George Trilling Elected APS Vice-President

Members of The American Physical Society have elected George H. Trilling, a professor emeritus at University of California, Berkeley and senior faculty physicist at Lawrence Berkeley National Laboratory, to be the Society’s next vice-president. Trilling’s term begins on 1 January 2000, when he will succeed James Langer (University of California, Santa Barbara), who will become president-elect. Trilling will become APS president in 2001.

The 1999 president is Jerome Friedman (Massachusetts Institute of Technology). [Look for our annual interview with the incoming APS president in the January 1999 APS News.]

In other election results, Michael S. Turner of the University of Chicago and Fermilab was elected chair-elect of the APS Nominating Committee, which will be chaired by Daniel Kleppner of MIT in 1999. The Nominating Committee selects the slate of candidates for vice president, general councillors, and its own chair-elect. Its choices are then announced to the APS membership. Elected as new general councillors were Philip H. Bucksbaum of the University of Michigan; L. Craig Davis of the Ford Research Laboratory; Leon Lederman of the Illinois Institute of Technology and Fermilab; and James Trefil of George Mason University. Several minor amendments to the APS Constitution were also approved by the membership in order to permit electronic ballots in future membership-wide elections and proposed Constitutional amendments. The Society hopes that electronic balloting will increase voter participation, lower expenses, and reduce the environmental impact generated by the mailing of paper ballots to each APS member. Confidentiality and accuracy of electronic ballots would be assured, although members preferring to vote on a paper ballot would retain that option for the foreseeable future.

Vice-President
Born in Poland, Trilling received his PhD in 1955 from the California Institute of Technology, joining the University of Michigan in 1957 as assistant professor of physics. Three years later he moved to the University of California at Berkeley, serving as Department Chair in 1968-72, and as Director of the Physics Division of the Lawrence Berkeley National Laboratory in 1984-87. His research is in experimental particle physics, and has included studies of hadron interactions and resonances, electron-positron annihilation at high energy, and colliding beam experiments and detectors. Within the APS, Trilling served on the Physics Planning Committee and as Chair of the Division of Particles and Fields. He is presently a DPF Divisional Councillor.

In his candidate’s statement, Trilling identified the Society’s general meetings, education and outreach, and communication with the membership as priorities for the APS. He supports emphasizing presentations by outstanding speakers on topics of general interest to help maintain interest in general meetings. Finding ways to make undergraduate physics education more valuable and attractive could help combat the reduced numbers of physics majors in many universities. With regard to outreach and research support, Trilling advocates working with other professional societies to play a leading role in informing the government and general public about the importance of R&D over a broad range of scientific fields, particularly emerging in nano-technologies.

Physicists Win Nobel Prizes in Physics and Chemistry

In October, the 1998 Nobel Prize in Physics was awarded to Horst Stormer of Columbia University, and Dan Tsui of Princeton, University, for their discovery of the fractional quantum Hall effect at Bell Labs in 1982. They share the prize with Robert Laughlin of Stanford University, who explained the puzzling phenomenon in terms of quasiparticles a year later. The award will be officially presented at the Royal Swedish Academy of Sciences in Stockholm, Sweden later this month. Stormer and Tsui, both APS Fellows, shared the 1984 Oliver Buckley Prize, which Laughlin won two years earlier. The trio also shared the 1986 Medal of the Franklin Institute for their work associated with the fractional quantum Hall effect.

Born in 1950 in Visalia, California, Laughlin received his PhD in physics in 1979 at the Massachusetts Institute of Technology. He has been a professor of physics at Stanford since 1989. Stormer was born in 1949 in Frankfurt/Main, Germany, and earned his PhD in physics in 1977 at Stuttgart University. He was a supervisor of the Physical Research Laboratory at Bell Laboratories from 1992-98, and is now a professor of physics at Columbia University. Born in 1939 in Henan, China, Tsui received his PhD in physics in 1967 at the University of Chicago, and has been a professor at Princeton University since 1982.

Two other APS Fellows shared the 1998 Nobel Prize in Chemistry. Walter Kohn, a physicist at the University of California, Santa Barbara, and John Pople, a chemist at Northwestern University were cited for their contributions to the theory of electronic structure. Their work associated with the quantum Hall effect has been used in the development of new magnetic materials, and has been a major factor in the growth of nanotechnology.

continued on page 6

Elucidating the Hall Effect

The Hall effect is named after Edwin Hall, who in 1879 observed that electrons moving along a strip of a metal conductor (under the influence of an electric field) will, if subject to a magnetic field perpendicular to the plane of the strip, be deflected toward the side of the strip. Because of this, an excess of charge will build up on one side of the strip. This Hall voltage is proportional to the strength of the magnetic field. That is, a plot of Hall voltage (or equivalently the electrical resistance of the material to the sideways current flow) versus field strength would be linear. All of this can be explained in terms of classical physics.

Later, the Hall effect would be studied in a very different setting. The time the electrons are those moving in the two-dimensional world at the interface continued on page 6
Rockey Tackles Range of S&T Issues as Congressional Fellow

G rapping with defense R&D issues, supporting the R&D tax credit, and lobbying to double federal investment in R&D in the decade are just a few of the challenges Peter Rooney, the 1998 APS Congressional Fellow, faced. Rooney spent the year as a legislative assistant in the Congressional office of Sen. Joseph Lieberman (D-CT), lending his technical expertise on a variety of science and technology issues.

Rooney received his PhD in physics in 1995 from the University of California, San Diego, where his research focused on studying the effect of deposition conditions on mixtures of superfluid thin-film binary-metal alloys. During graduate school, he obtained valuable experience as a research assistant with two industry-affiliated research centers, stimulating his interest in U.S. industrial competitiveness and its relation to technology-intensive industries. He also has prior experience as both an entrepreneur and public service advocate with his local school board, as well as lobbying organizations in California on behalf of environmental issues.

Just prior to his fellowship year, Rooney was a program officer for the National Research Council’s panel on the role of the responsibility for the management of the annual assessment of technical programs for areas of the National Institute of Science and Technology, which engages in physical science and information science research and development. He also served as a study director for three different NRC panels: one on planetary protection issues surrounding a possible Mars sample return mission; another evaluating various NASA space science technology projects for Mars exploration missions; and a third to examine the status of research and engineering directed toward developing alternative automobile fuel suppression agents to replace halons on naval platforms.

These experiences provided a valuable backdrop for Rooney as he tackled a broad range of science-related issues as a Congressional Fellow. A significant portion of his time was spent on innovation defense R&D issues related to Senator Lieberman’s position as ranking member on the Acquisition Technologies Subcommittee of the Senate Armed Services Committee, which has oversight over the defense R&D infrastructure.

Another critical thrust was civilian R&D funding, specifically the creation of a bipartisan bill that would double federal research funding over the next 12 years, currently known as S.217, the Prist- Rockefeller Federal Research Investment Act. While “we did get a bill through the Senate,” says Rooney, the effort must begin anew in the next Congress, since “there was no companion bill.” Still, he believes that this year’s main accomplishment was the building of a coalition of interest groups around the issue. The Association of American Universities was in the forefront in forming this coalition, along with other professional science and engineering societies (see APS News, January 1998, page 6). The groundwork is being laid to increase R&D funding in the next Congress, and it is my expectation that there will be coordination with both the House and the White House on this issue next year.

Another issue that cropped up during the year was the Research and Experimentation Tax Credit. Colloquially known as the R&D tax credit, the long-standing program is intended to create incentives for private sector investment; unfortunately, it tends to lapse every few years, according to Rooney. He aided the Lieberman office in lobbying for Senate support of a bill that seeks not only to make the tax credit permanent, but works to restructure the program to make it more efficient and accessible. That effort was spearheaded by senator Jeff Bingaman (D-NM), the ranking member on the Senate Joint Economic Committee, and his committee staff. Rooney also briefly found himself involved in efforts to digitize copyright issues for databases.

Rooney was encouraged by his observation of both increased Congressional interest in science and technology issues, and increased levels of scientific literacy as a result of that growing interest. He sees a growing recognition that the high-tech sector of the economy is in fact very important. As an example, he points to Texas, where employment in the high tech sector is currently more than twice that of the oil industry, as well as numerous other states that have traditionally been aligned with heavy manufacturing or agriculture but are moving into software and telecommunications.

“Eventually that seeps into the Members’ consciousness,” he says, “so there’s a perception that because of the way the economy is developing, science and technology issues are going to be very important in policy making.”

Overall, Rooney pronounced his fellowship year a success. “I would have gotten along better than I could have anticipated,” and praised the experience, professionalism, effectiveness and strong involvement in science issues of Senator Lieberman and his Congressional staff. Rooney intends to remain involved in the science policy arena, preferably on Capitol Hill. “I love what I’m doing now and would love to remain in this arena,” he said.

The APS Congressional Fellowship program is intended to provide a public service by making available individuals with scientific knowledge and skills to Members of Congress, few of whom have science backgrounds. The program has been important because public policy increasingly is determined by technical considerations, and science is a major component of many issues with which Congress must grapple—global warming, energy policy, defense technologies, AIDS, pollution, and more. Legislators, he says, “are not going to name a few. In turn, the program enables scientists to broaden their experience through direct involvement with the legislative process. It will ideally help them not only enhance their own careers, but the physics community’s ability to communicate more effectively with its representatives in Congress.

If you are interested in becoming a Congressional Fellow, turn to the announcement on page 7. The application deadline is January 15, 1999.

Distinguished Traveling Lecturer Program in Laser Science

The Division of Laser Science (DLS) of the American Physical Society announces the continuation of its sponsorship of a lecture program in Laser Science, and invites applications from host schools for the next round of awards. Lecturers will visit selected academic institutions for two days, during which they will give a public lecture open to the entire academic community and meet informally with students and faculty. They may also give guest lectures in classes related to Laser Science. The purpose of the program is to bring distinguished scientists to predominantly undergraduate colleges and universities in order to convey the excitement of Laser Science to undergraduate students.

Lecturers for the 1997-1998 Academic Year:

- Geraldine Richmond, Univ. of Oregon, Dept. of Chemistry. Surface Non-Lin- ear Optics.
- Jorgensen, AT&T Bell Laboratories. Quantum Optics, including semiconductor.
- Philip Buckmann, Dept. of Physics, Univ. of Michigan, High-Field Laser Physics.
- Carlos Stroud, The Institute of Optics, University of Rochester. Wave packets.
- Lee W. Casperson, Department of Electrical Engineering, Portland State University. Lasers and Optical Systems.

Applications should be sent to Win Smathers, Washington University, St. Louis, Missouri. The extended deadline for this year’s applications is February 18, 1999.

Detailed and up-to-date information about the Program and the application procedure is available on DLS homepage on the World Wide Web at http://www.physics.wustl.edu/~cooker/dls

Centennial Travel Awards for NY State High School Teachers

The New York State section of the Society will make two awards in 1999, each valued as much as $1000 each for high school science teachers from New York State or contiguous states or provinces to attend the Centennial Meeting in Atlanta, Georgia, March 20-26, 1999. Individuals interested in applying should write to:

Centennial Travel Awards Program, Chair NY SSPS, Physics University at Albany, Albany, NY 12222 [c.macdonald@albany.edu] for more information.

The deadline for applications is January 15, 1999.
Tenure Task Force Submits Final Report

The APS Task Force on Academic Tenure, chaired by John Poate (New Jersey Institute of Technology), presented its Final Report to the APS Executive Board in September, and to the APS Council in November. The task force concluded that no official statement from the APS is required at this time. The full report follows below.

The other members of the APS Task Force on Academic Tenure were Raymond Brock, Michigan State University; Jolie Cziewski, Rutgers University; Roger Falcone, University of California, Berkeley; Robert Gluckstern, University of Maryland; and Stephen Ralph, Georgia Institute of Technology. In addition, John Export, executive assistant to the APS President at the University of Maryland, College Park, served as legal consultant to the task force.

Final Report on Academic Tenure

After a thorough review of the extensive material on Academic Tenure, the task force concluded that the tenure system is still viewed by the physics community as a privilege not an entitlement and if institutions, which combine both research and teaching, were to start from scratch they would probably come up with a system very similar to the existing tenure system.

There is little evidence that the professions of academic community, or physicists in industry and national labs, are overly concerned about tenure. The tenures that exist are both the result of the non-tenured stream teaching and research staff. These tensions could grow as university research enterprises expand. Junior physicists discern that problems with the tenure system lie primarily with such factors as lack of retirement age for senior faculty. They also perceive the increase of the non-tenured stream to be a problem. Institutions that expand their missions from a predominantly teaching role to include both teaching and research experience tensions between the existing teaching faculty and the newly-hired research faculty. This is especially true if the institutions do not have the resources to hire an adequate number of research-oriented faculty.

The review process now spans the range from the usual annual salary review (and concomitant merit reviews) of junior and senior faculty to a periodic formal review of the person's tenure, a process which could ultimately lead to loss of tenure. Physics departments do not usually feature in tenure war because of quantitative standards, however, a better job could be doing articulating annually the criteria for tenure to tenure-track faculty. Realistic evaluations of the relative weights of teaching and research in the tenure decision process must be given, this implies an understanding of the institutional mission.

Finally, there is a lack of knowledge in the academic community as a whole regarding the legal basis and the very recent history of tenure. There is not a body of law relating to tenure or academic freedom. Tenure is essentially a contractual agreement and academic freedom items from the First Amendment right.

The Task Force recommended that the APS should not make a statement about the role or future of tenure in the physics community at this time. Such a statement could be harmful in the current environment where the tenure debate, which is not a uniquely physics phenomenon, appears to be largely driven by political or perceived financial imperatives. The Task Force feels that there are much larger challenges facing the physics community such as more comprehensive undergraduate and graduate training, financial constraints, and the physics research infrastructure.

If there are to be changes in the tenure process or structure of the physics community they will probably be driven by market and/or political forces. The time for a statement by the APS would be when these forces start to radically change the physics community.

The Task Force urged the APS to encourage all physics departments to articulate the requirements for tenure and promotion and mentor junior faculty at all stages. In addition, an APS sponsored article detailing the legal history of tenure and academic freedom in Physics Today or the Chronicle of Higher Education could be of general interest to the community.

executive Board reaffirms 1995 EMF statement

At its September meeting, the APS Executive Board reaffirmed the Society’s 1995 statement (http://www.aps.org/statements) on power line fields and public health, triggered by public concern over the perceived potential cancer risk from extremely low frequency electromagnetic fields generated by power lines. That statement concluded that “conjectures relating cancer to power lines is unsubstantiated.” In fact, since then, additional scientific studies and exhaustive evaluations by the NAS and AAAS, respectively, told no evidence of health effects from power line fields. The Executive Board was prompted by actions of a panel convened by the National Institute of Environmental Health Sciences, which voted to make EMF a “possible” carcinogen. Their claim contradicts a 3-year NRC review and the enormous number of epidemiological studies. In a second statement approved at the same meeting, the APS Executive Board of the American Physical Society affirmed the NAS and AAAS recommendations on the issue. The Board also expressed support for the efforts of its officers and others to achieve science-content standards in the State of California that are consistent with those developed by the NAS and AAAS.

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Senior/Retired Member Breakfast at Centennial

An APS Senior/Retired Member breakfast will be held Tuesday, March 23 from 7:30am to 9:00am Spouses and companions are welcome. This special breakfast will be hosted by the APS and Mid-Atlantic Senior Groups. Tickets can be purchased for $10 at the time you register for the meeting, either prior or on-site. Space is limited, and tickets will not be sold at the door. Information will be available about the activities of the newly-formed Mid-Atlantic Senior Groups and how other senior groups can get started.

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Attend a Grand Reunion at the Centennial

In response to an invitation to all PhD-granting physics departments, the universities and research laboratories listed below have chosen to participate in our special “Grand Reunion” which is part of the APS Centennial Celebration. The Grand Reunion will be held on Tuesday, March 23, 1999 from 6:00-8:30 p.m. at the Georgia World Congress Center. All of these institutions cordially invite current and previous students, post docs and faculty, as well as friends to visit their reception and renew old acquaintances.

Because space is limited, we regret that we can no longer invite additional universities to participate in the Grand Reunion.

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A century of physics

1975-1985: Images

By Hans Christian von Baeyer, William and Mary University

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July 20, 1976, a couple of weeks after the two hundred birthday of the United States, an automated spacecraft landed on the moon and beamed back images of its red soil. The world held its breath as a robot searched for extraterrestrial life (and found none). A significant result of the experiment, was the manner in which the written and spoken word which had been the principal carrier of news since ancient times.

Science itself has long recognized the value of human vision enhanced by technology. To the telescopes, microscopes, and cameras of classical physics the twentieth century has added television, holography, and, most importantly, the computer. The field of computer graphics, which builds upon discoveries in modern physics, has in turn become an indispensable tool for basic research.

In 1981 an ancient dream came true when the outermost of individual atoms were revealed to man’s eye for the first time. The instrument that made this possible, called the Scanning Tunneling Microscope (STM), consists of a fine needle whose tips gently scans a surface the way a blind person’s fingertip might scan an unfercible face. The instrument was first fed into a computer which organizes them into a picture resembling the underside of an egg carton: each bump represents a single atom. Synthetic color coding adds to the contrast and helps to identify atoms of different species. The resulting map of the invisible atomic landscape we inhabit is imbued with a haunting beauty.

In medicine the combination of computers with different probes has yielded equally dramatic results. Views of the brain produced by pencil-thin beams of X-rays — useless when considered individually — are assembled by Computerized Tomography (CT) scanners into three-dimensional color coded images that have revolutionized neurosurgery. Ultrasound images of fetuses have benefited obstetrics. Other techniques for peering into the human body include Magnetic Resonance Imaging (MRI), which produces the picture and Positron Emission Tomography (PET scanning), which records the radiation emitted when positrons from radioactive materials administered to the body annihilate electrons in nearby cells.

Even pure mathematics, the queen of the sciences aloof from the material world, has embraced computer graphics. The Mandelbrot set, for example, a mathematical structure whose delicate beauty and complexity fascinates mathematicians, artists, and computer whizzes, owed its discovery in 1979 to the result of the universal spread of color TV, visual images began to supplant the written and spoken word which had been the principal carrier of news since ancient times. The computer and the physics research infrastructure. The Time for a change in the tenure process or structure of the physics community might well be driven by market and/or political forces. The time for a statement by the APS would be when these forces start to radically change the physics community.

The Task Force urged the APS to encourage all physics departments to articulate the requirements for tenure and promotion and mentor junior faculty at all stages. In addition, an APS sponsored article detailing the legal history of tenure and academic freedom in Physics Today or the Chronicle of Higher Education could be of general interest to the community.

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Science Policy and the Science Community
by William R. Brinkley, President FASEB (Federation at American Societies for Experimental Biology)

This is truly a great time to be a scientist. New tools and technologies are enabling us to perform more research and do it more rapidly than ever before. Starling and revolutionary discoveries are occurring at an unprecedented rate. Every day, scientists allow us to work directly with colleagues around the world as though they were just down the hall. The bar for success is high, yet this is also a time of many serious challenges. Our system of graduate education and research training is experiencing strains, and many people are beginning to question the continued viability of a system that has produced such exceptional scientific and technical talent. There are ethical issues arising out of new discoveries and funding issues that grow more vexing as the cost of doing research increases.

As scientists, we must focus our critical attention on our own research enterprise as well as on the subjects of our various constituencies. Therefore, we were especially fortunate when the leadership in Congress chose a man of science, physicist Vernon Ehlers (R-MI), to chair a major review of U.S. science policy. We now have the report from this study (see “The Back Page”, APS News, November 1998). As President of the Federation of American Societies for Experimental Biology (FASEB), I have asked our public affairs committee to take a careful look at this report and its recommendations.

Our initial review of the report, Unlocking Our Future: Toward a New National Science Policy, has revealed several points of strong agreement, two of which are especially important to the long-term future of American science. We agree wholeheartedly with the suggestion that scientists become involved early in the political decision making process. We also support the recommendation that the federal government fund basic research at a level appropriate to the scientific disciplines. The contributions of these fields are essential to the accomplishments of the U.S. science enterprise and any growth in future funding must reflect their importance.

Regarding political involvement, FASEB has been and will continue to be actively engaged. We believe that our past and future successes are consistent with — and not antagonistic to — growth in other fields. The increases in funding biomedical research do not come at the expense of the other fields of science. There is no single pool of science funds, from which one field’s success is gained at the expense of others. FASEB’s successful program of articulate, focused, and persistent advocacy can be a model for other scientific opportunities to support those actions that are consistent with our programs and within our areas of expertise. Our efforts have been based on the view that strong and vocal support for research funding is our right as citizens and our responsibility as experts in our fields. We must not allow naysayers to define our agenda for us. The assumption that the federal budget cannot support growth in research funding has been proven false. Economic conditions change and budget caps can be raised, revised or surmounted. Success in science has always been characterized by a refusal to accept the limitations that others have set. Things once believed impossible are now so much a part of our everyday lives that we often forget how remarkable and revolutionary they are. We hold the same view in public policy and will continue to aggressively pursue the programs and policies that are in the best interests of the research community.

I can assure you that the community of biological scientists stands firmly behind the goal of funding in a broad spectrum of disciplines. For we truly believe that tremendous potential for progress in biological and medical research will only be achieved if there is a steady flow of new insights from the other fields of science. These discoveries have propelled much of our progress in the past and will undoubtably guide our success in the future. FASEB is on record in support of broad, multiyear, and multidisciplinary funding. Last year, our annual funding conference recommendations included a 10% increase for NSF, including all of its directorates and programs.

For several years, we have invited the leaders of the American Physical Society (APS), the American Chemical Society (ACS), and the American Mathematical Society to join us in developing our recommendations for federal science funding. Last year, we testified jointly on the NSF appropriation with the Presidents of APS and ACS and look forward to continuing this cooperation in the coming year. We have also been active supporters of the Coalition for National Science Funding (CNSF), an umbrella organization working to raise the profile of the NSF and increase funding for research in science, engineering, and mathematics.

FASEB’s testimony in support of the National Institutes of Health (NIH) was based upon our assessment of the tremendous opportunity for advancement in the health sciences. These recommendations, however, explicitly acknowledge the importance of physics, chemistry, mathematics, computer science, and other fields in medical research and call for funding increases to ensure that research in these fields is able to flourish. Our FY1999 funding conference report called upon NIH to establish more collaborative programs with physicists, mathematicians, and engineers.

Indeed, it is time to raise the funding levels of all areas of science in the name of improved health, quality of life and quality of life. Funding levels in other disciplines, physics, chemistry and engineering are vital to progress in medical science. Therefore, FASEB fully endorses Congressman Ehlers’ proposal that the federal government increase funds for basic research in a broader spectrum of scientific disciplines. We look forward to the opportunity to work with the leaders of these disciplines to help make this happen.

Ig Nobel Prizes Awarded at Harvard

The 1998 Ig Nobel Prizes, presented for achievements that “cannot or should not be reproduced,” were awarded at Harvard’s Sanders Theatre in early October before 1200 spectators in a ceremony filled with bizarre, quirky, and exotic duct tape. The event was produced by the science humor magazine, Annals of Improbable Research (AHR), and co-sponsored by the Harvard Computer Society, the Harvard-Radcliffe Science Fiction Association, and Manco, proud suppliers of Duck® tape.

The Prizes were physically handed to the winners by genuine Nobel Laureates William Lipscomb (Chemistry ’76), Richard Roberts (Physiology or Medicine ’93), Dudley Herschbach (Chemistry ’86), and Sheldon Glashow (Physics ’79). The evening also featured numerous tributes to duct tape, including a duct tape fashion show and a duct tape open. Richard Robert was the prize in the annual Win-a-Date-With-a-Nobel-Laureate Contest.

Recipients of the 1998 Ig Nobel Prizes and the prizes’ descriptions are:

Safety Engineering
Troy Hurtubise, of North Bay, Ontario, for developing, for personal use, and then testing a safety vest of armor that is impervious to grizzly bear bites.

Biology
Peter Feng of Gettysburg College, Gettysburg, Pennsylvania, for sending the happiness of clams by giving them Prozac.

Physics
Deepak Chopra of The Chopra Center for Well Being, La Jolla, California, for his unique interpretation of quantum physics as it applies to life, liberty, and the pursuit of economic happiness. Sheldon Glashow (Nobel ’79) accepted on behalf of Chopra, citing Chopra’s use of quantum mechanics in the pursuit of economic bliss. In his best-seller “Quantum Healing”, Chopra explained that “We need to consult the quantum to understand how the mind pivots on the turning point of a molecule.”

Chemistry
Jacques Benveniste of France for his research on the turning point of a molecule.”

Economics
Jerald Bain of Mt. Sinai Hospital in Toronto, Ontario, for demonstrating that the federal budget cannot support growth in research funding. Last year, we testified jointly on the NSF appropriation with the Presidents of APS and ACS and look forward to continuing this cooperation in the coming year. We have also been active supporters of the Coalition for National Science Funding (CNSF), an umbrella organization working to raise the profile of the NSF and increase funding for research in science, engineering, and mathematics.

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How Duct Tape Sealed My Place in History

by Max Sherman

“Daddy is famous,” declared my five-year-old. “Famous” is something Subrina can relate to, unlike “scientist,” which is what Daddy really is. While my daughter recognize that I spend a lot of time understanding of the purpose of my scientific work — “saving electricity” — she notes there is not much glory in my name in the paper and on the radio.

I owe this to what appears to be one of the foundations of American society: duct tape. I have a sense that any sticky stuff you probably have in your house, car, boat, truck, or garage is mentioned in Subrina’s book, hearing about me in September, or at least about my work, because I was credited with finding out that duct tape is really not so good for sealing ducts.

The story of my findings spread globally, breaking all barriers of age, class, and culture. The newsreel, appearing in more places than I dare to count, was a duct-tape feeding frenzy. Yes, I am really a scientist, and yes, I really am doing science, I thought, finding that I had other things as well. In the next week came the Life magazine story and the Mercury News. I formed an appreciation for what good science editors and writers do at metropolitan papers. Most of the other coverage was from The New York Times. Cernet Pyton of the Bee came to our lab to interview us and see the apparatus and the results. Glennia Chiu of the Mercury News came down to the conference where I was presenting the results.

The few days which followed are still a blur. I was interviewed (by phone) by MSNBC, NPR, CBS, the Australian Broadcasting Corporation, and several others that I can’t remember.

The Canadian Broadcasting Corporation’s “It’s Happened” radio program interviewed me with my Canadian co-author, Ian Walker; followed by a listener call-in on duct tape the following day.

So I was doing several interviews daily, answering questions like: “How did it get its name?” (I don’t know.) “What can you use it for?” (Anything but ducts.) “Do you use duct tape?” (All the time, just not on ducts.) It gives one a bit of a swelled head to have two producers from NPR fighting over the show you should be on, or to put the Associated Press on hold while you talk to CBS.

Early one morning while I was at the conference, my wife got a call from aluminum that he did.

I admit to selecting those words for their impact. “Catastrophically” is technically quite accurate, but sounds like something that big chunks of carbon were being added to our atmosphere needlessly. This was a significant problem, and one for which I had the correction.

There is a sort of duct tape cult, which was grabbed by the media, was that “it failed reliably, and often catastrophically.” I admit to selecting those words for their impact. “Catastrophically” is technically quite accurate, but sounds like something that big chunks of carbon were being added to our atmosphere needlessly. This was a significant problem, and one for which I had the correction.

Atom Wire Resist Conventions

As the electronic circuits on chips continue to be miniaturized, physicists have naturally looked ahead to the smallest wires possible: those of only a few atoms or molecules. Researchers have made some monumental ventures in the lab, but the electrical properties of atomic wires are not well understood. Calculations published on 19 October in Physical Review Letters show that even though the examples provided are surprising. While a normal wire increases its resistance with increasing length, they found that the resistance of a chain of carbon atoms oscillates with length, becoming higher for an even number of atoms than for an odd number. The result shows that the connections at either end of the atomic wire have important effects on the wire’s properties and behavior.

Atom wires are not only small; their lack of impurities should allow them to carry thousands of times the current density that normal copper wires can handle, according to Phaedon Avouris of the IBM Watson Research Center in Yorktown Heights, NY. He also says atom wires could be used to make carbon nanotube computers, the molecular cousins of buckyballs, which many researchers see as today’s most practical nanoscale wires. To better understand the properties of these tiny conductors, Avouris and his IBM colleague Neng Nang Lang analyzed a wire made of the two carbon atoms attached to large chains of metal atoms. By making electrical connections to the wire, voltage applied across the wire, they calculated its conductance (inverse of resistance).

According to their calculations, the conductance of such a wire does not change continuously with length, but is higher for odd numbers of atoms, lower for even. The reason, they found, is that for three, five, or carbon atoms, there are more available states for electrons to occupy as they traverse the wire. This pattern is determined not only by the structure of the free carbon chain, but also by the number of extra electrons that are permanently drawn onto the wire from the metal contacts. Subishing has already observed at the wire’s conductance as the two electrodes are moved apart, keeping the wire fixed in length and centered between them. Again, the result was surprising: the conductance drops, then increases to a maximum with increasing distance, even as the electrodes’ contact with the wire worsens.

Booth results point to the importance of carbon-metal interactions, says Uri Landman of the Georgia Institute of Technology in Atlanta. “It’s not enough anymore to just study the wire itself because everything depends on the contact,” he says. Landman has also looked at the wire’s conductance as the two electrodes are moved apart, keeping the wire fixed in length and centered between them. Again, the result was surprising: the conductance drops, then increases to a maximum with increasing distance, even as the electrodes’ contact with the wire worsens.

All of this conductance data, then, provides a hint for physicists to perform more detailed calculations of these effects and experimentalists to test the predictions.


Note: A line was dropped from the first paragraph of the November PR Focus article. The on-line version has the correction.

Physical Review Focus

PR Focus is a FREE APS electronic journal featuring highlights of selected Physical Review Letters accepted by all physics journals. PR Focus is available in April, 1998 APS News. PR Focus is available at the web address: http://publish.aps.org/FOCUS. APS News will print samplings from the next few issues to introduce the membership to this new journal. To receive one-per-season introductions and press releases, send the following message to majordomo@aps.org: subscribe-focus [Leave the subject line blank].

A world’s smallest electron. Electron density contours show the six-atom chain and semi-infinite states of metal used for the calculation of atom wire conductivity.
Plasma Processing, Electron Swarms Highlight 1998 GEC

Plasma processing, electron swarms, and innovative plasma sources were among the joint research topics presented at the 14th Interdisciplinary Laser Science Conference (ILS-XIV), held 5-9 October 1998 in Baltimore, Maryland. Sponsored by the APS Division of Plasma Science and held in conjunction with the annual meeting of the Optical Society of America, the conference combines fundamental studies of laser interactions with atoms, molecules, clusters, plasmas, and materials with research on emerging applications, such as environmental studies, atmospheric monitoring, and medicine.

The featured plenary speaker for 1998 was Philip Bucksbaum of the University of Illinois at Urbana-Champaign, who spoke on quantum wave packet sculpting with shaped ultrashort laser pulses. The talk emphasized exciting new developments in using lasers to create and control the evolution of quantum wave packets.

Four critical review talks were given by recognized experts on exciting new developments in the field of laser physics. Anand Dabak of Bell Laboratories/Lucent Technologies summarized the history and latest progress on organic and polymer lasers. William Torzelias of Washington State University reviewed the "Golden Age" of optical solitons followed by a review of the "Golden Age" of plasma physics by Grover Swartzlander, Jr., of Worcester Polytechnic Institute.

The final critical review session featured a talk on fiber gratings and ultrashort pulses by R. Jackon. The talk emphasized the need to recruit the active support of industrial leaders.

Organic, Polymer and VCSE Lasers Highlighted at ILS-XIV

Applications of ultrashort spectroscopy to biological problems and recent advances in vertical-cavity-surface-emitting (VCSE) lasers were among the technical highlights at the 14th Interdisciplinary Laser Science Conference (ILS-XIV), held 5-9 October 1998 in Baltimore, Maryland. Sponsored by the APS Division of Plasma Science and held in conjunction with the annual meeting of the Optical Society of America, the conference combines fundamental studies of laser interactions with atoms, molecules, clusters, plasmas, and materials with research on emerging applications, such as environmental studies, atmospheric monitoring, and medicine.

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The final critical review session featured a talk on fiber gratings and ultrashort pulses by R. Jackon. The talk emphasized the need to recruit the active support of industrial leaders.
Diverting Information: the Friends of Dwight Nicholson

**Eligibility:** All undergraduate and first-year graduate students enrolled in physics courses at any university or college in the U.S. can apply.

**Nominating Letter:** Physics department should forward to the APS a brief statement no more than 250 words concerning the rationale for selecting the student(s). It is recommended that the department has included certification that at least $250 of matching support will be provided by the department to supplement the APS award, and a completed information sheet. Any questions or requests for information should be directed to Erik Ridgway, 301-209-3290, ridgway@aps.org.

**Deadline:** All letters must be received at the APS by December 15, 1998. Selected students and their departments will be notified in early January, 1999. All nominations must be mailed to:

- Executive Office
- American Physical Society
- ATTN: Matching Grants
- One Physics Ellipse
- College Park, MD 20740-3844

**Special Note:** Since the APS has limited funds to support the attendance of physics students at the APS Centennial Celebration, departments may elect to support the attendance of more students on their own, even if no travel grant from the APS is awarded. The APS asks that if a department does choose to support more students, that the APS be informed so that all the students attending can be informed of the activities and events designed for them.

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**Grant for Outstanding Doctoral Thesis Research in Plasma Physics**

Established in 1985 and endowed by General Atomic.

**Purpose:** To provide recognition to exceptional young scientists who have performed original doctoral thesis work in outstanding scientific quality and achievement in the area of plasma physics.

- The annual award consists of $2,000, a certificate citing the accomplishments of the recipient, and an allowance of up to $500 for travel to attend the annual meeting of the Division of Plasma Physics at which the award will be presented.

**Rules and Eligibility:** Nominations will be accepted for any doctoral student (present or past) of a college or university in the United States or for a United States’ student abroad. The work to be considered must have been performed as part of the requirements for a doctoral degree. Also, the nominee must have passed his or her final doctoral examination or started regular employment more than 18 months before the nomination deadline for the selection cycle in which the nomination is to be considered. Each nominee will be considered in not more than two consecutive cycles.

- Send name of proposed candidate and supporting information before 1 April 1999 to:
  - Amitava Bhattacharjee
  - Dept of Phys & Astron
  - Univ of Iowa
  - Iowa City IA 52242
  - Phasis (319) 335-1686
  - Fax (319) 335-1753
  - Email amitava@physics.uiowa.edu

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**Excellence in Plasma Physics Research Award**

Established in 1981 with support from Friends of the Division of Plasma Physics.

**Purpose:** To recognize a particular recent outstanding achievement in plasma physics research.

- The award consists of $5,000 to be divided equally in the case of multiple winners, and includes a certificate citing the contributions made by the recipient or recipients to plasma physics research.

**Rules and Eligibility:** Nominations are open to scientists of all nationalities regardless of the geographical site at which the work was done. It may be a set of a given individual or set of individual scientists, as appropriate, who make original theoretical and experimental contributions to the cited research achievement. Nominations are active for three years.

- Send name of proposed candidate and supporting information by 1 April, 1999 to:
  - Charles P. F. Kamyo
  - Princeton Plasma Physics Laboratory
  - Princeton University
  - PO Box 451
  - Princeton NJ 08543-0451
  - Phone (609) 243-4000
  - Fax (609) 243-3348
  - Email kamyo@pppl.gov

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**James Clerk Maxwell Prize for Plasma Physics**

Established in 1975 and funded by Maxwell Technologies, Inc.

**Purpose:** To recognize outstanding contributions to the field of plasma physics.

- The prize consists of $1,000 and a certificate citing the contributions made by the recipient.

**Rules and Eligibility:** The prize shall be for outstanding contributions to the advancements and diffusion of the knowledge of properties of highly excited gases such as natural or laboratory origin. The prize shall ordinarily be awarded to one person but a prize may be shared when all the recipients have contributed substantially to the same advancement. Nominations are active for three years.

Send name of proposed candidate and supporting information by 1 April, 1999 to:

- Philip J. Morrison
- The University of Texas
- Department of Physics
- RM 11.164, Mail Stop C1500
- Austin, TX 78712
- Phone (512) 471-1527
- Fax (512) 471-4715
- Email morrison@searches.ph.utexas.edu

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**APS/AIP Congressional Science Fellowship Program**

The American Physical Society and the American Institute of Physics are currently accepting applications for their 1999-2000 Congressional Science Fellowship Programs. 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 lawmaker’s perspective. In turn, fellows may 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 to the solution of societal problems. Fellows are required to be U.S. citizens and, for the AIP Fellowship, members of one or more of the AIP Member Societies at the time of application.

**Term of Appointment:** For both fellowships, one year, beginning in September of 1999, with participation in a two-week orientation in Washington, organized by the American Association for the Advancement of Science. Choice of congressional assignment is reserved to Fellows.

A **Stipend** of up to $46,000 is offered, in addition to allowances for relocation, in service travel, and health insurance premiums.

**Applications** should consist of a letter of intent, a 2-page resume, and three letters of reference, accompanied by a cover sheet indicating: name, address, phone, email, references, US citizenship, PhD status, society membership, and where you learned about the programs. All submissions should be on standard 8.5”x11” paper, single-spaced, and unbound, and should be sent directly to the address below. Candidates should state in the letter why they think they are well qualified and briefly describe their public service experiences. Letters of reference should discuss not just the candidate’s competence as a physicist, but also the education, experience, and attributes which would particularly qualify the candidate to serve as a Fellow. Union otherwise specified in the letter, the applicant will be considered for both APS and AIP fellowships.

**ALL APPLICATION MATERIALS MUST BE POSTMARKED BY JANUARY 15, 1999.**

**APS/AIP Congressional Science Fellowship Programs**

- 529 14th Street NW, Suite 1050
- Washington, DC 20004

- APS and AIP HomePages: www.aps.org and www.aip.org

Please note that other physics-related Congressional Science Fellowship opportunities are sponsored by AIP Member Societies. For information on the American Geophysical Union program, contact Daryl Tat/202-939-3222. For programs sponsored by the Optical Society of America, contact Liz Balduino/202-416-1418.

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**CAUGHT IN THE WEB**

Notable additions to the APS Web Server:

The APS Web Server can be found at http://aps.org

- **Centennial**
  - Centennial Events updated—Raymond and Ruth S. Moore Foundation activities can be found at http://www.aps.org/centennial/Activities.html
  - Centennial Webpage: www.aps.org/centennial

- **General**
  - **Physics Internet Resources**—Commercial Sites & Community Science Center sections added

- **1999 APS Prize** and Award Recipient Announcements

- **Centennial Events**

- **2000 Physics Internet Resources**

- **Scientific Publishing**

- **Section Newsletters**

- **Centennial Page**

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**APS Mass Media Fellowship Program**

Applications are now being accepted for the 1999 APS Mass Media Fellowship, in conjunction with the popular AAAS program, the APS is sponsoring two ten-week fellowships for physics students to work full-time through mid-August over the summer as reporters, researchers, and production assistants in mass media organizations nationwide.

**Purpose:** The program is intended to improve public understanding and appreciation of science and technology, and to sharpen the ability of the fellows to communicate complex technical issues to non-specialists.

**Eligibility:** Priority will be given to graduate students in physics, or a closely related field, although applications will also be considered from outstanding undergraduates and post-doctoral researchers.

Applicants should possess outstanding written and oral communication skills and a strong interest in learning about media.

**Term and Stipend:** Following an initial three-day orientation in early June 1999 at the AAAS in Washington, DC, winning candidates will work full-time through mid-August. Remuneration is $4,000, plus a travel allowance of approximately $1,000. All travel, accommodation, and relocation expenses will be reimbursed. Mail application materials, which must be received by January 15, 1999, to:

- APS Washington Office
- ATTN: Mass Media Fellowship Program
- 529 14th Street NW, Suite 1050
- Washington, DC 20004

Information on application requirements can be found at http://www.aps.org/public_affairs/Media.html
How To Get Value from Industrial R&D
by Charles Duke, Xerox Corporation

The competitive environment for industry has changed over the past 10 years. Markets, suppliers and partners have become globalized. Information technology has resulted in new ways to work, and international trade has changed from one of military to economic competition. The net result has been an industrial pace of unprecedented speed and intensity, with profound effects on the working lives of physicists, especially those in industry.

So how does R&D contribute to the success of individual firms? Two commonly held models describe the process: the “big bang model” and the “evolutionary universe model.” Named after analogous models that physicists know well. A third, the “big brother model,” deals with the macroeconomic value of research to a nation or society as a whole.

In the big bang model, novel research discoveries or inventions spawn entire new industries. Familiar examples include nuclear power and nuclear weapons (1940-1960), xerography (1960s), the transition from vacuum tube to semiconductor electronics (1950-1960), the switch from propeller to jet aircraft (1950s), and the rise of the personal computer and the Internet (1980 to date). These new industries have a fragmented structure, containing many competing firms, particularly small ones. New products evolve rapidly, because both the market and technical structures are in a high creative phase but often relatively unstructured fashion.

In the evolutionary universe model, existing technology is continually refined, driven by gradual changes in market, manufacturing and technology — particularly technology generated by R&D. Familiar examples include electric power, jet aircraft, cars with internal combustion engines, and xerographic copiers after their introduction by Xerox (1950s) and the rise of the personal computer and the Internet (1980 to date). These new industries have a fragmented structure, containing many competing firms, particularly small ones. New products evolve rapidly, because both the market and technical structures are in a high creative phase but often relatively unstructured fashion.

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Selecting the Right Model
So which model works? Well, it depends. The way in which R&D contributes to a firm’s success depends on factors that determine the quadrant of the “market-technology” matrix, shown in the figure, that the company lies in. For example, the big bang model is most appropriate for those firms working on emerging technologies in emerging markets. For companies with established technologies in established markets, the evolutionary model is most appropriate. Evolutionary models describe the process by which technology is continually refined, without incurring the “downsizing” tendencies in manufacturing. R&D is the environment in which most physicists have spent their professional careers.

The time-to-market process is structured by the paradigm. The time-to-market process is structured by the paradigm. The way in which R&D contributes to a firm’s success depends on factors that determine the quadrant of the “market-technology” matrix, shown in the figure, that the company lies in. For example, the big bang model is most appropriate for those firms working on emerging technologies in emerging markets. For companies with established technologies in established markets, the evolutionary model is most appropriate. Evolutionary models describe the process by which technology is continually refined, without incurring the “downsizing” tendencies in manufacturing. R&D is the environment in which most physicists have spent their professional careers.

Meanwhile, the established markets/emerging technology quadrant belongs to the “global marketers” — firms like Coca Cola and McDonald’s, which take Coke and Big Macs to developing economies. For them, physical science research, as opposed to market research, is irrelevant to their success.

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Impact on Physicists
The new paradigm has described exerts a profound impact on the individual players who practice it. There are three classes of players: those who make things happen, those who help things happen, and those who watch things happen.

Those who make things happen are the committed players, who work directly on industrial R&D as an employee of the contractor. They play by the paradigm’s rules, and they create value for modern industrial firms. Those who help things happen are the company’s partners, be they universities, government institutes or contractors. They may have their own agendas, but they must nevertheless deviate their contribution to industrial value creation under the new paradigm in their role as suppliers. Those who watch things happen compute the bulk of the physics profession. Supported generously by government largesse for more than three decades until recently, they could — and often did — look with disdain at the supposedly mundane world of industry. Unfortunately, young physicists cannot enjoy this luxury because according to statistics collected by the American Institute of Physics, at least one in seven of them in the U.S. will find “traditional” physics employment.

For those who are or wish to be “players” in industrial R&D, you might consider three actions. First, the big bang value system is inappropriate in your new life; discard it. Second, commercial value rather than technical novelty or elegance is rewarded; so generate it by doing the right thing. Third, structured work processes that lead to continuous improvement are an essential vehicle for generating a value at a competitive cost; embrace them by doing the right thing. Third, structured work processes that lead to continuous improvement are an essential vehicle for generating a value at a competitive cost; embrace them by doing the right thing. Third, structured work processes that lead to continuous improvement are an essential vehicle for generating a value at a competitive cost; embrace them by doing the right thing. Third, structured work processes that lead to continuous improvement are an essential vehicle for generating a value at a competitive cost; embrace them by doing the right thing. Third, structured work processes that lead to continuous improvement are an essential vehicle for generating a value at a competitive cost; embrace them by doing the right thing. Third, structured work processes that lead to continuous improvement are an essential vehicle for generating a value at a competitive cost; embrace them by doing the right thing.