APS NEWS

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APS Members Elect Hopfield as New Vice President in 2004 General Election

APS members elected John Hopfield, the Howard A. Prior Professor of Molecular Biology at Princeton University, as the new APS vice president in the 2004 general election. Hopfield will take office January 1, 2005. In 2006 he will become president-elect, assuming the mantle of APS president in 2007. The APS president for 2005 will be Marvin Cohen of the University of California, Berkeley.

In other election results, the University of Chicago's Thomas Rosenbaum was elected chair-elect of the APS Nominating Committee, which is responsible for proposing a slate of candidates each year for the Society's general election. Ann Orel of University of California, Davis, and Lucent Technologies/Bell Laboratories' Richart Slusher were elected as general councilors. Also approved was an amendment to the APS Constitution, slightly modifying the mechanisms for the formation and termination of topical groups.

Kenneth Cole, Special Assistant to the Executive Officer, described the 2004 election as "the easiest and smoothest in the four years since we have been offering online voting." In addition to saving the Society a great deal of money in mailing costs, the online voting option has proven overwhelmingly popular with members: 91% of all those who voted did so online. Those few remaining members who prefer paper ballots can request them. The percentage of APS members voting was 22.8%, slightly higher than in 2003, but below the all-time high of 24.9% in 2002. Before the online voting option was offered, the percentage of members voting hovered between 18% and 20%.

VICE PRESIDENT

Hopfield was born into a physics household in the midst of the Depression. His father had taken a one-year position helping set up the physics exhibit at the Chicago World's Fair. His mother had met him when they were both graduate students in physics at Berkeley. "The culture of the household was that anything physical could and should be observed, measured, taken apart into its components, understood (if necessary even repaired) and that joy, deep satisfaction, and new technologies could all come with successes in this process," he said.

Hopfield received his PhD from Cornell in 1958. He joined the theoretical group at Bell Laboratories for two years, and began his teaching career in the physics department at Berkeley in 1961. In 1964 he re-

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Quinn Holds Summit Meeting With President of Vietnam

The President of Vietnam is 5th from the left, and Helen Quinn is 6th from the left, in the front row.

By Ernie Tretkoff

APS President Helen Quinn traveled in early August to Vietnam, where she attended a scientific conference and met the President of Vietnam.

Quinn attended the 5th Rencontres du Vietnam, a particle physics and astrophysics meeting in Hanoi. While she was there, she visited with the leadership of the Vietnam Physical Society, and talked about the relationship between the societies.

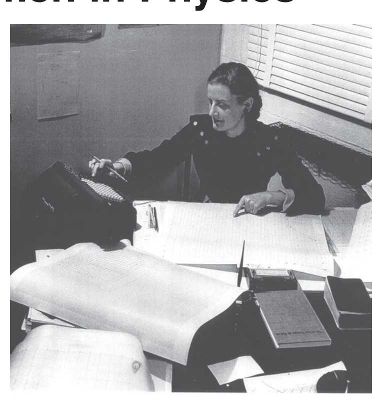
Some of the conference attendees were invited to meet with the President of Vietnam, Tran Duc

See QUINN *on page 3*

APS Establishes M. Hildred Blewett Scholarship for Women in Physics

The APS has been designated the primary beneficiary of a bequest of over $1 million from M. Hildred Blewett, an accelerator physicist who died in June. Blewett left nearly everything she had to APS for a scholarship for women in physics.

The scholarship will be known as the M. Hildred Blewett Annual Scholarship for Women in Physics. Eligible candidates will be women who have had to give up doing research for a time but would like to resume their careers, women who wish to change the area of their work, and recent postgraduates who are in their first academic position and need financial support to establish themselves. Additional information will be available in 2005 when APS solicits applications for the first scholarship.



Hildred Blewett, in the days when a computer was a person, not a machine.

While signing the will shortly before she died, Blewett said, "Everything I have came from physics, so everything has to go back to physics," recalled Frank Malinka, Blewett's financial advisor.

Blewett was born in Ontario on May 28, 1911. She began her career in physics working at General Electric in Schenectady, New York, in the 1940s, where she developed a method of controlling the pollution from smoke from factory chimneys. In 1947 she and her then husband, John Blewett, were among the original team members at Brookhaven National Laboratory. Hildred Blewett later worked at Argonne National Laboratory, and then at CERN. She retired from

See BLEWETT *on page 4*

Quinn Receives State Department Response on Improved Visa Process

APS President Helen Quinn received a letter in September from Maura Harty, Assistant Secretary of State for Consular Affairs, in response to her signing a joint statement on the need to streamline the visa process.

Harty indicated that new procedures arranged with the Department of Homeland Security and other Federal agencies have now reduced visa processing time. "As of September 2, 98% of all Visas Mantis cases are being cleared in less than 30 days," she wrote. "More than 2000 on-going cases were just cleared." The State Department has also recently begun posting visa appointment wait times on the Internet. See http://www.travel.state.gov.

In May, the APS joined more than 20 other science, higher education and engineering organizations in developing a joint statement urging the federal government to adopt six practical recommendations for improving the current visa processing crisis by removing unnecessary barriers to multinational collaborations. (See *APS News*, July 2004. Full text of the statement is available at: http://www.aps.org/statements/03_1.cfm

Taken together, the group represented 95% of the US research community. It was the first time that US science and academic leaders have endorsed a compre-

See VISA *on page 6*

Despite reported improvements, the APS continues to encourage all visa applicants to apply at least 3-4 months ahead of time. If an applicant has not received a visa within 30 days since the visa application, the applicant should visit the National Academy of Sciences visa website at http://www.nationalacademies.org/visas/

Fill out the "Visa Questionnaire" (4th link down in the list on the right hand side of the page). Once the questionnaire is completed, NAS staff review the information each week **to identify visa applications that are still pending 30 days past the initial application date.**

This is quite helpful, since once each week **every** case that has been pending over 30 days is now reported by the NAS to the State Department. If the case is not resolved the following week, the NAS continues to report it again each week until the case is resolved one way or another. The State Department also communicates each week to the NAS regarding which cases they have resolved.

This system helps make sure that the State Department is aware of those cases that have been significantly delayed, and also helps to make sure they don't "fall through the cracks." While this process doesn't guarantee US Government action, it guarantees visibility to pending applications.

Apker Award Finalists

Photo Credit: Shelly Johnston

The Apker Award is given annually to two students for outstanding research as an undergraduate. One award is for a student at an institution granting a PhD degree; the other goes to a student at an institution that does not grant a PhD. The recipients are chosen from six finalists, three in each category, who assemble in Washington in September for a day of interviews with the selection committee. Shown here after the long day of interviews had ended are: (l to r): Nathan Hodas (Williams College); Joseph Checkelsky (Harvey Mudd College); Yuk-yan Lam (MIT); Ibrahim Cisse (North Carolina Central University); Matthew Pysher (Colgate University); and Jonathan Heckman (Princeton University).

Highlights

7 Zero Gravity
Haiku winners

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Rembering Oppenheimer: The Teacher, The Man
By Edward Gerjuoy

Members in the Media

"If Los Alamos really was a bunch of arrogant… cowboys, they would appear to have a safety record and incidents safety violations twice as high as anyplace else or, you know, way out of the statistical clouds, and that wasn't the case."
—Brad Holian, Los Alamos National Laboratory, on safety and security at LANL, National Public Radio (NPR), September 20, 2004

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"Usually when people cite a work, it's because they found it useful. I'd say that this is something that I'd want to list among my major achievements."
—John Perdew, Tulane University, on having written the world's most cited physics paper, Times-Picayune (New Orleans), September 20, 2004

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"I'm sitting in my kitchen looking at this large collection of cells put together into this amazing thing called a cat. What is the difference between a cat and a crystal of salt, which also is the product of self-assembly?"
—George Whitesides, Harvard University, on self-assembly, Dallas Morning News, September 5, 2004

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"The Telescope Array experiment is meant to help solve the puzzle of the origins of ultra-high-energy cosmic radiation. We don't know where they are coming from. We don't know why they are here."
—Pierre Sokolsky, University of Utah, Salt Lake City, on cosmic rays, Knight Ridder Newspapers, August 30, 2004

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"There was a big pit in my stomach. This just wasn't supposed to happen. We're going to have a lot of work picking up the pieces."
—Roger Wiens, Los Alamos National Laboratory, on the crash of the Genesis space capsule, Associated Press, September 8, 2004

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"The science fiction aspect ... is not enough to justify doing this, but it doesn't hurt."
—Jeffrey Hangst, CERN, on producing anti-atoms, The Dallas Morning News, September 19, 2004

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Two quotes from Russell Hulse in the Dallas Morning News, September 19, 2004:

"My first reaction was not 'Eureka!,' but rather 'Nuts, what's wrong?' "

(on his discovery of a pair of pulsars orbiting each other)

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"Science was never a career to me, but a way of life. If you can give that to kids, it's a wonderful gift."

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"I wondered why hasn't anyone written a book about the science of football. It seemed to me that was odd because there's every bit as much physics in football as in baseball."
—Timothy Gay, University of Nebraska-Lincoln, on the physics of football, Pittsburgh Post-Gazette, October 4, 2004

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"For people like me that choose to work in this field, enhancing our knowledge is the payoff. And these scientific breakthroughs are really our payoff, and everybody that does basic research does it because it's a lot of fun."
—Deborah Jin, NIST, National Public Radio (NPR), September 28, 2004

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"The theorists will be surprised, but they do not exclude such a possibility."
— Moses H. W. Chan, Penn State, on having produced supersolid helium, The New York Times, September 21, 4004

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"I have written at least one paper in the remote past about the possibility of supersolid behavior. I would have bet at least 100 to 1 against it."
—Anthony Leggett, University of Illinois, on supersolid helium, The New York Times, September 21, 2004

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Quotes about the 2004 Nobel Prize in Physics:

"I was in the shower. I hadn't slept all night because I was just too nervous. And my wife answered the phone. I stepped out of the shower soaking wet, and I started listening to the people congratulating me. It was lovely. Then I called up my parents right away."
—Frank Wilczek, MIT, on receiving the phone call informing him he'd won the Nobel Prize, NPR, October 5, 2004

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"One of my colleagues at the time said, 'David, this is a great thing you've come up with, and a great theory, but it will never be proven.'"
—David Gross, University of California, Santa Barbara, Washington Post, October 6, 2004

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"What they provided us was a lovely insight, and a surprising one, into the fundamental nature of matter."
—Sylvester James Gates, University of Maryland, USA Today, October 6, 2004

See* MEDIA *on page 7

This Month in Physics History

November 25, 1975: Patent for Full-body CAT Scan

When British physicist Wilhelm Roentgen accidentally discovered x-rays cast by his cathode ray tube in 1895, the phenomenon quickly found practical application in medical imaging and diagnostics. It would be another 80 or so years before x-rays were harnessed in a new, improved form of diagnostic imaging: *computer-assisted tomography, or CAT scanning.*

In a CAT scan, the x-ray tube and detector rotate around the patient, capturing images of each cross-section of the body or organ under examination. A CAT scan uses crystal detectors that emit signals when struck by x-rays, which are stored and analyzed in a computer. The result is a 3-D image of the body part.

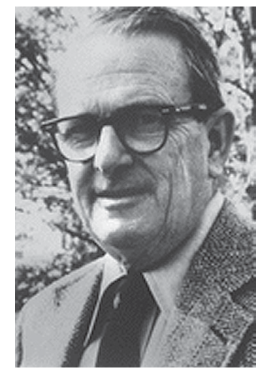
The two men credited with the CAT-scan's invention are Allan Cormack and Godfrey Hounsfield, who shared the 1979 Nobel Prize in Physics for the discovery.

A native of South Africa, Cormack became interested in astronomy as a teenager, and chose to study math and physics because they were essential to a career in astronomy.

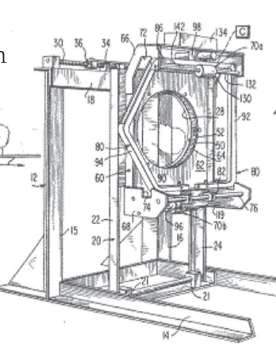
Career prospects for astronomers weren't good, so he studied electrical engineering instead at the University of Cape Town. Within two years his interests had reverted to math and physics; he eventually earned bachelor's and master's degrees in physics.

He worked at Cambridge University's famed Cavendish Laboratory before returning to his alma mater as a faculty member. Much of his research was in nuclear physics; he became interested in what is now known as CAT-scanning in 1956.

Cormack provided the theoretical framework for CAT scans, analyzing the conditions for demonstrating a correct radiographic cross-section in a biological system, which was published in two papers in 1963 and 1964, respectively. His results didn't initially garner much attention; it wasn't until 1970 that other developments in the field caused him to devote more sub-stantial efforts to that area. Cormack understood that it was basically a matter of finding a two-dimensional mathematical function to relate the observed transmission to the varying absorption as the x-rays pass through a cross-section. Although others before him had deduced similar methods of calculation, Cormack was the first to state the basic principles for reconstructing a cross-section of organ tissue. He also foresaw that solving this problem would open up radiotherapy and imaging diagnostic applications in medicine.



Allan Cormack



Patent drawing for Ledley's full-body machine.

Godfrey Hounsfield

Building a practical machine became the purview of Hounsfield. He grew up in the English countryside on a farm, the youngest of five children, and early on evinced a fascination with all things mechanical on the farm: the threshing machines, the binders, and generators.

During his teenage years he started doing his own experiments, building electrical recording machines, and investigating the principles of flight by launching himself from the tops of haystacks with a homemade glider. And he very nearly blew himself up while experimenting with water-filled tar barrels and acetylene to see how high he could propel the waterjet.

In school, he excelled primarily in math and physics. When World War II broke out, he joined the Royal Air Force, driven by his love of aeronautics. He eventually passed a City and Guilds examination in radio communications at the Royal College of Science and, later, the Cranwell Radar School. And he also built a large-screen oscilloscope and demonstration equipment as instruction aids.

After the war, he earned a bona fide degree from the Faraday House Electrical Engineering College in London. He joined the research staff of EMI in 1951, working on radar and guided weaponry, and on computers, which were then in their infancy.

After transferring to EMI's Central Research Laboratories, Hounsfield proposed a project on automatic pattern recognition. This work led, in 1967, to the idea that became known as computer-assisted tomography.

In his Nobel Prize autobiography, he recalled the many frustrations and technical hurdles he had to overcome to produce the first clinical brain-scanner—including traveling across London by public transport carrying bullock's brains for use in an experimental scanner in the lab.

Computer tomography was first used to take images of the skull, for study of diseases of the brain. A whole-body version of the CAT scan was invented by Robert Ledley, a professor of physiology and biophysics at Georgetown University.

Ledley received a patent for that device in November, 1975. Since then, CAT scans have become a mainstay of the medical profession, and not just for imaging the brain or specific organs. It has also been used to monitor effects of radioactive treatment of cancerous tumors.

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Science and Art Flow Together In Upcoming Conference

By Ernie Tretkoff

Many scientists recognize the artistic quality of their images, and many artists are inspired by science. As part of a growing movement to bring those two groups together, the fourth Science and Art symposium (ScArt4) will be held June 9-12, 2005 in New Brunswick, NJ.

The ScArt4 meeting will focus on fluids and waves, including waves in engineering, geophysics, astrophysics, and biology. Artists will present creations that use or were motivated by fluid and wave science. "It turns out that aside from fractals, fluid dynamics makes the nicest pictures—that and astronomy," said conference organizer and fluid physicist Norman Zabusky.

Engineers and scientists will emphasize the imagery of their work, and try to answer questions such as how they visualize their discoveries, and how they produce "art" from visualizations, observations and numerical simulations. Visual artists will discuss how they use aspects of fluid and wave motion in their creative work, and how science and technology motivated and aided them.

The scheduled keynote speakers include artists Ned Kahn, Donna Cox, and June Wayne, astrophysicist Michael Norman, and historian Peter Galison.

This interdisciplinary meeting will be the fourth meeting in the ScArt series, and is the first time the ScArt conference has been held in the United States. Zabusky hopes the conference will especially attract young people whose interests lie somewhere between art and science.

In addition to talks, there will be an exhibition room, where contributors' works will be displayed. All forms of visual art, including painting, sculpture, photographs, animations, and installations may be exhibited.

In association with the World Year of Physics, there will also be a visual art contest, with monetary prizes. The year 2005, in addition to being the anniversary of Einstein's miraculous year, is also the 50th anniversary of Fermi, Pasta, and Ulam's study of nonlinear oscillators. Works submitted for the visual art contest must be associated with some aspect of the Einstein or FPU anniversaries. "It would be nice to get people to submit artworks that symbolize the essence of 2005," said Zabusky.

Zabusky is a computational fluid physicist who became interested in the imagery of his work. "As I was working, I noticed that the things I was making had a certain kind of beauty, so I started asking, "what is art?" I decided after many years that what I was doing was art, if I extended it a little bit."

He found that he could converse with artists, and "within this certain group, there was a very strong rapport, and now it's a whole movement." There are now many conferences, in addition to ScArt, that bring together scientists and artists, said Zabusky.

Zabusky believes that scientific images can be considered art, but that the motivation for creating them is usually different from that of an artist. "Usually when an artist creates art, he's not doing it to try to understand nature, whereas when a scientist is creating an image, he's trying to understand some phenomenon, and trying to bring out the essence of that phenomenon in the image. The question is, 'is that art?' The motivation is completely different, but the end result could be beautiful, could be striking, or could be absorbing, and therefore I think it qualifies as art."

As an example, Zabusky mentioned the pictures taken by the Hubble space telescope. "Some of the pictures are so striking that you might want to hang them on your wall. Is that art? Well, nobody painted it, but it has an uncanny beauty, a mystery," he said.

He points out that there is a whole range from science to art. For many artists, said Zabusky, science is an important part of how they create their images.

See ART FLOW on page 7

President Bush Names Arden Bement to be Director of the NSF

The White House announced on September 17 that President George Bush intends to nominate Arden Bement Jr. to be the director of the National Science Foundation.

Bement became Acting Director of the NSF on February 22 following the unexpected resignation of Rita Colwell. Bement is also the director of the National Institute of Standards and Technology (NIST).

Bement's nomination will come before the Senate Health, Education, Labor and Pensions Committee. This committee is chaired by Judd Gregg (R-NH); Edward Kennedy (D-MA) is the Ranking Democratic Member. There is an outside chance that the committee might consider the nomination before this Congress adjourns. If this does not occur, the committee will consider it early next year.

Bement came to Washington in November 2001, after being nominated by President Bush to be NIST Director. Before then, Bement was the David A. Ross Distinguished Professor of Nuclear Engineering and the head of Purdue University's School of Nuclear Engineering. He holds a PhD in metallurgical engineering from the University of Michigan, and is a member of the National Academy of Engineering. He also served on the National Science Board for six years.

First reactions to the announcement were quite positive. House Science Committee Chairman Sherwood Boehlert (R-NY) stated, "I'm delighted that the President has nominated Arden Bement to be the Director of the National Science Foundation. Arden knows the agency well and brings a wealth of experience in industry, government and academia to the job. His calm, soft-spoken, steady, open-minded and firm leadership has already left its mark on NSF. With a permanent appointment, he will be able to be an even more forceful, effective and inventive director."

"Dr. Bement has had a long and distinguished career in industry and academia, and as Director of NIST," said Bart Gordon (D-TN), the Ranking Democratic Member of the Science Committee. "The NSF, by culture and constituency, is very different from NIST, but I am confident that he will excel in his leadership of this important research agency."

Rep. Vernon Ehlers (R-MI) also commented on the expected nomination, pronouncing Bement "an excellent choice for the Director of the National Science Foundation. Arden is a respected scientist with a wealth of management experiences in academia, industry and government—an unusual combination that will enable him to lead NSF with strength and vision."

Bement sent a message to NSF staff following the White House announcement, praising the foundation's "rich history of strong and independent Directors," and emphasizing the staff's importance to realizing NSF's goals and objectives. "Although NSF faces significant challenges in the near future due to Federal budget issues, I am committed to the policies and operations that have stood the test of time and have helped make NSF an extraordinary agency," he said.

"Our pursuit of research and education at the frontiers of science and engineering, our commitment to broadening participation both within and without the Foundation, and our desire to ensure that we have the resources to carry out this vision will be among my top priorities."

—Audrey Leath

Arden Bement

Ask the Ethicist

Editor's Note: *Please send ethical questions for Jordan Moiers or comments to: ethics@aps.org, or by mail to Jordan Moiers, c/o* APS News, *One Physics Ellipse, College Park, MD 20740. Contributors should identify themselves, but their names and addresses will be held strictly confidential unless they request otherwise. The opinions expressed in this column are not necessarily those of either the APS or* APS News.

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"In the past year, a colleague posed the following ethical question to me. We discussed it at length but never felt that we reached a satisfactory conclusion. Perhaps you can help.

When a student takes a course and part of the requirements for the course is to write a paper, I think that most people would agree that the paper written by the student for the course belongs to the student. If a faculty member wanted to keep the paper or use it for some purpose, they would need to obtain the student's permission.

When research is supported by a grant from the federal government or a foundation to an institution, it is typical for the institution to have rights to the results from the work. Typically a faculty member will acknowledge funding for the project but the rights to the work will remain with the faculty member (unless the foundation has specifically stated that they own the work).

So, the conundrum arises when a student performs research FOR CREDIT, not for pay, and writes a paper for the course that he or she got credit for, to whom does the paper belong? In one sense, it belongs to the student, who paid for the course he or she enrolled in and completed. In another sense, if any of the research was funded by a grant, it belongs to the faculty member in whose lab the results were obtained, even if the student was not paid from the grant to do the research. A corollary to the question posed above is, who has the rights to the results obtained by the student? That is, could the student publish the results without the permission of the faculty member or could the faculty member publish the results without the permission of the student?

Thanks, **N**

Jordan Moiers replies:

Dear N,

Intellectual property policies vary from university to university. Most schools consider the results of a student's academic efforts to be the property of the student, and any results of work paid for by the university to be university property. (Although I've read a few intellectual property policy statements that are framed so broadly that a university could claim copyrights to anything produced with the aid of university resources such as laboratory equipment, buildings, furniture, and blackboards. This suggests a love poem penned in a dormitory stairway is potentially university property, although I imagine few universities are going to attempt to enforce their policies that strictly.)

Students buy their educations from universities, and they should own the rights to the work they produce. The academic credit a student earns is not payment to the student because the student pays for the credit. A student who performs research for credit deserves to share in the rights to the resulting paper. An unpaid student becomes part of the research collaboration and should be included as a full-fledged coauthor on published works, and has the same rights and obligations as every other coauthor. The student also could potentially own a portion of any patent rights associated with the research.

As I see it, you have three, basic options: pay the student in addition to giving credit, have them sign over all rights in advance, or be prepared to share rights to publications and patents with them. It's probably worth talking to your university's lawyers, whichever option you choose.

Help on Ethics Needed

The recent APS Task Force on Professional Ethics recommended that APS work with physics departments to improve education on ethical issues that affect the physics community. If you have experience or interest in developing materials to help students understand and confront such issues and would be willing to help with this task, please contact Ken Cole, Special Assistant to the Executive Officer, at cole@aps.org.

QUINN *from page 1*

Luong. He told the group that he understands the importance of science and is committed to dedicating a portion of his budget for research and development, said Quinn.

Physics in Vietnam is developing, said Quinn, but scientists need better access to information about current research, such as APS journals. "One of the things that becomes clear is it's very difficult for people in countries like Vietnam to know what's available to them," said Quinn. "They're always looking for whatever help they can get. Information is their biggest deficit."

The opportunity to come work or study in the US is also helpful to scientists in developing countries like Vietnam. Quinn said she and the group discussed visa problems of students and researchers who want to study or work in the US. The Vietnamese also expressed the concern that when they send people overseas for training, those people don't often return to Vietnam. Korean and Taiwanese physicists at the meeting said that their countries had been in similar situations recently, but that as their countries' science and technology developed, more scientists began choosing to return home after receiving education abroad.

LETTERS

Field Equations are a Metaphor for Film's Purpose

My father is a member of the American Physical Society and forwarded me the July 2004 issue of *APS News* which featured a short article about *Les Triplettes de Belleville.* I am a graduate student at NYU and recently wrote a paper on the animated film for a Visual Literacy class and may be able to provide an answer to why Einstein's field equations of general relativity are featured at the beginning of the film.

It may not be immediately apparent to the general public, but *Les Triplettes de Belleville* is much more than a cartoon about a grandmother's adventure to save her grandson. Instead, it is an expression of Sylvain Chomet's ideas about many topics, particularly American consumerism and corporate domination taking over the world and crushing the small and individual.

In the film, that dominance is overthrown and Chomet's opinions are effectively expressed through visual parallels and many tiny visual details.

Einstein's field equations of general relativity are amongst those details and can be seen as a metaphor for the purpose of the film itself. The effects of gravity on space-time can be interpreted as a parallel for the effects of the film on the viewers. Gravity can be seen as a representation of the film's message while space-time represents reality. The effects of gravity on space-time are parallel with the effects of the film's message on the viewers and so affects the level awareness in reality.

The film itself also includes many details and references from great icons of world history and culture such as classical music (Bach) and fine art (Salvador Dali). Perhaps the simpler answer is just that Einstein is the appropriate icon for science.

Cheryl S Hark
New York, NY

Who's the Youngest of Them All?

Please permit me to make two comments on your article on C. D. Anderson in your *APS News* of August/September 2004.

The parents of Carl David Anderson were Swedes, not Swiss.

When Anderson (born 3 September 1905) shared the Nobel prize with Victor Hess in 1936 he was not the youngest so honored. William Lawrence Bragg (born 31 March 1890) who when he shared with his father, William Henry Bragg, the 1915 physics Nobel prize was only twenty-five years old. Heisenberg (born 5 December 1901) was about three months younger than Anderson, when he won (alone) the 1932 Nobel prize in Physics.

Ibrahim Adawi
Rolla, Missouri

Moon/Mars Offers Physics Opportunities

The August/September *APS News* highlighted a June resolution of the APS Executive Board, urging review of the Moon/Mars proposal and NASA's recent redirection. Calling the 10-15 year timeline for a return to the Moon a "rapid pace", the statement indicated concern about the impact on science and budgets.

Given that the most immediate scientific impact of the new "vision" is a termination of physical science research on the space station, there is certainly reason for this concern. But coming from APS the new statement is ironic in light of the still unrevoked 1991 APS Council "Statement on the Manned Space Station": "The United States needs a vigorous space science program, but such a program can be implemented for the foreseeable future without the proposed manned space station."

Science was never a good justification for the space station. Former APS Public Affairs director Robert Park is widely known as an outspoken critic of human space flight. Park is absolutely correct that human spaceflight is still far too expensive to justify any scientific returns. So far.

With a limited budget, hard choices have to be made on which programs will benefit society more. The money spent to make the aging space shuttles safer, since the Columbia accident, is taking away from science programs at NASA right now. The space station still has billions of dollars worth of committed funding before it can be declared even minimally complete. Bush, in announcing the new Moon/Mars direction, called for an end (by 2010) to the wasteful space shuttle, and thereafter a phasing out of space station commitments as well. This will both protect the substantial continuing science programs at NASA, and leave room for the new program as well. Whatever your views on our president, it's a logical way to proceed.

The reason we need humans in space is not for science. It is to learn how to do things better in space. Robots don't have the intelligence and insight that humans bring. The problems are basic: in our laboratories on Earth we take for granted simple things—shelter from the outside world, a steady internal climate, access to substantial electric power, and of course an abundance of graduate students to put the equipment together, twiddle the knobs, and fix it when it breaks. Fixing things in low gravity isn't so simple—even soldering doesn't work. Small-scale benchtop science that could bring great

See LETTERS *on page 7*

Physicists Honored at November Division Meetings

Eleven physicists will receive six APS prizes and awards at two division meetings in November. The Excellence in Plasma Physics Award, the James Clerk Maxwell Prize, and the Marshall Rosenbluth Award will be presented at the fall meeting of the APS Division of Plasma Physics, to be held November 15-19 in Savannah, Georgia. The Fluid Dynamics Prize, the Lars Onsager Prize, and the Andreas Acrivos Award will be presented at the meeting of the APS Division of Fluid Dynamics, November 21-23 in Seattle, Washington.

James Clerk Maxwell Prize

Valery Godyak
Osram Sylvania
Noah Hershkowitz
University of Wisconsin-Madison

Citation*: "For fundamental contributions to the physics of low-temperature plasmas, including radio frequency wave heating, sheath physics, potential profiles, diagnostic probes, and the industrial applications of plasmas."*

Godyak is a corporate scientist at Osram Sylvania. He received his PhD degree in plasma physics from Moscow State University in 1968. He joined the Laboratory of Fusion Engineering at the Institute of Electro-Physical Apparatus in St. Petersburg, where he conducted research on high-current relativistic electron accelerators, particularly on field emission and electron optics. He returned to MSU's physics department in 1972, but was expelled eight years later and forbidden to hold a professional job, working as an electrician in a Moscow hospital. He emigrated to the US in 1984 and joined GTE Corporation, now Osram Sylvania. Godyak has made many contributions to rf discharge physics and revolutionary products, including long life and compact rf lamps.

Hershkowitz is an experimental plasma physicist with current research interests in plasma-aided manufacturing, plasma physics, plasma diagnostics, and in fusion plasmas. He received his PhD in physics from Johns Hopkins University in 1966, and is currently director of the Center for Plasma-Aided Manufacturing (C-PAM), which provides important input to US industry. He also heads the Phaedrus Laboratory for Plasma Science, which investigates plasma applications.

Excellence in Plasma Physics Award

Liu Chen
University of California, Irvine
Chio Z. Cheng
Princeton University
William Heidbrink
University of California, Irvine
Edward Strait
General Atomics
King-Lap Wong
Princeton University

See DIVISION MEETINGS *on page 7*

BLEWETT *from page 1*

CERN in 1977 and moved to England and then, in 1990, to Vancouver, British Columbia. She died June 13, 2004, at age 93.

Blewett had always been good at mathematics and physics, said her brother, Talmage Hunt. Her father, an engineer who became a minister, supported her interests.

Few women went into physics at the time, and those who did often faced discrimination, but Blewett was a strong woman who always did what she wanted to do, said Hunt. But she felt she was being kept down in her career because she was a woman, and this feeling may have been one of the reasons she wanted to set up a scholarship specifically for women, said Hunt.

Another factor that may have influenced her decision was that at one point she had to take a year off from college because she didn't have enough money, said Malinka. "She didn't have any money to keep going to school, and she had to discontinue her studies, which was her absolute passion. So she would like to see that that doesn't happen to women these days," said Malinka.

Having grown up with little money, Blewett always accounted for her every penny, and lived modestly throughout her life. "Until the time she died she could tell you exactly how much change she had in her purse," said Hunt.

Though she was married for some time to John Blewett, another accelerator physicist, the pair divorced in the 1960s, and Hildred Blewett never remarried or had children.

Aside from physics, she loved traveling, opera, and reading. "She was an avid reader, even after losing most of her eyesight. She had to read large print books. She would read a couple dozen books a month," said Hunt. In her will, Blewett also left about $20,000 to the Vancouver Public Library Outreach Service, which delivered boxes of books to her home each month.

Blewett left the rest of her money to APS. "She really felt that what she had should go back to physics. It was really important to her," said Malinka.

APS ANNOUNCES FORMATION OF BEQUEST SOCIETY

Over the years, many APS members have thoughtfully included the American Physical Society in their bequest intentions. These generous gifts help provide needed funding for key Society programs and initiatives that our physics community has launched and strengthened since the Society's founding in 1899.

In recognition of individuals and families remembering the Society in their charitable estate plans, APS is pleased to announce the formation of a Bequest Society. The development of this Society is intended to thank past and current donors and encourage others to consider making such a gift through their will. With the permission of donors, APS will honor these individuals in publications of the Society and through other Development office means.

Gifts from one's estate can be made in an unrestricted manner, for use by the Society as it deems appropriate, or designated to a particular program or activity. These gifts may take the form of a percentage of the estate or a fixed dollar amount. As APS is a 501(c) (3) organization, these gifts can provide significant estate tax savings.

The American Physical Society invites those who have made arrangements for a contribution to APS through their will to become charter members of the Bequest Society by contacting **Darlene Logan**, Director of Development, using the contact information below. In addition, individuals considering a designated gift are encouraged to discuss the terms and wording of the gift with the Development office to assure that their future intentions can be carried out exactly as they wish.

The American Physical Society is extremely grateful to past and future donors who remember the Society in their legacy plans and we look forward to being able to provide appropriate tribute to them through this new Bequest Society.

For further information, please contact:
Darlene Logan
Director of Development
American Physical Society
One Physics Ellipse
College Park, MD 20740-3844
(301)209-3224

NIH to Attack Cancer Using Nanotechnology

By Ernie Tretkoff

The National Cancer Institute of the National Institutes of Health announced in September a $144 million dollar, five-year initiative for developing and applying nanotechnology to improve the detection, diagnosis, and treatment of cancer.

The new initiative is a multidisciplinary effort that combines physical science, engineering, chemistry, and medicine. "This is a comprehensive and multisector initiative that is designed to really develop and ensure the application of the best of nanotechnology to cancer." said Anna Barker, NCI Deputy Director.

As part of the initiative, NCI plans to fund about five "centers of cancer nanotechnology excellence," which will be collaborations of laboratories and research centers designed to integrate nanotechnology development into basic and applied cancer research. The initiative will also support multidisciplinary research teams and a nanotech-nology characterization laboratory that will develop standards for nanoscale devices.

At the announcement on September 13, several scientists spoke about the potential for nanotech to dramatically improve cancer detection and treatment.

Richard Smalley, professor of chemistry, physics, and astronomy at Rice University, and winner of the 1996 Nobel Prize in chemistry for the discovery of fullerenes, said, "What's new is the notion that we can actually build new nanoobjects that have never existed before." These objects could be coated with antibodies

See NIH *on page 6*

PHYSICS AND TECHNOLOGY FOREFRONTS

Magnetorheological Materials

John M. Ginder

Magnetorheological (MR) materials comprise magnetizable particles dispersed in a nonmagnetic host. In MR fluids, the particles are usually micrometer-sized carbonyl iron powders in a host medium such as natural or synthetic oil; in magnetic powders, the fluid medium is air. These materials transform from freely flowing to weakly solid under an applied magnetic field, a dramatic phenomenon that is the basis for a variety of commercial applications of these controllable or 'smart' materials. In MR elastomers, the particles are locked into viscoelastic solids, but these composites exhibit substantial magnetostriction. While MR fluids are similar to ferrofluids, nanometer-sized colloidal dispersions of single-domain magnetic particles, the two materials possess rather different behaviors: *ferrofluids display only small increases in viscosity with field, unlike MR fluids, because the magnetic forces in ferrofluids are orders of magnitude smaller.*

Background

The development of MR applications has had an intriguing and instructive history, undergoing several cycles of scientific discovery, technological 'hype,' waning interest, rediscovery and, finally, commercial utilization in the late 1990s.

Developments in MR materials have often paralleled those in electrorheological (ER) fluids, dispersions of electrically polarizable particles that exhibit field-induced solidification under high *electric* fields. These were extensively investigated by Willis Winslow in his basement laboratory in the 1930s.

Winslow inspired Jacob Rabinow of the National Bureau of Standards to develop their magnetic analogs in the late 1940s, demonstrating proofs-of-concept for many MR devices that would finally become feasible to produce and use five decades later, enabled by developments in chemistry, physics, materials science, and mechanical and electrical engineering.

The remarkable field-induced changes in MR materials are driven by dipolar magnetic attractive forces which form "pearl chains" of particles aligned with the field. These chains store magnetostatic energy and resist mechanical deformations that would reduce the energy. Particle chaining is relevant in a remarkable variety of systems, from magnetic toys and animated displays to natural "compasses" formed from nanoscale ferrite particles in magnetotactic bacteria. While real structures are often complicated due to the broad particle size distribution and high volume fraction *f* in practical MR materials, our understanding of magnetorheology has been greatly enhanced by studying particle chains.

Magnetic Forces

Much of the scientific research in magnetorheology has focused on quantifying the interparticle magnetic interactions, understanding the dynamics of structure formation, and characterizing the resulting field-induced mechanical properties.

While the interparticle magnetic interactions are approximately dipolar, multipole and many-particle effects, as well as magnetic nonlinearity and saturation, are important. Analytical solutions that account for nonlinearity and saturation are difficult, so my coworkers and I used a finite-element numerical approach to solve for the spatial variation of the magnetic field *H* and flux density *B* in a uniform chain of magnetically saturable particles.

The particles were assumed to be continuous, since each micrometer-sized particle can contain ~10^3 or more magnetic domains. Using symmetries appropriate to an isolated chain to reduce the problem size, we demonstrated that magnetic saturation controls the local fields and forces even in applied fields well below $M_s/3$ (M_s is the saturation magnetization of the particle and is roughly 1.7 x 10^6 A/m for iron), the field at which isolated spherical particles saturate. The high relative permeability of the particles causes magnetic flux to be channeled into their polar regions, (Figure 1.) Because the material comprising the particle is magnetically nonlinear, the magnetization at the poles saturates at relatively low fields; the saturated zone grows in size as the field is increased, eventually engulfing the entire particle.

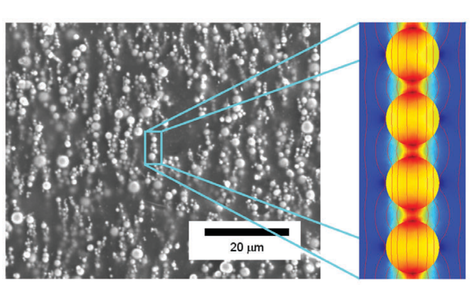

Figure 1: Left: electron micrograph of particle chains formed by solidifying carbonyl iron particles in a natural rubber matrix in a flux density of 5 kG. Right: spatial variation of magnetic flux density (color contours) and flux lines (lines) in an idealized particle chain as obtained by finite-element analysis.

From these solutions and the Maxwell stress approach, we estimated the mechanical stress required to deform the chains by a given tilt or shear angle. We focused on the magnetically-controlled portion of the yield stress, defined as the maximum stress encountered as the shear angle is increased; the modeled yield stress compares quite favorably with measurements made on 50 volume percent MR fluids, (Figure 2.) The model reveals that the stress varies as B^2— the behavior expected from a dipole model —only at *very* low fields. At applied fields sufficient to saturate the particle locally, the stress increases roughly as $B^{3/2}$, as confirmed by many experiments. The numerical model predicts a slight peak in the stress followed by a plateau signifying complete and uniform saturation of the particles. The maximum stress attainable at saturation varies as M_s^2.

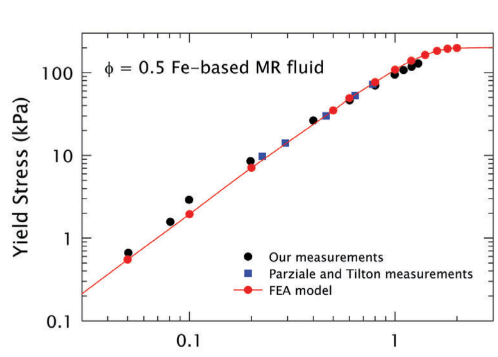

Figure 2: Increase in shear yield stress with applied flux density in iron-based MR fluids with volume fraction ϕ=0.5 and comparison to a FEA magnetostatic model.

Indeed, yield stresses of 100-200 kPa are routinely achieved in real MR materials, with a consistency of stiff putty. While they are much softer than most solids, MR fluids and magnetic powders are useful in a number of applications because the zero-field stresses they support are orders of magnitude smaller. Even higher stresses can be achieved by using particles with higher M_s, like iron-cobalt alloys. Other routes to high-stress materials include using a bimodal distribution of magnetizable particles, as implemented by Robert Foister and coworkers. One may regard the larger particles as embedded in a magnetic fluid comprising the smaller particles. Because the effective permeability of the suspending fluid is enhanced, the interparticle forces and resulting stresses increase.

Structure and Mechanics

The evolution and dynamics of the structures in MR materials have been of great interest. One key question is the response time required to form chains or agglomerates in quiescent conditions. Mark Jolly and coworkers used a magnetic induction technique to detect the formation of chains on time scales of the order of milliseconds. If the magnetic field can be introduced rapidly, the stresses generated by MR materials also appear on this time scale. Except in highly viscous host materials, the ubiquitous chains of particles eventually aggregate into multichain columns or stripes. Groups led by Alice Gast, Jing Liu, and others have used optical microscopy and light scattering to study the evolution of these chains in quiescent conditions. The aggregates typically grow in a power-law fashion with time. These observations are consistent with models of coarsening developed by Thomas Halsey and coworkers, in which lateral chain aggregation is driven by thermal fluctuations and chain defects. In sheared ER and MR fluids, large-scale oriented aggregates or "stripes" emerge over seconds or minutes, as observed by Frank Filisko, Georges Bossis, and others. Dan Klingenberg and coworkers have developed a continuum model of stripe formation that qualitatively predicts the geometry of these features and their dependence on shear rate.

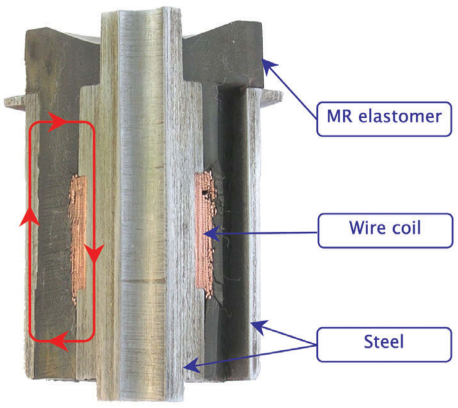

Figure 3: Cross-section of a MR elastomer bushing, showing the wire coil that produces a magnetic field, the low-carbon steel magnetic circuit that delivers the field, and the MR elastomer material that responds to the field. The flux path is shown schematically in red.

The short range of the magnetic force dominates both the microscopic and macroscopic mechanics of magnetized MR materials, which act as brittle viscoelastic solids under dynamic mechanical loading, exhibiting mechanical nonlinearity even at very small strains ~10^{-3}. Rongjia Tao and coworkers have compressed magnetized MR fluids, enhancing the shear yield stress—reaching almost 1 MPa—perhaps by inducing both structural changes and enhanced frictional forces between particles.

Applications

MR fluids are ideally suited to applications in which damping force must be controlled rapidly and over a wide dynamic range. The first commercially available MR fluid linear damper was developed by Lord Corporation to improve vehicle seat dynamics for long-haul and off-road driving. Delphi's Magneride™, an automotive shock absorber, can be modulated electrically to control damping force on a several millisecond time scale necessary to improve vehicle ride. MR dampers have also been used to minimize vibrations in cable-stay bridges and to produce a more natural gait for amputees in above-the-knee prostheses. QED Technologies uses the magnetically tunable rheological properties of abrasive-doped magnetic dispersions to enable a computer-controlled optical polishing system.

MR fluids and magnetic powders are also used in torque-transfer clutches and brakes. Magnetic powder clutches controlled the torque transfer between the engine and the transmission on several 1950s-era minicars, and were also used to control main engine attitude on the Apollo Service Module in the 1960s. Potential automotive applications include clutches to control engine accessories like the air conditioner and cooling fan.

Magnetostriction in MR elastomers is manifest both in field-dependent length changes and viscoelastic moduli. Mark Nichols, myself, and coworkers explored automotive suspension bushings using these materials for controlling the ride and handling of automotive vehicles. Several groups have developed MR-elastomer-based tuned vibration absorbers—mass-spring systems—to absorb vibrations at mechanical frequencies that change over time. The mechanical nonlinearity inherent in filled elastomers and exacerbated by the short-range magnetic interactions has so far prohibited successful commercial applications of these materials.

Applications of MR materials are enabled by a number of technologies, including additive chemistries to stabilize the suspended particles against irreversible settling or agglomeration, modify viscosity and lubricity, and inhibit oxidation and wear. Delivery and control of magnetic fields is obviously required in MR components; wire-coil electromagnets are often used. The design of an efficient magnetic circuit that does not add excess weight is essential. Required flux densities are of the order of 1 T—comparable to that utilized in most electric machines like motors. Control algorithms designed to minimize vibration amplitude have been developed for various MR devices and applications.

Opportunities

A few groups have used nanoparticles as a primary or secondary particulate in MR fluids. Nonetheless, the growing availability of nanoscale particulates has yet to be manifest in vastly improved MR materials; they may enable more stable, less abrasive MR fluids or MR elastomers with enhanced mechanical properties. Opportunities also exist to explore the effects of magnetic domain structure, which is particularly relevant as the particle size shrinks. The deformation and flow behavior of MR fluids and their coupling to applied field and other external factors has not been definitively modeled or explained. For example, little is known about instabilities in MR fluid flows. The behavior of MR fluids at short length scales, such as in microfluidic channels, has not been widely studied. While the past decade has seen much progress in understanding MR materials and in using them in commercial products, the field is still laden with opportunities and challenges for interested physicists.

John M. Ginder is the technical leader of the Physical and Environmental Sciences department of Ford Research and Advanced Engineering.

ELECTION *from page 1*

turned east to Princeton as a professor of physics. His research interests having turned toward the interface between physics and biology, he resigned his Higgins Professorship in 1980 to go to Caltech as the Dickinson Professor of Chemistry and Biology in order to help build the multidisciplinary interface. In 1996, he returned to Princeton

Hopfield's PhD thesis formulated a field-theoretic description of the interaction of light with excitons in solids. He continued research on the interaction of light with solids, and the interpretation of absorption and emission spectra, receiving (with experimental chemist co-worker D. G. Thomas) the Buckley Prize from the APS in 1969 for this work. In 1970 his interests turned toward understanding biology. His researches in molecular biology described "kinetic proofreading" which greatly enhances the selectivity of biochemical reactions by proofreading at the molecular level. In 1980 his interests in biology began to focus on how a nervous system carries out its "computations". He received the APS Biophysics Prize in 1985.

"I'm looking forward to the opportunity to put something back into an institution so important to the healthy state of American physics, and an institution that behind the scenes has helped me to have a fulfilling professional life," Hopfield said of his successful bid. "The institutions essential for physics to prosper do not function well unless serious scientists are enthusiastic about taking leadership roles."

CHAIR-ELECT, NOMINATING COMMITTEE

Rosenbaum is the James Franck Professor of Physics and the Vice President for Research and for Argonne National Laboratory at the University of Chicago. His research interests center on the quantum mechanical nature of materials at low temperature, where the mix of statics and dynamics leads to a new class of phase transitions and to states with unusual excitation spectra. Rosenbaum conducted research at Bell Laboratories and at IBM Watson Research Center before he joined the Chicago faculty in 1983. He directed the NSF Materials Research Laboratory from 1991 to 1994 and the James Franck Institute, an interdisciplinary research institute focused on problems at the intersection of physical chemistry and condensed matter physics, from 1995 to 2001. Rosenbaum received his PhD in physics from Princeton University in 1982.

In his candidate's statement, Rosenbaum identified three major challenges confronting the APS:

1. Reestablishing balanced funding for basic research in the physical sciences, with an emphasis on the benefits of interdisciplinary endeavors;

2. Educating policy leaders and the general public to think quantitatively and critically so that public policy decisions can be technically informed; and

3. Communicating the excitement of physics to our students so that physics can continue to attract to our profession the brightest men and women from all backgrounds.

GENERAL COUNCILLORS

Orel attended the University of California, Berkeley, receiving her PhD in chemistry in 1981. She worked in the Laser Program at Lawrence Livermore National Laboratory as a staff scientist from 1981 to 1985. She was then employed at the Aerospace Corporation as a member of the Technical Staff. In 1988 she accepted a position in Berkeley's Department of Applied Science. She currently chairs the department and is the Edward Teller Professor of Applied Science. Her research interests are in the area of theoretical molecular physics, particularly the study of low-energy collisions between electrons and molecules and molecular ions. She is particularly interested in systems where there is a strong interplay between the electronic and nuclear degrees of freedom, for example dissociative recombination and attachment.

"The face of physics is always changing. Even the definition of what is physics constantly changes," Orel said in her candidate's statement. She herself holds degrees in chemistry, is a professor in an applied science department, yet she identifies herself as a physicist. "This is not unique, but now becoming the norm for physics, multidisciplinary and multi- application. Yet the core of physics is the same. We are engaged in the search for truth, no matter if we are looking in different places."

Slusher is director of the Quantum Information and Optics Department at Lucent Technologies, Bell Laboratories. He received his PhD in physics from the University of California at Berkeley in 1965. His present research interests include nonlinear photonic crystals, nonlinear optical waveguides and fibers, quantum optics and quantum computation.

During the mid-1970s and early 1980s he worked at Princeton and MIT using CO_2 laser light scattering from Tokamak plasmas to study turbulence near their edges and radio frequency heating processes. He and his collaborators were the first to observe squeezed light in 1985, a new quantum state of light with uncertainties in one field component below the standard quantum limit.

In the early 1990s he and his collaborators demonstrated microdisk lasers in semiconductors as well as nonlinear optics and lasing in organic materials. He received the 1995 APS Arthur Schawlow Prize in laser spectroscopy.

In his candidate's statement, Slusher identified increased funding for physics, public awareness of the tremendous value of physics education and physics applications in our daily lives, and enhanced interdisciplinary activities and cooperation among physicists around the globe as top priorities for the APS.

Furthermore, "Applications of physics for long-range advances in energy, homeland security and restoring the environment should be highlighted and encouraged by the society in imaginative ways," he said. "All of this is based on a foundation of fundamental physics research and the inspiration we all find in the study of physics. We must preserve these values."

VISA *from page 1*

hensive plan to address the visa-processing quagmire in the wake of heightened security concerns following the 9/11 terrorist attacks.

The statement received much attention, including front page coverage by the *Financial Times*, and articles in the *Wall Street Journal, New York Times*, and *Science*.

Since then, the Departments of State and Homeland Security have reportedly taken action on a number of the statement's recommendations. According to informal reports from State and DHS officials, additional steps are also being considered to extend the duration of the Visa Mantis security clearance, although the timing of this change also remains unclear.

While the State Department's response indicates some positive changes, many scientists remain skeptical about the reported improvements. As Quinn said in a response to Harty, "A considerable number of our colleagues have had, or know others who have had, bad experiences with visa applications and it will take some time period of better results before many have faith that the system is working well."

INSIDE THE BELTWAY:

Washington Analysis and Opinion

Science in the Aftermath

By Michael S. Lubell, APS Director of Public Affairs

How would the outlook for American science be altered if voters had chosen differently? If you believe the published answers to questions posed to both candidates by *Physics Today, Science,* and *Nature*, probably not much—with a few notable exceptions: stem cell research and the Moon-Mars Program. Kerry made Bush's opposition to the first a centerpiece of his campaign, and he pledged not to pursue the second, which he said had "no clear objectives or cost estimates."

But even here, the differences were starting to narrow in the run-up to November 2nd. With public support for stem cell research deep and widespread, Republican insiders predicted privately—a few months before the election—that Bush's opposition would have to soften. As for Moon-Mars, early in the summer Congress had already begun to balk at the apparent mega price tag, and by September the Administration's Own Office of Management and Budget was also beginning to question whether the program was at all realistic, given the river of federal red ink.

On other issues—missile defense, climate change, energy policy and support for science research and education—you would have been hard pressed to find more than a nuanced difference. Whether either campaign was being honest is quite another matter. When needed, skilled spinmeisters—and both sides had plenty of them—can carefully craft wording that masks the true positions of a candidate.

So Bush was an advocate for reducing greenhouse gas emissions, and Kerry was a supporter of missile defense. Bush's handlers also said that he opposed developing new nuclear weapons, in spite of well-known White House pressure on congressional appropriators to fund development of the Robust Nuclear Earth Penetrator. And Kerry's spokesmen said that their candidate supported nuclear power, although his track record on the issue might have suggested otherwise.

Looking ahead, each candidate agreed that funding for the physical sciences, mathematics and engineering had shriveled as the NIH budget thrived. They agreed that more spending was needed.

But between Iraq, the war on terrorism and tax cuts, the Bush folks said the cupboard was bare. And with Kerry committed to spending more money on homeland security, expanding health care coverage, enlarging the army and keeping Social Security reform off the national agenda, even his staunchest supporters couldn't make the numbers work. Rolling back the tax breaks for the wealthy wouldn't provide enough revenue to cover all the expenditures.

In the first two years of his presidency, Bush portrayed himself as the great reformer: on taxes, on trade, on prescription drugs, on regulations, on education, on global projection of American interests. You might not have liked them or agreed with them, but they represented significant reforms of American policy. Kerry, by contrast, throughout his Senate service was more wedded to the status quo, acting more like a "New Deal" or "Great Society" Democrat" than a Clintonian "New Democrat."

Morton Kondracke, for whom I have great admiration as a political analyst—and, incidentally, as a staunch supporter of science—had this to say in his September 27 *Roll Call* column, as he pondered his choices on November 2nd, "So whom to vote for? A would-be reformer who can't pay, or a willing payer who can't reform? It's a hard one." Time will tell in the next few years if we chose wisely.

About the only prediction that I will make is that the federal budget will remain a mess for quite some

See **INSIDE THE BELTWAY** *on page 7*

NIH *from page 4*

or other targeting agents that will find cancerous cells, and could carry drugs to kill those cells.

Smalley also envisioned that in 10 to 20 years, nanotechnology will make possible blood tests that will be able to determine the concentration of 30,000 different proteins within half an hour, significantly improving the detection and diagnosis of disease.

Mauro Ferrari, a special advisor to the NCI and professor of biomedical engineering at Ohio State University, discussed several examples of nanotechnology being applied to cancer. He pointed out that some nanotech applications, including liposomes, tiny capsules that deliver drugs, are already clinically available. "As exciting as those developments have been, they are the tip of the iceberg," he said.

Other technologies are being developed. For instance, nanowires could detect cancer markers in samples flowing through microfluidic channels. Similarly, nanoscale cantilevers could be coated with molecules that attract and bind specific cancer markers, and could be used as part of a diagnostic device that could quickly and sensitively detect cancer-related molecules. Also being developed are nanoparticles that would enter the body and attach to cancerous cells, making it possible to image malignant cells that could not be detected through conventional imaging. Similar nanodevices could also deliver drugs directly to cancer cells while sparing healthy cells, thus reducing the side effects of treatment and improving quality of life.

Samuel Wickline, professor of medicine, physics and biomedical engineering at Washington University, said that one of the advantages of the NCI initiative is that it facilitates the interaction of scientists who work in different disciplines. "This is essentially a multi-disciplinary activity. You have to understand the language of chemists, physicists, biologists, immunologists, and going further, you have to understand the regulatory language that is required to get something done."

Though nanomaterials show promise in detecting and treating diseases, some people worry about possible unpredicted heath or environmental effects. Vicki Colvin, a chemist and director of the Center for Biological and Environmental Nanotechnology at Rice University, has investigated the safety of some nanoparticles. She said that the surface of the particle, more than its composition, determines how it interacts with a biological environment, so the key to making safe nanoparticles is controlling their surfaces. Colvin added that testing the structures early on in the process is essential. "A lot of nanostructures behave in ways we have predicted. Some don't." she said.

Janet Woodcock, Acting Director Commissioner for Operations of the FDA, said, "We'll have to be vigilant because there might be novel or unanticipated reactions." The FDA will work to assess the safety and effectiveness of new nanodevices. Nomenclature and classification of the devices will also have to be worked out, said Woodcock.

zero gravity

The Lighter Side of Science

Ed. Note: In the May issue of *APS News*, we announced a physics haiku contest, with a deadline for submissions of October 1. We received a large number of entries, most of them either just after the announcement in May or just before the deadline in October. We are now proud to announce the results. Every entry was considered on an equal basis, except for those that had nothing to do with physics or that didn't scan properly (three lines of 5, 7, and 5 syllables respectively).

Our overall winner is Celia Elliott of the University of Illinois. We reprint two of her entries below. She will receive a copy of the coveted coffee-table book "Physics in the Twentieth Century" and a World Year of Physics t-shirt.

In addition to the winning entries, we reprint several more that qualify as "honorable mentions." These were selected by our dedicated haiku-evaluation team. Each of the authors will receive a World Year of Physics t-shirt. We regret that we don't have room for even more of the excellent contributions that we received. In due course, we intend to post all the entries on our *APS News* online web site.

Hubris
Theoretical
Physicist am I. Mortals
Tremble before me.

Irresistible Force
Tripped. Fell on my ass.
Awesome demonstration of
F = ma.
—Celia Elliott

***

Newton's Laws of Motion
1. A body maintains
Its rest, or straight-line motion
Unless net force acts.

2. F equals p-dot.
That is all you need to know.
Use it with wisdom.

3. To ev'ry action
There's an equal reaction
Counter-directed.

E is m c-squared!
Mass, energy – the same stuff!
One makes the other!

Quarks
A quark is a quark—
There are no smaller pieces;
Or so I believe.

Two ups and a down—
(What other virtual quarks?)—
Dwell in a proton.
—Frank R. Paolini

***

Quantum paradoxes
I've had it to here
With quantum paradoxes;
My wave functions ache.
— Edward O. Stejskal

***

Quantum Uncertainty
Schroedinger's cat is
Dead or alive, they tell us
I can't bear to look!
—J. D. Jackson

***

Tell me, did the sun
Just burn out? I guess we'll know
Eight minutes from now.
—Jed Brody

***

Wither dynamics?
There is chaos in my soul.
Poincaré is proud.
—Mason Porter

***

Leptons have needs, too…
A lonely muon
meets SUSY at the H Bar,
leaves as a slepton.

In the dark
Behold the cosmos:
dark matter and energy,
playing hide and seek

Kids these days… !
Like grumpy old men,
Inductors tend to oppose
Any current change

Pivotal moment
Teaching **r x F**
Puzzled class does not know what
I'm torquing about
—C. J. Chiara

MEDIA *from page 2*

"It sorted out our ideas on how all of the nuclear matter is held together and how the protons and neutrons are built. And it's as beautiful a theory as exists, and that includes electrodynamics, gravity, anything you want to mention."
—James Bjorken, Stanford University, (NPR), October 5, 2004

***

"The history of understanding matter is taking things apart. How could it be that they are made of quarks and you can't get them out? It was a deep conundrum."
—Michael Turner, NSF, Los Angeles Times, October 6, 2004

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"How often do you get to explain one of the four fundamental forces of nature?"
— Lawrence Krauss, CWRU, New York Times, October 6, 2004

ART FLOW *from page 3*

"What they do is they draw their inspiration from something scientific, but the final product may not be very close to science. There's a whole spectrum."

For more information on the ScArt4 conference and the visual art competition, visit http://mechanical.rutgers.edu/scart4

INSIDE THE BELTWAY *from page 6*

time. The increasing demands on scant federal resources will cause Congress to miss budgetary deadlines more often than not. (This year, we could well be stuck with a Continuing Resolution through February.) And it will tie policy making up into such knots that it could turn the "do-nothing" 108th Congress into a fashion trendsetter.

If I had a solution, I would have run for the White House this year. After all, if Ralph Nader had the chutzpah to do it, why shouldn't I?

DIVISION MEETINGS *from page 4*

Citation: *"For the theoretical discovery and experimental identification of toroidicity Induced Alfven Eigenmodes."*

Chen received his PhD from the University of California, Berkeley, in 1972, and is presently a professor of physics and astronomy at the University of California, Irvine. His main research interest is in the area of instabilities excited by energetic particles in magnetically confined plasmas. These instabilities could explain not only observed electromagnetic wave perturbations, but could also lead to enhanced transport coefficients, which could impact fusion ignition conditions. He is currently developing particle simulation techniques to describe self-consistent nonlinear wave-particle interactions.

Cheng received his PhD in physics from the University of Iowa in 1975, and has been at Princeton University's Plasma Physics Laboratory ever since. He is currently the head of energetic particle physics and space plasma physics research areas. He has made significant contributions to fast ion physics, Alfven waves, ballooning modes, trapped electron modes, and disruption in tokamaks. In particular, he discovered the theory of Toroidicity-Induced Alfven Eigenmode (TAE) in toroidal plasmas. He has also studied solar flares and magnetosphere substorms.

After receiving his bachelor's degree from the University of California, San Diego, **Heidbrink** spent two years performing industrial research in pulsed power at Maxwell Laboratories before pursuing graduate studies at Princeton University. He received his PhD in physics in 1984, and worked at Princeton's TFTR tokamak and at the DIII-D tokamak at General Atomics before joining the physics department at the University of California, Irvine in 1988. He studies energetic ions in magnetic fusion experiments, as well as diagnostic development and measurements of fast-ion confinement.

Strait bio not available at press time.

Wong received his PhD from the University of Wisconsin, Madison in 1975, and after one year as a research associate at Columbia University, he joined the Princeton Plasma Physics Laboratory. His research involves linear and nonlinear wave physics associated with plasmas, and their effects on plasma current generation, heating and transport. Most recently, he has investigated MHD activity and density modification by high-power electron cyclotron waves, and current density profile modification due to redistribution of energetic ions induced by Alfven instabilities in the DIII-D tokamak.

Fluid Dynamics Prize

George M. Homsy
University of California, Santa Barbara

Citation: *"For many important contributions in multiphase flows, interfacial phenomena, polymeric flows, and convection, including the stability of fluidized beds, viscous fingering in porous media, and thin film behavior."*

Homsy received his PhD in physics from the University of Illinois in 1969 and spent one year as a postdoctoral fellow at Imperial College in London, England, before joining the faculty of Stanford University, where he remained for much of his career. In 2001 he joined the faculty of the University of California, Santa Barbara, as a professor of mechanical and environmental engineering. His research has spanned numerous areas related to the physics of fluids, including multiphase flows, porous media; thin films; viscoelastic flows; and most recently chaotic advection.

Marshall Rosenbluth Award

Kiyong Kim
University of Maryland

Citation: *"For his development and application of intense laser pulses with novel plasmas, including those produced in nanoscale clusters."*

Kim received his B.S. in 1995 from Korea University, and his PhD in physics from the University of Maryland, College Park, in 2003. His dissertation detailed the development of ultrafast optical diagnostics and their application to the measurement of ultrafast dynamics in the interaction of intense laser pulses with gases, atomic and molecular clusters, and plasmas. He is currently a postdoctoral fellow at Los Alamos National Laboratory, pursuing the study of coherent Terahertz radiation from intense laser-produced plasmas.

Andreas Acrivos Dissertation Award

Jacqueline Ashmore
Harvard University

Citation: *"For elegant theoretical and numerical analyses of coating and free-surface flows"*

Ashmore received her PhD in Applied Mathematics from Harvard in 2003, working with Howard Stone. She is currently a postdoctoral associate in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge, working on the analysis of transport in directional solidification of multicomponent fluids, and cavitation in lubrication flows.

LETTERS *from page 4*

breakthroughs in space requires all of these, and we don't know how to do any of them cost-effectively yet—and we'll never learn by just sitting in our armchairs and thinking about it.

If the APS is interested in having any real impact on NASA's future, it should make an effort to understand the changes under way. Is it a good idea to turn NASA centers into independent research centers more like the DOE labs? Are there physical science areas that can contribute significantly to the new program, and should receive new funding?

Can we imagine any science we would like to do if the more robust and inexpensive private and federal space infrastructure expected actually comes to pass?

The Moon/Mars decision doesn't have much to do with science—and despite its political origin, has an inevitable logic that a new administration would be hard-pressed to reverse. NASA people are energetically tackling the new challenges they've been given - there are real opportunities here for physicists and physics research, if we are willing to be a part of it.

Arthur Smith
Selden, NY

ANNOUNCEMENTS

APS CONGRESSIONAL SCIENCE

THE AMERICAN PHYSICAL SOCIETY is currently accepting applications for the Congressional Science Fellowship Program. Fellows serve one year on the staff of a senator, representative or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows have the opportunity to lend scientific and technical expertise to public policy issues.

QUALIFICATIONS include a PhD or equivalent in physics or a closely related field, a strong interest in science and technology policy, and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be US citizens and members of the APS.

TERM OF APPOINTMENT is one year, beginning in September of 2005 with participation in a two-week orientation sponsored by AAAS. Fellows have considerable choice in congressional assignments.

A STIPEND of $50,000 is offered in addition to allowances for relocation, in-service travel, and health insurance premiums.

APPLICATION should consist of a letter of intent of approximately two pages, a list of key publications, a two-page resume, and three letters of reference. Please see the APS website (http://www.aps.org/public_affairs.fellows.html) for detailed information on materials required.

ALL APPLICATION MATERIALS MUST BE POSTMARKED BY JANUARY 17, 2005 AND SHOULD BE SENT TO THE FOLLOWING ADDRESS:
APS Congressional Science Fellowship Program
c/o Jackie Beamon-Kiene
APS Executive Office
One Physics Ellipse

The Back Page

Remembering Oppenheimer: The Teacher, The Man

By Edward Gerjuoy

I was enrolled as a graduate student in the UC-Berkeley physics department from August 1938 to January 1942. When I arrived, I knew practically nothing about J. Robert Oppenheimer beyond his name. But I immediately became well acquainted with him via the courses he taught. In each, he manifested the same distinctive teaching style.

Oppenheimer gave no final exams or any other tests. He did assign numerous homework problems, many of which were highly instructive and non-routine. He did not designate a textbook for any of his courses. If we students desired alternative or otherwise clarifying presentations, we had to locate them on our own.

His reluctance to designate textbooks was rational. In his electromagnetic theory course, for example, much of the material he presented was intended to serve as an introduction to the newly formulated, and still developing, quantum theory of radiation; such hypermodern material simply could not be found in any of the then available electromagnetic theory textbooks.

Similarly at the time, barely a decade after Schrodinger's formulation of his wave equation, there weren't any English language texts for him to assign in his quantum mechanics course.

Each class hour was a lecture, delivered at high speed, accompanied by numerous equations written on the board at correspondingly high speed, along with rapidly performed, rarely erroneous calculations. The only way I possibly could grasp the material was to take hastily scribbled notes as he spoke. From these scribblings I would prepare more complete notes as soon as possible after the lecture, while it still was fresh in my mind. I am quite certain that every other serious student did the same. There were numerous occasions when several of us would argue at a blackboard about precisely what he had imparted. Each of Oppenheimer's courses required far more of my time, but taught me far more physics, than any of the other non-Oppenheimer courses I took in graduate school.

I have no memory of him ever initiating any sort of Socratic dialogue with the class, nor do I recall him pausing in any calculation to ask the class for suggestions on what to do next. If there was something a student didn't understand, said student could feel free to interrupt with a question. Oppenheimer would answer patiently unless the question was manifestly stupid; then his response was likely to be quite cutting. Unfortunately his patient answers often were not illuminating; Oppenheimer did not have the gift of putting himself in a student's place and recognizing that what was evident to him might not be evident to the student. A student who persisted with questioning could expect to find himself on the receiving end of sarcasm. But Oppenheimer never bore any grudges against students who momentarily had taxed his patience.

Perhaps the most distinctive feature of his lectures was his chain smoking. When one cigarette burned down to a fragment, he extinguished it and lit another almost in a single motion. I still can see him in his characteristic blackboard pose, one hand grasping a piece of chalk, the other hand dangling a cigarette, and his head wreathed in a cloud of smoke.

Although his primary interest was research, he nevertheless took his classroom teaching duties very seriously. He deserves credit for his painstaking efforts to construct unhackneyed courses that would lead students into productive physics research as rapidly as their native talents would allow.

Even more vivid are my recollections stemming from my time in his group of PhD students. I joined in the spring of 1939. He didn't immediately give me a research problem; I had been at Berkeley less than two semesters. I just showed up at the weekly theoretical physics seminar he ran. Although Oppenheimer could be fearsome, he did not put on airs. He didn't mind being called Oppie, and I have done so ever since.

Quantum mechanics was developed in Europe and remained essentially arcane until 1926, when Schrödinger's formulation of his famous equation made quantum theoretical research accessible to non-geniuses like myself.

Oppie was one of the very few American theoretical physicists who was both lucky enough to have learned quantum mechanics in Europe right around 1926, and talented enough to usably bring this learning back to the United States.

He received his PhD in 1927 from the University of Göttingen, having studied with Max Born; he joined the Berkeley physics department only two years later.

In the years between 1929 and 1935, before so many great European physicists fled Hitler and began to establish their own modern theoretical physics research groups in this country, students who wanted to do research at the forefront of theoretical physics without going abroad enrolled in the Berkeley physics department to work with Oppie, because there really were very few other professors in the US actively engaged in such research.

Oppie was tall and absurdly thin. He rarely was motionless; if nothing else he would be puffing on his cigarette or waving it around as he talked. He was well educated and well read; we all have heard of his ability to quote from the original Sanskrit. His face was mobile; how he was reacting was no secret. When I knew him he was between 35 and 40, and doubtless still at the peak of his physical and mental powers.

His relations with his students were surprisingly informal. He

Photo Credit: Los Alamos National Laboratory

J. Robert Oppenheimer

allowed his students to drop into his office at any time to consult physics books in his personal library. His office was deep, moderately wide, and quite bare, except for the bookshelves and a blackboard running the length of the room. He did not have regular office hours. He could be moody; if I found him alone, his demeanor instantly made it apparent whether or not I should dare speak to him. But if he was willing to talk, there was no need for an appointment. Assuming one did catch him willing to be disturbed, this didn't mean that a graduate student would toss physics questions at him without forethought. His reaction to a question he deemed stupid tended to be very caustic; one was likely to depart his company quite depressed.

The seminar was Oppie's domain, his fiefdom. He selected the speakers; except on rare occasions he totally dominated its proceedings. In complete contrast to his classroom practices, Oppie almost never allowed himself to be the seminar speaker. He preferred instead to sit in the front row and interrupt the speaker with questions. Unless he formally had scheduled a speaker from outside his group, Oppie's first choice for speaker always was whomever prominent theoretical physicist momentarily happened to be visiting the Berkeley physics department; a scheduled talk by any member of Oppie's group obviously could be and would be postponed.

In those years the Berkeley cyclotron was one of the seven physics wonders of the world. Famous physicists flocked to Berkeley from all corners of the globe. Enrico Fermi gave an extended series of lectures in 1940, and Wolfgang Pauli visited in 1941. Oppie managed to convince such visiting theorists to speak in his seminar. We were able to hear about research at the forefront of theoretical physics right from the horse's mouth.

Mostly, students would speak on research they had completed and were about to write up; occasionally Oppie would assign someone to talk on a published paper he thought worth discussing. When student speakers in such categories could not be mustered, the duty of speaking would fall back on Oppie's research associate. It was Oppie's practice each year to assign his research associate a broad subject, almost the equivalent of a course, which said associate would speak on in a continuing fashion whenever no other speakers were available.

Tossing questions at the speaker was Oppie's preferred seminar role with visiting and homegrown speakers alike. If a question was not answered to Oppie's satisfaction he would furnish his own answer, and he was not averse to brushing the speaker aside and going up to the blackboard if he felt the occasion warranted the intrusion.

Unfortunately, his answers often did not always clarify the issues at hand. I well remember the many occasions when, after one of Oppie's answers, the cry "But Oppenheimer!" uttered in a German accent, welled up from Stanford Professor Felix Bloch who approximately once a month drove to the seminar from Palo Alto. We students reveled in Bloch's discomfiture and were fond of saying that Bloch was Oppie's most advanced student. It was not until after the war that I realized Bloch was a distinguished physicist; he won a Nobel Prize in 1952.

Oppie's seminar performances avoided disconcerting any of his visiting speakers; he was a polite man. But with his students, his questioning was fierce, often cruelly so.

I do not believe Oppie was in any way sadistic; he legitimately could be termed kindhearted. And I feel confident that the questions Oppie put to his student speakers were designed not to embarrass but to elucidate, more often for the benefit of the audience than for himself. I wouldn't be surprised if Oppie's persistent questioning was nothing more than an automatic attempt to remedy the discomfort he clearly felt when hearing any theoretical physics statements he thought wrong or even imprecise; it could have been like scratching an itch.

Sadly, Oppie lacked the empathy that would cause him to draw back, once his previous questions had reshaped the student speaker into a quivering hulk incapable of profiting from, much less answering, any further questions.

Nor, when Oppie's research associate Leonard Schiff gave a seminar, did Oppie treat Leonard any more kindly than he treated his student speakers. On more than a few occasions Oppie had Schiff visibly on the verge of tears. As with Bloch, Oppie's treatment of Schiff left his students with no real appreciation of Schiff's talents. Certainly we would not have predicted that Schiff would have a distinguished career.

I cannot refrain from contrasting Oppie's treatment of Schiff with his treatment of Julian Schwinger, who in 1940 replaced Schiff as Oppie's research associate. We were eagerly anticipating Julian's first seminar. But whereas the other students were wondering how long it would take Julian to shrivel under Oppie's questioning, I was wondering how Oppie would react to Julian's refusal to shrivel. I had been exposed to Julian's talents during my undergraduate years at City College in New York.

Julian's first seminar went exactly as I expected. Julian started talking and very soon Oppie asked Julian a question, which Julian answered. Another question followed, and Julian answered. More questions came; more questions were answered. After about a dozen questions, answered by Julian with no visible sign of distress whatsoever, Oppie stopped firing questions and let him finish his seminar without further interruption. Nor did he ever again unduly interrupt during any succeeding seminar of Julian's. Oppie stopped asking questions because it became apparent that Julian always knew what he was talking about and would sufficiently discuss any subtleties inherent in his seminar subject without having to be prodded.

With the bulk of his students, Oppie was closely involved with their PhD researches. He was interested in many of the problems they were working on, and in not a few instances himself worked on the problems alongside his students.

Even if he wasn't terribly interested in the outcomes of some of those researches, the problems all were nontrivial and fully involved modern physics; any student who completed one of those assigned research problems was transformed thereby, into a significantly more competent theoretical physicist than when he had begun the work.

Of course, I would expect that in discussing their mentors my words would be echoed by the students of any of our great modern theoretical physicists, *e.g.*, by Oppie himself as a Max Born student.

Oppie did his physics, talked about his physics, lived his physics, with a rarely duplicated passion, which had to inspire his students; he certainly inspired me.

Despite his sometimes overly ferocious questioning, despite the sarcasms that Oppie really should have suppressed, we his students respected him and felt indebted to him; knowing that Oppie so obviously passionately loved doing physics, that he so obviously always had physics in the forefront of his mind, helped us believe that becoming a competent theoretical physicist was worth the fairly enormous effort required, especially in those prewar economically depressed days when the word physics had no popular resonance and jobs for theorists were very hard to come by. And, for imbuing me with this belief, I respect and feel indebted to him still.

Edward Gerjuoy is professor of physics emeritus at the University of Pittsburgh. This article is adapted from a talk presented at a Los Alamos symposium on "Oppenheimer and the Manhattan Project", June 26, 2004.

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.