APS NEWS

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Friedman Chosen as APS Vice-President in 1996 Election

Members of The American Physical Society have elected Jerome Friedman, professor of physics at the Massachusetts Institute of Technology, to be the Society's next vice-president. Friedman's term begins on 1 January, when he will succeed Andrew Sessler (Lawrence Berkeley Laboratory), who will become president-elect. Friedman will become APS president in 1999. The 1997 president is D. Allan Bromley (Yale University).

In other election results, Wick Haxton of the University of Washington was elected as chair-elect of the Nominating Committee, which will be chaired by Gerard M. Crawley of Michigan State University in 1997. The Nominating Committee selects the slate of candidates for vice-president, general councillors, and its own chair-elect. Its choices are then voted on by the APS membership. S. James Gates (University of Maryland), Paul S. Peercy (SEMI/SEMATECH), Virginia Trimble (University of California, Irvine/University of Maryland), and Sau Lan Wu (University of Wisconsin, Madison) were elected general councillors.

Vice-President

Friedman received his Ph.D. in experimental particle physics from the University in Chicago in 1956. After a year as a research associate there, he accepted a three-year appointment at Stanford University. In 1960, he joined the MIT faculty as an assistant professor, where he has served as director of the Laboratory for Nuclear Science and as head of the physics department.

Friedman's research has included studies of particle structure and interactions with high-energy electrons, neutrinos and hadrons. Recipient of the Society's W.H.K. Panofsky Prize in 1989, he shared the 1990 Nobel Prize in Physics with Henry Kendall and Richard Taylor for work demonstrating the existence of the quark. His professional activities include service as vice-chair of the Board of the University Research Association, and on the National Research Council's Board on Physics and Astronomy, as well as the APS Physics Planning Committee.

In his candidate's statement, Friedman stressed the need for better scientific communication, both within the physics community and with the public at large. "The APS must do more to ensure the health of physics at a time when science in general is facing serious challenges," he said. "Today the pursuit of scientific knowledge is increasingly viewed as a luxury the nation cannot afford in a period of budget deficits and major social problems. There are a growing number of people in government who... reject the implicit assumption that the pursuit of scientific knowledge has social as well as intellectual value, and [they] want guaranteed, short-term benefits as the justification for their support of science."

He also cited the need to develop mechanisms to enlist the support of the industrial community, since national productivity depends in part on a scientific enterprise capable of creating foundations for new technologies. Scientifically-trained employees are also critical, and hence so is quality science education, especially at the elementary and secondary levels. However, the U.S. educational system has failed to provide many young people with the scientific literacy required to succeed in a technological society. Nor can an uninformed public effectively participate in political decisions related to science and technology.

Friedman believes that the APS' elected officers and members can play a powerful role in informing members of government and the general public of the intellectual and practical benefits of science. In addition, because of the diverse range of subfields represented, the Society can help unify the various disciplines to enable the physics community to speak with one voice. He suggested sponsoring workshops in various disciplines for Congressional members and their staffs and improved contacts with science journalists as possible vehicles for improving public awareness of scientific issues. "In the long run, science can prosper only if the public truly supports it," he said.

Chair-Elect, Nominating Committee

Haxton received his Ph.D. in physics from Stanford University in 1976. He spent a year as a research associate at the Universität Mainz before moving to the Theory Division of Los Alamos National Laboratory. He was also an assistant professor at Purdue University from 1980-1981. Since 1984 he has been on the faculty of the University of Washington, where he is now a professor of physics and director of the Institute for Nuclear Theory. His research interests include atomic and nuclear tests of symmetry principles and conservation laws, nuclear astrophysics issues, and many-body techniques in nuclear, atomic and condensed matter physics. Haxton has served as chair of the APS Division of Nuclear Physics and will chair the Division of Astrophysics in 1996. He is also a former general councillor and editor of *Physics Letters B*.

In his candidate's statement, Haxton expressed continued optimism about the public's capacity to appreciate and support physics, solely for the excitement and discovery of new knowledge, despite the difficult budgetary climate in the U.S. As chair of the Nominating Committee, he said he will seek out individuals who share his optimism and can articulate this excitement, whether before Congress or high school students, and who can offset the tendency of the physics community to turn inwards during times of stress. "I think the Society would be stronger if we were less parochial," he said.

General Councillors

Gates received his Ph.D. in physics from MIT in 1977, and spent the next three years doing postgraduate research as a junior fellow of the Harvard Society of Fellows. He spent two years on the faculty of MIT's mathematics department before joining the physics department of the University of Maryland at College

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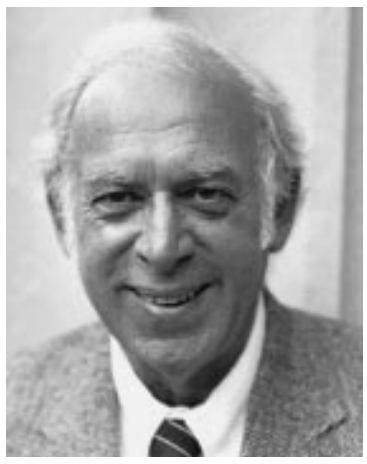

Jerome Friedman

INSIDE THE BELTWAY

Death, Taxes and Much More

by Michael S. Lubell, APS Director of Public Affairs

It's often claimed that the only certainties in life are death and taxes. Much the same can be said for politics. Let's first take a look at death.

To see how intimations of mortality affect Members of Congress, you need only consider the appropriations bills for the National Institutes of Health. For each of the last two years NIH has been the big R&D winner on the Hill. Having a champion like Labor-HHS House Appropriations Subcommittee Chairman John Porter (R-SC) doesn't hurt, but selling seven percent increases for biomedical research meets with far less resistance from a frugal Congress than mere cost of living increases for quantum optics.

Don't expect the new 105th Congress to behave any differently than the old 104th. Rep. Porter has been re-elected subcommittee chair, and the attitudes of his mortal House colleagues toward the life sciences are not likely to change.

And what about taxes? With election-year politicking rapidly receding into the forgotten past, you can barely hear a whisper anywhere in Washington these days about the across-the-board cuts Bob Dole was advocating during the presidential campaign. Even House Ways and Means Committee Chairman Bill Archer (R-TX), one of the most outspoken of the IRS abolitionists, has muted his tones that seemed to resonate so well in the corridors of power barely a year ago.

If death and taxes aren't up for grabs this year, what issues will be on the front burner in the 105th Congress, and how partisan will the debate be? To begin with, since both political parties now accept a balanced budget end game as inevitable, the squeeze on discretionary spending will almost certainly continue unabated during the next fiscal year. But as Members are forced to make hard choices on cuts in

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APS E-Print Server

Authors, try out the new APS E-Print Server. The server is open for postings of articles in any and all fields of physics and physics education. Applied, industrial as well as basic topics are welcomed. Posting is free and accessible by colleagues world-wide through the web. Instructions for submittal or use can be found under the E-Print Server button on the APS home page [http://www.aps.org] or directly at [http://publish.aps.org/eprint/].

Bederson Lead APS Journals Into Electronic Age

Continuing economic pressures, the phasing out of page charges, and an explosion in electronic product offerings are just a few of the revolutionary changes that have occurred in the APS publishing operations during the five-year tenure of APS Editor-in-Chief Benjamin Bederson, who retired in December. Bederson was appointed to the position in 1991, succeeding David Lazarus of the University of Illinois.

Bederson's appointment as editor-in-chief brought considerable editorial experience with scientific journals, and APS journals in particular, to the position. He served as editor of *Physical Review A* from 1978 to 1991 and was also an associate editor of *Atomic Data and Nuclear Data Journal*. His expertise proved to be a valuable asset in 1992-1993, when a task force on electronic publishing chaired by former APS president Eugen Merzbacher (University of North Carolina, Chapel Hill) recommended that the Society should make every effort to take advantage of the electronic revolution.

Since then, the development of the Society's online products has accelerated rapidly. "The enormous acceleration of electronic offerings has been a surprise to many people," said Bederson. "We are much further along than people thought we would be five years ago." In addition to producing online versions of several of its journals, the APS has also developed an Eprint Server, modelled after the one currently in place at Los Alamos National Laboratory. (For more information on the Society's electronic activities, see APS Online, a special insert to *APS News*, November 1996.)

Bederson served in the U.S. Army during World War II, the last two years in the "Special Engineering Detachment" at Los Alamos. Completing his interrupted undergraduate education at CCNY he obtained his Ph.D. at NYU, in atomic physics and gaseous electronics. He then held a postdoctoral appointment for two years at the Massachusetts Institute of Technology, working with Jerrold Zacharias in the atomic beams laboratory, measuring nuclear spins and magnetic moments.

Bederson returned to NYU in 1952 and has taught there ever since, chairing the Department of Physics from 1973 to 1976 and completing a three-year term as Dean of the Graduate School of Arts and Sciences in 1989. His research over the years has focused on the use of beam techniques to study atomic and molecular interactions and structure, including polarizability measurements in ground and laser-excited states, and small cluster physics. He has also worked on gaseous electronics and plasma physics. A former chair of the APS Division of Atomic, Molecular and Optical Physics, Bederson has served on numerous government and academic advisory committees, and was the first chair of the NAS-NRC Committee on Atomic and Molecular Science.

This year marks Bederson's third official "retirement" from his various positions, and while he plans to do some teaching and writing, he doesn't intend to take on any more administrative responsibilities. "Everybody always asks me what I'm going to do after I retire, and one way of stopping them is to tell them what I heard about Dr. Ruth Westheimer," he said of his future plans. "They ask her the same question all the time. She eventually shut them up by telling them that she's decided to go back to school to become a dental technician."

At his retirement party in Denver in November, Bederson (right) was joined by his wife Betty (left), their #4 son Benjamin and daughter-in-law Allison Druin.

Q What do you consider to be the most important changes that have occurred with regard to the APS journals during your tenure as editor-in-chief?

A I would say the continuing increase and prestige of all of our journals, and at the same time the increasing internationalization of the journals. Currently two-thirds of papers submitted to the *Physical Review* are from international authors. But it's not just the prestige, it's the fact that publishing in our journals ensures a large international audience for scientific papers. Our journals are also the ones of choice for international libraries. A similar percentage of our library subscriptions are now also international.

Q There has also been tremendous growth in the area of electronic publishing. Does the Society have any specific goals in terms of producing online versions of all its journals?

A First, it's important to point out that we have a partner in electronic publishing, the American Institute of Physics, and we're working very closely with them to ensure that our journals go online as fast and as easily accessible as possible. According to the present timeline, all APS journals, including *Reviews of Modern Physics*, will be online by the third quarter of 1997. We already have online versions of *Physical Review Letters, Physical Review B Rapid Communications, Physical Review C* and *Physical Review D* in various forms. It's still a little early to determine how many APS members are actually using the online versions, but the number of paid subscriptions for *PRL* has been encouragingly high.

Q What are some of the challenges currently facing the APS journals?

A The rapid growth of the Society's journals is perhaps our biggest problem apart from decreasing library subscriptions. During my tenure as editor-in-chief journal growth exceeded 8 or 9 percent annually in terms of the number of submissions. This was clearly an unstable situation, and it was difficult to see how we could keep this up. There were many reasons for concern. For example, the libraries simply couldn't acquire space fast enough to keep up with the increasing volume of our journals. Also, with growth comes corresponding increases in production costs. Although we believe our journals represent an enormous value compared to cost, libraries simply couldn't continually increase their budgets to accommodate our increasing costs because of growth.

Q How has the Society addressed the issue of growth?

A Eugen Merzbacher chaired a Task Force on Journal Growth which issued its report in 1995, recommending that APS editors significantly increase their acceptance standards. Even preceding the recommendation, acceptance rates for the APS journals had been steadily decreasing because of higher standards. Today, submissions have begun to level off. For example, our increase in submission rate last year was about 3 percent, much lower than in previous years.

So we feel we have the growth problem under control, which should be a blessing for libraries, until the day when electronic publishing becomes a standard and paper volumes no longer have to occupy enormous amounts of space. However, I must emphasize that despite claims that paper journals will eventually disappear, we do not in the foreseeable future see our archival paper journals disappearing. We believe that they still serve a valuable function and will continue to do so, even in these early days of the electronic revolution.

Q You mentioned the fall off in library subscriptions. What is the underlying cause of this?

A In the current tight budgetary climate, libraries continually have to make painful decisions: for example, choosing between cancellations of certain other journals or cancellations of multiple subscriptions to APS journals. Partly as a result of the growing number of libraries who opt for the latter, our library subscriptions continue to decline at a small percentage each year. This phenomenon has been going on for at least a decade and I don't see any indication of this changing.

Q The issue of page charges has long been a source of concern, particularly to journal editors. Has the Society made any progress towards resolving the dilemma?

A The page charge problem has been resolved. As previously reported in *APS News*, there was an experimental suspending of page charges in *PRD* for all articles and in *PRC* for electronically submitted articles. When the experiment ended, there was some controversy as to how to proceed. There were several important issues. One was equity among all journals; short-term experiments are fine, but in the long term, we must adopt an identical policy for all our journals. After agonizing over this throughout 1995, the decision was made to gradually phase down page charges for almost all of our journals for electronically submitted articles. Thus, in four years' time, page charges will vanish for all APS journals except *PRL*, which will continue to have page charges.

This will put a strain on our other income sources, since it leaves institutional subscriptions as our only source of real income, and these have been decreasing slightly each year. Although in the past page charges have been completely voluntary, with no penalty for non-payment, a majority of authors do honor them, even though that rate

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INTERNATIONAL NEWS

Establishing Global Communication Networks in Science

The APS has been actively involved for some time in ongoing efforts to improve networking and Internet access for academic and research communities in developing countries, working in conjunction with UNESCO's Physics Action Council (PAC) Working Group 2 on establishing communication networks in science, as well as numerous other foreign societies and organizations. Efforts to date have largely focused on Central and Eastern European regions, as well as Ghana and Asia.

For example, the NATO Advanced Networking Workshop, held in October in St. Petersburg, Russia, was a joint program to develop and implement electronic communications. According to APS Director of International Affairs Irving Lerch, chair of the workshop's International Coordinating Committee and also its co-director, it is part of ongoing efforts to provide essential telecommunications to the academic and research communities of Russia, and to foster an independent and vigorous physics community. It is also intended to strengthen associations between the APS, the Euro-Asian Physical Society, and the academic institutes of Russia and their counterpart research universities and laboratories in the U.S.

Participants were invited from throughout Russia as well as from Ukraine and Belarus, representing 25 academic and research communities in Russia and an additional seven institutions from those neighboring countries. The workshop consisted of two training tracks to orient node managers and their staffs, covering server set-up, router programming, node management, and network maintenance. In turn, these managers and technicians are expected to participate in regional and local training courses throughout Russia in 1997, in order to broaden expertise to node managers in university settings. Locations will include Novosibirsk, Yaroslavl, and Ekaterinburg, all current sites in the Open Society Institute Initiative to establish university Internet centers, funded by the Soros Foundation.

The workshop was organized by St. Petersburg State University, the Russian Foundation for Basic Research (RFBR), the Euro-Asian Physical Society, the APS, and Working Group 2 of UNESCO-PAC. Support was provided principally by NATO, with additional funds from the RFBR, the UNESCO-PAC working group, the International Science Foundation, and the Open Society Institute's University Internet Program.

Following the St. Petersburg workshop, Lerch traveled to Manila in the Philippines to moderate a panel discussion on Asian connectivity and accessibility of new technologies. The event was sponsored by the UNESCO-PAC working group as part of the conference on modern and innovative technologies for asian physics education organized by the Asian Physics Education Network. Panel participants included representatives from Australia, Japan, India, Sweden, Bangladesh, and the Philippines.

The St. Petersburg workshop is not an isolated effort. In association with the United Nations Development Programme and the International Telecommunications Union, the UNESCO-PAC working group is coordinating similar networking workshops in Ghana to provide technical training, starting this month. The training sites are the University of Ghana at Legon and Network Computer Systems of Ghana. According to Lerch, both sites will seek to supplement the existing commitments of government ministries to academic and research Internet access with corresponding commitments from other sectors of society: the private sector, universities, non-governmental organizations, the medical community, and both professional and learned organizations. Particular emphasis will be placed on gaining the collaboration and active commitment of the basic sciences and the wider scientific and research communities.

"The proliferation of organizations and programs aimed at providing Internet access for various international communities could result in dissipated resources, because of redundant or conflicting projects," said Lerch. "On the other hand, cooperation, coordination and collaboration among regional programs provides an opportunity for the sharing of experiences, information and resources."

To this end, representatives from the APS, UNESCO, the Open Society Institute, the Carnegie Corporation, and the New York Academy of Sciences, along with several other organizations, convened at Rockefeller University last July to help coordinate their respective efforts. The meeting was hosted by Joshua Lederberg, chair of UNESCO's International Advisory Council on Global Scientific Communication. The participants discussed the need to exchange information on regional activities and training programs and develop associations among regional programs.

A Conversation in Denver

Carmen Cisneros (left), President of the Sociedad Mexicana de Física, Herwig Schopper (center), President of the European Physical Society and Fumiko Yonezawa (right), President of the Japanese Physical Society, share a word at the APS Council meeting in Denver in November.

IN BRIEF

- At its November meeting, the APS Executive Board agreed to let the Society's Memorandum of Understanding (MOU) with the Chinese Physical Society (CPS) lapse. The agrrement was originally intended to promote broader collaboration between the two scientific communities. The conclusion was that such a document is no longer needed. The original agreement, signed in October 1994, contained a stipultation that its provisions be reviewed after two years to give both societies an opportunity to evaluate the need for a formal agreement or to determine if any of its conditions should be modified. The document's goals were four-fold: (1) to broaden interactions via the Internet; (2) to provide for ongoing contact between selected research groups with advanced workshops; (3) to develop a mutually satisfactory mechanism to ensure CPS members access to the *Physical Review*; and (4) to affirm that the rights of authorship will be respected.

  In a letter to CPS President Chia-erh Chen, 1996 APS President Robert Schrieffer (Florida State University) praised the vigor and quality of Chinese science, evidencedby the numerous international conferences hosted by the CPS, and the healthy representation of Chinese students and scientists in U.S. universities and laboratories. However, he noted that few Chinese institutional libraries have enrolled in the APS Library Outreach Program, funding difficulties on the part of the APS have delayed plans for a follow-up workshop to a successful Nanking workshop in April 1996, and the telecommunications program has not met with much success due to its members' busy schedules. He also reiterated the APS Council's ongoing concerns about human rights violations in China. Schrieffer and 1997 APS President D. Allan Bromley (Yale University) each plan to meet with the CPS leadership this February in Beijing to discuss future collaborative efforts.

- The APS Texas Section held its annual fall meeting October 10-12 at the University of Texas at Arlington, in conjunction with the Texas Section of the American Association of Physics Teachers and Zone 13 of the Society of Physics Students. Following opening remarks by university president Robert Witt, Friday morning's plenary session featured talks on the origins and applications of slow neutron spectroscopy, and on supramolecular spectra and sonoluminescence. Friday afternoon featured a special session on collaborations between universities and industry, with an invited lecture by APS Associate Executive Officer Barrett Ripin. Following the banquet on Friday evening, Geoffrey March of San Francisco State University gave a lecture on the recent discovery of planets orbiting solar-like stars. Recent advances in Bose-Einstein condensation were presented during Saturday morning's plenary session, while Saturday afternoon's session focused on the recent creation by NIST researchers of a state analogous to that of Erwin Schrodinger's famous cat, first postulated in 1935.

- The 1996 Gian Carlo Wick Commemorative Medal was awarded to Sidney Drell, professor of physics at Stanford University and deputy director of the Stanford Linear Accelerator Center. The award is from the World Federation of Scientists and a formal ceremony took place at the World Laboratory in Lausanne, Switzerland on November 22. Drell is honored for his "outstanding contributions to particle physics and for his unceasing efforts to reduce the risk of nuclear weapons." He expressed his pleasure that the award notes his achievements in physics as well as world peace, remarking, "We can derive genuine satisfaction from recent progress with the overwhelming approval of a true comprehensive test ban treaty at the United Nations General Assembly just two months ago."

  Drell, who was APS President in 1986, served on the President's Foreign Intelligence Advisory Board and has been a consultant to the National Security Council, the Arms Control Board, and has served as chair of the JASON study on nuclear testing. Wick, for whom the award is named, conducted research on atomic theory and taught at several universities: Carnegie Tech, UC Berkeley, and Columbia. Wick was fired from Berkeley in 1950 for refusing to sign a loyalty oath that had been imposed on the faculty, an oath that was later found to be unconstitutional. Past recipients of the award are physicists Freeman Dyson (Institute for Advanced Studies); Victor Weisskopf (MIT), and Yoichiro Nambu (University of Chicago). In his remarks accepting the award, Drell stated that Wick's "elegant studies have provided the language fundamental to essentially all subsequent theoretical work in quantum field theory and scattering processes."

- The National Science Foundation (NSF) continues to move toward electronic communication for proposal submission, processing and review through a service called FASTLANE. FASTLANE already provides information about awards with the Atomic and Molecular and Optical (AMO) physics program, as well as general information about the status of a proposal or award. Since November, the theoretical and experimental AMO programs have been using FASTLANE as an option for submitting mail reviews, a first step in what is intended to become full utilization of electronic communication in the agency's AMO programs. Further information can be found online at http://www.nsf.gov.

Plasma CVD, Etch Tools, and Displays Highlight 49th Annual GEC

Recent advances in plasma chemical vapor deposition (CVD), etch tools, and plasma display technologies were among the highlights of the 49th Annual Gaseous Electronics Conference, held 20-24 October in the conference facilities of the Advanced Photon Source at Argonne National Laboratory. The meeting was on endorsed topical conference of the APS. In addition to the standard technical program, the meeting featured the 1996 APS Will Allis Prize Lecture and a conference banquet on Tuesday evening, with a keynote address by Fermilab's Michael Turner on "The Age of the Universe and Other Large Questions."

Plasma CVD and Etching

According to John Arnold of Motorola's Advanced Products R&D Laboratory, as device geometries shrink and cost and performance demands increase, the semiconductor industry must find ways to etch dielectric materials with unprecedented levels of feature aspect ratio, mask and underlying film selectivity, and throughput. High density plasma (HDP) etch tools have demonstrated great promise for meeting present and future needs.

However, "The simultaneous deployment of this new technology and migration to unfamiliar and more complex etching chemistries has left a growing chasm between industrial practice and theoretical understanding of process mechanisms," said Arnold. To address this problem, he has applied a series of diagnostic tools to a commercial HDP etcher in a semi-production environment, which resulted in a qualitative but coherent model of the etching process. Of particular importance to controlling etch behavior are thermal transients, polymer deposition and removal and chamber wall interactions.

Characterization of gas phase species densities is also important to the understanding of complex plasma chemistry. According to Harold Anderson of the University of New Mexico, infrared diode laser absorption is particularly well-suited for aiding in process development in HDP etch tools. He has developed a single-pass, FM diode laser absorption spectroscopic system to measure chlorine and fluorocarbon dissociation in inductively coupled discharges in both laboratory and commercial plasma etchers. A relatively small, portable version of his system has been used on site at semiconductor lab facilities for etch tool process characterization.

Neutral radicals play key roles in plasma CVD and etching, but modelling and controlling such processing requires cross-section data for electron-impact dissociation of molecules into neutral radicals. Earlier electron impact studies resulted in extensive data of ionization cross sections, but little is known about dissociation into neutral fragments because their detection is extremely difficult. However, scientists at Japan's Nagoya University have developed a highly sensitive technique for radical detection — appearance mass spectroscopy — which they have used to measure cross sections for neutral radical yield from several species of molecules important for CVD and etching.

The predominance of multi-level metallization schemes in advanced integrated circuit manufacturing has greatly increased the importance of plasma-enhanced CVD and, in turn, in situ plasma chamber cleaning, according to John Langan of Air Products and Chemicals, Inc., in Allentown, Pennsylvania. "In order to maintain the highest throughput for these processes, the clean step must be as short as possible," he said, adding that it is also desirable to minimize fluorated gas usage during cleaning while maximizing efficiency, not only to achieve lower costs but also because many of the gases used in the process are global warming compounds. Using electrical impedance analysis and optical emission spectroscopy, he has studied the fundamental properties of various discharges emitted during cleaning to develop numerous strategies to optimize chamber clean processes.

Plasma Displays

Plasma display panels (PDPs) are arrays of individually addressable microdischarges that produce ultraviolet radiation which is, in turn, converted to visible radiation by a phosphor. In ac PDPs, the electrodes are coated with dielectrics, and discharges are initiated and extinguished on each half cycle as the dielectric surfaces become charged. To better enhance the understanding of the phenomena involved, scientists at the CPAT facility in Toulouse, France, have developed two-dimensional models to study the effects of changing discharge conditions on the characteristics of PDP cells in complex geometries. In addition, G.J. Parker of Lawrence Livermore National Laboratory has developed two-dimensional fluid/kinetic hybrid models for plasma switches, which have been introduced as replacements for thin-film transistors in liquid crystal displays, facilitating the manufacture of large-area devices suitable for TV and high-resolution computer terminals.

Plasma processing is also being used in the fabrication of liquid crystal flat-panel displays, which has much in common with integrated circuit processing on large diameter silicon wafers. However, according to Amy Wendt of the University of Wisconsin, Madison, it also presents new challenges, since it involves plasma processing for sputter deposition, plasma-enhanced CVD, etching, and hydrogen passivation for displays using polycrystalline silicon. She has studied plasma immersion as a possible technique for the introduction of hydrogen into the polysilicon film to passivate defects, demonstrating that high rates of hydrogen passivation can be obtained using electron cyclotron resonance discharges.

Plasmas in Growth of Thin Films

Pulsed laser deposition (PLD) uses laser ablation of a solid target to accelerate atoms in a high-density plasma to superthermal kinetic energies, which have proven essential for the formation of thin films of new ultrahard metastable phases, such as the synthesis of amorphous diamond from the laser ablation of pyrolytic graphite in a vacuum. However, in low-pressure background gases, the kinetic energy of the plume atoms is

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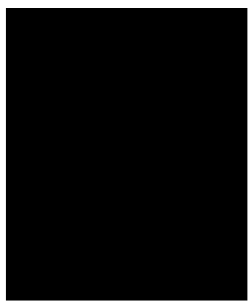
APS Announces Primakoff Lectureship and Forum Award Endowment

In November, the APS Council approved a proposal to establish an annual Henry Primakoff Lectureship, supported by an endowment from colleagues at the University of Pennsylvania to honor his contributions to a broad range of fields of physics. In addition, the funds for two other Society honors were supplemented by endowments from outside sources.

Primakoff Lectureship



Henry Primakoff

Primakoff was a theoretical physicist who made significant contributions to many areas of physics, and became the first Donner Professor of Physics at the University of Pennsylvania. While still in graduate school he developed the theory of spin waves with T.D. Holstein, which was based on a physical model and employed theoretical techniques. Later, while on the faculty of Washington University, he published a paper on the photoproduction of neutral mesons in nuclear electric fields, which first described the process known as the "Primakoff Effect," and ultimately led to a precise measurement of the very short mean life of the neutral pion. He was also one of the first to suggest the possibility of a collapsed state of nuclei.

In the 1950s, Primakoff turned to studying the nuclear and particle phenomena that manifest the weak interaction. He moved to the University of Pennsylvania in 1960, where he became the leading world authority on muon capture, double beta decay, and the interaction of neutrinos and nuclei. He continued to work in the fundamental symmetries of physics and the nature of their breaking until his death.

The University of Pennsylvania established an internal lecture series in honor of Primakoff in 1984. Past speakers include such luminaries as Tsung Dao Lee, Carlo Rubbia, Hans Bethe, Norman Ramsey, Abraham Pais, Victor Weisskopf, Leon Lederman, Vernon Hughes, and APS Past President J. Robert Schrieffer.

Professor C.N. Yang of SUNY, Stony Brook will deliver the first APS Henry Primakoff Lecture at the Spring APS/AAPT Joint Meeting in Washington, DC on April 18, 1997.

Joseph A. Burton Forum Award

The APS Council also approved a proposal to rename the APS Forum Award, established in 1974 by the Forum on Physics and Society. It is now the Joseph A. Burton Forum Award in light of a recent endowment from Jean Dickey Apker. Burton served as APS Treasurer from 1970 to 1985. The annual award now consists of $3,000, a certificate citing the contributions of the recipient, and a travel allowance to attend the Society meeting at which the award is presented. It is still intended to recognize outstanding contributions to the public understanding or resolution of issues involving the interface of physics and society, such as public education, arms control, energy policy, environmental protection, and international cooperation among scientists.

Burton was a long-term employee of AT&T Bell Laboratories from the time

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is slowly declining. So whereas page charges have accounted for a huge fraction of our income in the past, by the year 2000 they will virtually disappear, because we expect the rate of electronically submitted manuscripts to approach 100 percent by then.

Q How does the Society plan to counter these expected decreases in its net income?

A Not only are we phasing out page charges, but the APS Council has mandated that we can't increase our library subscription rates by more than 10 percent per year to make up the loss. In the past, increases have been about 15 percent per year. So there are going to be economic squeezes on the journals in the future. This will be made up to some extent by our decreasing acceptance rates, as well as mandated economies in our editorial office in Ridge, New York. It will simply have to become more efficient and operate on a tighter budget than in the past. Then all-electronic of the editorial office is expected to significantly reduce operating costs and production time of our journals.

However, we must recognize that the APS is almost unique in the fact that it has a central editorial office where career editors work together on its journals, in concert with number of field editors who are all practicing physicists. This does make for a costlier operation than having entirely remote editorial operations, but at the same time it has contributed to the reputation of our journals, and made it possible to have uniform standards and policies.

Q The surplus from the APS journals has traditionally been used to fund many of the Society's other activities, including those in the areas of education, career development, public affairs, and women and minorities in physics. Will the phasing out of page charges have an adverse effect on these activities in addition to journal operation?

A My feeling is that both the journals and the APS are going to do just fine in the future. Is likely that our net income — that is to say, our revenue over expenses — will decline in years to come. However, supplemented by investment income, it will remain large enough to supply the funds needed for the operation of all the important functions of our Society, including public service, services for physicists, and education.

Research Corporation Supports Basic Research in Academia

For more than 80 years, fledgling physicists, chemists and astronomers struggling to fund their research projects have found support through the Research Corporation, a privately funded, nonprofit philanthropic organization dedicated to the support of scientists and their work. Now celebrating the 50th anniversary of its formal award program, the foundation has a unique philanthropic mission to make inventions and patent rights more available and effective to manufacturing, and to devote any new resources derived from them to aid in the advancement and extension of technical and scientific investigation, research and experimentation at scholarly institutions.

The corporation also makes general awards in support of projects from nonprofit institutions of higher learning and scientific associations that fall outside its regular programs, but that nevertheless enhance science research or the infrastructure of science. For example, it provides funding for the APS Award for Research in an Undergraduate Institution and the APS Edward A. Bouchet minority Lectureship. It also sponsored the publication of *They're Not Dumb, They're Different: Stalking the Second Tier*, by Sheila Tobias, which explored problems in science education.

Grants are made for original research in chemistry, physics and astronomy at colleges and universities throughout the U.S. and Canada. The foundation was established in 1912 by Frederick Gardner Cottrell, a scientist, inventor and philanthropist who invented the electrostatic precipitator for controlling industrial air pollution. Cottrell believed that academic inventions should be developed in the public interest, and that a share of the profits should be reinvested in the scientific and technological fields that produced them. Hence, proceeds from his device provided the primary source of the organization's $106 million endowment. The foundation also administers other inventions contributed by public-spirited scientists, including cortisone; the first antifungal antibiotic; the concept of the laser; hybrid seed corn; anticancer drugs and cardiac pacemakers, and the vitamins A, B1 and B12.

"The foundation supports people and their programs, rather than bricks and mortar or broad institutional initiatives," said Brian Andreen, vice president of the Research Corporation of the rationale behind the organization.

However, the agency's guiding philosophy also recognizes that the foundations of academic science rest not only upon research, but also upon the public understanding of science, according to Andreen. "Effective communication of the power, role and value of science must be conveyed to the public at large if funding is to remain strong," he said. "The torch must also be passed on to the next generation of scientists, which must include women and under-represented minorities."

The agency currently makes between 200 and 300 awards each year, totalling more than $4.5 million in 1995 and nearly $5 million in 1996. Its programs have assisted in the early research of about 15,000 scientists, 27 of whom have won Nobel Prizes. Prominent past recipients include Carl Wieman of JILA/University of Colorado, who became the first researcher to achieve Bose-Einstein condensation last year, as well as 1996 Nobel Prize winners Richard Smalley and Robert Curl (Rice University) and Robert Richardson (Cornell University).

Funds are distributed primarily through seven formal award programs. The largest is the Cottrell College Science Awards, intended to encourage research with undergraduates through the support for research projects with the potential to add to fundamental scientific knowledge. The awards, which totalled about $2,800,000 in 1996, are designed to provide summer support and currently average about $31,000, covering such expenses as student and faculty summer stipends, equipment and supplies, travel costs to use off-campus facilities, and other services or requirements deemed essential to the research. The principal investigator must have a faculty appointment in a department of astronomy, chemistry or physics in a non-Ph.D.-granting institution in order to be eligible.

The Cottrell Scholars program rewards beginning faculty members desiring to excel at both teaching and research. Awards are for $50,000, to be used at the scholar's discretion, and are available only to tenure-track professors in PhD-granting departments in their third year of appointment. Eighteen such awards were made in 1996, totalling $900,000.

The Partners in Science program is intended to provide high school teachers with opportunities to work at the cutting edge of scientific research, better enabling them to bring inquiry-based methodologies into the classroom. Awards of roughly $14,000 apportioned over two years are made to colleges and universities to support collaborative summer research between high school science teachers and a faculty member with an active research program in a natural science department. Presently these awards are available only in Alaska, Arizona, Idaho, Montana, Oregon and Washington.

The program also seeks to make high school science teaching a more attractive career option, to help teachers guide students toward careers in science, to develop new teaching strategies, and to foster long-term scholarly collaborations.

Research Opportunity Awards are designed for mid-career scientists of demonstrated productivity seeking to explore new areas of research, and typically are in the range of $10,000 to $25,000. "Even proven academic scientists may sometimes need help to re-establish or re-direct their research in promising new directions," said Andreen.

The ultimate goal of these awards is to seed a vigorous, competitive basic research program. The institution is expected to provide matching funds. Eligible applicants must be tenured faculty without major research funding, and must be nominated by the chair of a Ph.D.-granting astronomy, chemistry or physics department.

The newest addition to the corporation's programs is the Research Innovation Awards, scheduled to go into effect sometime this year. These awards are intended for faculty in the first two years of a tenure-track appointment at a research university. According to Andreen, the foundation expects to award about 60 grants each year, of up to $35,000 each.

In addition to the formal award programs, the Research Corporation will occasionally invite proposals from promising candidates in private or public undergraduate chemistry or physics departments that produce a high volume of science graduates, based on suggestions and input from the academic community. "A very small group of undergraduate colleges have been conspicuously successful at producing science graduates," said Andreen of the rationale for the program. "The number of these highly productive schools is not growing."

Despite its humble beginnings, the Research Corporation became an engine of social change that has had a profound effect on science, education and industry today.

1997 DEADLINE INFORMATION

Below are the 1997 application deadlines for various award programs administered by the Research Corporation. For more information on eligibility and application requirements, contact the foundation directly at 101 North Wilmot Road, Suite 250, Tucson, AZ 85711-3332; phone: (520) 571-1111; fax: (520) 571-1119; email: awards@rescorp.org; Web site: http://www.rescorp.org.

Cottrell College Science Awards:	May 15 and November 15, 1997
Cottrell Scholars:	September 1, 1997
Partners in Science:	December 1, 1997
Research Opportunity Awards:	May 1 and October 1, 1997
Department Development Program:	By invitation only

APS Honors Two Young Physicists With 1996 Apker Award

Two promising young physicists have been named by the APS as recipients of the 1996 Apker Award for their research achievements as undergraduates. Christopher Schaffer and Benjamin S. Williams will each receive a $3,000 stipend, a certificate, and a travel allowance to attend the 1997 Joint APS/AAPT Spring Meeting in Washington, DC, in April, where the award will be presented. They will also be invited to present papers at an appropriate technical session during the meeting. Since 1992, the committee has sought to select two winners, one from a Ph.D.-granting institution and one from a predominantly undergraduate institution.

Schaffer was honored for his thesis entitled "Programmable Shaping of Ultrabroad-Bandwidth Pulses from a Ti:Sapphire Laser," which has been published in the *Journal of the Optical Society of America B.* He graduated from the University of Florida in Gainesville in December 1995, with minors in both mathematics and English. He is currently pursuing graduate studies in physics at Harvard University under a National Defense Science and Engineering Fellowship awarded him by the U.S. Department of Defense.

While an undergraduate, Schaffer worked on the development of ultrafast laser spectroscopy, with particular responsibility for the generation, manipulation, and amplification of femtosecond laser pulses. The ability to do spectroscopy at these ultra-short time scales could result in applications extending from basic science to practical applications in biophysics, such as the study of the back of the retina for early diagnosis of eye disease. In addition to successfully developing the theory and implementation of temporal pulse shaping techniques at ultrashort time scales, Schaffer recently worked on the construction of multipass amplifier systems for a femtosecond laser system.

Williams was honored for his thesis entitled "Mixing of a Passive Scalar in a Two-Dimensional Turbulence," which has been submitted to *Physics of Fluids* for publication. He is currently pursuing graduate studies at the Massachusetts Institute of Technology's Department of Electrical Engineering, where he has been awarded a research assistantship.

During his senior year at Haverford College, Williams embarked on a novel experimental study of mixing in two-dimensional turbulence, testing an old but never satisfactorily confirmed prediction about the spatial power spectrum at high wavenumbers of a weakly diffusing impurity that is passively advected by a flow. He obtained strong evidence for an unexpected result, namely, that the power spectrum of the concentration field falls off much more strongly with increasing wave number than had been anticipated. His result may have interesting applications to geophysical transport.

Established in 1978 through an endowment by Jean Dickey Apker in memory of her fellow solid state physicist and husband, LeRoy Apker, the Apker Award is given annually in recognition of outstanding achievement in physics by undergraduate students. It is intended to encourage young physicists who have demonstrated great potential for future scientific accomplishment. All students at U.S. colleges and universities who were undergraduates during at least part of the year prior to the deadline for nominations are eligible to apply.

Christopher Schaeffer

Ben Williams

OPINION

APS VIEWS

FIAP Celebrates Its First Anniversary

by Frederick Dylla and Leonard Brillson

Fred Dylla

Leonard Brillson

On behalf of the APS Committee on Applications of Physics (CAP) and the Executive Committee of the Forum on Industrial and Applied Physics (FIAP), we have the pleasure of reporting on the state of the FIAP as it passes its first year of operation. During this period, FIAP has grown from zero to nearly 5,000 members, reflecting a latent desire by a significant portion of the APS membership for attention to applied physics. FIAP is now the largest forum and the second largest single unit within the APS. During its first year, FIAP served the APS industrial and applied community in an array of activities, including symposia at APS meetings, fellowship and prize recognition, jobs and career development, community awareness and communication, and collaboration with other APS units.

Symposium Programs - FIAP developed an outstanding set of symposia for the 1996 APS March and Joint Meetings as well as for other meetings. These well-attended symposia provided insights into the physics and engineering underlying a diverse array of technologies, ranging from physicists at work on Wall Street to the "physics of garbage." A unique set of symposia were developed for next spring's meetings that emphasize applied science. Included are tutorials aimed at educating attendees on industrial environments and the opportunities for collaborative research arrangements.

Fellowship and Prize Recognition - Council approved FIAP's first slate of APS Fellows last November — the first time in APS history that physicists will be formally recognized specifically for industrial and applied achievements. The FIAP Fellowship Committee and a panel of widely respected senior physicists with industrial backgrounds developed a set of selection criteria that, retain the standards of excellence required for APS Fellowship while recognizing accomplishments of industrial and applied physicists. There are few APS prizes recognizing industrial and applied achievements. FIAP is exploring the possiblily of developing new APS prizes in these areas to supplement the existing APS George Pake Prize, which recognizes leadership of industrial research and development at a senior level.

Jobs and Career Development - FIAP has introduced several initiatives aimed at better serving our membership's needs for jobs and career development. It is a participant in the recently formed APS Task Force on Career and Professional Development (see *APS News*, December 1996). At the 1996 APS March Meeting in St. Louis, FIAP collaborated on a series of informal gatherings called "Meeting Industrial Physicists," where more than 250 attendees heard how physicists work in industry and what skills companies look for in potential employees. That program attracted so many participants that demand for informal groups exceeded the supply of speakers to staff them. The FIAP home page (http://www.aps.org/FIAP/index.html) now provides additional job and career information. This page contains a schedule of upcoming FIAP events, links to major R&D career sites, FIAP's latest newsletter, as well as a speakers list featuring more than 150 industrial and applied physicists. The speakers list is intended to serve as a resource for high schools and universities that desire to hear about industrial research. The FIAP newsletter includes articles on industrial R&D, new career paths for industrial physicists, tips on employment opportunities, and information on APS career workshops. Shortly, FIAP will launch a prototype Web site, that will allow confidential resume circulation and allow employers to advertise new jobs to members efficiently.

Community Awareness and Communication - FIAP is exploring new approaches to build community awareness and communication in the industrial and applied membership of APS. Several hundred members responded to a call for volunteers for specific activities. A database file has been developed by the APS of volunteers by activity, geographical location, and professional background. This will make it possible, for example, to provide locally-based volunteers for specific events related to jobs workshops, counseling, or technical symposia. This volunteer base will help provide opportunities for job and mentor contacts, as well as providing FIAP leaders with needed support for new initiatives.

Collaboration with Other APS Units - FIAP has joint activities planned with other APS units. Most notable thus far is a planned joint meeting of FIAP and the Division of Computational Physics (DCOMP), to be held August 25-28, 1997, at the University of California, Santa Cruz.

What's Next - As FIAP passes its first anniversary, it is poised for many new initiatives. We especially want to enlist the participation of a wider group of members in such activities as: organizing and participating in FIAP symposia and short courses, becoming mentors or counselors in our career workshops or "Meet Industrial Physicists" programs at meetings, helping develop FIAP web pages; becoming part of our employment network, becoming a lecturer in the APS Industrial Speakers list, or running for FIAP office. Overall, FIAP provides a forum for APS members to participate in addressing employment, career development, and professional recognition issues in the tough new R&D environment physicists are all facing.

H. Frederick Dylla is a scientist at the Thomas Jefferson National Accelerator Facility, and was 1996 chair of the APS Committee on Applications of Physics. Leonard J. Brillson is a professor at Ohio State University, former research manager at Xerox Corporation and is chair of the APS Forum on Industrial and Applied Physics. The authors thank a number of their colleaques who were instrumental in making the new Forum on Industrial and Applied Physics possible: Andrew Sessler, Abbas Ourmazd, Charles Duke, Arlene Modeste, Barrie Ripin and Judy Franz.

LETTERS

New Mechanisms Needed To Effect Change in Science Education

I was dismayed to read the article by Laurie Fathe regarding undergraduate education. I hope the NSF and NRC reports from which she quotes included more than the futile exhortations that she chooses to report. I doubt that anyone concerned with science or science education would argue with the need for changes and improvements, but "redefining scholarship" and a litany of "shoulds" and "oughts" won't produce any lasting change (and I vehemently oppose the denigration of the power of the term "scholarship" that will follow from its "redefinition"). To advance the importance of and attention to teaching, one must first analyze the basis for and origin of its present low status.

Universities first formed when researchers (and by no means only in science), who had learned they could finance their research by teaching activities, banded together to reduce costs and fluctuations in the number of students, hence income. The existence of a usefully large student population was due to a combination of faddishness and recognition that learning could be valuable in many practical pursuits. But this did not change the basic motivation of the teachers, namely, their research.

This continues to color all of our higher academic institutions. When other private universities were founded independently for other social reasons later, their administrations had to provide for research of the faculty or they could not compete with the original institutions for high quality faculty, that is, faculty that, by their brilliance, discoveries and accomplishments would attract paying students. Public colleges and universities are indeed free to make a different bargain, in principle, but again, only at a cost in quality: There seems to be a very close connection between those with the best understanding of academic subjects and those who seek to advance knowledge in each area. This may be recognized and dealt with, but it can neither be redefined nor chastised away.

I do not know of a supportable solution to the need to change this situation to better accommodate the needs for teachers as opposed to researchers. My own inclination would be to require higher degrees in particular subjects, right down to and including the high school level, as a prerequisite to any training with regard to teaching as a subject-independent discipline of its own. I am aware this contention is speculative, and politically opposed by current teachers.

However, no solution can possibly be viable if it totally ignores the antecedents that have produced the currently extant, and stable, dominance of research prowess as the determining factor in faculty accumulation. Obfuscating the facts with ponderous verbiage as is so frequently done by politicians and self-styled educators can never lead anywhere really useful. Fathe represents the NSF as merely seeking to force (or worse, buy) the desired end, rather than to creatively build new mechanisms, based on realities, that will intrinsically generate the respect and value for teaching that they (correctly) seek.

T. Goldman
Los Alamos, New Mexico

GEC Highlights *(continued from page 4)*

moderated by collisions with the background gas.

David Geohegan of Oak Ridge National Laboratory has employed a combination of fast plasma diagnostics to characterize fundamental collisional phenomena relevant to PLD film growth in vacuum and background gases, including optical emission spectroscopy, optical absorption spectroscopy, and fast Langmuir probe analysis. These phenomena are highly relevant to understanding cluster formation and aggregation by ablation into background gases, which in turn are of practical importance for the current synthesis of nanocrystalline and composite materials.

In addition, Dieter Gruen of Argonne National Laboratory has accomplished the first synthesis of diamond films using fullerene (C60) precursors in an argon microwave plasma without the addition of hydrogen, which strongly suggests that the diamond phase grows by a new and hitherto unexplored mechanism. According to Gruen, diamond films produced this way are nanocrystalline, smooth, and highly reflective, and maintain their nanocrystallinity to thicknesses of more than 20 μm. "Diamond nucleation occurs in preference to graphite nucleation as a result of the thermodynamic stability of nanocrystalline diamond," he said. "Once established at the level of supercritical or embryonic nuclear size, growth continues even in the absence — or virtual absence — of hydrogen because of the large energy barrier for the solid-state nucleation of the stable bulk graphite phase."

Waste Remediation

Scientists at the Naval Research Laboratory are investigating the application of plasma arc technology for the onboard remediation of waste material generated by sea faring ships. They use a 150kW arc torch within a one-meter diameter chamber for the pyrolysis of liquid and solid material to simulate the waste stream. According to NRL's John Giuliani, the greatest challenge for a shipboard plasma remediation is the overall size of the system imposed by the limited confines of a ship. "The research component of NRL's program is to characterize the gaseous byproduct emanating from the remnant slag and the plasma arc through systematic experiments, as well as to model the plasma dynamics and chemistry within the chamber," he said, adding that spectroscopy offers the potential of a non-invasive diagnostic to eventually be used for online process control, a necessary feature for a operating system because of the heterogeneous waste stream.

OPINION

In Search of an Improved Science and Public Policy Process

by David Hafemeister

Historians tell us that there are many driving forces of history, such as the forces of great persons, those that divide or unite nations, and those between competing economic systems. My personal conclusion is that science and technology is the foremost driving force of history. What we scientists and engineers discover, the industrialists will produce and society will consume. Take away modern agricultural, military, transportation and communication technologies and a very different society appears. It is clear that society is not eager to destroy our looms, automobiles and CD players.

Along with this primal role of creation, physicists have the concomitant responsibility to do our best to determine the impacts of implementation. This is serious business. There is no room for errors of omission or commission. Because the stakes are very high and because science means knowledge, we are obligated to be honest, objective and open. Too often our analysis fails to mention major uncertainties and competing issues that are not directly comparable. It is our job to lay out all the facts and ask the hard questions.

On several issues I have observed a less than stellar science and technology policy process: (1) lurching towards a plutonium policy in the 1970s; (2) determining the appropriate level of nuclear deterrence during the Cold War; (3) debating the extent and significant of Soviet "cheating"; and (4) considering a 2 mGauss standard for powerlines. These and other examples have convinced me that the science and technology decision process needs help.

I would argue that today's general cynicism of rational thought undercuts the policy process. As part of this, the anti-science movement has contributed to an environment in which the issues can be clouded and mishandled. This movement is not new — it has been with us since before Galileo was put under house arrest. Our main hope is the credibility of our scientific citizens who use an open, peer-reviewed process to state our limitations and uncertainties. I offer the following ideas on improving the science and technology public policy process.

Individual Ethics

The 1991 APS "Guidelines for Professional Conduct" and the 1993 AAAS position paper on "Good Science and Responsible Scientists" are excellent statements as far as they go, on nonfabrication of data, authorship, peer review and conflict of interests. But the importance of science and technology issues demands a stricter, more proactive code of ethics. This demands a discussion of uncertainties, ranges of estimates in numbers, opinions, and lists of omissions; peer review comments from a wide group of reviewers; condemnation of those who favor your conclusions, but who use data incorrectly or overstate the case; and responses to questions from nonpartisan omsbudsmen who represent truth-seeking as compared to advocacy.

A Non-Adjudicatory Process

In the 1970s, there was a flurry of interest in Arthur Kantrowitz's concept of the Science Court, in which scientific experts would be the judges and "case managers." The judges were to be unconnected to the dispute, with the hope of removing hard-charging advocacy. The Science Court was not to be empowered to make judicial decisions, but only to give recommendations to the courts or decision makers.

For a variety of conflicting reasons, the Science Court did not survive, but an excellent result appeared from its byproduct, the Scientific Advisory Procedure. In 1985, under the leadership of Kantrowitz, Edward Gerry (arguing in favor of the Strategic Defense Initiative) and Richard Garwin (arguing in opposition), discussed the issue under formal procedures and drew up a list of agreed statements that both could support. If those 15 agreed statements had been widely publicized and ultimately accepted as honest output from two excellent scientists who fundamentally disagreed, the SDI debate could have been narrowed and made more rational. If the results had been read in executive branch and congressional meetings, it would have considerably raised the level of discussion.

Questions for the Record

Sometimes the U.S. Congress has done a good job of handling controversial science and technology issues, but often it has not. The Congress has a unique opportunity to produce hearing records with penetrating follow-up questions to and from experts. However, the members of Congress often feel that hearing records are of little importance, and they are often printed after the issue has been settled. These decisions are often made by non-scientists who don't care about setting the record straight and don't worry about clarifying the issues.

For example, the concern that nuclear waste to be stored at Yucca Mountain might explode could have been rapidly clarified with some penetrating technical questions to those on both sides of the issue. It would not have taken a great deal to show what had and had not been calculated. Of course, the National Academy of Science can and does perform this task, but it often seems to take too long for the NAS to produce its product, and the system often doesn't know how to absorb it. And of course, we can all think of an NAS study that we thought was wrong!

Benevolent Omsbudspersons

Science must be honest, objective and open, and the same holds true for science and technology policy. If two divergent groups of honest scientists could work together and prepare an annual report of errors and overstatements on science and technology issues, this would put pressure on scientists to pay attention to the code of ethics discussed earlier. The APS has the credible intellectual talent to do this, but I can't imagine the Society would want to get involved in all of the issues. Perhaps two nongovernmental organizations with differing constituents could develop panels of impeccable scientists to ask questions of the proponents and assess who went beyond the truth. I am hopeful that our scientific training would make the difference for removing "lies, damn lies and bad statistics."

I am still searching for the perfect wave. Paraphrasing A.E. Housman's "A Shropshire Lad":

> When I was one-and-twenty
> I heard a wise man say
> "Give me scientific facts and logical thought and the society will choose wisely."
> Now I am two-and-sixty,
> And oh, 'tis not always, 'tis not always true.

David Hafemeister is a professor in the physics department at California Polytechnic State University in San Luis Obispo, California, and chaired the APS Panel on Public Affairs in 1996. An earlier version of this article appeared in the October 1996 newsletter of the APS Forum on Physics and Society.

The APS Mass Media Fellowship Program

by James J. Wynne

Physicists generally agree that the public does not understand or appreciate physics research. Furthermore, most physicists realize that the majority of non-physicists gain information about physics through the mass media, both print and broadcast. Recognizing that the physics community could greatly benefit from a broader and deeper understanding and appreciation of physics by the public, the inescapable conclusion is that we have to enhance the frequency and accuracy of physics reporting in the mass media.

The APS Forum on Education has focused its attention on programs to educate the public: both students of physics and adults. Ultimately we decided to have physicists join the ranks of science reporters, at least temporarily, through a short-term fellowship program. Rather than create an entirely new program, we decided to work with an established, successful program that has administrative infrastructure and contacts with media organization: the American Association for the Advancement of Science (AAAS) Mass Media Science & Engineering Fellows Program. In its 21-year existence, the program has placed approximately 350 fellows with news magazines, newspapers, TV networks and many local organizations. Following completion of their fellowships, about half of the fellows returned to traditional science and engineering careers, while the other half found employment in the mass media.

We proposed to the APS Council that the Society set up a similar program to enable physicists to spend up to three months working in the mass media. Initially, the fellowships will be intended for two physicists in the early stages of their careers, including, in particular, graduate students and postdoctoral fellows. Council approved our proposal in November 1995 and applications are now being accepted for internships this summer, with a deadline of January 15.

Just imagine what might happen to the public's perception of physics and physicists if one of our Mass Media Fellows became the screen writer for a popular TV program starring "cool" physicists — some sort of cross between "ER" and "Flash Gordon," with Dr. Zharkov (Flash's older, wiser scientist colleague) portrayed as not only smart, but also youthful and dynamic. We could call the program "College Park Crisis Center" and focus on a team of physicists called upon to troubleshoot when crises arise.

Here's a sketch of a possible episode: the federal government is threatened by financial crisis because the ink on the new $100 bills fades, making the money unreadable. Our heroes conduct spectroscopy experiments and discover that exposure to excess solar ultraviolet radiation (a consequence of ozone depletion) has optically pumped the dye molecules in the ink to a long-lived triplet state from which they do not absorb visible light. A brilliant graduate student from UCLA (who also happens to be an Olympic diving champion), spending her Kumar Patel fellowship at the American Center for Physics, solves the problem by two-photon irradiation of the dye molecules with an infrared photon from a carbon dioxide laser — that just happens to have been invented by Kumar Patel, recent National Medal of Science winner and 1995 APS president — and an ultraviolet photon from the NIST synchrotron, photochemically converting the ink dyes to a new isomer with a short-lived triplet state. A government default is thereby narrowly averted.

Too far-fetched, you say? Then consider the case of Neal Baer, 1983 AAAS Mass Media Fellow, who was originally hired as a technical consultant for "ER," but after rewriting Michael Crichton's pilot, replacing Crichton's dated medical school knowledge with state-of-the-science knowledge, was hired as a full-time writer — the only one with any medical training.

Whether or not the APS Mass Media Fellows become sources of hit TV programs, we expect them to provide their journalist colleagues with a better understanding of physics, while gaining on-the-job experience in mass media. At the end of their fellowship tenure, they will serve as a resource for the physics community to facilitate and enhance our communications with the mass media and, ultimately, the public.

James Wynne is a research staff member at the IBM/T.J. Watson Research Center and was the Forum on Education's representative to the APS Council from 1993-96. Application information for the APS Mass Media Fellowship Program can be found in the November and December 1996 issues of APS News *and on the APS home page.* ***The submission deadline is January 15, 1997.***

Inside the Beltway

(continued from page 1)

popular programs, look for many of them to take political cover by lining up in favor of a bipartisanship on entitlement reform. Whether they can move fast enough to relieve much pressure on the FY 1998 budget, however, is far from certain, particularly since the President was so politically successful in attacking Republicans for proposing Acuts@ to Medicare, Medicaid and Social Security. Still, the process of finding ways to constrain these programs will almost certainly begin during the first few months of the next session.

In the House, the prospects for bipartisanship are relatively good. Although publicly, many Republicans continue to express satisfaction that they successfully maintained control of the chamber, most are well aware that their governing majority is razor thin. Only five times during the last century has the majority party in the House had a narrower percentage advantage.

House Republican leaders also know that had a few thousand votes swung the other way in a dozen races around the country, they would have lost their majority status entirely. Chastened by these realities, Newt Gingrich (R-GA), who ran unopposed for Speaker within the Republican ranks, issued a call for cooperation with the Democrats almost immediately after the House results were known. He was joined in this appeal by the rest of the returning Republican leadership.

The Democrats, for their part, made a significant move toward the center, as well, when they chose seven-term conservative John M. Spratt, Jr. (D-SC) over liberal Louise Slaughter (D-NY) as ranking member of the Budget Committee. The Democratic tilt toward the center was also evidenced by the party's decision to award another conservative, Charles W. Stenholm (D-TX), the ranking position on the Agriculture Committee.

All this potentially bodes well for science, which for the last two years was an unwitting victim to the partisan wrangling that characterized what passed for debate in the 104th Congress.

The House leadership will feature a few new faces in the 105th Congress, as well as many old ones. Budget Committee Chairman John Kasich (R-OH) and Appropriations Committee Chairman Bob Livingston (R-LA) both will be returning, as will be Appropriations Subcommittee Chairmen Jerry Lewis (R-CA) for VA, HUD and Independent Agencies (including NSF, NASA and EPA), Harold Rogers (R-KY) for Commerce, Justice, State and Judiciary and Bill Young (R-SC) for National Security.

Jim Sensenbrenner (R-WI), a low-key conservative who was Space and Aeronautics Science Subcommittee Chairman in the 104th Congress, will assume the chairmanship of the full Science Committee in the 105th. He will be filling the shoes of the demonstrative and often contentious Robert S. Walker of Pennsylvania, who was a staunch proponent of basic research and an equally staunch critic of the Clinton Administration's technology programs. Walker retired last year after twenty years of service, much of it within the rarified circles of the GOP leadership.

Joseph M. McDade (R-PA), passed over for Appropriations Committee chairman last time around while the subject of a federal bribary investigation, a charge of which he was finally acquitted last summer, again lost out to Bob Livingston for the powerful, coveted position. Instead, McDade will take over control of the Energy and Water Development Appropriations Subcommittee, replacing another retiree, John R. Myers of Indiana. How physics will fare in the House this year will depend heavily on the actions of McDade and Sensenbrenner.

In the 104th Congress, the Senate, under the leadership of Majority Leader Bob Dole, was the more conciliatory of the two legislative bodies. In the 105th Congress, the tables are likely to be turned. As much as the new House is tilting toward the center, the new Senate will be listing toward the right. Majority Leader Trent Lott (R-MS) will have his hands full with eight new Republican Members, whose views are dramatically more conservative than those of the Republicans and Democrats whom they are replacing.

Lott and Senate energy czar Pete V. Domenici (R-NM) undoubtedly will be faced with renewed calls for abolishing the DOE, led by freshman Senator Sam Brownback (R-KS), who as a member of the House in the 104th Congress, spearheaded the drive to close down four federal cabinet-level agencies. Look for Domenici to offer a compromise: Eliminate DOE as a cabinet-level department and reconstitute it as an energy administration with a technologically trained director. Not a bad idea, huh? And if they called it the Energy Research and Development Administration, they could save taxpayers the cost of printing new stationery, assuming the old stuff is still around and hasn't turned too yellow. It should be an interesting year.

APS Election Results

(continued from page 1)

Park. His research centers on investigations of the mathematical properties and realizations of supersymmetry in quantum and classical theories of particles, fields and strings, and co-authored *Superspace*, the first advanced comprehensive book on supersymmetry. Gates was the first director of the NASA-supported Center for the Study of Terrestrial and Extra-Terrestrial Atmospheres, and was the recipient of the first APS Edward Bouchet Award.

In his candidate's statement, Gates cited the history of the physics community and its response in times of crisis, concluding, "We have always responded to adverse conditions with the same attention to observation of our surroundings, comprehension of the underlying cause-and-effect relations and actions based on a logical and rational assessment of these as we apply to the advancement of our field." As an APS councillor, he intends to draw upon his extensive personal and professional experiences to provide rational advice, opinions and suggestions for meeting the challenges of the present crises.

Peercy received his Ph.D. in physics from the University of Wisconsin at Madison in 1966, and spent the next two years as a postdoctoral fellow at Bell Laboratories. In 1968 he joined Sandia National Laboratories, performing research in such solid state physics areas as plasma in solids, inelastic light scatting in solids, phase transformations and ferroelectricity, and semiconductor physics. Most recently he served as Sandia's director of microelectronics and photonics, with responsibility for its silicon, compound semiconductor, sensor and packaging R&D activities. In August 1995 he left Sandia to assume the presidency of SEMI/SEMATECH, a consortium of more than 200 companies that provides the U.S. equipment and materials supplier base for the semiconductor device manufacturing industry.

In his candidate's statement, Peercy focused on the major changes occurring in U.S. physics research and development, particularly the end of the Cold War, the resulting loss of national consensus for research funding, increased international competitiveness, and corporate downsizing and the resulting decreased support for central research laboratories. "It is critical that we ensure a strong research university system that continues to provide the new knowledge and new scientists needed for the future," he said, calling for increased awareness of structural changes in industry within the academic community, as well as educating industry about the value of supporting a strong university system.

Trimble received her Ph.D. in astronomy and physics from California Institute of Technology in 1968, and presently divides her time between the physics department of the University of California, Irvine and the astronomy department of the University of Maryland. Her early research focused on advanced stages of star evolution, including white dwarfs, supernovae and pulsars. More recently she has investigated the statistical distributions of properties of binary stars and numerous topics in the history and sociology of physics and astronomy. She has served as secretary-treasurer of the APS Division of Astrophysics, and on the APS Committee on Meetings.

As a self-described "hyphenated physicist," Trimble believes that including additional subdisciplines as part of the Society's core — such as biophysics, engineering physics, geophysics, and medical physics — will further strengthen the APS and physics as a whole. She also called for greater diversity of generation as well as discipline in her candidate's statement, and for maintaining communication with those with undergraduate degrees in physics. In addition to providing support for young scientists, "We also need to think about ways that physics and the APS can maintain support and opportunities for young scientists, and make the best use of the wisdom and skills of more senior scientists," she said.

Wu received her Ph.D. in high energy physics from Harvard University in 1970 and did her postdoctoral study at MIT. She participated in the 1974 discovery of the charm quark at Brookhaven National Laboratory, where she had previously spent a summer as an undergraduate student. She has been a faculty member in the physics department at the University of Wisconsin at Madison since 1977. A co-recipient of the European Physical Society's 1995 High Energy and Particle Physics Prize for the first direct observation of the gluon, Wu is also a member of the DOE's High Energy Physics Advisory Panel.

In her candidate's statement, Wu identified her primary objective as improving international cooperation in physics. "The interests of overseas American physicists at international research centers are underrepresented in APS activities," she said. She feels that her upbringing in Hong Kong, as well as stints at DESY and CERN, will allow her to bring such an international perspective to the APS Council.

January 15 Deadlines

Physics Limerick Contest

Limericks selected will be printed in *APS News* and authors awarded a dunking bird, arguably the best physics toy ever invented. Author of the best limerick will win a flock. Submit entries to: letters@aps.org, or mail to: Limerick Contest, *APS News,* The American Physical Society, College Park, MD 20740.

Distinguished Traveling Lecturer Program in Laser Science

The Division of Laser Science is accepting applications from host schools for the next round of awards for the Distinguished Traveling Lecturer Program. The DTL Program is intended to bring distinguished scientists to predominantly undergraduate colleges and universities for two day visits, which may include lectures and informal meetings with faculty and students.

Lecturers for the 1996-97 academic year and their topics are Phil Bucksbaum (University of Michigan) on high-field laser physics, Steve Leone (JILA and University of Colorado) on chemical physics, Bill Phillips (NIST) on atom cooling and trapping, Geraldine Richmond (University of Oregon) on surface nonlinear optics, and Jagdeep Shah (AT&T Bell Labs) on quantum optics.

For information and/or applications:
DLS home page on the World Wide Web at:
http://www.physics.wm.edu/~cooke/dls/p_dtl.html

1997-1998 APS/AIP Congressional Science Fellowships

The American Physical Society and The American Institute of Physics are currently accepting applications for their 1997-1998 Congressional Science Fellowship Programs. Fellows serve one year on the staff of a senator, representative, or congressional committee.

For information and/or applications:
APS/AIP Congressional Science Fellowship Programs
529 14th Street, NW, Suite 1050
Washington, DC 20045
(202) 662-8700 • email: opa@aps.org
See the December issue of *APS News* or APS and AIP home pages: www.aps.org and www.aip.org for details about the program and application procedure.

APS Mass Media Fellowship Program - Summer 1997

For information and/or applications:
APS Mass Media Fellowship Program
529 14th Street, NW, Suite 1050
Washington DC 20045
(202) 662-8700 • email: opa@aps.org
http://aps.org/public_affairs/Media.html (includes PDF application forms)
See the December issue of *APS News* or APS home page (www.aps.org) for details about the program and application procedures.

The American Physical Society

Nomination for APS Fellow

To be sent to:
Fellowship Program
The American Physical Society
One Physics Ellipse, College Park, MD 20740-3844
If space is inadequate, please use separate sheet to answer and attach to form.

Name in full of person nominated: _____
(First Name) (Middle Name) (Last Name)

Address: _____

_____

Date nominee became a member of the APS: _____

Appropriate division(s) to assess nomination: _____

Supporting Data

Nominee's Academic Background

College/University	Location	Major Field	Degree	Year Awarded

Professional Honors _____

_____

_____

Nominee's Employment Background (please specify under "Duties" whether academic, administrative, or research)

Position	Employed By	Duties	Dates of Employment

(Continued on Reverse)

The American Physical Society

NOMINATION BALLOT

Council and Committee Positions

(To be Completed by Members of the Society Only)

Please Attach Appropriate Supporting Biographical Documentation

For Vice-President

Nominee: **Affiliation:**

_____ _____
_____ _____
_____ _____
_____ _____

For General Councillor

Nominee: **Affiliation:**

_____ _____
_____ _____
_____ _____
_____ _____

For Chairperson-Elect, Nominating Committee

Nominee: **Affiliation:**

_____ _____
_____ _____
_____ _____
_____ _____

For Membership on the Nominating Committee

Nominee: **Affiliation:**

_____ _____
_____ _____
_____ _____
_____ _____

(Continued on Reverse)

NOMINATION BALLOT

Council and Committee Positions *(continued)*

For Chairperson-Elect, Panel on Public Affairs

Nominee: **Affiliation:**

_____ _____
_____ _____
_____ _____
_____ _____

For Membership on the Panel on Public Affairs

Nominee: **Affiliation:**

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

Signature and Address of Nominator

_____
_____
_____

Please Address your Envelope to:
The American Physical Society
One Physics Ellipse
College Park, MD 20740-3844
Attn: Amy Halsted
(301) 209-3266
fax: (301) 209-0865
email: halsted@aps.org

The deadline for receipt of this ballot is 3 February 1996.

Nomination for APS Fellowship

(continued)

Nominee's most significant contributions and principal publications (list four publications):

_____
_____

Suggested Citation to Appear on Fellowship Certificate if Nomination is Approved (30 words or less):

_____
_____
_____
_____

Supporting Paragraph Enlarging on the Citation and Indicating the Originality and Significance of the Contributions Cited:_____
_____
_____
_____

Sponsor's Data (Each nominee must have two sponsors who are members of the APS.) **(PLEASE PRINT):**

1 Sponsor's Name:_____ Signature:_____

Sponsor's Address:_____

Sponsor's Recommendation: _____
_____
_____

2 Sponsor's Name:_____ Signature:_____

Sponsor's Address:_____

Sponsor's Recommendation: _____
_____
_____

3 Additional Information Recommended:(a) Curriculum Vitae _____ Date
or Biographical Information
(b) Supporting Letters

PLEASE NOTE: To facilitate this nomination, be sure you have answered every question.
Enclose original and duplicate of nomination form.

For information on deadline dates for specific units consult the APS WWW home page (http://aps.org) under the Prize, Awards & Fellowship button, or call the APS Honors office at (301) 209-3268.

ANNOUNCEMENTS

NOMINATIONS FOR PRIZES AND AWARDS

The following prizes and awards will be bestowed at meetings of the Society in the coming year. Members are invited to nominate candidates to the respective committees charged with the privilege of recommending the recipient. A brief description of each prize and award is given below, along with the addresses of the selection committee chairs to whom nominations should be sent. Please refer to the APS Membership Directory, pages xxiii- xxxix, or the APS home page [http://www.aps.org] under the Prize and Award button, for complete information regarding rules and eligibility requirements for individual prizes and awards.

James Clerk Maxwell Prize

Sponsored by Maxwell Laboratories, Inc.

Purpose: To recognize outstanding contributions to the field of plasma physics.

Nature: The prize consists of $5,000, an allowance for travel to the Division of Plasma Physics Annual Meeting where the prize will be awarded, and a certificate citing the contribution made by the recipient.

Rules and Eligibility: The prize will be awarded to U.S. residents for work done primarily in the U.S. The prize shall be for outstanding contributions to the advancement and diffusion of the knowledge of properties of highly ionized gases of natural or laboratory origin. This prize shall ordinarily be awarded to one person, but a prize may be shared among recipients when all recipients have contributed to the same accomplishments.

Nominations of candidates shall remain active for three years. Send name of proposed candidate and supporting information by 1 March 1997 to: Prof. Allen H. Boozer, Columbia University, Dept of Applied Physics, 500 West 120th St, Rm 202, New York, NY 10027; Tel: (212) 854-4785; Fax: (212) 854-8257; email: ahb17@columbia.edu.

Excellence in Plasma Physics Research Award

Sponsored by Friends of the Division of Plasma Physics.

Purpose: To recognize a particular recent outstanding achievement in plasma physics research.

Nature: The award consists of $5000 to be divided equally in the case of multiple winners, and each recipient will receive a certificate to be presented at an award ceremony at the Division of Plasma Physics Annual Meeting Banquet.

Rules and Eligibility: Nominations are open to scientists of all nationalities, regardless of the geographical site at which the work was done. The award may be awarded to a set of individuals as well as to individual scientists, as appropriate, to honor those who make essential contributions to the cited research achievement. Nominations shall remain active for three years.

Send name of proposed candidate and supporting information by 1 March 1997 to: Prof. Ian Hutchinson, MIT, NW 17-186, 175 Albany St, Cambridge, MA 02139; Tel: (617) 253-8760; Fax: (617) 253-0627; email: hutch@pfc.mit.edu.

Outstanding Doctoral Thesis in Plasma Physics Award

(formerly the Simon Ramo Award)

Sponsored by General Atomic, Inc., and the Division of Plasma Physics.

Purpose: To provide recognition to exceptional young scientists who have performed original doctoral thesis work of outstanding scientific quality and achievement in the area of plasma physics.

Nature: The award consists of $1,500, a certificate, and an allowance for travel of up to $500 to attend the annual meeting of the Division of Plasma Physics at which the award will be bestowed.

Rules and Eligibility: Nominations will be accepted for any doctoral student (present or past) of a college or university in the U.S. or for U.S. students abroad. The work to be considered must have been performed as part of the requirement for a doctoral degree. Also, the nominee must not have passed his or her final doctoral examination or started regular employment more than one and half years before the nomination deadline for the selection cycle in which the nomination is to be considered. Each nominee will be considered in not more than two consecutive cycles.

Send name of proposed candidate and supporting information by 1 March 1997 to: Prof. Raymond Fonck, Dept of Nuclear Engineering, University of Wisconson, 1500 Engineering Drive, Madison, WI 53706; Tel: (608) 263-7799; Fax: (608) 265-2364; email: fonck@engr.wisc.edu.

Nicholson Medal for Humanitarian Service

Established in 1994 by the Division of Plasma Physics and the Forum on Physics and Society, and sponsored by friends of Dwight Nicholson.

Purpose: To recognize the humanitarian aspect of physics and physicists.

Nature: Recognition consists of the Nicholson Medal and a certificate which includes the citation for which the recipient has been recognized.

Rules and Eligibility: The medal is given to a physicist exhibiting extraordinary quality in one of the following areas: (1) a physicist who, through teaching, research, or science-related activities, has implemented a vision for improvement of the quality of life in our society; (2) a physicist who has demonstrated a particularly giving and caring relationship with students or colleagues, has produced works of educational significance, or has created special opportunities for students or junior colleagues; or (3) a physicist who has been a leader in the promotion of international human rights or peace, or in the promotion of international ties in science.

Send name of proposed candidate and supporting information by 1 March 1997 to: Dr. John M. Finn, Los Alamos National Lab, T15, MS K717, PO Box 1663, Los Alamos, NM 87545; Tel: (505) 667-8156; Fax: (505) 665-7150; email: finn@lanl.gov.

CAUGHT IN THE WEB

Notable additions to the APS Web Server. The APS Web Server can be found at http://www.aps.org

APS News Online (latest edition)

Meetings
- 1997 Joint April APS/AAPT Meeting with CAM'97
- 1997 Particle Accelerator Conference
- APS Announces new web based abstract tester

Journals
- Manuscript Submission, by the Web, E-print, Email, or Hardcopy
- Online Journals

Prizes, Awards and Fellowships
- List of NEW 1996 Fellows
- List of NEW 1997 Prize and Awards Recipients

Primakoff Lectureship & Forum Award *(continued from page 4)*

he received his Ph.D. in chemistry from Johns Hopkins University in 1938 until his retirement in 1976. His early research was with photocathode materials and luminescent phosphors, both of which were important in the rapidly developing field of color television. He made many contributions to the early development of the transistor during his tenure there, and also helped promote emerging research efforts in nuclear physics, biophysics and space physics.

Burton served as APS treasurer from 1970 to 1985, volunteering his services while still a research director at Bell Labs. After retiring, he accepted a full-time post and developed a simple and easily understandable administrative system. During his 15-year tenure, the Society's assets grew by a factor of 20 while membership dues increased only modestly. In addition, he organized and managed several APS service programs, including industrial internships, travel grants for students, programs in minorities and women in physics, physics education, and the Apker Award for excellence in undergraduate physics education. According to former APS Executive Secretary W.W. Havens, Jr., "It was Joe Burton who enabled the APS to undertake these activities through his wise management of the Society resources."

Burton retired as APS treasurer in 1985 after an extended bout with cancer, but when he experienced a miraculous recovery he opted to become involved in the science and public policy process. At the age of 71, he chose to offer his services and expertise to the Arms Control Association in Washington, DC, until the year before his death in August 1986 at his home in Chatham, New Jersey.

THE BACK PAGE

Science, Politics, and Human Rights: Lessons Learned from Russia

by Yuri Orlov

Recent discussions of the political situation in China have revealed some emerging problems of defending human rights and, in particular, the human rights of scientists living in totalitarian regimes. The main problem seems to be stability. Opponents of strong human rights pressure on China insist that such pressure can dangerously destabilize the country given its huge, multiethnic and comparatively poor population. "Look at Russia," they sometimes argue. My answer is, "Yes, look at Russia!"

The return to a new type of totalitarian regime that may be less predictable than the previous ones is certainly possible in this country, because many people who thought democracy would provide a quick fix for all their problems are now disaffected with it. This is to be expected in any transition from totalitarianism to democracy. Even so, a large scale civil war is unlikely — Chechnya is a tragic exception — and the texture of political democracy in everyday Russia hasn't been particularly unstable. The pace of political democratization after Gorbachev and his reforms has been more or less normal. There have been some big bumps, of course, like the 1993 bloody conflict between the President and Parliament. However, a feedback system existed in this huge undeveloped democracy, and after the 1993 conflict both sides became much more careful. Basically, the country remains calm.

The major sources of instability in Russian democracy today are economic and legal. When the economic changes from the top came in 1992, they came as a kind of revolution: abrupt and inconsistent, without a prepared basis in law and law enforcement. The scale of crime and corruption in Russia today is the result of the revolutionary economic freedom, not political freedom. No one predicted these crimes, or how quickly people would exploit the new economic situation. The legal swamp in Russia — many laws in conflict, many needed laws absent — does represent a failure of the democrats and intelligentsia. It's hard to imagine how to create a real legal system and body of decent laws overnight, especially in a country with so little experience of them. This would be a problem facing any country shedding its totalitarian past, but certainly more progress should have been made in the last eight years.

A serious area of potential instability in the Russian Federation is multiethnicity. With the tragic exception of the war in Chechnya, there are no armed conflicts between minorities and Russians. Why? Precisely because the idea of solving the problem of national minorities in a maximally democratic way — giving them the full set of cultural, economic and administrative freedoms — was conceptually prepared by the democratic dissidents, who educated the intelligentsia in nonviolent opposition to a violent regime for a quarter of a century. Today there are several generations of intelligentsia in Russia, and even high bureaucrats, who have been educated in this approach, as well as most of the latest generation of journalists, who help to shape public opinion.

The situation is very different in the former Yugoslavia, the Caucuses, and Central Asia, where anti-violent opposition to the communist regimes either has never existed or has been underdeveloped. As a result, mutual solutions of interethnic conflicts are hard and violent in these areas. This is strong evidence that long-time preparation of public psychology by an anti-violence democratic opposition is a crucial factor in avoiding civil war. For such preparation to work, this opposition needs very strong support from around the world. The fact that we Russian dissidents had our partial success, and survived to see it, is partly due to the strong and steady support we received in the West.

The crucial issue, I think, is this: What is really more dangerous for domestic and international peace and security? A repressive totalitarian regime that may gradually improve itself without pressure, or an unstable democracy? I think choosing the former is wrong.

A totalitarian regime like China is a special case. You have the usual repressive regime with almost unlimited political power, a state ideology and restrictions on other ideologies, and a degree of xenophobia and conspiratorial secrecy combined with aggressiveness. However, you also have the dream of being a nuclear superpower. One more super poser is perhaps not a catastrophic problem, if it is a strongly democratic one. For international peace and security, it is extremely important that China become democratic before it achieves that status. For peace inside China, a democratic approach to social, national and religious problems can help avoid violent revolutionary explosions. All this means that scientists concerned with democracy and world peace urgently need to keep up the pressure for human rights in China, and help that small number of our extremely brave Chinese colleagues who oppose totalitarianism and push their leaders peacefully in the direction of democratic political reforms.

But what if such pressure helps give birth to an unstable democracy in China? Unfortunately, there seems to be no formula for making a transition from a totalitarian regime to a safe democracy. This is an area that urgently needs study and work. It is true that unstable democracies have terrorism and thefts of nuclear and other dangerous materials that you don't find in a totalitarian regime. But disappearing plutonium and terrorist massacres are far less dangerous than having yet another confrontation with a totalitarian superpower.

What about a totalitarian regime improving on its own? The very notion of a totalitarian regime gradually improving itself, without permanent and hard pressure, can be a fantasy. (Recall that the Soviet regime was pressed very, very hard.) There is some threshold beyond which a totalitarian regime is too totalitarian to be amenable to improvements. It will suppress them unless pressured, and in the case of China, often suppress them if not pressured hard enough.

Human rights in China is our affair, if only because an undemocratic China is a threat to international peace and security. We may still be uneasy about actively supporting Chinese scientific colleagues who are trying to protest against political repression, on the grounds they are only a tiny part of the scientific community there. Some scientists insist that they are a small minority not because the majority is afraid, but simply because it supports government policy. Even if this is true, it still does not mean that the majority is right.

Moreover, determining who is or is not really opposed to their totalitarian government is a rather more complicated phenomenon than it appears. For scientists in a totalitarian society, the line between the professional and the political collapses because neutrality is not tolerated by the regime. Scientists have only two choices: cooperation (some might say, complicity) with the regime, or resistance to it. Remember, your salary comes from the regime. Your promotions, opportunities for publication, and travel abroad depend on political evaluations. Your outstanding work supports the regime by adding to its international prestige and, in the case of technological and military work, its economic and military power. A line cannot be drawn between the cooperation and non-cooperation of an active, working scientist. It can only be drawn between degrees of cooperation.

The responses to this dilemma by scientists in Soviet Union were radically diverse. In April 1956, I declared at an open Party meeting in ITEP that we needed democratization on the basis of socialism. Along with three other speakers, I was immediately expelled from the Party and fired from ITEP, without the right to work in any scientific institute in or near Moscow. Also at that time, about 20 leading physicists, including Kapitsa and Sakharov, were very active in writing collective letters to the leaders protesting attempts to restore or protect Stalinism.

The majority of scientists, however, were afraid to participate in such activity, and maintained an ambiguous or hypocritical public silence. Some did criticize the regime, but only in the privacy of the famous Moscow kitchens. Only a small minority expressed strong professional and public support of the regime, and lack of support for colleagues opposed to the regime. A tiny minority chose ideological confrontation with the regime, which cost them their scientific careers and in some cases incarceration in prisons, camps, and exile.

In 1970, I told a friend who was a famous physicist that I was preparing a letter to the Soviet authorities about the situation in Soviet science. "But," he asked, "Do you want to continue to work as a physicist?" There was nothing wrong with this concern and indirect advice. What amazed me was that after this conversation he always avoided me and at one scientific meeting bypassed me as if I were a pole on a complex plane.

Nowadays, truly amazing numbers of Russians, scientists included, present themselves as having been longtime dissidents and democrats. Still, it is true that from the mid-1960s until Gorbachev's time, there were more free kitchen discussions, more people listening to foreign radio broadcasts, more samizdat readings, fewer citations

of Lenin and Marx even by Party-member intellectuals, and more non-dissident "outsiders," including scientists, secretly helping their oppressed colleagues by giving money and clothes, sending letters to camp, and helping to transmit our human rights information.

With regard to our colleagues in China, what should we do apart from active support of persecuted fellow scientists? We need to face the issue of collaborating with the fellow scientists who are officially acceptable to the regime. Their cooperation with the regime is a matter of degree, so it is desirable to examine each case, putting our emphasis on science but not closing our eyes to the obvious. Here it may be argued that any and all contacts with our Chinese colleagues are necessary to "keep lines of communication open" in order to have some beneficial effect on the regime. But what lines of communication are involved? Certainly not ones of genuine, serious political discourse. During the 1930s Stalin had several thousand Americans and Germans working in Russia, and it didn't make a bit of difference.

Furthermore, it is one thing to invite Chinese scientists to the West, and quite another to go to a conference in China. We organize independent, scientific conferences. They organize official conferences that are always mixtures of science and state politics. Western scientists who think that scientists should not be involved in politics should bear this in mind: attending a scientific conference in China is participating in a political situation. Attending such conferences is constructive if one publicly speaks out in defense of scientific colleagues being punished for their political views. Keeping silent in such circumstances helps the regime by legitimizing the persecution of colleagues.

In short, just as scientists in a totalitarian society cannot separate the professional and the political, neither can visiting western colleagues going to China or any other totalitarian state. This is one of the many reasons why totalitarianism is an affront to us as scientists and as human beings. It is one of the reasons why we should do our best to oppose it.

Yuri F. Orlov, recipient of the 1996 APS Nicholson Medal for Humanitarian Service, is at the Newman Laboratory, Cornell University, Ithaca, New York. *This article was adapted from a lecture given at the 1996 APS/AAPT Spring Meeting in Indianapolis, Indiana. A longer version appeared in the October 1996 issue of the newsletter of the Forum on Physics and Society.*