atheistic world view that accentuated the false antagonism between science and religion. Such mixing of science, philosophy, and theology must be openly discussed. What people object to is the teaching of an atheistic world view in the guise of science. Students of faith ought not to come out of biology classes with the notion that there is no God. Otherwise, theology and not merely biology is being taught in such classes.

Clearly everything evolves. However, it is not self-evident to me that the fundamental question of origins is a truly scientific question. If not, then the answer must be sought in the very same places where we seek answers to questions regarding meaning, values, and purpose. One must never forget that an explanation of the totality of the human experience may lie outside the realm of science.

The honest pursuit of an answer to the question of origins may lead ultimately to an Intelligent Designer. Max Planck, Nobel laureate and father of quantum physics, said: "God is at the beginning of every religion and at the end of the natural sciences." Let us not forget that our nation is founded on the creed that our freedom and unalienable rights are endowed by our Creator.

Moorad Alexanian
University of North Carolina at Wilmington

Stephen G. Brush's essay makes some good points about creationism. Unfortunately, he repeats some untrue statements about secular humanism that have been promoted by televangelists. Secular humanism is a philosophy that originated in the Enlightenment. It is based on the idea that a good, moral life can be led without the belief in a deity. The humanistic approach is that human affairs in the natural world are more important than concerns about the supernatural or an afterlife. For example, the US Constitution is a famous secular humanist document, in which the government is founded on the practical concerns and needs of citizens, rather than requiring a religious justification. Humanists base their morality on reason and compassion in a way that is consistent with scientific evidence about the world and human nature. Although there are not a large number of people who call themselves secular humanists, there are a growing number of local organizations led by the Council for Secular Humanism in Amherst, NY, publisher of Free Inquiry magazine.

William Creasy
Abingdon, Maryland

I am delighted that Professor Brush has added his name to the regrettably small cohort of physicists who take seriously the threat of creationist teaching in American public schools. As physicists, we must always bear in mind that no matter how specialized our own interests may be, science is a seamless whole. This is especially true from the point of view of teaching scientific methodology, a vital area which students too often fail to grasp. If, for example, biological evolution is "only a theory," why, then, perhaps quantum mechanics is "only a theory" as well.

I urge physicists to take heed of what goes on in their local schools. Those who wish to look into the specifics of what goes on in their home states may refer to my recent study, *Good Science, Bad Science: Teaching Evolution In The States*, The Thomas B. Fordham Foundation, Washington, D.C., September 2000. Single free copies may be obtained by calling 1-888-823-7474; the report is also posted on-line at http://www.edexcellence.net.

Lawrence S. Lerner
California State University, Long Beach

I'm always amazed at the extremes to which Creationists will go in harming science education. Yet, in so doing, I believe, they also hurt themselves if their goal is to get closer to God. As an Orthodox Jew and a physicist, let me give another perspective. One of the most famous Jewish sages and legalists, Moses Maimonides (12th century C.E. author of *Guide to the Perplexed*) explained that one very important way to get close to God is to learn and understand His creation. This means studying and uncovering the mysteries of the physical universe using the tools of science. The models scientists create in cosmology or biology may indeed be working hypotheses subject to modification as new observations are made, as Brush pointed out. But they none-the-less seek the truth and are generated using the very tools given by God to man- his mind and senses.

I'm also amazed at how limited the Creationist view of even the Bible can be. They take a simplistic English translation of an original Hebrew text and think they can make conclusions from it. Volumes of Biblical exegesis have been written trying to understand what the original Hebrew text of Genesis means at its various levels. The Jewish view has always held that the world is 5761 years old, as counted from the moment a human soul was placed in a human body.

The 13th century talmudist, kabbalist, and physician Rabbi Moshe ben Nachman of Gerona, stated that all matter and energy that composes the universe was created in the first instant of God's creation. Everything else was formed from the basic building blocks of material following the initial creation, and follows a general evolutionary trend from simple and chaotic to complex and ordered. Furthermore, says R. Nachman, time was created at the initial instance of creation, and the universe was created starting as a "small, thin, point". All this came many centuries before any Big Bang theory and while the rest of Europe thought the world was flat.

More recently, physicist Gerald Schroeder has written two books (*Genesis and the Big Bang*, Bantam Books, and *The Science of God*, Broadway Books) detailing his thesis that the Biblical version of creation can coexist in harmony with the modern standard cosmological model without having to resort to a metaphorical understanding of the first chapter in Genesis. He states that the first six Genesis days were indeed six twenty-four hour periods of time, though measured in a different reference frame, one looking forward in time rather than backward as we do now. Time, as viewed dynamically from this reference frame with its extreme gravitational potential dilating time, behaved very differently from time as measured on earth today. The two reference frames came into synch on the sixth Genesis day, when the first soul was placed in a human body. I personally would love to see his thesis written up as a paper for review in the physics community. Such a paper might help me evaluate his thesis better as well as appreciate and understand the meaning of this other preferred reference frame.

Larry Bigio
University Heights, Ohio

LETTERS

APS Should Go Metric

When is *APS News* going to embrace the metric system? The article on the physics of pole vaulting in the November 2000 issue has a mixture of inches, feet, meters, etc. If we, physicists, cannot get it right, how can we expect others to eventually do? I hope to never again see the abomination of inches, feet, and pounds in APS publications...

Carlos Wexler
University of Missouri-Columbia

More on Powers of Ten

In the Astronomy Greatest Hits (*APS News*, October 2000), you give Copernicus as the proponent of a heliocentric system. Aristarchus (about 310-230BC) had already proposed a heliocentric system. As Archimedes wrote in his book Psammites: "His (Aristarchus') hypotheses are that the fixed stars and the Sun remains motionless, that the Earth revolves about the Sun in the circumference of a circle, the Sun lying in the middle of the orbit, and that the sphere of the fixed stars, situated about the same center as the Sun, is so great that the circle in which he supposes the Earth to revolve bears such a proportion to the distance of the fixed stars as the center of the sphere bears to its surface". Archimedes disagreed with this hypotheses of Aristarchus. Even great men can be wrong sometimes.

Claudio Pellegrini
University of California, Los Angeles

Whose Famous Formula, Part II

It is true that specific cases of the mass-energy equivalence were known before Einstein's famous paper in 1905. The equation $E=mc^2$ was proposed (or implied) by Paul Langevin, Henri Poincaré, F. Hasenoehrl and others (not mentioned in the Letter by C. H. Thomson (*APS News*, October, 2000)). It is also true that Einstein derived the formula on very general grounds, as rightly pointed out by Abraham Pais (quoted in the Editorial reply). But it is equally true that Einstein's (first) derivation of the formula was based on a faulty reasoning (petitio principii), as revealed by Herbert Ives (J. Opt. Soc. Am. 41 (1952) 540). The same author argues that the first correct and generic derivation of the formula should be attributed to Max Planck (Sitz. der preuss. Akad. Wiss., Physik, Math. Klasse 13 (June, 1907)). (See, also, Max Jammer, Concepts of Mass, 1961)

Evidently, just as the now called Special Relativity was in the air around the turn of the century, so was one of the most famous formulae in physics (considered wrongly by many to be essentially an outcome of the latter). It belongs to the class of relations that connect qualitatively different entities, as the case with Euler's formula - exp[i(pi)] = - 1, or Boltzmann's (statistical) relation for the entropy.

Petar Grujic
Institute of Physics, Belgrade

Paean to Religion Ill-Placed

In the November 2000 *APS News*, Freeman Dyson asserts that science and religion are both trying to figure out why we are here. But the whys of religion and science differ. Science asks why in exploring and understanding the physical universe, while the why of religion (discounting the creationists) concerns purpose and interposes an undefinable god. Moreover, what does Dyson mean by religion? It seems to me to be what the Priests say, a domain of shifting meanings, sometimes interpreting of the mysteries of (man's place in) the world, other times trying to establish codes of human conduct. It is all about indefinable, vague, and shifting notions of god. Religion and science do not in fact address the same reality.

Furthermore, what is this infallible scientific dogma that Dyson uses as a straw man? In trying to demonstrate that neither party, scientific or religious, holds The Whole Truth, he trivializes the problems of the conflict of rationality and God. Dyson seems to resent the fact that scientific materialists scorn God, i.e., are insensitive to the religious and religion, and hence to morality. But why equate religious beliefs to morality? Moreover, it seems unfair to equate the influence of scientific materialists and religious creationists. For one thing, their numbers are vastly different, even if the media exaggerates their importance. Church and state problems are not exaggerated; school prayer and support of religious instruction are issues that challenge us everywhere.

Finally, Dyson praises the social importance of churches and temples in Princeton in creating a cohesive and healthy community. The other side of the coin can be found in Israel, Afghanistan, Turkey, and in religious conflict throughout history. It is highly questionable whether religion is the essential mortar in building a diverse, tolerant, and cohesive community.

I can't object to Dyson's desire to warn us of the possible consequences of unbridled technology upon life, and that scientists ought to consider moral issues of life and humanity. But his paean to religion as the home of a beneficent morality and sensitive humanity is ill placed.

Morton K. Brussel
Urbana, Illinois

When Something Seems Too Good to be True, It Probably Is

In a Letter to the Editor in the November 2000 issue of *APS News*, Professor Stuart Samuel informed the community that, according to a web site I choose not to identify, physicists are not only the highest paid scientists, but they earn $20,000 per year more than any other scientists.

This conclusion is grossly misleading. It is, quite simply, based on a comparison of apples and oranges.

The data were collected at the institutional level. This is a reasonable and cost effective approach to data collection. However, it does have shortcomings.

By way of example, tens of thousands of people work in the private sector with physics degrees at the bachelors, masters or PhD levels. But, very few are identified by their employers as physicists. Compound this with the fact that virtually all of those whose job title identifies them as physicists are PhDs, a few are masters and only a handful have bachelors degrees.

Compare this trend to engineering. There are well over a million people employed as engineers in the US. Most of them have a bachelors degree, about one quarter have a masters or professional engineering degree, and only a few have a PhD.

At the other extreme is the world of computer and information science. Go to the tech support group in any company in the US and compare the fields of bachelors degrees of the workers. Half or less will have bachelors degrees in computer science, systems engineering or a closely related field. Half or more will have degrees in mathematics, physics, social science, and any of the liberal arts majors including philosophy, history and religious studies. They are all paid similar salaries for similar work regardless of field of degree.

In short, when you ask employers, "how much do you pay your physicists?" they are reporting on some of the PhDs and very few lower degree holders. When you ask the same employers about practitioners in other fields, they are reporting salaries that are largely earned by lower degree holders.

The salary an individual earns is driven, to a large degree, by several factors: level of highest degree, years of experience, type of employment (academe tends to pay less than government which tends to pays less than the private sector), and the kind of work they do (e.g. job title or primary work activities). For example, physicists who are employed as engineers tend to have the same salary range as the engineers with engineering degrees working in the same sector of the economy with similar experience levels.

I have been studying the role of physics and the role of physicists in the education system and in the economy for twenty years. During that time I have come to several conclusions.

Physics is fundamental and physics is ubiquitous. Physics and physicists play a fundamentally important role. Physicists add to our knowledge base. They participate in innovation and technological breakthroughs. People with physics degrees (at any level) pursue a remarkably diverse range of professionally challenging and intellectually stimulating careers. Physicists succeed. The vast majority of people with physics degrees report that, if they had the opportunity to do it over again, they would major in physics.

Physicists are well paid. People with degrees in physics are among the highest paid of all fields. For example, people with bachelors degrees in engineering, computer science, pharmacology, mathematics and physics tend to have higher salaries than people with bachelors degrees in any other field (Monthly Labor Review, December 1995).

However, it is also important to remember that, anecdotal evidence not withstanding, physicists do NOT walk on water. During international recessions and other economic downturns, physicists suffer just like every one else.

I encourage you to sing the praises of physics and to sing the praises of physicists. But question and challenge every data source especially if that source tells you what you most want to believe.

Visit our web site www.aip.org/statistics. I am confident that it has the most accurate data and the most even handed interpretation of the trends affecting the physics community. However, I encourage you to challenge even the data that comes from my unit. We expect physicists to question our data. Your criticisms and scepticism keeps us on our toes. In addition, your questions and comments help us understand whether we have explained our research findings clearly and whether we are addressing the issues of greatest concern to the physics community. In short, we exist to serve your needs for timely and accurate data.

Roman Czujko
Director, Statistical Research Center; American Institute of Physics

VIEWPOINT…

The Moral Choice

One of the winners of the 2000 Nobel Prize in Medicine, Dr. Paul Greengard, was a physics and mathematics major as an undergraduate. When asked by a radio interviewer why he switched into the biological sciences, he said that as he was entering graduate school, in the late 1940's, the only funding for physics came from the Atomic Energy Commission, which was responsible for the atomic bombs that had recently been dropped on Hiroshima and Nagasaki. Dr.Greengard chose not to associate himself with the AEC, and went into biology instead, a career move that obviously worked out pretty well in his case.

No one will question Dr. Greengard's right to make this choice, or to couch his reasoning in moral terms. But his action evokes the stereotype of physics as the progenitor of weapons of mass destruction, and the contrasting image of biology as the science of healing and preservation of life. As physicists, we may have some disagreement with at least the first part of this dichotomy. Indeed, if we look back on the half-century that followed the resolution of Dr. Greengard's moral dilemma, we find remarkable progress in both physics and biology, and in both cases the consequences have been largely beneficial for humankind. The mass availability of personal computers, the internet, and the World Wide Web (based partly on advances that were recognized in the 2000 Nobel Prizes in Physics) have transformed our culture and energized our economy. These changes are no less profound than those wrought by discoveries in biology, especially genetics, that have grabbed so many of the recent headlines.

It has been said, by President Clinton among others, that just as the twentieth century has belonged to the physical sciences, the twenty-first will belong to biology. This is a problematic statement on many levels, but there is one sense, ironically, in which it may turn out to be true. In the twentieth century, as Dr. Greengard's decision attests, physics became fused in the popular mind with its potential for obliterating the human race. In the twenty-first, the capacity to manipulate the human genome that, on the one hand, is expected to yield such rich rewards in the battle against disease and death, may also, on the other, end up threatening the very existence of our species. The issues that have already surfaced, having to do with such things as surrogate motherhood, human cloning, and genetic engineering in the food supply, are surely just the first flickerings of an ethical firestorm that will sweep over our society in the years ahead.

One can imagine, in the not too distant future, that a young counterpart of Dr. Greengard's, contemplating the relative moral standing of the various sciences, will make a choice rather different from his as the scales weighing biology's potential for good or evil begin to tip ominously in the wrong direction.

—Alan Chodos

INSIDE THE BELTWAY: *A Washington Analysis*

Duels or Deals?

Outlook for Science Uncertain in Partisan Climate

By Michael S. Lubell, APS Director of Public Affairs

Washington scales tipped heavily toward the APS in Y2K. On three key issues, members weighed in and scored major victories. No recounts, no dimples, no missing chads, just outright wins.

On nuclear missile defense, an issue on which the APS has had a long history of involvement, President Clinton heeded the advice he received from the physics community and delayed a deployment decision. By doing so, he adhered to Defense Reauthorization legislation, requiring demonstration of technical feasibility prior to deployment, language that the APS helped craft a year earlier.

On the Spallation Neutron Source, which the House budget would have effectively killed, APS letters assisted Senate advocates in restoring funding. The SNS story and the APS role were big enough for CQ Weekly, the premier Hill journal, to feature it last summer in "Between the Lines," CQ's highlights on the congressional agenda.

But the science budget was the biggest story. At the outset of the congressional season, another 15 percent boost for NIH was the only certainty, this despite the President's request for major increases for virtually all other agencies. Budget caps, water projects, veterans programs and weaponry created a miasma that promised to suffocate science. But when the air cleared, NSF, DOE and DOD all came away with hefty gains, due in no small measure to the campaign waged by the science community in support of its House and Senate patrons.

Don't look for Y2K to be a precedent setter. The year 2001 could well be a deflator. Here's why.

During the presidential campaigns, both candidates carved out positions that severely constrain discretionary budget options. "W" promised major tax cuts that will reduce revenues in the short run, and Al committed to smaller tax cuts, compensated by big boosts for prescription drug and education programs. Fitting science into this policy landscape is a herculean task.

The political landscape offers science little solace. Lost amid the public fascination with the legal jousting over the presidential returns is the very real threat of chaos on Capitol Hill when the 107th Congress convenes. Both houses face the prospects of deadlocks, driven by the closest division of political power in American history.

Technically, the Republicans control both chambers, with a nine-vote margin in the House and with the Vice President serving as a tie-breaker in the Senate, if the 50-50 split holds up. But as a practical matter, GOP leaders will have to work across the aisle, if they are to achieve any meaningful results. Their prospects are not good. The election snarl in Florida has left both sides snarling.

In the Senate, Democrats have already threatened to tie up all legislation if they are not granted some form of power sharing, from evenly divided committees, at the least, to a sizable fraction of chairmanships at the extreme. Thus far, they have found meager support for their propositions, especially from GOP hardliners. Absent a deal, they could even hold up confirmation of a Bush administration's presidential appointments.

In the House, the dueling is apt to be worse, across party lines and within the Republican Conference itself. Democrats are howling for more accommodation. And the GOP right wing is pressing its leaders to bypass moderates and leapfrog conservatives into chairmanships.

Science fares best when deals are cut, not when duels become the norm. Stay tuned.

DFD Meeting, *from page 2*

fabricated a controllable single-bubble micro-pump, based on earlier work demonstrating that under certain conditions, thermally generated bubbles can rapidly and efficiently move fluid. In addition, a research initiative within the aerospace community is underway to study the feasibility of miniaturized "nanosatellites" with less than 1 kg of mass. These devices will require a corresponding miniaturization of the propulsion subsystem with thrust levels on the order of 10-500 uN. A team of researchers at the University of Vermont is developing a prototype MEMS-based H_2O_2 thruster capable of meeting these mission requirements.

Biofluid Dynamics

Biomedical investigators have increasingly realized that principles of fluid dynamics — especially an understanding of how hemodynamic forces and mass transport interact with the cells, proteins and molecules that constitute the arterial wall — play a major role in maintaining the health of human arteries, as well as contributing to arterial disease, according to Don Giddens of the Georgia Institute of Technology. For example, 3-D pulsatile blood flow in compliant arteries can now be described using computational fluid dynamics, with the potential to model blood flow in individual subjects. Giddens demonstrated how the local flow field can be manipulated to cause cellular proliferation in animal models, with important implications to the clinical problem of vascular grafts used to bypass diseased arteries. He also described recent fluid dynamical studies of the local shear stress on monocyte adhesion, and on expression of adhesion molecules on the endothelial cell surface.

Fluid Mechanics of the Earth's Core

Recent advances in numerical and laboratory modeling of the Earth's main magnetic field — which is induced by motions in the iron-rich liquid outer core (the geodynamo) — is revealing the fluid mechanics of the process by which the magnetic field is produced. Possible energy sources for the geodynamo include thermo-compositional convection and precession, with the former being the more likely option, according to Peter Olson (Johns Hopkins University). Olson reported that his numerical calculations of convection in rotating, electrically conducting spherical shells reveal that the columnar vortices contain large amounts of negative helicity in the northern hemisphere, and positive helicity in the southern hemisphere, and result in self-sustaining dynamo action.

Proposed APS Bylaws Amendments

Below amendments to the APS Bylaws that were proposed by a vote of the APS Council on November 19, 2000. These amendments are exhibited here for comments by the membership at large. All comments should be sent to Ken Cole (cole@aps.org), by April 2. They will be placed before the Council for its consideration at the Council meeting on April 27. If you wish to see the entire APS Constitution, it is available on the APS web site at http://www.aps.org/exec/bylaws/apsbylaw00.html. If you are unable to access the web, send an email to cole@aps.org to request a paper copy. Proposed additions are in bold; proposed deletions are stricken out.

PROPOSED CHANGES TO THE APS BYLAWS

ARTICLE III
B. PUBLIC AFFAIRS/OUTREACH COMMITTEES

3. *Committee on Education*. - The membership of the Committee on Education shall consist of nine members. Six members will be appointed by the President to staggered three-year terms while the Chair, Pas t-Chair and Chair-elect of the Forum on Education shall serve as statutory members of the Committee. The President shall appoint the Chairperson from among the members. The Committee shall be responsible for activities in the area of physics education designated to it by the Executive Board or the Council. It shall report periodically to the President, the Executive Board and the Council on physics education. It may suggest and supervise studies and programs to improve the cooperation between the educational community and other parts of the physics community.

ARTICLE III –STANDING COMMITTEES
B. PUBLIC AFFAIRS/OUTREACH COMMITTEES

8. *Committee on International Scientific Affairs.* The membership of the Committee on International Scientific Affairs (CISA) shall consist of nine **persons. Six members will be** appointed by the APS President to staggered three-year **terms, while the Chair, Past-Chair and Chair-elect of the Forum on International Physics (FIP) shall serve as statutory members of CISA.** The APS President shall appoint the Chairperson of CISA from among the members of the Committee. CISA will monitor the international science scene and **the balance between new APS initiatives and ongoing activities in this arena. Guided by the Objective of the Society as stated in** Article II of the APS Constitution, CISA will encourage APS efforts to strengthen interaction among researchers and institutions in different regions of the world and to further extend worldwide access of physicists to scientific information and its exchange. To this end, CISA will advise and assist the APS Director of International Scientific Affairs, the **Executive Board and Council, and provide** documentation and recommendations for action, consulting with other relevant committees as appropriate.

ARTICLE VIII - DIVISION, TOPICAL GROUP, FORUM, AND SECTION CONCERNS

4. Nomination and Election of Division and Forum Councillors. - During the final year of the term of a Division or Forum Councillor, the Division or Forum Executive Committee shall nominate at least two candidates for the open position. The election ballot shall contain these names and those of other candidates nominated by petition of the membership of the Division or Forum numbering at least five percent of the total number of members determined on 30 June of the year preceding the election. The Secretary-Treasurer shall poll the Division or Forum by mail <u>or electronic</u> ballot. Election shall be by plurality of those voting. If there is a tie, the Executive Committee shall decide the election, with the Chairperson voting only in the case of a tie among the other Executive Committee members. The Secretary-Treasurer shall communicate the results of the election to the Executive Officer before 1 January of the year in which the new Councillor assumes office.

Neureiter, *from page 1*

service entrance exam, but attracting scientists to the field remains difficult given the relatively low pay compared with other more technical positions.

The situation is further exacerbated by the fact that the State Department has suffered over the last decade from severe budget cuts; its operating budget has decreased 17% over the last five years alone, and one consequence has been the loss of a large number of qualified science and technology officers. At its peak, the department boasted 25 personnel in the science and science cooperation section; today that number has dwindled to 10, mostly held by foreign service officers with little technical background.

"This means that the department's leadership is weak in terms of managing bilateral relationships in science with other countries, because their substantive input is very small," said Neureiter. However, he was heartened to discover pockets of technical excellence in the OES and other sections of the State Department, most notably a regional bureau in the Near East that has a science advisor, a geologist assisting the Arab and Israeli governments with managing the region's diminishing water resources.

In light of his background, Neureiter seems eminently suited for the position of State Department S&T advisor. "I tell people I've been training for this job for 40 years," he quips. Born in Macomb, Illinois, Neureiter received his PhD in organic chemistry from Northwestern University in 1957 and joined Humble Oil and Refining (now part of Exxon) as a research chemist, specializing in the fields of butadiene chemistry, organic sulfur compounds and the development of antioxidant systems for polypropylene.

In the early 1960s Neureiter spent two years in the NSF's International Affairs Office, becoming program director of the US/Japan Cooperative Science Program. In 1965 he joined the US Foreign Service, serving in Bonn, Germany and Warsaw, Poland, and from 1969 to 1973 he worked as an international affairs assistant in the White House Office of Science and Technology, involved in preparing agreements on S&T cooperation with the Soviet Union and China. His diplomatic service was greatly aided by Neureiter's proficiency with languages: he is fluent in German, Russian, Polish, French, Spanish and Japanese.

In 1973 Neureiter returned to private industry, holding a variety of positions with Texas Instruments, including vice president of TI-Asia. He took early retirement in 1996, and has since served in numerous government capacities, including the Committee on International Space Programs (NAS/NRC) and the US/Japan Joint High Level Advisory Committee, a body of leading university and industry representatives that advises the US and Japanese governments on science and technology issues.

ANNOUNCEMENTS

Prize and Award Nominations

See detailed submittal information at ***www.aps.org*** *under the Prize and Awards button.*

Otto LaPorte Award *DEADLINE: 01/18/01*

Endowed by the friends of Otto Laporte and the Division of Fluid Dynamics. Purpose: To recognize outstanding research accomplishments pertaining to the physics of fluids.

Fluid Dynamics Prize *DEADLINE: 01/18/01*

Supported by friends of the Division of Fluid Dynamics and the AIP journal Physics of Fluids. Purpose: To recognize and encourage outstanding achievement in fluid dynamics research.

Nicholas Metropolis Award for Outstanding Doctoral Thesis Work in Computational Physics *DEADLINE: 01/15/01*

Establishment and Support: The award is supported by the Journal of Computational Physics, a publication of Academic Press. Purpose: To recognize doctoral thesis research of outstanding quality and achievement in computational physics.

APS MASS MEDIA FELLOWSHIP PROGRAM

Applications are now being accepted for the 2001 summer APS Mass Media Fellowships. In affiliation with the popular AAAS program, the APS is sponsoring two ten-week fellowships for physics students to work full-time over the summer as reporters, researchers, and production assistants in mass media organizations nationwide. Information on application requirements can be found at **http://www.aps.org/public_affairs/Media.html**.

DEADLINE: JANUARY 12, 2001

DCMP FELLOWSHIP NOMINATION DEADLINE: January 30, 2001

See detailed submittal information at ***www.aps.org*** *under the fellowship button.*

New APS Prize in Gravitational Physics

The APS has established a new Prize in Gravitational Physics, and the Topical Group on Gravitation has begun a campaign to raise $200,000 to endow the prize. Through the generosity of Dr. David Lee, a 1974 CalTech PhD in gravitational physics, a challenge gift of up to $100,000 has been promised, to match every dollar raised from other sources.

Please give generously to support this new APS Prize!

Contributions are tax deductible as a charitable donation, and can be sent to the attention of Darlene Logan, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844. Checks should be made payable to the American Physical Society.

APS Selects New Congressional Fellows

The APS has selected two new Congressional Fellows, after having none last year. After an intensive two-week orientation that includes visits to government departments and lessons on the budget process, new APS fellows Brendan Plapp and Sherri Stephan, along with their fellow Congressional fellows sponsored by other scientific societies, settled down to work as legislative assistants for Congressional committees or members of the House of Representatives or Senate.

Plapp chose to work as a legislative assistant in the office of Rep. Edward J. Markey (D-Mass.), and is now in charge of a caucus on nuclear proliferation and two bills for Markey's office. Plapp credits his interest in influencing nuclear weapons policy — what he terms "fallout from the Manhattan Project" — with drawing him to physics in the first place. He envisions his role as a fellow as providing expertise and enthusiasm for science to Members of Congress and to the public at large, adding, "Only with an appreciation of the contributions science can make to our society, both the tangible and the aesthetic, will the public be willing to continue to support the scientific enterprise."

Plapp has been involved in a wide range of scientific pursuits. His doctoral and postdoctoral work at Cornell University and the University of Texas at Austin, respectively, dealt with nonlinear, nonequilibrium phenomena in fluids, as well as more traditional condensed matter physics research. His first research experiences were two summers in a biochemistry lab at the University of Iowa, and in June 1999 he participated in an oceanographic research cruise off the coast of Oregon. Plapp combines science with a parallel interest in domestic and international affairs and military issues. As an undergraduate at the University of Illinois, he studied international affairs, focusing on the Trident II missile and the nuclear tension between Pakistan and India. As a Cornell graduate student, he was an avid attendee of colloquia and discussions on arms control issues.

Stephan is working with the Senate Governmental Affairs Committee, specifically on the minority staff of the Senate Subcommittee on International Security, Proliferation and Federal Services on issues ranging from ballistic missile defense and cyber-terrorism to global satellite imaging, technology transfer issues, and the shortage of technically skilled workers. She recently received her PhD from Boston University for research in the interface between the solar and interstellar winds, for which she designed, developed, assembled, tested and calibrated the first space-based ultraviolet interferometer.

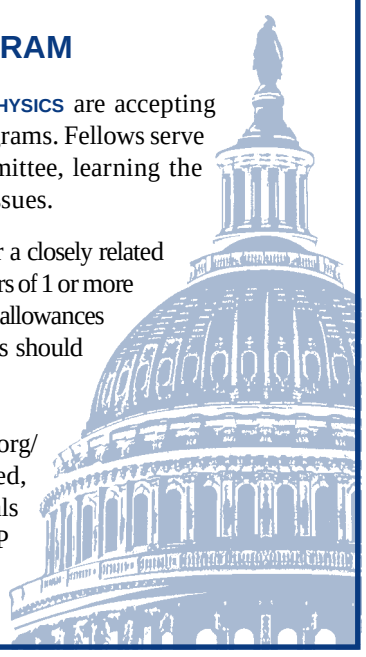
"I feel one of the most important issues facing our country is science literacy," says Stephan, and she has long been active in community outreach and public service. Since her days as an undergraduate astronomy student at the Vassar College Observatory, she has visited Boston-area elementary and secondary schools and adult education programs to teach astronomy and space science, and she also volunteered for the Boston University Observatory's Public Nights program. She participated in "Pathways," an annual program designed to bring high schools to Boston University to tour research labs. While a graduate student, she participated in political lobbying efforts through the Science Coalition, an alliance aimed at maintaining federal support of university research. Most recently she was a scientist mentor to seven young women as part of the "Eyes to the Future" education program that pairs middle school girls with local women scientists.

"Neither science nor society can function on its own," says Stephan. "As society determines science funding and priorities, society is shaped by scientific and technological innovations. Science policy is a bridge connecting the two, and something of which I want to be a part."

For more information about the APS Congressional Fellowship Program, see http://www.aps.org/public_affairs/fellow.html.

Deadline for 2001 Applications: January 15
See announcement below.

APS/AIP 2001-2002 CONGRESSIONAL SCIENCE FELLOWSHIP PROGRAM



The American Physical Society and the American Institute of Physics are accepting applications for their 2001-2002 Congressional Science Fellowship Programs. Fellows serve one year on the staff of a Member of Congress or congressional committee, learning the legislative process while they lend scientific expertise to public policy issues.

Qualifications include a PhD or equivalent research experience in physics or a closely related field. Fellows are required to be US citizens and, for the AIP Fellowship, members of 1 or more of the AIP Member Societies. A stipend of up to $49,000 is offered, in addition to allowances for relocation, in-service travel, and health insurance premiums. Applications should consist of a letter of intent, a 2-page resume, and 3 letters of recommendation.

Please see our websites (http://www.aip.org/pubinfo or http://www.aps.org/public_affairs/fellow.html) for detailed information on applying. If qualified, applicants will be considered for both programs. All application materials must be postmarked by January 15, 2001, and sent to: APS/AIP Congressional Science Fellowship Programs, c/o Erika Ridgeway/APS Executive Office One Physics Ellipse, College Park, MD 20740-3844.

APS COUNCIL AND COMMITTEE POSITION NOMINATIONS

Vice-President; General Councillor (2); Nominating Committee: Vice-Chairperson-Elect • Members; Panel on Public Affairs: Vice-Chairperson-Elect • Members

Please send your nominations to: American Physical Society; One Physics Ellipse; College Park, MD 20740-3844; Attn: Ken Cole; (301) 209-3288; fax: (301) 209-0865; email: cole@aps.org. A nomination form is available at www.aps.org/exec/nomform.html.

DEADLINE IS JANUARY 31, 2001.

Now Appearing in RMP...

The articles in the January 2001 issue of *Reviews of Modern Physics* are listed below. For brief descriptions of each article, consult the RMP website at <http://www.phys.washington.edu/~rmp/current.html>. *George Bertsch, Editor.*

Aspects of chiral symmetry and the lattice — *Michael Creutz*
Observations of atmospheric neutrinos — *Taakaki Kajita and Yoji Totsuka*
Muon decays and physics beyond the standard model — *Yoshitaka Kuno and Yasuhiro Okada*
Quantum Monte Carlo simulations of solids — *W. M. C. Foulkes, L. Mitas, R. J. Needs, and G. Rajagopal*
Resonant x-ray emission spectroscopy in solids — *Akio Kotani and Shik Shin*
Femtosecond x-ray crystallography (colloquium) — *Antoine Rousse, Christian Rischel, and Jean-Claude Gauthier*
Criticality and superfluidity in liquid ^{4}He under nonequilibrium conditions (colloquium) — *Peter B. Weichman, Alexa W. Harter, and David L. Goodstein*

Reviews of Modern Physics University of Washington; Physics/Astronomy B428; Box 351560; Seattle WA 98195; email: rmp@phys.washington.edu • phone: (206) 685-2391

DPP Distinguished Lecturers 2000-2001

The APS Division of Plasma Physics has announced the Distinguished Lecturers for Plasma Physics Program for 2000–2001. The Program is intended to share with the larger scientific community exciting recent advances in plasma physics. The following Distinguished Lecturers have been chosen by the DPP:

Professor Paul M. Bellan, *California Institute of Technology*
Simulating Solar Prominences in Laboratory Experiments
Dr. Greg Hammett, *Princeton Plasma Physics Laboratory*
Using Supercomputers to Understand Plasma Turbulence in Fusion Energy Research
Dr. Amanda Hubbard, *Massachusetts Institute of Technology*
Energy Transport in Fusion Plasmas: Recent advances in tokamak research
Professor Robert L. Merlino, *University of Iowa*
Dusty Plasmas in the Laboratory and Space
Dr. Bruce A. Remington, *Lawrence Livermore National Laboratory*
Scaling Astrophysics into the Laboratory
Dr. Mordecai D. (Mordy) Rosen, *Lawrence Livermore National Laboratory*
High Energy Density Plasmas: Quest for Fusion Ignition

The DPP travel grant program is funded by the Department of Energy and is designed to reach out beyond those universities that already have a strong plasma physics program. Additional information about the Plasma Travel Grant Program can be obtained from the Chair of the DPP Education and Outreach Committee: Don Correll; Lawrence Livermore National Laboratory; Science & Technology Education Program, (STEP); phone: 925-422-6784; fax: 925-422-5761; email: correll1@llnl.gov

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The New Security Environment

By Neal Lane

Editor's Note: This is an abridged version of the keynote address given by Neal Lane at the workshop on Scientific Communication and National Security held at the National Academies on September 27, 2000.

The title of this workshop is appropriate: Scientific Communication AND National Security, not OR, and I certainly agree with you that these two goals, both of which are essential, should not really be put in opposition. History clearly shows that we rely on science to ensure our security, not to mention our economy and our whole way of life. But at the same time we certainly cannot reap the benefits of that science unless our national security is secured.

Let me make three assertions:

- National security requires scientific excellence;
- Scientific excellence requires openness; and
- Openness is inherently international.

I'll return to these, particularly the last one, at the end.

I suggest four questions for you to keep in mind as this workshop proceeds. First, what information is absolutely critical to protect in order to minimize the threats facing us, while maximizing our ability to combat them? Second, from whom do we need to keep this information? Third, what are the costs of doing so, both monetary and also in terms of non-monetary costs, such as constraints on our scientific and technology enterprise? And fourth, are there better ways of protecting this information than the ones we have been using or that we are anticipating using?

A Look Back

Although the security environment is quite a bit different from the situation we faced twenty years ago, the issue of scientific communication, and its effect on national security, was just as salient then as it is today.

The National Academy of Sciences formed a panel under Dale Corson, President Emeritus of Cornell, that in 1982 completed a thoughtful and thorough report with a strangely familiar title — "Scientific Communication and National Security."

After three additional years of discussion and debate, President Reagan issued National Security Decision Directive 189 entitled, "National Policy on the Transfer of Scientific, Technical and Engineering Information." This Directive states that, "to the maximum extent possible, the products of fundamental research (are to) remain unrestricted." Referring to federally-funded fundamental research at colleges, universities, and laboratories, it goes on to say that when national security controls are required, the mechanism should be classification. "No restrictions," it continues, "may be placed upon the conduct or reporting of federally-funded fundamental research that has not received national security classification, except as provided in applicable US statutes."

Think about this a minute. At the height of the Cold War, an Administration that was greatly concerned about preventing adversaries from benefiting from our technological advantage issued a directive affirming that free exchange of scientific ideas is a vital component of our economic and physical security. To me, this Directive says that free exchange was deemed to be so important that it justified the risk that our adversary might receive some benefits as well.

NSDD 189 was a statement of Reagan Administration policy. However, since Presidential Directives remain in force until they are superseded or revoked, it remains in effect today.

In short, beginning with the Reagan Administration, US policy has explicitly recognized the first two of my assertions: our national security requires scientific excellence, and scientific excellence requires openness.

Is this appropriate, given the changed security circumstances? I would propose that if anything, it is even more appropriate today than in 1985. During the Cold War, the objective of our technology controls was to buy time—to preserve our lead in keeping our adversary from rapidly exploiting the latest technological developments. Our task today is somewhat different. We seek to protect mature technologies, such as those involved in nuclear weapons and ballistic missiles, from disclosure. The goal is not to prevent competitors from catching up to us. Instead, we want to keep them from catching up, say, to 1945, or maybe to 1960—a much harder task, but one for which controls over fundamental research would seem to be even less well suited.

Security Issues at DOE Labs

Let us turn to the issue of maintaining the scientific and technical excellence of DOE's nuclear weapons laboratories as we proceed to address the security shortfalls there that reviews and analyses have identified. The American people have been subjected to sensational allegations of Chinese espionage and lax security by the press over the past year or two, and to a Congressional response that in many ways can only be described as "ready, fire, aim." There has been an extensive newspaper and TV campaign covering the Congressional hearings; of bills introduced on the subject, many of which have passed. We have seen reports from the Congressional Cox Committee, the President's Foreign Intelligence Advisory Board chaired by Warren Rudman, and others. In this environment, the Department of Energy has introduced a number of new security measures in areas such as lie detector exams, travel restrictions, and visitor access.

Now let me make clear that I certainly believe there were problems involving security at the labs that needed fixing. Systems can always be improved, and where problems are identified it is important to move quickly and effectively to deal with them. However, I am also very concerned that the net effect of the press coverage, the hearings, the laws, and the regulations has been to create a kind of "siege mentality" at the labs. And I am very worried about the effects that this environment may have in the future, and may be having right now, on the labs' ability to do their mission. I am informed that the labs are already losing key personnel and experiencing difficulty in attracting new talent—trends that I think we all find deeply disturbing.

I can't help but think of how a foreign enemy might go about attacking the United States' national security technology base. A particularly insidious foreign enemy might try to destroy morale at our national laboratories, hamstring them with new regulations, isolate them from the international scientific community, drive away their most experienced, knowledgeable workers, and cut them off from promising new hires. As it says in one of my favorite philosophical treatises, "We have met the enemy and he is us."

As we address security AT the DOE labs, we must not lose sight of the critical contribution to our national security that we get FROM the labs. They are priceless national assets; their scientists and engineers, researchers and other professionals are devoted and patriotic public servants who perform a crucial mission, and we all owe them our gratitude and our support. I am committed to ensuring that those who have dedicated their careers to the service of their country in these institutions can work in an environment that allows them to do their jobs.

Let me add a personal note. I consulted at Los Alamos and Livermore over quite a long period of time earlier in my career when "cross sections" meant atomic cross sections and nuclear cross sections, and not annoyed groups within professional societies. During all that time, I cannot recall a single instance, not a single instance, when any lab scientists or lab individual that I worked with seemed to take security for granted, or treated classified information carelessly, joked about security or in any other way indicated that they did not understand the importance of security in the laboratories and the importance of their own commitment and professionalism. Instead, I found men and women doing outstanding classified and unclassified research and taking security matters seriously.

My Philosophy

I have a security philosophy: Security measures should be minimal in number; they should have easily understood objectives; and they should be strictly obeyed. It is also very important to look at security measures in their totality. One at a time, they can seem quite reasonable. In their entirety, they can be self-defeating. One should look for redundancies—and synergies—and, particularly, for their overall impact on the people whose lives they affect. For it is people who are the core of any security program.

I also believe that security cannot be guaranteed by making more rules, hiring more guards, or deploying more technology. In the right circumstances, any of these methods can help—but none of them, nor any combination of them, can substitute for trust, trust in the very people whose continuing effort, commitment and professionalism are required to make this whole system work. OSTP and DOE are working together to make sure that we guard effectively the information at our national laboratories that must be guarded—but, at the same time, that we guard an equally vital asset, the excellence, the dedication, and the enthusiasm of the labs' science and engineering workforce. Unless we guard both, our nation's security is indeed at risk.

International Engagement

Finally, my third assertion: openness is inherently international. One absolute requirement for preserving technical excellence in the US science enterprise is remaining fully engaged with the international scientific and technical community. I can't stress too highly the importance of the international nature of science.

Some Congressional statements and press reports make it seem like interaction with foreigners is a no-win game—one in which we only stand to lose, the only question being how much we give away each time. In the summer of 1999, a measure was introduced in Congress to ban all visits from "sensitive country" nationals to the DOE nuclear labs, unless a waiver were submitted personally by the Secretary of Energy for prior Congressional approval. Fortunately, the moratorium that ultimately passed eliminated the prior review and eliminated the requirement entirely for some important ongoing international collaborations. To his credit, Secretary Richardson—who certainly understands the value of international collaboration—has issued a waiver

every time he was asked for one, and I understand that the conditions that will remove this moratorium completely are close to being fulfilled.

It is worth emphasizing that US science is strong, in a large part, because US scientists and engineers have come from everywhere, and they continue to communicate—openly—with the world's best minds, whatever country they hail from. Diversity is at the foundation of American success, not just in science but overall. Furthermore, today we face a myriad of global problems that can only be addressed on a global basis. To argue that we should build walls around our laboratories and our country is to argue that we should return to some imagined "cold war" isolation that in fact never really existed, at least in science.

I sense that there is a growing awareness now that the policy response to issues of security at the DOE labs has overshot the mark. Indeed, the latest review of security at the labs, by Howard Baker and Lee Hamilton, has warned that we can do more damage to the national security by overreacting to security concerns than was ever at risk in the first place. It is a very important message. We should not be defensive about—but rather should enthusiastically promote—the importance of international engagement to our own scientific enterprise.

I can tell you that the White House and the Agencies appreciate the importance of science. The Administration has worked hard to improve science and technology across the board, to increase US efforts in basic and applied research—from climate research to the human genome, to facilitating the information revolution, to creating the nanotechnology initiative and the nuclear weapon stockpile stewardship program. The President and Congress have disagreed on many issues, but the importance of science has not been one of them. I am sure that neither branch of Government wants to see these joint efforts undercut by unnecessary and counterproductive security measures.

Neal Lane is Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy.

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.