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Myriam Sarachik Elected APS Vice President

Members of the APS have chosen Myriam Sarachik, a distinguished professor of physics at City College of New York's City University of New York, to be the Society's next vice president. Sarachik is the third woman to be elected to the presidential line in the Society's 101-year history, following C.S. Wu of Columbia in 1975, and Mildred Dresselhaus of MIT (who became Director of the Department of Energy's Office of Science in August) in 1984. Sarachik's term begins January 1, 2001, when she will succeed William Brinkman of Bell Laboratories/Lucent Technologies, who will advance to become president-elect. Sarachik will become APS president in 2003, following George Trilling of Lawrence Berkeley National Laboratory in 2001 and William Brinkman in 2002.

"It is important that we reassert and promote unity and a sense of shared vision."

In other election results, Susan Coppersmith, a professor of physics at the University of Chicago, becomes chair-elect of the APS Nominating Committee, which will be chaired by Curtis C. Callan of Princeton University in 2001. The Nominating Committee selects the slate of candidates for vice president, general councillors, and its own chair-elect. The choices are then voted on by the APS membership. Elected as new general councillors were Jonathan Bagger, a professor of physics and astronomy at Johns Hopkins University, and Cherry Murray, Senior Vice President of Physical Sciences Research at Lucent. Only two new general councillors were elected, compared to the four elected in previous years, to reflect recent changes in the APS Constitution, designed to reduce the size of the APS Council. These changes were published in the March 2000 issue of *APS News*.

VICE PRESIDENT

MYRIAM SARACHIK
City College of New York/CUNY

Born in Antwerp, Belgium, Sarachik earned her PhD in 1960 from Columbia University. Following a year as a research associate at the Watson Laboratories of IBM while teaching at City College in the evening, she became a postdoctoral member of the technical staff at Bell Laboratories. She joined the faculty of City College in 1964 and has remained there ever since. Sarachik's research interests have ranged from superconductivity, disordered metallic alloys, and metal-insulator transitions in 3-D doped semiconductors, to hopping transport in solids and properties of single-molecule magnets. Her extensive APS experience has included service on the executive committees of the APS Forum for International Physics, and the Division of Condensed Matter Physics, and on the Committee on the Status of Women in Physics, and the APS Council, among others.

Of the many very important issues that the APS is currently dealing with, Sarachik believes one of the most urgent is the substantial decline in the number of students who now choose to study physics. "A shortage is rapidly developing (abroad as well as in the US) of bright young scientists and engineers to meet the needs of industry and government labs, and to provide the next generation of educators at our universities," she says. One of her goals as President will be to strengthen the society's efforts to make a career in physics attractive. "We need to be more effective in explaining the pleasures that a career in physics can bring, the satisfaction garnered from teaching, and the excitement of research and discovery; we must also have salaries competitive with other professional options," she says. "At the same time, we must continue to make as strong a case as possible to our legislators and the public that it is essential to the health and future of the nation to invest in the science that produces major discoveries which seed the technology of the future."

In her candidate's statement, Sarachik emphasized the need for the APS to play an ever-expanding role in a much broader arena: political, social, educational, and international. She praised recent efforts to organize a consortium with other science and engineering societies to make a strong case for public investment in physical science R&D, as well as its development of successful programs in educational outreach and science teacher preparation.

Sarachik also called on the APS to play a leading role in the internationalization of physics, facilitating the participation of American physicists in multinational endeavors. Finally, she expressed concern over how the APS divisions have grown increasingly separate, and its journals more specialized and narrowly focused. "It is important that we reassert and promote unity and a sense of shared vision," she said, pointing to the enormous success

See ELECTION *on page 7*

VICE PRESIDENT
Myriam Sarachik

CHAIR-ELECT OF THE NOMINATING COMMITTEE
Susan Coppersmith

GENERAL COUNCILLOR
Jonathan Bagger

GENERAL COUNCILLOR
Cherry Murray

INSIDE THE BELTWAY
A Washington Analysis

Spending Floodgates Open as Election Nears

By Michael S. Lubell, APS Director of Public Affairs

Under the gun all summer, DOE's science accounts finally received major boosts when the House-Senate conference report won approval early in October. It was due in no small measure to the remarkable efforts of the research community throughout the preceding months.

The budgetary end game also drove a stake through the corpus of The Contract With America. At least that's the read around this town, where everyone is a card-carrying pundit.

Six years ago, the House Republicans unveiled a blueprint for reform that ultimately led to GOP control of Congress for the first time in 40 years. Cutting the size of government, reducing federal spending and cutting taxes were prime among the Contract's core principles.

One look at the spending bills that have emerged from the 106th Congress is enough to tell you that these principles have been blown away by the tried and true doctrine of all political life, "Get reelected first."

When President Clinton sent his budget up to Capitol Hill last February, Republican congressional leaders declared it dead on arrival. Even some Democrats termed it an election-year document, worth little more than the ink with which it was printed. It called for more than $623 billion in discretionary spending, with generous dollops of dollars for research.

The official White House line was that it didn't break the budget caps established in 1997. No small feat, since those caps called for $572 billion for Fiscal Year 2001.

Republicans said that, in the end, a good deal of the presidential ink would disappear. Early on, in April, to prove its point, Congress passed a Budget Resolution that stripped away almost

See BELTWAY *on page 2*

Apker Finalists Meet in Washington

On September 16, the six finalists in the Apker Award competition met in Washington to present their work in person to the selection committee. The Apker Award is given annually by the APS for physics research done by an undergraduate. The award was first given in 1978, and in recent years has been divided into two categories, depending on whether the institution has a PhD granting program or not.

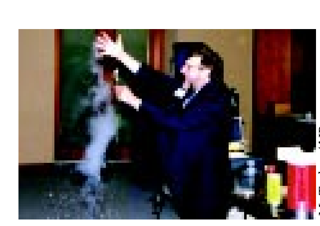
See FINALISTS *on page 3*

Previous Apker Winners Featured... *On page 3 of this issue we present a feature article by Richard M. Todaro about the 33 previous Apker Award recipients–where they are, what they're doing, and how they got there.*

Ken Cole/APS

Front row (l to r): Christopher Lee, Heather Lynch, Edina Sarajlic. Back row (l to r): Jacob Krich, Andrei Bernevig, Steven Oliver.

HIGHLIGHTS



M. Tarlton/AIP

6 ***ΣΠΣ Congress Zeros in on Career Diversity and Undergrad Education Reform***

8 ***The Back Page*** *Creationism Versus Physical Science*

This Month in Physics History

November 17 – December 23, 1947: Invention of the First Transistor

The story of the first transistor begins well before Bell Labs scientists first started working on developing such a device in the 1930s. It was scientists in the 1800s — including Maxwell, Hertz, and Faraday— who made the dramatic scientific discoveries that made it possible to harness electricity for human uses, while inventors applied this knowledge in the development of useful electrical devices like radio.

Wireless communication was born in 1895, when Marconi successfully sent a radio signal over a distance of more than a mile. But before the technology could be fully practical, better detectors needed to be developed to detect the radio signal carrying the information. Rectifying crystal detectors were eventually incorporated into radio receivers, which were able to separate the carrier wave from the part of the signal carrying the information.

However, crystal sets only worked with strong radio waves, which tend to weaken over distance and terrestrial obstructions. Amplification was needed. English physicist John Ambrose Fleming provided the first step towards a solution with his invention of the rectifying vacuum tube: a lightbulb outfitted with two electrodes attached to radio receiving systems. The American inventor Lee DeForest added a further innovation: a third electrode, called a grid, consisting of a network of small wires surrounding the cathode, with a negative potential that controlled the flow of electrons from the cathode to the anode, producing an amplifying current.

The amplifying vacuum tube was not only an essential component in the development of radio, but also in early telephone equipment, television sets, and computers. But the technology was less than perfect. Vacuum tubes consumed too much power, gave off too much heat, took up too much space, cost too much to produce, and eventually burned out and needed to be replaced. (The University of Pennsylvania's ENIAC computer, which incorporated thousands of vacuum tubes, filled several large rooms and consumed enough power to light ten homes.) These shortcomings prompted one Bell Labs engineer, J.R. Pierce, to proclaim, "Nature abhors the vacuum tube."

In the 1930s, Bell Labs scientists were trying to use ultrahigh frequency waves for telephone communications, and needed a more reliable detection method than the vacuum tube, which proved incapable of picking up rapid vibrations. They reverted to a crystal-based detector, which worked effectively and set them on the path of exploring the particular properties of the most reliable semiconductor material: silicon. In the process, they discovered that silicon was comprised of two distinct regions, one favoring positive current flow ("P") and one favoring negative current flow ("N"). The discovery of this "P-N junction", and the ability to control its properties, laid the foundation for the transistor.

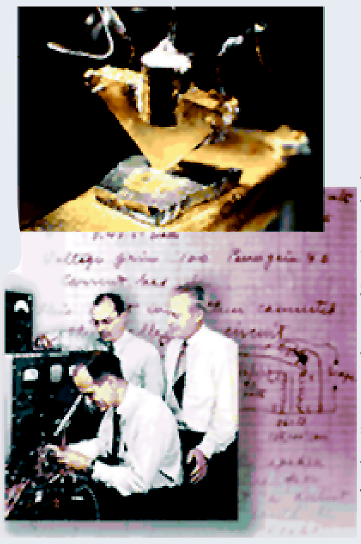


Image from http://www.research.att.com/history/47trans.html

John Bardeen, Walter Brattain and William Shockley spearheaded the Bell Labs effort to develop a new means of amplification, speculating that by adding a third electrode to the semiconductor detector, they would be able to control the amount of current flowing through the silicon. The resulting device would, theoretically, amplify as well as the vacuum tube with much less power consumption and in a fraction of the space.

The research efforts peaked during the so-called "Miracle Month:" November 17 to December 23, 1947. Brattain had built a silicon contraption to study the behavior of electrons at the surface of a semiconductor, in hopes of discovering what was causing electrons to block amplification, but condensation kept forming on the silicon. To cope, Brattain immersed the entire experiment in water, inadvertently creating the largest amplification thus far observed. Informed of the result, Bardeen suggested making an amplifier in which a metal point was pushed into the silicon and surrounded by distilled water. The device worked, but the resulting amplification was slight.

But Bardeen and Brattain were encouraged, and doggedly began experimenting with different materials and set-ups, eventually deciding to replace the silicon with germanium. The result: an amplification 330 times larger than before. Unfortunately, it only worked for currents with very low frequencies, while a phone line, for example, would need to handle all the complex frequencies of a person's voice.

The scientists decided to replace the liquid with a layer of germanium oxide. However, in the course of the experiment Brattain realized he'd accidentally washed off the oxide layer. Surprisingly, he was still able to achieve some voltage amplification, and he could achieve it at all frequencies. The gold contact was puncturing holes in the germanium which canceled out the obstructing effect of the surface electrons.

So the key components were a slab of germanium and two gold point contacts just fractions of a millimeter apart. With that in mind, Brattain placed a ribbon of gold foil around a plastic triangle, and sliced it through one of the points. When the point of the triangle was placed onto the germanium, the signal came in through one gold contact and increased as it raced out the other: it was the first point-contact transistor.

At roughly half an inch high, the first transistor was huge by today's standards, when 7 million transistors can fit onto a single silicon chip. But it was the very first solid state device capable of doing the amplification work of a vacuum tube, earning Bardeen, Brattain and Shockley the Nobel Prize in Physics in 1956. More significantly, it spawned an entire industry and ushered in the Information Age, revolutionizing global society.

For Further Reading: "Crystal FIre" by Michael Riordan and Lillian Hoddeson (W. W. Norton and Co., 1997).

Further Online Reading: http://www.pbs.org/transistors, and http://www.lucent.com/minds/transistor.

Birthdays for November:

7 Marie Cuire (1867)
7 Lise Meitner (1878)
24 Dmitry Skobeltsyn (1892)

BELTWAY, *from page 1*

$23 billion. The $600 billion remaining, GOP leaders said, really didn't break the cap. (Who were these guys kidding?)

Appropriators, with their political standing on the line in every spending bill, quickly warned that there was no way they could fund the programs the public demanded with the budget allocations they had received Still, the congressional leaders said, "Press on."

Savvy "cardinals," like James Walsh (R-NY), who has responsibility for the bill that funds the Veterans Administration, Housing and Urban Development and Independent Agencies, as early as last spring predicted that, by the time the session ended, deals would be struck and discretionary spending would approach the level of the presidential request, including the National Science Foundation. His advice to the science community, in so many words, was, "Scream loud and often."

But even Walsh underestimated the extent of the election-year thirst. By the time Congress returned from the convention recess after Labor Day, only two of the thirteen appropriations bills had been signed into law. True, House members had swallowed hard and passed ten of the remaining bills. Privately, however, many of them said that they trusted that the Senate would take responsibility and fill in the gaping holes.

But senators wanted no part of the blame for breaking the Budget Resolution barrier. Never quick to move on any legislation, the upper body dragged the appropriations bills along at the pace of a slug and often threw them back at the House with differences so large they couldn't be resolved without radical infusions of cash.

The Energy and Water Bill illustrates this well. The House had amply funded water projects but shortchanged the weapons labs, Basic Energy Sciences and the Spallation Neutron Source. The Senate had replied by cutting water projects, slashing high-energy physics and fusion, while restoring funding for the weapons labs and the SNS.

With the clock ticking and Election Day fast approaching, Congressional leaders, loathe to negotiate with the White House on an omnibus appropriations bill, finally opened up the flood gates, funding water projects, weapons labs and science.

As money flowed into the appropriators coffers, NSF, NASA and the National Institutes of Health all saw their budgets swell. But it didn't end there. Science, after all, doesn't win elections. Highways, court houses, bridges, parks and dams do.

You can imagine the talk: "If we're breaking the caps, what the hell, lets go whole hog and pork it up real big. And hot to trot, let's blow town before anyone adds up the numbers. What's the difference between $623 and $630 billion? Voters can't add numbers that big, anyway."

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Where Are They Now? *APS News* Finds Out What Happened to the Previous Winners of the Apker Award

Editor's Note: The following information was researched and written by Richard M. Todaro. This material has been greatly condensed from a much more complete description of the careers and achievements of past Apker Award winners. The full version is available on the APS News web site, http://www.aps.org/apsnews. The Apker award is given by the APS in recognition of outstanding research in physics by an undergraduate.

1970s

In 1978, David Heckerman became the first winner of the Apker Award. At the time, he was an undergraduate at UCLA working in the acoustics lab under Gary Williams. Today, Heckerman, 43, is the manager of Microsoft's Machine Learning and Applied Statistics Group in Redmond, Washington. He works in the area of artificial intelligence (AI) and machine learning, for example, incorporating AI into ever-more-sophisticated versions of Microsoft Office and Microsoft Windows and incorporating so-called "data mining" (the use of statistical tools to find patterns and relationships in large databases) into Microsoft's Enterprise software. Heckerman holds six degrees, including two bachelors of science, two masters of science, a PhD and a medical degree.

Louis Bloomfield, the 1979 winner, is today a professor of physics at the University of Virginia in Charlottesville, where he is best known for developing and teaching the hugely popular course "How Things Work." The course was an inspiration for similar courses at other schools. In 1996, using his course teaching notes, Bloomfield wrote the book, *How Things Work*. Attention surrounding the book has resulted in a side-career as a science writer. Bloomfield has written "how things work" articles for the *Washington Post* and the journal *Scientific American*. He reviewed George Johnson's book *Strange Beauty* for the *New York Times*. He also has done many of the AAAS-produced "Why Is It?" science question-and-answer radio spots. Bloomfield is currently working on a "physics of sports" television series for the Learning Channel. He will also be contributing to the upcoming APS website for the public, Physicscentral.com. He will write a weekly column answering how and why questions of physics.

1980s

Richard P. Binzel, the 1980 winner, is a professor of astronomy at MIT. His research is in planetary astronomy. After attending undergraduate school at Macalester College in St. Paul, Minn, Binzel went to astronomy graduate school at the University of Texas at Austin, earning his PhD in 1984.

Mark B. Ritter, the 1981 winner, is the manager of the communication design and architecture section of IBM's T.J. Watson Research Center in Yorktown Heights, NY Following undergraduate school at Montana State University, Ritter earned his PhD in applied physics at Yale University, finishing in 1986. Ritter's research interest is now in the area of fiber optic data communication technologies and circuit design.

Subir Sachdev, the 1982 winner, is a professor of physics at Yale University. Sachdev earned his undergraduate degree in physics from MIT in 1982. He then entered the physics program at Harvard, where he earned his PhD in 1985. He was hired at Yale in 1987. Sachdev has just written a book on the theory of quantum phase transitions, and his research is on the application of related ideas to the high temperature superconductors and other condensed matter systems.

Raymond E. Goldstein, the 1983 winner, is an associate professor of physics at the University of Arizona in Tucson. Born and raised in New Jersey, Goldstein attended MIT as an undergraduate, majoring in physics and chemistry. Goldstein attended graduate school in physics at Cornell, earning his PhD in 1988. He spent five years at Princeton as an assistant professor of physics before being hired at Arizona in 1996. His research is in nonlinear dynamics and pattern formation, fluid dynamics, and biological physics (i.e. the study of cell membranes).

Tak Leuk Kwok, the 1984 Apker winner, passed away in 1987 at the age of 20. Kwok attended Caltech as an undergraduate. His advisor, Harvey Newman, says that Kwok wanted to study high-energy physics.

"He was very accomplished," Newman says. "He had an unusual breadth of scientific knowledge and good achievements in the program."

Born in Hong Kong, Kwok was just a junior when he won the Apker, rather than a senior. Following graduation, Kwok attended Harvard as a graduate student. In the summer of 1987, Kwok was at CERN in Geneva, Switzerland working on a project in high-energy physics through a research fellowship program. He was jogging when he suffered a heart attack and died.

Julia Wan-Ping Hsu, the 1985 winner, is a scientist at Bell Labs in Murray Hill, NJ Hsu came to the United States from Taiwan in 1980 and started school as an undergraduate at Princeton University in 1981. She next entered the physics graduate program at Stanford University, earning her PhD in 1991 in superconductivity research. Following a two-year stint as a post-doc at Bell Labs, Hsu was an assistant and then an associate professor of physics at the University of Virginia from 1993 through 1999. She then decided to return to Bell Labs to focus on research.

Terence Tai-Li Hwa, the 1986 winner, is a professor of physics at the University of California, San Diego. His research is in unconventional areas, as he shuttles between statistical physics, molecular biophysics and theoretical genomics. After finishing undergraduate school at Stanford, where he had a triple major in physics, electrical engineering and biology, he entered MIT, where he earned his PhD in physics in 1990. Of his current work, he says, "I don't fit into any particular community." He believes his efforts at creating an interdisciplinary field have been a good success.

In 1987, there were two Apker Award winners, Chungsheng James Yeh and Gerard C.L. Wong. *APS News* was unable to locate Yeh.

Chungsheng James Yeh, a 1987 winner, attended Princeton University as an undergraduate. Thereafter, he attended the University of California, Berkeley from 1987 to 1993. Records indicate he earned his masters degree in physics in 1988 and a doctorate in physics in 1993. No further information could be found.

Gerard C.L. Wong, the other 1987 winner, is today an assistant professor of physics at the University of Illinois, Urbana-Champagne. He has a joint appointment in the departments of materials science and engineering and physics. Wong immigrated to the United States from Hong Kong when he was 10 years old. He attended Caltech as an undergraduate, earning his degree in 1987. He went to graduate school at UC-Berkeley, earning his PhD in 1994. His research was in semiconductors and interfaces. Upon finishing, he decided to enter a less "mature" field than traditional solid-state physics. As a result he switched to bio-molecular and soft matter physics, a field that studies systems like liquid crystals, polymers and membranes. Wong lives in Urbana, Ill.

Leo Radzihovsky, the 1988 winner, is an assistant professor of physics at the University of Colorado at Boulder. After attending Rensselaer Polytechnic Institute in Troy, NY, he entered the physics program at Harvard on a Hertz graduate fellowship, working on statistical mechanics of membranes and vortices. He completed his PhD in 1993 and was hired at CU-Boulder in 1995 after a post-doc. In his five years there, he has been awarded the Sloan Fellowship and the Packard Fellowship, as well as the National Science Foundation Career Award.

Deborah Kuchnir Fygenson, a 1989 winner, is an assistant professor at the University of California, Santa Barbara. Her research is in biological physics. After earning her undergraduate degree in physics from MIT, Fygenson attended Princeton, where she earned her PhD in physics in 1995. After a post-doc at Rockefeller University's Center for Study in Physics and Biology in New York and at the University of Southern California's Hedco Molecular Biology Labs in Los Angeles, she was hired in 1998 as an assistant professor at the UC- Santa Barbara. Fygenson's research explores the physical interactions between bio-molecular materials, such as microtubules and membranes. Fygenson is also involved in educational outreach programs to her community, such as the Girls Exploring Math and Science (GEMS) program, which teaches science to middle school girls.

Steven Simon, also a 1989 winner, is now the head of the physics theory department at Bell Labs in Murray Hill, NJ, where he carries out research in the area of condensed matter physics and communication, including subjects ranging from microwave propagation to high temperature superconductivity. He also oversees projects that are "of general interest to communications and biophysics," he says, including biophysics information theory. After attending Brown University in Providence, R.I., where he earned a degree in physics and math, Simon attended Harvard as a graduate student in theoretical physics, earning his PhD in 1995.

1990s

Charles J. Brabec, the 1990 winner, has left the field of physics and now works as a software developer for North Carolina State University in Raleigh. He describes himself as a "cross between a system administrator and a programmer." Brabec got both his undergraduate and graduate degrees in physics at NC State. He earned his PhD in 1996 for work on modeling carbon structures such as Buckyballs. As for leaving physics, Brabec says, "I didn't care for the academic track and I lost interest in the work," he says. "I wasn't keen on the job prospects, and I didn't want to do a post-doc. Nor do I care for publishing papers every few years to make a living."

Dean Lee, a 1991 winner, is a post-doc in theoretical physics at the

See APKER *on page 7*

April Meeting 2001 Program Committee Meets

Donna Baudrau/APS

In September the April 2001 Program Committee met to discuss and identify the invited sessions for the upcoming meeting.

Photographed are (clockwise from front left): Joel Moss, DNP; Betsy Beise, CSWP; Richard Deslattes, GFC; Jim McGuire, GFBS; Martin Lampe, DPP; Ben Bederson, FHP; Steve Smith, FPS; David Ernst, FIP; Bob Wald, GGR and Judy Franz, APS.

Also in attendance were Chuck Dermer, DAP; Stan Wojcicki, DPF; Ron Davidson, DPB; Bunny Clark, COM; and Co-chairs Trevor Weekes and Chris Quigg.

For more information on the APS April Meeting 2001 go to http://www.aps.org/meet/APR00/

April 2001 Plenary Speakers

David Kestenbaum, National Public Radio
"Bringing Science/Physics to the Public"

James F. Drake, University of Maryland
"Magnetic Reconnection"

Natalie Roe, Lawrence Berkeley National Laboratory
"CP Violation in B Mesons"

Maria Spiropulu, Fermilab
"In Search of Extra Dimensions"

David Wark, University of Oxford
"Neutrino Oscillations and the Sudbury Neutrino Observatory"

Andrew Lange, California Institute of Technology
"The Boomerang Experiment"

Steve Murray, Harvard-Smithsonian Center for Astrophysics
"Chandra Overview"

Paul Kwait, Los Alamos National Laboratory and University of Illinois
"Enlayered Photons for Quantum Information"

Wolfgang Ketterle, MIT
"Atom Wave Amplification"

FINALISTS, *from page 1*

Each finalist receives a plaque and a check for $2,000. The winners of the award, who will receive an additional $5,000 each, are selected by the committee from among the finalists, and will be announced in the next issue of *APS News*.

This year the three finalists and their research topics from the non-PhD-granting institutions were: Jacob Krich from Swarthmore College, "Correlation Length and Chirality of Isotropic Short-range Order in Nematic and Chiral-Nematic Liquid Crystals;" Christopher Lee from Reed College, "Supersymmetric Quantum Mechanics;" and Edina Sarajlic from Bryn Mawr, "State Selective Quantum Beat Spectroscopy by using Time-resolved Two-color Resonant Four-Wave Mixing."

In the PhD-granting category, the finalists were: Bogdan Andrei Bernevig from Stanford, "Spectroscopy of Matter Near Criticality:" Heather Lynch from Princeton, "A Kondo Box: Coulomb Blockade and the Kondo Effect in Iron-doped Copper Nanoparticles:" and Steven Oliver of the University of California at Berkeley, "3D Raman Sideband Cooling at High Density."

The selection committee was chaired by Andrew Sessler, the past-past-president of APS. Also serving on the committee were Harry Lustig, former treasurer of the APS who is retiring from the committee after 16 consecutive years, Rick Greene of Maryland, Michael Brown of Swarthmore, Stephen Ralph of Georgia Tech, Larry Marschall of Gettysburg, Alan Chodos of the APS, and Jerome Friedman of MIT, who will chair the committee next year when he succeeds to the past-past-presidency.

LETTERS

"Publication Embargo" Policy of *Nature* and *Science*

In listing objections to the embargo policy of *Science*, *Nature*, and the *New England Journal of Medicine*, and perhaps other journals (*APS News*, August/September 2000, p, 5), Alan Chodos was too polite to mention that it gives editors and the referees of manuscripts a long period of exclusive knowledge of advances that may affect share prices of companies on (and off) the stock market.

Charles W. McCutchen
Lake Placid, New York

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The policy of *Nature* and *Science* magazines of embargo on any prior public release as a condition of publication may be counterproductive and, perhaps, even plainly foolish. However, Alan Chodos unjustly puts all the blame on journals. At least part of it should be duly assigned to the authors.

Why, after all, they are so insistent on publishing exactly in *Nature*? If they indeed have something important and urgent to report, what stops them from making immediate public release through any of the news media and/or the Internet? Their priority claims (if there are any) will not be affected by the mode of publication they could choose. (A more detailed report can, of course, be submitted to a specialized peer reviewed journal).

In reality, what we have here is a fallacious notion of the "prestige" of some selected journals. As it was put once, "it is not the discovery, it is on what paper you manage to print it, stupid." The allure of publishing in a fancy tabloid overtakes the professional duty of scientists — to make their important discoveries publicly known without unnecessary delays. Yes, it is true that the publication in *Nature* brings with it some sort of celebrity status. But one is prompted to ask whether indeed our present-day science operates by the standards more akin to Hollywood than to Galileo and Darwin?

Alexander A. Berezin
McMaster University, Canada

Solar UV is Source of Ionosphere

In a comment on an earlier letter regarding the inclusion of solar processes in the Earth Science and Geophysics discipline, Erika Harnett passes on a misconception that the existence of the ionosphere is due to energetic particles from the Sun (*APS News*, Letters, August/September 2000). In fact, the dominant source of ionization in the ionosphere is not energetic particles, but rather solar ultraviolet radiation at wavelengths smaller than about 150 nm (See, for example, Roble et al. [*J. Geophys. Res.*, *92*, 8745, 1987].)

The incorrect view that energetic particles from the Sun are the only source of "space weather" is not uncommon. However, neither direct solar particles nor accelerated magnetospheric particles rival the solar radiative energy (and ionization) sources for the global thermosphere (the atmospheric region above about 90 km) and its embedded ionosphere, where the most important space weather effects on human activities take place. The solar ultraviolet irradiance varies on time scales ranging from minutes (flares) to decadal (solar cycle) and longer, and is indeed a major contributor to both weather and climate in the ionosphere.

Robert R. Meier
Head, Upper Atmospheric Physics Branch; Naval Research Laboratory

SORCE to Study Solar Variations

Erika Harnett, in her letter in the August/September issue of *APS News*, emphasizes that "one cannot ignore the effect on the Earth's environment caused by the Sun and its celestial neighbors," and she gives as examples auroral activity, existence of the ionosphere, and the dependence of life on production of heavy elements in supernovae. These examples are certainly important. But the most immediate influence of the Sun on life here at Earth's surface is the solar visible radiation that penetrates tens of meters into the oceans, and solar ultraviolet radiation that penetrates deep into the atmosphere, and solar infrared radiation that heats the lower atmosphere and the surface. Elements of NASA's "Earth Observing System" (EOS), as emphasized in my earlier letter, study impacts of the Sun on Earth, including ACRIMSAT and Terra.

Another major component of EOS is SORCE, or the "SOlar Radiation and Climate Experiment." Due to launch into low Earth orbit in mid-2002, SORCE will carry an active cavity radiometer like ACRIMSAT, and also three spectrometers being built at the University of Colorado's Laboratory for Solar Physics. SORCE will provide the first space-based measurements of variations in solar spectral irradiance near the peak of the Sun's energy output, extending continuously from the far ultraviolet, through the visible, into the near infrared, in particular including the wavelengths carrying the most energy into the troposphere and oceans. We know that the Sun's radiative energy output varies with an amplitude of about 0.1 % over the 11 year solar cycle. However, to understand the implications of this for Earth, especially near Earth's surface, where we live, we must know how these solar variations are distributed over ultraviolet, visible, and infrared wavelengths, since these most influence the Earth's ozone layer, clouds, and upper layers of the oceans.

Important contributions in Earth Sciences often go unreported, perhaps because supernovae and solar storms are so dramatic in themselves, that difficulties in working out their consequences here at home are sometimes overlooked.

Robert F. Cahalan
NASA/Goddard Space Flight Center

Software Crashes as Y2K Begins

I was interested to read Richard Klein's letter in the August/September *APS News*. Klein seemed to tacitly agree with the quoted statement of Hugh Porter that the Y2K computer bug "didn't really have any effect at all." Please inform Messrs. Klein and Porter that on Jan.1, 2000 my Quicken software crashed, and indicated a zero balance in every account that I had. Various attempts to fix the problem were futile, and I finally wound up buying a new computer and switching to Microsoft Money to keep track of my finances. In fairness to Quicken, I should mention that they did eventually provide a free and upgraded version of their software which was Y2K compliant, but by then it was too late.

Paul F. Zweifel
Blacksburg, Virginia

Physicists Are the Highest Paid Scientists

I have uncovered some good news for physicists, which I would like to share with the readers of *APS News*. Jupiter Scientific Publishing has produced an extensive, comparative tabulation of salaries by scientific discipline and experience based on data compiled from Salary.com. (See http://ajanta.sci.ccny.cuny.edu/~jupiter/pub/sciinfo/.) It turns out that physicists are the highest paid scientists! According to the data, the median annual salary of a physicist with five or more years work experience is currently about $96,000, whereas experienced biologists, chemists and geologists respectively earn about $73,000, $79,000 and $73,000. Thus, physicists earn around $20,000 more than scientists in other disciplines. These figures do not include bonuses or fringe benefits.

Physicists with 2 to 4 years of experience earn on average about $61,000 whereas those with 0 to 2 years of experience earn about $50,000. These salary figures are roughly $10,000 higher than those for biologists, chemists and geologists. Biochemists are relatively poorly paid with salaries in the $40,000-$50,000 range with only a slight increase for seniority.

Salary.com claims that its data are accurate and up to date. The American Institute of Physics conducts its own employment survey, the most recent of which is for 1997 and was published in the March, 2000 issue of *Physics Today*. There, it was reported that physics bachelor degree graduates obtained a median salary of $37,000 whereas new PhD graduates earned $62,000 in the industrial sector. Since Salary.com does not distinguish undergraduates and from graduates nor industrial from academic, its figures are in approximate agreement with those of AIP.

The data are good news to both established physicists and physics students. A degree in physics is not only worth a lot intellectually, it's worth a lot materially.

Stuart Samuel
City College of New York

VIEWPOINT…

Human Rights, at Home and Abroad

By coincidence, two important human-rights cases were settled on the same day, many thousands of miles apart. On September 13 in Moscow, the Presidium of the Russian Supreme Court dismissed the appeal of the prosecution in the case of Aleksandr Nikitin, thereby ending all attempts to jail him on charges of high treason. Later that day in Albuquerque, New Mexico, Judge James A. Parker set free Wen Ho Lee, the Los Alamos scientist who had been held without bail for nine months awaiting trial for allegedly mishandling nuclear secrets.

Someone not familiar with the details of these cases, especially someone in this country, might assume that the American system would be inherently superior to the Russian in dispensing justice and in protecting the rights of the accused. After all we have a proud tradition of more than two centuries of freedom and democracy, whereas Russia, heir to the oppressive Soviet system and before that the tyranny of the Czars, is only now emerging as a struggling democracy plagued by an unstable economy in which chaos and corruption abound.

So it is enlightening to examine the circumstances of these two cases, and to discover an interesting degree of similarity between them. Of course neither case reflects well on the government involved: Nikitin is an environmental activist primarily concerned with the nuclear waste generated by Russia's northern fleet, and the governmental response to his activities was to charge him with high treason. He spent 10 months in prison in 1996, and as the case dragged on for five years, even after his release he was the subject of harassment and persecution. The international scientific community, among others, engaged in public and private agitation on Nikitin's behalf. For example, Jerome I. Friedman, then President of the APS, wrote an open letter in November of 1999 in support of Nikitin, about a month before he was acquitted of the treason charge in St. Petersburg Municipal Court. It was this acquittal that was upheld on appeal in April 17 of this year, and again on September 13.

The Wen Ho Lee affair was shorter, but more intense. Fired from his long-term position at Los Alamos by Energy Secretary Richardson in March of 1999, amid allegations that someone there had leaked nuclear secrets to the Chinese (Lee himself is a naturalized American born in Taiwan), Lee was arrested in December 1999 and indicted on 59 counts of mishandling nuclear secrets. He spent the next 278 days either in solitary confinement or in shackles when transported out of his cell. Initially he was forbidden unsupervised meetings with members of his family, and forbidden to speak with them in Chinese. Although he was never charged with espionage, the government treated him as a severe threat to national security, and argued successfully against the granting of bail. Protests against the conditions of his incarceration were widespread both outside the scientific community and within it, including a letter written by APS President James S. Langer to Attorney General Janet Reno in February. In late summer the weakness of the government's case became increasingly apparent, and Lee's lawyers negotiated a settlement in which he pled guilty to only one charge in return for a sentence of time already served. In freeing him, Judge Parker said that the actions of certain government officials "have embarrassed our entire nation and each of us who is a citizen of it."

One important lesson of these affairs is that even in a nation of laws like ours in which freedom and democracy are cherished principles, there are forces at work willing to use slogans like "national security" to trample on basic human rights, and they are never very far from getting away with it. We succumb at our peril to the fiction that this can happen only in other countries.

The consequences of the Wen Ho Lee affair promise to be long-lasting and severe. Several of the news media have reported on the damage done specifically to Los Alamos as a scientific institution, and more generally to the broader community of scientists, many of whom are Asians or Asian-Americans who in the future will be less inclined to choose science as a career or less inclined to pursue their careers in the United States. The true threat to our national security and well being is much more likely to come from a loss of scientific competitiveness than from a loss of nuclear secrets to the Chinese or anybody else.

—Alan Chodos

The Physics of Pole Vaulting

In September, American Stacy Dragila became the first woman to win an Olympic gold medal in women's pole vaulting at the Olympic 2000 games in Sydney, Australia, clearing a height of 15 feet 1 inch. And a physicist from the University of Texas says women are poised to make even bigger leaps in the record books. Cliff Frohlich, who has written articles on sports physics in the *American Journal of Physics* and the book *The Physics of Sports*, points out that while the men's pole vaulting record has stood for more than 6 years, we've yet to see the heights to which women will vault.

By using a vaulter's sprint speed to determine the potential vertical height, Frohlich says he expects the women's record to top 17.5 feet soon. That's two feet higher than where the current record sits. (You can determine your own potential vault height online, and read more about the physics of pole vaulting — including the equations Frohlich uses to determine vaulting heights—at http://www.aip.org/physnews/graphics/html/polevault.html.) For example, at 5 feet 8 inches, with an approximate sprint speed of 18.7 MPH, Dragila, an assistant track and field coach at Idaho State University and the women's current world record holder, should theoretically be able to jump a height of about 14 feet 9 inches.

Dragila has already topped that approximation, setting her current record of 15 feet 2.25 inches in July at the Olympic trials in Sacramento, California. (The world record in men's pole vaulting is held by the Ukraine's Sergey Bubka, who cleared 6.14 meters or 20 feet 1.75 inches in a 1994 competition.) She fell short of her attempts to clear 15 feet 3 inches during the actual Olympic competition, but says she has cleared that height during practice sessions. Still, notes Frohlich, "the model predicts the height attained remarkably well." The difference is accounted for by the fact that the sprint speed used is only an approximation, and no other factors are considered.

Dragila's coach, Dave Nielsen, agrees with Frohlich that women probably have room for significant gains, but he isn't sure about the 17.5 foot figure.

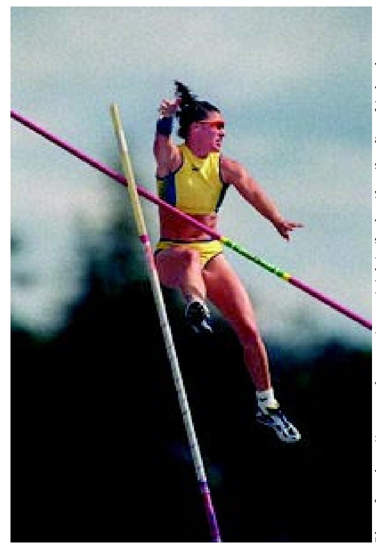


Photo from http://www.sacbee.com/sports/trials/spikeshoe/dragila_diary/bio.html

Olympic gold medalist Stacy Dragila.

Still, he thinks 16.5 feet is a good bet, and he says women will eventually break the 17 foot mark. "Women have different challenges than men in pole-vaulting, such as different upper body strength and a lower average height," Nielsen says. Nevertheless, he adds, "I don't doubt that women will eventually jump over 17 feet," as women pole vaulters continue to increase sprint speeds and improve other vaulting factors.

With current women's records at just over 15 feet, Frohlich says that "the women's record is likely to improve quite a bit" as women who can run faster and use the pole more effectively enter the field. The reason this is possible is that vaulting is an example of conservation of energy: The kinetic energy, of the runner's approach speed is converted, through the pole vault, into the potential energy of the jump height. The faster a vaulter sprints toward the vault bar, the more energy is available for the vault.

Nielsen says in addition to the approach velocity, other factors must be considered, such as how effectively the vaulter's horizontal running velocity is converted into vertical velocity, since this determines the amount of momentum that will carry the vaulter up and over the bar. This occurs through the "angle in" and "angle out" that the vaulter's body makes with the ground at the start of the vault.

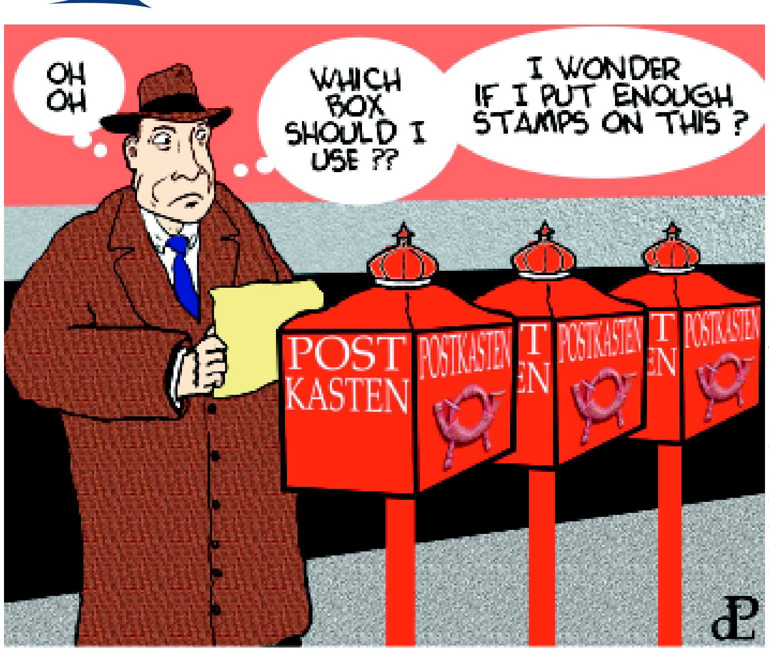
Upper body strength and the height of the vaulter's center of mass also play very important roles, since both are intimately tied up with the amount of mechanical work that must be done. The taller a person, the higher is their center of mass. Likewise, the distribution of mass affects center of mass. In general, men have a higher center of mass than women do.

In his recent presentation before the 2000 Olympic Trials USA Track & Field Super Clinic, Nielsen stated that everything else being equal, "the taller vaulter will likely be able to hold (the pole) higher and will be higher in the air at take off." As for upper body strength, Nielsen says, "Females are similar to males in leg strength, but have noticeably less upper body strength." He thinks this might be a liability during vaulting, which requires the execution of a series of maneuvers that amount to a somersault while holding the pole.

Louis Bloomfield, another physicist who teaches the popular "How Things Work" course at the University of Virginia agrees with Frohlich's expectations that women will likely make some big height gains in the near future. "He's probably correct," says Bloomfield. "His observations that women can do better than 15 feet, and will probably do so fairly soon, is probably correct, too."

—*Inside Science* news team

zero gravity



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The day Heisenberg mailed out his Uncertainty Principle.

IN BRIEF

Latest Figures on Women in Physics

Girls now account for half of high school physics students in the US, but in general, participation of women in physics decreases with the years, according to a new report by the American Institute of Physics. In 1993, girls represented two fifths of high school physics students; in 1998 women accounted for only one fifth of physics bachelor's degrees. The percentage of women PhDs in physics and engineering (about 13%) lags behind the percentages for math (25%) and chemistry (31%), and further behind biology and medicine. Among faculty, the proportion of women teaching physics decreases as academic rank and level of department increases. However, the percentage of women faculty members at each rank is consistent with the percentage of women earning PhDs at the time that they got their degrees. (See report "Women in Physics, 2000" at http://www.aip.org/statistics)

Townes Receives NAE 2000 Founders Award

Charles H. Townes, who served as APS President in 1967 and who was the co-recipient of the 1964 Nobel Prize in Physics, has been awarded the National Academy of Engineering's 2000 Founders Award, which was established by the NAE to recognize an Academy member's lifelong contribution to engineering, and whose accomplishments had benefit to the people of the United States. Townes was one of the pioneers in the development first of the maser (microwave amplification by stimulated emission of radiation) and then, in collaboration with his brother-in-law Arthur Schawlow, of the laser. The award consists of a gold medallion, a $2,500 cash award, and a certificate.

VIEWPOINT…

Science and Religion Can Work Together

by Freeman Dyson

"God forbid that we should give out a dream of our own imagination for a pattern of the world."

The above was said by Francis Bacon, one of the founding fathers of modern science, almost 400 years ago. Bacon was the smartest man of his time, with the possible exception of William Shakespeare. Bacon saw clearly what science could do, and what science could not do. He is saying to the philosophers and theologians of his time: look for God in the facts of nature, not in the theories of Plato and Aristotle. I am saying to modern scientists and theologians: don't imagine that our latest ideas about the Big Bang or the human genome have solved the mysteries of the universe, or the mysteries of life.

Here are Bacon's words again: "The subtlety of nature is greater many times over than the subtlety of the senses and understanding." In the last 400 years, science has fulfilled many of Bacon's dreams, but it still does not come close to capturing the full subtlety of nature. After sketching his program for the scientific revolution that he foresaw, Bacon ends his account with a prayer: "Humbly we pray that this mind may be steadfast in us, and that through these our hands, and the hands of others to whom thou shalt give the same spirit, thou wilt vouchsafe to endow the human family with new mercies." That is still a good prayer for all of us as we begin the 21st century.

Science and religion are two windows that people look through, trying to understand the big universe outside, trying to understand why we are here. The two windows give different views, but they look out at the same universe. Both views are one-sided, neither is complete. Both leave out essential features of the real world. And both are worthy of respect. As the old Swiss nurse who helped take care of our babies used to say, "Some people like to go to church, and some people like cherries."

Troubles arise when either science or religion claims universal jurisdiction, when either religious dogma or scientific dogma claims to be infallible. Religious creationists and scientific materialists are equally dogmatic and insensitive. By their arrogance, they bring both science and religion into disrepute. The media exaggerate their numbers and importance. Media people should tell the public that the great majority of religious people belong to moderate denominations that treat science with respect, and the great majority of scientists treat religion with respect, so long as religion does not claim jurisdiction over scientific questions.

In Princeton, we have more than 20 churches and at least one synagogue, providing different forms of worship and belief for different kinds of people. They do more than any other organizations in the town to hold our community together. Within this community of people, held together by religious traditions of human brotherhood and sharing of burdens, a smaller community of professional scientists also flourishes.

The great question for our time is, how to make sure that the continuing scientific revolution brings benefits to everybody rather than widening the gap between rich and poor. To lift up poor countries, and poor people in rich countries, from poverty, to give them a chance for a decent life, technology is not enough. Technology must be guided and driven by ethics if it is to do more than provide new toys for the rich. Scientists and business leaders who care about social justice should join forces with environmentalists and religious organizations to give political clout to ethics.

Science and religion should work together to abolish the gross inequalities that prevail in the modern world. That is my vision, and it is the same vision that inspired Francis Bacon 400 years ago, when he prayed that through science God would "endow the human family with new mercies."

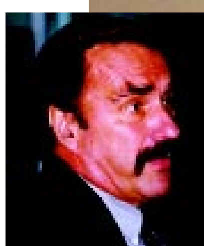
Freeman Dyson is at the Institute for Advanced Study in Princeton, NJ. The above commentary was delivered upon occasion of his receipt of the Templeton "Science and Religion" Prize in March, 2000.

APS Mass Media Fellowship Program

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

http://www.aps.org/public_affairs/Media.html

ΣΠΣ Congress Zeros in on Career Diversity and Undergrad Education Reform



M. Tarlton/AIP

Above: Nobel Prize winner William Phillips crumbles a flower frozen with liquid nitrogen as part of his lecture on absolute zero. Top inset: Luncheon speaker James Trefil. Bottom inset: Banquet speaker Felice Frankel.

Physicists from the premier alumni association for physics in the US gathered at ACP Headquarters in College Park, MD, for the 2000 Quadrennial Congress of Sigma Pi Sigma (ΣΠΣ), held in September. According to its mission statement, ΣΠΣ is a national physics organization that cuts across all career paths to unite individuals with a common heritage in physics, despite working in a broad variety of professions.

"Our goal is to spark the interchange of insight, experience, wisdom and connections among our membership for both personal and societal gains," says Bo Hammer of AIP. The Congress featured guest speakers from industry, business, government, the humanities and academia, to achieve the event's stated objective of recognizing "the varied paths taken by physics alumni," and "the relationship between a solid physics education and success in a variety of professions." There was also a special panel discussion featuring retired physicists sharing professional and personal insights gleaned during their years in such varied fields as atmospheric physics, space science, biophysics, materials science, and industry.

The Congress kicked off with a special dinner on Friday evening, featuring a keynote address on laser cooling and trapping — involving a visual demonstration with liquid nitrogen — by NIST's William Phillips, a Nobel Prize winner in 1997, and ΣΠΣ member since 1983. Saturday morning featured a distinguished panel of industrial physicists employed in diverse careers, discussing how their physics background has served them well in their chosen fields. For example, Amanda McDonald is now an actuary with American Fidelity, and says her physics background was useful almost immediately in her position, specifically in statistical probability and analysis.

Steven Morin is director of research, development and engineering for Omega Optical, a small high-tech manufacturing firm that produces optical filters for controlling signal to noise ratios. Omega competes in a $50 million niche market, and hence its focus is on application specific products and processes. Because of its small size (less than 100 employees), the company is able to respond to immediate customer product needs with incremental technological developments. However, its R&D projects require reasonably quick expected paybacks, and its employees must operate in a fast-moving environment with high pressure from competition and the need for short product development cycle. Hence, the company seeks out technical generalists, and Morin feels physicists are best suited to fill the technical needs of smaller companies like Omega.

John Sunderland is technical operations director and a medical physicist at the Biomedical Research Foundation of Northwest Louisiana, who taught high school physics before earning his PhD in physics, and now works with positron emission tomography. While his career path has been diverse, he found that such practical physics experience as the photoelectric effect, Compton scattering, diffraction, reflection and refraction served him well in the applied field of medical physics. In fact, "I use virtually everything I ever learned in physics in my job," he says, adding that it also significantly facilitated his pursuit of an MBA. Still, Sunderland feels that a fundamental problem today in physics education is that most physics educators have little applied experience outside academia, since most of those who find employment in applied fields tend not to return to teach, or even contribute to education.

A possible solution was offered by Stephen Cobb, chair of

See ΣΠΣ Congress *on page 7*

MEETING BRIEFS

• The APS Four Corners Section held its fall meeting September 29-30 at Colorado State University in Fort Collins, CO. A special session on Physics in Colorado on Friday afternoon, as well as a Saturday invited session that featured physics demonstrations by Brian Jones, creator of the "Little Shop of Physics", were open to the public and the press, in keeping with the general physics emphasis of the section's fall meeting. The session on local physics featured lectures on probing a quantum degenerate gas of fermionic atoms, the BABAR experiment in high energy physics, and NMR and MRI. Friday evening's banquet was followed by a public lecture by Roger Culver on celestial events that changed history. Other topics covered during Saturday's sessions included high pressure physics at Brigham Young University; dynamical localization in nonlinear lattices; extreme nonlinear optics; STM measurements of surface diffusion; and developing extracurricular programs for K-12 grads to interface scientists with schools.

• The APS Ohio Section held its annual fall meeting October 13-14 at the University of Toledo in Ohio, organized around the theme of photovoltaics and the environment. The meeting was held in conjunction with the corresponding geographical section of the American Association of Physics Teachers. Friday evening's after-dinner speaker was John P. Thornton of the National Renewable Energy Laboratory, who gave a lecture entitled, "Disaster! What Will You Do When the Electricity Disappears." Other invited speakers during the weekend's sessions covered such topics as high-throughput manufacturing of thin-film PV modules; amorphous silicon photovoltaic technology; photovoltaic arrays for NASA missions; and the potential commercialization of high-efficiency concentrator solar cells.

• The APS New York State Section held its annual fall meeting October 20-21 at the State University of New York, Buffalo's Amherst campus. The program consisted of three one-half day sessions devoted to three separate topics: cosmology, strings and particle physics, all intended for the non-specialist. In addition to the invited lectures, each session featured a special tutorial. Friday evening's banquet speaker was Fermilab's Rocky Kolb. Cosmology topics included the case for dark matter, the cosmological constant and the inflationary universe, and the evolution of the universe. The session on strings covered such topics as the physics of extra large dimensions, gravity in infinite volume extra dimensions, and strings and black holes. Particle physics topics included mass and mixing in the neutrino sector, quark-gluon plasmas, and CP-violation in rare kaon decay.

• Finally, the APS Texas Section held its annual fall meeting October 27-29 at Rice University in Houston, Texas, in conjunction with the corresponding units of the AAPT and the Society of Physics Students, as well as the National Society of Hispanic Physicists. Friday evening's banquet featured a lecture by Dava Sobel, author of the best-selling books *Longitude* and *Galileo's Daughter*. The meeting program also featured several workshops for physics teachers, as well as opportunities to tour local physics research facilities.

New APS Service Keeps Members in Contact

The American Physical Society has created a new service, the APS Technical Network, a web-based computer database that APS members can use to make informal connections with other members around the country. Unlike a membership directory, it holds a lot more information than address, phone, fax and email. APS members have the opportunity to input information such as their physics fields of expertise, their web page, all of their educational experience, and up to 2000 characters of additional information that can be used to explain some of the exciting work in which they're engaged. All APS members have the ability to search this database by physics fields, state, and/or keyword, and view the profiles of all the members who fit their parameters.

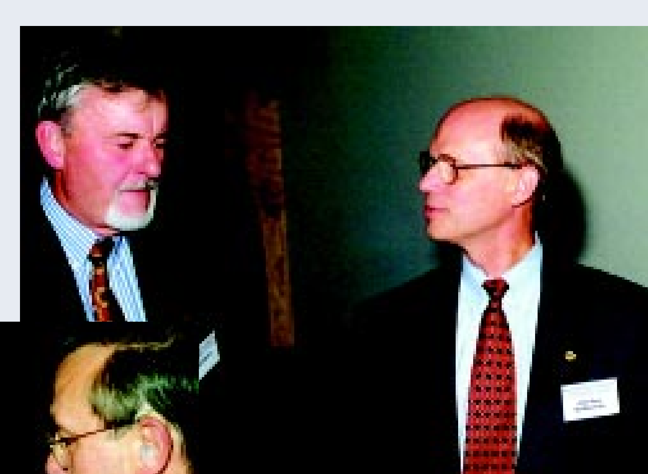
The idea for the Technical Database came about when several APS members in small companies petitioned the APS to help them find ways to solve technical problems given their limited resources. Arlene Modeste Knowles was enlisted to oversee the project. Knowles, who worked with Norval Johnson, the programmer who designed the database, believes that the Network can transform the sense of community among APS members: "This is a unique resource. Our members include some of the greatest intellectual minds in the world. Why shouldn't they be able to take advantage of that collective intelligence?" The Technical Network has grown from its original purpose of helping small start-ups find technical people, to allowing APS members to connect with each other more easily and find common ground upon which solid professional relationships can be built.

To become a part of this database, members can enroll at http://www.aps.org/TN and share their expertise with other APS members. Anyone who searches the database and wants to provide feedback can contact Arlene Modeste Knowles (knowles@aps.org). The APS wants to make this channel of communication as successful as possible and is eager to hear suggestions for possible improvements.

Santa Fe Fellows Recognized with New Fellow Pins

Approximately 85 APS fellows in the Sante Fe region gathered in September for a special reception at the Museum of International Folk Art in downtown Santa Fe. It was the latest in a series of such receptions organized at various geographical regions with a strong concentration of fellows, according to Darlene Logan, APS Director of Development. "The purpose is to recognize APS Fellows as an important constituency for the Society, and to update them on APS activities," she says.

The Santa Fe reception featured talks by APS Director of Education Fred Stein on education, and Michael Lubell, APS Director of Public Affairs, on the Society's public policy activities. The event also marked the first presentation of the new APS Fellowship pins, the majority of which will be mailed to APS Fellows in the near future.



Photos by Daniel Barsotti

Above: Albert Narath (l) speaks to John Pace VanDevender (r) as Fellows enjoy each other's company at the reception.

At left: APS Treasurer Thomas McIlrath presents Fellow pin to APS President-Elect George Trilling, host of the reception.

ΣΠΣ Congress, *from page 7*

the Department of Physics at Murray State University in Kentucky. He stressed the difficulty many potential employers experience in articulating the difference between a scientist and an engineer. To help combat this mindset, Murray State has instituted an alternative approach to the traditional undergraduate physics education: a combined physics and engineering degree. Thus far the new degree has proven quite popular with students in the department, more than 75% of whom are pursuing the combined degree. Cobb also reports that these students are routinely accepted into advanced degree programs, and have placements rates of 100% with such major companies as Boeing, NASA, Intel, Texas Instruments, Raytheon and Lockheed.

The "meat" of the two-day congress was the organization of breakout sessions on Saturday to discuss a variety of issues relating to physics education and public outreach, including undergraduate curriculum reform, the public face of physics, and the continued under-representation of women and minorities in physics. The National Task Force on Undergraduate Physics has asked ΣΠΣ for recommendations on revitalizing undergraduate physics education. The recommendations of the various groups will be gathered in a report and disseminated through numerous venues later this year.

The ΣΠΣ Congress organizers also bestowed special honorary membership on a few select attendees, including Phillips and former AIP Executive Director Kenneth Ford. The same honor was bestowed on luncheon speaker James Trefil, a physics professor and popular author, who also received the 2000 AIP Andrew Gemant Award for his efforts on behalf of physics outreach to the general public. Yet another new honorary ΣΠΣ member was Saturday evening's banquet speaker, Felice Frankel, an award-winning science photographer whose book, *On the Surface of Things*, has received both scientific and artistic acclaim. (For a profile of Frankel, whose work was exhibited during the APS Centennial meeting in Atlanta in 1999, see *APS News*, May 1999.)

ELECTION, *from page 1*

of last year's Centennial meeting in Atlanta as evidence "that physicists share common roots, interests and concerns."

CHAIR-ELECT OF THE NOMINATING COMMITTEE

SUSAN COPPERSMITH
University of Chicago

Coppersmith received her PhD in physics from Cornell University in 1983 and spent the next two years as a research associate at Brookhaven National Laboratory. Following a postdoctoral position at AT&T Bell Laboratories and a visiting lectureship at Princeton, she spent eight years as a member of the technical staff at Bell Labs. She joined the faculty of the University of Chicago in 1995. Her research interests include the properties of materials that are far from thermal equilibrium, particularly disordered materials, such as glasses, granular materials and disordered magnets.

In her candidate's statement, she praised the "vital role" the APS plays in informing non-physicists about the intellectual and practical benefits of the science, as well as the traditional activities of fostering communication between and within various sub-disciplines through its meetings and journals.

Coppersmith says she chose to run for office because of this, adding, "I am delighted to have the opportunity to help the Society respond effectively to the challenges and opportunities we will face over the next several years."

GENERAL COUNCILLORS

JONATHAN BAGGER
Johns Hopkins University

Bagger received his PhD from Princeton University in 1983 and took a postdoctoral research position at the Stanford Linear Accelerator Center, followed by three years on the faculty at Harvard University. He has been a member of the Institute for Advanced Study in Princeton, and is presently a member of the Fermilab Board of Overseers. His APS service includes a term as Secretary-Treasurer of the Division of Particles and Fields, as well as the Pricing Subcommittee of the Publications Oversight Committee. Bagger's research interests center on high energy physics at the interface of theory and experiment. His present work is focused on supersymmetry and supergravity between the weak and the Planck scales.

In his candidate's statement, Bagger concentrated on the need for the APS to continue to broaden its membership base and increase its reach, experimenting with new meeting and journal formats, and working with other societies to advance curriculum reform.

In fact, this was his primary motivation in running for APS office. "You really need a broad representation of fields on the APS Council," he says, "As General Councillor I will work to enhance communication between the divisions within APS, and to broaden the reach of the APS to other branches of science, to the government, and the public at large. We need a united front to advance the cause of science." Bagger also took issue with President Clinton's now-famous statement that the 20th century belonged to physics, but the 21st will belong to biology, noting, "I believe that physics is as important as never before," citing new materials, new ideas about the structure of matter and the shape of the universe, and new collaborations across fields as examples.

CHERRY MURRAY
Bell Laboratories/Lucent Technologies

Murray joined Bell Labs as a member of the technical staff in 1978, after receiving a PhD in physics from MIT in 1973. Her positions there over the years have included serving as department head for Low Temperature and Solid State Research, Condensed Matter Physics Research, and Semiconductor Physics Research. She was director of the Physical Research Laboratory from June 1997 until March 2000, when she assumed her present position of Senior Vice President of Physical Sciences Research.

She has a broad background in experimental research in low-temperature, surface, condensed matter and complex fluid physics, with emphasis on light scattering and imaging.

Her own research program currently encompasses imaging of order-disorder transitions in colloidal crystals and self-assembly of optical materials. Her APS service includes stints on the Forums on Education and on Industrial and Applied Physics, as well as the Panel on Public Affairs.

Murray's candidate's statement identified numerous critical issues facing the Society in the coming millennium: increasing government funding of fundamental physics research; stemming the decline in enrollments in undergraduate and graduate physics programs; and communicating the excitement and importance of physics research to the general public.

Murray has extensive experience with the latter objective, having served on the APS Task Force on Informing the Public, and serving on the NRC committee that published the successful pamphlet, "The Physics of Materials: How Science Improves Our Lives."

As its membership becomes increasingly diverse, "The APS needs to serve better those who are trained as physicists and end up in a career in which their job title is not 'physicist' — either in industry, finance, engineering, other fields of science, or medicine," she said.

APKER, *from page 3*

University of Massachusetts, Amherst. Lee went to Harvard as both an undergraduate and graduate student in physics. He earned his PhD in 1998.

Stephen R. Quake, the other 1991 winner, is an associate professor of applied physics with a joint appointment in biochemistry at Caltech. He does research in biophysics in the area of single molecule science in an effort to use biological molecules (like DNA) as models for studying physics. Quake attended Stanford as an undergraduate in physics, working under Steve Chu, a Nobel Prize-winning physicist. He then went to Merton College, Oxford University in England on a Marshall scholarship. There he earned his PhD in theoretical physics in 1994. Quake was hired at Caltech in 1996.

Christopher Barnes, a 1992 winner, is a post-doc at Princeton University, where he entered graduate school in physics in 1993 and earned his PhD in 1998. His current work is on the MAP satellite project, designed to measure cosmic background radiation. Barnes attended Reed College in Portland, Ore., as an undergraduate majoring in physics. He then went to Cambridge University in England for a year, where he completed the equivalent of a Masters degree in physics before going to Princeton. As a graduate student, Barnes did work in both theoretical and experimental physics. Barnes likes to write and has nearly completed work on a novel that he describes as a mixture of fantasy and science fiction.

Justin Mortara, the other 1992 Apker winner, is the vice president of business development at his father's medical device company, Mortara Instrument Company, at its Milwaukee, Wis., headquarters. Mortara attended the University of Chicago, where he majored in physics and worked under Stuart Freedman on the search for a particular type of heavy neutrino (which turned out *not* to exist, he says). He followed Freedman to UC- Berkeley, entering the physics graduate program in 1992 and earning his PhD in 1999. Thereafter, he joined his father's company, living in Bologna, Italy, working at its office there. He says he left physics because he can make a better contribution to society in the medical device industry.

David Kaiser, the 1993 winner, has just begun teaching a course on the history of science as an assistant professor in MIT's Science, Technology and Society (STS) Program. He is also a lecturer in MIT's physics department. After attending undergraduate school at Dartmouth College, Kaiser attended graduate school in physics at Harvard, where he earned the equivalent of two PhD's (although Harvard only awards one per person). The first was in physics, which he completed in 1997, and the second was in the history of science, which he finished this year. His second thesis dealt with the history of American physics following World War II and throughout the Cold War. Kaiser says that while he loves the physics research he does, his area "is a tiny, well-defined subspecialty, which can often seem cut off from other areas of physics. By contrast, his research on the history of American physics since World War II has required him to learn about a vast range of topics from foreign policy to culture and sociology to even art history. Above all else, Kaiser says that he wants to help bridge the divide between the humanities and the hard sciences, particularly physics.

Arthur Chu, one of three 1994 winners, works on Wall Street as a research analyst for the bond market at a major investment brokerage house in New York City.

Steven S. Gubser, another 1994 winner, is transitioning from a job as an assistant professor of physics at Princeton to a tenured position at Caltech. Gubser attended Princeton University as an undergraduate in physics, focusing on string theory and two-dimensional quantum gravity. Following a year at Cambridge University in England in a masters program, he returned to Princeton as a graduate student, earning his PhD in 1998 for work on the description of black holes and the relation of string theory to gauge theory. Gubser enjoys climbing mountains as a hobby.

Brandon C. Collings, the third 1994 winner, works at Bell Labs in Holmdel, NJ, as a research scientist in the area of fiber optics. After attending Hamilton College in Clinton, NY, where he had a double major in physics and mathematics, he went to Princeton University as a graduate student in electrical engineering, earning his PhD in 1999. He is currently on a research team that last November set a world's record in number of distinct wavelength communications channels carried by a single optical fiber. Collings plans to stay in the fiber optics industry for the time being.

Benjamin F. Williams, the 1995, the non-PhD institution winner, is an astronomy graduate student at the University of Washington in Seattle.

Frederick B. Mancoff, the 1995 PhD institution winner, has begun a post-doc position at the National Institute of Standards and Technologies in Boulder, Colorado. He just finished his PhD in the department of materials science and engineering at Stanford.

Benjamin S. Williams, the 1996 non-PhD institution winner, is pursuing his PhD at MIT in the department of electrical engineering, where he is working on the development of a new laser that operates in the far infrared.

Christopher Schaffer, the 1996 PhD institution winner, is currently working on his PhD in physics at Harvard in femtosecond laser research.

Cameron Geddes, the 1997 non-PhD institution winner, is a physics graduate student at UC-Berkeley, and he works as a plasma physicist in the L'OASIS group at Lawrence Berkeley National Laboratory. Geddes, who lives in Oakland, Calif., is an avid hockey and rugby player.

Anna Lopatnikova, the 1997 PhD institution winner, is working toward her PhD in physics at Harvard in the area of condensed matter physics. Lopatnikova has also been at Bell Labs in Murray Hill, NJ for four summers in a row in the Graduate Research Program for Women.

Gwendolyn Rae Bell, the 1998 non-PhD institution winner, received her masters degree in astronomy at Caltech and now works for the Technology Research Group at SAIC. She lives in San Diego, Calif.

Brian R. D'Urso, the 1998 PhD institution winner, is currently working toward his PhD in physics at Harvard.

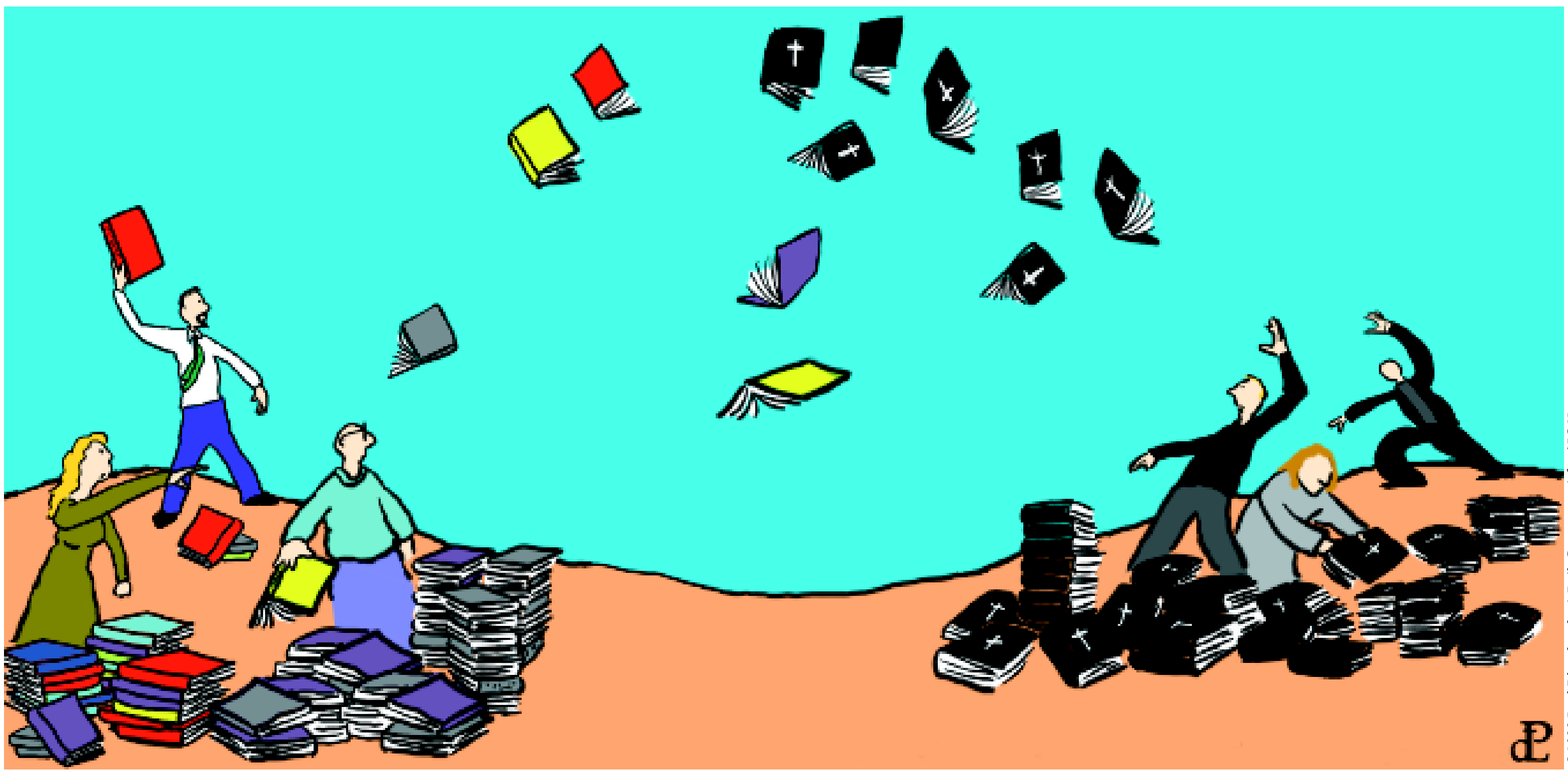
Brian Gerke, the 1999 non-PhD institution winner, is currently working on his masters degree at Cambridge University in England, where he studying on a two-year fellowship. Gerke plans to begin a PhD program in the fall of 2001.

Govind Krishnaswami, the 1999 PhD institution winner, is working on his PhD at the University of Rochester, continuing his undergraduate research there.

THE BACK PAGE

Creationism Versus Physical Science

by Stephen G. Brush



Last year, some scientists were surprised to learn from press reports that the Kansas State Board of Education voted to remove Big Bang cosmology, as well as biological evolution, from the required public school curriculum. This should be a wake-up call to alert everyone that all of science education is threatened by the political power of Creationism, even if the latest Kansas election result leads to a reversal of the 1999 decision.

It may seem odd that religious fundamentalists would attack the Big Bang theory, since only a few years ago a number of popular books praised that theory as being favorable to religion: if scientists declared they could never know what happened before the Big Bang, this seemed to leave plenty of room for theologians to fill the gap.

But Creationists refuse to consider any metaphorical interpretation of the book of Genesis. In particular, "Young Earth Creationism" (YEC) insists that the entire universe was created only a few thousand years ago. Hence they reject not only the Big Bang theory (because it postulates an event that must have happened several billion years ago), but any geological theory like plate tectonics, which relies on a time scale of several hundred million years.

In general, the Creationists say any scientific theory that assumes the world has existed for more than about 10,000 years is "Evolution Science," and, they argue, should either be excluded from the science curriculum or "balanced" by the alternative "Creation Science" doctrine. Since the typical general science course offered in secondary schools contains a substantial amount of astronomy and geology, complying with that demand would have a major impact on such courses, as well as on the standard biology course.

The Creationists have learned that they cannot accomplish their objectives directly through state laws banning the teaching of evolution or requiring "equal time" for Creationism. Instead, they now try to remove evolution from the official curriculum on which statewide tests are based; even if that topic is not actually banned, teachers will not spend much time on a subject that is not going to be on the test.

Another effect of the Creationist assault on science education is a threat to the supply of qualified science teachers. There is already a nationwide shortage of high school physical science and mathematics teachers. In smaller high schools, a teacher whose degree is in biology will sometimes also be assigned to the chemistry or physics course. Political pressure to abandon the teaching of evolution is one more factor that discourages good people from pursuing a teaching career.

Physicists should also be concerned about the Creationist claim that Darwinian evolution violates the Second Law of Thermodynamics. It turns out that their version of the Second Law is different from the one taught in thermodynamics courses: it simply asserts that entropy can never decrease. The usual response is to insist that entropy can decrease in an "open system" such as the Earth, as long as it interacts with another open system, such as the Sun, in which there is a compensating increase.

A better response is to point out that the equilibrium state of a system is determined by seeking not the maximum entropy but the minimum free energy, which balances energy against entropy (E-TS). An obvious example is the crystallization of water molecules from a vapor: at low temperatures a low-energy state with low entropy (a crystal) will be favored over a high-energy state with high entropy (a gas). The Creationist version of thermodynamics fails to explain why it snows. As Ludwig Boltzmann noted more than a century ago, thermodynamics correctly interpreted does not just allow Darwinian evolution, it favors it.

In an attempt to justify their rejection of the well-established multi-billion-year time scale for the Earth's history, YEC argues that the decay rates of the radioactive isotopes used to date rocks could have been much greater under extreme conditions in the past, so the rocks are "really" much younger than they seem to be. There is no legitimate evidence for this claim from experimental or theoretical physics.

One reason Creationists want students to accept a Young Earth is to persuade them that there has not been enough time for evolution to produce humans and other modern species by the slow process of Darwinian natural selection. They are willing to reject the foundations of modern geology and nuclear physics in order to get rid of biological evolution.

The justification for rejecting the multi-billion-year astronomical time scale, on which the Big Bang theory depends, is even more remarkable. In response to the objection that many stars visible to us must have existed millions of years ago, since they are millions of light years away, YEC claims that God created the light from those stars en route to us in space, to make it look like it came from actual stars, but that no such stars ever existed.

Some Creationists find that kind of argument a little hard to swallow. In recent years another version of Creationism has come into prominence, called Intelligent Design Creationism (IDC). Its leaders sound more reasonable and some have solid academic credentials: Phillip Johnson is a professor of law at the University of California, Berkeley, and Michael Behe is a biochemist at LeHigh University. They do not necessarily deny that evolution has occurred, but they argue that Darwinian theory cannot adequately explain it. IDC generally refrains from direct attacks on physical science, while trying to hijack some of its ideas, such as the Anthropic Cosmological Principle, to support the theory that the universe has been designed to allow the evolution of life. But the IDC advocates concentrate on trying to show that Darwinian natural selection is bad, because it is materialistic (i.e., it denies any role to supernatural or spiritual causes), and because it allegedly fails to explain all biological facts. I describe IDC as "soft" Creationism because it makes no testable statements, in contrast to YEC, which makes many testable statements, all of which have been tested and refuted.

IDC relies on a logical fallacy: if Darwinian evolutionary theory fails to explain a fact, then that fact is evidence for design. But it is well known to scientists that no theory (with the possible exception of quantum electrodynamics) explains all the facts in its domain; one has to pick the best working hypothesis and try to refute or improve it. Evidence against Theory A is not evidence for Theory B, unless there are no other possible theories; but there are already many anti-Darwinian theories competing with each other.

Advocates of IDC sometimes try to distance themselves from the pro-religious, anti-science views of other Creationists. For example, after the Kansas decision, Behe wrote an op-ed piece in *The New York Times* (13 August 1999) saying that rather than being banned, Darwinian evolution should be taught in public schools so it could be refuted. But whatever their motives, there is evidence that they are being used by other Creationists as a respectable front or "wedge" to undermine public support for teaching evolution. If that ploy is successful, it is sure to have dire consequences for all of science education.

Both YEC and IDC, along with the late 20th century postmodern skepticism about the universal validity of scientific knowledge, undermine public support for science. We need to understand why a substantial number of citizens — not just hard core religious fanatics — reject or doubt certain basic theories of modern science, if we hope to defend science education from such attacks in the future. A major reason seems to be "guilt by association": according to the televangelists, evolution is allied with secular humanism, which is blamed for abortion, pornography, drugs, homosexuality and crime in the streets. If you teach children they are descended from animals, the reasoning goes, they will assume they can behave like animals.

More thoughtful critics object that in presenting subjects like evolution and cosmology, there is a disturbing tendency for science teachers to treat speculative or unproved theories as fact. Moreover, some physical scientists and engineers do not accept that theories in biology have the same status as those in their own field, because biological theories are not subject to rigorous tests. In particular, the evolutionary explanations given in popular books have often seemed to be no more than plausible but untestable "just so" stories. Even in cosmology, theories like the Big Bang have been presented to students and to the public as established fact, rather than as simply the best working hypothesis, still subject to modification. Finally, physical laws and theories are sometimes taught as if they provide a complete explanation for everything worth knowing, including human nature and spirituality. I am not saying that these criticisms justify interference with science education, rather that scientists should be aware of them when they address the public.

Several of the mainstream churches have rejected the Creationist position that the credibility of the Bible depends upon the truth or falsity of a particular scientific theory, and actively opposed attempts to force YEC into schools in Arkansas and Louisiana. Scientists themselves, many of whom perceive no conflict between evolution and their own religious beliefs, will have to become more politically active, including running for election to school boards themselves, or at least learning how to lobby those boards effectively. The stakes are high.

Stephen G. Brush is a professor of the history of science at the University of Maryland, College Park. He is also co-author (with Gerald Holton) of Physics, the Human Adventure: From Copernicus to Einstein and Beyond, to be published in 2001 by Rutgers University Press.

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.