APS NEWS

MARCH 2000 THE AMERICAN PHYSICAL SOCIETY VOLUME 9, NO. 3

(Try the enhanced APS News-online: http://www.aps.org/apsnews)

IN THIS ISSUE: Prizes and Awards Insert

APS 100 years — celebrate a century of physics

APS Gears Up For Minneapolis March Meeting Madness

For those physicists with a taste for something different, the 2000 APS March Meeting — to be held March 20 - 24 in Minneapolis, Minnesota — offers a host of unusual sessions in addition to the usual technical symposia, covering an equally broad range of topics. Adventurous attendees will have the opportunity to hear speakers tackle the continuing flood of pseudoscientific claims; learn how to succeed with a technology-based start-up venture; hear reports on the latest research in the burgeoning field of econophysics; and discover how science can influence legal decisions in the nation's courtrooms.

A far-from-exhaustive sampling of a few of these sessions is provided below, along with a listing of planned special events (see page 3). APS members are encouraged to browse the full online epitome for the meeting at www.aps.org/meet/MAR00/baps/index.html. Unless otherwise indicated, all room listings refer to the Minneapolis Convention Center.

The Truth is Out There. Pseudoscience and superstition are rampant in our society, albeit frequently draped in the language and symbols of science, conclude the featured speakers at two sessions focusing on the foolish and occasionally fraudulent claims of the paranormal. Among them is Joel Achenbach, a journalist with *The Washington Post*. Achenbach will describe his experiences visiting the set of the popular TV series "The X Files"; traveling to Roswell, NM; meeting with the Mars Society; interviewing a man with plans to build his own spaceship to Alpha Centauri; and being hypnotized in a hotel room to determine whether he himself had ever been abducted by aliens. He will be joined by Michael Shermer of The Skeptics Society and Robert Park, APS director of public affairs and author of the forthcoming book *Voodoo Science* (see page 3). (Session G8, Tuesday morning, 101H)

A second session, "The Skeptical Inquirer," will explore a broad range of controversial paranatural topics. Paul Kurtz of the Committee for the Scientific Investigation of Claims of the Paranormal will discuss the history of hauntings and seances dating back to the notorious Fox sisters in 1848, who, along with other alleged mediums, were discredited as frauds. His colleague, Joe Nickell, will tackle the elaborate mythology — and occasional hoax, such as the notorious "alien autopsy" film — that has sprung up around the modern UFO craze, along with the popular fascination with alien

Continued on page 3

Photo courtesy of the Long Beach Area Convention & Visitors Bureau; Mary Tyler Moore photo from www.jyanet.com/mtm/episodes.htm; Jesse Ventura photo from www.venturaflies.com/

Minneapolis, the so-called "City of the Lakes," will host the 2000 APS March Meeting. The city is also home to two icons of popular culture Mary Tyler Moore as Minneapolis TV news person Mary Richards, and the equally indefatigable wrestler-turned-governor Jesse "The Mind" Ventura. (insets).

Inside...

Nanotechnology Symposium at March Meeting

Following in the wake of President Clinton's "major new National Nanotechnology Initiative" announced in his remarks at Caltech on January 21, the APS will present a special symposium at the March meeting to acquaint the physics community with the details of the initiative, and to review some of the legislative and budgetary hurdles it must still overcome.

One of the participants in the symposium will be Evelyn L. Hu, director of QUEST (the NSF Science and Technology Center for Quantized Electronic Structures) at the University of California, Santa Barbara, who pointed out that Richard Feynman foreshadowed the Nanotechnology Initiative in 1959 when he spoke about 'There's Plenty of Room at the Bottom'. According to Hu, President Clinton's request for a national investment in Nanotechnology underscores the importance of this area of research, the breadth of expertise it will draw from, and the range of applications which it will benefit. Other participants in the symposium will be Patricia M. Dehmer, Associate Director for Basic Energy Sciences at DOE; Thomas A. Weber, Director of the Materials Research Division of the NSF; and Robert C. Dynes, Chancellor of the University of California at San Diego. The symposium will be chaired by James Langer, President of the APS.

The symposium will take place Wednesday, March 22, between 5:30 and 7 pm.

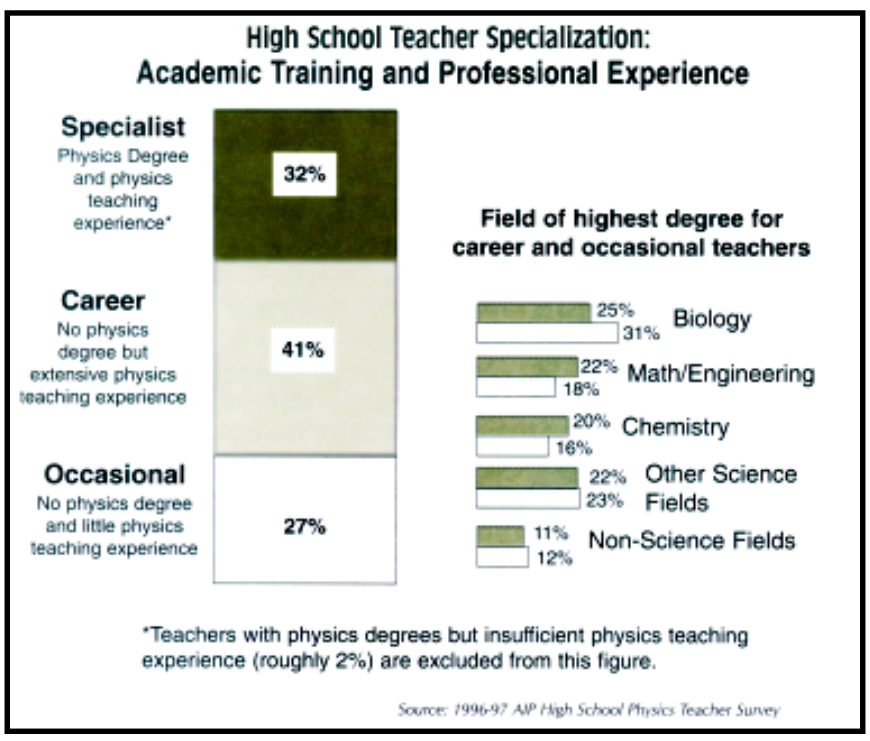
High School Physics Teachers in Short Supply

When Guilford High School in Connecticut abruptly found itself in need of a physics teacher this fall, science department chairman Bruce Faitsch discovered firsthand the difficulties of locating qualified high school physics teachers. The Fairfield Teacher's Agency confirmed his suspicions when he contacted them for help: physics teachers are in short supply, at least in the state of Connecticut.

The need for qualified physics teachers is particularly critical in light of a recent study by the American Institute of Physics (AIP), which found that over the last decade, the proportion of high school students who take physics has risen substantially, from about 20% to 28% (see *APS News*, November 1999). Yet a 1993 AIP survey found that, of the 30% of public school principals seeking to hire a physics teacher in the prior three years, more than one-third reported having difficulty finding qualified candidates, according to Michael Neuschatz, a senior research associate in AIP's Education and Employment Statistics Division. At private schools, where 41% of principals reported searching for a physics teacher, 40% had difficulty in finding qualified candidates.

This seems to be in keeping with national trends. A recent survey of schools and staffing conducted by the Department of Education's National Center for Education Statistics forecast a need of about 2.4 million teachers from 1998 through 2008. However, Neuschatz cautions that this figure must be viewed in context, since the forecast is based on speculative assumptions about teacher continuation rates, class size, and student to teacher ratio. The department also acknowledges that as much as one-third of this projected demand will most likely

Continued on page 7



To Advance & Diffuse the Knowledge of Physics

100 Years of the American Physical Society

Outreach and Community Service II

Excerpts from an exhibit displayed at the APS Centennial Meeting.

Curator: Sara Schechner, *Gnomon Research*
Exhibit Director: Barrett Ripin
With contributions by Harry Lustig, R. Mark Wilson, and others.

K-12 Education

The APS has led the way in improving K-12 science education. The Teacher Scientist Alliance Institute is a national program that brings scientist volunteers into school systems to develop hands-on, inquiry-based curricula. High School Teachers' Days are a feature of many APS meetings.

The Campaign for Physics recently raised $5 million dollars in support of educational programs.

Ramon Lopez, past APS director of education and outreach, with children.

Public Information

With the formation of the Panel on Public Affairs in 1975, APS had a vehicle to offer the physicists' view on matters of public concern, such as the viability of the Strategic Defense Initiative.

Activity was notched up significantly with the establishment of a Washington, DC, office in 1984. *What's New*, op-eds, and a mass-media fellowship program for physicists who want to become reporters are some of the ways that APS works to improve public awareness of the value of science.

PHYSICISTS EXPRESS 'STAR WARS' DOUBT; LONG DELAYS SEEN

Government Relations

Today APS has an active presence on Capitol Hill—in marked contrast to the Society's early disdain for politics. Lobbying for science is now valued.

In 1997, APS played a central role in forming a coalition of more than a hundred societies who issued a *Unified Statement of Research.* This led to legislation that calls for doubling the funding for scientific, medical, and engineering research.

APS president, D. Allan Bromley, presenting the *Unified Statement* to US Senators, 1997.

The Congressional Fellowship Program enables physicists to intern on Capitol Hill.

International Relations

APS has continued to have an international outlook, helping and collaborating with scientists throughout the world.

Shortly after Nixon's visit to China, APS initiated a successful China Program, which trained postdocs in the US in the mid-1980s.

After the collapse of the Soviet Union, APS helped hundreds of Soviet scientists continue their research. Funded by donations from international financier, George Soros and others, the program led to the creation of the International Science Foundation.

George Soros (center) with Irving Lerch, APS director of international affairs, and Ernest Henley, 1992 APS president.

Next Month: Mechanics of Publishing

APS News

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March Meeting, *continued from page 1*

abductions, dating back to the Roswell crash in 1947. Unlike so-called mediums, he finds that most alien abduction reports appear to be sincere, although unauthenticated, and investigators believe such claims are rooted in psychological factors. The University of Hawaii's Victor Stenger will target alternative medicine and other misuses of physics concepts. Finally, the recent Kansas evolution controversy provides an ideal backdrop for Eugenie Scott of the National Center for Science, who will discuss the "new kid on the antievolutionist block": Intelligent Design Creationism, whose most prominent practitioners are academics associated with secular universities. (Session M8, Wednesday morning, 101H)

Popularizing Science for Undergraduates. Lui Lam, a professor of physics at San Jose State University, outlines the usefulness of integrating popular science books into introductory physics classes, which are generally comprised of undergraduates with no intention of majoring in physics. "We want our college graduates to be informed about science matters, but there is no textbook available that teaches truly multiple disciplines for freshmen," he laments. He believes a solution might lie in the plethora of general interest nonfiction books about science, which are frequently written by the pioneers themselves or exceptionally gifted science writers, and combine ease of comprehension with an entertaining style to pique students' interest in science. "These are the places to learn how research and discovery are being done in very recent times," he says. (Session B6, Monday morning, 103AB)

Secrets of Entrepreneurial Success. New businesses based on innovative science and technology have been the driving force for the US economy for the last 25 years, according to Alexander Glass of the Bay Area Regional Technology Alliance, a featured speaker at a Monday morning session exploring physicists' experiences with start-up companies. Although thousands of scientists and engineers receive funding for establishing new, technology-based companies each year, many experience difficulty making the transition from a technology to a market focus. Glass will be joined by representatives/founders of Siros Technologies, New Focus Inc., IME Corporation, and JDS Uniphase, all sharing their experiences and advice for others interested in following in their footsteps. (Session B5, Monday morning, 102C.)

Bullish on Wall Street. Over the last decade, the number of PhD physicists employed in the financial community has increased dramatically. Once considered something of an anomaly, physicists have become a critical element to successful investment strategies. Wall Street provides a real-life laboratory for exploring complex nonlinear systems, and as a result, today the field of "econophysics" has moved beyond the fringe into the research mainstream. Speakers at a Wednesday afternoon session will describe a broad range of recent research centered on econophysics: critical phenomena in economics, the growth of complex organizations, the application of random matrix theory to economics, and elements for developing a theory of financial risk. (Session P5, Wednesday afternoon, 102C)

Physics and the Long Arm of the Law. Although most physics research takes place far from the courtroom, physics principles nevertheless are critical to settling numerous legal controversies, such as lawsuits claiming that cellular phones and electromagnetic fields cause cancer. Susan Poulter of the University of Utah will discuss the impact of recent science-based decisions of the US Supreme Court, which attempt to set standards for screening expert testimony on scientific topics to help trial judges distinguish good science from bad. Also speaking will be Aaron Manka of the National Science Foundation on how his agency handles allegations of scientific misconduct, and the University of Chicago's Mary Ellen Sheridan will discuss the impact of new Freedom of Information Act requirements on academic researchers. Former APS Treasurer Harry Lustig (University of New Mexico) will close the session with a summary of the Society's 10-year involvement in a lawsuit with scientific publisher Gordon and Breach. (Session E5, Tuesday morning, 102C.)

Sci-Trek: The Next Generation. Undergraduate physics majors from Hendrix College will present results from a wide range of physics projects at a special session highlighting undergraduate research, sponsored by the Society of Physics Students. Because of their extreme sensitivity and dynamic range, large laser ring interferometers are promising candidates for studying geophysical phenomena, according to Hendrix student Chelsey Bryant, whose senior project focused on employing the instrument for just such a purpose. Her fellow Hendrix students Eric Mortenson and Matt Reason worked with semiconductor laser models, while John Hunter Mack chose to focus on noninvasive detection of metallic ions in a hybrid plume. (Session B13, Monday morning, 103F.)

It Takes a Global Village. In today's world without walls, international collaboration in physics is critical, particularly for large science projects, such as the Large Hadron Collider, and international concerns are thus moving to the foreground of the scientific enterprise. James Vary, representing UNESCO and the International Institute of Theoretical and Applied Physics at Iowa State University, will describe how advances in high-speed digital communications have enabled the development of "virtual laboratories" to bridge geographical boundaries between scientists. David Pines will examine the importance of an open scientific environment at Los Alamos National Laboratory to science-based national security, and review unexpected consequences of recent actions taken by the US Congress and Department of Energy. Elisa Munoz of the American Association for the Advancement of Science will give an overview of current violations of scientific freedom and human rights in various countries. (Session B7, Monday morning, 101J)

Climate Control. Fostering a warm and welcoming atmosphere for women scientists in industry is the focus of Sue Chang, a researcher at Xerox's Wilson Center for Research and Technology, who is a featured speaker at a session sponsored by the APS Committee on the Status of Women in Physics. Chang will outline successful climate strategies employed by Xerox to improve the recruitment, retention and advancement of women in its workforce. Since 1991, the number of women hired and promoted at Xerox has been steadily increasing, and the company was cited three times by major professional women's magazines as a top company for working women in 1998. (Session H3, Tuesday afternoon, 101FG)

That Voodoo That You Do

Skewering practitioners of so-called "pseudoscience" is a perennial hobby for APS director of public affairs Robert Park, and many of his favorite targets are featured in his first book for a general audience, due out this spring from Oxford University Press. Three years in the making, *Voodoo Science* seeks to debunk many of today's most foolish and fraudulent scientific claims: magnetic therapy — whose sales topped $2 billion in 1999 — cold fusion, the Podkletnov gravity shield, free energy, and movements to build colonies in space, such as the notorious L5 Society. In the process, Park seeks to answer such questions as how otherwise respectable scientists can end up committing scientific fraud; how our evolutionary heritage makes us *want* to believe in an era when belief is a hindrance rather than a protective mechanism; and how the public can better distinguish pseudoscience from genuine breakthroughs.

Not surprisingly, many of the pseudoscientific examples detailed in the book are drawn from Park's prolific activities on behalf of the APS Office of Public Affairs, based in Washington, DC. In 1999 alone, he made 11 television appearances and 17 radio appearances on subjects ranging from Ballistic Missile Defense and polygraph testing to alternative medicine, space exploration and creationism. He also authored four opinion pieces for the *New York Times*, two full-page stories for the *Washington Post*, and delivered eight speeches or colloquia around the country — all in the name of educating the public about pseudoscientific foolishness and occasionally outright fraud.

(L) Mask from www.whimseys.net/

Robert Park (right) confronts an exponent of Voodoo Science (left).

In some cases, his efforts even resulted in government action. For example, when *USA Today* carried a full-page ad for the mysterious "Vitamin O," Park was the first to expose the product as nothing more than a solution of salt water in his weekly electronic newsletter, *What's New*. A subsequent interview on National Public Radio raised enough public pressure to cause the Federal Trade Commission to investigate. Last March the FTC charged the supplier with fraud and ultimately closed the company down. Similarly, Park's efforts to expose the fraudulent claims of free energy schemes — a movement which has achieved nearly cult-like status — led to the removal of State Department sponsorship of a free energy conference last April, and an investigation of the Patent and Trademark Office, resulting in the dismissal of the U.S. patent examiner who organized the conference.

And for all those pseudoscientists fond of citing Newton and Galileo as similarly misunderstood role models, Park has a typically pithy rejoinder: "It is not enough to wear the mantle of Galileo: that you be persecuted by an unkind establishment. You must also be right."

SPECIAL EVENTS

COM/CSWP Reception
Sunday, March 19, 2000
5:30 - 7:30 PM, Marquette Room (lecture) / LaSalle Room (reception)
A joint reception of the APS Committee on Minorities and Committee on the Status of Women in Physics.

Career Workshop
Sunday, March 19, 2000
6:00 - 9:00 PM, Room 101F
A free workshop open to all meeting attendees to offer insight on career choices in physics.

Third Annual Run for Health
Monday, March 20, 2000
6:30 - 7:30 AM
Runners will assemble at 6:15 AM at the Minneapolis Convention Center.

CSWP/FIAP Networking Breakfast
Monday, March 20, 2000
7:00 - 9:00 AM, Duluth Room, Hilton
CSWP and the Forum on Industrial and Applied Physics will co-sponsor a networking breakfast for women in industrial physics.

FIAP Networking Coffee Hour
Monday, March 20, 2000
10:00 - 10:45 AM, Lounge A

Physical Review and Physical Review Letters Panel Discussion
Monday, March 20, 2000
2:30 - 4:00 PM, Room 101H
Jack Sandweiss, editor of PRL, will moderate an open discussion to answer members' questions to the editors of APS journals.

Presentation of 2000 Prizes and Awards
Monday, March 20, 2000
5:15 - 6:15 PM, Ballroom B
A complete list of the individuals being honored can be found in the special honors insert.

Welcoming Reception
Monday, March 20, 2000
6:15 PM, Ballroom A

Book Signing
Tuesday, March 21
1:30 - 2:30 PM
Room 101H
Authors featured at the "Voodoo Science" session (see story, page 1) will sign copies of their forthcoming books.

Alumni Reunions
Tuesday, March 21, 2000
6:00 - 8:00 PM, Hilton Hotel, 2nd and 3rd floors
Back by popular demand! An opportunity for alumni from universities all over the country to meet and mingle. Lucent Technologies and IBM will also sponsor reunions for the first time.

Special Symposium: "The FY2001 Nanotechnology Initiative — What's in Store for the Future
Wednesday, March 22, 2000
5:30 - 7:00 PM, Ballroom B
APS President James Langer will chair this symposium on the new Nanotechnology Initiative

Student Luncheon / Meet the Experts
Thursday, March 23, 2000
12:30 - 2:00 PM, Ballroom A
Only on a first-come, first-served basis. Students will meet with experts from various fields for informal discussion over a complimentary box lunch.

OPINION

VIEWPOINT...

Quantum Justice

As this is being written, the physicist Wen Ho Lee, a naturalized American citizen, sits in a New Mexico jail, having been refused bail lest he somehow reveal to a confederate the whereabouts of seven missing tapes that may or may not still exist, the classified contents of which he may or may not want to transmit to a foreign power.

Less than a year ago, Lee was a respected long-term employee of Los Alamos National Laboratory, living what to all appearances was a normal family life in a suburbs of Los Alamos. Since then he has been fired by Secretary of Energy Richardson, and, after months of innuendo, has finally been indicted for downloading classified material and transferring it onto ten tapes, seven of which are still missing.

The background to all this is the fact that China seems to have acquired secret information related to our latest missiles and warheads, and there is the suspicion that that information was leaked from Los Alamos, where allegations of lax security have been enough to turn even such sober souls as former Republican Senator Warren Rudman virtually apoplectic.(Rudman was appointed by President Clinton to chair a panel that investigated security at our national weapons laboratories). Early on, Wen Ho Lee was fingered as the most likely source of the leaks, although he has not been charged with espionage, presumably from lack of evidence. I think it is fair to say that without the concern over espionage and the need to find the responsible party, Wen Ho Lee would never have been investigated, much less charged with the offenses that have him now languishing in prison awaiting trial.

We don't know whether or not Lee is guilty of espionage. But in either case, justice is not being served. If he is guilty, he is getting off altogether too lightly: he is facing lesser, although still serious charges, when he in fact has committed a heinous offense. It is like sending Al Capone up on tax evasion charges. If he is convicted, he could be out of jail sooner than would be warranted by his grievous betrayal of the nation's trust.

On the other hand, if he is innocent of espionage, his life has been unfairly ruined by political intrigue and media attention. Mere acquittal of the charges against him cannot possibly restore what he has lost. Worse yet, he may be convicted, when his motives may have been innocent and his actions no worse than those of many of his colleagues.

The reader may think that this case is unique and that Lee's misfortune is the price we have to pay for our national security. But similar things happen in other high-profile cases. In December 1998, a Yale senior, Suzanne Jovin, was found, dying from 17 stab wounds, in an upscale New Haven neighborhood about a mile and a half from the Yale campus. Suspicion quickly focused on James Van de Velde, a lecturer in political science who had been Jovin's senior thesis advisor and who lived not far from the crime scene. When the police described Van de Velde as being in a "pool of suspects" (whose other members were never identified) Yale reacted by first relieving Van de Velde of his teaching duties in the spring of 1999, and then not renewing his contract for the following year. If he is guilty of murder, Van de Velde, who has yet to be charged with anything, has escaped incredibly lightly. But if he is not guilty, his career has been terminated and his reputation destroyed totally undeservedly.

The circumstances imposed on Lee and Van de Velde bear the same relation to an ideal system of justice that a classical superposition bears to a quantum one. They are victims of a system in which those under suspicion of serious criminal activity are forced to endure what amounts to a classical superposition of innocence and guilt: they experience some, but not all, of the adverse consequences of their putative guilt. The ideal situation, which I unfortunately have no idea how to attain, is that they should be in a quantum superposition of these two states. A measurement (i.e. a verdict) would force them into one or the other of the possible eigenstates; but the nightmarish limbo that they now inhabit would not exist, just as for a spin-1/2 system there is nothing between spin up and spin down.

-Alan Chodos

zero gravity

The Physicists' Bill of Rights

(Author Unknown)

We hold these postulates to be intuitively obvious, that all physicists are born equal, to a first approximation, and are endowed by their creator with certain discrete privileges, among them a mean rest life, n degrees of freedom, and the following rights which are invariant under all linear transformations:

1. To approximate all problems to ideal cases.
2. To use order of magnitude calculations whenever deemed necessary (i.e. whenever one can get away with it).
3. To use the rigorous method of "squinting" for solving problems more complex than the addition of positive real integers.
4. To dismiss all functions which diverge as "nasty" and "unphysical."
5. To invoke the uncertainty principle when confronted by confused mathematicians, chemists, engineers, psychologists, dramatists, *und andere schweinhund*.
6. When pressed by non-physicists for an explanation of (4) to mumble in a sneering tone of voice something about physically naive mathematicians.
7. To equate two sides of an equation which are dimensionally inconsistent, with a suitable comment to the effect of, "Well, we are interested in the order of magnitude anyway."
8. To invent fictitious forces to delude the general public.
9. To justify shaky reasoning on the basis that it gives the right answer.
10. To cleverly choose convenient initial conditions, using the principle of general triviality.
11. To use plausible arguments in place of proofs, and thenceforth refer to these arguments as proofs.
12. To take on faith any principle which seems right but cannot be proved.

LETTERS

Readers Say Georgi is "Off the Mark"

In his back page article, "Unconscious Discrimination Against Women in Science," (*APS News*, January 2000) Howard Georgi takes a challenging task to diagnose the root causes of "white male domination" in sciences, as evidenced by statistics, and puts forth his bold thesis of skewed selection criteria, based on "assertiveness" and "single-mindedness." It baffles me to see a respected physicist to make such leap of faith (and go further to offer "remedies") without a shred of evidence to support it.

In my career I had a chance to grade, evaluate, reference and select dozens of students, postdocs, applicants, on different levels. Rarely, if ever, did I use "assertiveness and single-mindedness" in a positive, let alone decisive way. Nor have I seen many of my colleagues use them to any extent. On the contrary, it was first and foremost (to quote Georgi) "intellectual curiosity, thoughtfulness," creativity and persistence. Yet the overall results of my (anecdotal) statistics would pretty much go along the national trends and figures, offered by Georgi.

There should be something more sinister to skew the numbers, the way they are, that Georgi dares not (or knows not) to speak. As for his "remedies," those have little bearing on two "evil criteria," but amount to nothing less than a voluntary "quota system," the way it is practiced now in the Boston city schools. To make sure to succeed, his quota system should go well beyond hiring practices, and extend to all levels of education, starting from test scores and course grades. Indeed, all those build up in a single evaluation-selection process. So the only assured way to advance any under-represented group is to institute the overall quota.

Here, however, I could cut short Georgi's optimism for the future. Never in my career have I bent or twisted the "rules of the game," based on a single list and single (blind) grading system for all (under- and over-represented) students. As long as it stays that way, Georgi's "egalitarian dream" may never come true.

David Gurarie
Case Western Reserve University

I enjoyed reading Howard Georgi's commentary on the unconscious discrimination against women in science. The article was written with good intentions, but the focus on "assertiveness and single-mindedness" is simply off the mark, because it cannot explain why the life sciences have always had more women. Assertiveness and single-mindedness are selected for in every field of science (and business). Only a physicist would be arrogant (or naive) enough to think that physicists are any more aggressive than biologists.

I know this from experience. I did my PhD in experimental low temperature physics at Cornell University, transitioned to biology, and helped launch one of the major Genome Centers for the Human Genome Project. As a result, I have known some of the biggest names in physics and biology. I can assure you that, compared to some of the people that I have dealt with in genomics (or medical genetics), physicists are downright pansies. For that matter, when it comes to aggressiveness, none of these scientists can hold a candle to some of the pharmaceutical executives and venture capitalists that I have dealt with. I'm afraid Georgi will have to look elsewhere for answers, but I wish him well.

Gane Ka-Shu Wong
University of Washington

After reading Howard Georgi's article I feel that he did not understand the problem. As a woman graduate student in physics, I know that single mindedness and assertiveness do not affect women going into physics or staying in physics. It is true that most physicists are assertive and most physicists are male, but that does not mean that women are not assertive.

One obstacle that women face comes from the way that physicists solve problems. When physicists identify a problem, they pose a question by restating it. The problem is that there is a lack of women in physics, and the question that we pose is: "Why are there so few women in physics?" If your colleagues asked you three times a week every week for 10 years: "Why do you have a beard, when everyone else is clean shaven?" you would feel that you should shave. I get asked the question "Why are there so few women in physics?" routinely, and after 6 years of being asked this question, I am now starting to feel that maybe I should leave physics. We need to rephrase the question to: "How do we attract more women?"

After posing our question, we try to isolate the variables, by separating the women from the men. Most physics departments go out of their way to group all of the women together, whether it is special e-mail lists or TA office assignments. This separation of women from the men even occurs when one enters into math and science competitions (such as the Putnam exam) where the women's tests get identifying marks like red stickers. Since we know segregation causes one to have lower self-esteem, why then would we separate the women from the men in an endeavor to encourage women to stay in physics? As it stands now, the way we are approaching the problem is only causing women that are already in physics to leave. Let's re-think the problem and not make a "list of the best women .., even if they do not rate them as highly as the top men." This cheapens a woman's professorial title and accomplishments. Why do your best, when everyone is going to assume that you got the raise, tenure, or scholarship because you were on a special list? I do feel strongly that this attitude and not a lack of single-mindedness and assertiveness causes women to leave physics.

Evelyn J. Boettcher
University of Maryland

OPINION

My Opinion—Others May Differ

Who Wears Pythagoras' Trousers?

By David Markowitz

Male versus female, as an undercurrent in the practice of physics, has enlivened *APS News*. A book by science writer Margaret Wertheim transforms the current into a shock of discovery.

The book is *Pythagoras' Trousers,* or *God, Physics, and the Gender Wars*. The title reminds us that Pythagoras and his followers combined natural and supernatural studies. They originated the idea God is a mathematician, an idea that still has currency.

The author covers much of the history of Western science, religion, and society, and she does so with a deft hand. Her main points are that women have been deliberately excluded from the highest callings of the mind, encompassing both science and religion, and that the persistence of this situation bodes ill for science, for society, and for women.

In the introductory chapter Wertheim zooms in on the most egregious religion and the most offending science by saying: "Physics is thus the Catholic Church of science." Of Mathematical Man, one of her multi-purpose constructs: "He does not need a sex change, just a major personality realignment."

Through recorded history women have received less opportunity and recognition than men. In the Old Testament, the generations — whose reckonings supposedly gave the age of God's Earth — were virtually all male. There must have been an equal number of females, but they were cast in supporting and largely unreported roles. In the New Testament, men are spiritual beings and political figures, while women are either virgins or whores. Yes, it sounds unfair and unrealistic to me, too.

The book brings several questions to mind. Has the bulk of Western civilization been built upon these Biblical beginnings? Have science and religion been in cahoots, rather than at odds through the ages? Has the priesthood acted to exclude women, as well as other groups? How will we now include the disaffected outsiders? Will the inclusions materially change the way physics, in particular, is done?

It is apparent that religious and scientific societies have had explicit rules forbidding women to join. When rules were relaxed, votes still were not. Think of Marie Curie and the French Academy. Think of all the bright and achieving women who were refused admission to graduate schools in the US until fairly recent decades. In a persistence of discrimination, these same women were denied faculty positions over the same time period. A woman could no more become a professor than she could become a priest. The most mathematical of the sciences rejected women most completely. Physics uses math the way the Church used Latin, or so it is said. Without Latin, you could not lead a Mass. Without math, you cannot advance in physics. To stop women from entering either, simply prevent them from learning the holy language.

Wertheim contradicts my misconception that science and religion have been at each other's throats. I always think of the Scopes "monkey trial" in Tennessee — a trial that science teaching faces again and again in nearly every state. To Wertheim this is but a mole on the face of the science-religion complex.

Almost all of the notable scientists were deeply religious men. They agonized over their scientific findings if they appeared to veer from religious precepts. Think of Kepler resisting for years non-circular shapes for planetary orbits. Think of Einstein resisting for decades the dice-playing deity of quantum mechanics. Newton apparently spent more time on alchemy — considered a spiritual pursuit — than on what we recognize as physics. Hawking has adopted Einstein's preoccupation with the "mind of God," and is acting as if he is getting closer to reading the inside of it. The name of God is making multiple appearances in the lingo of contemporary physics, as in "the God particle," Leon Lederman's version of the Higgs boson — the one whose detection will clinch the claim of reading God's mind.

Are we in the physics community still as obsessed with God as the investigators of old? I think references to God in this enlightened age is largely a ploy. To a particle physicist, God is a bargaining chip, much like family values is to a politician. Sure, lots of folks believe in God and family values and few wish to argue against them. But their main purpose is what they earn for their promoters: money to do research on the one hand, and votes to propel them into office on the other.

A good deal of Wertheim's argument is that male physics and female physics are different, and, being different, it would be beneficial to have both. It is a yin/yang kind of thing. But is it so? Coming from the same world view as "Men are from mars, women are from Venus," is the assertion that men seek competition and women seek cooperation. Thus, men are the dynamic, gritty diggers into more basic levels of understanding, while women are the synthesizers of holistic patterns in nature. This is a nice division of behaviors, if true. It is also said that men have a component of arrogance, and the association of the male physics of the basic forces and fields with God's handiwork is a current manifestation of that arrogance.

Wertheim comes close to asking, "Why can't a man be more like a woman?" If men are seen as manipulators and women as nurturers, it might be refreshing to see men change more than women do. Could your superstring theorist be female, and your physicist of butterfly flight be male? Emphatically yes. The hardhitting woman and the soft-spoken man are around in small, growing numbers. What is more important to Wertheim is the need to shift toward the butterfly and away from the superstring. Why is that?

The big question in the final chapter, "The Ascent of Mathematical Woman," is the social responsibility of science. This pits the multi-billion-dollar accelerator establishment against just about everyone else. Are the largest physics machines the cathedrals of our age? They are certainly awesome marvels of architecture, at least figuratively reaching for the sky. But cathedrals make some claims about touching God; hence, the claim on behalf of the machines seeking the "God particle." Whatever one feels about the grandeur of cathedrals in the face of poverty or ignorance of the general populace in history, one still must ask whether the present world can afford to spend billions on particle physics.

Let me quote from Peter Matthiessen's *Tigers in the Snow*, in which the author's quest is to save the tiger as a species on Earth. Why save the tiger? Says Matthiessen: "In arguing for heroic efforts on behalf of tigers, one could cite the critical importance of biodiversity, as well as the interdependence of all life, but finally these abstractions seem less vital than... the aura of a creature as splendid as any on Earth, infusing man's life with myth and power and beauty." In fact, biologists are still attempting to study the tiger in the wild. Thus, the world may lose another species before it knows what it is losing.

This argument to me is not only persuasive on behalf of the tiger, it is the only one I would consider on behalf of a supercollider. Does the big machine infuse our life with myth and power and beauty? Like the tiger in the jungle (and the great cathedrals), will the giant accelerator make us better than we are? As physicists and as citizens, we are called to answer those questions.

David Markowitz is an emeritus professor of physics at the University of Connecticut, and editor of the APS New England Section newsletter.

Scientists Must Speak Out; We Depend On It

By Newt Gingrich

The fate of our country may well depend on whether or not scientists recognize that they have real responsibilities as citizens.

The fact is no one else is as qualified to make the case for increased funding in science research and reform of science education. Without a continued commitment to funding scientific research and development and a successful reform of science education it is very unlikely that the United States will maintain the momentum it has created over the last 60 years.

Our economic future depends directly on our ability to take new scientific research and translate it into entrepreneurial development. Without the last 60 years we would all have lesser incomes, lower standards of living, and fewer choices. Be it aircraft, manufacturing, marketing, entertainment — you name it — the American technological and scientific advantage has been key to our success as world leaders.

In the development of the high-tech world the role of government (in both defense research and nondefense research) has been vital. The modern entrepreneur of Silicon Valley is creating an entirely new economy based on the scientific advances of three generations of government funded research and development. The Internet itself is an example of government-funded research providing a platform upon which entrepreneurial success has been built.

In health and health care it would be particularly tragic to slow our investment in research at the very moment we are entering a wonderful new world of knowledge. We will learn more about the human body in next 20 years than in all of human history. Biology will be to the 21st century what physics was to the 20th.

If we invest wisely, we will extend life, minimize suffering, and create a healthier and less medically expensive America. But if we stand by and allow research funding to slow, literally more people will die, with greater pain, at higher cost. That is what's at stake.

Finally, regarding national security, scientific achievement is ultimately a matter of life and death. Without radar and sonar we could not have won the World War II (it took the first to win the Battle of Britain; the second to win the battle of the North Atlantic).

If our opponents had achieved nuclear weapons before us, we would have been defeated. In real terms, these breakthroughs saved an immeasurable number of lives. But America is only one wave of scientific breakthroughs away from being vulnerable. If at any point our scientific research and education fail to be the best, our national security will weaken and our ability to lead will disappear.

So, if all this is so important, why must scientists come forth as citizens and explain it? Because no one else has their understanding or credibility. C.P. Snow was correct in 1959 when he described two emerging cultures — the scientific and the nonscientific. Too often those who know enough about science cannot explain it in popular language. Conversely, those who are effective at communicating in popular language don't know science. In the scientific community the situation is worsened because scientists like Carl Sagan, who do popularize and reach out, become less than fully respected members of their guild.

Furthermore, most scientists by definition would rather be in their laboratories studying, at conferences learning, or in a classroom teaching than appearing in public settings and appealing for public support. Unfortunately, part of their mindset seems to be a determination that their work is so obviously important that they should not have to explain it.

Instead we need scientists to attend town hall meetings, address members of Congress, and appear on talk radio to explain why research matters. They must go to their local civic club and demand that science education be trusted to those who know science, and demand that the excitement of discovery (the heart of the scientific experience) replace bureaucratic memorization models of science education.

I have fought hard for doubling the science research budget across the board. I have argued strongly for a complete overhaul of science education in America. But frankly one former speaker of the House is not enough. America needs a science lobby fueled by scientists.

In our rapidly moving culture where people can shut out information, we need to hear from the people who are doing the research, making the breakthroughs, and inventing the future.

All I am asking is that every scientist spend an hour or two each month being an active citizen. Do your duty and educate your fellow countrymen about the exciting world that awaits us. Help us understand what is at stake and we will help you find the resources to achieve these great breakthroughs. Every day scientists work in labs and wind tunnels and at computers to make our country a better place. Surely a little citizenship is a small enough price to pay to do the same thing in the public arena. After all, our health, prosperity, and survival are at stake.

Newt Gingrich is a former speaker of the US House of Representatives. This story ran on page A19 of the Boston Globe on 12/28/1999.

Microfluidic Technologies on the Rise at DFD Meeting

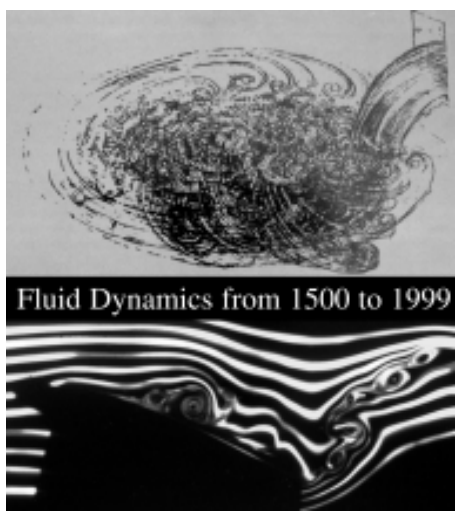
Emerging microfluidic technologies for mechanical, chemical and biological analysis at micron-scales have induced significant excitement in the fluid mechanics community, according to featured speakers at the 52nd annual meeting of the APS Division of Fluid Dynamics, held 21-23 November 1999 in New Orleans, LA.

Prashanta Dutta of Texas A&M University presented numerical simulations of liquid flows in microchannels with variable depth. He suggested the use of electro-osmotic flow to prevent or enhance recirculation flow in a gap. By applying different voltages across the gap, they obtained different flow patterns without recirculation and with non-symmetric vortices inside the gap. The implication is that such designs can reduce or enhance mixing in micro-devices. Sandra Troian of Princeton presented a new design for injecting and driving fluids in miocrochannels using temperature-driven Marangoni effects. She also suggested a self-assembly technique at microscales by inducing fluid fingering on a surface with periodic stripes of wetting and non-wetting materials. The large audience and the creative and preliminary nature of the reported work suggest that this field will blossom in the near future. Separation, mixing, dispersion reduction, driving mechanism, mutli-phase transport and reaction problems in microdevices will be the focus for the next few years.

During a session on electro-hydrodynamics: Paul Todd of the University Colorado studied the demixing of an emulsion of poly(ethylene glycol) in a phosphate-buffered solution in the presence of an electric field. Recirculation of liquid inside the drop was shown to be very important to its mobility, thus invalidating the infinite viscosity approximation.

Andreas Acrivos of CCNY reported particle separation in the presence of anelectric field when flowing in a wavy square channel. His experiments apply a high electric field across the channel to assemble the particles in wide parts of channel and removes particle in narrow parts, creating almost periodic packets of particles.

John Anderson of Carnegie Mellon University studied cluster formation near an electrode due to electrokinetic flow. Gravity keeps the particles on the electrode and the electrode field induces an electrokinetic flow that creates an attractive force between particles against their double-layer repulsion. This attraction can lead to cluster formation. These novel separation and clustering techniques could result in new devices, including microdevices.



The world's first flow visualization representation (top) is a sketch of a free water jet issuing from a square hole into a pool, drawn by the hands of Leonardo da Vinci, circa 1500. Da Vinci wrote, "Observe the motion of the surface of the water, which resembles that of hair, which has two motions, of which one is caused by the weight of the hair, the other by the direction of the curls; thus the water has eddying motions, one part of which is due to the principal current, the other to the random and reverse motion." The bottom photograph was taken close to five centuries after that of da Vinci. Laser-induced fluorescence is used to reveal a side view of a low-Reynolds-number lifting surface undergoing a pitching maneuver in a water towing tank. Flow is from left to right, and the argon laser sheet is generated using a rotating mirror located above the wing; hence the shadow seen below.

First Online Graduate Physics Textbook Hits the Web

Physics graduate students weary of lugging massive tomes on quantum field theory to and from campus will be relieved to hear that an electronic alternative is now available. Warren Siegel, a high energy physicist at SUNY-Stony Brook's C.N. Yang Institute for Theoretical Physics, is offering his own comprehensive textbook on quantum and classical field theory free of charge. Entitled *Fields*, the textbook can be accessed through Los Alamos National Laboratory's preprint archive (see http://xxx.lanl.gov/abs/hep-th/9912205).

Employing what he considers to be a more pragmatic approach to the subject than most traditional textbooks, Siegel's tome emphasizes both concepts and calculations. Besides the usual introductory topics, the book includes a chapter on general relativity, introductory chapters on supergravity and strings, and treatments of many practical techniques, such as the 1/N expansion (color ordering) and super spacecone (spinor helicity) gauges.

According to Siegel, an online graduate textbook is simply the next logical step in electronic publication, and believes that electronic textbooks have several advantages. For example, the PDF Web format enables more general and efficient searches than with a standard index, as well as a separate table of contents window with links to various chapters and subsections. In addition, the PDF format enables students to make use of built-in Web links for internal references to outside work, enabling them to remotely access related publications electronically. And rather than lugging heavy books around, students can download the file to a ZIP disk for easy transport to and from campus.

Nor is Siegel overly concerned with possible copyright infringements of his work, pointing to the fact that scientists routinely publish preprints via the LANL archive, which itself can serve as a publication record. And unlike standard preprints, *Fields* is more of a review of quantum field theory rather than presenting new research. There remains the slight possibility of someone downloading the textbook with an eye towards claiming it as their own and selling it for profit, but Siegel reasons, "Who's going to pay for something they can already get for free?"

For other online physics textbooks available to the public, see http://physics.miningco.com/education/physics/msubtext.htm?pid=2821&cob=home

Wilson Memorial Tribute Planned for April Meeting Session

A memorial tribute to Robert R. Wilson will be offered by Edwin L. Goldwasser at a plenary session of the April meeting of the APS in Long Beach, California. Goldwasser served under Wilson as Deputy Director of Fermilab from 1967 to 1978.

Wilson, one of the most influential figures in the history of the development of particle accelerators, died in January at his home in Ithaca, NY, at the age of 85. The Wilson Prize of the APS is named for him, and he served as APS President in 1985. Wilson earned his undergraduate and graduate degrees in physics from the University of California, Berkeley and worked with E.O. Lawrence on the cyclotron before joining the Manhattan Project to develop the atomic bomb. He conducted research at Los Alamos National Laboratory and Harvard University before being named director of Cornell University's Laboratory of Nuclear Studies in 1947. His research there focused on the structure of protons. In 1967 Wilson took a leave of absence to become the founding director of Fermi National Laboratory, currently the world's most powerful accelerator until it is succeeded by the completion of the Large Hadron Collider at CERN in 2006. He was also an early champion of the importance of funding basic research at a time when science funding was driven primarily by national defense concerns. According to Energy Secretary Bill Richardson, Wilson "had an unerring sense of what is important to the science of high-energy physics and its importance to the nation." When was asked whether the Fermilab research would benefit national security during 1969 testimony before a joint committee of Congress, he replied, "It has nothing to do with defending our country, except to make it worth defending."

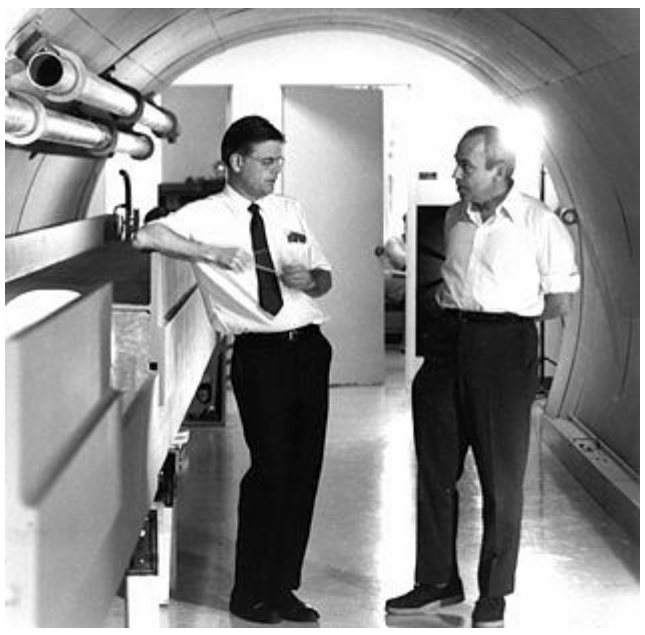


Photo from http://www.fnal.gov/projects/history/exhibit/

Robert R. Wilson (left) confers with Edwin L. Goldwasser during the early days at the National Accelerator Laboratory.

This Month in Physics History

First Transmission of Human Speech: March 10, 1876

Editor's Note: *Members may submit their own suggestions for historical physics-related events to Editor, APS News, One Physics Ellipse, College Park, MD 20740; letters@aps.org.*

Contrary to popular belief, Alexander Graham Bell (photo inset above) did not set out to construct the world's first telephone. Instead, his focus was on the development of the cutting edge technology of his day: the multiple telegraph, a device capable of sending multiple messages simultaneously over the same wire that was also the focus of his primary competitors, Thomas Edison and Elisha Gray.

A pivotal experiment on June 2, 1875 yielded a serendipitous discovery that changed the course of his research. Bell and his assistant, Watson, set up three multiple telegraph stations (A, B and C), each with three tuned-reed relays, to determine whether plucking the first reed in A would cause the corresponding reeds in B and C to vibrate. But while the corresponding reed in B vibrated well in response to A, the reed in C was stuck. When Watson plucked the reed, it produced multiple tones that caused the corresponding reed in B to vibrate powerfully — effectively demonstrating that a single reed, when dampened or stuck, could induce a current sufficient to transmit complex sounds over a distance.

Bell promptly constructed a prototype telephone in which the reed relay was attached to a membrane with a speaking cavity positioned above it, but this did not produce intelligible speech, apart from a low mumbling. Nevertheless, it was enough to convince Bell he was on the right track, and he submitted a patent for the device on February 14, 1876 — barely edging out Gray, who submitted his own design for a speaking telegraph a mere few hours later.

One month later, Bell once again revised his design. This new version included a speaking tube and membrane using a cork to attach a needle as a vibrating contact. One of his reed receivers was placed in another room, and Bell then spoke the now famous words — "Watson, come here; I want to see you." — to achieve the first documented transmission of human speech.

For a detailed discussion of Bell's work see http://jefferson.village.virginia.edu/albell/homepage.html.

Birthdays for March:

4 Robert R. Wilson (1914)
14 Albert Einstein (1879)
22 Robert A. Millikan (1868)
27 Wilhelm Roentgen (1845)

Requiescat in Pace:

On March 31, 1727 Sir Isaac Newton, the "father of physics," dies in London, England

Announcements

Positions Available Now!

Help Excite the Public About Physics!

The American Physical Society is launching a significant initiative to convey the importance and excitement of physics to the public via a new website.

We are looking for someone to fill a new position whose primary responsibility will be to gather materials for the site, to bring it into being, and to keep it continually up to date.

This person should have an MS or a PhD in physics (or equivalent experience), excellent communication skills, and be eager to interact creatively with all segments of the physics community and the public.

For more information, contact Alan Chodos (chodos@aps.org). To apply, send a resume and the names of at least three references to: Joseph Ignacio; American Physical Society; One Physics Ellipse; College Park, MD 20740

American Journal of Physics Seeks New Editor

A search committee has been appointed to seek a new editor for the American Journal of Physics, to begin his or her duties on July 1, 2001. The new editor will succeed Robert H. Romer, who has served as editor since 1988.

The search committee welcomes inquiries, suggestions, nominations, and applications. A more complete description of the procedures for the search and of the responsibilities of the editor will be published soon in the American Journal of Physics, on the AJP website, and elsewhere.

Applications should include: (1) a cover letter explaining the candidate's views on the role of the American Journal of Physics and how it might be improved to better serve the physics community; (2) a curriculum vitae; (3) a supporting letter from the candidate's department chair (or equivalent); and (4) two additional letters of recommendation. Applications should be complete by July 5, 2000 but will be accepted until the position is filled. Address correspondence to Professor Peter J. Collings, Department of Physics and Astronomy, Swarthmore College, Swarthmore, PA 19081.

The committee is chaired by Peter J. Collings of Swarthmore College. The other members of the committee are David J. Griffiths (Reed College); Donald F. Holcomb (Cornell University); Karen L. Johnston (North Carolina State University); Bernard V. Khoury (American Association of Physics Teachers, ex officio); Richard W. Peterson (Bethel College, St. Paul); and Robert H. Romer (American Journal of Physics and Amherst College, ex officio).

Get the ear of your Representative or Senator

The APS Washington Office, in cooperation with twenty scientific and engineering societies, is sponsoring Congressional visits on April 4th and 5th in Washington, DC. This will be a key time to promote increases in the Federal budget for research. Participants will be provided with all necessary background information including profiles of their members of Congress and a collection of briefing papers. For more information, contact the APS Washington Office at opa@aps.org or at (202) 662-8700.

APS UNDERGRADUATE PHYSICS STUDENT COMPETITION

2000 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 16 June 2000 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 **16 June 2000** 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 **16 June 2000** to:

Dr. Alan Chodos, Administrator, Apker Award Selection Committee
The American Physical Society, One Physics Ellipse, College Park, MD 20740
Telephone: (301) 209-3268, Fax: (301) 209-3652, email: chodos@aps.org

NAGPS Seeks Grad Student Responses to Online Survey

The National Association of Graduate-Professional Students (NAGPS) is conducting an online survey of doctoral students regarding their experiences in graduate school. Funded by a grant from the Alfred P. Sloan Foundation, the survey will cover issues in a number of areas, including information for prospective students, breadth and flexibility of the curriculum, career guidance and placement services, faculty mentoring, time to degree, departmental climate, professionalism, and overall satisfaction.

"For this survey to be useful, it is vital that we reach as many current and recent doctoral students," says Adam Fagen of Harvard Univesity, chair of the NAGP's Ad Hoc Committee on Faculty-Student Relations. "We are hoping to encourage a significant percentage of students to respond so that the results will represent a broad range of experiences and a realistic picture of department and institutional practices."

Anyone who has been enrolled in graduate school for at least one semester in the last five years is eligible for the study. The survey will run from January through May 1, 2000, and the results will be made available publicly on the Web in September. Interested graduate students may submit their responses at http://survey.nagps.org **no later than May 1, 2000.**

High School Physics Teachers, *continued from page 1*

be filled by trained teachers returning to the workforce after retiring or pursuing other career options. Indeed, Faitsch has hired a retired physics teacher willing to return for one semester to meet the immediate demand, although his search continues for a more permanent solution.

For Neuschatz, the overriding issue in science education is the quality of new elementary and middle-school teachers, particularly in terms of their science and mathematics backgrounds. While reviewing the physics curriculum offered at two-year colleges — where a large proportion of elementary education majors reportedly get their start — intermediate algebra and an introductory physics course were required for automotive mechanics, but not for those in the elementary education program. Other studies have shown that elementary education majors tend to have some of the lowest SAT scores of any college-bound group, according to Neuschatz.

The situation is much improved at the high school level. The AIP survey found that one-third of high school physics teachers have earned an undergraduate or graduate degree in physics or physics education, while another 12% have a minor in one of the two fields. The remainder generally have degrees in another field of science, mathematics, or science or mathematics education, and Neuschatz reports that cases of utterly unqualified instructors are rare. "This in no way implies that there is a generous supply of well-trained high school physics teachers ready to lead classes in the subject," he says. "But it does show that the situation is less dire than is often depicted, and that, if anything, teacher preparation seems to be improving, albeit slowly."

The APS, in partnership with the AAPT and AIP, has led the physics community in recently becoming involved in colleges and universities to produce more and better-prepared teachers of physics and physical science according to APS Director of Education Fred Stein. For the past seven years there have been efforts by science and mathematics departments to improve their preservice programs through the NSF-supported Centers for Excellence in Teacher Preparation in 14 states. Last December, the APS and its partners proposed a five-year project to the NSF to facilitate partnerships in colleges and universities between departments of physics and education to directly address the shortage of qualified physics teachers.

The reluctance of principals to bend or change the rules for hiring new teachers does not encourage applicants with more science background but fewer education credits. According to Neuschatz, only 9% of the public school principals surveyed in 1997 said they had altered hiring procedures in the last four years, and only 4% of the remaining respondents were aware of plans to initiate such changes in the future. Among private schools, where principals have more latitude in their hiring practices, 16% reported rule changes and half of those used those changes to hire physics teachers.

Faitsch believes that graduate students in physics could comprise a large potential pool of high school physics teachers, but admits this would require a significant change in attitude on the part of university physics departments. Several students at Yale expressed interest in the Guilford position, and one candidate was equally interested in coaching wrestling in the evenings. However, he found that the university tends to discourage its graduate students from teaching outside the institution, and ultimately most of the Yale candidates were unwilling to risk their research funding. Nor is Yale unique in this regard.

Ultimately, in Faitsch's experience, "the people who last in education tend to be those who wanted to teach in the first place, and then chose a subject," he says. "I've told all the juniors and seniors here at Guilford, 'If you have any interest in teaching, consider going into physics.'"

Further reading, see: The Physics Teacher, *February 2000, Vol. 38, No. 2:98-104.*

THE BACK PAGE

Spallation Neutron Source On Track Following Major Changes

An interview with David Moncton

This month, we devote the Back Page to an in-depth interview with David Moncton, director of the Spallation Neutron Source (SNS), a neutron scattering facility being built at Oak Ridge National Laboratory by a consortium of national labs that includes Argonne, Lawrence Berkeley, Brookhaven, and Los Alamos National Laboratory. Once completed, the SNS is expected to attract between 1000 and 2000 scientists and engineers each year from universities, industries, government labs and other nations. (See http://www.ornl.gov/sns for more information about the project.)

Yet when Moncton came on board in February 1999, the project was a troubled one. Despite unqualified praise for the obvious scientific merits of the SNS, House Science Committee Chairman James Sensenbrenner, Jr. (R-WI) expressed concern about project management and cost and schedule estimates, recommending that funds allocated for actual construction of the facility be withheld until these concerns were satisfactorily addressed. This monumental task fell to Moncton, and he reports on the project's status below. Support from the scientific community has been strong. Last November, the APS Council unanimously endorsed a statement urging Congress to provide the necessary funding for timely completion of the SNS (see *APS News*, January 2000).

Q: Much of your work over the last year has centered on meeting seven prerequisites issued by Congress to release allocated construction funds for FY2000. What were some of the major hurdles you had to overcome, and how did you meet those requirements?

Several were management issues. Congress wanted clarification that senior project management positions have been filled by qualified individuals, as well as a revised project management structure integrating the staff of the collaborating laboratories under a single project director. These were officially completed as part of a review last July. They also wanted cost baseline and project milestones for each major construction and technical system activity, consistent with the overall cost and schedule submitted to the Department of Energy's FY2000 budget. DOE engaged an outside contractor to independently ~~to~~ review the plans for the project and certify that it was the most cost-effective means to complete the facility.

Congress also desired binding legal agreements that specify the duties and obligations of each laboratory of the Department. We accomplished that with a memorandum of agreement signed by all the lab directors in the consortium. In particular, it set out legally binding performance measures that must be met by all contractors, included as part of their annual performance appraisal. If the participating labs were to perform below expectations, then in principle it's possible for the project to influence their performance appraisal and therefore the contractor fee.

There was also a Congressional request for official delegation by the Secretary of Energy of primary authority for the SNS to the project director. That was accomplished through a document called the Project Execution Plan, describing the interface between the project and the DOE, and the various roles of DOE officials and project officials. The Secretary signed it last fall. Congress also requested annual reports on the SNS project as part of the DOE's annual budget submission. That didn't require unusual action, since it's something the DOE does every year as part of its budget submission. We will simply continue the normal reporting.

Q: Another major bone of contention was a proposed tax on the project to be levied by the State of Tennessee, to which Congress objected strongly. How was that issue resolved?

That was really an issue between the Federal government and the State of Tennessee; we were more or less bystanders, but interested bystanders! Congress felt quite strongly that Tennessee should exempt the SNS from the proposed tax, and the Tennessee legislature approved such a proposal within the first three weeks of its legislative session in January. And it passed unanimously in both chambers. That was greatly facilitated by the University of Tennessee, which is taking over as a contractor for Oak Ridge. The university has very good contacts in the state legislature and they helped us make our case. That decision will provide the SNS with about $30 million of additional funding. We're using it to purchase scientific instruments to enable us to get a lot more bang for the same bucks.

Q: How do you feel about the prospects for the SNS one year later, after such a major management overhaul?

I think we met the challenge. The SNS one year later is in much better shape. I think we're going to see a healthy president's budget; we're requesting $281 million. And I hope we get Congressional support for the full project, including its management — the kind of support that has always been there for the scientific mission. Personally, I never quarreled with Sensenbrenner's position. The project had serious management issues that had to be dealt with, and this list was perfectly consistent with the actions we felt needed to be taken right from the outset to improve the quality of management. Since we concurred with the sentiment, we were happy to comply. In fact, we accomplished most of those goals in six months. The Tennessee legislature simply wasn't in session until January.

Image from http://www.ornl.gov/sns/figure_1.htm

Q: Why did you decide to accept the position of director of the SNS, particularly at such a critical juncture, when the project's future seemed to be in jeopardy?

I grew up in the field of neutron scattering. I was personally frustrated by the lack of new neutron sources from the early 1970s to the late 1980s. The US, which had invented this technology, was well behind Europe after the construction of the ILL in Grenoble. New facilities are the engine that drives science in particular areas: high energy physics, neutron and X-ray research can't really move ahead without regenerating their infrastructure and building exciting, new facilities periodically. Thirty years without a new facility is a long time for a field to survive.

I also had the experience of constructing the Advanced Photon Source, and some of the top people who had worked on that project were also available to work with me on this. I thought we could bring our experience there to bear very quickly on the SNS and turn the project around. We certainly did not want to have this project cancelled.

Q: Now that you've brought the project back on track, what are some of the challenges you face in the coming year for the SNS?

Now we have to actually construct the facility. We currently have a small crew of workers at the construction site, but over the course of this year that's going to build up substantially, and we need to be ready with design details and procurements. The President's budget shows a six-month extension of the project schedule from December 2005 to June 2006. That's what we call a late finish date. We actually now plan to finish about a year earlier, in the summer of 2005.

There are also some significant technical issues. One has to do with the adoption of superconducting technology for the LINAC. We're convinced that will offer a substantial improvement in beam availability. Also, from a manufacturing standpoint, there's a stronger infrastructure in the commercial world for the production of superconducting cavities than for the production of copper cavities. We want to fully implement that change in the next month or so. We're inviting Jefferson Lab to join the partnership, to take advantage of their experience in superconducting technology. We've also been working with the NSF who are anxious to participate in the construction of a second target station which will more than double the scientific impact of the SNS.

Q: What are some of the lessons learned from the difficulties of the SNS?

In a sense, we re-learned an old lesson: You don't have that many chances to make a good first impression. The system is not very forgiving. And I'm not saying it should be. After all, it's the taxpayers' money, and they have a right to hold science accountable. One can quibble and say, "Look, it's very difficult to know several years in advance exactly what it will cost to build a project of this magnitude with all its new technology." But we do have the experience from many projects that have been successfully executed over the last decade. Now we know how to make good estimates and manage the projects within those estimates.

David Moncton

The DOE's Office of Science has completed numerous successful projects over the last 15 years. The only problem was the SSC, which was effectively exempted from the normal peer review process. That's an important lesson. The Office of Science has developed a discipline based on peer review — every six months there's a major review — and that system has been internalized by the managers of DOE science projects. We conduct many of our own reviews in preparation for these semi-annual reviews. Perhaps we do it too much, but this review culture has turned out to be extremely valuable. We don't have a monopoly on wisdom, and any large project can benefit by bringing people in with outside expertise, both from the US scientific community and from abroad. Good advice is essential.

Q: With all the challenges you've encountered as director of the SNS, were there any pleasant surprises along the way?

Frankly, I went into this somewhat skeptical about the level of commitment of the other national laboratories. This project is unusual in the scope of its partnership; there has never been a collaboration of this many labs on a project this size, and a strong level of commitment by all the labs is essential for its success. Having worked closely with the directors of all of these labs, I have been very impressed by the level of commitment that they all have shown. It is essential to have the full attention of the upper management of the partner laboratories and the full personal commitment of the lab directors. It's definitely there for this project, which will certainly benefit the SNS throughout its construction phase. I have also been very gratified by the endorsements the SNS has received, including the APS Council resolution. The National Academy of Sciences has endorsed the SNS through its Solid State Sciences Committee. These kinds of broad endorsements from the scientific community don't happen very often, and demonstrate that there's essentially unanimous support for this project in the scientific community.

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.*