APS NEWS

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APS Launches New Web Site for the Public

This month APS is launching PhysicsCentral.com, a brand new web site targeted at the general public. "The site is designed to bring the importance and excitement of physics to everyone," said Jessica Clark, APS outreach specialist who is in charge of its overall management. "While the site highlights the research and activities of many APS members, PhysicsCentral is intended to reach beyond the physics community. We need our members to encourage non-physicists to visit the site as well," Clark adds.

Appearing in a magazine-like format, the site has several features that will be updated regularly. Among them is "Physics in Action," which presents a nugget of basic physics at the high-school level, and then relates it to current research. Another is "People in Physics," that highlights individual physicists, describing what they do both professionally and in their everyday lives. The site will also feature a "Picture of the Week," illustrating natural phenomena and the physicists who investigate them.

There is a news section that presents breaking news as well as features prepared by the Inside Science News Service of AIP. Those who want to know how things work can consult a weekly "Dear Lou" column contributed by University of Virginia physicist Louis A. Bloomfield, and they can ask Lou their own questions as well. A "Writers' Gallery" on the site contains short pieces by physicists who are also award-winning writers.

An annotated list of the best physics links is also available on the site, organized by audience with the help of the exclusive PhysicsCentral Buckyball user guide.

The content for the site is the responsibility of Clark, Ed Lee of the APS education and outreach department, senior media coordinator Randy Atkins, intern Richard M. Todaro, and associate executive officer Alan Chodos. The site was designed by Kimberley Quigley of the special publications department, and constructed by Joanne Fincham of APS Information Technology.

Kim Quigley/APS

Jessica Clark and the homepage of PhysicsCentral.com.

The idea for PhysicsCentral.com grew out of a report last year by a special APS task force on communicating with the public, chaired by Leon Lederman. Based on a detailed proposal presented by Michael Barnett of the University of California, Berkeley, the task force urged the APS to implement a web site for the public, pointing out that it could have a powerful impact on how the public views physics.

Clark was hired specifically to develop and maintain the site. She obtained her undergraduate degree, and is finishing her PhD in experimental nuclear physics, at the College of William and Mary. Before college, she enjoyed the peripatetic existence of a child of a US Parks Service employee, living in such varied locations as the Virgin Islands, Alaska, and the American Southwest.

Check It Out and Tell Your Friends

APS members are urged to visit PhysicsCentral.com, and to offer their comments and suggestions. This can be done either by using the "Contact Us" button on the site, or by emailing Jessica Clark directly at clark@aps.org.

They are also urged to spread the word by inviting relatives, friends, students and anyone else with access to the web and curiosity about the physical world to visit the site.

Three Budding Young Physicists are New Apker Recipients

Three promising undergraduate physics majors have been awarded the 2000 Apker Award. Jacob Krich of Swarthmore College was honored for his thesis entitled, "Correlation Length and Chirality of Isotropic Short-range Order in Nematic and Chiral Nematic Liquid Crystals." Heather Lynch of Princeton University was honored for her thesis entitled, "A Kondo Box: Coulomb Blockade and the Kondo Effect in Iron-Doped Copper Nanoparticles." And Steven Oliver of the University of California, Berkeley, was honored for his thesis entitled, "Three-Dimensional Raman Sideband Cooling at High Density."

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. The winners will receive $5,000, and are selected by a committee from among the six finalists.

The experiment that forms the basis of Krich's award-winning thesis measured the pitch of the chiral fluctuations in the isotropic phase of a liquid crystal. The purpose was to test two theories that predict strong discontinuities in the pitch at this transition. Despite the difficulty of conducting such an experiment, Krich succeeded in obtaining results that demonstrate unequivocally that the two theories do not describe the chirality at this transition well at all, according to his thesis advisor, Peter Collings. He presented his results at the International Liquid Crystal Conference in Sendai, Japan, this summer.

Jacob Krich

Heather Lynch

Steven Oliver

Photos by Ken Cole/APS

In addition to the Apker Award and numerous graduate fellowships, Krich received awards from Swarthmore for the graduating senior with the strongest academic performance

See APKER *on page 7*

End of an Era

Harry Lustig

After this year, the APS Apker Award Selection Committee will be minus a man who has become a fixture of the committee for more than a decade. Harry Lustig, former APS treasurer who retired from that position in 1996, will be retiring from the selection committee after 16 consecutive years of service.

Lustig first became involved with the Apker Award selection committee when he succeeded Joe Burton as APS Treasurer in 1985. At that time, the Apker Award was

See ERA *on page 7*

2000 Nobel Prizes Announced in Physics, Chemistry and Medicine

The 2000 Physics Nobel Prize recognizes the vital role of physics in the information technology revolution. Half the prize will be awarded this month to Zhores I. Alferov of the Ioffe Physico-Technical Institute in St. Petersburg, Russia and Herbert Kroemer of the University of California at Santa Barbara for their early work in such areas as the design of heterostructures, semiconductor lasers, epitaxial growth techniques, and optoelectronics. The other half of the prize will be awarded to Jack Kilby of Texas Instruments, one of the pioneers in producing integrated circuits.

Tiny transistors replaced vacuum tubes as a means of performing the important tasks of switching and amplifying in electronic circuits, but it wasn't until many transistors and other elements could be wired up in a small space that today's information revolution could begin. Integration and miniaturization not only led to more efficient packaging but also to quicker processing since signals travel shorter paths.

The Nobel Prize in Chemistry goes to Alan J. Heeger (University of California, Santa Barbara), Alan G. MacDiarmid (University of Pennsylvania), and Hideki Shirakawa (University of Tsukuba, Japan) for discovering that plastics polymers, modified in certain ways, can conduct electricity very well. From Saran wrap to foam cups, polymers are normally insulating materials, but in the 1970s, Shirakawa, finding a new way to make the polymer polyacetylene, accidentally added 1,000 times too much catalyst. He produced a silvery film, which he later presented in 1977 to Heeger and MacDiarmid, who had been investigating the possibility of "synthetic metals."

The three studied the properties of the material. When they added iodine, the polymer's electrical conductivity shot up by several million times. The result was a whole new field—conducting polymers—which has led to plastic versions of many electronic devices, such as light emitting diodes. Compared to inorganic materials, plastics are more flexible and potentially cheaper and easier to manufacture.

See NOBEL *on page 6*

HIGHLIGHTS

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Members in the Media

Editor's Note: With this issue we begin a "Members in the Media" feature in which we highlight appearances by our members in the popular press. We welcome submissions by our readers of relevant quotations (email: letters@aps.org).

"The integrated circuit, along with the transistor, has probably emerged as the greatest discovery of the last century. The prize really recognizes the boom associated with communications spawned by this work."

—Marc Brodsky, American Institute of Physics, commenting on the 2000 Nobel Prizes, USA Today, October 11, 2000

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"Einstein didn't win the Nobel Prize for the theory of relativity. He won it for showing that you don't need to worry about radiation from your cell phone."

—Robert Cahn, UC Berkeley, oped article, San Francisco Chronicle, August 30, 2000

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"Yes, it has had problems, but it is a difficult and challenging project, which, because of its importance, we should not dodge."

—Richard Petrasso, MIT, on the National Ignition Facility, USA Today, September 14, 2000

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"It's easy to say foolish things about thermodynamics, and some very wise people have said foolish things."

—John Ross, Stanford University, Science News, October 7, 2000

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"Some of the signals that we'll get from the present run could turn out to be from the quark-gluon plasma."

—John Harris, Yale University, on first results from the STAR detector at RHIC, Long Island Newsday, September 26, 2000

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"We don't have really good sources for bright, entangled photons."

—Paul Kwiat, LANL, on improving microchips using quantum theory, New York Times, October 26, 2000

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"If you can go into a plasma and change something this basic, you've just changed the rules about how it works."

—Robin Marjoribanks, U. of Toronto, on the breakdown of Debye shielding in the presence of intense laser-generated fields, Toronto Star, October 27, 2000

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"It's like having plastic explosive in space. You're releasing that energy in an explosive manner."

—James Drake, University of Maryland, on how magnetic fields energize plasmas in space, New York Times, October 24, 2000

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"The significance of this finding? It's just, Wow! After all these years, we can still find something new in our solar system."

—Charles Baltay, Yale University, on the discovery of a new 'plutino', Reuters News story, October 25, 2000

New Scientific Coalition Targets Climate Change on the Hill

Whether or not human activity is adversely affecting the Earth's atmosphere and surface is a key unanswered question in scientific research. To help Congressional members and staffers sift through the often contradictory evidence, the APS is weighing in on global warming and climate change issues through a coalition of scientific societies, at the instigation of its Panel on Public Affairs (POPA).

POPA first became interested in organizing an effort focused on climate change two years ago, according to Francis Slakey, APS associate director of public affairs. To broaden the scope and effectiveness of the effort, the APS joined with four other societies to foster a plan of action: the American Chemical Society, the American Geological Society, the American Geophysical Union, and the American Institute of Physics. Since then, the coalition has grown to 10 societies, including, the American Institute of Chemical Engineers, the American Meteorological Society, the American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America.

Last year, the coalition hired a firm, Fleishman-Hillard, to carry out a series of focus groups and one-on-one interviews with congressional staff, focusing on what role science plays in the debate, as well as what science is known, unknown or distorted. In addition, the firm identified several ways in which the societies could enter into the debate in a unified and meaningful fashion. Based on the Fleishman-Hillard report, the coalition agreed on a goal and structure for a pilot program. The program's primary goal is to develop a grassroots education effort that will provide a regular and objective source of climate-related scientific information to the Hill, with the intent of countering the plethora of misinformation. It is also intended to develop a reliable relationship with a group of key Congressional staff and members.

To achieve its goal, the program will specifically target approximately 50 members of Congress considered key to climate change issues, either because they have not yet taken a stand on climate change but are in a position to influence the debate, or are simply concerned about the science behind the issue. A constituent scientist will then be identified in each of the 50 districts or states to serve as a contact point with the members of Congress. On a regular basis, climate-related information from peer-reviewed sources will be organized into a newsletter called *Climate Focus*, whose contents will be reviewed by a 10-member panel of scientists with expertise in climate change. The newsletter will be emailed to each constituent scientist, who will then contact the key staffer for their Member of Congress with the information.

For example, the first issue of *Climate Focus*, disseminated on September 1, summarized the findings of the draft National Assessment Report on global warming, released this summer by the US Global Change Research Program. It is the first ever national assessment of the regional impact of climate change. It also presents scientific evidence that the earth is warming, and that the atmospheric concentration of CO_2 is increasing, although accompanying commentary in the newsletter cautions that the evidence is insufficient to determine the degree to which natural climate variability and human influence are causing global warming.

The report also looked at the two most popular climate models

See COALITION *on page 6*

This Month in Physics History

December 29, 1959: Feynman's Classic CalTech Lecture

Richard Feynman

Image from www.scs-intl.com/online/

Nobel-Prize winning physicist Richard Feynman is known for many things: an enthusiasm for playing the bongos; a penchant for breaching security systems at Los Alamos while working on the Manhattan Project; his definitive Congressional testimony attributing the 1986 Challenger disaster for faulty "O"-rings; and a myriad of published works encompassing both physics research and personal reminiscences. And just before the series of classic CalTech lectures that formed the basis of *The Feynman Lectures on Physics* (first published in 1963), Feynman gave a seminal talk on the problem of manipulating and controlling things on a small scale, entitled, "There's Plenty of Room at the Bottom."

By the time Feynman gave his lecture in December 1959, scientists had succeeded in constructing electric motors the size of a small fingernail, and created a device capable of writing the Lord's Prayer on the head of a pin. Yet he dismissed such advances as "the most primitive, halting step" on the road to miniaturization, concluding, "It is a staggeringly small world that is below." He envisioned writing the entire 24 volumes of the Encyclopedia Britannica onto the head of a pin, maintaining that the only requirement to accomplishing this was reducing in size the text by 25,000 times.

Of course, he acknowledged that writing and reading such tiny text would require improvements in manufacturing techniques and instrumentation, particularly a hundred-fold improvement in then-existing electron microscopy, which needs to be capable of observing individual atoms but at the time could only resolve about 10 angstroms.

Feynman believed so strongly in the possibilities of miniaturization because biology is teeming with examples of writing information in a small scale. "The fact that enormous amounts of information can be carried in an exceedingly small space is well known to the biologists... and resolves the mystery of how, in the tiniest cell, all of the information for the organization of a complex creature such as ourselves can be stored," he said. Furthermore, human cells are active, capable of the manufacture of various substances, movement, and storage of information. Based on this, he envisioned the possibility of small but movable machines (recognizable as today's micro-electrical mechanical systems), computing at the quantum scale, arranging individual atoms, and perhaps one day even performing surgery internally with miniature movable devices.

History has borne out Feynman's now-famous observations. The fields of nanotechnology, MEMS, quantum computing, and molecular self-assembly, among others, have exploded, with groundbreaking research paving the way for the realization of Feynman's early vision. Even President Bill Clinton harkened back to Feynman's comments when he announced the new National Nanotechnology Initiative in January 2000 — an announcement made, appropriately enough, at CalTech. Feynman's prescience in anticipating the likely developments in miniaturization and nanotechnology is one of the many reasons why former CalTech president Marvin Goldberger cited him as "a towering figure in 20th century physics," and MIT physicist Philip Morrison once called him "the most original theoretical physicist of our time."

Further Reading: *Nano*! By Ed Regis (1995: Little Brown).

Birthdays for December:

5 Arnold Sommerfeld (1868)
5 Werner Heisenberg (1901)
14 N. G. Basov (1922)
15 Henri Becquerel (1852)
18 J.J.Thomson (1856)
19 Albert Michelson (1852)
25 Isaac Newton (1642)
27 Johannes Kepler (1571)
28 John von Neumann (1903)
28 Arthur Eddington (1882)

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Better Tabletop Accelerators, Fusion in a Beer Can Featured at DPP

Leading researchers announced some of the most exciting new results in plasmas at the 42nd Annual Meeting of the APS Division of Plasma Physics (DPP) and the International Congress on Plasma Physics (ICPP), held October 23-27, 2000, in Quebec City, Canada.

Advances in Tabletop Laser Accelerators

Donald Umstadter of the University of Michigan's Center for Ultrafast Optical Science reported on advances at his lab and elsewhere in tabletop laser accelerators, devices that use light to accelerate beams of electrons and protons to energies of a million volts in distances of mere microns. Not only is this acceleration rate up to a thousand times larger than in conventional accelerators, but Umstadter's lab has just shown that the brightness of the tabletop particle beam is roughly ten times higher than that produced by conventional accelerator technology. This is because, in part, laser accelerators can produce extremely narrow particle beams. Another reason is that tabletop lasers can now exert light pressures of gigabars, the highest ever achieved, approaching that of the thermal pressure of the Sun. Umstadter and colleagues have also demonstrated a thousand-fold improvement in repetition rate, which is how often bursts of electrons can be accelerated with these devices. Tabletop accelerators now have a repetition rate of 10 Hz (corresponding to 10 electron bursts per second), compared to previous tabletop acceleration rates of one burst per ten minutes.

Researchers are now considering using such a tabletop device as an injector for coherent x-ray sources, such as the Linac Coherent Light Source facility proposed at the Stanford Linear Accelerator Center. The natural shortness of the tabletop pulses makes it potentially possible to eliminate the usual requirement for magnetic beam compression, in which an elaborate series of magnets causes the charged particles of a conventional injector to travel different distances so that they pile up in time. Preliminary experiments from three different countries indicate that when ultrashort light pulses are used, the electrons might be accelerated by a novel mechanism, in which the laser light directly accelerates the electron oscillations of the plasma.

Improvements in "Direct Drive" Fusion

Lasers converge on a fusion target at the University of Rochester's OMEGA facility.

Plasma researchers have made the first use of a technique for improving a major form of laser-induced nuclear fusion known as "direct drive." In direct-drive fusion, lasers from many directions deposit energy directly on a shell containing fusion fuel; the light causes the shell to implode and trigger fusion reactions. Traditionally, direct drive has suffered from serious limitations, mainly because non-uniformities in the laser light's intensity cause the shells to implode in a less than optimal fashion. At the University of Rochester's 60-beam OMEGA laser system, researchers have used "polarization smoothing" to significantly improve the laser beam uniformity. In a large laser such as the ones at OMEGA, each beam typically has unavoidable spatial fluctuations in intensity. To reduce these intensity fluctuations, researchers split each beam into two parts, each containing complementary or "orthogonal" components of the beam's electric field. Each of the polarized beams fluctuates independently of the other, so overlapping them averages or smooths out such intensity modulations.

When such beams were used to induce fusion reactions, the primary neutron yield from deuterium or deuterium-tritium filled plastic shells increased by about 70% compared to similar implosions without polarization smoothing. The emission of neutrons is generally proportional to the fusion reaction rate. At the same time, the smoother beams increased the compressed shell's areal density by 40-70%. The results bode well for direct-drive implosions of targets on OMEGA and Livermore's planned National Ignition Facility.

Fusion in a Beer Can?

Researchers are investigating an approach that offers the possibility of creating fusion energy in a small, inexpensive device. Known as Magnetized Target Fusion (MTF), the approach can potentially be developed on a short time scale because of its low cost. The MTF technique preheats and injects magnetized fusion fuel into an aluminum cylinder the size of a large beer can. Then the "beer can" is rapidly compressed by driving a giant electrical current along the wall of the cylinder. The compressed high-density plasma fuel burns in a few millionths of a second. The fast-moving solid metal wall, which compresses the fuel, has been developed for defense programs. The fuel-compression region implodes at pressures millions of times greater than that of the Earth's atmosphere. The process is analogous to that of a diesel engine, which compresses fuel to conditions where it more readily burns.

The essential advantage of MTF is its potential to be tested for scientific feasibility and even developed up to the prototype stage using apparatus that costs a fraction of conventional approaches. Last fall, several components of MTF technology were demonstrated. Los Alamos, in collaboration with the Air Force Research Laboratory, now leads a project to develop the preheated plasma needed for MTF. Researchers subsequently hope to conduct an experiment that will test this preheated plasma along with components of the implosion system.

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First RHIC Results Highlight 2000 DNP Meeting

The first results from RHIC, and reports of a natural endpoint to the RP process took center stage at the annual fall meeting of the APS Division of Nuclear Physics (DNP), held October 4-7 in Williamsburg, VA.

Searching for QGPs at RHIC

The search for the QCD phase transition has been the quest of ultra-relativistic heavy ion physics for the past two decades, according to Axel Drees of the State University of New York at Stony Brook, who kicked off a Wednesday morning session on the topic. "The hope is to establish the existence of the transition and by studying it in detail, to unveil fundamental puzzles of QCD, in particular confinement and chiral symmetry breaking," he says. Two recent major developments in particular are expected to herald a new era in the field: the completion of the experimental programs at CERN's SPS and Brookhaven National Laboratory's AGS, and the successful first run of BNL's new Relativistic Heavy Ion Collider (RHIC).

Drees opened the session with a summary of results obtained from previous experiments at CERN and BNL, which he maintains support researchers' hopes that the higher energies possible with RHIC (about 25 TeV) will be sufficient to create in the laboratory the conditions which must have existed about 2 microseconds after the Big Bang. Specifically, measurements of the energy emitted from Au-Au and Pb-Pb collisions over the last two decades indicate that if the ions collide head-on, energies are reached which should be sufficient to free the quarks and gluons normally confined in nuclear matter and form a quark-gluon plasma (QGP), a new state of strongly interacting matter. The key question now is whether the system spends some time in a QGP-like phase, and several characteristic features of such a state are believed to have been observed at both CERN and BNL.

"Clearly the evidence remains circumstantial," says Drees. "But even assuming a QGP-like state is formed, we know little about its properties." He adds that only limited progress can be expected from further experiments at the SPS because the energies aren't high enough to give a clear signature for the QGP-like state, which is just above the critical temperature and cools down rapidly. These limitations can be overcome at RHIC, where the Au ions collide at much larger energies: "The initial temperature should be higher and the system should spend a longer time in the deconfined phase," says Drees. "I have no doubt that RHIC will revolutionize our understanding of QCD over the next decade." In fact, he reports that the first published data from the PHOBOS collaboration at RHIC indicate that the initial energy density is increased by at least a factor of 1.5, which would correspond to an initial temperature above 250 MeV.

Rapid Proton Capture Process in Accreting Neuton Stars

The rapid proton capture (rp) process is the dominant reaction sequence in both X-ray bursters and X-ray pulsars, types of neutron stars found in X-ray binary systems that accrete matter from the envelope of their companion star. The process was first identified in 1981, and since then its natural endpoint has been an open question, with the latest calculations finding reaction networks ending at Yttrium and Tin. More recently, Hendrick Schatz of Michigan State University, and his colleagues performed the first calculations of the rp process beyond tin, and discovered that a natural endpoint of the process does, in fact exist: namely, the low binding energy of the proton-rich Tellurium isotopes leads to the formation of an Sn-Sb-Te cycle. According to Schatz, this cycle is a very effective barrier for the rp process because it prevents the synthesis of heavier nuclei in explosive and steady state burning on the surface of accreting neutron stars for all model parameters.

The result is significant, says Schatz, because in X-ray bursts with large amounts of hydrogen available at ignition, the Sn-Sb-Te cycle can operate at the end of the burst, leading to late time helium production, which in turn results in additional seed nuclei for the rp process and an increase in energy

See DNP MEETING *on page 6*

MEETING BRIEFS

APS Southeastern Section Meeting

The APS Southeastern Section (SESAPS) held its annual fall meeting November 2-4 at Mississippi State University in Starkville, MS. The conference covered subjects such as physics education research, applied physics, materials science, computational physics, optics and quantum optics, astrophysics, and free electron laser physics. The meeting also featured a program of physics teaching demonstrations. The evening's banquet speaker was Walter E. Massey, President of Morehouse College and a former APS vice president, who spoke on responsibilities of scientists to 21st century society. During the banquet, three awards were presented: the Jesse W. Beams Award for Outstanding Research; the George B. Pegram Award for Excellence in Teaching; and the Francis Slack Award for Excellence in Service. In addition, several other organizations held meetings in conjunction with SESAPS: the Mississippi Association of Physicists (this is the Mississippi Chapter of the AAPT), the Chairs of Southeastern Physics Departments, and the Society of Physics Student. A WebTop Workshop was held before the formal SESAPS Meeting, it was organized by John Foley of Mississippi State University. WebTop is a computer graphics system whose purpose is to help instructors teach optics and students to learn optics.

APS New England Section Meeting

The APS New England Section held its annual fall meeting November 10-11 at Central Connecticut State University in New Britain, CT. Friday afternoon's session focused on photonics, and featured invited lectures on such topics as microlithography for electronics and photonics; excitons in quantum dots; and a summary of recent advances in optical communications. The keynote speaker for Friday evening's banquet was Robert Adair of Yale University, who gave his popular lecture on the physics of baseball. On Saturday, contributed papers and a poster session were followed by an invited talk on the status of low and high temperature superconductor wire fabrication. The meeting closed with an industrial round table, organized by the APS Committee on Careers and Professional Development.

Conference Experience for Undergraduates at DNP2000

Photo courtesy of Tom Clark

Peter Rosen, DOE's Associate Director for High Energy and Nuclear Physics, gathers around student poster presentations with participants of this year's third annual CEU held at the Fall 2000 DNP meeting in Williamsburg, Virginia. The goal of the CEU program is to provide a "capstone" conference experience for undergraduate students by giving them the opportunity to present their research to the larger professional community and to one another.

LETTERS

Olympiad Coaches Play Key Role

It is a pleasure to see the October issue of the *APS News* give visibility and recognition to the successes of the US Physics Team which represented our country in the International Physics Olympiad. All of the physics community is well served by our continuing to emphasize the importance of physics education at all levels. In your article, however, you failed to mention those teachers who prepare and coach the team during this intensive competition. Mary Mogge of Cal State Pomona was the academic leader of the 2000 Team. Leaf Turner of the Los Alamos National Lab was senior coach; Warren Turner of the Brunswick School, Greenwich, CT was a coach; Boris Zbarsky, a former Gold Medalist, now an MIT undergraduate, was the junior coach. Lab responsibilities were carried out by Jennifer Catelli and Ryan McAllister of the University of Maryland.

Again, thanks to *APS News* for the encouragement and recognition offered to physics education at all levels. If physics is to be widely recognized as the basis for much of our understanding of the universe as well as the stimulus for much of our technology, we need to assure that all students study and understand our discipline. Recognizing our teachers is a crucial part of such encouragement.

Bernard V. Khoury
Executive Officer, AAPT

We thank the writer for pointing out this omission. Both the coaches and the dedicated AAPT staff were crucial to the success of the American team in this year's Physics Olympiad.

—Ed.

Readers Respond to Astronomical Top Ten

Among the list of the "Top Ten Astronomical Triumphs of the Last Millennium" appearing in the October issue of *APS News* is "There exist...other universes (Steinhardt, Linde, Guth, Hawking, Hartle, Rees, etc., 1990s)." I did not know that the existence of other universes was established. Perhaps either the compiler of the list or the editors of *APS News* can enlighten me.

Don Lichtenberg
Indiana University

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In Virginia Trimble's article on Astronomy's Greatest Hits, she lists as a scientific discovery, "There exist other universes." I had to check twice to make sure I was reading *APS News* and not Bob Park's "What's New." How could such scientific speculation ever find its way into an article on scientific discoveries?

As an assignment in my introductory physics class I have students look for examples of poor scientific reporting in the popular press. Now I have found my own example in *APS News*.

Michael G. Strauss
University of Oklahoma

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In your October 2000 issue, Virginia Trimble lists the top ten astronomical triumphs of the last millennium. Fine; but under # 5, "the Universe is expanding", she mentions the most significant contributors thus: Hubble, Gamov, Alpher, Herman, Ryle & Scheurer, Penzias & Wilson, while missing, it seems to me, the top players, *i.e.*, Friedman, de Sitter and particularly Georges Lema tre who invented the notion of "Primitive Atom", precursor of the Big Bang.

Incidentally, Lema tre was a Catholic priest who wrote his doctoral dissertation at MIT on the "Primitive Atom," showing that Einstein's "Cosmological Constant" was not required. In fact, in 1931, Lema tre, Hubble and Einstein met at Mount Wilson to discuss the problem, with the first two named having a hard time convincing Einstein that the Universe was in fact expanding. Only then did Einstein abandon his cosmological constant ("My most serious blunder"), which is now being resurrected by cosmologists.

Didier de Fontaine
University of California, Berkeley

Virginia Trimble Comments

The "top ten" list printed in a recent APS news was never intended for this venue. It started as a press release, prepared for the 100th anniversary of the American Astronomical Society in 1999 (and so very strongly emphasized observations over theory). It was then recycled as a press release at the April APS meeting (at the request of those organizing the press briefings there). And, finally, an APS News editor asked permission to excerpt the material. The editor did, of course, edit. And perhaps I should have said "no." But it is good to know that I have at least three readers — this exceeds the average readership of a technical paper in most physics and astronomy journals by a factor of roughly four (according to the late Sam Goudsmit). And if any of them should be interested in what I have said about some of the topics in contexts other than press briefings, please take a look at the following:

"The Origin and Abundances of the Elements" *Rev. Mod. Phys* 47, 877 (1975)

"Cosmic Abundances: Past, Present, and Future" in S.S. Holt & G. Sonneborn, eds. *Cosmic Abundances* (ASP Conf. Ser. 99, 3, 1996)

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And the series of pieces in BeamLine that have been appearing in most issues since 1992 with titles like "The Solar Neutrino Problem and How We Know the Stars Run on Nuclear Energy"

VIEWPOINT…

Squeeze on Science

By Harold Varmus

In the latter weeks of this year's presidential race, both candidates voiced their support of efforts to double the budget of the National Institutes of Health. This is an encouraging sign that the current bipartisan enthusiasm for medical research will continue in the next administration. But it also offers an opportunity to make an important point about the kinds of science required to achieve breakthroughs against disease.

The NIH does a magnificent job, but it does not hold all the keys to success. The work of several science agencies is required for advances in medical sciences, and the health of some of those agencies is suffering.

For the coming fiscal year, Congress has again—magnanimously and appropriately—slated the NIH for a major increase, its third consecutive 15 percent increase. By these actions, Congress has shown that it is determined to combat the scourges of our time, including heart disease, cancer, diabetes, AIDS and Alzheimer's disease.

But Congress is not addressing with sufficient vigor the compelling needs of the other science agencies, especially the National Science Foundation and the Office of Science at the Department of Energy. This disparity in treatment undermines the balance of the sciences that is essential to progress in all spheres, including medicine.

I first observed the interdependence of the sciences as a boy when my father—a general practitioner with an office connected to our house—showed me an X-ray. I marveled at a technology that could reveal the bones of his patients or the guts of our pets. And I learned that it was something that doctors, no matter how expert with a stethoscope or suture, wouldn't have been likely to develop on their own.

Of course, the X-ray is routine now. Medical science can visualize the inner workings of the body at far higher resolution with techniques that sound dazzlingly sophisticated: ultrasound, positron-emission tomography and computer-assisted tomography. These techniques are the workhorses of medical diagnostics. And not a single one of them could have been developed without the contributions of scientists, such as mathematicians, physicists and chemists supported by the agencies currently at risk.

Effective medicines are among the most prominent products of medical research, and drug development also relies heavily on contributions from a variety of sciences. The traditional method of random prospecting for a few promising chemicals has been supplemented and even superseded by more rational methods based on molecular structures, computer-based images and chemical theory. Synthesis of promising compounds is guided by new chemical methods that can generate either pure preparations of a single molecule or collections of literally millions of subtle variants. To exploit these new possibilities fully, we need strength in many disciplines, not just pharmacology.

Medical advances may seem like wizardry. But pull back the curtain, and sitting at the lever is a high-energy physicist, a combinational chemist or an engineer. Magnetic resonance imaging is an excellent example. Perhaps the last century's greatest advance in diagnosis, MRI is the product of atomic, nuclear and high-energy physics, quantum chemistry, computer science, cryogenics, solid state physics and applied medicine.

In other words, the various sciences together constitute the vanguard of medical research. And it's time for Congress to treat them that way. Sens. Christopher Bond (R-Mo.) and Barbara Mikulski (D-Md.) have just proposed to double the budget of the National Science Foundation over five years. This admirable effort should be vigorously supported and extended to include the Department of Energy's Office of Science, which funds half of all research in the physical sciences and maintains the national laboratories that are central to biomedicine.

Scientists can wage an effective war on disease only if we—as a nation and as a scientific community—harness the energies of many disciplines, not just biology and medicine. The allies must include mathematicians, physicists, engineers and computer and behavioral scientists. I made this case repeatedly during my tenure as director of NIH, and the NIH has made significant efforts to boost its support of these areas. But in the long run, it is essential to provide adequate budgets for the agencies that traditionally fund such work and train its practitioners. Moreover, this will encourage the interagency collaboration that fuels interdisciplinary science. Only in this way will medical research be optimally poised to continue its dazzling progress.

Harold Varmus is president of Memorial Sloan-Kettering Cancer Center and a former director of the National Institutes of Health. He received the Nobel Prize in Medicine in 1989. The above article originally appeared in The Washington Post, October 4, 2000. Reprinted with permission.

Security Tightened at National Labs
—News Item

Referencing the Buttered Toast Problem

I thoroughly enjoyed the "Zero Gravity" column in the October issue of the *APS News*, which among other things points out that chicken tikka masala has a stronger affinity for carpets than buttered toast. But your readers may enjoy tracking down the seminal paper on toast by Held and Yodzis[1]. This paper not only purports to give a relativistic analysis of the buttered toast problem, but also provides a historical account of the origin of Murphy's Law.

Tevian Dray
Oregon State University

[1]A. Held and P. Yodzis, On the Einstein-Murphy Interaction, *Gen. Rel. Grav.* 13, 873-882 (1981).

Help for Displaced Scientists

For those of you who have been struggling to keep your job, wondering why you haven't had that hoped for physics career, or have been repeatedly downsized and are now being told that your PhD in physics makes you "over-qualified" for programming jobs — check out: http://www.zazona.com

This web site has been developed by a displaced engineer and contains hiring information of US companies who have used imported labor in the past five years. Sources include direct data from the US Department of Labor. The site is very user friendly. Check out the comments made by members of the US House and Senate about how these elected officials feel about American technical talent. Read the stories of other displaced US and foreign workers' stories of being laid off and downsized in this "great, robust US economy."

Dwight Walsh
Alumni, Brigham Young University

Assessment Tests Can Marginalize Science Education

Editor's note: This story was researched and written for APS News by Richard M. Todaro.

The release in October of a controversial report by the RAND Corp. think tank questioning the significant rise in test scores on the Texas state-wide assessment tests is the tip of a larger controversy over whether such assessment tests are inadvertently undermining the education of America's school children. While there is no shortage of strongly held opinions, available data indicates that US students today are doing about as well as they were in 1990, significantly better than around 1980 and, with a few exceptions, about the same as in 1970.

The RAND study was addressing the question of whether excessive test preparations are actually degrading classroom instruction by failing to improve genuine understanding in reading, writing, and math. Another, less well-known aspect of the controversy is the charge that science education is being neglected in order to prepare students for the tests in math and language arts.

Ted Schultz is the director of the Teacher-Scientist Alliance Institute, an educational outreach program run by the APS. He is a strong advocate of a "hands-on, inquiry-centered science" approach that he says allows students to "do" science rather than just memorizing and reciting. Schultz is also wary of some of the increased emphasis on state standardized tests.

"We work with about 60 school districts nationwide, and we are finding that a recent emphasis on math and language arts is driving teachers, schools and whole districts to increase the amount of time and professional development money allocated to these," Schultz says. "This collides head-on with our efforts to build new standards-based science programs."

Jerry Valadez is the K-12 science coordinator of the Fresno, Calif., Unified Public School District. He coordinates all science programs in the 80,000 student-strong school district, the fourth largest in California.

Valadez is also a major critic of California's current standardized testing with the Stanford Achievement Test -Version 9, known by its acronym SAT-9, because the state omits the science component of the test.

"'What matters is what is measured,'" Valadez says, quoting the old cliché. "Because science is not assessed in California, science is being somewhat marginalized as one of the core subjects."

Brenda Evans is also highly critical of her state's assessment test. Evans coordinates K-8 science education throughout North Carolina.

In 1994, North Carolina adopted an assessment program called ABC, an abbreviation of the buzz words "accountability," "the basics," and "local control." The ABC program only measures reading, writing and math skills. Evans believes that the high stakes nature of the test causes teachers to neglect science education even as the overall quality of education is degraded.

"Teachers are spending too much time teaching to the test that doesn't encourage real-world problem solving," Evans says. "Math teaching is shallow and by rote while science and social studies are suffering greatly. We have teachers who love teaching science but are told not to do so."

Michael Kestner also works for the North Carolina Department of Public Instruction, where he serves as the section chief for mathematics and science. He says there is simply not enough hard data to support the conclusions of critics like Evans.

"We are getting a lot of anecdotal evidence saying that there is less attention [being paid] to science [but] I don't think we have enough data to make any formal, concrete statements to say science is being neglected," Kestner says.

Although Kestner was referring to North Carolina, there is a great deal of US test score data that compare US students in different states. It is collected by the US Department of Education's statistical office, the National Center for Education Statistics, known by its abbreviation, NCES.

NCES has run a highly-regarded assessment program known as the National Assessment of Educational Progress (NAEP) since 1969.

The NAEP program conducts a yearly assessment of 9, 13, and 17 year olds in a series of subject areas, including reading, math, and science. A given subject area is assessed every two to four years. Dating back to 1969-1970, NAEP's long-term trend assessment has used the same methodology since its inception, and so measures progress in various subject areas over time. NAEP also conducts periodic, comprehensive assessments of all 50 states, providing a "cross-section" of how students are doing a particular time.

So what do the data show regarding science performance?

The 1999 NAEP trends report indicates that over the past 30 years, test scores among 9-year olds fell from 1970-1973, remained stable from about 1973-1982, and rose "significantly" thereafter until 1990. Scores have been stable ever since.

Among 13-year olds, scores fell from 1970-1977 and then rose "significantly" until 1992. Scores have fallen slightly since 1992, but are about where were in 1970.

Finally, among 17-year olds, test scores fell "significantly" from 1969-1982 and then rose "significantly" from 1982-1992. They have been relatively stable since, and are about where they were in 1973.

"It may be tempting to look at recent trends in NAEP science scores to see any effect of the increased emphasis on language arts and math testing," Schultz notes, "but the most recent national NAEP science assessment was done in early 1996, and the smaller long-term trend assessment was done in 1999, while the emphasis on language arts and math has been gathering strength only in the last two or three years. Thus, even for 9-year olds, the effects won't be visible until the reports on the national test in 2000 or the long-term test in 2003. For the two older age groups, it will take four or eight years longer and there will be other important variables that could obscure the effects."

Peggy Carr, the associate commissioner for assessment at NCES, says that while this trend assessment will be maintained, newer ones are being used.

"The newer assessment is a more contemporary one looking at what experts thinks kids should know and be able to do in today's society," Carr says. She adds that the 2000 science report will be released in September or October of 2001. It will provide more data to address the question of what effect state assessment tests are having on science education in the classroom.

Schultz cautions, though, that this will be possible for the elementary grades only in the small fraction of states that have standardized testing of science in those grades, and even then it will be difficult to disentangle the effect of such tests from other changes that will also be occurring.

zero gravity

The 2000 Ig Nobel Prizes

The 2000 Ig Nobel Prizes, presented for achievements that "cannot or should not be reproduced," were awarded at Harvard's Sanders Theatre on October 5 before 1,200 spectators, in a ceremony filled with hijinks, paper airplanes, and bubble wrap. The event was produced by the science humor magazine "Annals of Improbable Research" (AIR), and co-sponsored by the Harvard Computer Society, the Harvard-Radcliffe Science Fiction Association and the Harvard-Radcliffe Society of Physics Students. The evening also featured numerous tributes to the theme of "Intelligence," including a debate to determine which of the participants is the Smartest Person in the World, and the world premiere of "The Brain Food Opera, which starred Margot Button, Brian Nash, and the Nobel Laureates. William Lipscomb (Chemistry, 1976) was the prize in the annual Win-a-Date-With-a-Nobel-Laureate Contest. (To see a video recording of the entire ceremony, go to http://ignobel.org) Here are the new winners:

Psychology

David Dunning of Cornell University and Justin Kreuger of the University of Illinois, for their modest report, "Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments."

Literature

Jasmuheen (formerly known as Ellen Greve) of Brisbane, Australia, first lady of Breatharianism, for her book "Living on Light," which explains that although some people do eat food, they don't ever really need to.

Biology

Richard Wassersug of Dalhousie University, for his first-hand report, "On the Comparative Palatability of Some Dry-Season Tadpoles from Costa Rica."

Physics

Andre Geim of the University of Nijmegen (the Netherlands) and Sir Michael Berry of Bristol University, UK, for using magnets to levitate a frog and a sumo wrestler.

http://www.sci.kun.nl/hfml/frog-ejp.pdf

Chemistry

Donatella Marazziti, Alessandra Rossi, and Giovanni B. Cassano of the University of Pisa, and Hagop S. Akiskal of the University of California (San Diego), for their discovery that, biochemically, romantic love may be indistinguishable from having severe obsessive-compulsive disorder.

Economics

The Reverend Sun Myung Moon, for bringing efficiency and steady growth to the mass-marriage industry, with, according to his reports, a 36-couple wedding in 1960, a 430-couple wedding in 1968, an 1,800-couple wedding in 1975, a 6,000-couple wedding in 1982, a 30,000-couple wedding in 1992, a 360,000-couple wedding in 1995, and a 36,000,000-couple wedding in 1997.

Medicine

Willibrord Weijmar Schultz, Pek van Andel, and Eduard Mooyaart of Groningen, The Netherlands, and Ida Sabelis of Amsterdam, for their illuminating report, "Magnetic Resonance Imaging of Male and Female Genitals During Coitus and Female Sexual Arousal."

Computer Science

Chris Niswander of Tucson, Arizona, for inventing PawSense, software that detects when a cat is walking across your computer keyboard.

Peace

The British Royal Navy, for ordering its sailors to stop using live cannon shells, and to instead just shout "Bang!"

Public Health

Jonathan Wyatt, Gordon McNaughton, and William Tullet of Glasgow, for their alarming report, "The Collapse of Toilets in Glasgow."

Palestinian Visits: Irresponsible or Just Ill-timed?

On the front page of the October issue of *APS News*, we ran a story implying that it might be beneficial for members traveling in the Middle East to schedule visits to Palestinian universities on the West Bank, and we suggested our Director of International Affairs, Irving Lerch, as a useful point of contact for anyone interested in doing so.

The appearance of this article coincided with the recent renewed outbreak of hostilities between the Israelis and the Palestinians. We have had some private correspondence claiming that we acted irresponsibly in enticing our members into a dangerous situation. To clarify our position, *APS News* has interviewed Lerch, and we present some of his comments, based on his long experience in international scientific affairs.

AN: What was your intention in promoting these visits?

IL: The APS Executive Board and Council have among their constitutional responsibilities the dissemination of physics information for the health of the international physics enterprise. Insofar as this can be accomplished by promoting exchanges, we do.

AN: Wasn't it risky to advocate visits to the West Bank?

IL: We do not send colleagues into harms way. When a State Department advisory is issued we abide by it—as in the case of a canceled meeting in Colombia 2 years ago. I can assure you that no one will be encouraged to go to Ramallah in the near future nor will we ask APS members to risk their safety by traveling to Yemen or to any other part of the world where bullets and bombs have replaced civil discourse.

AN: Can APS members be confident that your advice in these matters will not get them into any dangerous situations?

Irving Lerch

IL: In this our record is pretty good. In my term as director of international programs, we have conducted more than 40 international meetings/workshops all over the world without the loss or injury of a single APS participant.

AN: How do you feel about the recent violence in the Middle East?

IL: On a personal note, the tragic events in and around Israel and the gulf are cause for reflection and mourning—not for the attempt to make debating points.

AN: Thank you, Dr. Lerch.

DPP Meeting, *from page 3*

The National Spherical Torus Experiment

Researchers presented some of the first physics results from the National Spherical Torus Experiment (NSTX), the new magnetic fusion device at the Princeton Plasma Physics Laboratory. In addition to the traditional way of driving the plasma current, the researchers are developing a new method for producing this current. Known as coaxial helicity injection (CHI), this technique involves injecting an electric current directly from coaxial circular electrodes inside the plasma chamber, in the presence of an applied magnetic field. The magnetic field causes the injected current to wrap many times around central column in its passage between the electrodes, so the current can be many times that injected.

The current loops formed during CHI have similarities to the coronal loops seen on the sun's outer surface during solar flares. These loops can become unstable and relax to a lower energy state through a process known as magnetic reconnection. In the case of the ST, this lower energy state is one in which some of the current flows on field lines which close on themselves inside the vessel to form a confined plasma core. Whereas the traditional technique can only produce brief bursts of plasma current in an ST, the CHI technique holds promise for helping them to operate continuously, as needed for a future fusion reactor.

—Compiled by AIP Public Information Division

Physicists Honored at Annual DPP, DFD Meetings

Six physicists were honored for their work in plasma physics and fluid dynamics in November. The 2000 James Clerk Maxwell Prize for Plasma Physics, Excellence in Plasma Physics Research Award and Outstanding Doctoral Thesis in Plasma Physics Award were presented during the annual fall meeting of the APS Division of Plasma Physics in Quebec, Canada (see story, page 3). The 2000 Otto LaPorte Award and Fluid Dynamics Prize and were presented during the annual fall meeting of the APS Division of Fluid Dynamics, held November 19-21 in Washington, DC (highlights to appear in January 2001 *APS News*).

2000 JAMES CLERK MAXWELL PRIZE FOR PLASMA PHYSICS

Akira Hasegawa
Kobe Womens University & Himeji Dokkyo University

Citation: "For innovative discoveries and seminal contributions to the theories of nonlinear drift wave turbulence, Alfen wave propagation in laboratory and space plasmas, and optical solitons and their application to high speed communication."

Hasegawa is a native of Japan. As a Fulbright scholar, he received his PhD from the University of California, Berkeley in 1964 on his work on plasma physics. In 1967, he received a Doctor of Science degree from Nagoya University. He was an associate professor at Osaka University until he joined Bell Laboratories in Murray Hill, NJ in 1968. He returned to Osaka University in 1991 as a professor of communications engineering. Upon retirement from Osaka University in 1998, Dr. Hasegawa was appointed research professor at Kochi University of Technology and as a consultant at NTT Science and Core Technology Laboratory Group. Hasegawa chaired the APS Division of Plasma Physics in 1990.

2000 AWARD FOR EXCELLENCE IN PLASMA PHYSICS RESEARCH

John J. Bollinger
National Institute of Standards & Technology

Daniel H. E. Dubin
University of California – San Diego

Citation: "For successful theoretical and experimental studies of trapped cryogenic plasmas, including precise characterization of plasma modes and crystal equilibria, and direct observation of structural phase transitions."

Bollinger received his PhD in atomic physics from Harvard University in 1981. He joined the Time and Frequency Division of the National Institute of Standards and Technology (NIST) on a National Research Council Postdoctoral Fellowship. In 1984 he became a permanent staff member the division and has been employed there ever since as part of a research group working on trapped atomic ions. Bollinger's research interests are focused on the use of stored-ion techniques for high resolution spectroscopy, time frequency standards, and the study of non-neutral plasmas.

Dubin received his PhD in 1984 under the supervision of John Krommes and Carl Oberman. In his thesis he derived a set of self-consistent Hamiltonian gyrokinetic equations for charged particle motion in a fusion plasma, and he examined statistical closure schemes applied to low-dimensional chaotic systems. Immediately afterwards, Dubin joined the nonneutral plasma group at the University of California, San Diego as a postdoctoral researcher.

2000 OUTSTANDING DOCTORAL THESIS IN PLASMA PHYSICS AWARD

Mark Christopher Herrmann
Princeton University

Citation: "With elegant use of analytical theory and computation, and insightful comparisons to experiment, this thesis lays the foundation for how radio frequency waves might cool fusion byproducts in a tokamak."

Herrmann graduated *cum laude* from Washington University with a BS in physics, a BS in Applied Science, and a MS in Systems Science and Mathematics in 1991. He enrolled in the graduate program in Plasma Physics at Princeton University with the support of a fellowship from the Fannie and John Hertz Foundation. His thesis work, which was done under the direction of professor Nathaniel Fisch, was completed in 1998. He is currently employed at Lawrence Livermore National Laboratory (X-division) where he is researching inertial confinement fusion.

2000 OTTO LAPORTE AWARD

Hassan Aref
University of Illinois

Citation: "For his pioneering contributions to the study of chaotic motion in fluids, scientific computation, and vortex dynamics, and most notably for the development of the concept of chaotic advection."

Aref holds a cand. scient. degree from University of Copenhagen, and a PhD from Cornell University, both in physics. He was a faculty member at Brown University 1980-1985 and at University of California, San Diego 1985-1992. From 1989-1992 he was chief scientist at the San Diego Supercomputer Center. He assumed his current position of professor and head, Department of Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign, in 1992. Aref's main field of research is fluid mechanics. He is particularly well known for introducing and naming the mechanism of "chaotic advection."

2000 FLUID DYNAMICS PRIZE

Friedrich Hermann Busse
University of Bayreuth

Citation: "For his seminal and extensive contributions to the understanding of instabilities in convective and rotating flows, for his development of upper-bound theories and their application to complex fluid flows, and for his use of fluid mechanics to elucidate geophysical and astrophysical problems."

Busse is a native of Germany. He received his PhD in theoretical physics in 1962 from the University of Munich. He was a scientific assistant at the Institute for Theoretical Physics at the University of Munich until 1965 when he moved to the United States where he was a research associate in the Department of Mathmatics at MIT. A year later he moved to UCLA where he was an associate research geophysicist before moving back to Germany as a scientist at the Max-Planck-Institute for Physics and Astrophysics in Munich. In 1970 he returned to UCLA where he became a full professor in 1973 and worked as a member of the Department of Earth and Space Sciences and the Institute of Geophysics and Planetary Physics. In 1984, Dr. Busse assumed the position of Professor for Theoretical Physics at the University of Bayreuth where he remains today.

DNP Meeting, *from page 3*

production and fuel consumption. In addition, this cycle provides an important constraint for the crust composition of accreting neutron stars, limiting it to light *p* nuclei. According to Schatz, knowledge of the neutron star crust composition is crucial to resolve such open questions as the evolution of magnetic fields; the possibility of gravitational wave emission from a deformed, rotating neutron star; or the possibility of distinguishing neutron stars and black holes by observing thermal radiation from the star crust during the off-state in transient systems.

The Future of Nuclear Physics

The DNP meeting also featured a special plenary session on future directions in nuclear physics. Walter Henning of the University of Frankfurt in Germany summarized the status of rare isotope physics, in which intense beams of unstable short-lived nuclei are providing scientists with new opportunities for studying the nuclear many-body system and fundamental symmetries and interactions, as well as answering some vital questions in nuclear astrophysics. Wick Haxton of the University of Washington's Institute for Nuclear Theory discussed numerous remaining opportunities for testing the predictions of the standard model using electroweak interactions, and for seeking signs of new physics beyond the standard model. Finally, Argonne National Laboratory's Donald Geesaman reported that several new experimental tools have been developed over the last decade that hold considerable promise for resolving some of the outstanding issues in spin-flavor physics, including the quantitative contribution of the glue to the nucleon's spin, which is still under debate.

Coalition, *from page 2*

used to evaluate the potential impact of climate change. A third newsletter item reported on the first precise measurements of the Greenland Ice Sheet, which indicate that its edges are melting at a rate of one million cubic feet per year, although the study only compares measurements carried out in 1994 and 1999, and hence it is unclear whether the recent melting is indicative of a long-term trend, or whether it is the result of global warming.

The second issue of *Climate Focus* was mailed on November 1, and Slakey reports that the program is currently reaching 39 of the targeted 50 offices, in addition to key committee staff. He expects to be reaching all 50 targeted offices by February 2001. Feedback from the Hill has been encouraging, he says, and the newsletter will become a two-story monthly publication. The entire pilot program will be evaluated after one year to determine its effectiveness, and whether to discontinue it, continue in its present format, expand the target list, or broaden the goal to include legislative advocacy in addition to the present goal of providing accurate information to Congress.

Nobel, *from page 1*

In addition, the discovery of conducting polymers provides a foundation for the development of molecular computers, in which electrically conducting molecules act as the building blocks of computing devices.

The 2000 Nobel Prize in Medicine shares a theme similar to the two Nobels awarded today—whereas the physics prize celebrates silicon circuits, and the chemistry prize recognizes plastic circuits, the medicine/physiology prize cites neural circuits, a topic which is of great importance to physicists alongside many other types of scientists. The prize went to Arvid Carlsson (University of Gothenberg, Sweden), Paul Greengard (Rockefeller University), and Eric Kandel (Columbia University) for their discoveries concerning the transmission of chemical signals in the nervous system.

The brain has about 100 billion nerve cells; messages from one cell to another get relayed at in-between points called synapses. The three researchers made discoveries in one type of communication, known as slow synaptic transmission, involving chemical signals that alter nerve cell function for periods ranging from seconds to hours. Carlsson, for one, identified dopamine as a transmitter in the brain and realized its importance for controlling movements; this research has led to drugs for Parkinson's disease.

Understanding signal transmission in the body has become a major area of physics research. For example, chaos researchers have been striving to elucidate and control the electrical patterns that lead to disorders such as epilepsy. In another example, new research shows that the tree-like structures called dendrites, which feed a nerve cell with information, send out stronger signals the farther their distance from the nerve cell's main body, or soma; that's because dendrites lack insulating material and act like leaky wires which must compensate for lost electrical charge.

—Philip P. Schewe, AIP Public Information

New Fellowship in the Washington Office

This fall, the APS Office of Public Affairs launched a new fellowship that gives a physicist the opportunity to spend a year in the APS Washington Office gaining hands-on experience in science policy work.

The first fellow is Christina Hood, a recent PhD graduate from CalTech. She says her training in quantum optics provided some background for politics, "From the outside, political events sometimes seem illogical — but make more sense when you look for underlying connections." Though unlike quantum mechanics, "politics is driven by hidden variables," she added.

During her tenure as Public Affairs Fellow, Hood will focus on increasing the grassroots involvement of APS members in science policy through congressional visits and action networks, and on lobbying for K-12 science education funding.

Christina Hood

ANNOUNCEMENTS

New APS Prize in Gravitational Physics

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

The prize was established to recognize outstanding achievements in gravitational physics, both theoretical and experimental. The APS is planning to name it the Einstein Prize in Gravitational Physics.

Please give generously to support this new APS Prize!

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

APS Mass Media Fellowship Program

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

DEADLINE: JANUARY 12, 2001

APS Council and Committee Position Nominations

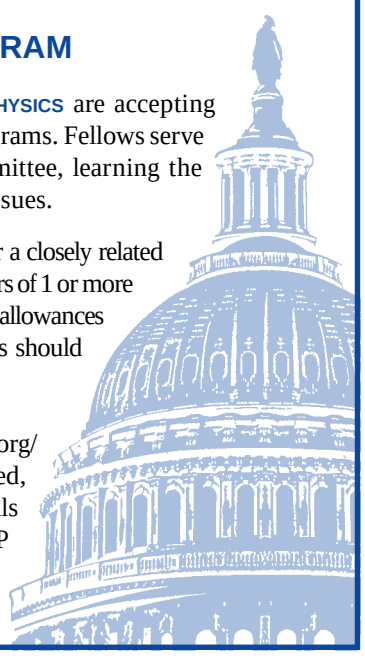
VICE-PRESIDENT; GENERAL COUNCILLOR (2); NOMINATING COMMITTEE; Vice-Chairperson-Elect • Members; PANEL ON PUBLIC AFFAIRS; Vice-Chairperson-Elect • Members

Please send your nominations to: American Physical Society; One Physics Ellipse; College Park, MD 20740-3844; Attn: Ken Cole; (301) 209-3288; fax: (301) 209-0865; email: cole@aps.org. A nomination form is available at www.aps.org/exec/nomform.html. **DEADLINE IS JANUARY 31, 2001.**

Correction

In our story on the new PhysTEC education program in the October issue, we incorrectly referred to the University of Western Michigan. The correct name of this institution is Western Michigan University. *APS News* regrets the error.

APS/AIP 2001-2002 CONGRESSIONAL SCIENCE FELLOWSHIP PROGRAM



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

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

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

2000 Year-End Gift Ideas: Help Physics Programs

Support science education, shape national science policy and promote international collaboration by making a contribution to the American Physical Society.

APS membership dues cover the cost of member benefits, services and publications. APS research publications and meetings are budgeted to pay for themselves through subscriptions and registration fees. However, important APS education and outreach programs rely in part on tax-deductible member contributions to maintain and broaden their impact. These vital outreach programs were instituted by the APS Council in direct response to member requests and committee recommendations.

Additional resources are needed to continue to strengthen our education, public affairs and international programs. Many members make a voluntary contribution in conjunction with renewing their APS membership each year and gifts can be designated to specific program areas, if you so desire. If you haven't yet made a gift this year, or if you would like to provide further support, here are some 2000 year-end gift ideas:

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• *Gifts of stock*. Gifts of appreciated stock allow you to avoid paying capital gains tax on the increase in stock value and receive an income tax charitable deduction for the full fair market value of the stock at the time of the gift. The gift is fully deductible — up to a maximum of 30 percent of your adjusted gross income. Any excess can generally be carried forward and deducted over as many as five subsequent years. Please call the APS Development Office at (301) 209-3224 to obtain transfer of stock instructions.

As you consider your year-end tax planning, we hope you will consider making good use of the income tax charitable deduction. Your 2000 year-end gift can significantly reduce your income taxes, while providing meaningful support for the APS.

For further information on these and other ways to give, contact Darlene Logan, director of development, APS, One Physics Ellipse, College Park, MD 20740-3844; (301) 209-3224; fax: (301) 209-0867; email: logan@aps.org.

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Apker, *from page 1*

and graduating physics or astronomy major who has performed at the highest level in both course work and research. Krich is currently attending Oxford University in England as a Rhodes Scholar studying mathematics, and plans to pursue graduate study in experimental condensed matter physics at Harvard University when he returns to the US.

Lynch came up with the idea for her award-winning thesis independently after reading an article in *Physical Review Letters* on superconducting nanoparticles. According to department chair Curtis Callan, she "had an overwhelming curiosity" to understand the complex interplay between spin-polarized tunneling and finite-size effects in a metallic nanoparticle doped with a magnetic impurity. She learned the required experimental techniques, including nanofabrication and low temperature low noise measurements, and did so with minimal supervision.

Lynch's research results gave her the opportunity to present a talk at the 2000 APS March Meeting in Minneapolis, and at the meeting of the Materials Research Society in April in San Francisco. She also received the Undergraduate Materials Research Society Initiative Award for her work, as well as Princeton's "Shenstone" prize honoring the most outstanding senior experimental thesis in the Physics Department. Lynch is currently pursuing graduate studies at Harvard University under a fellowship from Lucent Technologies.

Oliver's award-winning thesis research on 3D Raman sideband cooling at high density was one of several laboratory experiments he performed as an undergraduate. He achieved the highest laser-cooled phase space density to date, according to his thesis advisor, David Weiss, and his results should enable a host of future experiments, including quantum entanglement in an optical lattice, and studies of cold gases in reduced dimensions. As one of six team members, Oliver carried out some critical calculations that helped the team redesign their technique during the course of the experiment, and also took the lead in implementing several modifications to the experiment's complex beam timing and control. Oliver received UCB's Departmental Citation for his work, the highest honor for an undergraduate, and is pursuing his graduate studies there.

End of an Era, *from page 1*

administered by the Treasurer's Office, and Lustig assumed that responsibility as part of his APS duties. He continued his association upon his retirement from the APS at the suggestion of then-APS associate executive officer (and former *APS News* editor) Barrett Ripin.

Lustig admits he will miss the opportunity to read such excellent physics research work, and to meet so many brilliant young physicists, but says he believes the committee should consist primarily of those who are active in physics research. "It's a wonderful experience and really shows that physics is in good hands," he says of his committee service. As his next projects, he will be reviewing the 4,500 new physics entries in the latest edition of the Oxford English Dictionary, and will be teaching a course on solar energy at the University of New Mexico.

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Vermeer's Camera

By Philip Steadman

For more than a hundred years it has been suggested that the great Dutch master Johannes Vermeer (1632-75) made use of the camera obscura as an aid to painting. The camera obscura ('dark room') was the predecessor of the photographic camera. It is a simple optical device incorporating a pinhole or — from the 16th century onwards — a lens, with which an image of a scene can be projected onto a screen. The image can then be traced and copied. Some early camera obscuras took the form of blacked-out booths, tents or rooms (hence the term) in which the observer was enclosed. Later versions took the form of small boxes like photographic plate cameras or reflex cameras. Medieval and early modern astronomers used the camera for observing the sun without damaging their eyes. Leonardo da Vinci was the first person to suggest possible uses in art, and by the early 17th century the camera was being described in perspective manuals intended for architects and painters.

It was the American etcher and lithographer Joseph Pennell, writing in the *Journal of the Camera Club* in 1891, who first speculated that Vermeer might have used some optical aid. Since then the idea has been taken up again and again, notably by the painter Lawrence Gowing in his beautiful monograph *Vermeer* (1952), and the art historian Svetlana Alpers in *The Art of Describing* (1983), among many others. This belief does not however rest on any documentary evidence. Very little is known about Vermeer's life other than what can be gleaned from official records, and we do not know whom he studied under or who his pupils were, if indeed he had any. No drawing by his hand has survived. The belief is based rather on certain properties of the paintings themselves.

Pennell drew attention to the 'photographic perspective' of certain pictures such as *Officer and Laughing Girl*, in which the figure of the soldier is very close to the painting's viewpoint and appears disproportionately large. Other writers have pointed to the way in which Vermeer seems to reproduce in paint some idiosyncrasies of optical images and 'out-of-focus' effects, that would be visible on the camera's screen but not to the naked eye. One example is in his treatment of *highlights*: reflections of sources of light off shiny surfaces such as metal, ceramics or polished wood. When Vermeer was painting indoors, by north light, the illumination would have come from the windows, whose reflections as highlights would have been rectangular in shape — perhaps distorted when seen on curved surfaces like those of glasses or jugs. However Vermeer uses blobs of light-colored pigment to represent these as perfect circles. It has been suggested that he is copying here from slightly unfocused images, in which small bright patches of light are spread by the lens into 'discs of confusion'. In other places Vermeer renders certain details — the skeins of thread in *The Lacemaker*, sculptured brass lions' heads on the backs of chairs — in a particularly loose and schematic style, which is 'photographically' true to tone and hue, but nevertheless lacks sharpness or precise outline.

Scholars have discussed who might have been the source of Vermeer's knowledge of optics and lenses — although it has to be said that there are absolutely no documents to support any of these speculations. The names of the painters Carel Fabritius and Samuel van Hoogstraten have been mentioned. Both men were fascinated by perspective illusion and *trompe l'oeil*, and van Hoogstraten wrote of seeing cameras on several occasions. He had met with Jesuit scholars and tried out their optical instruments at the Imperial Court in Vienna in the 1650s. Vermeer possessed canvases by both men, a fact that suggests he knew them personally. Otherwise the main candidate for the role of Vermeer's 'optical consultant' is Anthony van Leeuwenhoek, the pioneer of microscopy and the first man ever to observe protozoa and bacteria. Vermeer and Leeuwenhoek were exact contemporaries and lived a few streets apart in Delft, not a big town. What is more, when Vermeer died in debt, Leeuwenhoek was appointed by the town's Aldermen as the curator of his estate, a fact that some historians have interpreted as evidence of a friendship. It has even been suggested that Leeuwenhoek was the sitter for Vermeer's two 'scientific' paintings of scholars in their studies, *The Astronomer* and *The Geographer* (see illustration). Both bear curious resemblances to known portraits of Leeuwenhoek — although the identification remains controversial.

It is worth mentioning a couple of further scraps of biographical information about Vermeer. He is known to have received two distinguished visitors in Delft, who are usually described in the context as connoisseurs of painting, but who also had extensive connections in the world of European optical science. One was Constantijn Huygens, secretary to the Prince of Orange and father of the astronomer Christiaan. The second was the French diplomat Balthasar de Monconys, who made significant developments in

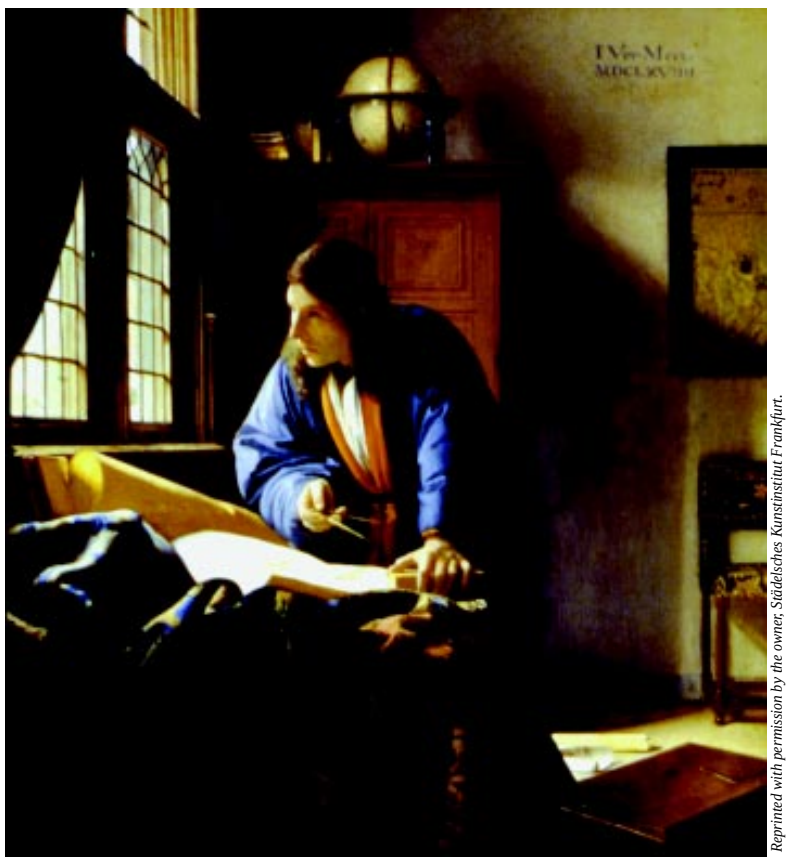
Rijksmuseum, Amsterdam

Portrait of Anthony van Leeuwenhoek by Johannes Verkolje (1686).

the design of microscopes. Huygens and Monconys were sufficiently prominent in this field to be received together at a meeting of the Royal Society in London in 1663. Both knew about the camera obscura, indeed Huygens himself possessed a portable instrument that he bought in London in the 1620s and took back to show to his artist friends in Holland. (Whether Vermeer was among them we do not know.)

I have approached this old subject from a new direction: via the perspective geometry of the pictures. Vermeer produced more than two dozen paintings of domestic interiors with one, two or three figures. A few of them depict distinctive and unique spaces. But the majority seem to show just a few rooms repeatedly, with sitters and furniture rearranged. It is possible to draw some tentative conclusions about how many rooms might be involved, by making an inventory of their architectural features: floor surfaces, wooden ceilings, some very characteristic decorative patterns of leading in the window panes. As many as ten pictures appear — with a few anomalies — to represent the very same room. I have tested this possibility more rigorously, by reconstructing the geometry of the spaces of the paintings through a process that, in effect, reverses the conventional method for setting up perspective views. It is possible to do this for paintings, like Vermeer's, that show rooms whose floors are tiled. The actual dimensions of the spaces, and the shapes and sizes of pieces of furniture, can all be calculated with some precision. This is because Vermeer depicts a number of recognizable objects — chairs, Delftware tiles, musical instruments, wall-maps and paintings by other artists — which all survive in museums today and whose sizes are therefore known. It turns out that the ten paintings do indeed depict a single room whose dimensions are broadly consistent throughout.

In one painting, *The Music Lesson*, Vermeer includes a mirror that reflects his own vantage point and a small part of the back



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Johannes Vermeer van Delft's "The Geographer"

wall behind him, not otherwise visible in any picture. This evidence provides a measurement for the overall length of the room. The dimension is nicely compatible with the width in plan of both of the houses in which it is believed Vermeer may have had studios: the inn called Mechelen on the Market Place owned by his family, and a house nearby owned by his mother-in-law Maria Thins. It is my belief that the room in the pictures in question was in fact in Maria Thins's house.

How does all this relate to the camera obscura? The perspective reconstructions make it possible to plot the positions in space of the theoretical viewpoints of the ten relevant paintings. Everything that can be seen in each picture is contained in a 'visual pyramid' (a pyramid on its side), whose apex is at the viewpoint. Suppose that the sloping edgelines of this pyramid are extended back, through the viewpoint, to meet the room's back wall. They define a rectangle on that wall. In six out of the ten cases this rectangle is the exact size of Vermeer's painting. The geometry is that of a booth-type camera, with its lens at the painting's viewpoint and the screen on the wall. The image is the same size as Vermeer's canvas because he has traced it. The image would have been upside down, and might have been reversed left-to-right. But there are several ways — including optical ways — in which Vermeer could have reversed the image, all of them reasonably practicable and straightforward. Some writers have argued that Vermeer constructed his perspectives mathematically, or that he used mirrors or other mechanical aids to painting. But it is difficult to see how these could account for the very curious results shown by the geometrical analysis, that are so readily accounted for by the camera hypothesis.

I have had a one-sixth scale physical model made of the room, with a photographic plate camera in the place of Vermeer's camera obscura. Using this it has been possible to create photographic simulations of the paintings, and test phenomena such as the patterns of light and shadow, all of which Vermeer reproduces — in general — with great fidelity. Recently a team in California led by Jonathan Erland has been building a 3D computer model, that should provide a more flexible tool for experiment. The BBC built a full-size reconstruction for a television film, with a booth-type camera incorporating a simple bi-convex lens of 10 cm diameter. This cast an image of *The Music Lesson*, at full size, onto a translucent screen, that was quite bright enough to film. These experiments have served to test the basic geometrical findings of the perspective reconstructions, and have shown the feasibility of casting images at the sizes of Vermeer's canvases using very modest optical technology. What has long been suspected — that Vermeer was a camera user — is now confirmed.

Philip Steadman is a professor of architecture and town planning at University College London. His book Vermeer's Camera, the product of twenty years' fascination with the painter, will be published by Oxford University Press in February 2001. More details will be available at http://www.vermeerscamera.co.uk

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.