APSNEWS

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APS 100 years celebrate a century of physics

APS Council Statement, State-Wide Poll Responds to Kansas Controversy

At its November meeting, the APS Council approved a statement denouncing the recent decision by the Kansas Board of Education to remove references to evolution and the Big Bang from the state-wide science curriculum. The APS statement came on the heels of an October 1999 poll of Kansas residents conducted by two local newspapers, *The Wichita Eagle* and the *Kansas City Star*. Conducted by the *Star's* marketing research department, the poll surveyed 604 respondents, with a margin of error of plus or minus 4 percentage points.

Roughly half of the respondents disagreed with the board's decision, compared to 32% who supported the board, with the rest undecided or neutral. Fifty-seven percent said they thought students should be tested on evolution. About 80% of the respondents said they believe dinosaurs existed millions of years ago, and 65% said they believe sea creatures developed into land animals, based on the fossil record. It is human evolution that seems to be the sticking point. Forty-five percent said they believe God created human beings much as they are today within the past 10,000 years, while an almost equal number (43%) said they believe humans evolved like other animals, but the process was guided by God.

If nothing else, the controversy appears to have, at least temporarily, stimulated the population's interest in local school board elections. More than half the respondents (52%) said they would be more likely to vote in the next board election because of the evolution decision. Sixty-four percent of those who disagreed with the board's decision said they would be more likely to vote in the next election.

> "The American Physical Society views with grave concern the recent Kansas State Board of Education decision to remove references to evolution and the Big Bang from its State Education Standards and Assessments. The decision to modify its previous draft of these standards is a giant step backward and should sound the alarm for every parent, teacher and student in the United States. On the eve of the new millennium, at a time when our nation's welfare increasingly depends on science and technology, it has never been more important for all Americans to understand the basic ideas of modern science.
>
> "Biological and physical evolution are central to the modern scientific conception of the Universe. There is overwhelming geological and physical evidence that the Earth and Universe are billions of years old and have developed substantially since their origins. Evolution is also a foundation upon which virtually all modern biology rests.
>
> "This unfortunate decision will deprive many Kansas students of the opportunity to learn some of the central concepts of modern science."

SNS Critical to US Science Health States APS Council

The APS Council unanimously endorsed a statement urging Congress to provide the necessary funding for timely completion of the national Spallation Neutron Source (SNS). Councillors from all sectors of the APS agreed to its scientific necessity and "urgent national need" to meet the growing needs in the US research community for more powerful neutron sources that are competitive with those in Europe and Japan.

Neutron scattering is a powerful and unique tool for elucidating the fundamental structure of both physical and biological matter. It is routinely used to unlock the secrets of superconductors, magnetic materials, advanced polymers, and other materials of crucial interest to industry. It is estimated that the SNS will attract 1000 to 2000 scientists and engineers each year from universities, industries, government laboratories, and other nations.

The SNS is being built at Oak Ridge National Laboratory by a consortium of national laboratories including: Argonne, Berkeley,

Continued on page 4

Inside...

Council Votes to Reduce its Size by Constitutional Amendment

To any observer at the November Council meeting in Seattle, it would appear obvious why a motion to amend the APS Constitution to reduce the size of the Council passed overwhelmingly. Sixty-three people gathered around a hollow rectangle, which was so large that it was difficult to see from one side to the other. "We strongly believe that the most important action that can be taken to make the APS Council more effective is to reduce its size to the point that its members feel that they can be seen, that their views can be heard, and that their presence can make a real difference," said Stephen Holt (NASA/GSFC), the member of the APS Task Force on the Structure and Responsibilities of the Council who presented the draft recommendations to Council. The Task Force, chaired by Ernest Henley (University of Washington) recommended that the number of voting members be reduced from 51 to 39 and the number at the Council table from approximately 65 to 42.

Stephen Baker (left) and Stephen Holt.

The drafting of changes to the APS Constitution and Bylaws needed to implement the Task Force recommendations were carried out by the Committee on Constitution and Bylaws, chaired in 1999 by Stephan Baker (Rice University). The relevant sections of the sections with the proposed changes can be found online at http://www.aps.org/apsnews/0100/proposal.html, and are presented for comment by the APS membership at large. To become effective the Constitutional amendments must be voted on by the APS membership, while the amendments to the Bylaws require a second Council vote.

Continued on page 7

The Physics of Football

Millions of viewers nationwide had the opportunity in November to learn what college football fans in Nebraska have been hearing all season about the physics of football, thanks to a special news report on the ABC network featuring Timothy Gay, a professor of physics at the University of Nebraska, Lincoln (UNL). The segment aired November 15th on *ABC World News Tonight with Peter Jennings*. "Football is a manifestation of physics and it's something people can relate to," says Gay, who loves the strategy and tactics of the game as much as his chosen career. "It's physics in action. My main hope is that somehow I'll turn some kid onto physics or science in general."

A former tackle for the California Institute of Technology, Gay has been using college football to illustrate the laws of physics via a series of 45-second videotaped lessons presented on the two giant HuskerVision screens at UNL's Memorial Stadium. For example, an imperfect pass (i.e., wobbly, as opposed to a perfect spiral) will have insufficient force to overcome air resistance, resulting in a dragging effect, while a punt needs sufficient trajectory to attain the proper projectile motion. Helmets serve to distribute the force of a blow and lessen the impact to the players' heads, while the combined energy expended by an offensive line could lift an entire pickup truck about 10 yards into the air.

Continued on page 3

Photo by Randy Atkins

ABC News Correspondent Bob Jamieson reports from the site of what may be the world's largest physics class.

To Advance & Diffuse the Knowledge of Physics

100 Years of the American Physical Society

Consciousness Raising

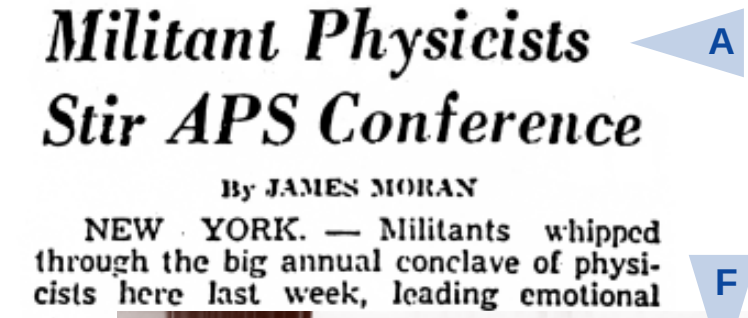
Excerpts from an exhibit displayed at the APS Centennial Meeting.

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

D

Physics Today

A



Militant Physicists Stir APS Conference

By JAMES MORAN

NEW YORK. — Militants whipped through the big annual conclave of physicists here last week, leading emotional

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AIP Niels Bohr Library

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AGl. I Pledge That I Will Not Participate In War Research Or Weapons Production; I Further Pledge To Counsel My Students And Urge My Colleagues To Do The Same. CHARLES SCHWARTZ, University of California, Berkeley.-- Arguments and supporting data will be presented to demonstrate that this pledge represents a realistic and constructive way in which an American physicist today can serve the cause of world peace.

APS session on women in physics, 1971. *From left:* Henriette Faraggi, Gloria B. Lubkin, Betsy Ancker-Johnson, Fay Ajzenberg-Selove, Charles Townes. Courtesy of Gloria Lubkin.

C

Martin Perl with Richard Lapidus, Stan Shepherd, and David Wolfe at the Penn State conference, 1974. AIP Niels Bohr Library.

B

AIP Niels Bohr Library

E

BAPS (1970): 28.

1967

▶ **Schwartz Amendment —** In 1967, Charles Schwartz, a nuclear physicist and antiwar activist at Berkeley, petitioned the APS to amend the constitution to allow 1% of members to call for a vote on any social or scientific issue. The Council opposed the amendment. It was defeated by a vote of members, who thought APS should not take a public stand on social issues.

Debate over the Schwartz amendment led to soul-searching on the social responsibilities of physicists and the APS.

1968

▶ **Chicago Protest —** In the wake of riots and police brutality at the Democratic National Convention in Chicago, physicists began to petition the APS not to hold its 1970 meeting there.

In 1969, the APS Council polled members and upheld its decision to keep the meeting in Chicago. ***(Image A)***

1969

▶ **Physics-and-Society Division Proposed**

▶ **Scientists and Engineers for Social and Political Action** (SESPA) organized by Martin Perl and Charles Schwartz at January APS meeting. Radicals called for "Science for the People." ***(Images B, C)***

▶ **APS-sponsored debate on the anti-ballistic missile system** (ABM) with Hans Bethe, Donald Brennan, George Rathjens, and Eugene Wigner at the April meeting.

▶ **Protest March —** During the April APS meeting, SESPA held an orderly march of 250 physicists to the White House to protest the ABM. ***(Image D)***

1970

▶ **Peace Breaks Out in *BAPS* Abstract** ***(Image E)***

▶ **Bombing at University of Wisconsin-Madison —** Violence directed at an Army-funded mathematics research center led to the mistaken bombing of the nuclear physics labs. (A post-doc was killed.)

1971

▶ **Proposed Amendment on Professional Responsibility —** Resolution to change the Society's mission statement to include the phrase "The Society...shall shun those activities which are judged to contribute harmfully to the welfare of mankind." Not passed.

1972

▶ **Forum on Physics and Society —** organized with broad constituency.

Concerned with the social consequences of physics, the Forum has sponsored programs at APS meetings and created awards in recognition of science policy work. It also initiated the Congressional Fellowship program whereby physicists are placed on Capital Hill in order to offer their technical expertise to members of Congress.

▶ **Women's Rights —** Committee on the Status of Women in Physics formed. ***(Image F)***

1975

▶ **Panel on Public Affairs —** Formed in 1975, POPA has convened panels of experts to study and voice the physicists' viewpoint on:

- Nuclear reactor safety
- Photovoltaics and renewable energy
- Feasibility of directed-energy weapons and other matters of public policy.

1979

▶ **ERA Boycotts —** Council resolved to boycott states that had not ratified the Equal Rights Amendment.

1983

▶ **Arms Control Resolution —** APS Council issued a statement in support of nuclear arms control and was attacked by George Keyworth, science advisor to president Ronald Reagan.

Next Month: Outreach and Community Service

APS News

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Langer Outlines Challenges, Priorities for APS in Y2K

James Langer, a professor of physics at the University of California, Santa Barbara, assumed the APS presidency on January 1, 2000. In the following interview, he outlines his prevailing concerns and priorities for the Society as it enters the new millennium.

Q What do you see as the primary challenges facing the APS as it enters the new millennium?

A There are two big issues that are driving everything else, and must be dealt with seriously and with a great deal of energy. One is the publications and how they will develop in our rapidly changing world. The other is political advocacy, speaking up for the scientific community in general and physicists in particular. We have to make our own case these days and we've been doing that very effectively in recent years.

Q What do you see as the main objectives for the APS journals in the future?

A The APS journals — the *Physical Review*, *Physical Review Letters* and *Reviews of Modern Physics* — are the most successful physics journals in the world. More generally, we're among the leaders in scholarly publication, largely because we've innovated. [APS Editor-in- Chief] Marty Blume has done a fantastic job. We're trying new things and we're taking risks. The main challenge is in electronic publication. We're participating actively in the development of bulletin boards so that physicists have easy communication with each other. Most important is the task of making the APS publications as accessible as possible, archiving them electronically, having them cross-linked to other journals, and making them a research tool of a sort that was unthinkable until just a few years ago. That's our top priority.

Q What are the challenges the Society's journals must overcome to realize those objectives?

A Clearly, we need to figure out how at least to break even financially in this new era of electronic publishing, to receive adequate compensation for the effort we put into it. This is a very deep practical and philosophical question that's much debated around the country at the moment. What is the role of scientific societies, and who has responsibility for the scientific journals? I believe that the best institutions for taking this responsibility are not government agencies or for-profit publishers, but independent scientific societies that are broadly representative of the scientific community. We need to bring our scholarly scientific capabilities to bear on choosing the best modes for disseminating information and maintaining the quality of the publications. The APS can do this more effectively and economically than any other kind of agency.

Q How do you view the role of the APS in terms of political advocacy, particularly when it comes to key policy issues and federal funding for science?

A The APS has been playing a leading role in political advocacy in the last few years, especially with Allan Bromley's presidency and the organization of the consortium of scientific and engineering societies. We'll continue to play as out-front a role as is diplomatic. We'll try to provide advice and exert influence in areas where we are especially competent, like arms control and the comprehensive test ban treaty, or how science ought to be funded in this country. So long as we can be accurate and responsible, I think we're obliged to be outspoken on such issues.

We're also obliged to help the physics community make contact with people in government. We have been stepping up our efforts to inform our members about how and when to make those contacts, and what the prevailing issues are. A particularly good example is the budget situation this past year. It looked for some months as if this was going to be an absolutely disastrous budget year for science, but it turned out to be much better than expected. There were many people from the physics community as well as other scientific societies making contacts in Washington, and we had built up the credibility of those contacts over the course of several years, making the arguments in Congress about the importance of investing in basic research.

Q The Society has had tremendous success in cooperating with other scientific organizations on policy activities. Why is this so?

A For one thing, just count the numbers. The consortium of science and engineering societies represents a lot of votes and a lot of influential people in many constituencies across the country. It also makes a much more convincing statement when it's not just everybody out for his or her own special interest. We're making the point that the driving forces for the current economy and national security are advances in basic and applied science, particularly physics, chemistry, mathematics and engineering. These were points that for many years after WWII we just assumed were taken for granted in Washington. Well, they're not now. So it's our responsibility to state them clearly.

Q The APS has ramped up its education and outreach activities in recent years, most notably in the smashing success of the City-Wide Physics Festival held in conjunction with the APS Centennial meeting in Atlanta last March. What does it have planned for the future?

A Both the APS and AIP are now very active in trying to produce television spots and making contact with the folks in the news media to ensure that they not only have access to, but understand the importance of, developments as they occur in the sciences. We're also working to make lots of material available on websites, including our archive of events from the Centennial meeting.

There are other ways by which efforts on our part, especially through our units and our direct contacts with university and college physics faculty, can have big effects. We can have major impacts on education, improving the APS meetings, getting more young people and more women and minorities into physics. I would like the APS to work with academic physics departments to make the physics curricula much more broadly interesting to a wider range of students, not just physics majors. For example, the physics undergraduate degree ought to be a wonderful prelaw or premed degree. Similarly, one of [APS Director of Education and Outreach] Fred Stein's major goals is getting more university and college physics departments involved in elementary and high-school teacher preparation. The Teacher Scientist Alliance is another program that has had significant impact.

One goal that I would like to emphasize is getting more industrial physicists actively involved in the APS. Many of our activities, especially the meetings, could be much more useful to physicists in industry than they are now. I would like to see lots more industrial participation in the March Meeting, for instance, and I would like more input from industrial physicists so that our policy statements better reflect the needs of the industrial community. We need those points of view.

James Langer

Q The APS geographical sections seem to be becoming more active and prominent within the Society in recent years. What do you see as their emerging role in APS activities?

A I have never lived in an area where there was an active geographical section, and had hardly been aware of them. But, as a member of the APS presidential line, I'm now seeing the sections in operation. Of all the APS units, they have the best connections at the grass-roots level, including to the smaller colleges and universities, and to the smaller industrial laboratories. The most effective politics is grass-roots politics, so the sections should be especially effective in maintaining contacts with Congressional representatives. Also, the pricing of APS journals is of very great importance to the smaller institutions. We need the section input on lots of such issues.

Q What do you see as the role of the Society in the international arena as it enters the 21st century?

A I think it is clear that, today, the APS is effectively an international organization. Close to one-quarter of APS members are residents of foreign countries, and 70% of all manuscript submissions to the APS journals come from outside the US. Our involvement in international affairs also continues to increase through interactions with other national physical societies and efforts to develop research collaborations with scientists in developing countries. Our participation in global affairs will be even more important in the coming decades. Environmental issues, such as global climate change and the development of alternative energy sources, as well as the construction of very large facilities such as the Large Hadron Collider, will require increased cooperation among the scientific communities around the world. I've already been abroad once in part on APS business, and expect to do much more travelling next year.

LANGER LOWDOWN

- Born in Pittsburgh, PA, in 1934.
- Briefly considered a career as an artist, but found himself pulling out his math notebook during art classes and realized that was where his true interest lay.
- BS from Carnegie Institute of Technology (now Carnegie-Mellon University) in 1955.
- PhD in mathematical physics under the supervision of R.E. Peierls at the University of Birmingham, England in 1958, as a Marshall Scholar.
- Joined the faculty of Carnegie Mellon University in 1958; in 1982, became a professor of physics and member of the Institute for Theoretical Physics (ITP) at the University of California, Santa Barbara; served as director of the ITP from 1989 to 1995.
- Research in quantum many-body theory of transport in solids; kinetics of first-order phase transitions; dendritic pattern formation in crystal growth; and, most recently, in the dynamics of earthquakes and fracture.
- Received the 1997 APS Oliver Buckley Prize for his contributions to the theory of the kinetics of phase transitions, particularly as applied to nucleation and dendritic growth.
- Former chair of the APS Division of Condensed Matter Physics.
- Member of the National Academy of Sciences; chaired the Physics Section of the AAAS in 1992, and the National Research Council's Panel on Research Opportunities and Needs, Materials Science and Engineering Survey, from 1986 to 1989.
- Why he ran for APS presidency: "Physics has been a wonderful career for me, and has given me many opportunities. So I have a strong sense of responsibility to do my part in maintaining the vitality of the American physics community."

Physics of Football, *continued from page 1*

The idea for the series originated with the university's athletic department, which is in charge of half time programming for the giant screens, as a means of bringing academics and athletics together. Gay was quickly tapped for the job. He is already mulling possibilities for next year's series of mini halftime lectures, such as artificial turf vs. natural grass, or the sonic energy produced by a screaming crowd, "I have a passion for physics and I enjoy teaching all aspects of it," Gay told ABC correspondent Bob Jamieson. "That's the one thing besides football that I really love." For Gay's online lessons on the physics of football, see http://physics.unl.edu/football.html.

"This is an excellent example of how individual APS members can help bring physics to life for the public," said Barrett Ripin, APS Associate Executive Officier. When member Diandra Leslie-Pelecky notified APS of Gay's videoshows, Randy Atkins [atkins@aps.org], APS Media Coordinator, "pitched" the story to ABC giving it national attention.

APS Honors Two Undergrads with 1999 Apker Awards

Brian F. Gerke, a recent graduate of Williams College in Williamstown, MA, and Govind Krishnaswami, a recent graduate of the University of Rochester in New York, have been named by the APS as recipients of the 1999 APS LeRoy Apker Award for their research achievements as undergraduates. The Apker Awards were established by Jean Dickey Apker as a memorial to her husband, LeRoy Apker. Both were physicists employed at the General Electric Research Laboratories in Schenectady, NY.

Brian F. Gerke

Govind Krishnaswami

Each year the Apker Award selection committee invites five or six finalists out of the nominees to give presentations of their undergraduate work. Award recipients are selected from the finalists. In general, one is selected from a PhD-granting institution and another from a non-PhD-granting institution. Finalists receive a $1000 award, a certificate, and expenses to an APS general meeting. Their undergraduate institutions receive $500 each. Apker Award recipients each receive an additional $5000 and an invited paper at an APS general meeting. Their institutions also receive a $5000 grant to further encourage undergraduate research.

Gerke was honored for his senior thesis, entitled, "Ultrafast Photoisomerization Dynamics: A Tight-Binding Model Applied to Small Alkenes," based on an original computational study he conducted of the photoisomerization of conjugated polyenes, which are related to retinal, the molecule in the eye's retina that detects light. His model explains how these molecules can change shape within tens of femtoseconds in response to light, and Gerke applied it both to small double-bonded molecules, and to larger ones, switching to numerical methods to compute the latter. [Part of his thesis has been submitted to *The Physical Review*.]

As a sophomore, Gerke spent one summer as a research intern at William and Mary College, where he worked on a possible astrophysical test for an exotic form of matter. In addition to his physics studies, Gerke completed a second major in English and sang in The Elizabethans, a Renaissance vocal music ensemble. At commencement, Williams College awarded him a Herchel Smith Fellowship for two years of graduate study at Cambridge University in England as a master's student in theoretical physics and mathematics. Gerke plans to pursue a PhD in physics at a US university when he returns.

A double major in physics and mathematics, Krishnaswami quickly distinguished himself as one of the most promising students the university has seen in years, and has won every major honor the institution bestows to undergraduates in physics and mathematics, including a teaching award as the best undergraduate teaching assistant. In 1998 he won a Fulbright Award for excellence in advanced physics, and is believed to be the first undergraduate student to present three papers (in experimental physics, mathematics, and theoretical physics) at the National Conference on Undergraduate Research in April 1999.

As a sophomore, Krishnaswami spent the summer working with Rochester professor Arie Bodek at Fermilab on the CCFR/NuTeV neutrino experiment, searching for the oscillations of muon neutrinos to electron neutrinos. When he returned to school in the fall, he opted to work on aspects of QCD theory, particularly a means of deriving the structure functions of hadrons from the first principles in QCD, a problem that has stumped physicists for the last 25 years. His resulting thesis, part of which has appeared in *Physical Review B*, combines physical importance and mathematical elegance, according to his thesis advisor and collaborator, S.G. Rajeev. "The best theoretical physics is as real as an experiment, and as beautiful as mathematics," Rajeev explains, adding, "[Krishnaswami's] work was the last piece of the puzzle to fall into place; we are well on our way towards a theory of the structure of the proton." Krishnaswami has elected to remain at Rochester for his graduate studies on a Sproull Fellowship.

APS Council Approves Revised "What is Science?" Statement

The APS Council approved a revised statement defining science and describing the rules of scientific exchange that contribute to the field's success at its November meeting. Submitted by the APS Panel on Public Affairs (POPA), the statement was amended in light of additional input sought from other scientific societies, as well as the APS membership [see *APS NEWS*, June 1999, p. 1, and October 1999, p. 4]. Concerned about the growing influence of pseudoscientific claims, POPA prepared a succinct draft statement in November 1998, adapted from E.O. Wilson's book *Consilienc*e, which was shared with the APS membership via *APS News*, and also with other scientific societies, in hopes that it would initiate a dialogue within the scientific community about the best way of dealing with the problem. The text of the statement follows.

"Science extends and enriches our lives, expands our imagination and liberates us from the bonds of ignorance and superstition. The American Physical Society affirms the precepts of modern science that are responsible for its success.

"Science is the systematic enterprise of gathering knowledge about the universe and organizing and condensing that knowledge into testable laws and theories.

"The success and credibility of science are anchored in the willingness of scientists to:

(1) Expose their ideas and results to independent testing and replication by other scientists. This requires the complete and open exchange of data, procedures and materials.

(2) Abandon or modify accepted conclusions when confronted with more complete or reliable or observational evidence.

Adherence to these principles provides a mechanism for self-correction that is the foundation of the credibility of science."

zero gravity

Quantum Baseball

Editor's note: *In the October 1999 issue of **APS News**, we announced a new contest for stories or tales designed to teach specific concepts or principles in physics. Peter Siska, a professor of chemistry at the University of Pittsburgh, eagerly submitted the following entertaining — if highly theoretical — account.*

How big would Planck's constant $\hbar$ have to be to turn a baseball into a "wavicle" or "waveball"? Probably big enough so that a pitched waveball, on the way to home plate, would broaden enough to be as wide as the plate (43 cm) for a pitch of average speed, say 80 MPH = 3600 cm/s. Since the plate is 60'6" = 1844 cm from the pitcher's mound, the travel (and broadening) time is about t = 1844 cm/(3600 cm/s) = 0.5 s.

The width of the waveball after a time t is $\delta x = \delta x_0[1+t^2/\tau^2]^{1/2}$ where $\tau = (2m\delta x_0^2)/\hbar$. If we assume δx_0 = 0.1 cm (localization in the pitcher's hand) and δx = 43 cm, then $\tau \approx t/430 \approx 1$ ms. For m = 140g this implies that $\hbar \approx 3000$ erg sec. So $\hbar$ needs to be about 10^{30} times larger to make quantum baseball a reality.

Now, let's imagine a few seasons under the new rules of Quantum Baseball (QB):

1. Pitcher arguing with home plate umpire: P: "Whaddaya mean, ball three? The chances were two in three it was a strike!"

2. Fastball pitchers are at a disadvantage — their pitches don't broaden so much and are easier to hit.

3. Only 300 lb. (136 kg) catchers who keep shifting from foot to foot now make it to the majors (NQL or AQL), since they provide localized targets [deBroglie wavelength $\lambda = 10^{-3}$ cm) for the pitcher. The pizza-pie catcher's glove makes a comeback.

4. Baseball bats (~800 g), when swung quickly, are much more localized than the ball when it arrives at the plate. Unfortunately, a reduced-mass correction must be applied. Bunting is now difficult in the extreme.

5. Skilled hitters have an instinctive feel for swatting at the waveball, although even perfect contact occasionally results in a swinging strike, due to tunneling of the waveball through the bat. Less skilled hitters often blame their failures on tunneling.

6. When a waveball is hit squarely, you can hear a loud crack, and see the waveball suddenly become sharply outlined before it whirs out into the playing field and becomes broadened again. If the ball tunnels through the outfield wall, it's a ground-rule triple. What used to happen only in Wrigley Field is now a regular occurrence in all the parks.

7. Games are best played in dim light, so that visible protons ($\hbar\nu > 10^{12}$J!) do not disturb the flight of the ball too much. One season so many games were "sunned out" that all the games are now played at night. Watching a ball game is now like watching in old black and white movie of street life at night.

8. Only the most skilled defensive players become outfielders; finely honed instincts and reflexes are required to snare a broadened waveball, which might have a breadth approaching 6 feet (1.8 m). Last year's Golden Glove center fielder had a fine fielding fraction of .575. Balls hit through infielders' legs are a special problem due to diffraction interference, although it cannot be said which infielder committed the error. Throwing out runners from the outfield is a rarely accomplished feat.

9. The best infielders now have careers lasting only four or five years, because they must now dive even for waveballs seemingly out of their reach, on the chance that the ball will show up in their glove. Only fast hard throws to first can be snagged by the first baseman. Whether the batter and ball can arrive at first simultaneously in the reference frame of the umpire is left for a future project on relativistic baseball.

10. Foul poles are 7 feet (2 m) wide, to accommodate the typical waveball breadth should it reach the fence. Foul line umpires have developed three signs: both hands towards foul territory, both hands toward fair, and both hands straight up. In the third case, the defensive player closest to the ball has to compute the probability that it is fair, and then choose whether to play it or not. Of course, first he has to find it.

10-1/2: Bleacher bums just hold their cupped hands up on a long hit. Their chances at a souvenir are just as good as the next guy's.

***Author's Disclaimer**: Unsponsored speculation: Proposal to the NSF was judged meritorious but not fundable. Research was performed in despair after a players' strike shortened baseball season and canceled that year's World Series.*

SNS Statement, *continued from page 1*

Brookhaven, and Los Alamos. The total cost of the SNS was originally set at $1.3 billion with a year 2005 completion date. The State of Tennessee has pledged $8 million to the project. When completed, the SNS will provide the US with a world-class neutron facility capability delivering high-powered (1-MW), short-pulsed (<1μs) neutron bursts. A sketch of the facility may be viewed at http://www.ornl.gov/sns/figure_1.htm.

House Science Committee Chairman James Sensenbrenner, Jr. (R-WI), who conducted a well-publicized oversight visit to Oak Ridge last March, praised the project's unquestionable scientific merit and recommended full funding for R&D. But Sensenbrenner also expressed concern about project management as well as cost and schedule estimates and recommended no allocation of funds for construction in FY2000.

A new project director and tighter management procedures has helped allay many concerns. A total allocation of $117.9 million for the SNS was allocated for FY2000 which includes only $100 million of the original $196.1 million construction request. APS Director of Public Affairs Michael Lubell warns that "the project remains at risk and is greatly in need of support from the scientific community."

"The timely completion of the Spallation Neutron Source is an urgent national need. American scientists who study the structure of both physical and biological matter must have access to modern neutron facilities. Otherwise, our nation will be at a severe disadvantage in advancing new science and technology. The Council of the American Physical Society urges Congress to continue to provide the necessary funding for completion of the project in a timely manner."

Solar Eruptions, Pollution Reduction Featured at DPP Meeting

Physicists discussed the latest discoveries in the universe of plasmas when the APS Division of Plasma Physics (DPP)—one of the Society's largest units—held its annual meeting November 15-19, 1999, in Seattle, Washington, capitalizing on what has proven to be a banner year for plasma research. Last spring, Livermore physicists announced that they had produced modest amounts of nuclear fusion on a tabletop—by shining a laser pulse on a small cluster of deuterium and tritium atoms (see *APS News*, July 1999). Conducting basic research into the plasmas created by laser removal of material, University of Michigan researchers accidentally discovered a tabletop method for separating chemical isotopes of the same element. Other Livermore researchers created antimatter with laser light using the Petawatt, the world's most powerful laser.

Solar Eruptions

In efforts that may ultimately improve forecasting of space weather, Naval Research Laboratory scientists have come up with a new explanation for what triggers coronal mass ejections (CMEs), violent eruptions of plasma from the Sun. An important determinant of the environment between Earth and the Sun, CMEs can create geomagnetic storms which interfere with cell-phone communications on Earth. The prevailing theory for CMEs says that the energy responsible for these eruptions comes from the corona, the Sun's outermost atmosphere. But this theory often clashes with actual observations of CMEs.

Examining a wealth of new data on CMEs from the SOHO spacecraft, James Chen and Jonathan Krall of the Naval Research Laboratory argue that the magnetic energy responsible for these eruptions (about 10^{15} grams of mass ejected at speeds of up to1000 km/s) is stored below the photosphere, the visible solar surface underneath the corona. Their explanation involves the concept of "solar flux ropes," giant magnetic field loops rooted below the photosphere. When subphotospheric processes increase the amount of electrical current along a flux rope, the rope expands, taking plasma with it and ejecting it into interplanetary space.

Advances in Plasmatrons

Dan Cohn of MIT reported on advances in a fuel-preparation device known as a plasmatron. A wine-bottle-sized device, the plasmatron can greatly reduce pollution emissions in vehicles while being completely compatible with conventional automobile technology. Head of the MIT Plasma Technology Division, Cohn believes that the plasmatron can be a "game changer" in the automobile field. Specifically, he believes that the plasmatron can provide a reasonable alternative to much publicized fuel-cells—considerably sooner and at much lower cost —if implemented in hybrid electric-gasoline vehicles which offer high fuel efficiency.

When connected to a fuel tank, the plasmatron converts some of the fuel into a hydrogen-rich gas. The hydrogen then travels to the engine along with untreated fuel. Because of its favorable combustion properties, the hydrogen enables the engine to run with a greater proportion of air—bringing about a lower engine temperature (greatly reducing nitrogen oxide pollutants) and more efficient operation (because of the properties of air molecules). Cohn now estimates that the plasmatron can reduce hydrocarbon emissions by up to 90% at engine startup, the time at which most automotive emissions occur. Along with co-plasmatron inventors Leslie Bromberg and Alexander Rabinovich at MIT, Cohn has done work indicating that employing the plasmatron in diesel engines might significantly reduce pollution in those vehicles. With the success of their laboratory tests, Cohn and his colleagues have proposed to demonstrate the plasmatron within a year in a bus that runs on natural gas, with the aim of significantly reducing the smog that results from these vehicles.

Powerful Protons

In a development that may provide benefits to electronics manufacturing and medical radiation therapy, Livermore researchers have devised a way to generate intense beams of powerful ions from a tiny spot. Using a single pulse of light from Livermore's Petawatt laser, the most powerful in the world, the researchers have generated 30 trillion protons with energies of up to 50 MeV, from a tiny spot approximately 400 microns in size. Although no other laser is as powerful as the Petawatt, the researchers nonetheless believe that their technique can be widely applied to provide more compact sources of high-velocity ions than previously possible.

In their demonstration, a single laser pulse strikes a thin slab of plastic or gold, ejecting electrons which form a cloud of negative charge around the back of the target. The cloud pulls positively charged ions from the back of this target which are rapidly accelerated to high energies. The ions are accelerated to extremely high energies over a short distance (almost 1 MeV/micron for protons). In principle, any type of high-velocity ion can be generated simply by depositing atoms of the desired species onto the back of the target. The researchers envision the possibility of creating an "ion lens." By shaping a concave section from a target, one can imagine that the ejected ions focus toward a point, further enhancing the brightness of the ion beam.

Vortex Crystals

For several years, UC-San Diego researchers have been observing surprising patterns in turbulent plasmas of electrons. In their experiments, they trap billions of electrons in magnetic fields to make them act like fluid particles flowing turbulently on a flat surface. Many important turbulent flows in nature are principally two dimensional, such as the Great Red Spot of Jupiter and large-scale ocean currents. The researchers have noticed that the electrons can spontaneously form a "vortex crystal," consisting of 2-20 tightly spinning whirlpools frozen in place amidst an utterly turbulent background.

Physicists have lacked a comprehensive theory of what enables these structures to arise. Presenting the first quantitative theory of vortex crystals, Dezhe Jin of UC-San Diego says that the large whirlpools or vortices must shuffle around other particles in a flow to optimize how randomly these background particles are distributed—thereby maximizing the amount of disorder, and creating the most stable state for the system—before they have the opportunity to merge with one another and form a single larger whirlpool. Says Jin, "We should not be surprised if some day we observe orderly sets of large scale hurricanes or storms in large scale fluid systems of some planets—even the Earth or on Jupiter."

—Philip F. Schewe and Ben P. Stein, AIP Public Information

Open Letter to APS Members

The American Physical Society has as its core mission the advancement and diffusion of physics. We have long championed the principle that science is universal and that open exchange among scientists is essential for advancing science. As physicists, we all speak the same language and have the same objective — to understand the physical world. The laws of nature that we uncover transcend national borders. The remarkable achievements of physics are the product of the world community, and we owe an immense debt of gratitude to physicists from many nations.

The APS Council resolution adopted on 21 May 1999 states that "Any negative characterization of scientists on the basis of ethnic or national origins is destructive to science and American values." As a deeply held general principle, the APS deplores actions by government or any other institution that target individuals on the basis of ethnicity or national origins. Over the course of many years, the contributions of immigrant scientists, foreign students, and visitors from many nations have enriched our knowledge and culture and improved the quality of our lives.

We are also deeply concerned about actions that impede the free communication of unclassified work in the international community. Especially distressing to us are restrictions on international scientific exchanges. Science can only flourish in an atmosphere of openness.

The American Physical Society takes pride in and derives strength from its internationally diverse membership. I want to reaffirm the Society's commitment to the universality of science and express anew our immense appreciation for the invaluable contributions of our colleagues from around the world.

With my best wishes—Jerome Friedman, 1999 President, APS

MEETING BRIEFS

Division of Nuclear Physics, 20-23 October 1999, Asilomar, CA

The APS Division of Nuclear Physics (DNP) held its annual fall meeting in October at the Asilomar Conference Center in Pacific Grove, CA. In addition to invited sessions on a wide range of topics in nuclear physics — such as neutron physics, short-lived nuclei, broken symmetries and frontiers in the composition of matter — there were four mini-symposia focusing on such topics as next generation cold neutron experiments, and science with the next generation of radioactive beam facilities, as well as two parallel workshops: one on quark and lepton mixing, and the other on structure functions of heavy nuclei at the Relativistic Heavy Ion Collider (RHIC).The conference also featured a special plenary session summarizing results of a recent survey by the National Research Council ["Physics in the New Era," conducted by the late David Schramm] of the status of physics research in the US A panel of distinguished speakers reviewed the current status of research in elementary particle physics, nuclear physics, atomic, molecular and optical science, condensed matter and materials physics, and astrophysics and cosmology.

Gaseous Electronics Conference, 5-8 October 1999, Norfolk, VA

The 52nd annual Gaseous Electronics Conference (GEC), held in October in Norfolk, VA, is an official topical conference of the APS run under the auspices of the Division of Atomic, Molecular and Optical Physics (DAMOP). The program included a GEC Foundation lecture by Alex Dalgarno of the Harvard-Smithsonian Center for Astrophysics on the historical evolution of cross section calculations in atomic and molecular collision theory, as well as a one-day workshop on non-coherent light sources, covering such topics as electronic stabilization of high density discharge (HID) lamps, low pressure discharge light sources, and advanced X-ray diagnostics using HID lamps.

In addition, there was a special memorial session honoring Will Allis, a co-founder of the GEC and honorary chairman since 1996, who died after a brief illness in March 1999. The session featured three distinguished speakers. Mark Kushner of the University of Illinois summarized Allis' landmark contributions to the theory of electron and ion transport in low-temperature plasmas, along with his other academic, technical and administrative accomplishments. James Lawler of the University of Wisconsin focused on resonance radiation transport in low-pressure discharges in atomic gases. And Graeme Lister of Osram Sylvania Inc. summarized recent developments in the modeling and diagnostics of fluorescent lamps.

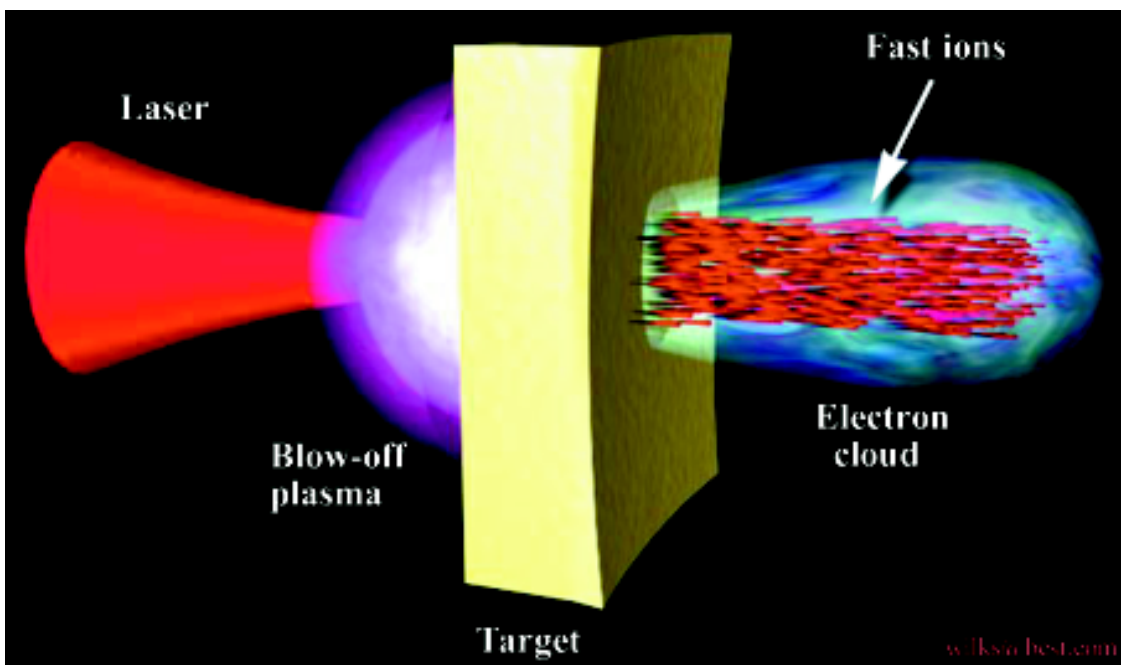


Figure courtesy of Scott C. Wilks of Lawrence Livermore National Laboratory

Demonstrating a technique that may lead to advances in certain forms of radiation therapy and electronics manufacturing, Livermore's Petawatt, the world's most powerful laser, impinges upon a target to generate 30 trillion protons from a tiny spot only 400 microns in size. Two other research groups, in Michigan and the United Kingdom, have demonstrated this technique with smaller-scale lasers.

APS Council Approves New Journal Pricing Model

The APS Council approved a new, multi-tiered pricing model for the Society's journals at its November meeting, which includes differential prices between institutions to reflect differences in size and online usage. The new scheme — developed by APS Treasurer Thomas McIlrath with input from the APS Publications Oversight Committee, and in consultation with various librarians — was prompted largely by the rapid growth of electronic access to, and usage of, online APS journals, as well as concerns over declining subscriptions to the Society's paper journals, particularly the nonmember (library) subscriptions, which form the core of the financial support for the Society's publishing activities.

Recent years have brought major changes in both the usage of APS journal content and in subscription patterns supporting the journals, according to APS Treasurer Thomas McIlrath. The APS now has electronic versions of all its journals available to APS members at low cost, as well as special electronic publications such as *Physical Review Focus* and internal monitoring of usage shows these products are immensely successful, with high usage by the research community. In addition to current articles, members can also subscribe to the *Physical Review Online Archive* (*PROLA*), which contains half of all material ever published in the *Physical Review*, with plans to extend the archive all the way back to the journal's genesis.

However, the development of electronic distribution of the journals and PROLA represents a multi-million dollar investment by the Society, and the cost of maintaining these products now exceeds 10% of the overall Publications budget. At the same time, nonmember subscriptions dropped 4% between 1997 and 1998, and another 5% between 1998 and 1999, while member subscriptions to print journals also continue to decline at a rapidly accelerating rate.

Furthermore, large research-intensive institutions that have maintained multiple subscriptions in the past are also abandoning this practice in favor of downloading electronic articles, reducing their level of contribution to journal support. In fact, the only sector that shows rapid growth is member online subscriptions, causing the Society to consider charging more for electronic access to offset the continued economic squeeze on publications.

According to McIlrath, the proposed new pricing structure will feature a base price for the journals charged to all nonmember subscribers, but will institute a surcharge for research intensive institutions, based on the standard Carnegie Classification scheme. [The revenue expected to be thus obtained is roughly equivalent to the cost of maintaining the APS journals on the Web.] Since there is no equivalent to the Carnegie classification for foreign subscriptions, records of online usage will be used to establish these prices. Institutional subscribers with multiple subscriptions will only be required to pay the enhanced charges on their first subscription.

For the first time, there will also be an online-only option available at a 15% discount below the print-plus-online price, as well as the possibility of special consortium agreements for institutions or non-traditional subscribers who may have special needs and don't fit within the confines of the new pricing model. Unlimited online access through registration of an IP address will still be included with all subscriptions.

Subsequent modifications to the new pricing scheme will be made as needed, based on experience and further consultation both with librarians and the scientific member communities. "As with any fundamental change, it is expected that the model will evolve as experience is accumulated and as reaction is obtained from subscribers and users," says McIlrath, adding that preliminary discussions with librarians revealed broad support for such a change in pricing. "The involvement of the community is essential to acceptance of the change by the libraries and various user communities."

APS Editor-in-Chief Martin Blume noted that "Three years ago it was decided to include access to electronic versions of our publications at institutions who subscribed to the print versions. It is now appropriate, with the reliability of electronic access no longer in question, to charge for the electronic products, and to charge more for access by larger research institutions."

APS and AIP Jointly Launch Virtual Journals

The APS and the American Institute of Physics (AIP) announced in October that they would launch the first two of a series of "virtual" journals in the physical sciences this month. Jointly developed by the two organizations, the *Virtual Journal of Biological Physics Research* and the *Virtual Journal of Nanoscale Science and Technology* will be online journals that will collect relevant papers from a broad range of physical science journals, including those published by the APS and AIP, as well as selected journals from participating publishers in AIP's Online Journal Publishing Service.

According to APS Editor-in-Chief Martin Blume, the impetus for the venture arose from discussions with AIP about the difficulty both organizations have had in the past launching what are known as "niche journals"—i.e., journals that focus on rapidly emerging specialized topics, such as high-temperature superconductivity or ferroelectrics. Taking advantage of the ease of electronic access, the virtual journals are intended to highlight advances in important fields that might otherwise be buried in broadly based science journals. Authors may also be encouraged to submit such papers in these areas to those journals, such as the *Physical Review* or *Physical Review Letters*, if they know they will receive special attention. "Virtual journals will provide users with quick, convenient access to information in cutting edge fields," says Blume. "Gathering into one spot all the papers on a given topic will help specialists keep abreast of the latest developments, not only with title 'alerts,' but with abstracts and full-text articles."

Initially, the virtual journals will consist primarily of a browsable, monthly table of contents listing articles in biological physics appearing in participating journals, along with a link to the various abstracts and, if the user has a subscription to the source journals in question, to the articles themselves. Non-subscribers will have the option of purchasing articles from the source journals for immediate online delivery. In the longer term, APS and AIP are mulling the possibility of selling separate subscriptions to the virtual journals, targeting such specialized audiences as pharmaceutical companies, who may wish to keep abreast of developments in, for example, biological physics, but don't wish to invest in expensive multiple journal subscriptions that contain many papers in fields not of interest to them.

"Virtual journals will provide affordable access to individuals or small institutions with specialized interests," notes Marc Brodsky, AIP's executive director and CEO. "Those who could not afford to subscribe to the complete line of journals contributing to a given virtual journal will now be able to get the content that they need rapidly, conveniently, and for less money than is possible by traditional hardcopy document delivery."

Articles appearing in the two new virtual journals will be selected by editors who are recognized experts in those fields. Robert Austin of Princeton University will serve as editor of the *Virtual Journal of Biological Physics Research*, while David Awschalom of the University of California, Santa Barbara has been named editor of the *Virtual Journal of Nanoscale Science and Technology*. Other virtual journals will be launched as warranted, focusing on new and developing fields that cut across a range of traditional publications.

For additional information, see http://www.ojps.org/vj, or contact Martin Burke, Publisher, AIP Journals and Technical Publications, 516-576-2406; mburke@aip.org.

APS Leads Effort for Teacher Preparation

The APS is taking the lead in helping physics departments play a major role in the preparation of physics and physical science teachers. In a partnership with the American Association of Physics Teachers (AAPT) and the American Institute for Physics (AIP), the APS has proposed a comprehensive program aimed at significantly improving the science background and the instructional approaches by (1) encouraging an active collaboration between the physics department and the school or department of education; and (2) involving the local school community through the employment of a local Teacher-in-Residence. Dubbed the Physics Teacher Education Coalition (PhysTEC), the proposal is being prepared for submission to the National Science Foundation in support of activities that would dramatically increase the role of physics departments nation-wide in the preparation of science teachers. As proposed, over the next five years 20 universities and colleges will form a coalition with the three societies to improve teacher preparation, with six to eight selected as primary program institutions.

From 1984 to the present, various national reports on science education have decried the inadequate preparation and lack of competency of new science teachers at all levels of K-12 education, calling for the radical reform of ineffective and antiquated teacher preparation program. According to APS Director of Education and Outreach Fred Stein, recent reports "continue to be critical of the ability of teachers to provide their students with a sufficient level of understanding so students can contribute to an increasingly complex, information-rich and technical society." Inadequate understanding of science content (physics in particular) and a lack of student-centered, inquiry-based approaches in science classrooms are the two most frequently cited criticisms. "The results of these deficiencies are high school graduates who lack problem-solving abilities and adequate knowledge of science, and are unprepared for the worlds of work and higher education," says Stein.

It is hoped that PhysTEC will provide physics departments with the support and technical assistance they need to dramatically improve science teacher preparation, and to widely distribute new teaching models through the combined resources of the APS, AAPT and AIP. "If it is true that students teach as they were taught, then we believe that to improve physics and physical science teaching and learning in K-12, universities must model effective teaching and learning approaches for prospective physics and physical science teachers," says Stein. Rather than focusing on many scientific disciplines at one collaborative site, PhysTEC will concentrate its efforts and resources to reform one discipline at many major university sites. It will build in part on the pioneering physics education research of the past 20 years. For example, PhysTEC will draw on the experience of Lillian McDermott of the University of Washington, who delineated the deficiencies of the numerical problem-solving approach, as well as Dean Zollman at Kansas State and John Layman of the University of Maryland, who promote active learning through the creation of inquiry-based university physics courses.

The first phase of the program began last September with a series of professional contacts, interviews and visits to institutions. Selection criteria included their degree of enthusiasm to model good teaching practices; their commitment to be actively involved with preservice teacher reform; their willingness to work in collaboration with faculty from the school or department of education; their degree of success with previous efforts; and their willingness to shift their own resources to the PhysTEC program. The initial sites include a mix of Research One and smaller institutions, as well as one or more members of the historically black colleges and universities.

Once PhysTEC begins major effort will be made to implement two key components: a teacher-in-residence who will work full-time in the physics department, and a restructured introductory physics course that will promote active learning in an integrated lecture and laboratory format. "This model will encourage less reliance on the authoritarian, teacher-dominated transfer model of science instruction, and will allow a more spontaneous interchange of ideas to discover relationships, rather than confirm them," says Stein. There will also be a strong emphasis on field-based experiences of future teachers by increasing contact between the physics departments and teachers in local public schools, initially through outstanding in-service teachers and, later, through former teachers-in-residence.

Announcements

January 15, 2000 Deadlines

See the December issue of *APS News* or APS home page (www.aps.org) for details about the fellowship program and application procedures.

APS Mass Media Fellowship Program — Summer 2000

In affiliation with the popular AAAS program, the APS is sponsoring two ten-week fellowships for physics students to work full-time over the summer as reporters, researchers, and production assistants in mass media organizations nationwide. Visit http://www.aps.org/public_affairs/Media.html (includes PDF application forms)

MAIL APPLICATIONS TO:
APS Washington Office • ATTN: Mass Media Fellowship Program
529 14th Street, NW, Suite 1050 • Washington DC 20045

2000-2001 APS/AIP Congressional Science Fellowships

The American Physical Society and The American Institute of Physics are currently accepting applications for their 2000-2001 Congressional Science Fellowship Programs. Fellows serve one year on the staff of a senator, representative, or congressional committee.

MAIL APPLICATIONS TO:
APS/AIP Congressional Science Fellowship Programs
c/o Erika Ridgeway • APS Executive Office
One Physics Ellipse • College Park, MD 20740-3844

Prize and Award Nominations

See detailed submittal information in December 1999 APS News *or at www.aps.org under the Prize and Awards button.*

DEADLINE: JANUARY 18, 2000

OTTO LAPORTE AWARD
Endowed by the friends of Otto Laporte and the Division of Fluid Dynamics.
Purpose: To recognize outstanding research accomplishments pertaining to the physics of fluids.

FLUID DYNAMICS PRIZE
Supported by friends of the Division of Fluid Dynamics and the American Institute of Physics journal *Physics of Fluids.*
Purpose: To recognize and encourage outstanding achievement in fluid dynamics research.

DEADLINE: APRIL 1, 2000

JAMES CLERK MAXWELL PRIZE IN PLASMA PHYSICS
Sponsored by Maxwell Technologies, Inc.
Purpose: To recognize outstanding contributions to the field of plasma physics.

AWARD FOR EXCELLENCE IN PLASMA PHYSICS RESEARCH
Established with support from friends of the Division of Plasma Physics.
Purpose: To recognize a particular recent outstanding achievement in plasma physics research.

OUTSTANDING DOCTORAL THESIS IN PLASMA PHYSICS AWARD
Established originally as the Simon Ramo Award and endowed in 1997 by General Atomics Inc.
Purpose: To provide recognition to exceptional young scientists who have performed original thesis work of outstanding scientific quality and achievement in the area of plasma physics.

NICHOLSON MEDAL FOR HUMANITARIAN SERVICE
Sponsored by friends of Dwight Nicholson.
Purpose: To recognize the humanitarian aspect of physics and physicists.

Now Appearing in RMP...

The articles in the January 2000 issue of Reviews of Modern Physics are listed below. For brief descriptions of each article, consult the RMP website at <http://www.phys.washington.edu/~rmp/contents.current.html>. George Bertsch, Editor.

Gauge theory: historical origins and some modern developments — *Lochlain O'Raifeartaigh and Norbert Straumann*

Theory of the *CP*-violating parameter ε'/ε — *Stefano Bertolini, Marco Fabbrichesi, and Jan O. Eeg*

Final focus systems in linear colliders — *T. O. Raubenheimer and F. Zimmermann*

Suppression of turbulence and transport by flow shear — *P. W. Terry*

The physics of fast Z pinches — *D. D. Ryutov, M. S. Derzon, and M. K. Matzen*

Dipolar effects in magnetic thin films and quasi-two-dimensional systems — *K. De'Bell, A. B. MacIsaac, and J. P. Whitehead*

Heteropolymer freezing and design: towards physical models of protein folding — *Vijay S. Pande, Alexander Yu. Grosberg, and Toyoichi Tanaka*

Dynamical supersymmetry breaking — *Yael Shadmi and Yuri Shirman*

Pulsed reactive crossed—beam laser ablation (colloquium) — *P.R. Willmott and J.R. Huber*

APS Council and Committee Position Nominations Call

For:
VICE-PRESIDENT
GENERAL COUNCILLOR
NOMINATING COMMITTEE
Vice-Chairperson-Elect • Members
PANEL ON PUBLIC AFFAIRS
Vice-Chairperson-Elect • Members

Please send your nominations to: The American Physical Society; One Physics Ellipse; College Park, MD 20740-3844; Attn: Danita Boonchaisri; (301) 209-3288; fax: (301) 209-0865; email: boonchai@aps.org. A nomination form is available at www.aps.org/exec/nomform.html. **DEADLINE IS JANUARY 31, 2000.**

Constitutional Admendment, *continued from page 1*

The last major revision to the APS Constitution in 1990 established a representational scheme based on X, a percentage of the total APS membership (currently, X = 3). X was used to determine the number of councillors from divisions (with larger divisions having more); while forums would gain a Councilor, topical groups could become divisions, and geographical sections were entitled to a Council advisor once their membership percentage exceeded X. X also determined the number of General Councillors, currently 16, in an indirect way.

The task force presented an interim report to Council at its May 1999 meeting (see *APS News,* August/September 1999), recommending that the role of X be reduced and limiting divisions to one councilor each (14) and reducing the number of general councilors from 16 to 9. In addition the threshold for forums to have Council representation was increased from X to 2X. Currently this will have no effect on the number of Forum Councillors. There was strong Council support for reducing its own size. However the Council asked the Task Force to consider replacing the 5 Section Advisors with 2 voting Section Councillors, which the Task Force decided to do, and to reconsider the role of the General Councillors.

The task force declined to lower the number of general councillors further than to 8, since they often provide balance and diversity to the Council through the election of women, minorities, younger physicists, and physicists employed in industry. One International Councillor with a 2-year term was added to the Council. The rationale for this, according to Holt, is that foreign members currently have no direct representation on Council and have difficulty winning election when running against US physicists. Two-year terms were deemed preferable to the usual four-year terms to alleviate the extra burden of travel for non-US physicists to attend Council meetings. To make the Council table significantly smaller, the Task Force recommended that only a very limited number of non-voting Council Advisors be asked to sit at the main table. Other Council advisors would sit at additional tables close by.

PROPOSED AMENDMENTS TO THE APS CONSTITUTION AND BYLAWS

The Council-approved additions and deletions to the relevant sections in the APS Constitution and Bylaws to reduce the size of the APS Council (see story, page 1) can be found online at http://www.aps.org/apsnews/0100/proposal.html. The APS membership is encouraged to read over the proposed amendments and comment accordingly; responses should be directed to the attention of Danita Boonchaisri, Council Administrator, APS, One Physics, Ellipse, College Park, MD 20740; boonchai@aps.org.

Corrections

Largest Industrial Employers

Although a third of the PhD industrial physicists belonging to one of the AIP member societies work for approximately 20 employers, hundreds of companies from large multinational corporations to small businesses employ PhD physicists. The second part of the industrial employers list on page 1 of the December 1999 issue of *APS News* illustrates this diversity. However, due to the nature of the sampling techniques used, some of the companies are small and do not employ large numbers of PhD physicists.

"Bow-Tie" Lasers Addition

The article on new "bow-tie" lasers at Bell Labs in the November 1999 issue of *APS News* failed to mention the contributions of another team of researchers to the technology's development. A. Douglas Stone of Yale University devised the underlying theory with Evgenii Narimanov (a former Yale postdoc now at Bell Labs) and Jens Noeckel (Stone's former PhD student, now at MPI Dresden) in 1994, drawing on chaos theory to design optical cavities, which culminated in a 1997 article in *Nature*. Noeckel shared the 1999 DAMOP Thesis Award for his contributions.

THE BACK PAGE

Is There an Unconscious Discrimination Against Women in Science?

by Howard Georgi

Much progress has been made by women in science in the last 25 years, but "unconscious discrimination" still remains. I offer the following tentative theory of unconscious discrimination, along with possible strategies for improving the situation. While I have struggled with these issues, I wish to emphasize that I am not an expert. This is a personal attempt to understand the troubling fact of gender discrimination that I see in science.

"Discrimination" is an interesting word. There are two kinds of meanings: positives that describe the mental process of differentiation, discernment or judgement; and negatives that describe the misuse of differentiation to treat unfairly those who are different. My simplistic theory is that in unconscious discrimination against women in science, the latter follows from the former. I will argue that unconscious discrimination arises because the application of our tools for discrimination between different scientists selects for many things, including qualities that are at best very indirectly related to being a good scientist, and that clash with cultural pressures.

In particular, our selection procedures tend to select not only for talents that are directly relevant to success in science, but also for assertiveness and single-mindedness. This causes problems for women (and others as well). There are probably other gender-linked traits that we also select for, but I will focus on these two because I think that they are particularly obvious and damaging.

Do we really select for assertiveness and single-mindedness?

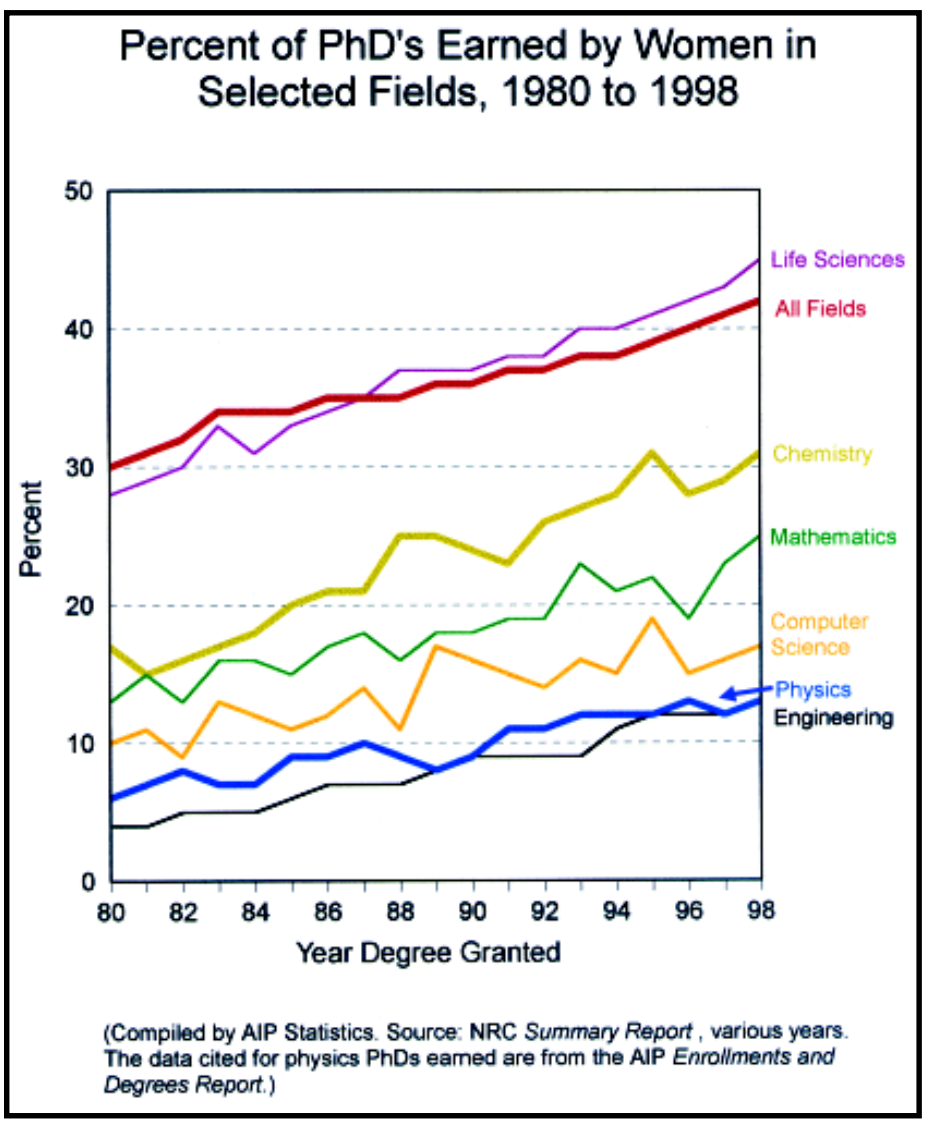
This question hardly needs an answer. There are many obvious examples of situations in which this selection is almost explicit. One of my favorite examples is the Physics GRE exam. I can expand on this if necessary. It is not impossible to succeed as a scientist without being assertive and single-minded, but the system encourages and rewards people with these traits in a number of ways.

How does selection for assertiveness and single-mindedness differentially affect women?

Why should this matter more for women than for men? I realize that I am treading on dangerous ground here. Obviously, for these traits, as for any other similar traits, there is a broad distribution in both men and women, and the distributions overlap. Nevertheless, the distributions of assertiveness and single-mindedness are strongly skewed towards men. I think that most people would agree that there are very strong cultural biases that make it more difficult for women than for men to be assertive and single-minded.

Isn't this a problem in academia in general? Why is it worse in science?

I think that the answer is that in science, we actually do have quantitative tools. There are quantitative ways of distinguishing good science from bad science, and for training good scientists. These tools really exist and they work! We produce people who do great science. This system has been honed over many years to the point that we now tend to take it for granted. It is this very success that makes it possible to accept the system uncritically, and that makes unconscious discrimination easy. I hasten to add, however, that just because we have a system that produces good scientists does not mean that the system is not eliminating many others who could be equally good.



(Compiled by AIP Statistics. Source: NRC *Summary Report* , various years. The data cited for physics PhDs earned are from the AIP *Enrollments and Degrees Report*.)

Are assertiveness and single-mindedness really necessary (or even desirable) for a scientist?

This question is more difficult to answer. I am not sure that any controlled experiments have been done. My personal view is that what we want in a scientist is not assertiveness, but intellectual curiosity and thoughtfulness, and not single-mindedness, but dedication and perseverance. For the moment, I hope that you will accept this as a working hypothesis.

If assertiveness and single-mindedness are not really what we want, why did the system develop to select for these, rather than what we are really interested in?

This is a question for historians and sociologists of science. But my suspicion is that the answer here has two parts. The system could develop because when it developed, there was overt discrimination against women, and so there was no selective pressure to develop a system that worked for women as well as men. It actually did develop, I think, and persists, because assertiveness and single-mindedness are easier to measure quantitatively than the qualities that we are really interested in, intellectual curiosity, dedication, and so on, which have more human dimensions. Assertiveness and single-mindedness are stand-ins that worked pretty well for a large group of men in previous generations. Even though they are no longer very appropriate, our system still selects for them. And because it "works" (at least if you ignore gender discrimination and such things), we haven't tried very hard to do better.

How does the selection for assertiveness and single-mindedness give rise to unconscious discrimination against women?

Here there are many answers. From the top down, when department chairs and search committees look for the best scientists, they tend to exclude those who are not demonstrably assertive and single-minded. This tends to eliminate women. In fact, the situation is worse, because the cultural bias against assertiveness in women puts even those women who are selected by the system at a disadvantage. They may be perceived as good scientists, but disagreeable people. From the bottom up, the mismatch between the cultural stereotypes of women and scientists makes it harder for girls to develop as scientists. They are constantly pushed towards other vocations. I hope that this is changing, but if so, the process has been very slow.

This contributes to the familiar pipeline problem that we hear so much about today. There are not as many women as men in the pool at any level and the disparity increases as we go up the academic ladder. Those of us who are committed to increasing the participation of women in science find these pipeline issues incredibly frustrating. The small number of women in the pipeline makes it much more difficult to counteract the effects of unconscious discrimination in hiring. We have to convince search committees to work hard twice; both to overcome their preconception that good scientists must be assertive and single-minded, and also to identify women from a smaller pool.

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What can be done about this?

The good news is that the system is not evil, just misguided. But the bad news is that unconscious discrimination arises due to deep-seated habits that will be very hard to change. There are many proposed ideas for changing this from the bottom up. I hope that we can do it by changing our system of educating and evaluating scientists, rather than simply encouraging girls and women to break out of the cultural stereotypes against assertiveness and single-mindedness. But meanwhile, we should try to support women's sports programs, and other things that help break down these stereotypes. From the top down, there are a few strategies that may help in hiring. The idea, in each case, is to try to open up the search procedure and make it easier to break out of the same old system.

(1) Do not make a single ordered list of candidates. Make several lists using different criteria. This may help remind the search committee that many talents are important to success in science, and that different candidates will rate differently in each one. Try to think carefully about all the different ways that candidates can contribute.

(2) Do not define the area of the search too narrowly. Very narrow searches tend to exclude women just because of pipeline issues. And the more narrow the search, the easier it is to fall into the trap of making a single ordered list without thinking carefully about the criteria.

(3) Open up the search procedure. Don't let it be handled exclusively by a small committee of "experts."

(4) If you send a search letter, ask your informants to list the best women and minorities in the field, even if they do not rate them as highly as the top men. This will at least get people thinking about the issue, and may turn up candidates that would be overlooked otherwise.

(5) And most important, keep trying even when none of the strategies work. This is a job for optimists.

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