APS NEWS

DECEMBER 1996 THE AMERICAN PHYSICAL SOCIETY VOLUME 5, NO 11

Two New APS Officers Begin Tenures

Two new operating officers are joining the APS, one as of November and the other in January 1997. Thomas McIlrath, associate dean for research and graduate studies at the University of Maryland, College Park, replaced retiring APS Treasurer Harry Lustig on November 11. Martin Blume, deputy director of Brookhaven National Laboratory, succeeds retiring APS Editor-in-Chief Benjamin Bederson on the first of the year.

As the Society's chief financial officer, the APS Treasurer is responsible for the preparation and administration of the APS budget, for the Society's investments, for business interactions with the American Institute of Physics, for the Society's legal affairs, and for personnel policies and administration. The Treasurer is also expected to participate in all aspects of the governance, policy formation and administration of the Society, and along with the Executive Officer and Editor-in-Chief, has the responsibility for supervising the APS staff.

McIlrath received his Ph.D. in physics from Princeton University in 1966 and spent the following year as NATO postdoctoral fellow at England's Oxford University. After several years as a research associate at Harvard College Observatory, he joined the faculty of UMD, where he is presently a professor in the Institute for Physical Science and Technology, in addition to his deanship and role as staff physicist for the National Institute of Standards and Technology in Gaithersburg. He is an active member of the APS Division of Laser Science, which he chaired in 1988.

The APS Editor-in-Chief has responsibility for the research journals published by the Society, including the large editorial and journal support staff located in Ridge, New York. Responsibilities include preserving and enhancing the quality of APS journals, leading APS efforts in electronic publishing, working with senior editors to set journal polices, and handling appeals and ethics cases involving authors.

Blume received his Ph.D. in physics from Harvard University in 1959 and spent the following year as a Fulbright Fellow at Tokyo University. After two years as a research associate at Atomic Energy Research Establishment (AERE) in Harwell, England, he joined the staff of Brookhaven, where he headed the solid state physics group and chaired the National Synchrotron Light Source department before becoming deputy director in 1984. From 1972 to 1980 he was also a professor of physics at SUNY-Stony Brook.

Marty Blume

Tom McIlrath

Blume's research interests include theoretical solid state physics, magnetism, phase transitions, slow neutron scattering and synchrotron radiation. His extensive APS service includes stints as chair of the Panel on Public Affairs and Nominating Committee, as well as service with the Forum on Physics and Society and on the APS Council and Executive Board. He has also served on the editorial board of the *Physical Review* in addition to several other publications.

Data Storage, New Laser Advances Featured at ILS-XII Meeting

Optical and laser scientists from around the world gathered in Rochester, New York, 20-24 October 1996, for the twelfth annual Interdisciplinary Laser Science Conference (ILS-XII). The conference serves as the annual meeting of the APS Topical Group on Laser Science, in conjunction with the Optical Society of America (OSA). First held in Dallas, Texas, in 1985, the ILS series was established to survey the core laser science areas, including lasers and their properties, nonlinear optics and ultrafast phenomena, the physics of laser sources, lasers in physics and chemistry, and other laser applications.

Optical Data Storage

The most direct means of achieving large increases in the capacity of optical disk storage is by using three dimensions rather than the two presently used, according to F.B. McCormick of Call/Recall Inc. in San Diego, California, who maintains that two-photon absorption induced changes in dye-doped plastic media offer an inexpensive means of producing high-density multilayer memories.

Scientists at the University of Dayton in Ohio have discovered that micromirrors measuring about 100 microns are suitable for angle multiplexing in holographic data storage systems. Such devices demonstrate fast response times, due to their small inertia, and can readily be designed to scan over two dimensions in angle while simultaneously executing displacements that induce phase shifts, according to UD's Steven Gustafson, who spoke at a Monday morning session. More practical advantages include superior ruggedness and low cost.

To achieve improved imaging performance, Stephen Kowel (University of Alabama, Huntsville) has fabricated a liquid crystal adaptive lens using a novel conductive ladder meshing technique to minimize the number of control electrodes. The focal distance and transverse image position can be set by microcomputer, thus improving image quality. Other speakers covered such topics as recent advances and future optical head architectures using increased integration; the optical design and analysis of thin-film media structures used to produce CD-recordable discs; and a novel method of using an extended recording reference to reduce cross-talk noise in angle- multiplexed volume holographic data storage.

Thomas Mossberg of the University of Oregon's Center for Optics in Science and Technology described recent advances in spectral holographic optical data storage. The spectral recording dimension enables multi-kilobit storage at single spatial locations and the writing of frequency-dependent gratings keyed to deflect specific temporal data patterns. According to Mossberg, these capabilities lead, respectively, to high capacity, high speed, optical RAM, and content-controlled optical switching devices.

Norbert Hampp of Philipps University in Germany reported that bacteriorhodopsin processed into a polymeric film constitutes an excellent medium for optical and holographic recording. Bacteriorhodopsin — a relative of the visual pigment rhodopsin — is a photochromic retinal protein with a highly efficient primary photoreaction, large spectral shift, and excellent reversibility. The material's photochromic and related photorefractive properties can be modified over a pe-

(Continued on page 3)

APS Members Share 1996 Nobel Prizes in Physics, Chemistry

In October, the 1996 Nobel Prize in Physics was awarded to David Lee and Robert Richardson of Cornell University and Douglas Osheroff of Stanford University for their 1972 discovery of superfluidity in helium-3. This special liquid state of matter, which can flow without viscosity, was detected during a search for an antiferromagnetic phase in solid He-3, after the researchers chilled their sample to a temperature of about 2 microkelvins. Superfluidity was discovered in helium-4 in 1938, at the much warmer temperature of 2 kelvin.

Superfluidity in He-3 is very different from He-4. For instance, the former is a fermion and the latter is a boson. And in He-4, the superfluid state is essentially a Bose-Einstein condensation of He atoms in a single quantum state, whereas the He-3 superfluid state is a condensation of pairs of atoms, which are magnetic and possess an internal structure. In fact, superfluid He-3 exists in three different phases related to different magnetic or temperature conditions. The highly anisotropic nature of the A phase (resembling a liquid crystal) was recently exploited in an experiment in which vortices set in motion within an He-3 sample simulated the formation of topological defects, or "cosmic strings," in the early universe. [See *Nature*, 25 July 1996]

(Continued on page 3)

IN THIS ISSUE

Strangelet Searches, Spin Effects, QCD Field Theory Highlight 1996 DNP Meeting

Recent studies of quantum chaos in mesoscopic systems, and effective field theory were among the topics featured at the annual fall meeting of the APS Division of Nuclear Physics (DNP), held 2-5 October 1996 at the Massachusetts Institute of Technology in Cambridge, Massachusetts. The meeting consisted of six invited sessions, including a plenary session on basic research in nuclear physics, five mini-symposia, and 20 contributed sessions. A town meeting was also held on Friday afternoon to provide an opportunity for a large segment of the nuclear science community to contribute to the ongoing discussion regarding future challenges and priorities for the field.

Effective Field Theory

Although traditional nuclear structure calculations have benefitted from new methods and increased computer power, they have lacked direct input from quantum chromodynamics (QCD), the basic theory of strong interactions. According to Richard Furnstahl of Ohio State University, who spoke at a Friday morning session, "Effective Field Theory provides a framework for connecting the energy scales and degrees of freedom appropriate for nuclear structure with those in the underlying QCD." He has found that, for heavier nuclei, this framework provides new insight into issues of nucleon compositeness, vacuum contributions and extrapolations to high density, for example. David Kaplan (University of Washington), who spoke at the same session, has found effective field theory techniques to be powerful tools for theoretical descriptions of nucleon-nucleon scattering.

Chiral dynamics is an effective low-energy field theory of QCD which provides a framework to make rigorous and model-independent predictions at the confinement scale. However, in a Saturday morning session, Michael Frank of the Institute for Nuclear Theory discussed how the advent of a new generation of accelerators, such as Thomas Jefferson National Laboratory, has enlarged the energy domain of nuclear physics beyond the scale for which such low-energy effective theories are valid. As a possible solution, he suggested developing and exploring an effective field theory of subhadronic degrees of freedom which maintains the global symmetries of QCD and reproduces chiral perturbation theory in the appropriate limit. He has used such a theory to calculate low-energy chiral coefficients and hadronic form factors, for example.

Searching for Strangelets

On Saturday morning, Huan Huang of the University of California at Los Angeles reported on recent progress in the search for strange quark matter and other exotic forms of matter at Brookhaven's Alternating Gradient Synchrotron. "Heavy ion collisions at the BNL-AGS are characterized by formations of high baryon density and yields of large strangeness, in which quark gluon plasma (QGP) may be formed due to fluctuations," he said, adding that strangelets are predicted to be possible remnants of this QGP formation. At the same session, Thomas Glasmacher of Michigan State University's National Superconducting Cyclotron Laboratory described a new technique using fast radioactive ion beams to investigate the evolution of nuclear shell structure.

Measuring Spin Observables

Polarized targets internal to electron storage rings represent a unique opportunity for the measurement of spin observables in electro-nuclear physics, according to Massimiliano Ferro-Luzzi of The Netherlands' NIKHEF facility. The technique has several advantages — including parity of the target species, high polarization, clean recoil hadron detection, and the ability to manipulate the target spin — which allow the study of the electromagnetic structure of the nucleon and light nuclei with high statistical and systematic precision. Ferro-Luzzi reported on measurements obtained from two recent experiments scattering unpolarized electrons from tensor polarized helium-2 and helium-3 targets. A third experiment is underway using a polarized electron beam and interal targets, in order to study simultaneously several channels over a broad kinematical range.

Quantum Chaos in Mesoscopic Systems

Recently there has been considerable interest in the transport properties of mesoscopic devices such as quantum dots: isolated regions of a few microns or less in length to which several hundred electrons are confined. While previous studies have focused on disordered systems, where the elastic scattering length is small compared to the size of the dot, recent advances in nanostructure technology allowing the fabrication of ballistic dots that are smaller than the elastic path of the electron. According to Yoram Alhassid of Yale University's Center for Theoretical Physics, because of the irregularities of the dot's shape, the electron dynamics are chaotic in nature, and the universal features of the conductance fluctuations are consistent with quantum chaos theory.

Attention is also shifting from studies of open dots — characterized by many overlapping resonances — to closed dots which are weakly coupled to the external leads via tunnel barriers. "In this regime, a single electron resonance whose energy is closest to the Fermi energy dominates the conductance, and it is thus possible to probe the chaoticity of the electronic wave functions," said Alhassid. He has developed a theory for the statistical properties of the conductance peaks using random matrix theory, and his predictions have recently been experimentally confirmed. In the same session, Argonne National Laboratory's John Schiffer described new simulations of the behavior of cold confined ions, which revealed that when both spherical and spheroidal ion clouds are cooled they form ordered structures that exhibit classical shells with magic numbers.

Mini-Symposia and Workshops

Speakers at the Thursday afternoon and Friday morning symposia on giant resonances described recent accomplishments, problems, and experimental challenges in giant resonance research, covering such topics as giant monopole resonance in cold and hot nuclei, multiphonons, the giant dipole resonance in hot nuclei, and the possibilities and promises of using unstable particle beams. Friday afternoon featured a mini-symposium on the phenomenon of "identical bands" in nuclei, whereby rotational cascades in different nuclei exhibit very similar transition energies and/or moments of inertia. Speakers at Saturday's symposia described recent investigations of a "caloric curve" of nuclear matter indicating a possible low-density phase transition, as well as of weakly bound halo nuclei.

Prior to, but in conjunction with, the DNP meeting, two workshops were held on Sunday. The first, focusing on the quark-gluon structure of the nucleon, covered such aspects as electric form factors of the neutron, quark seas and strangeness in the nucleon, and using lattice QCD to model nucleon structure. The second workshop featured talks on collective effects and the quark gluon plasma in heavy ion collisions, and disoriented chiral condensates. Speakers discussed multistrange baryons, signatures for quark gluon plasma, and recent experimental results at chiral phase transitions.

APS News

Coden: ANWSEN ISSN: 1058-8132
Series II, Vol. 5, No. 11 December 1996

Editor: Barrett H. Ripin
Newswriter: Jennifer Ouellette
Production: Elizabeth Buchan-Higgins
Coordinator: Amy Halsted

APS News (ISSN: 1058-8132) is published 11X yearly, monthly, except the August/September issue, by The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, (301) 209-3200. It contains news of the Society and of its Divisions, Topical Groups, Sections and Forums; advance information on meetings of the Society; and reports to the Society by its committees and task forces, as well as opinions.

Letters to the editor are welcomed from the membership. Letters must be signed and should include an address and daytime telephone number. The APS reserves the right to select and to edit for length or clarity. All correspondence regarding *APS News* should be directed to: Editor, *APS News*, One Physics Ellipse, College Park, MD 20749-3844, email: letters@aps.org.

Subscriptions: *APS News* is an on-membership publication delivered by Periodical Mail. Members residing abroad may receive airfreight delivery for a fee of $20. **Nonmembers:** Subscription rates are: domestic $130; Canada, Mexico, Central and South America, and Caribbean $145; Air Freight Europe, Asia, Africa and Oceania $170.

Subscription orders, renewals and address changes should be addressed as follows: **For APS Members**—Membership Department, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, membership@aps.org. **For Nonmembers**—Circulation and Fulfillment Division, American Institute of Physics, 500 Sunnyside Blvd., Woodbury, NY 11797. Allow at least 6 weeks advance notice. For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Requests from subscribers for missing issues will be honored without charge only if received within 6 months of the issue's actual date of publication.

Periodical Postage Paid at College Park, MD and at additional mailing offices. Postmaster: Send address changes to *APS News*, Membership Department, The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

APS Council Establishes Task Force on Career Development

The APS Executive Board approved a proposal to establish a Task Force on Career and Professional Development to provide guidance to the Society on its activities in this area. Intended for a term of one year, renewable for a second, the task force is expected to present a report of its initial recommendations to the APS Council in April 1997.

The task force is charged with advising the APS on efficient and effective mechanisms for coordinating and integrating the Society's existing career-oriented programs; formulating a long-term strategy to address career and professional development issues; and identifying and assisting implementation of new programs that can effectively serve the physics community in dealing with career issues. The first meeting will be held this winter, featuring a review of the present employment situation for physicists and ongoing APS activities in this area, as well as identifying gaps or superfluous programs and possible sources of outside funding for future initiatives.

"We hope to receive specific advice from the task force on how the APS should proceed to help physicists cope with the current employment situation and, in the long term, to develop a good match between training and professional expectations of physicists, and the needs of the work force and society," said APS Associate Executive Officer Barrett Ripin, who is the APS staff adviser to the task force. "There is a need to step back and assess our efforts in this area with the objective of moving in the most effective path with the appropriate amount of resources."

Examples of APS activies to help alleviate the employment situation include issuing a special Graduate Student Packet; providing forums for discussion at APS meetings and in *APS News*; sponsoring career workshops and placement centers; including young activists in APS governance; and formation of the APS Forum on Industrial and Applied Physics (FIAP). Most recently the Society has produced a special insert to *APS News*, "CareerPlus,"

(Continued on page 3)

ILS-XII Meeting *(Continued from page 1)*

riod of several years, making it well-suited for technical applications.

Lasers Applications

In the area of telecommunications, the advent of the optical amplifier, together with ever-increasing communication demands, has made wavelength-division multiplexing (WDM) an attractive method for transmission capacity upgrade over existing standard fiber, according to R.C. Alferness (Bell Laboratories/Lucent Technologies). "The potential to build reconfigurable transmission networks and possible evolution into the access portion of the network offer further growth for the application of WDM technology," he said, adding that highly functional, mass producible, cost-effective sources will be key to the ubiquitous deployment of WDM systems.

In addition, a great deal of progress has been made in understanding the active region properties of ultrahigh speed diode lasers, including electron and hold dynamics — alternatively known as the transport and capture problem for quantum well lasers — and the effect of active region doping and strain, resulting in improved dynamic performance of these devices.

In the medical sphere, fluorescence spectroscopy of native tissue can provide a noninvasive rapid diagnostic tool, according to A. Katz (City College of New York), who has found that differences in spectra can be used to distinguish malignant from benign tissues. Currently three generations of optical biopsy diagnostic instruments with organ-specific optical probes are under development for in vitro and in vivo tissue diagnosis, along with various algorithms to improve the prediction accuracy.

Laser-aided manufacturing is another important emerging application. For example, in the automotive industry there is great interest in tailored blank welding and option hole cutting, according to David Rosenberg of General Motors R&D Center. In addition, scientists at the Illinois Institute of Technology are developing a new, versatile, automated laser shaping system for the manufacture of ceramic and ceramic composite components.

Advances in Fiber Lasers

On Monday afternoon, D.J. Richardson of England's Southampton University described recent advances in the development of novel fiber components for short pulse generation and manipulation, particularly the development of high power/high pulse energy fiber sources based on novel doped fiber designs. In addition, all-fiber modelocked lasers have found technological applications in recent years, and cladding-pumped erbium fiber oscillators and amplifiers have enabled the construction of high-power ultrafast fiber pulse sources delivering pulses as short as 100 femtoseconds, and average powers in excess of one Watt.

3-D Imaging and Display

Improved dimensionality from displays has required an increase in the amount of information conveyed, including binocular disparities and motion parallax, according to Stephen Benton of MIT's Media Laboratory, who focused on autostereoscopic technologies that do not require viewing aids (such as spectacles) in his Thursday afternoon overview of the field. Other advances reported in the session include the first demonstration of the use of a photorefractive crystal to display a three-dimensional image in space, and the development of a new technique called optical scanning holography, which extracts holographic information by two- dimensional active optical heterodyne scanning.

In addition, scientists at the University of Alabama in Huntsville are studying the partial pixel approach to 3-D displays, which they believe provides a conceptual framework for such displays that are functionally equivalent to holographic stereograms. According to team leader Gregory Nordin, he and his colleagues have implemented both monochromatic and full color displays based on the use of diffractive optical elements and conventional liquid displays.

Special Lectures

In addition to the regular technical sessions, four critical reviews were given on exciting new developments in the field of laser science by recognized experts. First instituted in 1995, this year's lectures covered photonic band gaps, semiconductor cavity QED, wave packet dynamics, and the realization of Bose-Einstein condensation in dilute, trapped alkali gases. The conference also featured a plenary lecture by Will Happer of Princeton University on the medical application of lasers and spins to the illumination of lungs, and the Schawlow Prize Address on laser spectroscopy of atomic hydrogen by Theodor Hänsch of the Max Planck Institute for Quantum Optics.

1996 Nobel Prizes in Physics, Chemistry

(continued from page 1)

A graduate student at Cornell when the discovery was made, Osheroff went on to achieve the first experimental verification of the "baked Alaska" model, a theory first formulated by Anthony Leggett (University of Illinois) to explain the somewhat piecemeal transition from the A phase of superfluid He-3 into the lower-temperature B phase, by supposing that B-phase droplets can be nucleated within the supercooled A phase by the ionizing energy of passing cosmic rays. [See *Physics Today*, June 1992]

The 1996 Nobel Prize in Chemistry was shared by Richard F. Curl and Richard E. Smalley of Rice University, along with Harold W. Kroto of the University of Sussex, for their 1985 discovery of fullerenes, new forms of carbon that include the soccer-ball shaped carbon-60 atoms otherwise known as "buckyballs", because their shape resembles the geodesic domes pioneered by the architect Buckminster Fuller.

Lee, Richardson and Osheroff are APS Fellows and were awarded the APS Oliver E. Buckley Prize in 1981 for their discovery. Smalley, who is also an APS Fellow, was similarly honored in 1991 with the APS Irving Langmuir Prize in Chemical Physics. In addition, Richardson is a former chair of the APS Division of Condensed Matter Physics, and Osheroff has been active in numerous APS activities.

IN BRIEF

- The International Union of Pure and Applied Physics (IUPAP) has issued a revised version of its "Guidelines for the Use of Major Physics Users Facilities," based on comments received on existing large facilities that recover operating costs from users. The revised guidelines explicitly detail a realistic special treatment for such existing facilities. Originally drafted in 1994 by the U.S. Liaison Committee to IUPAP, the guidelines are the result of extensive consultation with other national liaison committees, UNESCO Physics Action Council, and the physics community at large, thus incorporating a wide perspective on major facilities. The revised version was approved by the IUPAP Executive Council in September 1995, and by the IUPAP General Assembly in September 1996.

- A new report by the American Institute of Physics puts the number of physics graduate students for the 1994/1995 year academic year at 13,285. Of these, 43 percent were non-U.S. citizens, 16 percent were women, 2 percent were African-American, 3 percent were Hispanic-American, and 4 percent were East-Asian-American. Considering only the non-U.S. citizens, China (28 percent), the Former Soviet Bloc (16 percent), and Western Europe (14 percent) sent the highest fractions of students. 1,461 Ph.Ds were granted. The median time between the B.S. and Ph.D. degrees for U.S. citizens was 6.5 years. The favorite subfields of study were condensed matter (23 percent) and particle physics (13 percent). For more information, contact Patrick Mulvey of the AIP Education and Employment Statistics Division (301) 209-3076. (Item courtesy of Phil Schewe, AIP Public Information.)

- In September, the APS Executive Board approved a proposal by Elsevier Science Publishers to sponsor the John H. Dillon Medal, in the amount of $2000 per year for a minimum period of five years, with an option to extend the sponsorship for another five-year term. No cash award was previously given with the medal. "We feel that the purpose of the Dillon Medal very much coincides with the objectives of our journal, *Polymer*," said Henri G. van Dorssen, a senior pulishing editor for Elsevier's materials science group. Established in 1983 by the APS Division of High Polymer Physics, the medal is intended to recognize outstanding research accomplishments by a young polymer physicist.

News from APS Sections

- The APS **Ohio Section** held its annual fall meeting 1-2 November at Ohio University in Athens, Ohio, organized around the theme of nonlinear dynamics and chaos. On Friday, Ohio University's Earle Hunt spoke on chaos in electrical circuits, incorporating live demonstrations of the phenomenon. William Ditto, director of the Applied Chaos Laboratory at the Georgia Institute of Technology, discussed recent experiments exploiting the sensitivity of chaotic systems to manipulate their dynamical behavior in desirable ways, emphasizing the control of chaos in biomedical systems. Friday evening's banquet featured a talk by Neil Gershenfeld, director of MIT's Physics and Media Laboratory, on musical instruments, models and machines. A co-director of a Santa Fe Institute/NATO study on nonlinear time series, Gershenfeld was also a featured speaker on Saturday, reviewing a number of the more broadly applicable recent extensions to the notion of state estimations for nonlinear systems. Saturday's program also included a lecture on quantum signatures of classical chaos by Martin Gutzwiller of IBM/T.J. Watson Research Center.

- Two weeks later, the APS **Southeastern Section** held its annual fall meeting, 14-16 November in Decatur, Georgia, just outside of Atlanta. Invited speakers gave presentations on such topics as cold atoms, computational physics, computerized and Web-based teaching methods, elementary particle physics, high energy physics, high spin nuclei and women in physics. In addition, some of the contributed abstracts were deemed of broad enough interest to merit special 20-minute invited presentations at the start of the session to which each paper was assigned. Friday evening's banquet featured a keynote address by D. Allan Bromley, as well as the presentation of the George Pegram Award to Wendell G. Holladay (Vanderbilt University) and Dudley Williams (Kansas State University). The meeting was held jointly with the Society of Physics Students and Sigma Pi Sigma to celebrate their Diamond Jubilee.

Task Force on Career Development *(continued from page 2)*

and enhanced the APS career guidance Web page with employment listings and other resources, including a speakers' list on industrial and applied physics topics.

The APS task force membership includes representatives from the Forum on Education, the Forum on Physics and Society, and FIAP, as well as one graduate student, junior faculty member, industrial physicist, and two postdocs. Ed Goldin, director of AIP's Career Services, and Roman Czujko, director of AIP's Statistical Division, will serve in an advisory capacity.

Diandra Leslie-Pelecky of the University of Nebraska's Center for Materials Research and Analysis will chair the task force. The other members are Peter Abbamonte (University of Illinois), Robert Bartolo (University of Maryland, College Park), Glen Crawford (Stanford University), Robert Kwasnick (General Electric Corp. R&D), Anthony Nero (Lawrence Berkeley Laboratory), Steven J. Smith (National Center for Atmospheric Research), and Peter Wolff (Massachusetts Institute of Technology).

OPINION

APS VIEWS

Sections: APS' Mini-Physical Societies

by Barrett Ripin, APS Associate Executive Officer

When I attended my first section meeting a couple of years ago, my initial reaction was that it seemed much too enjoyable to be a 'real' physics meeting. A stimulating range of current physics topics outside of my specialization presented in an understandable tutorial manner reminded me of what enticed me to become a physicist. My second reaction was irritation at not being introduced to sectional meetings much earlier, particularly during my college/graduate school days.

There are five geographic APS sections in the United States (see map below) with memberships in the one to two thousand range. In 1931 Council amended the APS Constitution to allow both geographic sections and technical divisions to be established. A number of independent physics clubs were already active at different locations in the US. All sections were formed in the 1930s except for the Texas Section, which was established in 1982, fifty years after the first, the New England Section. Distant travel was not so prevalent back then and, for many, these sections were the focus of physics communications.

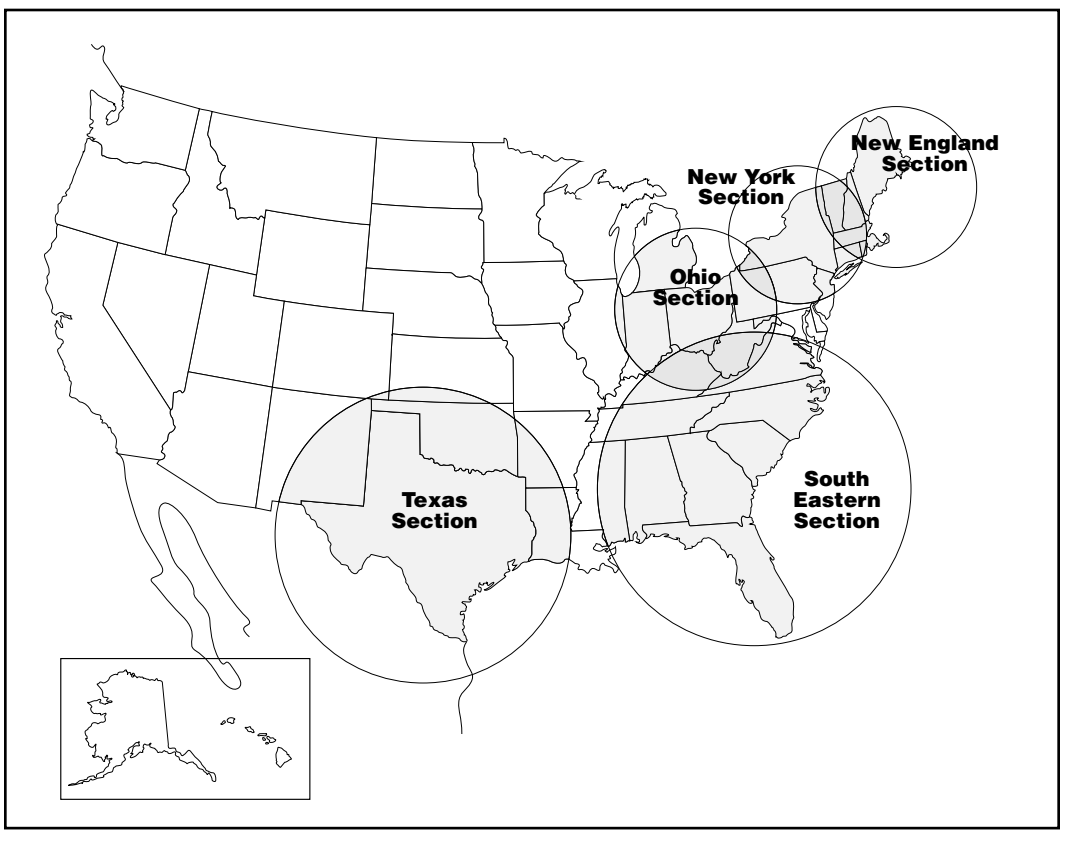
Regional physics activities are still vital, even in our fast-paced mobile world. Industrial-academic interactions are typically local phenomena, as are many professional collaborations that enhance our research, teaching, and pleasure of doing physics. Students from physics departments feed local industry and graduate schools. Faculty are a resource of technical expertise for industry and government laboratories. Industry, in turn, often provides regional departments with a technical focus, internships, and support. Regional meetings enable faculty and students from small departments to become connected to the broader physics community.

Section meetings draw professors, undergraduate and graduate students, retirees, and physicists working in local industry together to discuss a diverse range of research or educational issues. They are usually held at easy to reach (and inexpensive) sites and have low registration fees. Professor/mentors from physics departments throughout the region will cram their students into vehicles and go on a section meeting 'road trip.' Meetings are usually informal and attendees tend to get to know each other well. They provide a unique educational experience for PITs (physicists in training) to meet working physicists, to experience the terror of presenting their work to others (in as nurturing a context as they will encounter in the outside world), as well as possibly making post-graduation employment connections.

Sections develop unique characters to suit their region's membership. Some hold meetings that are primarily comprised of thematic tutorial invited sessions. Thematic sessions typically feature world-class researchers selected for their ability to give both tutorial background and a good feeling for research frontiers. Other sections draw large numbers of invited and contributed papers in diverse areas and have the flavor of small general meetings. Close to 500 attended the most recent Texas Section meeting. There is a strong student involvement and educational component to most section meetings and they are frequently held jointly with sections of the American Association of Physics Teachers (AAPT) and the Society of Physics Students (SPS).

If you live in a region that has a section and you wish to join, then contact the APS Membership Department at: membership@aps.org or 301/209-3280. There is no charge to join an APS section.

If you do not live in a region that has a section and are interested in helping to form one, please contact me at: ripin@aps.org or 301/209-3233.



LETTERS

Of Grammatology and Beyond...

An occasional light note is certainly to be encouraged, but I take exception to your limerick in response to Fabrizio Pinto (*APS News*, October 1996, p5). In selecting a classic of the genre and coarsening it a bit to meet modern entertainment standards, you have achieved a verse which does not scan (an unpardonable sin!) — that is, unless you want the reader to accent the first syllable of "eloped" and "conceived," making for a very artificial, strained reading. Moreover, you have lost the sense of the "impossible," which was, of course, the essential feature of the original (conceiving before eloping being perfectly possible and quite likely these days, in fact).

The original, innocuous as it is, would have been preferable on all counts:

There was a young fellow named Bright
Who travelled much faster than light.
He set off one day, in a relative way
And came back the previous night!

Ralph P. Hudson
Chevy Chase, Maryland

Editor's Response...

There once was a poem misquoted
And commas left out that were noted.
When genders reversed,
The writer was cursed
And regrets he transgressed as denoted.

(M. Freedhoff, 1996)

Physics Limerick Contest

Clearly physicists care deeply about their limericks. In response to member demand, we announce the APS 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. Deadline for submissions is January 15, 1997.

McKinsey & Co. a Boon to Downsizing

The opinion by Wolfgang Hierse in the October 1996 *APS News* ("Leaving Science Can Be a Good Career Decision") hits the nail on the head: by choosing to join McKinsey & Company he will help eliminate the few physicists that still remain. McKinsey & Co. has been the star of such management consulting firms all over the industrialized world for a great many years. Their activities have been good for society, because the current oversupply of scientists and others might turn into an oversupply of culinary experts (see the *NEW YORK TIMES*, Sunday, September 16, 1996), and who would turn down a good meal? Rich meals might even cut the life expectancy of the general population enough to help reduce Medicare budgets.

The writer is grateful to the McKinsey organization for having been instrumental in forcing his early retirement after more than 30 years of service to a major corporation, thereby bringing him into an academic career.

James L. Lauer
San Diego, California

More Thoughts on Leaving Science...

I enjoyed the Opinion article by Wolfgang Hierse on "Why Leaving Science Can Be a Good Career Decision." I credit him for being blunt... it's needed! Society can only afford to support a certain amount of pure "quest for knowledge" research, and I believe that society is telling us that we can no longer be this big. Take this as a wake-up call. As physicists, we all have valuable skills in analytical thinking, problem-solving, mathematics, etc. Unless you're one of the "absolute geniuses," you should think seriously about applying some of your valuable skills elsewhere. Like Dr. Hierse (and myself), you might even find it more enjoyable than doing traditional physics!

Peter Heimann
Middletown, New Jersey

The commentary by Wolfgang Hierse illustrates a large and welcome trend, as we witness competent newly minted science Ph.Ds compete successfully for well-paid non-academic positions. This means that science is respected outside of its field. How many bankers, business analysts, or consultants could, in three months, jump into the position of a physics or chemistry professor?

But I was very sad as I read Hierse's following words: "I chose to join the consulting firm McKinsey last August. It seems to me that these people care about the right problems. I also have the somewhat disturbing impression that what they are doing is actually science in a way — the way it should be."

Well-educated scientists, especially those who have earned Ph.Ds, should know when something is a science and when it isn't. And most practicing scientists and engineers at all degree levels would agree that management consulting is not a science, nor are management consultants scientists. There may be some similarities, but they are not the same. "We must make clear that if a thing is not a science it is not necessarily bad," Richard Feynman once said. "For example, love is not a science. So, if something is said not to be a science, it does not mean that something is wrong with it; it just means that it is not a science." Hierse's misunderstanding of the endeavor of purely academic research and for the

OPINION

The Research Environment in a Global Economy

by Robert M. White

The research paradigm has changed since the early years of the Cold War, when basic research was generously supported in the belief that this research would serendipitously lead to new technology or, at least, establish a reservoir of knowledge that could be tapped when needed. In the post-Cold War era, economic growth has become the national focus in research and development.

A list of the topics covered in "Physics News" in 1995 provides a list of commercially relevant technologies of current interest to physicists: lasing without inversion, protein folding, semiconductor noncrystallites, biomembranes, quantum computing, nanotribology, and high temperature superconductors.

There are two principal causes for this change in the research paradigm. First, we face global competitors both in the domestic U.S. market and in increasingly important world markets, competitors who are very adept at tapping into the knowledge base to manufacture products with qualities and development cycles that give them a competitive advantage. Secondly, technology today has become extremely complex and multidisciplinary. Electronics now comprises 20 percent of the value of an automobile, for example. The innovation process has also become tightly coupled from discovery to application. Sophisticated analysis techniques and rapid communication have shortened the development time. Thus, high risk research may not mean long-range research!

A good example of this is the recent discovery of giant magnetoresistance. With the development of thin film deposition techniques, physicists naturally began to explore the properties of ultrathin films and multilayers. In 1989, a group in France discovered that multilayers of iron and copper showed a very large change in their in-plane resistance, depending on whether the magnetization in the iron layers was parallel or antiparallel. As a result of a combination of theory and materials science, these so-called spin valves now operate at room temperature in fields as low as a few oersteds. This makes them candidates for field sensors, such as for the fields associated with the data patterns recorded on magnetic disks or tapes. Indeed, recording heads employing this phenomenon are now in development, only seven years after it appeared in *Physical Review Letters*.

In this changed environment, corporations cannot independently develop technology. The corporate laboratory is being supplemented, if not replaced, by alliances, quite often with small companies that have developed unique technologies with venture capital. Such alliances also free corporations from the old sequential innovation process. To use a metaphor from computer architecture, innovation today is like "pipelining," where multiple events are simultaneously overlapped in execution.

The national laboratories, somewhat isolated from the global economy by their agency missions, have not seen the dramatic change that corporate laboratories have. They still attempt to be self-sufficient. However, political forces during the early 1990s have opened the national labs to industrial collaboration through the mechanism of the Corporate Research and Development Agreement (CRADA) program.

Our laws have also changed in recognition of this need to establish partnerships. The National Cooperative Research Act of 1984 allows corporations to form research consortia without fear of antitrust reprisal. Since partnerships involve the exchange of information, protection of intellectual property rights is important. In 1980, the University and Small Business Patent Procedure Act (known as the Bayh-Dole Act) gave universities the right to own and subsequently license research results developed with federal funding. Prior to this time, such results were in the public domain, which inhibited their commercialization. Programs driven by federal agency missions, such as those of the Department of Defense and NASA, will continue to be a source of commercially relevant technology.

Since technology is such an important factor in economic growth, some felt that its development should not be left to chance. Thus, the federal government has also created new programs specifically to stimulate industry to develop technologies which they might otherwise regard as too risky. The Advanced Technology Program (ATP) in the Department of Commerce is an example. While ATP provides matching funds to industry for technology development, its greater value may be its impact on the innovation process through the growth and acceptance of partnerships. ATP's unrestricted funding to partnerships provides an incentive for the formation of research consortia. Furthermore, more than $85 million has flowed from ATP to more than 100 universities subcontracted by ATP grant recipients, largely to provide the fundamental understanding associated with the technology being developed.

This new paradigm means that physicists will increasingly find themselves in a much more complex, less sheltered research environment, one that is

characterized by multiple funding sources, by concerns about intellectual property, by technology transfer mechanisms, and by partnership agreements. I believe the challenge facing the APS is to help prepare young physicists for this new world.

Robert M. White heads the Electrical and Computer Engineering Department at Carnegie Mellon University. Prior to joining CMU in 1993, he served as the first Undersecretary of Commerce for Technology. White will chair the APS Panel on Public Affairs in 1997. This article appeared in the August 1996 issue of the newsletter of the APS Forum on Industrial and Applied Physics.

Practicing Civic Science: Notes From the Field

by Joel A. Snow

On numerous occasions in recent months, NSF Director Neal Lane has suggested that the science community has a "new need to share with the American public the value and promise of science and technology." Indeed, he has suggested that "it may be time to expand the professional responsibilities of science to include informing fellow citizens about science…" This mission of carrying science to the citizenry has been called a "civic role for scientists," or "civic science."

Unlike public science, which is aimed at advocacy of public policy related to science and technology, the objective of civic science is to inform citizens of how science functions and contributes to our society, and therefore why it merits the public's interest and support. It is a broader issue than building a constituency for science, but includes appreciation of the appropriate uses of science. It's not that the public lacks interest, but rather that knowledge and understanding of science are unfortunately not widespread.

Despite the reality that science has enabled an unprecedented transformation of human society, many of the daily activities of most people are similar to those of earlier generations, though with different tools. The transforming technologies that make our society different (from instant electronic communications to highly productive, disease resistant seed corn) are seldom obvious in their relevance to everyday life. Little wonder that what takes place in the research laboratory now may seem hopelessly arcane and irrelevant. The pace of change has been so rapid that it is hardly surprising that formal education has not kept up. The public, clearly, must learn outside the classroom.

Improving the science and science-awareness content of general education has long-run benefits for the unknown and unanticipated vocations of the 21st century. But education, and public education in particular, seems to resist revolution and is entwined with so many other aspects of society (including financing) that improving its pertinence and performance will be a long, tough struggle. Civic science, on the other hand, is for today. The challenge is to discover how to communicate with today's working, reading, viewing and voting public on the basis of the tools and experience that they have on tap on their home ground. They will not be interested in laboratories or lectures, but rather in finding out about things that affect their jobs, businesses, health and daily lives.

On the basis of some 30 years of field experience as a civic scientist, let me offer a few observations or guidelines:

1) Doing civic science is not for everybody. It is a calling where there needs to be a rapport between you and your audience. You need to speak their language.
2) What you have to say is not for everybody. Interesting Joe and Jane Farmer in cosmology may just be too hard a sell, although why the

(Continued on page 6)

Letters *Continued*

people conducting it is so unfounded and distressing because it is the very skills, abilities and credentials that he acquired through his Ph.D. that gave him entree into the types of jobs he was pursuing.

"If you tackle problems nobody has solved yet," says Hierse, "If you do whatever it takes to solve them, if you believe in the power of reason, you are a scientist." I disagree. It is curiosity about the natural world (not the financial, business, or social world) and the courage to try to intelligently pose and answer questions about it; it is the humility that one may or may not be able to offer some insight; and it is the rational application of the imagination. These, in my mind, are the defining characteristics of scientists.

Aaron Moment
Boston, Massachusetts

Population Growth is Root of Energy Problem

The facts recounted in "The Current Energy Situation: Federal Role Remains Important" (The Back Page, October 1996) have been recounted before and have been largely ignored for years. The situation is truly frightening. But it is really distressing to see that the article contains a clue to, but no overt recognition of, the root of the problem, in the statement, "On the other hand, energy use [in the U.S.] on a per capita basis has been relatively constant…" This suggests that perhaps the main cause of the continuing increases in total energy consumption in the U.S. is the continuing rapid growth of the U.S. population, which is now over 3 million additional people each year.

Here is a challenge. Can you think of any problem, on any scale, from microscopic to global, whose long-term solution is in any demonstrable way aided, assisted or advanced by having large populations at the local, regional, national or global levels?

Albert A. Bartlett
Boulder, Colorado

OSTP Releases Report on Reducing Excess Plutonium Stockpiles

An interim study by independent U.S. and Russian scientists released in November by the White House Office of Science and Technology Policy (OSTP) recommends a broad program of cooperation between the United States, Russia, and other countries to reduce stockpiles of excess weapons plutonium resulting from ongoing nuclear arms reductions. The group's key recommendations are included in the interim report; a final report is expected in 1997.

The interim report released in November recommends that both the U.S. and Russia move forward quickly, and in parallel, to safely and securely store and then reduce their stockpiles of excess plutonium, with international inspection applied from very early in the process. The report urges that both countries pursue a dual-track approach, using some of the excess plutonium as fuel in existing nuclear reactors, and immobilizing the rest in glass or ceramic with high-level wastes.

U.S.-Russian technical cooperation to demonstrate the feasibility of various approaches is already underway. These approaches are among the options being considered in the U.S. plutonium disposition program, led by the Department of Energy (DOE). The DOE is expected to announce preferred alternatives for disposition of U.S. excess plutonium later this year. [Copies of the interim report are available upon request from the White House Office of Science and Technology Policy.]

"Moving forward to get rid of the vast stocks of excess bomb materials built up over nearly five decades of Cold War is one of this Administration's highest priorities," said John H. Gibbons, Assistant to the President for Science and Technology and co-chairman of President's Committee of Advisors on Science and Technology (PCAST). "This report provides both Presidents with the views of this distinguished group of scientists on the quickest, most cost-effective, and most secure ways to reach that end, while protecting the environment and public safety." The Clinton Administration is expected to review the recommendations in preparation for deciding on options both for dealing with U.S. excess plutonium and cooperation with Russia and other countries.

The U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium is an independent group chartered as a result of a proposal by Russian President Boris Yeltsin at his Hyde Park meeting with President Clinton in October 1995. The commission was formally established in mid-1996 at the initiative of the PCAST, and the Russian Academy of Sciences. The group was directed to make recommendations to the two Presidents on specific steps that could be taken to reduce stockpiles of excess weapons plutonium. These independent recommendations complement the government-level joint technical assessment of plutonium disposition options, also released today.

The U.S. team was chaired by Professor John Holdren of Harvard University, a member of PCAST, and included John Ahearne, an adjunct professor of public policy at Duke University; Richard Garwin, fellow emeritus of IBM Research Laboratories and who served in an advisory capacity under Presidents Kennedy, Johnson and Nixon; Wolfgang K.H. Panofsky, director emeritus of the Stanford Linear Accelerator Center; and John Taylor, emeritus vice president for nuclear power of the Electric Power Research Institute. Every member of the team is also an APS member; Ahearne and Garwin are Fellows; Holdren is a Fellow and Recipient of the 1995 APS Forum Award; and Panofsky is a Fellow and was APS President in 1974.

The Russian team was chaired by Academician Evgeniy Velikhov, president of the Kurchatov Institute, and included Aleksei A. Makarov, director of the Institute of Energy Economics in Moscow (and also an APS member); Fedor M. Mitenkov, director of the Ministry of Atomic Energy (MINATOM) nuclear design institute; Nikolai N. Ponomarev-Stepnoi, vice president of the Russian Research Center at the Kurchatov Institute; and Fedor Reshetnikov, senior scientist at MINITOM's Bochvar Institute of Organic Materials in Moscow.

Notes From the Field *(Continued from page 5)*

night sky isn't bright might work. Most people are willing to have faith that scientists know what they are doing.

3) Keep it simple. We who are addicted to precision in terminology and expression, along with the ifs and buts and caveats of a detailed argument, can quickly lose our audience in a welter of detail. But a simple ice cube analogy can show why warming that melts the west Antarctic ice cap would cause global flooding.
4) Avoid "talking down." The audiences may be literate, though not literate in science.
5) Be clear on what your message is and what connection hooks it to some matter of general public interest with which people identify.
6) Credibility is precious, so be sure your facts are really facts, that your interpretations of the importance of the work you are discussing is not overblown, and that your conclusions or opinions are not unduly self-serving. This is particularly the case in communicating with politicians where invidious remarks about subspecialities other than your own seldom result in overall benefit.
7) An out-and-out sales pitch for science funding is seldom appropriate. The funding issue is always there in the background, but public investments are made for many public purposes and haves many different rationales. Civic occasions are usually ill-suited to complaining about money — particularly if the complainer's personal income is well above the local median income. Making a pitch to a politician is a legitimate personal advocacy, but be careful about seeming to represent your institution if that's not your job.
8) The mundane may be more interesting than the profound. The discovery of quantum mechanics may be less compelling to a general audience than the tale of the invention of Velcro or the Post-It Note, which also illustrate the scientific method, serendipity, and how chance favors the prepared mind.
9) Seek out opportunities. Probably no one will come beating on your door asking you to speak, but opportunities are everywhere if you pursue them.
10) Communicating about science with the general public is hard work. It takes time and talent to do it well. Moreover, the rewards are largely psychic — it's a paying profession for only a few. But you might be surprised at how open the public in your community may be to hear about what you know, what you do, and why you do it. For them it's a new and different world.
11) Finally, remember to lighten up. Science is fun, after all, and sometimes can be funny. Public radio in many locations carries a parody called "Dr. Science" that spoofs the smug, all- knowing scientist who pontificates on practically everything. A year or so ago, a film called "I.Q." featured Walter Matthau as a slightly batty Einstein with equally batty Institute for Advanced Study buddies. This summer's movie fare included "Phenomenon," "The Nutty Professor," and "Twister," about chasing tornadoes for scientific purposes. These films are full of stereotypes involving science and light humor, to be sure, but also reflect perceptions in popular culture that include a certain odd respect with which science is viewed, and some frustration at how hard it can be to understand.

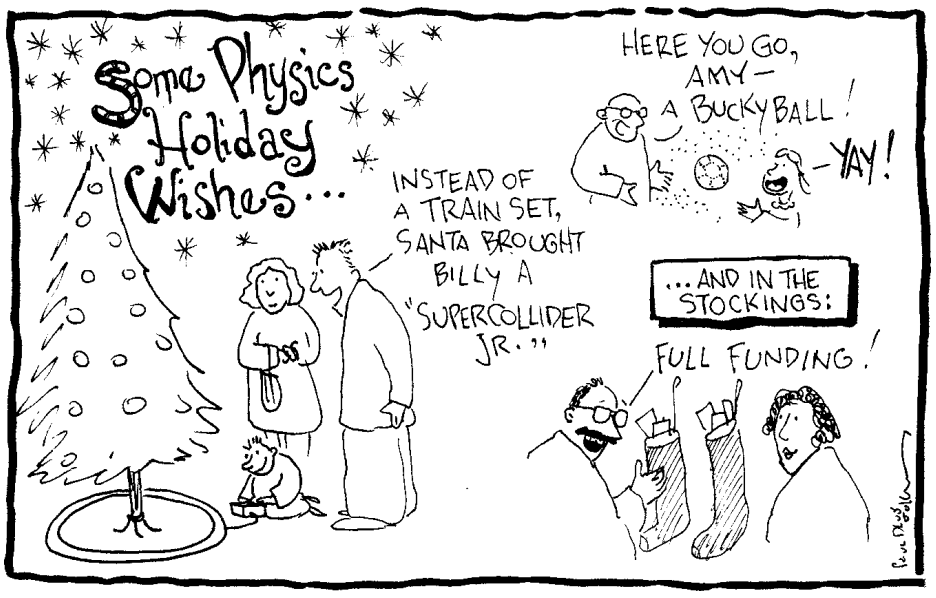
Joel A. Snow is director of the Institute for Physical Research and Technology at Iowa State University. A longer version of this article appeared in the Summer 1996 newsletter of the APS Forum on Education see http://www.research.att.com/~klb/APS/newsletter.html.

Improbable Researchers Gather for 1997 Ig Nobel Prize Ceremony

Some of the world's top scientists convened at Harvard University's Sanders Theatre for the 1996 Ig Nobel Prizes, presented at the Sixth First Annual Ig Nobel Prize Ceremony, held October 3, 1996. The prizes were handed out by genuine Nobel Laureates Dudley Herschbach, William Lipscomb and others. A good-natured spoof of science and the Nobel Prizes, the ceremony honors people whose achievements "cannot or should not be reproduced."

The event was reluctantly presented by The Annals of Improbable Research (AIR) (which has been described as "the MAD Magazine of science"). The ceremony also featured the world premiere of "Lament Del Cockroach," a mini-opera for Nobel Laureates and mezzo-sopranos. The event was telecast live, worldwide, on the Internet, and recorded for later broadcast on National Public Radio's "Talk of the Nation/Science Friday" program, as well as the television network C-SPAN.

The 1996 honoree in physics was Robert Matthews of Aston University, England, for his studies of Murphy's Law, and especially for demonstrating that toast always falls on the buttered side. Other awards include: Peace—Jacques Chirac, President of France, for commemorating the 50th anniversary of Hiroshima with atomic tests in the pacific; Medicine—Tobacco company CEOs for their unshakable discovery, as testified to the U.S. Congress, that nicotine is not addictive; and in Art—Don Featherstone for the plastic pink flamingo. Additional information on the studies cited or on the ceremony itself can be obtained by sending email to INFO@IMPROB.COM and/or visiting the AIR web site http://www.improb.com.



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 Homepage [http://www.aps.org] or directly at [http://publish.aps.org/eprint/].

ANNOUNCEMENTS

STOP!

THINK!

NOMINATE!

Which of your APS member colleagues do you admire most? Who shares your views and concerns? Who has the best combination of knowledge and experience to represent you, and lead the APS in the right direction? Well, why not nominate the person (who could be you) to be a candidate for an elected position in the APS?

The Nominating Committee depends on APS members to propose candidates for positions elected by the membership: Vice President, Chair-Elect of the Nominating Committee, and General Councillors; and those elected by the Council: members of the Panel on Public Affairs and of the Nominating Committee.

For a nomination form contact: Amy Halsted, Administrator for Operating Committees, APS, One Physics Ellipse, College Park, MD 20740-3844, phone: (301) 209-3266; fax: (301) 209-0865; (email: halsted@aps.org). Please provide biographical/supporting material on your nominees. The deadline is January 31.

APS Mass Media Fellowship Program - Summer 1997

Deadline: 15 January 1997

▶ NEW IN 1997!
In affiliation with the popular AAAS program, APS will sponsor two ten-week fellowships for physics students to work full-time over the summer as reporters, researchers, and production assistants in mass media organizations nationwide.

▶ PURPOSE
The intent of the program is to improve public understanding and appreciation of science and technology and to sharpen the ability of the fellows to communicate complex technical issues to non-specialists.

▶ ELIGIBILITY
Priority will be given to graduate students in physics, or a closely related field, although applications also will be considered from outstanding undergraduate and postdoctoral researchers. Applicants should possess outstanding written and oral communication skills and a strong interest in learning about the media.

▶ STIPEND
Remuneration is $4,000, plus a travel allowance of approximately $1,000.

▶ TERM
Following an intensive three-day orientation in early June at the AAAS in Washington, winning candidates will work full-time through mid-August.

▶ SELECTION PROCESS
During February, a review committee will screen completed applications received by the January 15 deadline. Files of the four or five most qualified applicants will be submitted to host media organizations for final selection in April.

▶ TO APPLY
The following materials must be received at the address below by **JANUARY 15**:

- Completed application form (available from the program office, below)
- A copy of your résumé
- Brief sample(s) of your writing (3-5 pages on any subject, written in language understandable to the general public — no technical papers, please), on single-sided, 8 1/2" x 11" paper, unstapled
- Three letters of recommendation (to be mailed directly to the program). Two of these letters should be from faculty members; one should be a personal reference.
- Transcripts of your undergraduate and graduate work (to be mailed directly to the program)

▶ MAIL TO
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)

CAUGHT IN THE WEB

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

New/Updated Links:

APS News Online (latest edition)
- APS Online Supplement
- Electronic Abstract Submission Guide

Units
- DHP Newsletter (Vol VI No 5, Oct 1996)

Meetings
- March 1997 Meeting Announcement
- April 1997 Joint APS/AAPT Meeting Announcement

Education and Outreach
- Industrial Summer Intern Program

Online Journals
- Physical Review D online

Commonwealth of Independent States: 1996-1997 Directory of Physics and Astronomy Staff

Now Available from the Russian Academy of Sciences

The Russian Academy of Sciences (RAS) is now offering the first Directory of Physics and Astronomy Staff for the Commonwealth of Independent States, retailing for US$94.50 plus postage and handling. It numbers more than 516 pages. Compiled by S.I. Shkuratov and E.F. Talantsev of the Institute of Electrophysics or RAS' Urals Division, the hardcover book includes listings for members of national academies of sciences, professors, doctors of sciences and philosophy, researchers, as well as more than 540 organizations doing physics, in all the republics of the former Soviet Union: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Turkmenistan, Tajikistan, Ukraine, and Uzbekistan. Email addresses are included in the listing. To order, complete and return the form below.

❑ YES, Please send me:

Please Print in Block Capitals	QUANTITY	PRICE
Commonwealth of Independent States: 1996-1997 Directory of Physics and Astronomy Staff (hardcover)		
	SUBTOTAL:	
	*POSTAGE & PACKING:	
	TOTAL:	

POSTAGE & PACKING PER BOOK

Russia: US$5.50	North America: US$10.50
former Soviet Union: US$7.50	Europe: US$10.00
Israel & Middle East: US$11.50	All other countries: US$11.00

Draw a cheque to:
Dr. S.I. Shkuratov
Institute of Electrophysics
Urals Division of the Russian Academy of Sciences
34, Komsomolskaya Str.
Ekaterinburg, 620049, RUSSIA
Telephone: (3432) 49-91-80
Facsimile: (3432) 44-50-51
email: shkurato@ief.intec.ru

Signed:_____Date:_____

Name:_____

Position:_____

Organization:_____

Address:_____

_____

Postal/Zip Code:_____

Country:_____Internet Address:_____

THE BACK PAGE

Is Science a Victim of its own Success?

by John Horgan

These are trying times for truth-seekers. Scientists feel increasingly besieged by technophobes, animal-rights activists, religious fundamentalists, post-modern philosophers and stingy politicians. After decades of stupendous growth, funding for basic research has begun to decline.

Also, as science advances, it keeps imposing limits on its own power. Einstein's theory of special relativity prohibits the transmission of matter or even information at speeds faster than that of light. Quantum mechanics dictates that our knowledge of the microrealm will always be slightly blurred. Chaos theory confirms that even without quantum indeterminacy many phenomena would be impossible to predict, because minute influences can have have gigantic consequences. And evolutionary biology keeps reminding us that we are animals, designed by natural selection not for discovering deep truths of nature but for breeding.

All these limits will make the search for truth more difficult in years to come. But in my view, by far the greatest threat to science's future is its past success. Researchers have already mapped out the entire universe, ranging from the microrealm of quarks and electrons to the macrorealm of planets, stars and galaxies. Physicists have shown that all matter is ruled by a few basic forces.

Scientists have also stitched their knowledge into an impressive, if not terribly detailed, narrative of how we came to be. The universe exploded into existence 15 billion years ago, give or take five billion years, and is still expanding outwards. About 4.5 billion years ago, the detritus from an exploding star, a supernova, condensed into our solar system. Sometime during the next few hundred million years, single-celled microbes emerged on the earth. Prodded by natural selection, these primordial organisms diversified into an extraordinary array of more complex creatures, including Homo sapiens.

My guess is that this basic narrative that scientists have constructed from their knowledge, this modern myth of creation, will be as viable 100 or even 1,000 years from now as they are today. Why? Because it is true. Moreover, given how far science has already come, and given the physical, cognitive, social and economic limits constraining further research, science is unlikely to make any significant additions to the knowledge it has already generated. By science I mean not applied science but science at its purest and grandest, the primordial human quest to understand the universe and our place in it. Further research may yield no more great revelations or revolutions but only incremental, diminishing returns.

The vast majority of scientists are content to fill in details of the great paradigms laid down by their predecessors. They try to show how a new high-temperature superconductor can be understood in quantum terms, or how a mutation in a particular stretch of DNA triggers breast cancer. But some scientists are much too ambitious and creative for merely "mopping up" after the pioneers (as the philosopher Thomas Kuhn, who died this past June, liked to put it). These overreachers want to transcend the received wisdom, to create revolutions in knowledge analogous to those triggered by Darwin's theory of evolution or by quantum mechanics.

For the most part these ambitious types have only one option: to pursue science in a speculative, non-empirical mode that I call ironic science. Ironic science resembles literary criticism or philosophy or theology in that it offers points of view, opinions, which are, at best, "interesting," and which provoke further comment. But ironic science does not converge on the truth.

The most obvious source of ironic science in this century is social science, which has given us such wonderfully provocative paradigms as Freudian psychoanalysis, Marxism and structuralism. But ironic hypotheses have cropped up in the so-called hard sciences as well. One striking specimen is superstring theory, which for more than a decade has been the leading contender for a unified theory of physics. Often called a "theory of everything," it posits that all the matter and energy in the universe and even space and time stem from infinitesimal, string-like particles wriggling in a hyperspace consisting of 10 (or more) dimensions.

Unfortunately, the microrealm that superstrings allegedly inhabit is completely inaccessible to human experimenters. A superstring is supposedly as small in comparison to a proton as a proton is in comparison to the solar system. Probing this realm directly would require an accelerator 1,000 light years around. This problem led the Nobel laureate Sheldon Glashow of Harvard University to compare superstring theorists to " medieval theologians."

Some optimists contend that these unconfirmed, far-fetched hypotheses are signs of science's vitality and boundless possibilities. I see them as signs of science's desperation. By far the most common objection to my end-of-science spiel is some variant of "That's what they thought 100 years ago." Implicit within this response is the following argument: As the 19th century wound down, physicists thought they knew everything. But then Einstein and other physicists discovered relativity and quantum mechanics, opening up vast new vistas for modern physics and other branches of science. Moral: anyone who predicts science is ending will surely turn out to be as short-sighted as those 19th-century physicists were. A similar anecdote alleges that in the 19th century a U.S. patent commissioner quit his job because he thought everything had been invented.

First of all, both of these stories are apocryphal. No American patent official ever quit his job because he thought everything had been invented. And physicists at the end of the last century were engaged in debating such profound issues as whether atoms really exist. The historian of science Stephen Brush of the University of Maryland has called the "Victorian calm" in physics a "myth."

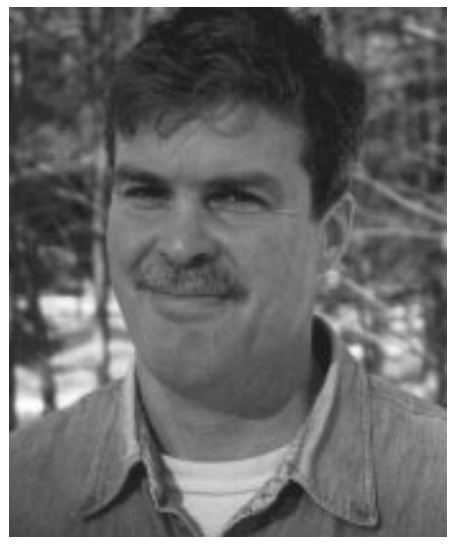
Furthermore, the inductive logic underlying the that's-what-they-thought-at-the-end-of-the-last-century argument is also deeply flawed. Because science has advanced so rapidly over the past century or so, this logic suggests, it can and will continue to do so, possibly forever. But viewed from an historical perspective, the modern era of rapid scientific and technological progress appears to be not a permanent feature of reality but an aberration, a fluke, a product of a singular convergence of economic, political and intellectual factors.

"The age in which we live," the great Nobel laureate Richard Feynman once declared, "is the age in which we are discovering the fundamental laws of nature, and that day will never come again."

Modern science, as far as it has come, has left many deep questions unanswered. But the questions tend to be ones that will probably never be definitively answered, given the limits of human science. How, exactly, was the universe created? Could our universe be just one of an infinite number of universes? Why is there something rather than nothing?

These are the kinds of unanswerable questions that give rise to superstring theory and other ironic theories. I do not mean to imply that ironic science has no value. At its best, ironic science, like great literature or art or philosophy, can ensure that we retain our sense of wonder before the mystery of the universe. But ironic science cannot give us the truth.

John Horgan is a senior writer at Scientific American *and author of* The End of Science*, published this year by Addison-Wesley.*



"Unfortunately, the microrealm that superstrings allegedly inhabit is completely inaccessible to human experimenters... This problem led the Nobel laureate Sheldon Glashow of Harvard University to compare superstring theorists to 'medieval theologians."

"The age in which we live,' the great Nobel laureate Richard Feynman once declared, 'is the age in which we are discovering the fundamental laws of nature, and that day will never come again."

The Back Page is intended as a forum to foster discussion on topics of interest to the scientific community. Opinions expressed are not necessarily those of the APS, its elected officers, or staff. APS NEWS welcomes and encourages letters and submissions from its members responding to these and other issues.