APS NEWS

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APS Established on May 20, 1899

More on APS origins begin on page 2.

APS 100 years — celebrate a century of physics

Richardson Vows to Keep DOE Labs Open in Keynote Address

Bill Richardson, US Secretary of Energy, delivered the keynote address at the APS Centennial meeting on Monday evening, March 22, to a packed room of physicists in town for the biggest physics meeting in the world. Also presiding at the event — which culminated with the unveiling of the APS timeline wall chart — were APS President Jerome Friedman (Massachusetts Institute of Technology), William Brinkman of Lucent Technologies, and Robert Eisenstein of the National Science Foundation.

Richardson opened with a recognition of the vital role physics has played in the last century. "This century of physics has done more than merely make significant discoveries... it has fundamentally altered how we think of the universe and of the forces that bind it together," he said. "Whether it is basic science, national defense, energy research or environmental quality, physics is the enabler and provider of solutions, an inseparable part of our livelihoods."

But the majority of Richardson's talk focused on the future, beginning with a summation of President Clinton's efforts to promote world leadership in basic science, mathematics and engineering for the US, emphasizing the goals set out in the 1994 study *Science in the National Interest*, undertaken by the presidential Council of Advisors. These include enhancing connections between fundamental research and national goals; stimulating partnerships that promote investments in fundamental science and engineering, and raising the scientific and technological literacy of all Americans. In addition, the Information Technology for the 21st Century initiative, will, he said, "enable us to develop and deploy new, faster computers for advanced simulation," providing "powerful tools to design a new generation of cars, develop new pharmaceuticals, and help us improve our weather and climate research."

Another area of concern to Richardson — one that has been echoed by many scientists and government representatives alike in recent years — is the need to improve communication between the American people and the physics community. To most Americans, physics is an inaccessible subject that "many people gladly left behind in high school," he said. Translating physics research into plain English — "decoding" it for the public similar to the way in which medical breakthroughs are presented for general consumption — is critical for accomplishing this.

Richardson also took the opportunity to respond to recent Congressional calls for heightened security at DOE laboratories. The issue came to the fore in recent weeks after a Taiwan-born American Los Alamos scientist was accused of passing nuclear secrets to China. Richardson vowed to "maintain and strengthen the tall fences that protect the nation's secrets," but added, "We can't be intimidated into closing ourselves off. It is critical that our laboratories — which house so many of our important research facilities and our finest scientists — do not become isolated from the world."

Pledging to fight any proposal to close off American science, Richardson emphasized the DOE's dedication to technological

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Photo by Ron Sherman

The entrance to the APS Centennial gala celebration at the Fernbank Science Museum, Atlanta, Georgia. For more photos from the gala and city-wide Physics Festival, see pages 5 - 8.

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Hawking Draws Packed House to Atlanta Civic Center

Over five thousand local and visiting spectators—scientists and the general public alike—crowded into the Atlanta Civic Center Wednesday evening, March 24, to catch a glimpse of best-selling author and theoretical physicist Stephen Hawking, in town to accept the 1999 APS Lilienfeld Lectureship Prize and give a free public lecture. Those unable to obtain tickets to the lecture watched it televised live on screens in the adjacent SciTrek Science Museum. Even those physicists skeptical of Hawking's highly mathematical, often speculative, and heavily debated theories — and knack for generating publicity — were on hand to witness what was unquestionably an "Event." [Said one, "This is something you see once in a lifetime."]

Hawking, 56, is the Lucasian professor of mathematics at Cambridge University in England — a chair once held by Isaac Newton — and author of *A Brief History of Time*, which has been translated into 40 languages since its publication in 1988. Microsoft technical guru Nathan Myhrvold, a former postdoctoral student of Hawking's, has said that the wheelchair-bound theorist has "sold more books on physics than Madonna has on sex," and Hawking himself estimates that Brief History "has sold about one copy for every 750 men, women and children in the world." His latest book is *Black Holes and Baby Universes*, published in 1997.

Stephen Hawking

The Lilienfeld prize check and certificate were presented by APS President Elect James Langer (University of California, Santa Barbara) to thunderous applause from the packed auditorium. Hawking, who suffers from amyotrophic lateral sclerosis — an incurable degenerative neuromuscular disorder more commonly known as Lou Gehrig's disease — then delivered his lecture on the computerized synthetic speech machine he uses to communicate with the outside world. Entitled "The Universe in a Nutshell," the subject matter was nothing new to those who have read his best-selling books — namely, that the universe is a self-contained system without boundaries, and that time has no meaning outside the laws of physics — but the addition of illustrative cartoon graphics on three large screens behind him added considerable visual impact to the concepts.

At a press conference the day before, Hawking played recorded answers to questions submitted previously by reporters. Most notably, he endorsed the recent discovery that the universe may be expanding at an ever-increasing rate — listed as the "Breakthrough of the Year" by *Science* magazine in 1998. Initially skeptical, Hawking told reporters that after examining the data collected from distant supernova blasts, he has "reconsidered" his "theoretical preferences" about the cosmological constant that would cause space to inflate more quickly with time. "I now think it is very reasonable that there should be a cosmological constant," he said. "I have had more time to consider the observations, and they look quite good." Furthermore, he believes there is not enough known matter in the universe to halt its expansion, and thus "the universe may keep flying apart forever."

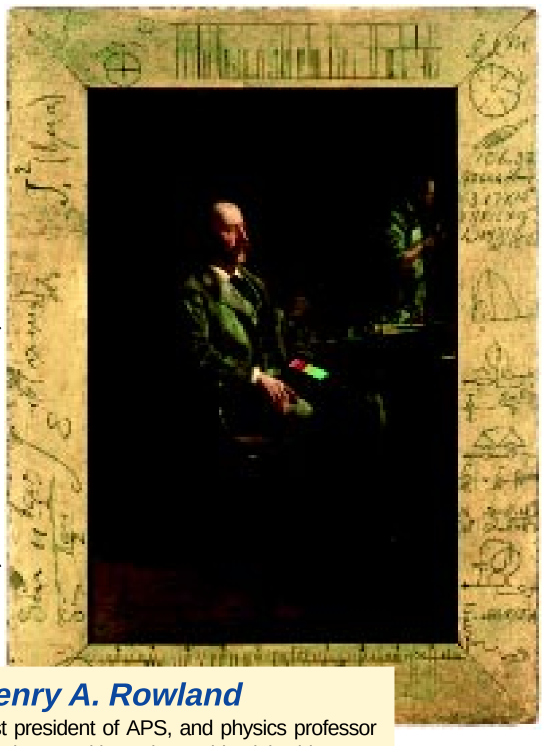
Hawking also said that he believes there is a 50-50 chance that scientists will achieve a Grand Unified Theory (GUT) within the next 20 years. One of the best candidates, he said, is the so- called "M theory," an extension of string theory that allows multiple universes to arise from an ever-changing quantum foam of space-time. However, he refused to identify any single example as the greatest development

Continued on page 3

To Advance & Diffuse the Knowledge of Physics

100 Years of the American Physical Society

Curator	Sara Schechner Genuth *Gnomon Research*	Researchers	George Trigg Ruth Kastner Steven Norton Amy Halsted
Exhibit Director	Barrett Ripin	Exhibit Design	Puches Design Inc.
APS History	Harry Lustig	Fabrication	Malone Displays
Journals History	R. Mark Wilson		



Addison Gallery of American Art, Phillips Academy, Andover, MA: *Professor Henry A. Rowland*, 1897, oil on canvas by Thomas Eakins

Henry A. Rowland

First president of APS, and physics professor at Johns Hopkins. His presidential address set the tone for the Society:

"To encourage the growth of any science, the best thing we can do is to meet together in its interest, to discuss its problems, to criticise each other's work and, best of all, to provide means by which the better portion of it may be made known to the world."

Origins of APS

Moving Forces

In 1899, thirty-six scientists met in New York to form a physics society. What was the context? What needs impelled them?

Physics in America was a meager profession by European standards of the late 19th century. Its first professors were not appointed until the 1870s, and they often paid for apparatus out of their own pockets. University administrators respected teaching more than research. The public applauded technological achievements over abstract ones.

In spite of these deterrents, the aspirations of American physicists were on the rise. So too were their numbers.

During the 19th century, physical sciences became increasingly specialized. In one discipline after another, scientists formed their own professional societies. Section B of the AAAS had been the primary meeting ground for physicists, but it met only once a year.

Physicists were inspired by the formation of the American Chemical Society and the American Mathematical Society.

In the 1890s, Americans were startled by news that European scientists had discovered x-rays, radioactivity, and the electron. New friendships were forged at international electrical meetings in Chicago.

U.S. physicists wanted to be part of the international community. To do this, they needed to meet more often and raise research standards in America.

Thus, self-definition, professionalization, and aspiration were the bedrock on which the American Physical Society was built.

COST OF DOING BUSINESS

APS Budget (1899)	$285
APS Budget (1999)	$37,253,325

The American Physical Society was established one hundred years ago; the *Physical Review* six years before that. Together they have shaped and promoted physics research in the 20th century.

This exhibit, commissioned for the APS Centennial, looks at the evolution of the American Physical Society and its research journals, their responsiveness to the needs of science, and their dynamic relationship with American culture.

APS News will serialize excerpts from this exhibit throughout the Centennial year. Next month: Early Years of the *Physical Review*.

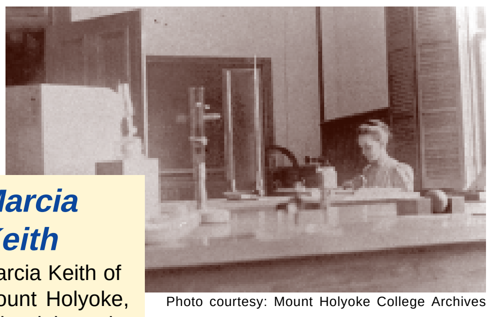


Photo courtesy: Mount Holyoke College Archives

Marcia Keith

Marcia Keith of Mount Holyoke, in her lab, and Isabelle Stone of Vassar were among the 36 founding members.

Photo courtesy: Nimitz Library, USNA/AIP Niels Bohr Library

Albert A. Michelson

First vice-president and second president.

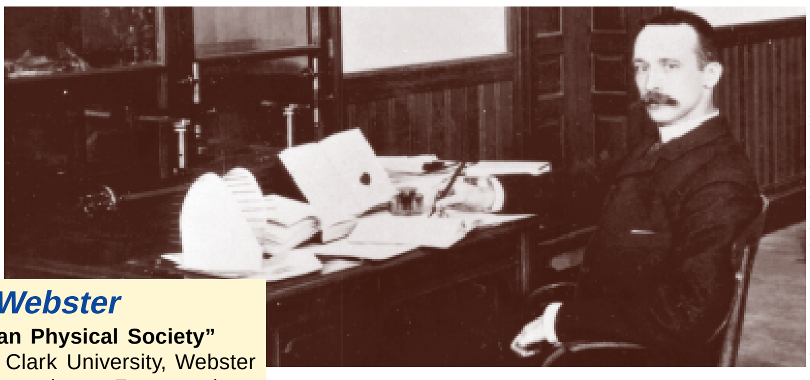
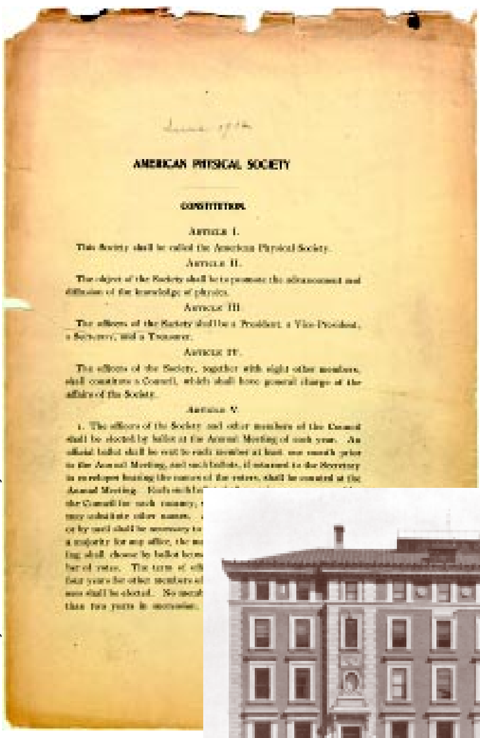


Photo courtesy: Clark University Archives

Arthur Gordon Webster

"Father of the American Physical Society"
Professor of physics at Clark University, Webster organized the first APS meeting at Fayerweather Hall, Columbia University on 20 May 1899.



AMERICAN PHYSICAL SOCIETY

CONSTITUTION.

ARTICLE I.

This Society shall be called the American Physical Society.

ARTICLE II.

The object of the Society shall be to promote the advancement and diffusion of the knowledge of physics.

ARTICLE III.

The officers of the Society shall be a President, a Vice-President, a Secretary, and a Treasurer.

ARTICLE IV.

The officers of the Society, together with eight other members, shall constitute a Council, which shall have general charge of the affairs of the Society.

ARTICLE V.

[illegible]

Photo courtesy: AIP Niels Bohr Library

Mission:

"To promote the advancement and diffusion of the knowledge of physics." Adopted 1899.

Fayerweather Hall

Columbia University was the site of the first meeting and remained the home of APS for 60 years.

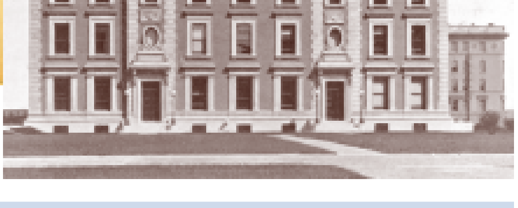


Photo courtesy: Columbia University Archives

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FESTIVAL PROFILE

Envisioning Science Through the Camera's Eye

Revelers at the APS Centennial gala hosted by the Fernbank Museum in Atlanta (see page 2) had the opportunity to view a new exhibit of work by renowned scientific photographer Felice Frankel. Frankel is currently artist in residence in science and technology and a research scientist in electrical engineering and computer science at the Massachusetts Institute of Technology (MIT). Her photographs, taken in collaboration with scientific researchers, have appeared on the covers and inside pages of such noteworthy publications as *Nature*, *Science*, the *Journal of Physical Chemistry*, and *Cellular Biology*, as well as a number of MIT publications.

Constructed around the theme of "Envisioning Physics," Frankel's Fernbank exhibit was commissioned by the APS specifically for the Centennial meeting. Like most of Frankel's work, the photographs are spare, composed of three-dimensional forms and structures recorded on two dimensions, and carefully focused upon the particular point of scientific investigation. "For me, form, shape and composition are integral to a scientific image," she says of her work. "I compose data, making it readable and comprehensible, and the scientists with whom I work agree that visually clarified information adds another dimension to the exchange of ideas."

Frankel earned her undergraduate degree in biology and worked as a laboratory assistant at Columbia University, conducting research on subcellular systems before leaving to raise a family. She subsequently established a solid reputation as a photographer of landscapes and architecture, eventually publishing a book entitled *Modern Landscape Architecture*. Her success resulted in her being awarded a Loeb fellowship from Harvard University's Graduate School of Design, giving her the freedom to pursue any course of study she desired in 1991, at the age of 47. While her colleagues in the program opted for the usual architecture and design courses, Frankel found herself rediscovering her passion for science, taking classes with E.O. Wilson and Stephen J. Gould, among others.

The turning point came when she audited a course with George Whitesides, a professor of chemistry who presented lectures "in a very imaginative and visual way," says Frankel. Intrigued enough to want to work in his laboratory, she introduced herself, and he offered her the opportunity to come up with a photograph to accompany an article he'd submitted to *Science* magazine. The image she created wound up gracing the cover, and with Whiteside's continued support and encouragement, she found herself embarked on an entirely new career: science photography.

"It was one of the those unbelievably serendipitous situations," she now says. "If I had started with another research group, this probably might not have happened." In 1997 she coauthored a book with Whitesides, entitled *On The Surface of Things: Images of the Extraordinary in Science* (Chronicle Books),

Image from web.mit.edu/feliceF/www/aps1.html

Ferrofluid on a glass surface, with 7 circular magnets. From *On the Surface of Things, Images of the Extraordinary in Science* by Felice Frankel and George M. Whitesides

based on an exhibit of the same title which is presently traveling around the country.

A strong proponent of the importance of the visual element in communicating science to a broader public, Frankel is dedicated to providing researchers and students of science alike with "a visual vocabulary" of science. "Too often the visual beauty of scientific research seems to be kept secret," she says. "Scientists are trained to be suspicious of visually stunning displays, often dismissing them as unnecessary or superficial, and thus remain largely unaware of the value of the visual poetry of their own work."

To this end, Frankel has received a grant from the National Science Foundation to develop a guidebook for students and researchers on how to incorporate powerful visual images into the communication of their data. "It's literally a how-to recipe book," she says, crossing all spectra of the various fields of research. Along with several colleagues, she is also organizing a major conference on envisioning science and technology, to be held at MIT in June 2001.

The conference, entitled "Image and Meaning" will gather together researchers in all disciplines, as well as journal editors, art directors, science and biomedical imagers, photographers, illustrators, animators, museum exhibitors, writers, and TV and film producers — anyone involved in the visual presentation of science to the general public.

The unique process by which Frankel creates her own images is decidedly collaborative in nature. She meets with willing researchers, learns as much as she can about their work, and uses their input to create an image that captures the essence of the research. However, she balks at elevating her photographs to the level of art. "I do not view myself as an artist because an artist has a personal agenda and a very particular point of view, that of communicating the part of herself she wants the world to perceive," she says, adding that the primary purpose of her images is to communicate scientific information. "To suggest that art and science are related may dangerously redefine each. Scientific images may be beautiful and even artistic, but they are not art, and art is not science."

An online version of Felice Frankel's exhibit, "Envisioning Physics," is at http://web.mit.edu/feliceF/www/aps1.html. In addition, the entire exhibit is available for touring at select venues around the country. Interested parties should contact Frankel directly at felicef@mit.edu, or (617) 253-5604.

BOOK REVIEW

Celebrating Scientific Silliness

The Best of Annals of Improbable Research. Edited by Marc Abrahams. [W.H. Freeman & Company, 1998.] $14.95.

Buried amid the commemorative volumes, posters, T-shirts, Einstein mousepads, and other trinkets on sale at the APS Centennial meeting in Atlanta, I stumbled across *The Best of Annals of Improbable Research* (AIR), edited by Marc Abrahams, emcee of the notorious Ig Nobel Prize ceremony, held annually at Harvard University every fall. Numb from an endless parade of sessions earnestly detailing the unquestionable glories of science past and present, the volume provided me with an unabashedly gleeful celebration of scientific silliness. It's impossible not to love a journal that reviews the cafeterias at the world's great research institutions, rating not only food quality and trendiness of the setting, but also the number of photos of bearded men displayed on its hallowed walls.

The book opens with a brief history of AIR — including its early origin as the *Journal of Irreproducible Results* — and a reprint of the first ground-breaking article by the late Alexander Kohn in 1955, entitled "Kinetics of Inactivation of Glassware," which explored the high degree of breakability of glass products. Likewise, the entire seven-year history of the Ig Nobel Prize ceremonies are highlighted, including entertaining photographs of the festivities, snippets of the more amusing "acceptance speeches," and shortened versions of a few of the original papers honored in the ceremony.

The bulk of the volume is devoted to a generous sampling of humorous "papers" that have appeared in the pages of AIR over the years, subdivided according to specialty. For instance, under "Astronomy, Physics and Food," we find an insightful analysis of the chaotic "butterfly effect," in which the authors apologize to the country of France for excessive rainfall, which they attribute to a single butterfly living in Lausanne, Switzerland. Also included are seminal studies of the aerodynamics of potato chips, the effects of peanut butter on the rotation of earth [conclusion: "none"], and the correlation between tornadoes and the preponderance of trailer homes in any given region.

Under "Medicine and Biology," we find the classic 1995 AIR article investigating the taxonomy of Barney, which concludes that the creature is not, in fact, an actual dinosaur, as well as a paper exploring the medical effects of kissing boo-boos. In "Mathematics and Models," one paper estimates the value of love based on Bob Dylan lyrics, most notably 1965's "(Love-0)/No Limit" from the album *Subterranean Homesick Blues*. Those interested in educational issues can peruse a thorough investigation of the behavior of dead students in a classroom, concluding that while dead students exhibit exemplary behavior and perfect attendance, they perform very poorly on exams.

One of my favorite entries was "Cindy Crawford Discovers" (or, "The Face Value of Science"), in which AIR staff member Alice Shirrell Kaswell scans the latest women's beauty magazines for emerging scientific breakthroughs. Her findings include supermodel/actress Elizabeth Hurley's foray into engineering with a skimpy Versace dress held together by safety pins. Kaswell also laments her ignorance of mysterious substances called "volumizers," and ponders the scientific significance of such pithy statements as "Women over 30 should avoid dark mascara," and "Night creams are more emollient than day lotions."

Also excerpted are the best of Abraham's irreverent "Nobel Thoughts" column, in which Nobel Laureates expound on such pressing concerns as how to deal with junk mail, the relative merits of beer and potato chips, whether to use a pencil or pen, and how to distinguish between fatheads and phonies. Harvard's William Lipscomb, the 1976 Nobel Laureate in Chemistry and a devoted admirer of Sherlock Holmes, responds to every question with an example of the fictional detective's famous scientific method, as illustrated in various case histories. And consider the classic response of Dudley Herschbach, a co-recipient of the 1986 Nobel Prize in Chemistry, when asked to give advice to young people entering the field: "One thing that frightens students is the feeling that you've got to get it right. But science lets you get it wrong a lot of the time. Being a scientist is like being a musician. You do need some talent, but you have a great advantage over being a musician. You can get 99% of the notes wrong, then get one right and be wildly applauded."

But perhaps the greatest insight into the scientific mind is offered by Karen Hopkin of National Public Radio, the originator of the highly popular *Studmuffins of Science* calendar project and an occasional contributor to AIR. What has she learned? "That most scientists, at heart, believe themselves to be studmuffins," she writes. "I had very little trouble convincing my PhDs to pose. It's like they were just sitting in the lab, waiting for the phone to ring. 'A pinup calendar? Why, of course. I'll have my assistant bring my Speedos at once.'"

—Jennifer Ouellette
Associate Editor, APS News

Hawking *(continued from page 1)*

in 20th century physics, stating flatly, "It is a ridiculous question. Physics is a unified corpus. You cannot isolate a single aspect." And asked whether time travel will be possible in the next millennium, he replied with a succinct, "No."

At a special, invitation-only reception just after the evening lecture, guests had the opportunity to meet Hawking in person, as well as sample hors d'oeuvres and mingle with many of the featured lecturers and performers associated with the city-wide Physics Festival. Many crowded about Hawking's wheelchair, curious to witness the workings of his computerized speech synthesizer first-hand. [He manipulates a toggle switch with his left forefinger to select words and phrases from the computer screen displayed in front of him, which then converts the text into speech.] Science magician Bob Friedhoffer demonstrated some basic card tricks, causing one card to "visibly" melt through another, and a card packet to vanish, reappearing in his mouth. The performance elicited a smile of delight from one of the world's most famous physicists, along with the comment, "That's why I'm not an experimental physicist. You can never believe the evidence."

On Friday, Hawking and his entourage toured the Centers for Disease Control, a national program based in Atlanta of particular interest to him. Hawking's father was a prominent microbiologist specializing in tropical diseases, who had hoped his son would follow in his footsteps. Asked by Altanta festival coordinator Karla Jennings whether he'd ever considered a career other than physics, he quipped, "I considered becoming Prime Minister of England, but now I'm glad that Tony Blair has the job."

OPINION

A Brief Review of Physics in the 20th Century

by D. Allan Bromley

Science and its applications — which today we call technology — has from its very beginning been an important part of the American society. As we approach the close of the 20th century, it is entirely appropriate that we celebrate the role of our particular sector of this science and technology: physics and its applications.

What, then, is physics? The best definition I have encountered is that of my old friend, the late Edward Purcell. In 1970 he wrote, "Science is knowing. What man knows about inanimate nature is physics — or rather, the most lasting and universal things that he knows make up physics." We physicists have the arrogance to believe that the laws we deduce from our measurements here on earth apply throughout the universe, and that what is true today was true throughout the entire life of the universe. Our measurements support that arrogance. Purcell goes on to say, "As he gains more knowledge, what would have appeared complicated or capricious can be seen as essentially simple and in a deep sense, orderly." Turning to applications, he said, "To understand how things work is to see how, within environmental constraints and the limitations of wisdom, better to accommodate nature to man and man to nature." Many have noted that the 20th century of science truly began in 1897 with J.J. Thompson's discovery of the electron. This reflects the enormous impact that our ability to manipulate the atom and its component electrons has had on such diverse areas of modern civilization as communications, computation, energy, and medicine. In 1905, Albert Einstein published his classic papers on Brownian motion, the photoelectric effect and special relativity, the latter providing us with one of the classic equations of all time: $E=mc^2$. And in 1911 Ernest Rutherford discovered the atomic nucleus. The next two decades saw the emergence of quantum mechanics, culminating in 1932, truly an annus mirablis in the physics of the time, with the discovery of positrons in cosmic rays; experimental confirmation of the relativity of time; the first electrostatic accelerator; and the first cyclotron.

The 1930s closed with the discovery of convincing evidence for nuclear fission, and recognition of the potential military consequences came rapidly, with the establishment of the Manhattan Project, as well as MIT's Radiation Laboratory, devoted to the development of radar. These activities ushered in a total seachange in the scientific and technical communities. Prior to World War II, basic research was directed toward the understanding of nature, while invention and technology were directed toward the mastery of nature, and the two proceeded on rather parallel and noncommunicating courses. What the wartime projects made very evident was that basic understanding could greatly facilitate the development of technology, and basic technology could facilitate whole new areas of basic research. The prewar activities that had frequently been called natural philosophy and invention, respectively, were irretrievably joined, and nowhere more so than in physics.

This 20th century in physics began with a rush of new insights and, happily, it is ending in much the same way. For example, our ability to understand, to probe, and to structure surfaces has opened up entirely new areas of catalysis and corrosion resistance, and an entirely new understanding of phenomena such as friction and adhesion. Entire optical benches and chemical laboratories are now being fabricated on single chips with nanoscale rotary and linear motors powering the necessary motions. The development of new materials has had a major impact on our ability to develop human prosthetic devices to replace both bones and soft tissue. Our understanding of chaotic phenomena and their dependence on nonlinearities and initial conditions marks one of the major achievements of the 20th century in physics.

Photo by Ron Sherman

D. Allan Bromley

Elementary particle physics and cosmology are slowly coming together to address some of the most fundamental questions in physics, because with ever more powerful accelerators, it becomes possible to recreate, if only for tiny fractions of a second, the conditions that were present within the first moments of the existence of our universe. Atomic and nuclear technology has found wide application in biology and medicine, and the interconnections are growing on almost a daily basis. In communications, single optical fiber bandwidths have been doubling every nine months and the actual in-the-field telephone company products now lag the research frontiers by only four years. The resulting communication and computation explosion has truly reduced our planet to a global village and changed the entire nature of our society. There are far too many other exciting developments at the frontiers of physics to attempt a complete list here.

With regard to the future, there are ten open questions in physics that strike me as being of particular interest. How does mass originate? Does nonbaryonic dark matter exist, and if so, in what form? Why are we in a matter universe? What is the ultimate fate of our universe? What is the structure of quantum gravity? Are quarks and leptons truly elementary, or composite? Do the physical constants change with time? What are the consequences of a nonzero neutrino mass? How does one build a quantum computer? And finally, is room temperature superconductivity possible?

Lord Raleigh, then president of the British Association for the Advancement of Science, was asked 115 years ago to give a review of physics in the 19th century as his presidential address. He began by noting that this was impossible, and I know only too well how he felt. But I would like to quote one of his closing comments: "Increasing knowledge brings with it increasing power, and great as are the triumphs of the present century, we may well believe that they are but a foretaste of what discovery and invention have yet in store for mankind."

We remain a vital, active and productive science. We physicists are among the most fortunate of humans; we have been privileged to engage in that greatest adventure of discovery at a time when technology has allowed us to push outward the frontiers of knowledge at unprecedented rates. And in so doing, we have also bettered the lives of humans everywhere. Physics, as the most fundamental of the sciences, will always remain a vital part of this great adventure.

Former APS President D. Allan Bromley is Sterling Professor of the Sciences and Dean of Engineering at Yale University and former advisor to the Bush Administration. The above text was heavily condensed from his address at the opening plenary session; APS Centennial Meeting; Atlanta, Georgia.

LETTERS

Another Alert Reader Weighs In...

This note relates to the Back Page article, "Discovering our Roots: The PhD Lineage Contest winners." In that piece the author used the word "geneology" or "geneologist" several times. I would like to point out that "genealogy" is properly spelled with an "a" instead of an "o", as opposed to most other "—ology" terms. This results from the "genealogy" of the word itself—it comes from a combination of two French terms, genea, meaning descent, plus logos, meaning discourse. [See Webster's New Collegiate Dictionary, G & C Merriam Co (1951)]. Note also that my spell checker (WordPerfect 4.2) catches the erroneous spelling. How come yours didn't?

Robert A. Levy
El Paso, Texas

Editor's Note: Is it too early to blame the error on the Y2K bug?

Scientific Travel and Nuclear Proliferation

In a situation where two neighboring countries with nuclear weapons capabilities maintain a hostile posture, bringing together scientists from the two sides to discuss the situation and alleviate tensions was, in our opinion, an eminently sane and rational course of action. Therefore, as citizens and scientists belonging to Argentina, Brazil, India, Israel, Pakistan, Sri Lanka and the US, we had enthusiastically welcomed the efforts of the American Physical Society to host a round-table discussion at the Atlanta Centennial Meeting to identify the role of physicists to build bridges between nations which otherwise may be having conflicting interests on nuclear issues or issues related to physics. Some of us had even arranged discussions on the same issues in our institutions to take advantage of these visitors. To our disappointment, we subsequently learned that the invited speaker from India, Dr. T. Jayaraman, was denied leave to participate in the APS discussion by the Director and the authorities of the Institute of Mathematical Sciences, Chennai, where he works as a theoretical physicist.

The reason given by the Institute's Director for his action was that Dr. Jayaraman's participation was not in the interests of, "...the Institute and the nation." Several appeals did not change the Director's decision. Subsequently the Director stated that as the Institute is under travel restrictions by the U.S. government, and the APS has been unable to remove these restrictions, it would not be appropriate for Jayaraman to participate in the APS panel. On the contrary, the American Physical Society has succeeded in removing such restrictions in specific cases and has continued to work for the removal of all impediments to the free circulation of scientists through both public appeals and by close interaction with U.S. governmental agencies.

We feel that the present age compels us to think in global terms and thus the denial of leave to Dr. Jayaraman to participate in the panel discussion is a violation of his academic freedom and has done disservice to the cause of promoting international peace. We urge the Director of the Institute of Mathematical Sciences, and the Government of India, to desist from applying such restrictions in the future.

Physicists have an important role to play as promoters of peace. Preventing open scientific exchange injures science as an instrument to advance the international scientific enterprise, to develop comity among scientists, to advance our common culture and to contribute to the welfare of nations.

Luis Masperi, *Argentina*; **Luis Pinguelli Rosa**, *Brazil*; **T.R. Govindarajan**, *India*; **M.V. Ramana**, *India*; **Zia Mian**, *Pakistan*; **A.P. Balachandran**, *India*; **Jeeva Anandan**, *US/Sri Lanka*; **Saeed Durrani**, *UK/Pakistan*; **Avner Cohen**, *US/Israel*; **W.K.H. Panofsky**, *US*; **M.H. Engineer**, *India*; **Pervez Hoodbhoy**, *Pakistan*; **Irving Lerch**, *US*

FIP Resolution Objects to New State Department Advisory

The APS Forum on International Physics (FIP) has issued a resolution objecting to a new "advisory from the U.S. State Department with likely negative effects on the issuance of visas to scientists from the People's Republic of China coming to the US as scientific visitors or students." According to an urgent communication sent out to FIP members by 1999 FIP Chair Joseph L. Birman (City College, City University of New York), the wording of the State Department advisory is vague, applying to, "Applicants who are nationals of the Peoples Republic of China and who will be involved in an activity related to materials technology." Says Birman, "We are concerned that it will be interpreted to encompass many fields in physics, materials science, chemistry, and related areas." The "advisory" requires that the application must get an additional "advisory opinion" from Washington before being issued, an extra step that could take at least one additional month, or longer.

RESOLUTION

The Forum is deeply concerned by the recent US State Department advisory [reference to Section 221 (g) of the Immigration and Naturalization Act] which restricts visa applications from The Peoples Republic of China. While we are mindful and support appropriate security measures in important Laboratories we believe the advisory is ill-placed. The effect of the advisory is to deviate from the principle of The Free Circulation of Scientists to which the United States has committed itself,along with the international scientific community. The principle of Free Circulation is also one we have used against restrictions imposed by other countries. The Forum is disturbed by the generalization of the possible adverse activities of one individual to a larger group, and the singling out of one group based on nationality. Our National Security depends in no small part on the vitality of the scientific enterprise — and this enterprise is put at risk by the State Department advisory. Thus, the Forum urges the leadership of the American Physical Society to protest the State Department Advisory at the highest levels, and to publicly state its opposition to the advisory. The Forum also urges the American Physical Society to reach out to the entire membership to inform them of the seriousness of this measure.

Physicists Step Out in Style at Fernbank Gala

Tuxedos and gowns, fine dining and dancing were the order of the day for those attending the APS Centennial gala celebration, hosted by Atlanta's Fernbank Museum. While not everyone opted for the formality of black tie fashion, most seemed to relish the opportunity leave their meeting badges and hefty volumes of abstracts behind and don the requisite finery, mixing and mingling with both old and new acquaintances in the distinctly elegant surroundings.

The catered buffet dinner featured three menus from different geographical regions, while a jazz combo provided accompaniment in a side room for anyone desiring to dance. Guests milling about the upper balcony could stay close to the open bar while viewing a special exhibition by award-winning science photographer Felice Frankel [see page 3], constructed around the theme of "Envisioning Physics." Commissioned by the APS specifically for the Centennial meeting, the exhibit is available for touring at venues around the country. An online version can be found at http://web.mit.edu/feliceF/www/aps1.html. Those desiring additional entertainment had the option of viewing the popular IMAX film, "Cosmic Voyage," at various screening times. Meanwhile, in the auditorium, science magician Bob Friedhoffer delighted audiences with clever asides and magical sleights-of-hand, alternating 20-minute shows with Lynda Williams, "the Physics Chanteuse," who wowed them with her cosmic cabaret, featuring such crowd-pleasing tunes as "Solid State of Mind" and "Carbon is a Girl's Best Friend."

Finally, alert attendees circling the room might have noticed the appearance of a few especially stellar celebrities: Albert Einstein (two versions, in fact, for those who thought they were seeing double), Marie Curie, and a dapper J. Robert Oppenheimer were on hand to greet the guests and pose for photographs, all in the name of celebrating a century of physics.

Photo by Ron Sherman

The lavish interior of Atlanta's Fernbank Museum, site of the APS Centennial Gala Celebration.

Photo by Scott Martin

"Albert Einstein" takes a turn with "Marie Curie" during the APS gala celebration at the Fernbank Museum.

Photo by Guerry Redmond

Above: Blowing giant soap bubbles at the Fernbank Museum's interactive science exhibit, open to all those attending the APS gala celebration.

Photo by Guerry Redmond

APS President Elect James Langer soaks up the elegant atmosphere with wife, Lily.

Photo by Ron Sherman

At left: Listening to the tones produced by a giant wind harp at the Fernbank interactive exhibit.

At right: Will the real “Albert Einstein” please stand up? Gala guest gets double the fun with a different kind of special relativity.

Below: B.S. Chandrasekhar of CSI, APS Executive Officer Judy Franz, Charles Duke of Xerox R&D Center, and gala organizer Brian Schwartz observe the festivities from a quiet corner.

Photo by Ron Sherman

Photo by Guerry Redmond

Photo by Guerry Redmond

Photo by Guerry Redmond

Above: An Illustrious “Nobel” Trio: Valentine Telegedi, Leon Lederman and APS President Jerome Friedman pause in their revels for the camera.

At left: Ken McNaughton, editor of *The Industrial Physicist* magazine, gets a brush with greatness as he hobnobs with “Marie Curie” and a dapper “J. Robert Oppenheimer.”

Photo by Ron Sherman

Above: Science magician Bob Friedhoffer enchants young partygoer with a demonstration of the principles of air pressure.

At right: Isaac Chuang of IBM/Almaden investigates acoustic resonance.

Photo by Ron Sherman

Emory University’s Sid Perkowitz admires the fashionably “retro” bowtie of APS Associate Executive Officer (and *APS News* editor) Barrett Ripin, while Marilyn Ripin looks on. Sara Schechner, curator of the *Physics Works!* and APS History exhibits, enjoys conversation at the table.

Photo by Guerry Redmond

Newly elected New Jersey Congressman Rush Holt compares notes on “What’s New” in Washington with Robert Park, APS Director of Public Affairs.

Photo by Ron Sherman

Photo by Ron Sherman

Lynda Williams, a.k.a. “The Physics Chanteuse,” gave three standing-room-only performances in the Fernbank auditorium.

Physics Festival

At left: Science magician Bob Friedhoffer elicits a smile from 1999 Lilienfeld Prizewinner Stephen Hawking.

Below: Centennial meeting attendees peruse the APS History Exhibit featured in the GWCC lobby.

Photo by Sara Schechner

Noontime passerby takes in Eric Heller's exhibit on *Fractals and Chaos*, on display outside the Georgia Pacific Building auditorium.

Sid Perkowitz answers students questions following a Friday public lecture on the physics of beer.

Atlanta art students take in the *Microscapes* exhibit sponsored by Lucent Technology.

Above: Atlanta's Rialto Theatre marquee announcing "The Physics of Star Trek" public lecture.

At left: "Star Trek" guru Lawrence Krauss explains the finer points of the Enterprise's many (as yet uninvented) technological marvels.

At right: Even baseball, the All-American pasttime, has benefited from understanding physics principles, as deomnstrated by NYU's Richard Brandt.

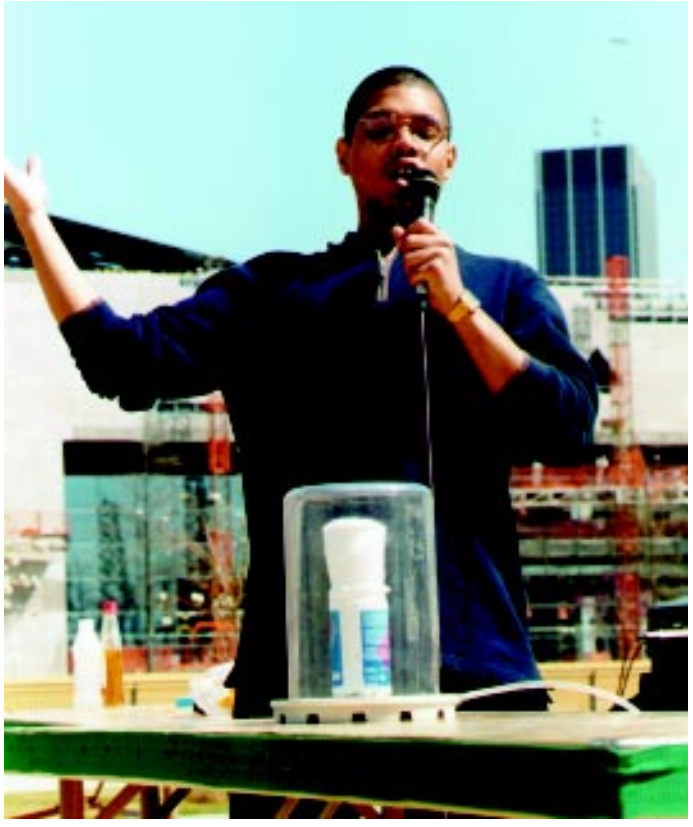
Below: AIP Executive Officer Marc Brodsky crouches in the quantum corral, part of the *Physics Works!* exhibit at the Georgia World Congress Center (GWCC).

Photo by Sara Schechner

Brian Holmes employs various brass instruments to demonstrate the basic physics principles behind them.

At right: Robert Greenler demonstrates the geometric structure of ice crystals responsible for "halo effects" at the South Pole during a lunchtime public lecture.

Ken Laws and his best ballerina demonstrate the physics of dance.



Above: Noontime demonstration of air pressure by Hampton University demo team.

At right: "Fractals and Art" lecturer Richard Voss following his presentation at the Woodruff Arts Center.

ESPN2 Series Investigates the Science in Sports

Science educators looking for new ways to pique their students' interest should be pleased to hear about SportsFigures, an innovative, award-winning educational television series that employs sports celebrities, irreverent humor, edgy music, exciting locations, lively hosts, cool graphics and a fast pace to engage kids and get them interested in learning. Produced in association with ESPN, the series premiered in 1995 as part of the industry-wide program, *Cable in the Classroom*. It's designed to teach young people, aged 12 to 16, the principles of physics and math using sports to grab their attention and provide a practical real-life example.

Each weekly, commercial-free, half-hour show features two segments in which a celebrity athlete helps take the math or physics problem out of the classroom and into the field, exploring such questions as why a curve ball curves, and why a gymnast spins faster in a tuck position. The 1998-1999 season features segments on baseball, soccer, track, sailing, race cars, scuba diving, basketball, snowboarding and golf.

The recent recipient of a Parent's Choice Award for educational television, SportsFigures' only problem seems to be that no one knows of its existence, no doubt due to the air time: Monday mornings at 5:30 AM on ESPN2. But hopefully that will soon change. ESPN recently announced that, through sponsorship with Infoseek's GO Network, it will distribute the series to all 18,000 public and private U.S. high schools. ESPN already provides free curriculum guides to accompany the television episodes, including lesson plans and student activity sheets. Copies are available on the Web at http://www.ESPN.com.

FUTURE SHOWTIMES

Editor's Note: *Episode 1, featuring segments on "Running with Momentum" and "Relaxing with Impulse" as illustrated in the NFL, last aired on April 26, 1999.*

Episode 2 — Airs May 3, 1999

That Mu You Do. Features NASCAR superstar Jeff Gordon. How does friction keep a NASCAR car on the track? Explores what friction is and how to quantify it.

Bouncing Basketballs. Features WNBA Sacramento Monarchs star Pamela McGee. Why does a basketball bounce? How does a league get all the balls to bounce the same?

Episode 3 — Airs May 10, 1999

The Sounds of Summer. Features New York Yankees All-Star shortstop Derek Jeter. Explores the travel of light and sound and how a game is broadcast.

Golf is a Drag. Features PGA golfer Harrison Frazer. Hooks and slices plague golfers. The physics of aerodynamics can help solve the problem.

Episode 4 — Airs May 17, 1999

In Golf Gravitas. Features PGA putter Brad Faxon. Explores how understanding topography can help you master your putting.

Tracking Speed. World champion and Olympic gold medalist decathlete Dan O'Brien sprints through the physics of motion to explore speed versus acceleration.

Episode 5 — Airs May 24, 1999

The Trig to Soccer. Olympic team gold medalist Julie Foudy talks about soccer, life and trigonometry in a practical introduction to tangents.

Sailing Through Bernoulli. Professional sailboat racer Scott Dickson and yacht designer Alan Andrews help explain the physics of a sailboat in terms of the Bernoulli principle and force vectors.

Episode 6 — Airs May 31, 1999

Shooting Stats. Features the NBA's second highest scorer, Ruthie Bolton-Holifield of the Sacramento Monarchs and Olympic Dream team, and explores what statistics mean to a player.

Math Under Pressure. Richard Murphy, director of the Jean-Michel Cousteau Institute, helps demonstrate the principles of atmospheres and pressure along with some algebra.

Episode 7 — Airs June 7, 1999

Big Air Rules. Features world-class brother/sister snowboarders Mike and Tina Basich. Explores the physics of projectile trajectory and parabolas through the jumps of snowboarders.

How Sweet It Is. Features Atlanta Braves All-Star Third Baseman Chipper Jones. Explores the physics of standing waves and vibrational nodes, such as why hitting a ball with a bat sometimes hurts your hands.

INSIDE THE BELTWAY

A Washington Analysis

Cornpone and Southern Comfort

by Michael S. Lubell, APS Director of Public Affairs

Getting out of Washington is one thing; getting away from Washington, something else. Atlanta injected hospitality into the political rhetoric during the APS Centennial, but it couldn't mask the fault lines entirely.

No surprise there, you say. Put a Democrat and a Republican on the same platform, and there's bound to be some quaking. But, in the case of Atlanta, you'd be wrong.

At the Centennial Symposium, *Science Policy for the New Millennium*, sponsored by the Forum on Physics and Society, it wasn't Representatives Vern Ehlers (R-MI) or Rush Holt (D-NJ) who rattled any cages. It was Defense Research and Engineering Director Hans Mark, the chief technology advisor to the Secretary of Defense.

A former Secretary of the Air Force from 1979 to 1981 and later Chancellor of the University of Texas System, Mark holds a Ph.D. in physics from the Massachusetts Institute of Technology. He is a member of the National Academy of Engineering and a fellow of the American Physical Society, the American Association for the Advancement of Science and the American Institute of Aeronautics and Astronautics. He holds four honorary degrees and a host of medals for public service and scientific achievement. He is, in short, well credentialed, a person who commands your attention.

He didn't disappoint. For openers, he challenged the very premise of the symposium. Is he right? You be the judge.

When the Berlin Wall came crashing down a decade ago, Beltway science advocates began to search for rationales to replace national defense as the umbrella for Federal investments in research. Biology found disease and everyone else found the economy.

Mark, though, says that defense is still the 800 pound gorilla, accounting for just over 53 percent of Federal R&D outlays in Fiscal Year 1999, almost exactly what it was thirty years ago. Moreover, he notes, in 1949, outlays for defense R&D amounted to 0.3 percent of the Gross Domestic Product. Today, it is 0.4 percent. To discern policy, he says, follow the money trail. It goes to the same place it did a quarter or a half century ago.

Perhaps he was too kind to say so, or perhaps he simply had not read Vern Ehlers's report, *Unlocking Our Future*, which the House of Representatives endorsed last fall. But Mark was making a frontal assault on that document. Here's what Ehlers and the House Science Committee had said:

"The end of the Cold War had a profound impact on the Nation's research and development enterprise, and brought with it the end of the second mega-era of science policy. Without the backdrop of the Soviet military threat or the race to conquer space, convincing and often-used justifications for federal research funding became less compelling."

It might have been Southern air or just his naturally non-confrontational manner, but Ehlers opted not to fight. He, Holt or National Science Foundation Director Rita Colwell, the fourth panelist, could have pointed out that today, defense accounts for only a quarter of Federally funded research — development dominates defense R&D — while in 1949, it accounted for almost all of it. But none of them did. Nor did any of them point out that Federal R&D outlays now account for only 0.8 percent of the Gross Domestic Product, compared to 2.2 percent near the peak of the defense build-up in Fiscal Year 1964 and 1.1 percent just a decade ago.

Mark also staked out his own patch of controversial territory on missile defense. Responding to a query from the audience, he said, "[There is] no question that we can build a national missile defense system designed to protect the continental United States against attack.... By definition, this is feasible, and it can be built." Right or wrong, you could almost hear dropping jaws hit the floor.

Only a few days earlier, Ehlers and Holt, the only two physicists in Congress, had voted against the House National Missile Defense bill on the grounds that technological and scientific feasibility of the system remains largely unproven. Holt had put it succinctly in the floor debate: "Wishing won't overrule physics."

But if Mark, whose assertion represents the strongest position yet articulated by a senior member of the Clinton Administration, was looking for a fight, Holt and Ehlers refused to rise to the occasion. Would they have, had the Washington media been prowling around, as they do inside the Beltway? Perhaps it was just Atlanta etiquette: cornpone and Southern comfort.

zero gravity

The Official 1998 Pigasus Awards

Awarded by the James Randi Educational Foundation

Every April 1st, the James Randi Educational Foundation (JREF) announces the coveted Pigasus awards in four categories, for accomplishments in the period from January 1 to December 31. The awards are announced via telepathy, the winners are allowed to predict their winning, and the Flying Pig trophies are sent via psychokinesis. "We send; if they don't receive, that's probably due to their lack of ability," the foundation insists. This year, the foundation awarded the prizes to the following individuals:

Science: Dr. Jacques Benveniste

Category #1, to the scientist who said or did the silliest thing related to the supernatural, paranormal or occult, goes to Dr. Jacques Benveniste, for his insistence that the magical qualities of homeopathic medicines can be transmitted via the Internet in digital form, transferring curative qualities from a bottle of homeopathic water located in Paris, France, to a bottle of quite ordinary water located in Albuquerque, New Mexico. For this amazing discovery, Dr. Benveniste also became the only individual to have received the Ig Nobel Prize awarded by the Annals of Improbable Research, twice! Surely French pseudoscience can take pride in this distinction. (The JREF has offered a one-million-dollar prize to any homeopath who can distinguish between homeopathic and non-homeopathic water.)

Funding: Mr. Joe Firmage

Category #2, to the funding organization that supported the most useless study of a supernatural, paranormal or occult, goes to Mr. Joe Firmage, the computer genius who gave up his $2.1 billion company to pursue humanity's potential rendezvous with space aliens, despite a perceived government conspiracy to conceal the abundant evidence he says exists. He points to "retro-research," which he says explains the existence of the transistor, which ordinary mortals were unable to develop without first finding the technology on one of those numerous crashed UFOs. Mr. Firmage has published a 600-page manifesto titled, "The Truth," which he describes as a "synthesis of science and faith."

Media: Montel Williams

Category #3, to the media outlet that reported as fact the most outrageous supernatural, paranormal or occult claim, the prize goes to TV talk show host, Montel Williams, who has essentially made one Sylvia Browne into a psychic superstar by featuring her on show after show doing her second-guessing act to titillate the public. (On a 1989 TV special, Sylvia gave a demonstration of her powers. On this occasion, she was not allowed to contact the potential subjects in advance, and her performance was singularly unimpressive.)

Image from www.randi.org

Psychic: James Van Praagh

Category #4, to the "psychic" performer who fooled the greatest number of people with the least effort, is given this year to the very popular best-selling author and psychic performer, James Van Praagh, who is a "cold reader" featured on almost every major TV program, some of them more than once. Though he is a mediocre performer, he has gained a huge following of bereaved persons who embrace his banal and obvious statements as evidence of the return of the deceased. In our experience, there are much better performers of this art working the circuits today.

More information on past and present Pigasus Awards, and the James Randi Educational Foundation in general, can be found online at http://www.randi.org.

SPS Symposia Showcase Undergrad Research

Buried among the plethora of technical sessions at the APS Centennial meeting were four unique symposia sponsored by the Society of Physics Students (SPS), intended to showcase undergraduate physics research. Approximately 30 papers were presented on such topics as the use of LEDs to measure Planck's constant, photoassociative spectroscopy of laser-cooled atoms, northern lights and magnetic storms, monitoring metallic compounds in rocket plumes, stability analysis of coupled chaotic oscillators, and aperture effects in optical resonators.

According to Bo Hammer, Education Manager at the American Institute of Physics (AIP), the idea behind holding undergraduate research sessions at the national meetings of AIP member societies is that these sessions significantly add to the professional development and sophistication of participating students. "The physics curriculum is pretty standard, regardless of where you go to school," he says. "The thing that distinguishes many physics programs is whether undergrads have the opportunity to do research and then participate as physicists in disseminating their results among their peers." SPS and its cadre of faculty mentors provides students with this opportunity in a nationally organized way, supplementing the traditional undergraduate experience. The AIP plans to leverage the success of the Centennial undergrad symposia into a greater presence at the meetings of other AIP member societies. A prime example of the positive impact of such experiences can be seen in the strong presence of undergraduate researchers from the physics department at Northwestern State University (NSU) in Louisiana, headed by Professor Gary White. His student, Kristen Russell, gave one of the more intriguing talks during Wednesday's focus session. She presented a mathematical connection between Fermat's principle — in which light chooses a path that minimizes the time of travel as it passes through different substances — and the often vexing "rental car problems," in which one tries to minimize the cost of fuel in a round trip between cities with varying fuel prices along the way — all while returning with a full tank of gas.

Russell also collaborated with fellow students Benjamin Williams and Holly Arabie on a new method for producing curved light paths in the laboratory using a thermal gradient instead of the usual sugar solution. The behavior of light in a mirage was then mathematically modeled using the differential form of Snell's law. Sports provided a rich arena for other NSU undergraduate researchers. Seth LeGrand focused on baseball bats and the significance of torsional modes in relation to the "sweet spot" of a bat. He experimentally calculated the spring constant for torsional modes (i.e., the twisting of a bat along its axis), and estimated typical baseball collision forces to find the resulting angle of twisting with respect to torsional modes. Although many papers have discussed the baseball bat problem, says LeGrand, there has been little or no mention of torsional modes and how they might affect the location of the sweet spot of a baseball bat (see Zero Gravity, page 5, for more on the physics of baseball). Magnus Akerstrom, explored the simple harmonic motion of a golf shaft. Watching a golf swing in slow motion, he became intrigued by the fact that the golf shaft bends forward at the moment of impact when hitting a drive. To explain why this happens, Akerstrom pictured the golf shaft's flex as a simple harmonic oscillator, then determined the shaft's spring constant and used those measurements to calculate a frequency, confirming his findings. His talk employed these parameters to understand why good golfers have this flex of the shaft.

Two papers specifically dealt with educational issues. Charles Miller and Courtney Willis of the University of Northern Colorado developed applications and activities related to Kepler's three laws of planetary motion suitable for use in elementary classrooms, helping young students to build a firm conceptual understanding of them despite their limited mathematical background.

Photo courtesy of Bernie Khoury

Happiness is: Students & Free Food Nearly two thousand attended an APS sponsored student luncheon Wednesday at the Centennial.

Other student researchers sought to address practical applications. Gregory Kubicek of Creighton University reported on his efforts to determine a new standard for the radio-pharmaceutical known as fluorodeoxyglucose (FDG), used as a tracer element in PET scans. However, some dose calibrator readings used to measure the amount of radiation being injected into patients are incorrect. "With the growth in the number of PET procedures using FDG, it is vital to have accurate information concerning the exact amount of radiation used in such techniques," said Kubicek of his interest in this research. "Creating and correcting standards for radioactive diagnostics is an important step in maintaining the efficiency, integrity, and safety within the nuclear medicine community."

Sessler Reviews "Glorious" Past, Sees Hopeful Future in Retiring Presidential Address

APS Past President Andrew Sessler (University of California, Berkeley) invoked a glorious past as evidence of a hopeful future in his traditional retiring presidential address, presented during a session at the APS Centennial that also honored the recipients of thirty-one of the prizes and awards given by the Society in 1999. [see special honors insert, *APS News*, March 1999]

Sessler first reviewed a few highlights of the last century of physics, beginning with the discoveries of the electron (1897), radioactivity (1896) and X-rays (1895), moving through to the explosion of revolutionary breakthroughs and technological developments that now form the backbone of modern society. He also commented on the ways in which the sociology of physics has changed in the last 100 years. "No longer does a single professor, with one student, work in a physics building basement or attic with antiquated, dusty and inadequate equipment," he said. "Most physicists work in large groups, with large machines, which require travel, with consequent impact upon teaching and presence at the home facility."

In addition, rapid improvements in communication and transportation — jet airplanes, FAXes, emails and the like — have helped globalize the physics enterprise, making it much easier to keep current with the work of researchers throughout the world. Funding practices have also changed since the beginning of the 20th century, when research was supported modestly by private foundations, universities, industry, and even by physicists themselves. Today most financial support of physics has come from the U.S. government, in recognition of the importance of physics research to the continued economic growth and well-being of the country.

And the APS has evolved right along with these social and institutional changes. In particular, Sessler emphasized the transition from a primarily research-oriented organization to one concerned about broader social concerns and impacts related to the physics enterprise. Sessler cited 1953 as a pivotal year in the changing nature of the APS. That was the year when Allen V. Astin, director of the National Bureau of Standards, was fired over a battery acid that the NBS found to be "worthless," prompting the APS Council to integrity of scientists in government service. It was also the year that J. Robert Oppenheimer found himself the subject of a federal investigation on alleged breaches of security, with subsequent revoking of his security clearance. The incident caused the APS through then President Hans Bethe to protest the unfairness of the reprimand, which he believed was "based on policy disagreement," in 1954. That was the year when the McCarran Immigration Act was invoked to deny a visa to Paul Dirac, who had been invited to spent a year at the Institute of Advanced Study in Princeton.

According to Sessler, the precedents for social awareness and action set during the 1950s continued into the turbulent 1960s and beyond, with the formation of the Forum on Physics and Society, and of committees devoted to women and minorities in physics, national science policy, and federal funding of scientific research. By the 1980s, international activities also moved to the forefront, with the Society's highly successful scholarly exchange program with China, and a program to aid colleagues in the former Soviet Union in 1992. And in the last decade, growing concern over the careers and professional development of physicists, and the relation of the Society to applied physics, resulted in the establishment of respective committees and subunits devoted to addressing those issues.

Sessler described the APS today as being "in excellent shape; it is far and away the strongest physical society in the world and one of the strongest professional societies in America." But he views the Society's key source of strength as the excellent officers and staff, the many volunteers that keep the various units, committees and programs in operation, and an excellent journal referee system to maintain the high quality of papers published in the *Physical Review*.

In terms of the future, Sessler cited the impact of electronic publishing, continued fractionalization of the physics enterprise (and hence within the APS itself), science education, and public information and outreach as among the critical issues the APS must face in the coming years. Yet he remains resolutely optimistic about the Society's ability to meet those challenges. "Because we are able to stand on the shoulders of giants — namely, the shoulders of all those who preceded us and built the Society into its present state — we are ready to move on to the next 100 years," he concluded. "Our future looks good. I think it will be even more glorious than our glorious past."

The full text of Andrew Sessler's retiring presidential address is available on the APS Web site: http://www.aps.org/ under the APS News *button. Dr. Sessler's APS historical remarks were based on materials in the exhibit* To Advance and Diffuse the Knowledge of Physics—100 Years of the APS *(see page 2), and a forth coming brief history of the APS by Harry Lustig.*

Keynote address *(continued from page 1)*

and scientific innovation, which is crucial if the country is to remain a global leader in the next millennium. With this goal in mind, he reported that the DOE is dedicated to improving the opportunities of well-trained scientists to pursue innovative research, to educate the next generation of scientists, and to apply science in all areas of importance in the U.S. "I don't know what the next century will bring, but I am doing what I can to ensure the right conditions that science will continue to flourish in the 21st century."

Richardson concluded his speech with a dramatic unveiling — complete with drum rolls — of "A Century of Physics," a timeline wall chart funded by Lucent Technologies as well as the Department of Energy, National Science Foundation and United Parcel Service, to mark the APS Centennial. Excerpted monthly in *APS News* for the past year, the chart chronicles the discoveries of physics and their impacts on each decade of the 20th century. The full-sized panels were displayed April 14 in the foyer of the Rayburn Congressional office building in Washington, DC, and will be distributed free of charge to 20,000 colleges, universities, high schools, libraries and science centers throughout the country.

A complementary website has been developed with support from IBM Corporation which allows more in depth exploration of the timeline. The website address is www.timeline.aps.org.

US Secretary of Energy Bill Richardson delivered the keynote address and unveiling the APS timeline wall chart at the APS Centennial meeting.

Announcements

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

1999 APKER AWARDS

For Outstanding Undergraduate Student Research in Physics

Endowed by Jean Dickey Apker, in memory of LeRoy Apker

DESCRIPTION

Two awards are normally made each year: One to a student attending an institution offering a Physics Ph.D. and one to a student attending an institution not offering a Physics Ph.D.

- Recipients receive a $5,000 award; finalists receive $1,000. They also receive an allowance for travel to the Award presentation.
- Recipients' and finalists' home institutions receive $5,000 and $500, respectively, to support undergraduate research.
- Recipients, finalists and their home physics departments will be presented with plaques or certificates of achievement. The student's home institution is prominently featured on all awards and news stories of the competition.
- Each nominee will be granted a free APS Student Membership for one year upon receipt of their completed application.

QUALIFICATIONS

- Students who have been enrolled as undergraduates at colleges and universities in the United States at least one quarter/semester during the year preceding the 15 June 1999 deadline.
- Students who have an excellent academic record and have demonstrated exceptional potential for scientific research through an original contribution to physics.
- Only one candidate may be nominated per department.

APPLICATION PROCEDURE

The complete nomination package is due on or before **15 June 1999** and should include:

1. A letter of nomination from the head of the student's academic department
2. An official copy of the student's academic transcript
3. A description of the original contribution, written by the student such as a manuscript or reprint of a research publication or senior thesis (unbound)
4. A 1000-word summary, written by the student, describing his or her research
5. Two letters of recommendation from physicists who know the candidate's individual contribution to the work submitted
6. The nominee's address and telephone number during the summer.

FURTHER INFORMATION (See **http://www.aps.org/praw/apker/descrip.html**)

DEADLINE

Send name of proposed candidate and supporting information by **15 June 1999** to:

Dr. Barrie Ripin, Administrator, Apker Award Selection Committee
The American Physical Society, One Physics Ellipse, College Park, MD 20740-3844; Telephone: (301) 209-3268, Fax: (301) 209-0865,
email: ripin@aps.org

Call for Nominations for Y2K APS Prizes and Awards

Members are invited to nominate candidates to the respective committees charged with the privilege of recommending the recipients. A brief description of each prize and award is given in the March 1999 *APS News Honors and Awards* insert, available online at www.aps.org under the APS News button, along with the addresses of the selection committee chairs to whom nominations should be sent. Please refer to the APS Membership Directory, pages A21-A40, for complete information regarding rules and eligibility requirements for individual prizes and awards or visit the Prize and Awards page on the APS web site at www.aps.org under the Prize and Awards button.

PRIZES

WILL ALLIS PRIZE FOR THE STUDY OF IONIZED GASES
HANS A. BETHE PRIZE
BIOLOGICAL PHYSICS PRIZE
TOM W. BONNER PRIZE IN NUCLEAR PHYSICS
OLIVER E. BUCKLEY CONDENSED MATTER PHYSICS PRIZE
DAVISSON-GERMER PRIZE IN ATOMIC OR SURFACE PHYSICS
DANNIE HEINEMAN PRIZE FOR MATHEMATICAL PHYSICS
HIGH POLYMER PHYSICS PRIZE
FRANK ISAKSON PRIZE FOR OPTICAL EFFECTS IN SOLIDS
JULIUS EDGAR LILIENFELD PRIZE
JAMES C. MCGRODDY PRIZE FOR NEW MATERIALS
LARS ONSAGER PRIZE
GEORGE E. PAKE PRIZE
W.K.H. PANOFSKY PRIZE IN EXPERIMENTAL PARTICLE PHYSICS
EARLE K. PLYLER PRIZE FOR MOLECULAR SPECTROSCOPY
I. I. RABI PRIZE IN ATOMIC, MOLECULAR AND OPTICAL PHYSICS
ANEESUR RAHMAN PRIZE FOR COMPUTATIONAL PHYSICS
J. J. SAKURAI PRIZE FOR THEORETICAL PARTICLE PHYSICS
ARTHUR L. SCHAWLOW PRIZE IN LASER SCIENCE
PRIZE TO A FACULTY MEMBER FOR RESEARCH IN AN UNDERGRADUATE INSTITUTION
ROBERT R. WILSON PRIZE

AWARDS

LEROY APKER AWARD *(15 June 1999 Deadline)*
JOSEPH A. BURTON FORUM AWARD
MARIA GOEPPERT-MAYER AWARD
JOSEPH F. KEITHLEY AWARD FOR ADVANCES IN MEASUREMENT SCIENCE

MEDALS AND LECTURESHIPS

DAVID ADLER LECTURESHIP AWARD
EDWARD A. BOUCHET AWARD
JOHN H. DILLON MEDAL
LEO SZILARD LECTURESHIP AWARD

DISSERTATION AWARDS

OUTSTANDING DOCTORAL THESIS RESEARCH IN BEAM PHYSICS AWARD
NICHOLAS METROPOLIS AWARD FOR OUTSTANDING DOCTORAL THESIS WORK IN COMPUTATIONAL PHYSICS
DISSERTATION AWARD IN NUCLEAR PHYSICS

NOMINATION DEADLINE IS JULY 1, 1999, UNLESS OTHERWISE INDICATED.

MEETING BRIEFS

• The APS New England Section held its annual spring meeting April 9-10 at Yale University's Sloane Physics Laboratory in New Haven, Connecticut. Friday afternoon's sessions focused on the history of physics, with talks on Lars Onsager's tenure at Yale, J.W. Gibbs at the beginning of the 20th century, and the physics of water. The session was followed by a banquet at the New Haven Lawn Club, featuring a keynote address by Yale's Bradley Schaefer on superflares on normal, Sun-like stars. On Saturday morning, Gregor Novak of Purdue University discussed how to use the World Wide Web to teach physics, while Robin Ollerhead of the University of Guelph gave an update on recent results from the Sudbury Neutrino Observatory.

• The APS New York State Section held its annual spring meeting April 23-24 at Lucent Technologies in Murray Hill, New Jersey, organized around the theme of "The Physics of Communication." Topics included lightwave systems, wireless systems, silicon VLSI and new materials, and presentations were given by a wide spectrum of researchers from industry, university and government laboratories. The Lucent-affiliated speakers addressed such subjects as optical nonlinearities in glasses; fiber grating devices; the physics of microwave materials; neural circuits; the physics of novel materials for communications; MEMs; and ultrasmall transistors.

• The APS Ohio Section held its annual spring meeting April 30-May 1, at Kettering University in Flint, Michigan, on the theme of industrial and applied physics. Speakers at the Friday afternoon and Saturday morning sessions addressed such topics as MEMs; thermoacoustics; optics for processes, products and metrology; and materials simulation and the workplace. Friday evening's banquet featured a keynote address by Leonard Brillson of Ohio State University on the changing roles of researchers in industry.

THE BACK PAGE

The Science and Politics of Climate

by Freeman J. Dyson

In the nineteen-sixties the fluid dynamicist Syukuro Manabe was running global climate models on the supercomputer at the Geophysical Fluid Dynamics Laboratory in Princeton. Manabe began very early (before it became fashionable) to run models of climate with variable amounts of carbon dioxide in the atmosphere. He ran models with carbon dioxide at two and four times the present abundance, and saw in the computer output the rise in average ground temperature that is now called Global Warming. He told everybody not to believe the numbers. But the politicians in Washington believed. They wanted numbers, he gave them numbers, so they naturally believed the numbers.

It was not unreasonable for politicians to believe Manabe's numbers. Politics and science are two very different games. In science, you are not supposed to believe the numbers until you have examined the evidence carefully. If the evidence is dubious, a good scientist will suspend judgment. In politics, you are supposed to make decisions. Politicians are accustomed to making decisions based on shaky evidence. They have to vote yes or no, and they generally do not have the luxury of suspending judgment. Manabe's numbers were clear and simple. They said if the carbon dioxide goes up, the planet will get warmer. So it was reasonable for politicians to believe them. Belief for a politician is not the same thing as belief for a scientist.

Manabe's numbers were unreliable because his computer models did not really simulate the physical processes going on in the atmosphere. Over and over again he said that his purpose when he ran computer models was not to predict climate but to understand it. But nobody listened. Everyone thought he was predicting climate, everyone believed his numbers.

The biosphere of the earth contains four reservoirs of carbon: the atmosphere, the ocean, the vegetation and the soil. All four reservoirs are of comparable size, so that the problem of climate is inescapably mixed up with the problems of vegetation and soil. The intertwining between the four reservoirs is so strong that it makes no sense to consider the atmosphere and ocean alone. Computer models of atmosphere and ocean, even if they can be made reliable, give at best a partial view of the problem. The large effects of vegetation and soil cannot be computed but must be observed and measured.

The way the problem is customarily presented to the public is seriously misleading. The public is led to believe that the carbon dioxide problem has a single cause and a single consequence. The single cause is fossil fuel burning, the single consequence is global warming. In reality there are multiple causes and multiple consequences. The atmospheric carbon dioxide that drives global warming is only the tail of the dog. The dog that wags the tail is the global ecology: forests, farms and swamps, as well as power-stations, factories and automobiles. And the increase of carbon dioxide in the atmosphere has other consequences that may be at least as important as global warming — increasing crop yields and growth of forests, for example. To handle the problem intelligently, we need to understand all the causes and all the consequences.

Several successful, important programs of local observation have been started in recent years. One program is measuring directly the fluxes of carbon dioxide moving between the atmosphere and the biosphere. This is done by putting instruments on towers above the local trees or other vegetation. In daytime in the summer, the vegetation is vigorously absorbing carbon dioxide. At night or in winter, the flux is going the other way, with plants giving off carbon dioxide by respiration. The soil also gives off substantial fluxes of carbon dioxide, mostly from respiration of microbes and fungi. The instruments do not distinguish between vegetation and soil. They measure the total flux leaving or entering the atmosphere.

During the last few years, instrumented sites have been built in many countries around the world. Within a few years, we will know for sure how much of the carbon released by fossil fuel burning is absorbed by forests and how much by the ocean. And the same technique can be used to monitor the carbon fluxes over agricultural croplands, wetlands and grasslands. It will give us the knowledge required, so that we can use the tools of land management intelligently to regulate the carbon in the atmosphere. Whether we manage the land wisely or mismanage it foolishly, we shall at least know what good or harm we are doing to the atmosphere.

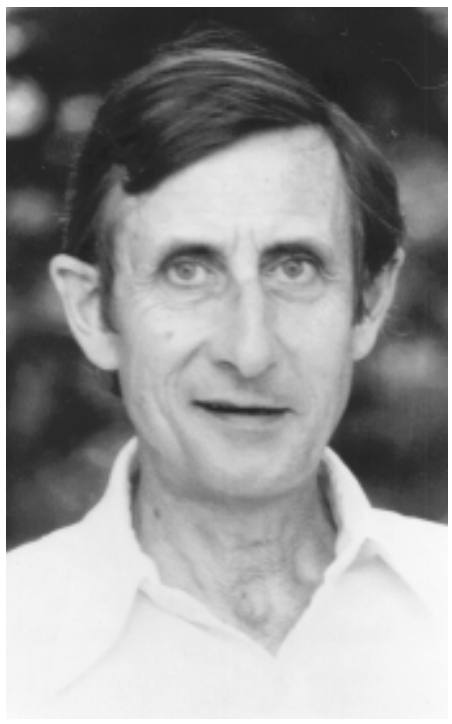
The amount of money spent on local observations is small, but the money has been well spent. The Department of Energy is funding another successful program called Atmospheric Radiation Measurements (ARM). ARM's activities are mainly concentrated at a single permanent site in Oklahoma, where systematic observations of radiation fluxes in the atmosphere are made with instruments on the ground and on airplanes flying at various heights. Measurements are made all the year round in a variety of weather conditions. As a result, we have a database of radiation fluxes, in a clear sky and in cloud and between clouds.

One of the most important measurements is made by two airplanes flying one above the other at different heights. Each airplane measures the fluxes of radiation coming up from below and down from above. The difference measures the local absorption of radiation by the atmosphere. The measured absorption of sunlight turns out to be substantially larger than expected. The expected absorption was derived partly from theory and partly from space-based measurements. The discrepancy is still unexplained. If it turns out that the anamolous absorption measured by ARM is real, this will mean that all the global climate models are using wrong numbers for absorption.

A third highly successful program of local measurements is called Acoustic Thermometry of Ocean Climate (ATOC). It is the brainchild of Walter Munk at the Scripps Institution of Oceanography. ATOC uses low-frequency underwater sound to measure ocean temperatures. A signal is transmitted from a source on top of a seamount at a depth of three thousand feet near San Francisco, and received at six receivers in deep water around the north Pacific. The times of arrival of signals at the receivers are accurately measured. Since the speed of propagation depends on temperature, average temperatures of the water along the propagation paths can be deduced.

The main obstacle that Walter Munk had to overcome to get the AOTC project started was the opposition of environmental activists. This is a long and sad story which I don't have time to tell. The activists decided that Munk was an evil character and that his acoustic transmissions would endanger the whales in the ocean by interfering with their social communications. They harassed him with lawsuits, delaying the project for several years. Munk tried in vain to convince them that he also cared about the whales and was determined not to do them any unintentional harm. In the end, the project was allowed to go forward with less than half of the small budget spent on monitoring the ocean and more than half spent on monitoring the whales. No evidence was found that any whale ever paid any attention to the transmissions. But the activities are continuing their opposition to the project and its future is still in doubt.

During the two years that the ATOC system has been operating, seasonal variations of temperature have been observed, giving important new information about energy transport in the ocean. If measurements are continued for ten years and extended to other oceans, it should be possible to separate a steady increase of temperature due to global warming from fluctuations due to processes like El Niño that vary from year to year. Since the ocean is the major reservoir of heat for the entire climate system, a measurement of ocean temperature is the most reliable indicator of global warming. We may hope that the activists will one day admit that an understanding of climate change is as essential to the preservation of wildlife as it is to the progress of science.



Freeman J. Dyson

To summarize what we have learned, there is good news and bad news. The good news is that we are at last putting serious effort and money into local observations. Local observations are laborious and slow, but they are essential if we are ever to have an accurate picture of climate. The bad news is that the climate models on which so much effort is expended are unreliable because they still use fudge-factors rather than physics to represent important things like evaporation and convection, clouds and rainfall.

Besides the general prevalence of fudge-factors, the latest and biggest climate models have other defects that make them unreliable. With one exception, they do not predict the existence of El Niño. Since El Niño is a major feature of the observed climate, any model that fails to predict it is clearly deficient. The bad news does not mean that climate models are worthless. They are, as Manabe said thirty years ago, essential tools for understanding climate. They are not yet adequate tools for predicting climate. If we persevere patiently with observing the real world and improving the models, the time will come when we are able both to understand and to predict. Until then, we must continue to warn the politicians and the public: don't believe the numbers just because they come out of a supercomputer.

Freeman J. Dyson, professor emeritus of physics at the Institute for Advanced Study in Princeton, New Jersey, is the recipient of the 1999 APS Joseph Burton Forum Award, and author of a number of books about science for the general public. His most recent is The Sun, the Genome, and the Internet, *which will be published this year.*

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. Responses may be sent to: letters@aps.org.*