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2001 APS March Meeting Moves To Pacific Northwest

The annual APS March Meeting is well-known for featuring exciting groundbreaking research in a broad range of subjects: from condensed matter and materials physics, biological physics, and chemical physics, among other subfields. But the meeting also offers a wide variety of non-traditional topics relating to physics research, science policy, and public outreach. The 2001 conference — to be held 12-16 March in Seattle, Washington — is no exception, featuring talks on the physics of foam and earthquakes, secrets of successful hi-tech start-ups, ethical issues associated with genetically engineered organisms, the future of physics in the national defense, and a panel discussion with physicists who have carved out successful second careers writing science fiction.

A sampling of these sessions is offered below, along with a listing of planned special events. APS members are encouraged to browse the full online epitome for the meeting at http://www.aps.org/meet/MAR01/baps.index.html. (***Note**: All room designations refer to the Washington Convention Center unless otherwise noted.*)

Bubble, Bubble, Toil and Trouble

General physics lectures with a regional twist will be offered at a Monday morning session on the physics of Seattle, and what could be more appropriate for the country's cappuccino capital than a lively discussion of the science and art of foam by Emory University's Sidney Perkowitz (see profile, *APS News*, July 1999). "Foam, bubbles and their patterns are widespread in nature and science, and in human culture, from the birth of the goddess Aphrodite, to artistic usage, to pleasing food and drink," says the popular author of *Universal Foam: From Cappuccino to the Cosmos,* released last year. Perkowitz will present the human and scientific sides of foam and survey current foam-related research, including Seattle-based efforts, to understand and apply its special dynamic and structural properties.

He will be joined by the University of Washington's Steve Malone, who will discuss the physics of both earthquakes and volcanoes in the greater Seattle region. "Seattle may be known for its rain and gloom, but for serious environmental impact they can't begin to compare to our earthquakes and volcanoes," says Malone. The city lies inland from a classic subduction zone, and hence is subject to earthquake shaking from three major source zones — major earthquakes were recorded in 1949 and 1965 — as well as ashfall from volcanic eruptions. Chief among the latter potential disasters is Mount Rainier, a staple of the Seattle area, and considered the most dangerous volcano in the Cascade mountain range. While not a threat to the downtown area, some nearby communities lie directly in the path of devastating mud-flows from the volcano, according to Malone, although scientists expect to have recognizable precursors and hence ample warning of any future eruption.

Session A4, Ballroom 6E

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Seattle skyline and (inset) one of its most famous fictional residents, Dr. Frasier Crane.

Invasion of the GEOs

Recent highly publicized studies suggest serious potential environmental risks associated with releasing genetically engineered organisms (GEOs), renewing public concerns over the evaluation and regulation of these products in both domestic and international arenas. LaReesa Wolfenbarger, an AAAS Environmental Fellow with the EPA, will present an overview of the risks of GEOs — most notably, the emergence of new viral diseases and the spread of invasive (weed-like) characteristics — summarize the available evidence addressing such risks, and discuss challenges for realistic risk assessment to kick off a Monday morning session on biological policy issues. "Ecosystems are a dynamic and complex network of biological and physical interactions," she says. "Introducing a new biological entity, such as a GEO, may potentially alter any of these interactions, but evaluating all of these is unrealistic," and thus she believes that the most useful information for risk assessment is likely to come from experiments that address sources of variability.

Another ethical challenge being raised by the explosion of technological advances in basic biological research is the potential physical risk to human participants, such as stigmatization, discrimination in insurance and employment, invasion of privacy, or breach of confidentiality. Such concerns will be the focus of Elisa Eiseman of the National Bioethics Advisory Com-

See MEETING *on page 5*

APS Holds Unit Convocation

Jessica Clark/APS

On January 27, more than 60 representatives from the 35 divisions, topical groups, forums and sections of the APS gathered at APS headquarters to hear about the society's activities and to exchange information. Here, Director of Meetings and Conventions Donna Baudrau addresses the group on the three fundamental laws of meeting dynamics.

Kleppner, Lamb to Head NMD Study

Daniel Kleppner of MIT and Frederick K. Lamb of the University of Illinois will be the co-chairs of the APS study on National Missile Defense that was approved by Council in November.

The study will analyze a possible boost-phase intercept system, and is on a very fast track, with a final report, to be approved by Council and released to the public, targeted for the end of the year. As Lamb remarked to the APS Panel on Public Affairs (POPA), of which he is a member, the intention is for the study to provide input to the decision-making process, not to comment on decisions already made. Kleppner agreed, saying "Our goal is to define and clarify technical issues that can be helpful to policy makers in formulating our national strategy."

George Trilling, President of the APS, noted that "the APS is extremely fortunate that Dan Kleppner and Fred Lamb, two outstanding physicists, have agreed to devote a significant amount of their time over the next year to lead the NMD Study."

Photo courtesy of Daniel Kleppner

Daniel Kleppner

Photo by William Edelstein

Frederick K. Lamb

Frederick K. Lamb is the Brand and Monica Fortner Professor of Physics at the University of Illinois at Urbana-Champaign, and is Director of the Center for Theoretical Astrophysics there. He has had extensive experience in defense-related studies, including being a member since 1989 of the University Scientists Program of the Institute for Defense Analyses. He chaired the advisory panel that recommended the boost-phase NMD study to the APS Council.

Daniel Kleppner is the Lester Wolfe Professor of Physics at MIT and the Director of the Center for Ultracold Atoms. He is a member of the National Academy of Sciences, and the recipient of both the Davisson-Germer and Lilienfeld Prizes of the APS. His experience in public affairs includes service on POPA from 1989 to 1992, and as Chair of the APS Physics Planning Committee from 1992 to 1996.

Further details about the NMD study can be found in the January issue of *APS News* at http://www.aps.org/apsnews/0101/010103.html.

Major Improvements Underway at PROLA

APS members who currently have access to the Society's *Physical Review Online Archive* (PROLA), either through an institutional or a personal subscription, will now be able to enjoy a variety of new and improved features.

PROLA also has an expanded repertoire of previously published material: *Physical Review*, *Physical Review Letters* and *Reviews of Modern Physics* are online back to 1981. When completed, the archive will consist of all of *Physical Review* back to 1893, all of *Physical Review Letters* back to its origin in 1958, and all of *Reviews of Modern Physics* back to its inception in 1929. The project is scheduled for completion within this calendar year. "PROLA can bring 100 years of physics to every researcher's desk," says Barbara Hicks, APS Associate Publisher.

The PROLA project was first prototyped by APS in 1993 at Los Alamos National Laboratory, with the original goal of creating a searchable index for *Physical Review* from

See PROLA *on page 6*

HIGHLIGHTS

Alicia Chang/APS

"Members in the Media"

Ed. Note: Much press coverage in January was devoted to experiments that achieved the "stopping of light". We begin with three sample quotes on this topic:

"We've been able to hold it there and just let it go, and what comes out is the same as what we sent in. So it's like a freeze frame."

—Ron Walsworth, Harvard Smithsonian Center for Astrophysics, New York Times, January 18, 2001

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"The idea of quantum information is in its infancy. We hope for wonderful things. Our imagination hasn't figured out what the possibilities are."

—David F. Phillips, Harvard-Smithsonian Center for Astrophysics, Harvard Crimson, January 19, 2001

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"What we're talking about is something which on the one hand is much simpler than what they're saying, and also subtler."

—Marlan Scully, Texas A&M University, Dallas Morning News, January 29, 2001

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"These are terrible books, and they're probably a strong component of why we do so poorly in science."

—John Hubisz, North Carolina State University, on his research into errors in physics textbooks, AP, January 14, 2001

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"If I had been a congressman assessing the project on a cost-benefit basis I might have been doubtful. But since the space station is up there it would be silly not to use the real estate."

—Richard Mewaldt, Caltech, on doing science on the space station, Financial Times, January 12, 2001

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"It's not something that particle physicists wanted, desired, predicted or anticipated. This is something we have been forced to consider because of observations."

—Paul Steinhardt, Princeton University, on the "dark energy" in the universe, Dallas Morning News, January 8, 2001.

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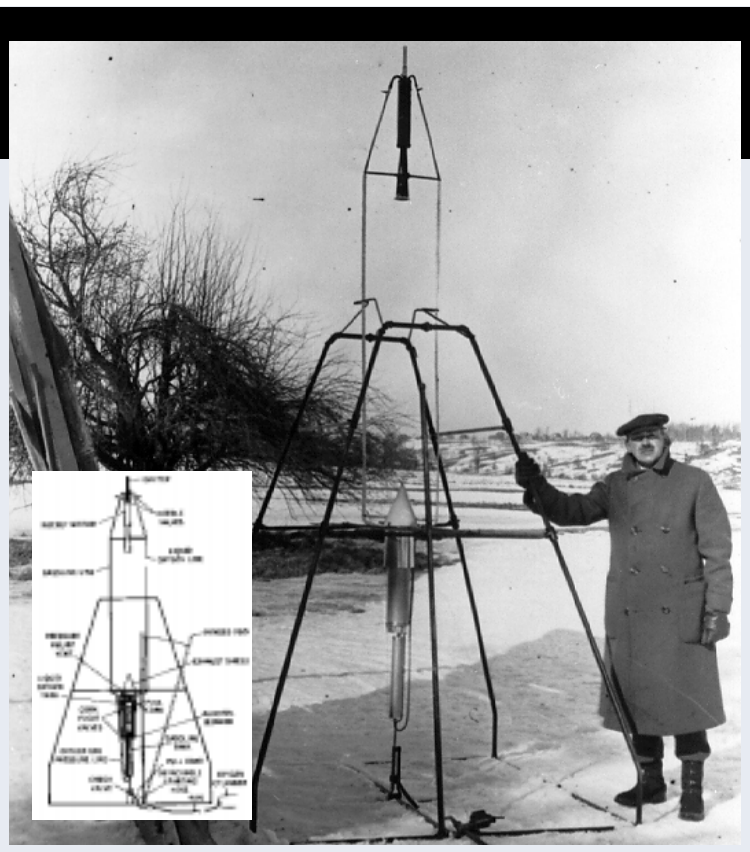
"Brad Pitt, Julianne Moore, Tiger Woods and Lisa Ling can all give thanks to the turkey that gave its life not just to be Thanksgiving dinner but to be the specimen used in the first experiment that gave birth to LASIK."

—James J. Wynne, IBM, on the experiments (unfortunately fatal to the turkey) that led to LASIK surgery, W Magazine, February issue.

This Month in Physics History

March 16, 1926: Launch of the First Liquid Fuel Rocket



For hundreds of years man lived with the deficiencies of the solid, gunpowder type rocket first developed by the Chinese in the 13th century, which were notoriously inaccurate and had declined steadily in use as artillery improved in the late 19th century. One man who did not accept these limitations was Dr. Robert H. Goddard, a New England physics professor and American rocket pioneer who has become known as the father of modern rocket propulsion. His groundbreaking work helped pave the pay for the now booming significance of rocket propulsion in the fields of military missilery and the scientific exploration of space.

Born in 1882 in Worcester, Massachusetts, Goddard was staying with his family at the suburban home of friends near Worcester when, on October 19, 1899, he climbed into an old cherry tree to prune its dead branches. Instead, he gazed at the sky and began daydreaming about the possibility of a device capable of one day going to Mars. "I was a different boy when I came down from that tree," Goddard once said, and he marked the day as an anniversary and private holiday for the rest of his life, since it was then that he essentially dedicated himself to the realization of space flight.

Goddard first attracted public notice for his work in rocketry in 1907, in a dramatic cloud of smoke from a powder rocket fired in the basement of the physics building of Worcester Polytechnic Institute. To their credit, school officials did not expel him, subsequently granting him several leaves of absence to sustain his lifelong interest in and devotion to rocket propulsion.

As early as 1909, Goddard considered the idea of a liquid fuel rocket utilizing hydrogen and oxygen. He continued his research after joining the faculty at Clark University in Worcester. In his studies he recognized that solid fuels produced a lower exhaust velocity than could be obtained by the use of liquid fuels. However, a liquid fuel requires a continuous source of oxidizer to be able to burn at a rate capable of producing the rocket thrust desired. Thus, a means for combining the fuel and the oxidizer at the proper rates in the combustion chamber had to be developed. The high pressures created by combustion required that the fuel and oxidizer be injected into the chamber under even higher pressure.

After a number of design attempts, Goddard finally chose gasoline as the fuel and liquid oxygen (lox) as the oxidizer. Below - 297°F oxygen is a liquid at atmospheric pressures. At higher temperatures it vaporizes, and produces tremendous pressures in closed containers. Goddard used the pressure of this gas to push both liquids simultaneously from their tanks, through separate pipes, to the combustion chamber where they mixed and burned. To speed the vaporizing of the lox, he applied heat with an alcohol burner.

There was a pipe connection for the pressurizing gas between the lox tank and the gasoline tank. Safety required that neither liquid should pass through this pipe and mix with the other before entering the combustion chamber. Once the rocket left the ground, this gas pressure would be the only means for pumping fuel and oxidizer. Before launch, however, it was necessary to pressurize the system from an oxygen cylinder located about 30 feet from the rocket. Heavy rubber tubing fed the oxygen into the rocket's pressure line. As the rocket began to rise, this hose had to be pulled free. The resulting opening was rigged with a flap check value to slam shut and prevent loss of pressure. The combustion chamber was equipped with an igniter system containing match heads and black gunpowder to provide the starting fire for ignition of the lox and gasoline when they were forced into the combustion chamber.

Only a few steps were necessary in the countdown and launch. First, an assistant using a blowtorch on a long pole reached up and heated the igniter casing until the enclosed match heads caught fire and ignited the black powder. He then closed the pressure relief vent on the lox tank and quickly lighted the alcohol soaked cotton in the burner. Next, Goddard piped oxygen from the cylinder to the propellant tanks at 90 pounds per square inch pressure. This forced gasoline and lox to the combustion chamber, where the igniter was still burning. With a loud roar, the rocket motor fired. When the rocket motor's thrust exceeded the weight, it rose a few inches from the ground, tethered only by the hose. With a long rope, Goddard pulled a hinged rod that yanked the hose away, and the rocket was free to fly. The swing of this rod also unseated a spring loaded valve, allowing lox to drip into the heated chamber surrounding the lox tank. The lox flashed into vapor, and the resulting gas pressure fed the liquids to the combustion chamber.

Thus, after 17 years of theoretical and experimental work, Goddard finally achieved flight of a liquid fueled rocket on March 16, 1926, at his Aunt Effie's farm in Auburn, Massachusetts. Goddard recorded the occasion in his diary. "It looked almost magical as it rose, without any appreciably greater noise or flame, as if it said, 'I've been here long enough; I think I'll be going somewhere else, if you don't mind,'" he wrote, adding, "Some of the surprising things were the absence of smoke, the lack of very loud roar, and the smallness of the flame."

After 2½ seconds of flight, the fuel was expended, the roar ceased abruptly, and the rocket fell to earth 184 feet away. It had reached an estimated speed of 60 miles per hour and the height of 41 feet. Although rudimentary and far from a practical design, Goddard's basic concept was validated, and the event is considered comparable in its significance to the Wright Brothers' achievement of manned flight at Kitty Hawk. In the ensuing years, Goddard continued to develop rockets, controlling their motion by gyroscope, steering them with small vanes thrust into their exhaust jet, and building larger and faster rockets.

Yet it fell to others to fully realize his dream. Eighteen years after his successful demonstration at Auburn, Goddard's pioneering achievements came to life in the German V-2 ballistic missile, and he went on to be granted 214 separate patents in rocketry. Alas, the man who in 1920 envisioned a rocket reaching the moon did not live to see the arrival of the modern space age; he died in 1945. NASA's Goddard Space Flight Center in Maryland was established in his memory in 1959, and he is recognized worldwide as the first scientist who not only realized the potentialities of missiles and space flight, but also contributed directly in bringing them to practical realization. In the words of Goddard himself, "It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow."

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Dresselhaus Reflects on Brief but Productive Term at DOE

Editor's Note: Mildred Dresselhaus, an MIT professor who served as APS president in 1984, became Director of the Office of Science at the Department of Energy in August 2000. She stepped down from office in January upon the inauguration of President Bush and returned to teaching and research at MIT.

Q *What do you see as the primary policy issue currently facing the DOE?*

A The DOE budget has basically been decreasing for the last 10 years (see The Back Page, *APS News*, October 2000). Over the last decade, an increasing fraction of the Office of Science budget has gone into the design, construction and operation of large facilities. With level budgets, the support for small group research has been seriously eroded. That is obviously not addressing national needs in terms of being among the world's leaders in the scientific fields represented by DOE. To turn around the declining budgets of the last decade, we need annual increases on the order of 15%. This past year, we managed to achieve a reasonably strong budget, the best in about 10 years. But once again, the lion's share of the funding went to facilities. Overall, DOE has done a very good job in providing research facilities to the nation.

We have a number of facilities that are under-utilized because funding has seriously limited operating time, even though the demand is there on the part of the research community. So the US is not reaping the full potential benefits of their excellent research facilities. More effective utilization of the most active facilities is critically needed. Even though we should be putting more money into research to maintain some kind of balance between research and facilities, the pressing nature of the facilities and the investment required to construct and operate them is a factor that works in favor of getting more funds invested into facilities. We need to turn these trends around before the consequences of this under-investment in the research itself become more damaging and widespread.

Q *Bearing in mind that nobody can predict the future, what would you like to see happen in the DOE in the coming year?*

A I would like to see a continuation of the course we started, namely, maintaining funding for the construction and operation of DOE facilities, but also expanding funding for the research component substantially. Sustained increased funding for the next few years is needed for the Office of Science to provide our unique contribution to the team effort in interdisciplinary research — such as in the nanotechnology initiative — and in the development of important new state-of-the-art instruments and user facilities for this area of opportunity. Particularly timely are the special opportunities now available for research in the US in high energy and nuclear physics, because of the new facilities now coming online. Research funding is needed here. We need to regain lost ground, after 10 years of constant budgets and receding amounts of research funding. The Office of Science received a great deal of support from the research community in getting that message across, including support from many APS members. That kind of input is essential, because it communicates to Congress what is important to researchers, as well as what is not as important.

Q *You maintain that the DOE facilities play an important role in education, particularly in providing hands-on training for budding young scientists. Are there any recent initiatives in this area?*

A The DOE for many years has had a very small education program, in which undergraduates visit the labs in the summer. In recent years that program has focused heavily on women and minorities, and also on community college students, bringing them to the national labs for a summer of hands-on training. Many of them opt to go to a four-year college afterwards. Working very closely with Rita Colwell and her staff at the NSF education division, we established a cooperative agreement between DOE and NSF which expands the former DOE program by a factor of two. This summer twice as many youngsters will be coming to the national labs to benefit from this hands-on training. The hope would be to increase that further by another factor of two the following year.

"The Office of Science received a great deal of support from the research community ... including many APS members. That kind of input is essential, because it communicates to Congress what is important to researchers."

We have also built into the program an evaluation procedure, so that we can see what to focus on, where to put more resources, where we need to make changes. One new experimental aspect is an interface program to help community college students make the transition to four-year colleges. Students in community colleges often are lacking certain classroom experiences they would normally get in a four-year college, so it's difficult for those students to make the transition; their academic records show a very difficult adjustment period. So we implemented a summer program where they would come and get both classroom training and hands-on experience to close that gap.

This program is an excellent example of a new initiative that arose as a collaborative venture between NSF and DOE. It's been a useful collaboration from the perspective of both sides. The NSF has a charter to do science education. But DOE has laboratories that can be used to implement the hands-on training programs that NSF will organize and fund. It's a natural synergy.

Q *How has the role of the DOE changed over the years, and how do you envision its role in the future?*

A I believe that the DOE is one of the primary funding agencies of physics research. It certainly funds more physics research than any of the other agencies. In my youth, the amount of money allocated to NSF, NIH and the predecessor of the DOE was about the same. So I feel that the DOE at least historically at one time was an equal partner with these other agencies in the funding of research in the US. For whatever reason, DOE has come on harder times. This is partly a structural problem. The NSF has sort of a freewheeling independent identity. That isn't the case with DOE. Having the Office of Science buried a few administrative layers below the Secretary of Energy perhaps works against the visibility of physics in terms of funding nationwide. The advantages and disadvantages of such an administrative structure are arguable.

Balance between the sciences is very important. Unless there's enough physics being done, the progress of other fields will be impeded. The NIH budget is now about $20 billion, roughly 50% of the total federal research support, while the physical sciences comprise about 20% of the total, with the DOE accounting for only maybe half of that. The repertoire of the DOE has to be much broader than just the research that is done at the facilities. It has to mirror more of the research opportunities presently available to physics, much of which is not facility-driven. We don't want physics to just be driven by facilities, we want physics to be driven by research or ideas, with the facilities supporting that research.

Mildred Dresselhaus

Q *Would you describe your experiences at the agency as positive? Was there anything in your past experience that helped prepare you for that position?*

A It was a great experience. I think many people value an opportunity to serve the nation and it was an opportunity to do exactly that: serve the research community, and also serve the nation more generally. I was, myself, well established in the research world, I knew what it meant to do research, and I could understand the content of the research programs. I was also sufficiently well known that people were willing to listen to me. I found that the folks on the Hill really like science, they want explanations of what scientists are doing, what the DOE programs are about, and the potential benefits of these programs for society.

Perhaps a lot of teaching and research experience helps one to be able to present the fundamentals in a simple way. Having served on the boards of various companies helped me with that communication, too. Also, I think all the science policy work I've done over the years educated me in science policy so that I was better prepared when encountering some of these major issues in a real-world context. While it may not be necessary to always have a practicing scientist in these kinds of positions, it is a major advantage most of the time, provided the person is one who can communicate with the public, and desires to do so.

INSIDE THE BELTWAY

A Washington Analysis

Bingo! APS Policy Planners Score on Education and Energy

By Michael S. Lubell, APS Director of Public Affairs

There's nothing like 20-20 hindsight — except 20-20 foresight. And when you've got it, flaunt it. So I will.

More than half a year ago, the APS political sages put their heads together, pondered the imponderable and tried to forecast the hot issues for the next administration. Science education and energy policy bubbled to the top. Impossible, we said. Too wonkish, too cerebral. No political pizzazz.

But often, life in Washington is nothing more than a craps shoot. So, we rolled the dice, used some body english and watched as, gasp, the cubes came up reading science education and energy policy. Hallelujah, now what?

No choice but to rev up the policy engine, call in the experts and formulate appropriate APS positions. Taking a cue from industry, we applied "just-in-time" techniques and emerged from the November 19, 2000 Council meeting armed with two statements that fueled our audacity: *Energy Policy for the 21st Century* (http://www.aps.org/statements/00.3.html) and a *Policy Statement on K-12 Science and Math Education* (http://www.aps.org/statements/00.5.html).

Then, along with the rest of America, we sat numbly and watched the Disney show from Florida, until the Supreme Court told us that boots and Stetsons would set the inaugural fashions. Yeehaw! We had scored one bulls eye. The "Education President" was moving into 1600 Pennsylvania Avenue.

Scroll forward six weeks. A White House transition is never a pretty sight, and this one didn't disappoint.

The one-month election delay sent members of the Clinton clan — many of whom had hoped for promotions in a Gore government – packing in record time. But just as "w" keys were disappearing from West Wing work stations, and copiers were coughing up unflattering pictures of Dubya, the lights went out 3,000 miles away in California.

Yeehaw, another bulls eye. Energy policy was also on the front burner.

Here's how the education landscape is shaping up. At least ten major bills will be in the congressional hopper come the end of March: GOP leadership bills that embrace Bush's devolution and choice proposals, Democratic leadership and liberal Democratic bills that retain many federal controls, New Democrat bills that try to strike a middle course, physicist Vern Ehlers's (R-MI) package and physicist Rush Holt's (D-NJ) bill that emphasize science and math education. All the bills add significant money to federal education programs, and all try to improve outcomes through assessment and teacher training. But none of them address all of the major science concerns in the APS Council statement.

Still, it's a long way to the legislative finish line, and there will be many opportunities for the APS members to weigh in on the final bill.

Out of the chute, Vice President Dick Cheney, former CEO of the Halliburton oil exploration company and all purpose guru, is dominating the energy terrain. He is heading a task force charged with developing a national energy policy focused on new energy supplies and energy efficiency. The early line has increased production of fossil fuels leading the policy picks, accompanied by relaxed environmental standards to accomplish that goal.

But the Bush-Cheney plans could run into a buzz saw on Capitol Hill, where the House Science Committee is preparing to tackle the same issue. Staunch environmentalist Sherwood Boehlert, a moderate New York Republican, who now chairs the committee, identified energy, environment and K-12 science education as his top three priorities for this session. In its quest to identify long term energy research needs, the Science Committee is likely to stress alternate sources and conservation.

In his "maiden" speech before the University Research Associates, Boehlert also expressed strong interest in passing the "Doubling Bill", which his right-wing predecessor, James Sensenbrenner (R-WI), had long held hostage. But translating that commitment into solid appropriations may prove very difficult this year. Although science now has many allies on Capitol Hill, the Bush-Cheney budget request they will receive is likely to have little in it that will please research advocates.

The top priorities for the new administration are hefty cuts in taxes, big increases for K-12 education, and plus ups for military salaries and nuclear missile defense. Even the DOD's R&D budget, which during his campaign President Bush promised to boost by $20 billion, will be held in check, pending a full review by the service chiefs. Only NIH is expected to emerge unscathed.

With science not even a small blip on the White House radar screen, the action on R&D has already shifted to Capitol Hill. It's still winter, but the odds are that it will be a long, hot summer.

LETTERS

Claim Many Artists Used Optical Devices

"The Back Page" article in the December 2000 *APS News* discusses the long-standing argument that the Dutch master Johannes Vermeer used a camera obscura as an aid to painting. The article is interesting in itself, and also in conjunction with another article in another publication. An article by Lawrence Wechsler in the January 31, 2000, "New Yorker" presents an intriguing and controversial theory by the contemporary British painter, Joseph Hockney. Hockney claims he was struck by the fact that, in a comparatively short time, artists progressed from not using (presumably not understanding) perspective to using it with remarkable skill and accuracy. He cites an observation by the German art historian Norbert Schneider, who said that "It remains a source of continual astonishment that so infinitely complex a genre should develop in so brief a space of time, indeed within only a few decades of the fifteenth century, especially in view of the constraints imposed upon it by the individual requirements of the patrons."

Not coincidentally, in Hockney's view, is that this development in artistic technique coincided with the development of lenses. He believes that many artists used optical devices as aids. For example, he points out that Caravaggio, who was criticized by his peers for working in cellars with limited lighting, didn't leave behind any preparatory studies for his very complex compositions. Hockney argues that Caravaggio used a camera obscura and traced directly onto the canvas. He believes that many other artists did similar things.

Hockney himself has been working with a camera lucida (which can't have been used in the fifteenth century since it wasn't invented until 1807). Hockney's evidence for his theory about the development of realism in art is all indirect, and he is careful to credit the genius of the artists for the quality of the resulting work. He regards the (supposed) optical devices as tools, which skilled people can use much more effectively than others. Needless to say, there is a great deal of skepticism in the art world about Hockney's ideas. But it is interesting that there is evidence that optical devices may have contributed to the production of great works of art, hundreds of years ago as well as more recently.

Matthew Lybanon
Naval Research Laboratory

An Energy Crisis of Neglect

When the OPEC oil embargo struck in the seventies, President Carter, dressed in a sweater and sitting in front of a wood fire, called it "the moral equivalent of war". The country responded strongly - for one thing people turned *en masse* to their own wood-burning fireplaces.

Today the energy crisis is really more serious than in the seventies. The cost of heating with natural gas is soaring, California is experiencing rolling blackouts, and the problem is not the very temporary one of an embargo, but of deep internal problems of supply and demand, of depletion of natural resources, and of neglect by policy makers and professionals in the field.

Today we have about fifty million fireplaces in America and twenty-seven in the White House, but the number of them used for domestic heating is negligible. Yet their potential is vast. What *TIME* called "The Physicist's Fire" delivers five kilowatts of radiant power (see http://www.texasfireframe.com) at 30% efficiency, with minimum maintenance. And only a small fraction of homes heated with wood fires instead of electricity would save thousand of megawatts.

It is obvious that the physics community should be centrally involved. I hope the April APS meeting will feature papers on our energy problems, and that we shall stop neglecting a problem that falls squarely within our professional jurisdiction.

Lawrence Cranberg
Austin, Texas

Microscopic Halos Favor Recent Creation

Here is a creation/evolution issue pertaining to nuclear physicists, astrophysicists, and cosmologists. I have reported Earth's foundation rocks, the granites, contain microscopic halos traceable to the alpha decay of certain primordial Po isotopes. Their short half-lives demand almost instant creation of the host rocks, prior to the Po decaying away. Geologists resisted accepting this result; so two decades ago I challenged them to sustain their objections by: (i) duplicating just one Po-218 halo in an annealed piece of granite, and (ii) synthesizing a small piece of granite to confirm that it can form naturally. To me the prolonged silence about this test means the Creator uniquely designed both the Po halos and the granites to spotlight Genesis' literal six-day creation of the visible cosmos and its seventh-day memorial. (See http://www.halos.com for more on this topic.) In 1997 I published a new cosmic model based on a finite, nonhomogeneous, vacuum-gravity universe with a nearby cosmic Center (C), and showed it accounts for the 2.73K CMB, the CMB at higher z, and the Hubble redshift relation. More recently, see http://xxx.lanl.gov/ for year 2001, I reported it also accounts for six other of big bang's major predictions.

Robert V. Gentry
Knoxville, Tennessee

Letters Policy Now Online

APS News encourages our readers to submit letters to the editor. The best way to do this is to send them to letters@aps.org. Our policy on publishing letters can be found on the web at http://www.aps.org/apsnews/letters.html

Kansan Dissects Soft Creationism

Moorad Alexanian's letter in the January *APS News* is a useful example of the new "soft" approach of creationists which is becoming increasingly widespread. Typically, it uses many of the techniques of familiar old-style creationism but dressed up in more intellectually respectable language and with a considerably narrowed attack (usually limited to evolution).

It is a useful exercise to dissect his letter and expose all the unstated assumptions and logical jumps. He first says that all those who believe in a Creator are not Young Earth Creationists (as claimed by Brush in the November issue). I urge you to go back and re-read Brush's back page; you'll see he didn't make that claim. This is the first instance of the "Wedge Strategy", which is to make a forced choice between science and (their kind of) religion. They understand that if they can force this choice, in our culture, science will lose.

He says Darwin's evolution includes the origin of life. It doesn't; it's only a theory about its development. Later on he says "What people object to is the teaching of an atheistic worldview in the guise of science. Students of faith ought not to come out of biology classes with the notion that there is no God." There are two assumptions here. The most obvious is the idea that if someone becomes an atheist, someone must have taught them atheism. There is no recognition that someone might come to conclusions independently. Secondly, though he rightly condemns the mixing of theology (or anti-theology) into science class, it is clear from his letter that what he means by atheism is the idea that life arose and developed "entirely by natural means." He believes intervention by God along the way is required, and teaching science without including this is atheism. (Since he apparently believes God created everything, are we supposed to mention that in every science class in every field of science? And all other classes?) He says, "The evidence for evolutionary transition of humans from apelike ancestors is not abundant enough to conclude, beyond a reasonable doubt, that it has occurred. That is why the overwhelming majority of Americans still believe in a Creator."

Note here (1) A claim which would be big news to people working in the field. This claim is typically supported by repetition, which actually is a very effective propaganda technique. (2) The use of legal rather than scientific language regarding verification. (3) The forced choice—if A is wrong, then (my) B must be right. In this case it's done as descriptive. Note also the Wedge—you accept the evidence for human evolution OR believe in a Creator.

He wants us to teach that evolution and cosmology are "working assumptions". Again, let's examine: "Unlike physics, evolution and cosmology are sciences in the sense of forensic science." Note that cosmology is given in counterpoint to physics here. Imagine a sentence starting, "Unlike physics, acoustics is...". Creationists try to set aside special status for evolution (and sometimes cosmology) because it includes dealing with the past. This is false on several counts. (1) Nearly all physics relies on indirect evidence. We don't see quarks or phonons, we infer their effects. (2) There is considerable "benchtop evolution" now, even finding biotech applications, and much of the past Universe is directly observable along our past light cone (we "see" the microwave background and primordial galaxies). (3) The crucial criterion for science is confrontation with experimental data, which comes in many forms.

He names a number of famous physicists who were Christians, and two biologists who are atheists. (True in the case of Dawkins, questionable with regard to Darwin). Better join Our Club (the smart guys) and reject demon evolution. He is a member of the staff of the "Earth History Research Center", (headquarters at Southwestern Adventist University) which states as its goal, "Our mission is to develop a view of origins that is scientifically credible, and consistent with the Biblical account of origins, for a world that has largely abandoned belief in its Creator."

This organization promotes a great deal of material designed to cast doubt on the age of the Earth. This doesn't belie his comment about Young Earth Creationists in and of itself, but it calls into question his motives in making the comment about Brush near the beginning of this letter. You'll find there (http://origins.swau.edu/) things designed to convince you coal and sediments could have been rapidly deposited, radiometric dating is highly unreliable, much of geology can be explained by worldwide Flood, etc. Note that they have real scientists working for them.

He notes that the fundamental question of origins may not be a scientific question. If not, then he says we may need to look to an Intelligent Designer. (1) There is no such thing as a scientific question, only a scientific way of looking for answers. (2) This method may or may not work for specific kinds of questions. (3) He and anyone else are welcome to look for answers in non-scientific ways. They merely aren't welcome to pass them off as science, especially in public schools.

The voters in Kansas, most strongly in the Republican primary, rejected the people who attempted to inject religion into the state science standards. This didn't happen accidentally. It required vigilance and a collaborative effort of scientists and many other people with diverse backgrounds, including clergy. Some of what we've learned can be found on the website of Kansas Citizens for Science, http://www.kcfs.org. I also recommend the National Center for Science Education, http://www.natcenscied.org.

I urge readers to particularly be alert for "Intelligent Design", the latest repackaging of creation science which is attracting many educated persons (medical doctors, engineers, and humanities grads seem highly susceptible). Although it may be "creation science in a cheap tuxedo" as L. Krishtalka has said, this tux seems able to impress many people who are not experts. No part of the country is immune. We in Kansas fought back publicly, which drew a lot of press. Look in your back yard.

Adrian L. Melott
University of Kansas

Physicists Have a Distorted Sense of History

In the January 2001 issue of *APS News*, Morton K. Brussel took issue with Freeman Dyson's characterization of religion as a force for building community, citing the Taliban in Afghanistan and other famous cases of religious abuse of citizens as his reason.

The actions of the Taliban don't represent the power of religion by itself. The aim of the Taliban is to build a religious state, to tie all secular political power to religious authority. Most if not all of the ugly abuses of citizens by religious organizations in the history of the world — the witch hunts, the Crusades, the violent struggles between Catholics and Protestants, the persecution of native religions by conquering colonial forces, the Taliban, etc, came about because secular political power was tied to religious authority.

When religion and state power are combined, then the religion is, of course, going to get exactly as violent as the furtherance and maintenance of state power requires it to be. Because religion is not some external force field put upon the world, but a human adaptive enterprise that can be adapted and fitted to many functions — as is also true with science.

Why are the Taliban so violent, when the Koran preaches peace and justice? Any religious group that succeeds in securing and maintaining state power in a violent land is going to have adapted their religious belief system so that it supports the violence needed to achieve that state power.

The founding fathers and mothers of America were right to value a separation of religion and state to the extent that they would lay down their precious fragile human lives fighting for it on the bloody field of battle. That was a very wise commitment on their parts, because it led to a great flowering of religious thought unburdened by the needs of furthering and maintaining the power of the state.

This was good for religion, not bad. This is one reason why American are so religious. Because we vastly improved Western religion by unhooking it from the burdens and temptations of state power.

But at whose feet can we lay the horrific abuses of the Stalinist and Maoist regimes?

The aim of Marxism-Leninism was to create a state based not upon religion, but on science. Marxist-Leninists deeply believed that there was a rational, scientific way to engineer an economy, and a rational, scientific way to engineer the lifestyles and belief systems of everyone under their state power, into

See LETTER *on page 7*

VIEWPOINT…

Swimming Against the Tide

Diligent readers of *APS News* may recall a "Viewpoint" in last year's August/September issue entitled "End the Embargo" (http://www.aps.org/apsnews/0800/080010.html) , which took *Science* and *Nature* to task for their strict policy of forbidding news coverage on research submitted to them for publication, until the article actually appeared in print. The "Viewpoint" contrasted this with the policy of APS that actively encourages news about physics in the media, regardless of whether the peer-reviewed version has yet seen the light of day.

In January, events conspired to produce a head-to-head clash between these two policies, with a result that, at least in this writer's opinion, further exposed how silly, artificial and contradictory the embargo idea is. Two papers were slated for near-simultaneous publication, one in *Nature* and the other in *Physical Review Letters*. The two different groups had each made essentially the same experimental breakthrough, bringing a light signal to a complete halt in a specially prepared medium, and then releasing it again with the information it carried intact. *The New York Times* got wind of this story, and featured it on the front page on January 18, almost 2 weeks before the PRL publication date. The PRL group, leaders Ron Walsworth and Mikhail Lukin at the Harvard-Smithsonian Center for Astrophysics, were free to talk about their results, and the news story concentrated mainly on their work. The leader of the other group, Dr. Lene Vestergaard Hau, was not in the same position. "Citing restrictions imposed by the journal *Nature*, where her report is to appear, Dr. Hau refused to discuss her work in detail," according to the story in the *Times*. It is cause for amazement and dismay that scientists, who after all are providing the material on which the journals depend, will voluntarily submit to the whims of editorial policy even when they are made to suffer thereby.

That's almost the end of the tale—Dr. Hau gets muzzled by *Nature*'s embargo. But there is one more wrinkle: later the same day that the *Times* story appeared, *Nature* issued the following statement, referring to its own press release about Dr. Hau's paper: "Effective immediately, *Nature* is lifting the embargo on THIS STORY ONLY. Reports have already appeared concerning a similar paper published in another journal, and making mention of the *Nature* study. In view of the existence of the other, unembargoed, paper, we have decided it is in everybody's interest for the two studies to be discussed together. Please note, however, that this is an exceptional case. In general, we will not lift an embargo on a paper just because one media source has mentioned it."

Ironically, *Nature*'s press release begins: "Stopping light sounds like the equivalent of King Canute's attempt to halt the incoming tide on an English beach." The analogy with King Canute is equally appropriate to *Nature*'s own embargo policy. Stopping the tide on an English beach is no more difficult than shoring up a monopolistic practice in the face of genuine competition.

—Alan Chodos

zero gravity

I am here to refute any perceived "risks" of our work with genetically engineered organisms.

Meeting, *from page 1*

mission, a federal advisory committee addressing issues in basic science research involving human participants. She will describe two recent reports proposing recommendations in this regard. "Both of these reports make it clear that the protection of research participants is key to conducting ethically sound research," she says. "Our goal is to develop guidelines by which important basic research can proceed while making sure that the rights and welfare of human research participants are not compromised."

Session C23, Room 606

Does Size Matter? Secrets of Successful Start-Ups

High-tech start-ups are a magnet for engineers, MBAs and venture capitalists alike, but the vital role of physicists in their success is often overlooked. A Monday afternoon session will focus on roles for scientists at start-ups, particularly female scientists like Hilary Lackritz of ACLARA BioSciences, Inc., who will give a realistic assessment of the rewards and risks in the start-up world. "Size usually does matter, and in this case, small size can equal independence, entrepreneurship, and other advantages that are hard to come by in Dilbert's corporate world," says Lackritz. "For those who want constant excitement, change and rapid opportunities to have an impact in the technical world, start-up companies offer wonderful challenges."

Her enthusiasm is shared by fellow speaker Laura Smoliar, manager of device reliability at Silicon Light Machines, who will discuss the essential contributions physicists make and the various positions they hold in high-tech start-ups. "As the high-tech economy continues to heat up, especially in telecommunications, the opportunities for physicists continue to expand," she says. "This is truly a time for physicists to make their mark in the start-up world." Also featured in the session is Lisa Dhar of Lucent Technologies/Bell Laboratories, who will describe the incubation of a new commercial venture within that company focusing on high-density holographic recording media and storage systems.

Session E2, Ballroom 6B

Putting the Physics Back into Phiction

So-called "hard" science fiction makes a serious attempt to portray science and scientists as accurately as possible, often by using scientists as principal characters, and scientific problem solving as a major plot element. John Cramer, a physics professor at the University of Washington, is the author of two such novels: *Twistor*, about "small" science in a university physics research laboratory, and *Einstein's Bridge*, in which the 1993 cancellation of the SSC project is played out against a fictional background of breakthrough discoveries, alien contact, wormholes and time travel. During a Wednesday afternoon session on successful physicist writers, he will discuss his experiences in writing and publishing hard science fiction, and how this relates to the general problem of public appreciation, perception and (more frequently) mis-perception of science.

Also featured in the session is Michael Riordan of the Stanford Linear Accelerator Center, author of *The Hunting of the Quark* and *Crystal Fire*. He will discuss how development of a strong narrative often relies upon having strong characters, illustrated with examples of central characters in his books. "I have built my narratives around larger-than-life physicist characters, who help me to portray how physics occurs in actual practice, in contrast to the desiccated accounts usually found in textbooks and scientific publications," he says. Sidney Perkowitz will also be on hand for an encore appearance, discussing some common challenges in presenting physics in the popular media, illustrated with examples from his books, lectures and television appearances.

Session T1, Ballroom 6A


USGS/Cascades Volcano Observatory

The view is southeast of Mount Rainier in Washington.

Optoelectronics Goes Organic

Nanostructured organic optoelectronic materials and devices have the potential to generate a revolution in telecommunications, information processing display and transportation, according to Larry Dalton, a researcher with the University of Washington and the University of Southern California. He will kick off a Wednesday morning session on the topic by describing a number of impressive new prototype devices and phenomena using new materials, including frequency agile oscillators with bandwidths on the order of 100 Ghz; large angle 3-D optical beam steering; optical gyroscopes; acoustic spectrum analyzers; and novel phased array radar systems. Other session speakers will discuss the electrophosphorescence phenomenon, polyfluorene light-emitting devices, and the development of an organic solid state injection laser at Lucent Technologies/Bell Laboratories.

Session N4, Ballroom 6E

The Future of Physics in the National Defense

While silicon CMOS technology has served us well for 30 years, ever-diminishing feature sizes are causing DARPA and other agencies and laboratories associated with the Department of Defense to look beyond silicon to possible, equally revolutionary alternatives. According to Jane Alexander, DARPA's deputy director, the agency is investing in a variety of technologies and approaches to extend electronic device design beyond the traditional CMOS approach, including leveraging quantum effects, using spin effects in semiconductors, developing electronics based on molecular self-assembly, and understanding biologically inspired systems. Other talks will focus on current research for potential national defense applications at the Naval Research Laboratory, MIT's pioneering Lincoln Laboratory, Boeing, and the University of Maryland.

Session C4, Ballroom 6E

SPECIAL EVENTS

Saturday and Sunday
March 10-11
8:00AM - 5:00PM
Convention Center, Rm. 602

Short course on recent advances in polymer computer simulations, sponsored by the APS Division of Polymer Physics.

Sunday, March 11
7:30AM - 3:00PM
Westin Hotel, 5th Avenue Rm.

Career and Professional Development Liaison Workshop, featuring a luncheon keynote address by John Poate, vice president and chief technology officer of Axcelis, one of the largest semiconductor equipment manufacturers in the world.

Monday, March 12
6:30AM - 7:30AM
Convention Center

Get a jump-start on the day with the fourth annual APS Run for Health.

5:30PM - 6:30PM
Convention Center

Presentation of 2001 APS prizes and awards for outstanding contributions to physics.

6:30PM - 7:30PM
Convention Center Ballroom

Welcome reception.

Tuesday, March 13
7:30AM - 9:30AM
Westin Hotel

CSWP/FIAP Networking Breakfast, open to all (men and women) with an interest in issues pertaining to women in physics. Breakfast: $15 ($5 for students)

3:00PM - 5:00PM
Convention Center, 6th floor lobby

Physical Review Drop-In Reception.

6:00PM - 8:00PM
Westin Hotel

Alumni reunions, hosted by various universities, laboratories and companies.

Wednesday, March 14
1:00PM - 2:30PM
Convention Center

Back by popular demand, students can enjoy a complimentary lunch with an expert on a topic of interest to them.

PHYSICS AND TECHNOLOGY FOREFRONTS

Magnetic Storage Industry Continues to Grow and Grow...

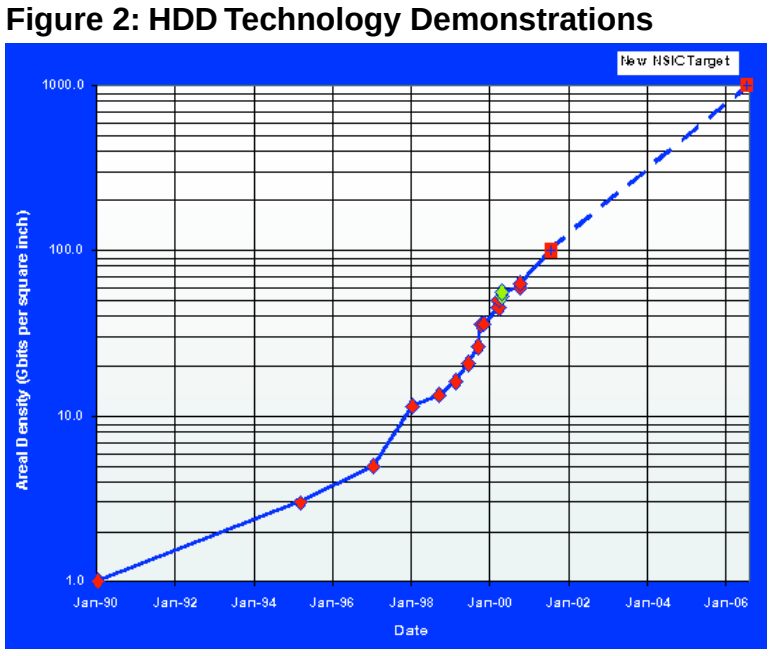
By Robert M. White

When the only way of creating bits was through a keyboard, it was difficult to imagine ever needing more than perhaps hundreds of megabytes of storage on a PC. However, with digital images and networks, PC's will soon easily require 100 gigabytes. Corporate storage requirements are mind-boggling. The amount of data corporations are creating is growing at a rate of 100% per year. One talks about terabytes and petabytes. Companies are establishing dedicated networks for storage (storage area networks, or SANS). EMC, the leader in providing storage solutions, is approaching $5B in sales.

Storage, like networking, has several levels. At the upper level, there are applications like "datamining" and "data warehousing." As the amount of data grows, there is increasing need for a middle level of automated data management tools. Standards are also being developed to define the management and control of data objects so different storage devices can easily work together on a network. However, for physicists, the interesting story is at the physical level. The figure of merit in storage is how many bits can be stored in a square area. This metric has increased by nearly a factor of ten million since IBM introduced the disk drive in 1956. It is remarkable that this dramatic improvement in storage has been based on an electromechanical technology — the hard disk drive (HDD) that depends upon maintaining a read/write stylus 5 nm from a data surface that is moving at 40 m/s!

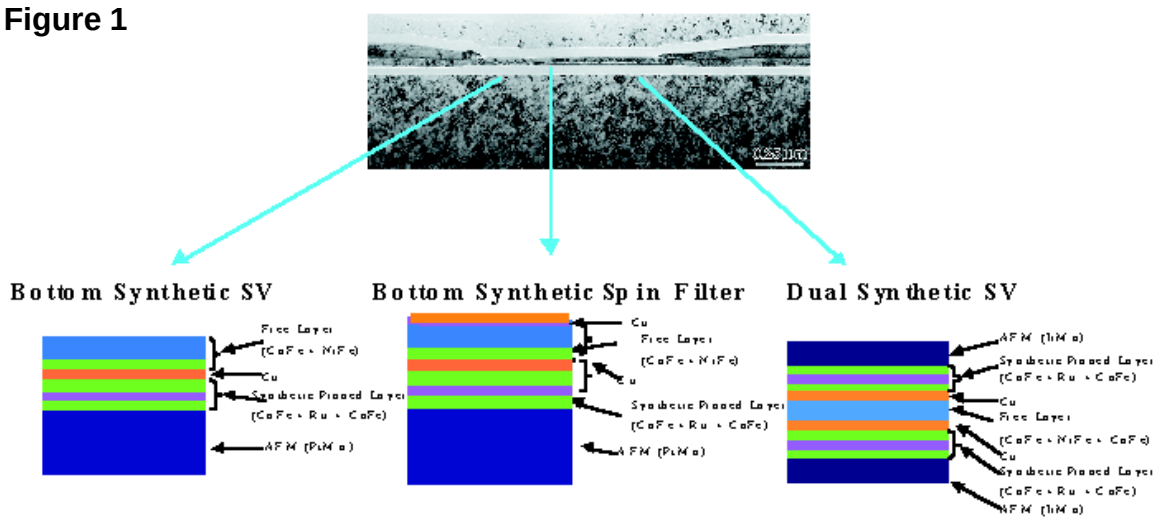
Storage densities today are increasing at their highest rate in history, over 100% per year. This growth is leading to lower storage prices, currently approximately 10¢ per megabyte. Another interesting fact about storage is that a 1% decrease in price leads to a 4% increase in demand. The corresponding ratio for semiconductors is only 1.5.

Figure 2: HDD Technology Demonstrations



This graph shows the areal densities demonstrated since 1990 as well as the target of the National Storage Industry Consortium (NSIC), a consortium of companies such as IBM, Seagate, Quantum, Read-Rite, etc. involved in the hard disk drive (HDD) industry.

Figure 1



Cross sections of read sensors used in hard disk drives today. In the bottom synthetic spin valve, the bottom magnetic layer (CoFe) is part of a (two-layer) synthetic antiferromagnet, which is pinned by a "real" antiferromagnet (IrMn). In the spin filter device, there is a layer of copper on top, which provides additional scattering and enhances the magnetoresistance.

Before describing the most recent developments in recording, let us review the basics. In digital magnetic recording, "1's" and "0's" are stored in the form of magnetic transitions or the absence of magnetic transitions in a longitudinally, magnetized coating. These data may be recorded circumferentially around circular tracks on a disk or serially along a tape. Originally, these magnetic coatings consisted of magnetic particles embedded in a binder. Today, the disk in a hard disk drive consists of a very thin sputtered film on an aluminum or glass substrate. Tapes may still contain iron particles or evaporated films. Data is written onto the medium by an electro-magnetic transducer consisting of a copper coil with a highly permeable core which is photo lithographically produced.

For many years, data was read by inductively sensing the magnetic fields associated with the magnetic transitions in the medium. In 1990, IBM introduced a magnetoresistive sensor. Since the amplitude of the readback signal is proportional to the width of the recording track, introducing the more sensitive magnetoresistive transducer meant it was possible to reduce the track width thereby increasing the track density. The initial magnetoresistive sensors employed permalloy, an alloy of Ni and Fe, which has a magnetoresistance of 2%. That is, there is a 2% change in the resistance when the magnetization changes from being aligned with the current to being perpendicular to it. This is referred to as the anisotropic magnetoresistive effect.

This attack on track density was greatly aided by the discovery in 1988 of the "giant" magnetoresistive effect (GMR). Albert Fert and his colleagues in France discovered that the change in magnetoresistance in the plane of a sandwich of two magnetic films separated by a thin conductor, such as copper, depended upon the relative orientation of the magnetizations in the two magnetic films. Experimental studies indicate that this effect is associated with interfacial scattering. When the magnetizations are parallel, majority spins can scatter both forward into the other magnetic layer or backward into the layer from which the spin originated. Anti-parallel magnetizations restrict the scattering. This structure is therefore referred to as a spin "valve."

This effect was first discovered at low temperatures and required large fields to align the moments in the two magnetic films. Subsequent research led to room temperature operation with magnetoresistances above 10% in fields of a few oersteds. In a recording application, one of the magnetic layers is pinned by placing it adjacent to an antiferromagnet.

In order to reduce the influence of magnetostatic fields from the pinned layer on the free layer, an oppositely magnetized layer is added making the pinned layers look like a synthetic antiferromagnet. Figure 1 shows several cross sections of GMR heads used in drives today. The writing coil and reading sensors are deposited on the back vertical surface of a small block or slide. The bottom surface of the slider contains channels, which guide the flow of air when the slider rides above the spinning disk. This flow of air creates a stiff suspension that maintains the fixed and incredibly small spacing between the writing and reading elements and the data surface.

A major challenge today lies in the media. The thin magnetic film consists of approximately 100 Å of an alloy of cobalt. It is prepared by sputtering which gives it a granular structure. Typical grain sizes are 20 Å. If there are N grains within a bit cell the signal, being coherent across the cell, is proportional to N^2 while the noise varies as N. Therefore, the signal-to-noise is proportional to N. As the bit cell decreases with increasing density, if the SNR is to remain constant, the grains must be made smaller. However, if the grains become too small, they become thermally unstable. This is referred to as the superparamagnetic effect and leads to degradation of data.

The first estimate of the superparamagnetic limit to recording density was 40 Gbits/in^2. Slightly more than 50 Gbits/in^2 has been demonstrated in the lab. This indicates that superparamagnetism may not be as limiting as originally feared. In fact, we believe we should be able to achieve 1 Terabit/in^2 (see Figure 2).

There are two strategies currently being pursued toward this goal. One is to increase the volume of the bit cell by making it deeper. One way of doing this is to record perpendicular to the plane of the medium. This will require new writing and reading designs as well as new signal processing, or "channel" techniques.

The second strategy is to increase the coercivity of the medium making it more "resistant" to thermal switching. The difficulty with this approach is that increasing the coercivity also makes it more difficult to write. Nevertheless, there is a very interesting solution — thermally assisted writing! If the material can be "designed" so that its coercivity decreases with temperature, then the simultaneous application of a magnetic field and heating will enable writing on high coercivity media. This is not unlike what occurs in a traditional magnetooptic recording system today. What is particularly appealing about this idea is that the "footprints" associated with the magnetic field gradient and thermal gradient can be made different so that their intersection results in a very small-recorded spot.

The "Terabit Challenge" will require a deeper physical understanding of nanoscale magnetics. It will also very likely require new discovery. It is interesting to note that the continual march of areal density to higher values has benefited from such relatively recent fundamental discoveries as the magnetic force microscope, the giant magnetoresistive effect, and spin-dependent tunneling.

Last year, IBM announced a 250 MByte drive with a one-inch formfactor, the so-called micro drive. One can hardly imagine the storage applications if the perpendicular or hybrid magnetic-optical technologies described above are employed in this form-factor!

Robert M. White is University Professor, Electrical and Computer Engineering, and Director of the Data Storage System Center at Carnegie Mellon University.

PROLA, *from page 1*

the legacy data used to typeset the journals. Soon thereafter the Naval Research Laboratory joined to provide scanning on a cooperative basis. APS took over direct management of the project in the summer of 1997 and moved it entirely in house in May, 1998. Mark Doyle, a physicist in the Long Island office who is Manager of Product Development, took over the project, and by the end of the year the server was launched with an archive of online copies of *Physical Review* from 1985 through 1996. The majority of the collection consists of scanned images of the printed journals available as either GIF images or as PDF files. In addition to the scanned images, the front and back matter of the articles is rekeyed. PROLA uses this, coupled with a bibliographic database, as the basis for its search index and reference linking. Full text searching will be available using optical character recognition on the scanned images.

The quality of the pre-1985 material has been improved by scanning the articles at a higher resolution. In response to membership requests, internal article references are now linked to external resources (at AIP and SLAC, among other sites), although this feature is currently limited for the time being to the 1997 APS journals. Subscribers can now view references displayed with abstracts, while non-subscribers may purchase individual articles from PROLA with their credit cards. Each year the most recent content will be updated as material is transferred into PROLA from current journal files.

Those who will be using PROLA's search capabilities will be pleased to hear that replacing the current search engine is a top short-term priority for the PROLA staff. Material dating before 1981 will be added continually, and the new reference linking feature will be extended to all of PROLA, along with the integration of links to citing articles. Bandwidth-challenged users will also soon have the option to download lower-resolution PDF files.

Future plans include implementing new external linking resources, and rescanning all of the articles from 1985-1996 at the higher quality level. In addition, the APS has entered into an agreement with the Library of Congress to provide a long-term repository for the files that are in PROLA, and is negotiating for a live mirror site at a major university to further improve access and availability.

ANNOUNCEMENTS

2001 APS Fellowship Nomination Deadlines

For submittal information see: http://www.aps.org/fellowships

DIVISIONS

Astrophysics 05/01/01
Atomic, Molecular, Optical 03/31/01
Biological Physics 04/02/01
Chemical Physics ..... PAST
Computational Physics 04/14/01
Condensed Matter ..... PAST
Fluid Dynamics ..... PAST
Polymer Physics 04/15/01
Laser Science 04/02/01
Materials Physics ..... PAST
Nuclear Physics 04/02/01
Particles & Fields 04/02/01
Physics of Beams 03/15/01
Plasma Physics 04/02/01

FORUMS

Physics & Society 04/02/01
History of Physics 04/02/01
International Physics 04/02/01
Industrial and Applied Physics ..... PAST
Education 04/15/01

TOPICAL GROUPS

Few Body Systems .. 04/10/01
Precision Measurement Fund. Const. 04/02/01
Instruments and Measurement 04/02/01
Shock Compression . 04/02/01
Gravitation 04/02/01
Magnetism and Its Applications 04/02/01
Plasma Astrophysics .. 04/02/01
Statistical and Nonlinear Physics 04/02/01

APS GENERAL 06/01/01

Help Bring Sound Science to US Arms Control Policy

The Union of Concerned Scientists invites you to attend a series of issue briefings on National Missile Defense and other US arms control policy issues, and training workshops on how scientists can work effectively with the media and members of Congress on these issues. These events will coincide with the APS March meeting in Seattle, and will take place at the Westin Hotel in downtown Seattle on Thursday evening, March 15 and Friday afternoon, March 16.

These meetings are designed to inform scientists and engineers attending the APS March meeting about critical US security policies that scientists can - and should - play an important role in setting. Topics include:

- National Missile Defense and the Bush Administration (Thursday 6-9PM, with dinner)
- US Nuclear Weapons Policy (Friday noon-2PM, with lunch)
- Working with Local Media (Friday, 2:30-3:30PM)
- Educating Congress on Arms Control Policy (Friday, 4-5PM)

The meetings are self-contained, and it is not necessary to attend them all.

For more information on the events or to RSVP, contact John Spykerman at UCS by Friday, March 9 via phone (202) 223-6133 x113 or email: armsnet@ucsusa.org or visit the UCS information booth in the Exhibit Hall at the APS meeting by Wednesday, March 14. If you can't attend the meetings, but are interested in becoming involved in arms control policy issues, join ArmsNet — UCS's email network for scientists and engineers working to bring sound science to US arms control policy. For more information, email armsnet@ucsusa.org.

Letter, *from page 4*

one rational scientific whole.

But these idealistic scientific socialists committed atrocities numbering in the millions. These were purely rational atheist atrocities, and a large percentage of the victims were religious followers who refused to renounce their religious faith in the name of scientific socialist atheism.

By the way, Lenin himself came from a physics family. His father was a student of Lobachevsky, his brother studied physics before he was executed for terrorism against the Tsarist state, and the original career plan of young Vladimir Ulyanov was to study physics, possibly under Lobachevsky as well.

Millions of human beings were slaughtered in the 20th century in the name of so-called scientific socialism. It is just as fair, or unfair, to blame those deaths on the general human practice of science, as it is to blame the atrocities committed by religious state power on the general human practice of religion.

Frankly, I am appalled at the distorted and selective sense of history that seems common in the physics community. Millions of people died under the banner of a more scientific way to live and and OOPS, we forget. Because we're all upset at religion, because Galileo got put on celebrity house arrest by the Pope. (During a time when women accused of being witches, and heretics without close connections to the Pope, were hanged or burned alive by the hundreds, let's consider what almost happened to Kepler's mother, for example....)

Let's get over ourselves, please, and look at human history in a less hysterical and more balanced manner, one that doesn't inevitably lead us to a simplistic victimization scenario between science and religion. Human history is a much more rich and complex story than that.

Patricia Schwarz
Pasadena, California

Good Works (and Good Work) at the APS Editorial Office

RIDGE, NY—In addition to processing the 24,000 or so manuscripts that come into the APS Editorial Office each year, staff members here have found time to engage in a number of good works. Most of these benefit the local food drive in Brookhaven Township, in eastern Long Island's Suffolk County, and are conducted in conjunction with Brookhaven National Laboratory (BNL). Others are inspired by the holiday spirit.

Many of the 120 staff members contribute and participate, but Senior Editorial Administrative Assistant Barbara Maddaloni deserves credit for keeping these efforts going over the last ten years. Once a month Maddaloni undertakes to send around a donation envelope for staff who want to give a few dollars to the food drive. With the proceeds, usually $80-$100, one of a team of volunteer shoppers buys staple foods at a warehouse store. Maddaloni also monitors the bin in the lunch room where staff deposit their own donations of non-perishable foods and the boxes of soda cans contributed for their deposit value. Each month the purchased and donated items are picked up by a representative from the central feeder pantry, and from there the food is divided among local agencies and volunteer groups that offer the food to those in need.

In 2000, the APS Editorial Office and BNL together donated nearly 23,000 pounds of food for needy individuals and families in the area.

In addition, several times a year a gift basket is created and displayed in the lunchroom. Staff members contribute the contents, the basket is arranged and wrapped attractively, and Maddaloni sells the raffle tickets. "We get $50 to $100 or more for each basket," Maddaloni reports. "It depends on how much people want what's in it. The Beanie Baby basket did especially well, and so did the bath towels and toiletries basket. We did another one with coupons for movie rentals plus all the trimmings: popcorn, chips, drinks and snacks." Raffle proceeds supplement the other monthly collections.

This past December, the entire Journal Services department at the Editorial office adopted a needy family, identified through a local nonprofit human services agency, and conspired to give them the best Christmas ever. Danielle Buckley, a journal services assistant for *Physical Review B*, brought the idea of family sponsorship to her department. The family was anonymous but the number and ages of its members were known so that gifts could be chosen appropriately.

So when they weren't hard at work turning editors' instructions into actions or getting ready for their own holiday celebrations, the Journal Services staff shopped for toys, other gifts, and foods so that the family could have a wonderful Christmas complete with a feast. According to Iris Gordon, Assistant Manager in Journal Services, "We all got a whole lot more from this experience than we gave."

Journal Services staff with gifts for their adopted family. Standing: Carla Lamberti, Donna Vassil, Danielle Buckley, Patti Merlo, Jennifer O'Brien, Maria Poko, Jennifer Lukert, Joyce Masterson, Mary Ann Kirchner, Rose Ellen Walls, Janet Spinelli; sitting: Donna Kalista, Kathy Occhino, Enessa Fusco, Mary Jane Meyer, Maria Asaro, Carol Morales, Marie Sauer, Dawn Musraca.

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

2001 APKER AWARDS

For Outstanding Undergraduate Student Research in Physics

Endowed by Jean Dickey Apker, in memory of LeRoy Apker

DESCRIPTION

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

- Recipients receive a $5,000 award; finalists $2,000. They also receive an allowance for travel to the Award presentation.
- Recipients' and finalists' home institutions receive $5,000 and $1,000, respectively, to support undergraduate research.
- Recipients, finalists and their home physics departments will be presented with plaques or certificates of achievement. The student's home institution is prominently featured on all awards and news stories of the competition.
- Each nominee will be granted a free APS Student Membership for one year upon receipt of their completed application.

QUALIFICATIONS

- Students who have been enrolled as undergraduates at colleges and universities in the United States at least one quarter/semester during the year preceding the **JUNE 15, 2001** deadline.
- Students who have an excellent academic record and have demonstrated exceptional potential for scientific research through an original contribution to physics.
- Only one candidate may be nominated per department.

APPLICATION PROCEDURE

The complete nomination package is due on or before **JUNE 15, 2001** and should include:

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

FURTHER INFORMATION

See **http://www.aps.org/praw/apker/descrip.html**

DEADLINE

Send name of proposed candidate and supporting information by **JUNE 15, 2001** to: Dr. Alan Chodos, Administrator, Apker Award Selection Committee; The American Physical Society; One Physics Ellipse, College Park, MD 20740-3844; Telephone: (301) 209-3268, Fax: (301) 209-3652, email: chodos@aps.org.

THE BACK PAGE

To Pledge or Not To Pledge: An Oath for Scientists?

By Irving Lerch

In his play, *A Man for All Seasons*, Robert Bolt puts the following words into Thomas More's mouth as More tries to explain to his wife his reasons for defying the King and thereby condemning himself: "When a man takes an oath, Meg, he's holding his ownself in his own hands. Like water. And if he opens his fingers then, he needn't hope to find himself again."

At the end of the 15th century, Leonardo da Vinci, aside from providing his patron, the Duke of Milan, with dozens of innovative designs for machines of war, nonetheless suppressed his work on yet another invention, submarines, "on account of the evil nature of men, who would practice assassination at the bottom of the sea." It would appear that Leonardo apprehended a spectrum of horrors and drew a line over which he would not tread. But the line was his alone.

This stratagem would be codified in 1627 by Sir Francis Bacon in his Utopian tract, *The New Atlantis*, in which he reported a kind of scientific oath for scientist and technologists. He described an elaborate enterprise, very much like our own, consisting of travelers who collect the scientific output of various nations, scholars who catalog written reports, those who study and collect technologies, scientists who develop their own lines of inquiry, pedants who order the collected information into a kind of encyclopedia, and a council of the whole to decide on the disposition of this knowledge. The narrator then adds, "We have consultations, which of the inventions and experiences which we have discovered shall be published, and which not; and take all an oath of secrecy for the concealing of those which we think fit to keep secret; though some of those we do reveal sometimes to the State, and some not."

The quotes from Bacon and Bolt bracket our contemporary concerns. There is the ethical and moral dimension of the scientific enterprise contained within our own commitment to society and our higher ideals, and our strong impulse to protect society from the darker fruits of our aptitude — presumably those undertakings that demean the human condition. These impulses confront us with immediate problems. One era's morality will not do for all time. The sensibility of a 20th century author to a 16th century historical figure does not provide us with insights to guide us through the manifold layers of today's turbulent affairs. Nor does Francis Bacon's secretive society make sense in the global intellectual venture that defines contemporary science. If we have learned anything in the postwar era, it is that secrecy will not compel evil genius to remain ignorant, nor our colleagues to be virtuous.

The simple fact is that our society pays the bills and demands that its interests be considered. Physicists, engineers, architects and others whose labors directly affect the public welfare must demonstrate competence and accountability. Increasingly, basic and applied science connects with technology to accelerate profound social change. Science has prolonged our lives, taken us to the planets, given us an understanding of life and the stars, and has also made possible the greatest carnage in human history. The life sciences are now amassing the knowledge and wherewithal to fundamentally alter this planet's biological order. In short, science promises us eternal life or immediate extinction.

An Oath for Scientists

Some of the world's great scientists have long championed an oath for scientists, including Nobelists Albert Einstein, Joseph Rotblat, Abdus Salam, Maurice Wilkins and John Kendrew. But many more have resisted the call. The proponents were often motivated by their horror of the poisonous outcome of science applied to war and their sense that a prescription must be found to restrain the development of future terrors — even if it meant expurgating the range of scientific inquiry. But many other eminent scientists have reacted with equal distaste, remembering all too clearly the last American experiment with oaths for scholars which sought to cleanse academia of all vestiges of ideological socialism in the 1950s, with disastrous results.

Of course, there are important historical distinctions between the professions — where an act of swearing an oath constitutes a declaration of commitment to the public welfare — and the sciences, which have traditionally not directly served the public. Nonetheless, the numbers and varieties of ethical codes have proliferated as learned and professional communities sense public unease and depreciating confidence, usually measured in appropriations levels for research and declining student enrollments — despite the fact that polls consistently put scientists and science at the apex of public esteem.

An oath is a public declaration and therefore an element in public discourse. But for such a dialogue to be effective, the vocabulary and culture must provide a context within which an ongoing exchange is possible. The question is whether we can construct a global edifice acceptable and valid for all professions and sciences and the public. But even if we succeed in achieving a sound foundation on which a consensus can be built, can we find the key for guiding science in the name of social virtue without the risks inherent in conferring power over the conduct of science on an authoritarian meritocracy? The risk, of course, is that freedom in the conduct of science will be arbitrarily curtailed.

Different cultures and religions place different interpretations on prescriptions such as limiting one's work to socially and environmentally constructive ends. What is socially and environmentally constructive to one group is blatant exploitation or ineffective drivel to another. And behaviors based on one interpretation may be judged unproductive or contrary to public welfare in another time. To be effective, therefore, all such prescriptions must be subjected to intense rounds of negotiation and argument. There will have to be compromise arising from such consultations, and this process must be renewed continuously as circumstances and local mores change.

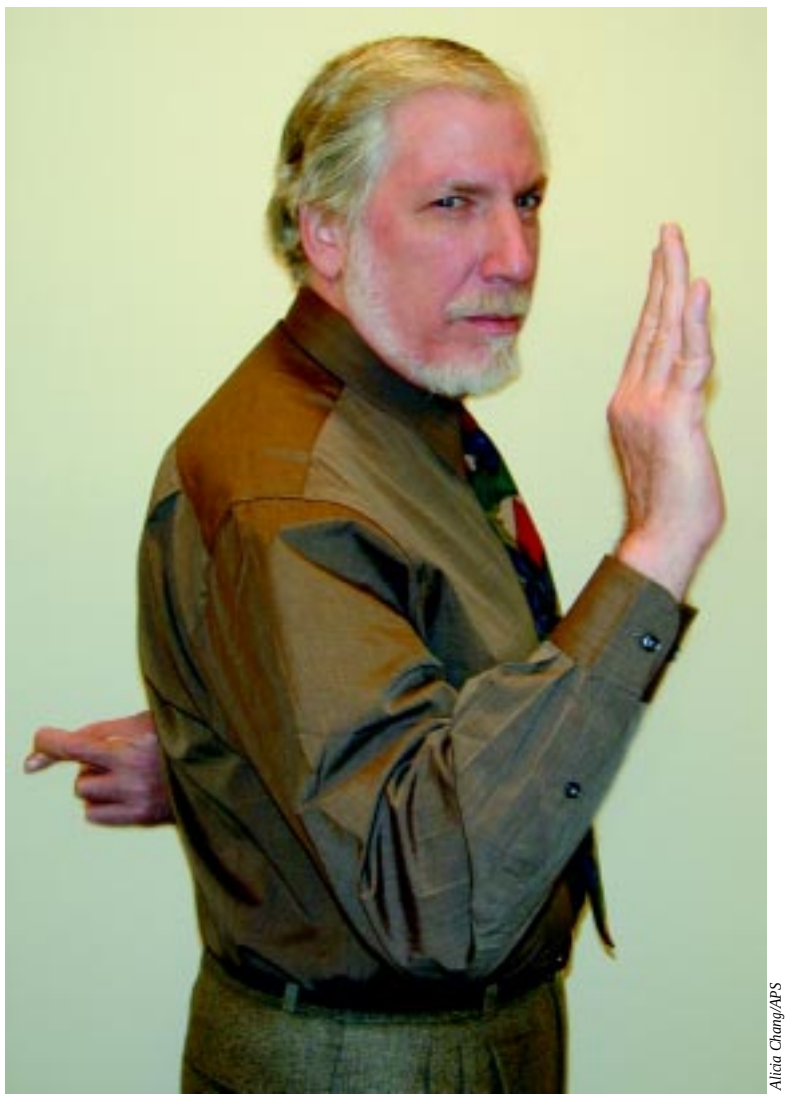
Ethics must be integrated into the education of technologists and scientists, and should include an examination of the impact that science and technology has had on society. There must also be an ongoing dialogue among and between scientists and the public, especially at the interface of the societal impacts of innovation and research. By "dialogue," I do not mean the one-sided effort of specialists to "educate" the public. While most lay people want to understand the canons of science and technology and the impact of future discoveries, they prefer that this discussion occur within the framework of a true exchange.

For example, the findings of science, in their purest form, are cultural expressions which contain intellectual, artistic and literary stimulation. The discoveries of extra-solar planets, the "freezing" of light in space, the exploration of the human genome — all these carry fascination and beauty. But cosmology and evolution threaten belief systems, and genetic engineering is accompanied by a long shadow of fear over our biological heritage and environment.

Another important element is that big science is, by and large, a state-funded enterprise, and legislatures worldwide have imposed an ever more elaborate filigree over public accountability. Even the very large private science and technology sector has been transformed by economics and the changing face of intellectual property rights law. This process has widened the political dimensions of the public face of science and is integral to any exchange between the public and scientists. In 1993, the US Congress passed the Government Performance and Results Act (GRPA), which requires federal agencies to compose strategic plans and annual performance evaluations. The public dialogue is becoming more complex.

The Devils Within

It is not only government that seeks accountability from scientists. A few writers, such as Daniel Sarewitz in his 1996 book, *Frontiers of Illusion: Science, Technology, and the Politics of Progress*, have argued that basic research can and should be focused on societal problems and that researchers should publicly anticipate the potential negative aspects of their work. As early as 1974, the UNESCO General Assembly declared, "Each Member State should strive to use scientific and technological knowledge for the enhancement of the cultural and material well-being of its citizens, and to further the United Nations ideals and objectives." The statement put national interest and the culture of science on the same platter, even though these undertakings occupy the antipodes of public policy.



Alicia Chang/APS

Irving Lerch

We are besotted with devils, with contradictions, with warring impulses that defy resolution. We are awed with what the scientific intellect can achieve, yet wary of the impact on society as our power grows. We now suspect that we can alter the planet, destroy civilization, feed starving mankind, cure and create horrendous diseases. We seek the patronage, support and admiration of the public at large, but resist interference, controls and participation. We resent the uneducated fear of millions who question our intentions and competence, but are tongue-tied when we try to explain our capacities and motives. We savor the admiration and respect we are immersed in, yet are confused by the increasing alienation of the young who have turned away from science.

But the devils lay many traps for the unwary. John Wiens of Colorado State University, in a 1997 journal article, warned about the insidious results if scientists become too closely associated in their own and the public mind with the process and outcome of their work. "Perhaps the most pernicious and subtle effect of advocacy is on the interpretation of results. Even if a study is objectively framed and conscientiously designed and analyzed, the findings still must be placed in a context," Wiens wrote. "[Irving Langmuir] drew attention to what he called 'pathological science,' in which researchers unknowingly lose their objectivity in interpreting data that are near detection limits when much is riding on the results."

Objectivity in science is an absolute necessity. Free exchange assures objectivity by permitting critical evaluation and the continuous testing of results and conclusions. So if we are to develop and sustain open dialogue, it must contain a built-in barrier impermeable to the predilections, political sentiments and factual misunderstanding that characterize all open discussion. It requires a civility and an honesty of all participants rarely manifest in human affairs.

Irving Lerch is director of international scientific affairs for the American Physical Society.

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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.