APS NEWS

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New Survey Reveals APS Members Unaware of Many Outreach Programs

APS members continue to be a diversified lot in terms of employment sectors, according to preliminary results of the 1996 APS membership survey. In addition, while most respondents felt education outreach and public affairs activities were particularly important for the Society, most were unaware of APS programs in these areas, indicating a need for better advertisement of such services to the APS membership.

The survey was prepared under the auspices of the APS Committee on Membership (COM) and Membership Department and conducted by the American Institute of Physics (AIP) Division of Employment and Education Statistics. Approximately 50% of the 2,789 U.S. resident members who were sent a copy of the 8-page questionnaire responded. The survey was intended to help identify the needs and concerns of APS members and to monitor demographic changes in the physics community, as well as within the APS membership. A survey of the APS membership was last conducted in 1990, according to Jolie Cizewski (Rutgers University), past chair of the APS COM. However, the committee felt that because of the many changes in the Society since then, another survey was needed. In fact, Cizewski believes a survey should be done every five years to keep abreast of the trends.

Demographics

The survey revealed that the demographic characteristics of APS members are generally the same as those reported in 1990. The number of members employed full time has dropped by 5%, from 73% in 1990 to 68% in 1996. Retired members have increased by more than one third in the same period. "The average age of physicists is in the 50s," said Cizewski, adding that the increase is a natural outgrowth of a peak in the production of physicists in the late 1950s/early 1960s, most of whom are now over 65. "I think we're going to be seeing more senior members: people who are retired, but still want to maintain their contact with the physics community."

The results also revealed a detailed disaggregation of the types of individuals who belong to the APS encompassing PhD chemists, engineers and employed physics master's and bachelor's degree holders, in addition to PhD physicists according to Roman Czujko, director of AIP's statistics division. "While employed PhD physicists are still the majority, there are many other kinds of people with different needs, backgrounds and environments," said Czujko. "Many PhD physicists are not all doing basic research in an academic environment, and a fair number of them are not doing physics."

On the whole, PhD physicists said that they joined the APS because they felt obligated to join as a physicist and wanted to keep in touch with the physics community. Those with PhDs in other fields joined for similar reasons, but without the sense of obligation. Over two-thirds of student members indicated that discounts influenced their decision to join APS.

Survey data collected on collaborations revealed little, other than the fact that it occurs "at an extremely high

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Donald Cox, Membership Committee Chair and Jolie Cizewski, Past Chair

APS & AIP Win Court Decision

Federal District Court Judge Leonard Sand has ruled completely in favor of the APS and AIP in a suit brought by Gordon and Breach. The judge found no basis for G&B's complaints about publication and dissemination of the 1988 Barschall study that analyzed cost effectiveness of physics journals. In that study, APS and AIP journals came out high and G&B's among the lowest. More information can be found in the October 1997 issue of *Physics Today*, in McIlrath's Q&A on page 2 and on the APS home page.

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Sailing Against the Tide?

by Michael S. Lubell, APS Director of Public Affairs

Scratch the skin of a Washington pundit and more often than not you are likely to find a nay sayer. It's not a predisposition. It's just the nature of the business. It's also the nature of the federal government.

Propose anything new, and you'll quickly find yourself sailing against the tide. Like a vintage ocean liner, the government doesn't change direction easily, and when it does, it is not apt to reverse course anytime soon. That's particularly true today when it comes to federal spending.

By the beginning of Fiscal Year 1997, almost all publicly supported research had taken four straight years of budgetary hits. And as a fraction of the gross domestic product, the federal investment in research had fallen to less than half of its 1960's peak.

For science and engineering, particularly, the storm clouds of deficit reduction seemed to be looming large. Policy makers and bean counters had become all too comfortable squeezing the breath out of the research endeavor. Not one of them would promise anything better than hard freeze in current dollars for Fiscal Year 1998. That translated into a forecast for a fifth consecutive year of cuts.

In the White House and on Capitol Hill, science lobbyists were advised to take yet another deep breath. The message was succinct: Scientists and engineers must learn to be grateful for whatever the federal government doled out. Whiners need not apply at all. After all, other discretionary domestic programs were being pared back even more.

Scientists had long believed that their work contributed to societal good. But for decades they had failed to tell their story to the public. As a result, politicians and policy makers simply viewed science as one more hungry mouth feeding at the federal trough. To get them to change course meant dispelling that notion.

To be fair, not everyone in government labored under the belief that federal support of science was an ex-

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1997 Fall Meeting Madness

No fewer than nine APS units — four divisions and five geographical sections — are holding their fall meetings in October and November, making it one of the busiest times of the year for the Society. The APS is also sponsoring the 50th Annual Gaseous Electronics Conference, October 6-9 at the University of Wisconsin, Madison, focusing on basic phenomena and plasma processes in ionized gases, as well as the relevant theory and measurement of basic atomic and molecular collision processes.

OCTOBER:

October 5-8	Division of Nuclear Physics	Whistler, BC, CANADA
October 6-9	Gaseous Electronics	Madison, WI
October 9-11	Texas Section	Denton, TX
October 10-11	Ohio Section	Oxford, OH
October 12-17	Division of Laser Science	Long Beach, CA
October 17-18	New York State Section	Saratoga Springs, NY
October 24-25	New England Section	Bedford, MA

NOVEMBER:

November 6-8	Southeastern Section	Nashville, TN
November 17-21	Division of Plasma Physics	Pittsburgh, PA
November 23-25	Division of Fluid Dynamics	San Francisco, CA

McIlrath Maintains Fiscal Health Amid Rapid Economic Changes

Since assuming the position of APS Treasurer last November, Thomas McIlrath has helped steer the Society into the brave new world of electronic publishing, with all its associated economic ramifications, while continuing to follow the sound fiscal policies and procedures implemented by his predecessor, Harry Lustig. As the Society's chief financial officer, he is responsible for the preparation and administration of the APS budget, for the Society's investments, for business interactions with the American Institute of Physics (AIP), for the Society's legal affairs, and for personnel policies and administration.

The Treasurer also participates in all aspects of the governance, policy formation and administration of the Society, along with the Executive Officer and Editor-in-Chief. Along with these duties, McIlrath also assumed the new role of publisher of the APS journals, a position which previously had not existed. "One of my roles as publisher is marketing," he said. "I use the word in the best sense of finding ways of bringing physics information to people whom it will benefit, and to better serve our customers." McIlrath feels that this focus reflects the Society's growing recognition that it has a wide spectrum of members and must serve a broader range of needs than in the past.

McIlrath initially intended to study chemical engineering as an undergraduate in college, since "my physics course in high school convinced me that physics was a very uninteresting subject." However, the daunting prospect of the required memorization in organic chemistry compelled him to explore physics as an alternative with a course in classical mechanics, and he found he greatly enjoyed it. "Physics quickly became an intellectual discipline that I couldn't let go of," he said of the experience. "I discovered that I had not had a good representation in high school. It reminds me continually of the need to present physics in its true glory in the classroom."

Of course, "Once I got into it, there was no question about staying there," said McIlrath. He received his PhD in physics from Princeton University in 1966 and spent the following year as a NATO postdoctoral fellow at England's Oxford University. After several years as a research associate at Harvard College Observatory, he joined the faculty of the University of Maryland, where he was a professor in the Institute for Physical Science and Technology prior to joining APS, in addition to serving as associate dean for research and graduate studies and as staff physicist for the National Institute of Standards and Technology. He has also been an active member of the APS Division of Laser Science, which he chaired in 1988.

Q One of the Society's stated priorities in recent years has been the establishment of on-line versions of its scientific journals. How close are we to achieving that goal?

A Currently, all of our journals are online except for *Reviews of Modern Physics (RMP)*, which we hope to have online by January 1, 1998. The electronic journals are clearly going to be central to the way the Society develops. Our fundamental mission is the advancement and diffusion of the knowledge of physics, and clearly the electronic medium is the most efficient way to distribute knowledge. The expenses for preparing scientific journals are not going to drop dramatically when we get the online vehicle in place. But for a very modest increase in cost, we can greatly increase accessibility to the information we distribute, as well as the quality of that information.

Also, more unit news is being sent out electronically to save on postage and paper costs, and we're moving as much as we can towards trying to get our members to use our Web pages. The effect is often that you find an increase in the volume of information transferred which at least partially cancels your efficiency. You end up coming out ahead, but you accomplish a lot more than just saving money. So it is a tool that will allow us to more effectively serve our stated goal.

Q How has the APS chosen to price its new electronic journals and other electronic products?

A All APS journals, except RMP, are currently available electronically to members at the cost of a very modest dinner ($25). Furthermore, we have instituted a plan whereby institutional libraries can register IP addresses when they subscribe to a journal that allow access with no additional charge across the campus, company or institution. One caveat is that it's very early in the development of the economics of electronic journals and other electronic products. Services and pricing are going to evolve, and every year will be a little different until we find the method that provides the most efficient and effective distribution with the fairest distribution of cost.

There are a variety of models for handling cost. For example, some electronic journals and products of other societies are supported by a fee paid by the author, and/or the agency supporting the work. The information then becomes free to the entire community. This model puts the cost on those who want to disseminate the information electronically, whereas the print subscriptions put almost all of the cost on the library subscribers. With the print subscriptions, it's very difficult to charge large libraries differently than small libraries, resulting in what some perceive to be an inequity in cost. Having the cost borne by the provider of the information removes that particular imbalance. All of these issues are now being discussed and evaluated.

Q There has been a great deal of discussion and experimentation with page charges for the APS print journals in recent years. What is the process currently in place?

A Page charges have been eliminated for *Physical Review C* and *D (PR-C* and *PR-D)* and are being phased out over a period of a few years for all of the other APS journals except *Physical Review Letters*. However, in all cases the removal of page charges is for manuscripts which are submitted electronically, via Compuscript. The page charge for non-Compuscript paper manuscripts will remain for all of the journals. In addition, a page charge continues to be assessed for all submitted manuscripts for *Physical Review Letters (PRL)*.

Q Do electronically submitted manuscripts help cut down on the overall production costs for APS journals?

A Not at present. This is because of the variety of formats which people use to submit manuscripts electronically, and because the community as a whole has not developed tools that will allow the mathematics in these multiple formats to be electronically converted into the final file type needed. So the immediate goal in our new page charge policy is to get our community more accustomed to electronic submissions. As we develop the authoring tools to convert different submission formats to the final SGML

product that we need — or the XYvision product in the case of AIP — we do expect to save money. But that savings will appear in the future.

Q The APS remains in a strong position financially, especially in terms of its investments and reserve fund. What are some of your guiding policies for maintaining the Society's fiscal health in the coming years?

A I try to keep the operating budget roughly even, with maybe even a small loss reflecting the work we're doing in education and public policy. Fundamentally each activity covers its own costs except for education and public policy and we use some portion of the investment income to cover those activities. Basically we follow a somewhat conservative pattern, in which we allow the investments to continue to strengthen. This is in part because we don't know how the investment picture will change. We may earnestly believe that all of our heavy rowing allows us to control our fate, but the truth is the winds and the tides are sweeping us where they will, and we often have a small effect on where the economic ship is going.

We also need the investment income to keep abreast with the effects of inflation in increasing the expenses of the Society. One of the features of the movement towards electronic publishing is that even if you can be more efficient and need fewer staff, those staff need to be much more technically proficient, and the cost per staff member is almost certain to rise above the adjusted cost of living level. Furthermore, there is much concern that we will enter into a period of very challenging economics when the library community begins to move heavily towards electronic journals, possibly cancelling their institutional paper subscriptions. There's a small 7-8% surplus on publications which we invest in new resources, especially in the electronic arena, to increase the quality of the publications.

Q Are there any plans to increase or decrease membership dues in the near future?

A It's been several years since there was any increase in membership dues. Ours are low compared to professional dues in many organizations, and they cover activities which directly benefit members. We do not use membership money to handle the education and public policy activities. To cut dues would result in using the library subscriptions to pay for membership activities, and we really don't want to do that. Libraries are under tremendous

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Optical Spectroscopy, Modeling Techniques Featured at 1997 Shock Compression Meeting

The latest results in molecular modeling, spectroscopic techniques, and mechanical properties of shock-compressed materials were presented during the 10th biennial International Conference of the APS Topical Group on Shock Compression of Condensed Matter (SCCM), held July 27 through August 1, 1997 at the University of Massachusetts in Amherst. The conference emphasis was on the physics of materials at elevated stresses or pressures. In addition to standard invited and contributed papers, the conference featured a lecture on molecular and planetary fluids at high shock pressures, focusing on the achievement of metallic hydrogen, by the 1997 APS Shock Compression Award winner, W.J. Nellis of Lawrence Livermore National Laboratory.

Time-Resolved Optical Spectroscopy

Despite many experimental developments, a detailed understanding of shock induced chemical decomposition in explosives at the molecular level remains an outstanding problem, according to Y.A. Gruzdkov of Washington State University, who has been using time resolved optical spectroscopic techniques in his laboratory to address this problem. Gruzdkov reported the detection of a transient intermediate in sensitized nitromethane with one of these techniques, subsequently identified as a radical anion of nitromethane, and the base catalysis by amines is favored as the most plausible mechanism.

In a Tuesday afternoon session, T.P. Russell of the Naval Research Laboratory described a new approach that permits real time (nanosecond to microsecond) investigation of condensed phase chemical reactions under extreme conditions of high pressure and high temperature. Time-resolved optical techniques are used in conjunction with a high pressure gem anvil cell to monitor reaction time, reaction sequences, and products in chemical changes induced by pulsed laser heating in statically compressed samples.

Deformation of Ceramics

Determining the material strength and understanding the inelastic deformation mechanisms of ceramics under plane shock wave compression is important for characterizing their response to rapid impulsive loading. In recent experiments, R. Feng of Washington State University used two independent methods to determine the material strength of ceramics in the shocked state: longitudinal and lateral stress gauge measurements, and combined compression and shear wave experiments. Feng reported that the data collected, along with related one- and two-dimensional computations, have provided a complete characterization of the stress state in shocked silicon carbide.

Molecular Modeling

In a Thursday afternoon session, Brad Lee Holian of Los Alamos National Laboratory described the history and recent developments of nonequilibrium molecular-dynamics (MD) simulations. His research group carried out the first such simulations of shock waves in single crystals in 1979. Nearly a decade later, the LANL team performed similar calculations in systems of up to 10,000 atoms. Today, with the advent of massively parallel computers, Holian and his colleagues have studied systems with approximately 270,000 atoms, and are attempting simulations with even larger cross-sectional areas, and with pre-existing defects embedded in the sample, which could nucleate plastic flow at lower shock strengths than those characteristic of pure single crystals.

Banquet attendees at the Tenth Biennial International Conference of the American Physical Society Topical Group on Shock Compression of Condensed Matter, held at the University of Massachusett, Amherst, MA July 27, through August 1, 1997. Standing is D.P. Dandekar, Chair of the Topical Group's Meetings Committee.

IN BRIEF

- In June, the leadership of the APS Divisions of Materials Physics (DMP) and Condensed Matter Physics (DCMP), as well as the Materials Physics Society (MPS), met in Washington, DC, to visit a cross section of Congressional and agency leaders who play key roles in federal support for science. The three groups, representing nearly 20,000 materials researchers, joined together to express strong support for all science; to offer their assistance in making the case for science; and to stress the importance of interdisciplinary research in all fields, especially materials research. In total, more than a dozen offices from Capitol Hill to the Pentagon were visited over a two-day period, including members and staff in both houses of Congress, representatives of science-related Congressional committees, and the Office of Management and Budget, the Defense Research and Engineering directorate, and the National Science Foundation.

  Participants found the Washington visit to be useful and timely, according to DMP Chair Jim Roberto, Oak Ridge National Laboratory. A return visit is already being planned for next year and contacts are being maintained. "Translating these positive steps into action is a significant challenge which will require an unprecedented effort by all scientists working together, making the case for science to their Congressional representatives and to other key policy makers throughout the administration and Congress," said Roberto.

- In July, President Clinton nominated Ernest J. Moniz as Under Secretary at the U.S. Department of Energy (DOE). Moniz, formerly the associate director for science in the White House Office of Science and Technology Policy until January 1997, is currently serving as Head of the Physics Department at MIT. In this new position, he will be responsible for integrating the laboratories into a cohesive national system and for strengthening the links to academia and the private sector, while further enhancing laboratory core competencies. The Under Secretary at DOE is responsible for the issue areas of science and technology, environment, national security, and fundamental research, as well as the promotion of streamlining and management reform of the DOE national laboratories. He will also oversee national security and non-proliferation issues and provide the Secretary with critical advice in carrying out his responsibility of assuring the security of the nation's nuclear stockpile.

  Moniz received a B.S. in physics from Boston College and a Ph.D. from Stanford University in theoretical physics. His career spans teaching, research, administration, management of major scientific ventures, and diverse services to the federal government. He served as head of the MIT Department of Physics, from 1991 to 1995 and Director of the Bates Linear Accelerator Center from 1983 to 1991. He served as chair of the Department of Energy's and the NSF's Nuclear Science Advisory Committee, as well as the Physics External Advisory Committee for the Los Alamos National Laboratory.

- In July, Robert A. Eisenstein, who has served as director of the physics division of the National Science Foundation (NSF) since 1992, was appointed Assistant Director for Mathematical and Physical Sciences at NSF. The appointment became effective September 8. Eisenstein came to NSF with a well recognized background in nuclear and particle physics. As physics division director, he has played significant roles both in the management of large-scale projects such as the Laser Interferometer Gravity Wave Observatory, and in the establishment of physics division initiatives in biological physics and complex phenomena. He also led the division to a greater involvement of undergraduate students in its supported research activities. "Bob has the leadership and wisdom to help pave a new road for integrative, multidisciplinary, and increasingly interdependent science and engineering," said NSF director Neal Lane. "Since coming to the agency, Bob has enhanced NSF's reputation for innovation in science funding and sound management practices." Prior to joining NSF, Eisenstein was a professor of physics at the University of Illinois, where he also directed the Nuclear Physics Laboratory. Prior to that, he was a professor of physics at Carnegie Mellon University. Bob was chair of the APS Division of Nuclear Physics and was a Councillor-at-Large on APS Council from 1991 to 1994. Eisenstein received his masters and doctoral degrees in physics from Yale University.

McIlrath

pressure these days. I would rather have our members come to us with suggestions as to what additional services we can provide to better serve them rather than simply reduce dues.

Q Along with AIP, the APS has been embroiled in a long, complicated lawsuit brought in several different countries with the scientific publishing company, Gordon and Breach (G&B). What is the current status of the various venues?

A The German lawsuit has been settled in favor of the APS and AIP. The APS and AIP have won the Swiss suit many times, but the decision continues to be appealed by G&B. The French lawsuit is still under consideration. There is also an American lawsuit with two aspects to it. One was the publication of the original articles themselves, which was quickly decided by the judge in favor of APS and AIP on the basis of freedom of speech, although it is possible that G&B will appeal that decision. The issue of whether the articles were used in what's called "secondary use" for advertising was felt to be worthy of a hearing. A trial before the judge, not a jury trial was scheduled. That was held in early June, after an extensive period of discovery and preparation. The judge has just ruled completely in favor of the APS and AIP.

Q Are there any new services or journals planned for specific groups within the APS?

A One APS Division has expressed some dissatisfaction with the major journal that they were using for publication. So we are looking into setting up an all-electronic journal to serve that community. The preliminary outline of what that could involve has been sent to the division for discussion. That initiative has stimulated us to think about the way electronic journals can be used for our diverse communities. We feel that the use of all-electronic journals will greatly increase our ability to address the needs of special groups within the Society, and to expand our journal offerings without having to burden the libraries with large numbers of new paper journals. So we're excited about the prospect of doing something in this area.

OPINION

APS VIEWS

A Hazy View Down the Electronic Superhighway

by Martin Blume, APS Editor-in-Chief

As of July first all of the *Physical Reviews* and *Physical Review Letters* are available electronically on the Internet. Physicists can now take advantage of the low cost personal subscriptions offered to our membership, or may gain on-line access through their institutions to all print journals to which the institutions subscribe. Many new features, such as searching and linking, are now possible online, and more are in store. We expect to have all our journals online in the *Physical Review On-Line Archive - PROLA* - back to 1985 in the next year, and in the long term will go all the way back to the beginnings.

The distribution of physics journals has been largely unchanged since the founding of the *Physical Review* in 1893. The splendid centenary collection of two hundred important *Physical Review* papers, edited by Henry Stroke, shows this clearly. The founders of *Physical Review* would have been astonished by the incredible development of physics in one hundred years, but they would have been quite familiar with the product: a paper journal, different in layout and type, but otherwise quite recognizable. Only in back of the centenary volume is there a hint that things are in process of change. A thin silvery disc, hard to find in the seven-centimeter-thick volume, is included in the package. This CD contains the two hundred papers selected for printing, but also *eight hundred* more that were worthy of note, but which could not be printed without busting the budget.

We are in the midst of a revolution in the distribution of the results of scientific research, and physicists are playing a major role, both technologically and conceptually, in that revolution. The CD ROM was only an initial harbinger, and the online availability of our journals is but a step toward a hazily defined future. We have put our journals online by completing the printing process and then making a few additions so that they can be posted on the Internet. This is a smart way of getting on-line quickly, but clearly the wrong way to do things. Print should be a derivative of the electronic version, and not the other way around. Only then can we take advantage of the many enhancements, cost savings and speedup of publication potentially made possible by electronic submission, refereeing, and distribution. Many pieces of this future are already in place - Paul Ginsparg's "xxx" e-print archive at Los Alamos embodies these modes of distribution, and gives scientists the results of research at a very rapid pace. While the papers are unrefereed (though there is the possibility of commenting on submitted e-prints) they can be used by editors and referees to supplement their own knowledge of the papers being reviewed.

The American Physical Society must move as quickly as possible to adopt these ways of working, but should not abandon its own strengths. Peer review is essential, but we can enhance the quality and speed of the refereeing process by using electronic tools. We also need print, because it provides the only archival medium now recognized as "permanent," and because many physicists still prefer it to reading something on a screen. We can, however, imagine a future in which print is still important, but in which print *distribution* has disappeared. Those wanting paper copies would be able to download and print their own "journals" from the electronic versions. (Or have their librarians, colleagues or a contractor do this for them.)

A robust, reliable, fast, cheap Internet is required for the entire electronic enterprise to work. Right now the Internet is cheap, but neither fast nor reliable, especially where international transmissions are involved. Nor do we have assurance that the low cost will continue, particularly since telecommunications companies regard the Internet as a potential source of considerable revenue. Each improvement in Internet connectivity is often matched by a disproportionate increase in public access, which leads to reduced speed and even gridlock. It may therefore be necessary to arrange for an international research network separate from the public one. This was, of course, the origin of the Internet, and would simply take us back to its roots.

The present situation in publishing can be compared to the revolution in personal transportation that took place in the fifty years after the founding of the Physical Review. The horse and buggy was gradually replaced with the automobile. At the same time the highway system was developed -pavement, four lane, and limited access. Our publishing situation is at the stage where the horse and buggy is being replaced, but with an automobile that looks like a buggy with an internal combustion engine. Only when the automobile was designed from the ground up, did it reach its full potential. As far as the roads are concerned we are looking at a paved but not limited access highway. In many parts of the world there are either dirt paths or no roads at all. We are in process of removing some of the horse manure left over from the horse and buggy era, which we hope will not be replaced with air pollution. We must also work to avoid having the electronic superhighway become a toll version of the Long Island Expressway.

There are remarkable possibilities in the electronic future, but many economic, technological, and sociological potholes to be avoided if those possibilities are to be realized. At the American Physical Society we are intent on being in the forefront of the new era - we don't want to be the blacksmiths of this revolution. We must do this while maintaining the high quality of the published research that has been our focus for the past one hundred years, and continuing the present mode of distribution until it can be safely discontinued without cutting off many physicists from the refereed literature. The membership of the Society has a significant role to play in determining the directions in which we move. Please try our online journals. Even without a subscription the tables of contents and abstracts can be viewed without charge. They can be reached through the Research Journals link on the APS home page: aps.org. Please give us your feedback.

LETTERS

Last Word on Creationism

Since his letter was sent to *APS News*, we may assume that John Cimbala has been trained in science. That he is able to crowd so many misconceptions about the scientific method and the theory of evolution into so little space is a sad commentary on the quality of that training.

Although a letters column is not the place for an extended discussion, the following should be noted: in contrast with creationism, evolution is a science, not a religion, and as such takes no position on the existence of God, either for or against. Science provides for inferences regarding unobserved past events, such as the origin of life, basing them on present observations. The mounting evidence is mostly for, not against, evolution. Even if evolution were eventually rejected on the basis of future evidence, it would not then follow that creationism would be proven, since it is not, in fact, the only alternative.

John G. Fletcher
Livermore, California

Intratomic Superconductors?

In the *APS News* of July 1997, the summary of events from Washington, DC, mentioned "Proton-Neutron Correlations"; an effect was introduced by the statement (p. 1) that, "It is a little-known fact that all nuclei are superconductors,…"

I think it should be even less known than little: In a classical regime, electrical conductors dissipate energy as heat because the individual electrons can excite the crystal lattices at random. But, it seems that a superconductor conducts by paired electrons, which pairs have so low a spatial frequency that they rarely transfer energy to the crystal lattice. So, superconductors dissipate essentially zero heat.

All energy or momentum transfers inside a nucleus are quantized; it can't transfer random, small amounts of heat to the surrounding electron cloud or neighboring atoms. So, why apply the term "superconductor" in a circumstance in which infinite conductivity, and perpetual motion, is the norm, anyway? Are paired nucleons faster than single ones—or, do they waste less energy when used to do work?

Let's look at the phenomena, and leave the analogies for the after-hours poetry meets.

John Michael Williams
Redwood City, CA

Pittel Responds…

On the one hand, what Dr. Williams says in his letter is correct. Nuclear superconductivity is not the same thing as superconductivity in solids. As noted in the Virtual Press Release [aps.org/BAPSAPR97/vpr/laye80.html], for example, the pairing correlations that enter are somewhat different in the two cases. In solids, it involves "momentum pairing." In nuclei, it is "angular momentum pairing." Clearly the physical manifestations will be different. In addition, the number of particles contributing to the collectivity is different in the two cases. It is a fairly small number. In solids, the number is much much larger. AIt is only the "valence nucleons" that pair correlate in this way. The nucleons of the core do not.

Nevertheless, there are some interesting similarities. In both cases, there is a sizable gain in energy associated with the "superconducting solution" of the BCS equations. In both cases, the system behaves as a set of "independent correlated pairs". And there are other similarities as well, athough some people may feel they are a bit forced. The Josephson tunneling analogy is one example.

From my perspective, the important point is that there is a pervasive collective mode in nuclei which involves pair correlations. Whether it should be called superconductivity (in the strictest sense) isn't the key point.

Let me add, however, that it is nice to think of this collective mode vis a vis superconductivity. It establishes a connection between physical phenomena in very different fields. Not a precise connection, I agree. But an interesting and useful one, I believe.

Stuart Pittel
Bartol Research Institute, DE

U.S. Productivity Figures Under-Estimated

In the Back Page article by President Clinton (*APS News*, July 1997), there occurs the following sentence. "Fully half the growth in economic productivity over the last half-century can be traced to research and technology." I have seen this statement elsewhere, though none of the people who use it say where the information comes from. I would like to challenge this statement as a gross under-estimate.

Over the period in question, productivity wealth generated per member of the workforce in the United States has about doubled. The implication of the statement is that, if the incorporation of new science and technology into the workplace had ceased in 1947, that half of this increase in productivity would have happened anyway.

Moreover, this does not take into account the greater variety, power, durability, value and usefulness of the products produced today - all of which comes from science and technology. If I were to claim that 95% of the increase in productivity and the increase in our material wealth as being due to research and technology, could anyone contradict me?

Alwyn Eades
University of Illinois

Importance of Publicly funded science to industry

This article was interestingly juxtaposed with the George E Brown piece claiming that publicly funded science needed to be downsized. Does this not make clear that we need a method of funding science which has a direct feedback with the needs, rather than as filtered though our politicians? This will not happen unless scientists take the initiative of inventing better methods than the patent system currently in place.

Elmer Eisner
Houston, TX

OPINION

zero gravity

TOKYO (AP) — Here in the chic pubs of the Aoyama district, the latest fad inspired by beer makers struggling through a sluggish economy is the flammable suds of the new Hydrogen Beer. The latest craze among the environmentally conscious crowd of twentysomethings, the "Suiso" beer made by the Asaka Beer Corporation has been extremely popular at karaoke sing-along bars and discotheques.

Hydrogen, like helium, is a gas lighter than air. Because hydrogen molecules are lighter than air, sound waves are transmitted more rapidly; individuals whose lungs are filled with the nontoxic gas can speak with an uncharacteristically high voice.

Exploiting this quirk of physics, chic urbanites can now sing soprano parts on karaoke sing-along machines after consuming a big gulp of Suiso beer.

The drink comes in a transparent hexagonal bottle imported from the maker of the new American drink "Zima," according to Hideki Saito, marketing director of Asaka Beer Corp. While the bottles are imported from Tennessee, the labels are made with a 100% biodegradable polymer. The bottle caps are equipped with a safety valve to prevent excess build-up of pressure in high temperatures.

The flammable nature of hydrogen has also become another selling point, even though Asaka has not acknowledged that this was a deliberate marketing ploy. It has inspired a new fashion of blowing flames from one's mouth using a cigarette as an ignition source. Many new karaoke videos feature singers shooting blue flames in slow motion, while flame contests took place in pubs everywhere in Tokyo on New Year's eve.

So far, Asaka beer has insisted that the quantities of hydrogen used in the drinks is too low to create potential for bodily harm. In the factory, the carbon dioxide that is dissolved in the beer is partially extracted and replaced with hydrogen gas. Mr. Saito maintained that the remaining carbon dioxide mixed with hydrogen prevents the rate of combustion from increasing dramatically. Carbon dioxide is a nonflammable gas that is naturally contained in the exhaled breath of humans.

However, the company has hesitated from marketing the product in the US due to legal complications.

Each bottle of Suiso beer sells for approximately 1,200 yen, or eleven US dollars. The bottles are packed in special crates lined with concrete to prevent chain explosions in the event of a fire.

Readers are invited to send in their favorite humorous science item. If published, you will be sent a (water-drinking) dunking bird.

The 'unknown author' for *If Dr. Seuss were a technical writer…* in the August/September issue is Prof. Gene Ziegler, Cornell University. His complete poem may be found at: www.gsm.cornell.edu/staff/gene/DrSeuss.HTML under the title of *A Grandchild's Guide to Using Grandpa's Computer.*

Inside the Beltway

(continued from page 1)

argued for some time that science dollars rightfully should be placed on the investment side of the ledger. But his argument had lost much of its impact, because, as many of his colleagues were quick to point out, the Clinton Administration was now using the same claim to advance much of its spending agenda — in some cases appropriately and in others not.

Still, Rep. Brown continued to press his case in the House. And in the Senate, as the 105th Congress convened, Phil Gramm (R-TX), relying on much the same logic, offered a resolution to double the federal civilian research budget over ten years. Even though Brown and Gramm attracted a few early supporters, advocates of science investments remained a dangerously small minority.

Two major arguments aided their cause. It had long been known that technology was a significant driver of American economic growth. But just how significant, was rarely cited. Using statistics developed by economists such as Edwin Mansfield and Michael Boskin, investment advocates could claim, with little risk, that more than half of the nation's economic growth since the end of World War II could be traced to technological development that had science as its underpinning.

Even more significantly, a new study carried out for the NSF by CHI Research, Inc., an international consulting firm, concluded that 73% of the papers cited by American industrial patents in recent years were based on publicly supported research. The implications were clear. All that remained was driving the message home.

To do that, the leaders of 46 professional societies united behind the Joint Statement on Science Research, which argued that federal research budgets should rise by 7% in FY 1998. With more than 1.5 million scientists, engineers and mathematicians behind it, "The Seven Percent Solution" — as it had become known — made its mark. The hard freeze, which policy makers only months earlier had held out as the best that could be expected, was replaced with real gains, a number of them approaching the 7% figure.

The science community had weighed in with cogent and compelling arguments and had carried the day. But ominously, the budget accord reached before Congress went into its summer recess, now promises even more difficult days ahead. Should the out-year projections be realized, science investments will decline by 15% or more over the next five years.

Of course, budgetary forecasts are notoriously unreliable, as any pundit will tell you. Right now, the science investment lobby has the current on its side. But the waters are choppy and the winds, variable. Scientists would be wise to follow the advice of the savvy sailor: Keep a watchful eye on the tell tails, a firm arm on the tiller and ready hands on the main sheet. Otherwise, they will find themselves sailing against the tide once more.

APS Members Survey

(continued from page 1)

level, whether people are in academia, industry or the national laboratories," said Czujko. Additionally, collaboration crosses national boundaries. An international survey completed in 1992 found that half of APS members in industrialized countries have spent several months in the U.S. engaged in some kind of research collaboration. There is also a high level of membership in multiple societies, with the AAAS, the IEEE, and the American Chemical Society leading the list.

Benefits and Services

More than half (53%) of the respondents felt they received fair value for their membership dues. A sizable majority of APS members (79%) find *Physics Today* valuable, a higher percent than any other benefit, followed by the paper and online versions of the APS directory, *APS News*, unit membership, and reduced registration at meetings, all of which were rated valuable by at least 37% of the respondents.

In terms of electronic publications and services, nearly half of those who access physics research literature regularly do so online on a monthly basis or more frequently, and over a third of all respondents had accessed online journals within the past year. However, paper journals and photocopied articles are still more prevalent. More than half had accessed the APS home page, mostly frequenting the *BAPS* meeting information (62%), *APS News* (54%), and "What's New" (53%).

More than two-thirds of the APS members who responded said that the APS should make informing and educating the government and the general public about physics issues and improving pre-college physics and math education its highest priorities. About half said that the APS should be more involved in public affairs or outreach activities. By the same token, half indicate no opinion on how well APS is actually performing in these areas.

"Clearly the APS needs to work harder to advertise its services, in particular its educational and public affairs outreach activities," said Cizewski of the responses. Although information on these programs and services is regularly covered in *APS News*, as well as unit newsletters, getting APS members to read those publications is a continuing challenge. "It would appear that a lot of members are just busy with their professional and personal lives and, even when an issue is of general important and they admit it, they just don't have the time, energy or inclination to read the details about APS activities in these areas," she said.

Meetings

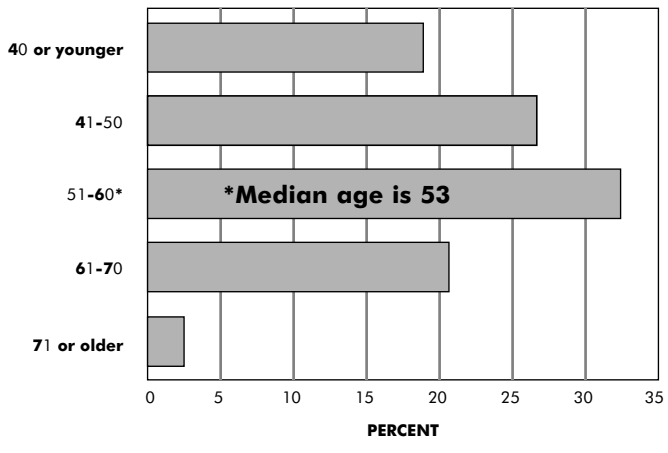
This survey was also the first time extensive data was made available on APS meetings, according to Czujko. The 1996 survey revealed that a majority of the respondents with PhDs who identify themselves as physicists attended an APS meeting within the last five years, while just over a third of those with PhDs in other fields attended. Most did so in order to present a paper or give a talk; the second most cited reason was for the purpose of informal discussion with colleagues.

The main reasons which discourage respondents from attending more APS-sponsored meetings are work or time constraints, and limited travel budgets. "Essentially, people are very busy. They have to make choices about which meetings they will attend, and part of that choice is time, money and perceived value," said Czujko. "So there is a core group [of APS members] who attend meetings regularly and many others who can't find the time or don't find it as valuable as other meetings they attend."

The survey results are currently being scrutinized by the APS with the objective of changing and improving services and benefits to members. A report detailing survey results and recommendations, will be sent to the Committee on Membership and the Executive Board in November for final approval.

Factal

Age Distribution Of Physics Faculty, 1996



Based on physics faculty in universities and four year colleges with professorial ranks: full, associate and assistant. Does not include postdoctorates. Source: 1996 Membership Survey, AIP Education and Employment Statistics Division, unpublished data

Corrections

The coverage of the 1997 APS/AAPT April Meeting (*APS News*, July 1997) has two corrections. First, the person who gave the talk on antihydrogen production at Fermilab was Glenn Blanford (University of California, Irvine), and not David Christian. Second, in the section on low-temperature glow discharge plasmas, the second paragraph on recent developments in the field was covered in a "layman's version" in the APS Virtual Pressroom [aps.org/BAPSAPR97/vpr], but not discussed in the session itself.

Students Find Summer Internships With ISIP; Program Discontinued

Since its inception 18 years ago, the APS Industrial Summer Intern Program (ISIP) has helped over 270 U.S. college students secure summer employment in some of the country's best industrial laboratories, thus gaining valuable hands-on experience in that research environment. This year the program placed 10 students in some of the nation's top industrial and national laboratories, out of 54 applications received. Unfortunately, while participating interns and their employers has been overwhelmingly positive, the program will be discontinued this year because of declining student participation.

Established by the APS Committee on Education in 1978, ISIP provided an opportunity for qualified U.S. physics students to broaden their training by working in an industrial environment for ten weeks during the summer. Interns received their salaries from their industrial employers. The primary benefits of the program include exposure to industrial research and the opportunity to establish important contacts in industry. "Students aren't generally aware that interesting physics can be done in an industrial setting," said APS Associate Executive Officer Barrett Ripin. The program also benefited the participating industrial laboratories. Interns often produce useful results that help advance a company's scientific program, and may return to industry after earning their PhDs.

For example, Mead Mason Jordan spent his summer at Analog Devices, working with the computer-aided design (CAD) research group, which prepares and fine-tunes tools for circuit and layout designers. According to his supervisor, Adolfo Nemirovsky, his project was very successful. In fact, as a result of Jordan's internship, the company's upper management recently approved hiring people with physics backgrounds for positions in the CAD group, which previously hired mostly electrical engineering or computer science people. Jordan is currently pursuing graduate studies at Washington University in St. Louis, Missouri.

During her internship with Milliken Research Corporation, Erica Bramley helped build equipment to draw ferroelectric polymer fibers which, under certain conditions, exhibit piezoelectric ("smart material") properties. She drew the fibers and then used differential scanning calorimetry to measure the degree of phase change created, and even did a little x-ray scattering to confirm the results. Her liquid crystal background proved especially useful in helping her orient the project quickly. Her supervisor, Brian Morin, said the ISIP program helped him recruit qualified applicants more effectively, adding that Bramley's work advanced the project far enough to make a decision as to whether it was worth pursuing more avidly, with a planned application in textiles.

Matthew Abraham spent the summer at Lucent Technologies after graduating with a B.S. in physics from Haverford College. He made differential mode delay measurements in novel types of optical fibers, injecting pulsed modes one at a time and measuring their propagation velocity directly, a strong indicator of the amount of information that can be transmitted over an optical fiber. Despite the complexity of the experiment and numerous equipment setbacks, Abraham managed to make the experiment work, according to his supervisor, Whitney White. Abraham is currently pursuing graduate studies at Harvard University.

The other ISIP interns and companies for the summer of 1997 were Nathan Noble, Dow Corning Corporation; Mark Williams, Exxon Corporation; Eric Shields, Sandia National Laboratories; Alexei Erchak, Sandia National Laboratories; Eric Gansen, GE Lighting; Jenny Magnes, Argonne National Laboratory; and Goran Krilov, AT&T Bell Laboratories.

The reason for the declining interest in ISIP among students appears to be the large number of local summer intern programs available in industry, government, and through NSF REUs. However, APS involvement in student internships may return, but geared to the graduate level in an effort to broaden graduate training to include industrial experience, said Ripin.

Ippen and Shank to Be Honored at ILS-XIII

Erich Peter Ippen of MIT and Charles V. Shank, director of Lawrence Berkeley Laboratory, will be awarded the 1997 Arthur L. Schawlow Prize in Laser Science during the Division of Laser Science ILS-XIII meeting, to be held 12-17 October 1997 in Long Beach, California. Sponsored by the NEC Corporation, the prize is intended to recognize outstanding contributions to basic research that use lasers to advance knowledge of the fundamental physical properties of materials and their interaction with light. Their citation reads, "For their pioneering work in developing femtosecond sources and for their leadership in applying these sources in broad areas of science."

Erich Peter Ippen

Charles V. Shank

Ippen received his BS in physics from MIT in 1962 and his PhD in electrical engineering from the University of California in 1968. He was a member of the technical staff at Bell Laboratories in Holmdel, NJ from 1968 until 1980, when he joined the faculty of MIT, where he is the Elihu Professor of Electrical Engineering, as well as a professor of physics.

His research interests have included nonlinear interactions in optical fibers, dye lasers, semiconductor diode lasers, ultrashort pulse generation, femtosecond optical techniques and studies of ultrafast processes in materials and devices. His current research involves femtosecond spectrometry of solid-state materials, ultrafast nonlinearities in semiconductor waveguides, and ultrashort-pulse optical fiber devices.

Shank received his PhD from the University of California, Berkeley, in 1969 and promptly joined the staff of AT&T Bell Laboratories. During his 20-year tenure there, he held numerous leadership positions, including director of the Electronics Research Laboratory. He made pioneering contributions to the study of ultrafast events that occur in a millionth of a billionth of a second using short laser pulses, and contributed to fiber optic communications with the invention of the distributed feedback laser, a component in high data rate transmission systems.

Shank assumed his present position at LBL in 1989, and also holds a unique triple appointment as a professor at UC-Berkeley in the departments of physics, chemistry, and electrical engineering and computer sciences. During his tenure at LBL, he has served on numerous state and national committees and councils, including the Council on Competitiveness and the National Critical Technologies Panel of the U.S. Office of Science and Technology Policy. In 1996 he was awarded the APS George Pake Prize for his pioneering research accomplishments in the area of laser development and ultrafast phenomena, as well as his leadership roles at Bell Labs and LBL.

Division of Plasma Physics Program Committee Members arranging their Fall 1997 Annual Meeting at APS headquarters.

Announcements

AWARD NOMINATIONS SOUGHT

Please refer to the APS Membership Directory, pages xxi-xxxvi, or the APS home page for complete information regarding rules and eligibility requirements.

AWARD FOR OUTSTANDING DOCTORAL THESIS RESEARCH IN ATOMIC, MOLECULAR OR OPTICAL PHYSICS

Sponsored by members and friends of the APS Division of Atomic, Molecular and Optical Physics.

Purpose: To recognize doctoral thesis research of outstanding quality and achievement in atomic, molecular or optical physics, and to encourage effective written and oral presentation of research results.

Nature: The award, which is given annually, consists of $1,000 and a certificate citing the contributions made by the recipient. The award will be presented at the DAMOP Meeting in Santa Fe, New Mexico, in May 1998. Nominees must submit an abstract for presentation at the meeting. The selection committee will choose finalists who will be required to present their work orally in a special invited paper session devoted solely to such presentations. The selection committee will choose the winner from among the finalists based on both oral presentation and the written material described below. All finalists will receive a travel stipend of $500.

Rules and Eligibility: Doctoral students at any university in the U.S. or abroad who passed their thesis defense for the PhD in the disciplines of atomic, molecular or optical physics after 5 December 1995 are eligible for the award, except for those whose thesis advisors serve on the current selection committee. Any APS member may submit a nomination for this award.

The complete nomination package must be submitted by 5 December 1997 to the chair of the selection committee: Carol Tanner, Department of Physics, University of Notre Dame, Notre Dame, IN 46556, Phone: (219) 631-8369, Fax: (219) 631-5952, email: carol.e.tanner.1@nd.edu.

APS Mass Media Fellowship Program - Summer 1998

Deadline: 15 January 1998

In affiliation with the popular AAAS program, APS will sponsor 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.

▶ PURPOSE

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

▶ ELIGIBILITY

Priority will be given to graduate students in physics,or a closely related field, although applications also will be considered from outstanding undergraduate and postdoctoral researchers. Applicants should possess outstanding written and oral communication skills and a strong interest in learning about the media.

▶ STIPEND

Remuneration is $4,000, plus a travel allowance of approximately $1,000.

▶ TERM

Following an intensive three-day orientation in early June at the AAAS in Washington, winning candidates will work full-time through mid-August.

▶ SELECTION PROCESS

During February, a review committee will screen completed applications received by the January 15 deadline. Files of the four or five most qualified applicants will be submitted to host media organizations for final selection in April.

▶ TO APPLY

The following materials must be received at the address below by **JANUARY 15**:

- Completed application form (available from the program office, below, or at http://www.aps.org/public_affairs.html)
- A copy of your résumé
- Brief sample(s) of your writing (3-5 pages on any subject, written in language understandable to the general public — no technical papers, please), on single-sided, 8 1/2" x 11" paper, unstapled
- Three letters of recommendation (to be mailed directly to the program). Two of these letters should be from faculty members; one should be a personal reference.
- Transcripts of your undergraduate and graduate work (to be mailed directly to the program)

▶ MAIL TO

APS Mass Media Fellowship Program
529 14th Street, NW, Suite 1050, Washington DC 20045
(202) 662-8700 • email: opa@aps.org

CAUGHT IN THE WEB

Notable additions to the APS Web Server. The APS Web Server can be found at http://www.aps.org

APS News Online latest edition

APS Committees and Governance
- Directions link added to APS Contacts
- Women, Minority, and Industrial Speaker List updates
- UG Education in Physics (1997 Dept. Chairs Conf.)
- Thesis Award in Computational Physics
- Int'l. Reciprocal Soc. and CIFS page updates

Units
- DMP and DCMP Newsletters
- Four Corners Section homepage
- New York State Section pages updated

Meetings
- DNP, GEC, PC97, Shock Physics and DPP Meeting

Membership:
- Programs
- Meeting Calendar updates

APS/AIP CONGRESSIONAL SCIENCE FELLOWSHIPS: 1998-1999

The American Physical Society and The American Institute of Physics are currently accepting applications for their 1998-1999 Congressional Science Fellowship Programs. Fellows serve one year on the staff of a senator, representative, or congressional committee. They are afforded an opportunity to learn the legislative process and explore science policy issues from the lawmakers' perspective. In turn, Fellows may lend scientific and technical expertise to public policy issues.

QUALIFICATIONS include a Ph.D. in physics or a closely related field, a strong interest in science and technology policy and, ideally, some experience in applying scientific knowledge toward the solution of societal problems. Fellows are required to be U.S. citizens and, for the AIP Fellowship, a member of any of the AIP Member Societies at time of application. In exceptional cases, the Ph.D. requirement may be waived for applicants with compensating experience.

TERM OF APPOINTMENT for both fellowships is one year, beginning September 1, 1998, with participation in a two-week orientation in Washington, organized by the American Association for the Advancement of Science. Choice of congressional assignment is reserved to Fellows.

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

APPLICATIONS should consist of a letter of intent, a 2-page resume, and three letters of reference, accompanied by a cover sheet indicating: name, address, phone, email, references, U.S. citizenship, Ph.D. status, society membership, and where you learned about the programs. All submissions should be on standard 8.5" x 11" paper, single-sided and unstapled, and should be sent directly to the address below. Candidates should state in the letter why they are applying and briefly describe their public service experience. Letters of reference should discuss not just the candidate's competence as a physicist, but also the education, experience, and attributes which would particularly qualify the candidate to serve as a Fellow. Unless otherwise specified in the letter, the applicant will be considered for both APS and AIP fellowships.

ALL APPLICATION MATERIALS MUST BE POSTMARKED BY JANUARY 15, 1998.

APS/AIP Congressional Science Fellowship Programs
529 14th Street, NW, Suite 1050
Washington, DC 20045
(202) 662-8700 • email: opa@aps.org
APS and AIP home pages: www.aps.org and www.aip.org

Please note that other physics-related Congressional Science fellowship programs are run by The American Geophysical Union (202-462-6900) and The Optical Society of America/The Materials Research Society (contact: Gail Oare/ 412-367-3004). Please contact these societies directly for information on their Fellowships.

ON-LINE RESUME POSTING SERVICE

The Career Services Division of the American Institute of Physics announces the establishment of an on-line resume posting service, offered free of charge to physicists seeking employment.

Resumes are entered into a searchable database which is available to employers around the world. The identity of the job seeker and a complete resume will only be released to employers who contact our office directly.

AIP's clients are looking for highly talented people to fill open positions. Come visit the site today on the World Wide Web for more information: http://www.aip.org/resume_post

THE BACK PAGE

Points of Derailment: The Making of a Female Physicist

by D. Elizabeth Pugel

Being a physicist is not simply an occupation, but a manner of living that carries with it a distinctive mind set. Physicists question, investigate and scrutinize all systems. This same scrutiny should be applied also to interactions between members of our field, addressing any problems and determining their nature. In attacking problems, physicists look for the statistical anomalies and demand explanation for a state. The disproportionate number of men over women in physics is just such an anomaly, worthy of investigation.

Historically, the number of women in physics in the U.S. has been small. Currently, 12% of the PhDs awarded in physics in this country are presented to women. Several articles in *Physics Today* and other prominent physics journals have attempted to address this issue through statistics, but have not been able to elucidate the distinct sociological deterrents for women. Thus, if we are to understand the roots of this dilemma, it seems that the use of statistics alone will not provide substantial insight.

As physicists, we are used to reams of data to characterize behaviors. In the study of the male-female asymmetry in physics, we must acknowledge that there are few studies in existence capable of discussing in statistical detail the sociological aspects involved in the process of becoming a physicist. The inability to quantize this problem does not lessen its magnitude. We must scrutinize the education and socialization processes of physicists, to further pinpoint the mechanisms which result in such a small number of women in this field. In this article I will outline the progress of a young female physicist in the U.S., attempting to pinpoint the times in her life where she may be derailed from her track to become a professional physicist.

Nature vs. Nurture

An important argument for the small number of women in physics rests in most familiar differences between men and women: the tug-of-war between social and biological forces (nature vs. nurture). The nurture-governed destiny to be a physicist has been distilled by sociologists to four main issues: parental interaction, toy selection, and both childhood and adolescent interactions with peers.

Parental expectations direct the child's notions of appropriate or inappropriate behaviors, and these set the stage for a life of pre-determined actions, where girls expect to become the passive object of adoration and boys become independent innovators. The invocation of Melville Feynman's comment to his wife while she was pregnant with Richard Feynman should be sufficient evidence: " If he is a boy, he will be a scientist." Feynman's father started to hone Richard's physical intuition at an early age, showing him patterns in colors of floor tiles when he was only a few months old. At a few years old, Richard was provided with simple explanations of fundamental physical phenomena, such as why balls roll to the back of a moving wagon. Thus, Feynman is an example of parental expectations shaping the course of a child's future.

Both great physicists such as Feynman and mere mortal physicists are shaped by their experiences as young children with toys and with their first friends in elementary school. Before school, young friends and toys are the outlets for personal expression. It is claimed that toys such as blocks are believed to develop logical and spatial skills, while dolls develop social skills. This is not so terrible an observation if we assume that the possibility to be a scientist is linked to the development of social as well as logical skills. Unfortunately, parents may falsely assume that the choice of dolls eliminates the possibility for logical thought, thus limiting their daughter's exposure to physics.

As a young woman enters elementary school, she is faced with gender expectations of new found friends and teachers. Female teachers tend to carry their own ideas about gender appropriate behavior, and some come from a generation where science education was emphasized less for women. In fact, the majority of K-8 teachers, who are predominantly women, suffer from insufficient science training or a fear of teaching science. Thus, they may have difficulty serving as female role models, or in articulating that science is a viable career option for young women.

In the middle and high school years, pressure to conform reaches its peak. There are few female role models in our popular culture to encourage young women to pursue or maintain their interests in the sciences. Rather, the common images of women as super models or seductresses serve to lure adolescent females from a path of science. In addition to the social aspect, studies have shown that high school teachers selectively call on boys more than girls, compounded by the socialization of boys in earlier stages to be more aggressive and confident in their capabilities. All of these notions continue to inhibit women as they enter the undergraduate and graduate levels of education, painting a dismal picture for the female physicist-in-training, who is unlikely to pass through secondary education unmarred by social pressures.

There are three main fallacies in the nurture aspect of the problem. The first is that the development of social skills inhibits the ability to become a physicist. The very basis of physics is to communicate ideas regarding the natural world and validate or disprove these ideas via experimentation. As the interdependence of scientific groups rises, communication is an essential skill. The second fallacy is that social people do not possess the skills to be physicists. We often mistake intelligence as a trait associated with social maladaption, but the human mind is not polarized. The presence of social capacity does not limit the logical skills of an individual. The third fallacy is that since these differences exist, it should come as no surprise that women are minorities in physics. To claim that women are not geared for physics because of social conditioning is to believe in the status quo that has persisted for centuries, and to believe that it cannot be changed.

With regard to nature, biology is an oft-abused tool to deter women from entering into the intellectual world. For centuries, women were considered members of a "lesser species," incapable of surviving in the mental world of their male counterparts. The few women who managed to be physicists during the Victorian era of science in Europe, the golden age of quantum mechanics, or the post-War era in the U.S. went unnoticed or were thought of as genetic aberrations. Even today, remnants of the abuse of biological theories remain.

Gender-Biased Bureaucracy

If a young female physicist survives and achieves her PhD, she is now deeply involved with "the system": organized Western bureaucracy. Perhaps she is seeking a postdoctoral position, tenure, or an industry position. In all of these situations, she will encounter an organizational structure that maintains her work environment. In most, she will notice that the members of those structures are predominantly male and that the policies which govern the structure tend to exclude the needs of women.

A high percentage of professional women end up with positions such as full-time lecturer, associate professor or technician, unlike their male counterparts, who usually end up in full professorships or in senior research positions. A young woman's dream of a full professorship or senior research position are dashed by a system which views women as primarily social beings who are incapable of the harsh competition inherent in the research venue, or of sole responsibility for a laboratory. In addition, sparse policy on maternity issues, child care, and sexual harassment do little to promote women to senior positions. With few support structures in place, the edifice of the bureaucratic system implicitly favors those who have someone to care for existing children, someone who is not pregnant, has no glass ceiling, and is not different from the other members on the board: a man.

To change the bureaucratic system while in the thick of it is a delicate task. It is best to change the system once one has made it to a higher position, but many women neglect this option and ignore the issue of bureaucratic bias. This is known as the "Queen Bee Syndrome," where women who have attained senior positions do not use their power to assist struggling young women or to change the system, tacitly validating it. Change, however, is the essence of survival for women seeking success among the bureaucratic ranks.

Any growing system requires competition to survive. One must have the willingness to make some sacrifices and deal with their consequences, regardless of gender. Denial of femininity, however, does not seem beneficial for the young physicist or the system. Successful women who have broken through the glass ceiling must be immune to the Queen Bee Syndrome in order for progress to occur. They must be willing to talk with male counterparts about benefits for women and men during and after maternity, reasonable options for child care, and perhaps even a different mode of achieving tenure for women who choose to have children during that time. Policies that are gender-sensitive or gender-free will be the policies that support our young physicist and her sisters of the future.

Gender-Free Thinking

Becoming a physicist should be about becoming a person: a bright, competitive innovator in touch with nature. This genderless approach, where we acknowledge people, not men or women, has been mentioned as a possible solution to the small number of women in physics. This is a lofty goal, that requires generations of change. Right now, we are far from a gender-free society and must deal with the current conditions. To live in today's society in terms of a genderless model would commit the flaw of internalized sexism. We must acknowledge, for now, that society still thinks in gender-stratified terms. Thus, using a genderless model would be devastating rather than helpful in promoting women to study physics, given the standards and stereotypes the majority holds.

We are living in a time of transition, where our forefathers have realized the importance of supporting women and our foremothers have realized the poor logic used to keep women from pursuing their dreams. We live in a time where people are starting to acknowledge that stereotyping at any stage from birth along the way of career development is neither helpful nor appreciated.

Our young physicist cannot be a queen bee. She must act upon her ideals and promote change at several levels. For example, she can raise her children, male and female, to be curious about the world. Knowledge has no gender-specific limitations. She can encourage their interests, and insure an education that does not carry with it a gender-based bias. She can mentor middle, high school or college women to buffer their struggles and to provide a challenging intellectual environment. She can even argue for representation by the mass media, so that young physicists can find inspiration from her work or life.

Within the system, she can strive for equal pay, or a shift in the age for tenure in women. Child care, maternity policies, and standards for admitting and retaining female graduate students could also be addressed. Our young physicist, aware of the struggles involved, can stay on course in pursuit of her heart's desire, working within a system in transition and seeking to change not only her understanding of nature's interactions, but interactions among members in her field.

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