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CSWP Gazette

The Newsletter of the Committee on the Status of Women in Physics of the American Physical Society

INSIDE

An Interview with Katharine Gebbie

Barbara L. Whitten, Colorado College, Guest Editor

Last spring at the meeting of the Division of Atomic, Molecular, and Optical Physics (DAMOP), we celebrated the 100th anniversary of the National Institute for "Standards and Technology (NIST). The talks on the past, present, and future of high-precision measurements were fascinating to a theorist like me; I rarely think about the practicalities of measuring the physical constants on which all our science depends.

But the highlight of the meeting occurred at the banquet, where Katharine Gebbie, the Director of the Physics Laboratory at NIST, received a special award for her contributions to AMO physics. Katharine is one of the most senior women in our field, and has been an inspiration, role model, and good friend to me and many other women for years. I decided, as my contribution to this issue of the *Gazette*, to learn more about her life and work. This "interview" was carried out by email.

What influenced you to choose physics as a career? Did you have important role models as a young woman?

I'd like to think I chose Bryn Mawr for my undergraduate studies entirely for its high standards, but the fact that my mother and two aunts on both sides of the family were Bryn Mawr graduates probably had a lot to do with it. They all—my mother and the two aunts—graduated second in their classes. I didn't. One of my aunts, the one on my father's side, was the first woman to get her Ph.D. in Physics from Cambridge University. She subsequently worked with Irvine Langmuir at GE in Schenectady and was the Blodgett in Langmuir-Blodgett films.

I guess she must have been what is now called a "role model", but I didn't realize it then. Perhaps it never occurred to me that everyone didn't have aunts who were distinguished physicists. What was special about Aunt Katharine was that she always arrived with suitcases full of "apparatus", with which she showed us such wonders as how to make colors by dipping glass rods into thin films of oil floating on water.

My plans for my senior year at Bryn Mawr changed when my father disappeared in a small plane in the jungles of Costa Rica. He had taken up flying when he was 50 so he wouldn't grow old, and it did the trick, although perhaps not quite the way he had intended. During the extensive search for him, I arranged to take my senior courses at MIT so that I could be in Cambridge with my mother. At that time there were 30 female undergraduate scientists, engineers and architects at MIT—three in physics, which was one more than in my class at Bryn Mawr. All my correspondence from MIT was addressed to Miss Blodgett but began "Dear Sir". Morale was high among the MIT women; it never occurred to

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Workshop on Survival Skills for Women Physicists

CSWP will host a workshop tentatively named "Survival Skills for Successful Women Physicists" at the American Physical Society's March 2002 Meeting. This will be an informational workshop aimed at technically competent women physicists who seek advice and training to improve their skills in navigating through the waters of today's research world to advance to the top. These include faculty members in universities, researchers in industry and government labs, and aspiring postdocs and graduate students. The half-day workshop will feature a mixture of respected training professionals and highly successful women physicists and will cover such issues as raising research funds, balancing career and family, effective communication and networking, negotiation, leadership, advancement in organizations, and more. To ensure sufficient interaction, the seats are limited. Both men and women are invited to participate. Further information on times, registration, and costs will be available at a later date on the APS Meetings website at as well on the CSWP's website at http://www.aps.org/meet/ as well on the CSWP's website at http://www.aps.org/educ/cswp/index.html

If interested, please remember to sign up promptly, or contact Dongqi Li at Argonne National Laboratory (dongqi@anl.gov) for more information.

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An Interview with Katherine Gebbie, continued

any of us not to go on to graduate school. The others felt bereft; they scorned liberal arts colleges, but MIT didn't usually take its own undergraduates, and Cal Tech didn't take women at all.

I, on the other hand, wanted to live in London and study astronomy. I had in the meantime met a Scots physicist. He was a great admirer of A. A. Michelson, which led him to the crazy idea of Fourier Transform Spectroscopy. I was his first analogue to digital converter. Such is love. I was also probably the first American ever to travel to fog-bound London to study astronomy. But it was fun taking an undergraduate course in the Astronomy Department of University College London. When it was cloudy—which was most of the time—we measured spectra or calculated comet orbits or used telescopes to observed light bulbs strategically placed on the door of a nearby pub. Which is why I ended up doing my graduate work in the Physics Department with Mike Seaton, an atomic theorist with closely related interests in astronomy.

After I got my degree, our careers took us back and forth between Boulder, Washington and London, with time out for trekking in Nepal, hiking in Kashmir, mountaineering in Turkey, and flying my mother's airplane around North America. When the music stopped, I was in Boulder working as an astrophysicist in JILA, a cooperative enterprise between the then National Bureau of Standards and the University of Colorado; Alastair was in London at Imperial College. We've had a transatlantic marriage ever since, with homes in Boulder, Washington and London.

What is the most interesting science that you have ever done? What is the most fun science? If the answers to these two questions are not the same, why are they different?

Interesting question. Being a graduate student in the Physics Department of University College London—having for the first time my own research project—was certainly enormously exciting. There were two other young women in the group, and we had a lot of fun. They are still there. We were treated like anyone else. Seaton was a great supervisor. He was using planetary nebulae as extended, optically thin laboratories in which to apply his newly computed atomic-physics data. The stars at the center of these nebulae are extremely hot, so they emit large amount of ultraviolet radiation, which ionizes the hydrogen in the expanding gas. Because conditions in the nebulae are very far from thermodynamic equilibrium, a large amount of atomic data is required to interpret the observed line intensities. Thus the nebulae provide a laboratory to study processes taking place in a low-density gas exposed to dilute ultraviolet radiation of the central star. For most of these studies, it was assumed that the central star radiates as a black body.

To find out to what extent that was true and to study the effect of a variation in gravity on the emergent flux, I was computing some of the first models of these very hot stars. This was 1960, and I was one of the first people to use a computer to model stellar atmospheres. Because my matrix inversions required four consecutive hours, I was allocated the least desirable time on the College's Mercury computer—from 2 to 6 am.This meant walking from where I lived near Sloane Square, up Sloane Street, across Knightsbridge and Hyde Park, along Piccadilly, up Shaftsbury Avenue, and Tottenham Court Road to Gower Street. It never occurred to anyone that it might not be safe for a young woman to walk across London alone at 1:00 o'clock in the morning. And it was safe—entirely safe.

But in retrospect, what makes a research project interesting or important?

One metric might be the extent to which it changes the way we view the world—or, less grandly, the extent to which it pushes back the frontiers of knowledge (as opposed to just adding information). Another might be a measure of the time it would have taken someone else to do it if you hadn't—assuming of course that it was worth doing in the first place. While I was thrilled with my models of the central stars of planetary nebulae, I'm not sure they would have rated very highly on either scale.

To me my most exciting and memorable work was during the gestation period of an altogether new field called helioseismology, the study of wave oscillations in the Sun and how they can be used to study the interior structure and dynamics of the Sun with ever increasing precision. Helioseismology is currently the best method we have for verifying theories of stellar structure and evolution. Just as seismologists learn about the Earth's interior by monitoring waves caused by earthquakes, so helioseismologists study wave oscillations in the Sun. But whereas for the Earth, there is generally one source of agitation, an earthquake, in the Sun, a continuum of waves is stochastically excited in the turbulent subsurface convective boundary layer. So the Sun is ringing like a bell struck continually by many grains of sand. But back in the 60's, we didn't understand that. We thought that the five-minute oscillations were localized patches of the solar atmosphere that had been thumped. We were using ground based and satellite observations to study the height variation of steady flows in the solar atmosphere and discovered the existence of mesogranulation, a new horizontal scale of solar convection. This new scale of motion has since been confirmed by higher resolution observations, with important implications for the movement of magnetic fields and their effect on the heating of the upper solar atmosphere.

How did you come to change from research to administration?

There is no such thing as an unmixed motive. Helioseismology was, as I have said, in its gestation period, and the prospect of taking part in its birth and infancy was certainly exciting. At the same time, NIST (then NBS) was evolving away from astrophysics and focusing more on standards, measurements and data. My work and I were tolerated but it was not—how shall I put it—a situation in which I seemed destined to thrive. It didn't improve matters that I had financed and orchestrated a successful Title VII suit (someone else's) against NIST. So I had to make a decision, and the decision I made was to spend what turned out to be two years working in Gaithersburg on the NIST Director's staff. Towards the end of that time, I was taken out for a glass of scotch and asked if I'd go back to JILA as Chief of the Quantum Physics Division, the NIST part of JILA. There I had a wonderful time working with the scientists in JILA and flying my little airplane over the mountains and deserts of the South West. And three years later I was asked to return to Gaithersburg to design and head what is now, after several reorganizations, the NIST Physics Laboratory.

What are the good and bad points about such a shift?

I doubt that there is a single answer to this question. It must be different for each individual in each situation. Clearly there's not the same personal involvement in research, the thrill of discovery, the excitement of finding totally new and unexpected results, the fun of planning the next experiment or calculation. I know many "real" scientists who wouldn't give that up for anything in the world. But there are many other joys and thrills. I get them from the part I have in building and honing a first class Laboratory. As children we used to buy seed packets that said, "plant and stand clear". It's a little like that with the Physics Laboratory. And instead of having to focus on a single area, I have the fun of learning about—and hopefully understanding at some level—a whole range of programs from cold atoms to clocks, from neutron interferometry to proton therapy, from optical temperature measurements to LED photometry, and from atom assembly to EUV lithography. Perhaps I'm just a dilettante at heart.

How do you see your role as director of a laboratory?

Perhaps I've already answered that. I guess my role is to set the climate in which the scientists and engineers can thrive and contribute to the Nation's measurement infrastructure. I guess I belong to what is known as the "get-the-best-people, steer-them-in-the-right-direction, give-them-the resources-they-need, and-let-them-run" (plant-water-and-stand-clear) school of management. It's not politically correct, but I prefer to be judged on my results rather than my processes. I've been accused of supporting people not programs, and to some extent it's certainly true.

How do you encourage scientists at different stages in their careers?

I suppose the flip answer is that what good scientists need are resources not encouragement. The better they are, the more they spend. I'm not sure it varies as much from one career stage to another as from one individual to another. Except that whereas we can promote the young, the majority of our more senior scientists are already capped at the top of the Federal pay scale. We appreciate the recognition afforded our scientists by NIST management, by professional societies, by the international community, and by the customers for our measurement services; and we acknowledge the efforts of those who take the trouble to nominate their colleagues for such recognition. But perhaps most important, we try (I'm not suggesting for a moment that we always succeed) to create opportunities for people in which they can thrive. Perhaps that is one advantage we have over universities—the variety of different kinds of opportunities we can provide for different kinds of talents and at different stages in their careers. It frequently happens that a scientist who, for one reason or another, is not prospering in one program will flourish in another. Or equally, a scientist who *is* flourishing in one program may simply want a new and different challenge. They come in all shapes and sizes. One thing I've learned is not to try to guess what any individual wants; you have to ask her. Some truly outstanding scientists have chosen to move from the laboratories to NIST's external programs, the Advanced Technology Program, the National Quality Program, and the

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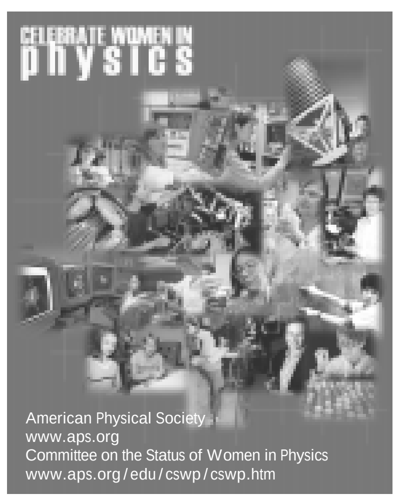

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What do you do to ensure the quality of the science that is being done?

Attract and retain the best people.

Do you think that your management style is different from that of male peers? If so, in what way?

My management style *is* different from that of my male peers. But I only appreciated quite recently, and I'm not sure it has anything to do with sex (or more delicately, if you will, "gender"). I believe it to be consistent with the way the NBS/NIST forerunners of the Physics Laboratory have been managed; it's consistent with the way Ed Condon managed NIST, and its consistent with the way Lewis Branscomb managed JILA. I never knew anything else.

What has been your role in encouraging younger women scientists?

Maybe you would have to ask them; they would be much better judges of that than I. I don't think my role in encouraging the Laboratory's young women is very different from encouraging the young men.

We do have a very exciting Summer Undergraduate Research Fellowship program that provides competitively selected, predominantly minority and female undergraduates with 12 weeks of hands-on research experience with our world-class scientists. It started nine years ago with 20 students in the Physics Laboratory and has now, with support from NSF and the NIST Director, expanded to 64 students in all seven NIST Laboratories. Their arrival each June changes the whole demographics of NIST. At the end of the 12 weeks, they each give a 10-minute talk on their research. The talks this year were awesomely good. It was really quite thrilling to watch these poised young people making lucid, interesting Powerpoint presentations—and obviously enjoying it.

Like most woman physicists, I have served as a member and/or chair of many committees, including the IUPAP's Working Group on Women in Physics, the APS Committee on the Status of Women in Physics, the APS selection committee for the Maria Goeppert-Mayer Award, the NSF Panel for Professional Opportunities for Women in Research and Education (POWRE), and the Committee on Diversity in the Navy's Scientific Work Force.

Can you contrast the struggles you faced as a young woman in science with the challenges facing you now?

I'm not sure where to take this. Much has changed in 40 years. The climate for women has changed; I have changed; and, perhaps most significantly, my position has changed. I certainly wouldn't have my present job without a lot of support from men. By definition, they made all the decisions. The government is perhaps different from a University in that once you have a position such as Laboratory Director, you have the same salary, the same office space, the same opportunities to compete for resources as your peers. Whether or not we all have collegial relationship probably depends more on our individual styles and personalities than directly on our sex—although, of course, sex is a contributing factor to our styles and personalities.

The CAWMSET Report and the Renewed Focus on Diversity in the Technical Workplace

Kimberly S. Budil, Lawrence Livermore National Laboratory

In October 1998 Congress passed HR3007, legislation developed and sponsored by Congresswoman Constance A. Morella (R-MD), creating the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology (CAWMSET). The CAWMSET was charged with recommending strategies to improve the recruitment, retention, and representation of women, underrepresented minorities (namely, African Americans, Hispanic Americans, and American Indians), and persons with disabilities in science, engineering, and technology (SET) education and employment. [1] Yet another high-level commission might not seem to be a pivotal event in efforts to increase the diversity of the technicalworkforce. The problem has been studied time and again and, particularly in physics, the representation of women and minorities has remained stubbornly small. However, the combination of a changing environment where scientists and engineers are in high demand and an economy increasingly driven by technology gave this effort an immediacy and relevance that were hard to ignore.

The formation of the CAWMSET acted as a catalyst for a group of technical women at the Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories (SNL) California site to focus our efforts to improve our workplaces. Congresswoman Ellen Tauscher first brought this group of women together and gave us the notion that the national policy arena was within our sphere of influence. She challenged us to reach the members of the CAWMSET, to give them a view of in-career technical women, women at the National Laboratories, and women working in the heart of this vital economic engine, the Silicon Valley. With her support we launched an effort that has reached far beyond the boundaries of our home laboratories and shown us first hand what it means to influence without authority. I hope that our efforts can be used as an example for improving the climate in other technical organizations.

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Initially our group focused on providing input to the CAWMSET and we chose to host a one day forum, Strategies Within—*Forging New Realities for Women in Science, Engineering, and Technology,* held November 10, 1999 in San Ramon, California. This event brought together 100 women scientists and engineers from national laboratories, industry, and universities, principally from the San Francisco Bay Area and was co-sponsored by Lawrence Livermore National Laboratory (LLNL), Sandia National Laboratories/California (SNL) and the Society of Women Engineers (SWE). It focused specifically on in-career technical women. While many of us actively work to increase the number of women in the educational pipeline we felt that it was important to ensure that those leaving the pipeline find a supportive and inclusive workplace to enter. Three members of the CAWMSET participated in this Forum, which utilized a combination of discussion groups with facilitators and panel presentations to draw upon individual stories of success. The goal was to find the common threads in these stories of achievement, the conditions that had supported and enabled success. From this we would distill a series of national policy recommendations for the recruitment, retention and advancement of women in the technical workforce. A mere twenty days after the Forum, on December 1, 1999, we presented the Commission with a draft of our final report *Attracting and Retaining Technical Women—What Works?* The four recommendations contained in this document represented the main strategies we identified for creating an inclusive, supportive, and diverse workplace.

We recommended the creation of a centralized web-based communication and information hub to facilitate efforts to diversify candidate pools. This database would include recruitment kits highlighting best practices collected from various institutions, a registry of science and engineering graduations with accompanying statistics, and a national repository of resumes and job openings. In particular, we envisioned that this hub would include all science and engineering subfields to help break down barriers between disciplines in our increasingly multidisciplinary scientific enterprise. Next, we proposed the development of a national campaign to fundamentally alter the image of scientists and engineers and their work. The participants in the Forum spent much of the day discussing how difficult it was to counter negative stereotypes that keep many young people from seeing the myriad opportunities that science and engineering present. Not to mention that many people still are not in on the scientist's big secret—our work is a lot of fun!

Awards lie at the heart of our final two recommendations. For flexible workplace initiatives we proposed a National Balancing Act Award to recognize employers that do an exceptional job of helping employees find the elusive work/life balance. This would serve as an incentive and also highlight best practices for other institutions to emulate. Some key components of this "model" work environment we envisioned were flexible work time options, telecommuting, job sharing, paid leave for maternity, paternity, elder care, adoption, and high-quality child care. To help advance women in the technical workplace we proposed the creation of a Presidential "Shattering the Glass Ceiling" Award to recognize those employers who have done an exemplary job of advancing capable women into senior positions. This would be supplemented by programs to help provide leadership and management training for women to create a well-qualified pool of candidates upon which to draw.

The publication of the final CAWMSET report, *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology,* [2] in August 2000 was a central event for our effort and clearly showed that we had strongly influenced the Commission's thinking regarding in-career women. The report focused largely on increasing the number of women and minorities in the educational pipeline, advocating for implementation of high-quality science and mathematics education standards, focused intervention efforts to encourage the participation of women and minorities in science and mathematics at the high school and community college level and to aid their transition to the university environment, and to increase the federal and state financial support for higher education in the form of grants rather than loans. The fourth recommendation proposes holding public and private S&T employers accountable for the career development and advancement of women and minorities via monitoring of statistics, incentive awards and flexible workplace policies, closely mirroring the recommendations contained in our report. Next they discuss positively reshaping the image of science and scientists again reflecting one of the topics discussed at the Forum. Our report received an acknowledgment in the opening section of the CAWMSET report, providing high-profile recognition of our efforts.

Their final recommendation was that a new body be created by Congress to help realize their recommendations and work to implement them. It was recently announced (April 2001) that the Council on Competitiveness has received a $2.3 million National Science Foundation grant to create BEST (Building Engineering and Science Talent), a new nonprofit organization to act as the agent for this implementation. BEST will spearhead a three-year, $10 million (1/3 federal and 2/3 private sector funds) initiative to broaden the demographic base of the technical workforce by increasing public awareness and private financial support, and launching new policy initiatives. [3] This group plans to start a web site to provide a shared resource, drawing together information on best practices in regions where there is a high demand for technically skilled workers. The organization will be guided by a prestigious National Leadership Council comprised of public and private sector leaders. Congresswomen Connie Morella (R-MD) and Eddie Bernice Johnson (D-TX) have agreed to serve as co-chairs.

The women at LLNL and SNL/CA who were involved in this process came away energized and empowered, certain that we had an important role to play in our home institutions. The idea had taken root that while we did not necessarily have power in the traditional sense (official roles or titles) we could exercise a great deal of informal influence. By presenting our ideas to the right people—those with the formal power to make decisions—as well as energetically pursuing action at the grass roots level we believed we could begin to guide the discussion of reshaping our workplace. Working groups were formed at both Sandia National Laboratory/California and Lawrence Livermore National Laboratory to provide recommendations for change tailored to these specific institutions. In both cases, we sought to work with management in a positive, proactive way to make

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these organizations stronger and more inclusive and to improve their ability to attract and retain women scientists and engineers.

At LLNL, we formed a working group to craft a set of recommendations tailored to the environment at our laboratory, which allowed us to take the general framework put into place by the CAWMSET activities and apply it to our everyday circumstance. We tried to identify areas that we could directly influence as well as those that would require efforts by senior management. Again, timing played an important role in this process. LLNL was in the process of reorganizing, and this process would lead to a number of positions that would need to be filled. Here was a unique opportunity to participate in making our workplace more inclusive starting at the very top of the organization. We made it a top priority to help in this process, one that could fundamentally alter the makeup of the senior management team.

Additionally, the National Laboratories had endured several difficult years characterized by an ever-increasing safety and security bureaucracy to counter the belief that the Labs were " soft" in these areas and an intense barrage of negative press coverage. This had caused serious morale problems in the workforce, and Laboratory management was investigating ways to improve the climate. We knew if we could propose concrete actions that would positively impact the workforce there was a very good chance our ideas would be implemented. While our focus was on women in the technical workforce, it was very clear that the changes we were proposing would benefit everyone at LLNL regardless of their gender or ethnicity. Energized by this sense of urgency and opportunity, we presented LLNL senior management with a set of recommendations in July 2000.

These recommendations were crafted to apply to the specific needs of LLNL and were grouped into four major categories: (1) accountability and the organization, (2) recruitment, (3) retention and advancement, and (4) work-life issues. We researched the current state of the organization and gathered as much historical information as possible about what had been tried in the past to avoid reinventing the wheel and to ensure our effort was viewed as credible—we did our homework. We tried to provide concrete suggestions for action and a mix of short and longer-term goals within each category. Providing for some readily achievable early successes would help to build trust in our dealings with management and get this effort off on the right foot. Finally we vetted our ideas with friends and colleagues in management roles at the Laboratory to make sure we had answered all the important questions.

In the category of accountability and the organization, we focused on the lack of a clear line of authority in senior management for "people" issues. Despite the claim that people were the enduring currency of the organization, there was no single senior manager responsible for the people; rather, the responsibility was shared across a number of organizations. In an environment where "fire-fighting" is common, people issues are often the ones that get lost, so a single point-of-contact is critical for keeping change efforts focussed. Additionally, we proposed that managers be evaluated more critically for their people management skills since this too is often undervalued in the standard environment of too much work for too few people given too little money.

Our discussion of recruitment focused heavily on the open senior management positions although our ideas applied equally well to hiring at all levels within the Laboratory. We developed a "toolkit" of best practices and resources to help search committees develop diverse candidate pools. This included an emphasis on recognizing the biases inherent in any decision making process. It is not just gender, race or ethnicity that may act as a filter effectively denying people opportunities but rather includes things like what school your degree is from, your style of communication, the way you dress and any number of other things. The concept of a "standard model" for any particular assignment is a tremendous barrier to diversifying an organization. This concept also flows through our retention and advancement sections. There is not an active conspiracy seeking to block women and minorities from career advancement, but many subtle, often unintentional barriers still effectively serve to do this.

We made a strong point of the importance of thinking strategically about the workforce. This means both developing relationships with scientists and engineers outside the Laboratory to introduce them to our environment and effectively "warm" the climate for external recruiting as well as developing the internal candidate pools for advancement. It is clear that there is no "accidental" advancement but that much of the succession planning that does get done is incomplete and non-inclusive. The Laboratory needs to place a high value on developing its primary resource, the people, and giving the opportunities and training they need to lead LLNL into the future.

Another strong theme that was present throughout our recommendations was communication. There needs to be more transparency in decision making and much better communication at all levels so that employees do not have to wonder at what is driving the decision-making process. Trust is a two-way proposition. Senior management needs to empower working scientists and engineers to pursue the technical work and scientists need to trust that they are valued and that their questions and concerns are taken seriously. As an example of this increased transparency at LLNL, when the search committees for the open Associate Director positions were created, the names of all members were published in our Laboratory newspaper, Newsline, with an explicit invitation for all employees to contact the committees and suggest candidate names. This was a wonderful way to engage the entire Laboratory population in this very important search process.

Finally we discussed the importance of the Laboratory continually adapting to the changing needs of its workforce. In this tight job market, the national laboratories can gain a competitive edge in recruitment and retention by being flexible and proactive in work-life issues. This includes being supportive of employees raising children, trying to balance the demands of a two-career couple, caring for aging parents, battling illness, or any number of other issues. While the Department of Energy does not offer stock options it can offer its employees a high quality of life as compensation offset.

We took this set of recommendations on the road and spent many hours meeting one-on-one with managers at LLNL. This educational process helped us to better understand the thinking of our management and to become a resource for them. In many cases our ideas included specific actions we were willing to undertake to help the process along. The combination of specific proposals for change, both long and short term, and a "here's where we can help" approach helped us have a significant impact in a fairly short time. While this is only a brief sketch of the recommendations we gave to our senior management team, it illustrates the spirit with which we undertook this effort. All good organizations strive to be better, and we are proud to be a part of this process.

At LLNL, the senior management team consists of the Laboratory Director, two Deputy Directors, the Laboratory Executive Officer and twelve Associate Directors. When the search began for six new Associate Directors (ADs) the existing group of ADs could definitely be defined by a "standard model", with no racial or gender diversity in the group. However, at the end of May 2001 six new Associate Directors were announced, and this outstanding group included two women and an Asian-American male, bringing the Laboratories stated commitment to diversity into reality. While there is still work to be done, our group is once again energized by this newly diverse face LLNL is showing the world.

1. http://www.nsf.gov/od/cawmset/start.htm
2. *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology,* the report of the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, available at http://www.nsf.gov/od cawmset start.htm
3. https://www.fastlane.nsf.gov/servlet showaward?award=0110028

Internship Programs Offer Summer Research Opportunities for Undergraduate Women

Barbara A. Jones, IBM Almaden Research Center, San Jose, CA

There has been an increasing realization in industrial research labs that increasing the pool of excellent women applicants has multiple benefits.

Introduction

As far back in time as the physical sciences have had recorded publications and professional activities, women have been a minority, and this situation continues today. It affects hiring and work practices, and also often affects morale of women, not only in graduate school but in the professional years beyond. However, there has been an increasing realization in industrial research labs that increasing the pool of excellent women applicants has multiple benefits. Two successful industrial programs aim in particular at the undergraduate years as a critical time to expose young women to research and mentors, the APS/IBM Research Internship for Undergraduate Women, and the Summer Research Program for Minorities and Women (SRP) of Lucent/ Bell Laboratories.

Bell Lab's Summer Research Program

The Summer Research Program was started at Bell Laboratories in 1974, prior to the voluntary breakup of AT&T. A group of influential Bell scientists shared a vision of putting in place a program which would have a lasting effect on changing the demographics of minorities and women in the technical fields. Bell Labs upper management took to their plan, and the program was born. The goal of the program has remained the same to this day: to identify and nurture research ability in women and minorities and to increase their representation in science and engineering. From the SRP web site, "The program, primarily directed toward undergraduate students who have completed their second or third year of college, is designed to attract students into scientific careers, by placing participants in working contact with experienced scientists and engineers." A range of relevant disciplines is emphasized, from computer, communications, and information science, to electrical and radio engineering, to data networking, to the physical sciences. Summer technical employment at one of Bell Labs' research and development laboratories is provided, along with a mentor who is the Bell Labs scientist with whom the student works.

The program quickly became large scale. Between 1974 and 1987, 977 students, men and women, participated in the program. Focusing on the data for the women, in 1974, the first summer of the program, there were 36 minority and non-minority females; this number increased steadily until in 1987 there were 68 female interns coming each summer in the program. In the 1990's the numbers dropped off as Lucent separated from AT&T and now with Agere separating from Lucent. There are around 20-30 students total coming this summer, of which, based on past statistics, roughly 16 will be women. Housing is provided to all students at a nearby university, along with daily transportation to and from the work site.

APS/IBM Research Internship for Undergraduate Women

Concerned about the low numbers of women and underrepresented minorities in science and engineering at all degree levels, a group formed in 1998 at the IBM Almaden Research Center in San Jose, California to discuss ways to address this issue. The diversity group included both management and research staff members, from the sciences as well as from Human Resources. There was a recognition that one of the key junctures of a

IBM Almaden Research Center established a number of internship programs, each targeted at a particular underrepresented subgroup.

potential scientist's career is the undergraduate experience. For women and underrepresented minorities, if their experience in their scientific major is negative, off-putting, and discouraging (even for those students with good grades), many decide to leave the field and do not continue into professional careers in the physical sciences. Assisting the very best students at this critical time may make a big difference in their career paths. In addition, often the best track in the science and engineering fields is to continue on to graduate school for a M.S. or Ph.D. It was felt that a significant impact we could have would be to expose undergraduates to science and engineering research through an internship. They would first and foremost get encouragement, confidence building, experience, and mentoring in their technical careers. Moreover, by working with us, students would be in an environment where they could realize that the majority of our technical people have advanced degrees. They would learn what having a Ph.D. allows them to do, and be able to see the technical activities at all degree levels. The overall goal would be to encourage women and underrepresented minority students to pursue graduate studies in science and engineering. The Bell Labs SRP program was held as a model, with its wide and continuing impact. The summers after students' sophomore and junior years would be optimal, since by that point they would have completed a core of courses, and not yet be beyond the point of being able to apply to graduate school.

With the commitment and support of local research management, in 1998 the IBM Almaden Research Center established a number of internship programs, each targeted at a particular underrepresented subgroup. The highlights of the program for women follow (for other groups, the provisions are the same, with the substitution of the appropriate group for "female" in point 1 below):

1) Applicant must be a female with sophomore or junior standing at a US college or university at the time of application.
2) Students must be pursuing a degree with a major in either chemistry, physics, materials science or engineering, computer science or engineering, or chemical, electrical, or mechanical engineering.
3) Applicant must have a minimum 3.0 GPA.
4) Awardees are offered a salaried summer research internship at one of IBM's U.S. Research Centers (San Jose, CA; Yorktown Heights, NY; Austin, TX) 5) Those participating in the internship receive a grant of $2500.
6) A mentor from the participating IBM laboratory is assigned to each student.
7) Paid travel to IBM's laboratory during the academic year for a 1-2 day visit with their mentor.
8) A minimum of 1 new award per year is made, depending upon candidates meeting the selection criteria. Internship awards for sophomores are also eligible for renewal the following year.

The stated goal would be to encourage students to pursue graduate studies in science and engineering. To emphasize the commitment to the target group of potential recipients, and to focus the advertising and applicant pool, IBM in each case asked an appropriate professional organization for members of the target group to co–sponsor the award. Cosponsoring groups include the National Society of Black Engineers (NSBE), as well as a pilot program with WIC (Women in Computer Science, at UC Berkeley and UC San Diego).

To have a plan specifically for women, and specifically focused on physical science, it was decided to contact the American Physical Society (APS) and its Committee on the Status of Women in Physics (CSWP), regarding cosponsorship. The author, as chair of the program, contacted the APS late in 1998, and there followed a two-year period of negotiations and information exchange. During this time, CSWP participated informally in the program by publicizing the internship award, while its APS staff liaison acted as a collection point for the applications. With the help of CSWP, the petition process culminated in 2000 with the APS Executive Council voting to officially co-sponsor the award, henceforth known as the APS/IBM Research Internship for Undergraduate Women.

It should be noted, with regard to the steps and time needed to secure cosponsorship, that the APS, serving a nationwide and in fact worldwide community of physicists at all professional levels, is a rather different organization than, for example, NSBE, which has an emphasis specifically on students. NSBE has a staff and resources to handle the publicity and incoming applications, whereas at APS such duties would fall to the CSWP, a committee of 9 volunteers with a limited budget. APS does not adopt scholarships or awards lightly. Positioned as an internship and not as an award, and with full administrative support provided by IBM, the program in this way won cosponsorship providing benefits to both APS and to IBM.

Besides lending its name, APS cosponsorship involves the following:

1) At least one member of the selection committee for the award will be named by APS with the recommen dation of CSWP;
2) APS, through CSWP and other appropriate units such as the Forum for Industrial and Applied Physics (FIAP) and contacts with Physics Department Chairs will publicize the award;
3) APS will serve as the collection site for the applica tions and forward them to IBM for evaluation and selection.

IBM selected two awardees the first year, 1999, and four in 2000. For 2001, due to the success of the program at the Almaden site and the quality of the applicants, the program was expanded division-wide, extending across all three IBM research sites in the U.S. (San Jose, CA; Yorktown Heights, NY; and Austin, TX). Eight awards were made in 2001.

Advertising

Advertising for both programs begins several months in advance of the due date, around mid-January for the APS/IBM program, and earlier for the SRP. Both programs post the information on their external summer employment web sites, and also contact the universities and colleges directly. The APS/IBM program does an emailing to physics department heads, but the Bell Labs program, especially in years past, also has special SRP recruiters visit the colleges directly. At its peak, the SRP program received 500-600 applicants per year. The SRP program markets through recruiting conferences, posters and mass mailings, and places banner ads on the web sites of individual minority student organizations such as the Society of Hispanic Professional Engineers. Even with corporate split-offs and a reduced reliance on recruiters over the years, the Bell Labs program still receives 100-150 applications yearly, women and underrepresented minorities combined.

The APS/IBM program focuses advertising on reaching women students and their professors through the APS. The program is extensively advertised on the APS's CSWP web site and on the WIPHYS (Women in Physics) email bulletin board. Several APS divisions send a notice to their members, which number in the thousands for each (over 5000 members for FIAP). The yield from this advertising is quite good, around 110 applicants yearly, spread across all applicable fields. The distribution among subjects is similar each year, and is roughly 50% physics and applied physics, 20% materials science/engineering, 15-20% computer science, and 10-15% chemistry and related fields. It is interesting and beneficial that the advertising, which is primarily and almost solely through physics channels, should yield such a range of applications from different fields. It speaks of both the efficacy of the advertising, and the interdisciplinary nature of much of physics today. The applicants are uniformly excellent across subject areas, with each field appearing roughly proportionate to its applicant numbers in the final short lists.

Intern selection

The stated criteria used for intern selection are essentially the same for both the Bell Labs SRP and the APS/IBM Internship. As laid forth in the SRP web site, "Selection of candidates is based on academic achievement, personal motivation, and compatibility of student interests with current [Laboratory] activities." "Candidates must have demonstrated interest and motivation in scientific fields. They will be asked to supply information on their scholastic achievements, an official transcript, as well as letters of recommendation from faculty members familiar with their work." A strong emphasis is placed on the essay required by both programs, as a key indicator of interest in, and indeed passion for, their chosen subject and for research. The selection committee tries to interpret what the student is saying, in light of other factors in the application packet. The Bell Labs SRP program particularly emphasizes trying to look for individuals who can most benefit. "The challenge is to look beyond what is on paper... The Chair needs to set the tone — this is for people who won't get this opportunity otherwise." Of course, excellent students and top schools are also well represented. For the SRP program, candidates and/or faculty members may be interviewed individually. IBM calls faculty members to confirm details on occasion, but does not contact the student in advance of program decisions. The SRP requires applicants to be U.S. citizens or permanent residents of the U.S. The APS/IBM program requires only that the student to be attending a U.S. college or university, and the absence of a citizenship restriction results in many excellent foreign-born applicants for the APS/IBM program.

The selection process for the APS/IBM program is similar to the Bell Labs program. Since the applications which come in are in a wide range of technical fields and are quite numerous (over 100, as noted above), the selection committee is divided by expertise into four teams: physics, chemistry and chemical engineering, materials science and all other engineering, and computer science. Each team reads over the applications in their area, and comes up with an ordered list of roughly the top 30%. The whole committee then reads all of the top (30 or so) choices, and each comes up with an ordered list with all subjects combined. Using these individual rank-order lists, the committee meets to decide the final ordered list. Upper management and funding availability decree the number of interns per year, and calls are made starting from the top of the list and going down until the maximum number of interns have accepted the offer. (The excellence of the candidates can often be used as an argument for one or two more.)

As mentioned above, the number of interns allowed for the APS/IBM program has roughly doubled each year. It is not expected that this will continue, as the sister programs at IBM such as women in computer science are also coming into their own. It is likely the numbers in the APS/IBM program will remain roughly as they currently are, with fluctuations over the years based on business conditions. Sophomore students who are in their first year of participation are eligible for renewal the next year, based on maintaining their academic standards. Any renewed interns subtract from the number of new ones which can be awarded in a year, and need to be counted in when the number of new interns in a year is determined.

All in all, the applicant pool has been excellent each year, with essentially not a single applicant who should not have applied. This makes the choice each year very difficult. The number of notable candidates from lesser-known, smaller, undergraduate institutions highlights the need for the advertising to continue to be broad and nationwide. We value the small colleges for the diversity of the candidates they produce.

Intern placement and mentors

An important part of the summer internship experience for both industrial host and intern is the choice of project and mentor. For the Bell Labs SRP, the laboratory researcher with whom the student works during the summer is also the mentor, and so this person plays a critical role. According to the SRP official web site, "This scientist, experienced in a discipline closely related to the student's chosen field of study, is a professional who can provide guidance, nurturing, inspiration, and advocacy during the student's summer at Bell Labs. "A strong emphasis is placed on mentor training and preparation, and on the necessity of having a well defined project laid out ahead of time, which is both challenging for the student, but within their capabilities for the summer. The project should also be meaningful and with clear objectives, requiring the mentor to devote time to this before the summer starts. A handbook is provided to Bell Labs

The applicant pool has been excellent each year, with essentially not a single applicant who should not have applied. This makes the choice each year very difficult.

If such students are passionate about research in their science, the internship may have tremendous impact in opening their eyes, and enabling them to realize what they can do

mentors, with valuable and insightful information on being the mentor for an undergraduate. The mentors are volunteers, and students are assigned to them, rather than having free choice of internship projects. There are usually more mentor volunteers than students.

Student comments gathered over the summers indicate that students consider their mentor should fill a number of important roles, to be critical to their success as an intern, and to act in general in a very different way than as a "boss." Students saw themselves as "working with [their mentors] and learning from them rather than working for them."

The APS/IBM program is similar to the SRP in that students are assigned a research project, rather than being allowed to choose one. Projects for the students are chosen very carefully, taking into account the student's interests, aptitudes, and training. The project management is expected to contribute at least half of the summer funding, to show a commitment to the value of the intern's project. (The other half of the APS/IBM project funding, as well as the $2500 grant, comes from upper management and HR recruiting.) In this there is a critical difference from the Bell Labs program. At Bell Labs, the full budget for SRP is at the VP level of Research; no money from departmental budgets is called for. This leaves mentors with much more freedom to volunteer, and creates a much bigger pool. In the APS/IBM program, the mentor chosen is often someone other than the laboratory researcher with whom the intern works, for instance, scientist members of the admissions committee. This has the advantage of having someone impartial to mediate with the project scientist in case something goes wrong, to make sure that a suitable project has been assigned, and that progress is being made. The separate mentor situation can have the disadvantage, however, that it can tend to create more of a worker/employer relationship with the intern. Ideally the student sees the separate mentor as just an opportunity for a second mentor at IBM, in addition to their primary one in the laboratory. With the program only in its third year, it is likely that the mentor selection and relationship will continue to be optimized over time.

Both programs offer a seminar series just for the students which runs throughout the summer. At the end of the summer, each student prepares and gives a 15 minute presentation on their project. Both programs also survey the students before they leave about their experiences in the program.

Conclusions: Challenges, successes, key elements, and comparisons

For Bell Labs, the challenge is to maintainin their historical program (now 27 years old) at a significant level in the face of corporate and industry change. With several internship programs nationwide for students to choose, can the high level of both students and mentors continue? For both programs, the corporate and technology shift of emphasis over the years from physical science to computer science creates new challenges, in trying to attract computer science students who can find readily available high paying summer employment in the IT industry.

For the APS/IBM program, the small number of interns compared to the number of applications means, on the one hand, the good news that a very high quality of interns can be chosen. The modest size will also likely help maintain longevity. On the other hand, however, a modest number means that the program needs to seek ways to maximize impact. One challenge for the program is that it does not have any trouble attracting the cream of the crop, but what about the "middle level"? In a sense, the absolutely very best students will likely land on their feet and go to graduate school even without such programs. Research staff are used to having outstanding interns; can they have the patience for less fully trained and experienced students, who may be the ones who need, and can benefit from, the program the most? To what degree can we take on more risk in terms of elevating students to reach their potential? If such students are passionate about research in their science, the internship may have tremendous impact in opening their eyes, and enabling them to realize what they can do (this is also a theme of the SRP program). A second, and related, challenge is finding and preparing the very best mentors. It takes a special kind of person who can mentor undergraduates. We need to establish a pool of mentors, and make sure all mentors are advised in preparing in advance for the summer.

In a different type of challenge, the connection with a prestigious professional organization such as the American Physical Society, and advertising through it, also brings the program into greater public visibility, beyond undergraduate academic circles. Yearly there are outside remarks, primarily directed at the program chair, but also at times at CSWP, regarding the fairness of having programs for women, "Where are the programs for men?" (It should be noted that both IBM and Bell Labs, in addition to the programs described here, offer multiple summer employment opportunities for undergraduate and graduate students, without regard to gender or ethnicity.) There are occasional hostile requests from individuals to remove them from "mailing lists" (in fact only a single notice of the program is sent to members of various units in APS). In time, with the solid establishment of the program, these reactions will likely decrease. A further, welcomed, challenge for those administering the program at IBM is adapting the program to the various cultures at each site, now that it is division- (and nation-) wide. A final challenge is to maintain continuity with the students once they leave the program. Important questions are how to keep track of them, once they leave their undergraduate institution and move; and should the follow–on be a process, or just at the more personal level of the mentor maintaining contact.

For each program there are certain key elements which are useful to know for anyone else interested in starting such a program. For the APS/IBM internship, founded recently, the key ingredients were three-fold. First , there was a pool of volunteers who were enthusiastic about getting undergraduates excited about research and graduate school, who formulated the program and got it off the ground; and then a group who was willing to serve on the selection committee, with its considerable time demands; and a volunteer willing to serve as chair and to champion it, to shepherd the co-sponsorship with APS through, and then to coordinate the relationship after that. The second key ingredient, no less important, is the IBM Almaden Lab director and his predecessor, who gave funding and full support for the program, and the other IBM Research Executives who provided support and money to expand the program past its second year. The final key ingredient is visibility and luster, to attract the best candidates. For the APS/IBM program it is the weight of these two names and the emphasis on research which draws the students.

For the Bell Labs SRP program, a key to the start was a group of visionaries who positioned the program successfully at high levels of management, and a management which immediately started it up at a high level. Over the years the size of the program creates a key visibility, combined with the high reputation and mystique of the Bell Labs name. At this point, the original students are now mid-career professionals, many of them established professors with students of their own to send. Another key ingredient is the training, preparedness, quality, and dedication of the Bell Labs mentors, who provide a strongly memorable experience for the student. A third key is “an environment which strives to achieve the highest levels of excellence in all we do.” And finally, there is the genuine support and awareness of the Bell Labs management, which has managed to maintain the program at a consistently high level, of participants and mentors, for nearly three decades.

By any measure the Bell Labs SRP program is wildly successful. The program, together with a companion program for graduate students (GRPW) is legendary among women for giving them a critical head start in physics. (This may well also be true in other fields covered.) A significant number of women physicists owe their success in physics to their experiences in the program. Students often maintain their relationships to the Bell Labs mentors over decades. Past program participants are now Bell Labs employees. Nonetheless, this material is mainly nonempirical. Historically, there has not been any systematic study or tracking of women SRP interns, and it is clear that such a study could be very valuable and interesting.

The APS/IBM program is recent enough and small enough that every student can be accounted for. The original two awardees are now in graduate school, one in physics and one in chemistry. Three of the four from summer 2000 are now seniors in college, planning their future, and one who was a sophomore last year was renewed and is returning as a junior this summer.

The intent of both programs is to increase the number of women who are professionals in science and technology fields, primarily through increasing graduate school enrollment. These two programs share several characteristics, notably in the selection criteria, aspects of the advertising, and goals of intern placement. There are, however, some sharp contrasts. The Bell Labs program is large scale, long term, and legendary among many women. Its funding comes at the VP level, and mentors are the scientists with whom the interns work. There is considerable mentor development and training. Advertising is done via the company HR department. The APS/IBM program is only three years old, relatively modest in scale, but growing, especially as seen as part of a family of programs which includes programs for underrepresented minorities and also women in computer science. The program has active co-sponsorship with a visible outside organization, the American Physical Society, with whom it shares advertising. Mentors are often assigned separately to internship placement, and departments contribute a share of the summer salary to ensure relevance of the project. One common theme which emerges, however, and which is critical to any development program for women or under-represented minorities at the undergraduate level, is the critical role of the mentor for the student, and for the company. Mentor education and preparation are key as is strong management support, a pool of dedicated, committed volunteers to launch and maintain the program. The comparison points up the need for a systematic study of the 27 years of Bell Labs SRP female interns, and for the APS/IBM program to start and maintain its tracking early. Both programs are successes in their own way, and invite emulation.

A significant number of women physicists owe their success in physics to their experiences in the program.

Acknowledgments

This article is adapted from a paper presented at the Careers of Women in Science: Issues of Power & Control Conference, May 12-13, 2001 at the University of California at Berkeley. The author wishes to acknowledge the help of Lucent Technologies Bell Laboratories in providing data on the SRP program for this paper, in particular George Valdez and Alice White (CSWP Chair), who were unfailingly helpful and open in answering questions and supplying information about the program. All quotations regarding the program, if not attributed otherwise, are quotes from George Valdez. The author also wants to thank IBM’s Mike Sampogna, for his helpful comments on the manuscript, and for his high level of support for the APS/IBM program. Finally, the author thanks Sue Otwell of the APS’s CSWP, for bringing this conference to my attention, and overall for her invaluable support and assistance over the years with the IBM/APS internship program. And finally, appreciation to the CSWP as a whole, for their enthusiastic co–sponsorship of the program.

Further information on Bell Labs SRP Program may be found at at. Information on the APS/IBM Research Internship for Undergraduate Women can be found at http://www.research.att.com/academic/urp.html. Information on the APS/IBM Research Internship for Undergraduate Women can be found at http://www.aps.org/educ/cswp/index.html

BOOK REVIEW

The Woman's Guide to Navigating the Ph.D. in Engineering & Science

by Barbara B. Lazarus, Lisa M. Ritter, and Susan A. Ambrose (IEEE Press, New York, 2001) 134 pgs., paperback
Reviewed by Laurie E. McNeil, Dept. of Physics and Astronomy, University of North Carolina at Chapel Hill

This slim volume is a "how-to" guide for women pursuing a doctorate in the sciences or engineering. The authors, although not scientists themselves, have administrative experience in university programs for women in science and engineering and have published other books on the subject (notably Journeys of Women in Science and Engineering: No Universal Constants, a book of profiles of female scientists). Although it goes unmentioned in her biography, one of them has an additional qualification as the daughter of a physics professor who has always been very supportive of female graduate students (including this reviewer). In the preface the authors present statistics about women's participation in science and engineering over time and across fields, and a brief history of doctoral study by women in the U.S. The first chapter is a short description of what graduate study is all about, and how its demands differ from those of undergraduate study. The following three chapters are the heart of the book, and they present friendly advice for coping with graduate school and the early stages of the professional career. Because women are less likely to be socialized into the department culture than men are, especially early in their graduate school careers, they can miss out on some of the basic information necessary to their success. This book lets them know what they may be missing, and tells them how to get it. It also provides the kind of "pep talk" that all of us need from time to time. Female science and engineering students, because they tend to be isolated due to their small numbers, may not have friends who can play that role. This book is meant to fill the gap.

Chapter 2 outlines various aspects of graduate school (choosing an advisor, getting funding for graduate study, qualifying exams, and the dissertation), and highlights both the challenges that are common to all students and those that are particular to women. These are supplemented with sidebars quoting female students and graduates in various fields. Chapter 3 focuses more on personal reactions to those challenges, with sections on Self-Esteem, Feeling Alone, Learning by Critique, and Balancing Competing Needs. The tone of the text is upbeat, repeatedly emphasizing that occasional feelings of frustration and depression are normal, and giving specific ways to cope with them. "Horror stories" are scrupulously avoided—even the stories of conflict with advisors have happy endings. Some of the advice is repetitive, but this is the nature of "self-help" books. Stressed-out graduate students may need to be told more than once that they should take a little time for themselves! In the final chapter the authors give advice about job searches, including interviewing and negotiating offers, as well as a short section on coping with the demands of a Ph.D.-level career. A bibliography of relevant literature and a list of Web resources (over 85% of the addresses are still valid, which is good for a printed book) complete the volume.

Because the book is meant to be a generic guide for all sciences and engineering, it is necessarily general. However, it identifies where to look for more specific information and guidance relevant to a particular field or program, and emphasizes the importance of acquiring multiple mentors. Some issues are ignored or dealt with only marginally in the book, though they are of concern to at least some women in all technical (and other) fields. These include combining child-rearing with graduate study (and coping with the attitudes of faculty about it), sexual harassment, other forms of overt or covert discrimination, and difficulties associated with spousal employment. In a manual meant to encourage young women to pursue and persist in doctoral study in science and engineering, this may be an appropriate choice. However, a student turning to it for solutions to the really hard problems that some women encounter in graduate school and shortly thereafter will be disappointed. The majority of students, who experience no "horror stories" of their own during their studies, will find it a useful source of general advice and encouragement. None of what is offered here is deep (some of it has the flavor of "everything I need to know about life I learned in kindergarten"), but all of it is what female science and engineering students need to hear from time to time. The authors certainly achieve their goal of "help[ing] women navigate a still imperfect system," even if some of the grosser imperfections are not emphasized. I have purchased a copy to put in my lab for my students to use, and I recommend that others who mentor female students do the same.

Have you moved? Changed jobs? Changed fields? Take the time now to update your name/address/qualifications on the Roster of Women in Physics (this database also serves as the Gazette mailing list).
See pages 16-17.

Trying to reach more women and minority candidates for job openings in your department or institution? Consider a search of the APS Roster of Women and Minorities in Physics. (see www.aps.org/educ/roster.html)

The Committee on the Status of Women in Physics and the Committee on Minorities cosponsored a reception at theAPS Annual Meeting in April in Washington, DC. Our thanks to Tom Clark who took the photos!

Simonetta Liuti and daughter

(left to right) Bunny Clark, Sandra Collier, and Betsy Beise

Lawrence Norris and Meg Urry

Women Physicists and Chemists Make Slow Progress in Academe

Valerie J. Kuck, Bell Laboratories-Lucent Technologies

Since the mid 1960s, there has been a steady rise in the number of women seeking and achieving doctorates in the physical sciences. In spite of their success in reaching this level of accomplishment, women are still very underrepresented in the ranks of faculty members in the physical sciences at leading institutions. Even in the 1990s, a decade when many people have argued that gender discrimination has been successfully attacked, this situation continued. Today the representation of tenured or tenure-track women faculty at Ph.D. granting institutions in the physical sciences remains woefully below the doctorates awarded to women.

The progress that women physicists have made in attaining tenured positions has been well documented by Ivie, Stowe and Czujko of the American Institute of Physics (http://www.aip.org/statistics/trends/highlite women/women.htm). Similar studies on chemists have been conducted through the years by the staff of the American Chemical Society, with Jordan (Women Chemists 2000 published by the ACS) and Long (Chemical and Engineering News Sept. 25, 2000) addressing this matter recently.

Since comparisons of hiring practices in physics and chemistry based on the composition of the entire faculty would be biased towards the past, this study focuses on recent hiring at the assistant professor level. For the physics departments, Schabel of Bell Laboratories, Lucent Technologies directly contacted each school by phone and/or ascertained the information on the Internet. Long's faculty analysis by gender was used for chemistry.

Preliminary work using the ACS 1999 Directory of Graduate Research for the top twenty-five Ph.D. granting institutions in chemistry showed that a significant number of the faculty members had received their doctorates from a small number of schools, about half having received their degrees from one in the top ten. (The 1995 National Research Council rankings were used.) At the top ten universities, 70% of the faculty members had obtained their Ph.D. degrees from that elite group of schools. Strikingly, nearly 80% of recent hires, the assistant and associate professors, had doctorate degrees from that same group of schools. Since these ten universities had such a great impact, we concentrated on the hiring practices in the chemistry and physics departments at these same institutions.

As a conservative approximation for the candidate pool used in filling these assistant professor positions in 2000, the gender distribution of the doctorates awarded by the top ten schools between 1988-92 was provided by Joan Burrelli at the National Science Foundation.

In physics, the percentage of women assistant professors hired at top ten schools was higher than their representation in the candidate pool (Figure 1). In chemistry, even though the pool of women was more than 2.5 times larger, the percentage of women hired was smaller than for physics, and substantially smaller than their representation in the candidate pool.

Figure 1. Hiring of Tenure-Track Women by the Top Ten Ranked Universities

	Physics	Chemistry
Number of Female Ph.D.'s 1988-92	138	364
Female Percent of Pool	10.7	21.6
Assistant Professors (women/total number)	11/61	8/49
Percent Female	18.0	16.3

Considering the total number of tenured or tenure-track women faculty members at the top ten institutions, the representation of female physics faculty members was 9.1% of the total in the year 2000, giving an average of 3.5 women per school. In chemistry the average was 2.8 (9.0%). For all Ph.D. granting universities, the number of tenured and tenure-track female faculty members is about the same for physics and chemistry. This is striking because four times as many women have earned Ph.D's in chemistry since 1966.

These findings bring into serious question the validity of the often-voiced statements justifying the low number of women faculty members in the physical sciences at these institutions on the small size of the available pool of women. Currently, for all Ph.D. granting institutions, female faculty members are about 6% in physics and 11% in chemistry. The challenge of having faculties mirror the female composition of the graduate student population (14% for physics and 32% for chemistry), requires that dramatic changes be made in the hiring, retention, and mentoring of women.

The Ph.D. attainment rate for men and women in graduate school was also examined. The yield of women scientists for a school was determined by dividing the number of doctorates earned by women between the years 1994-98 by the number of full-time female graduate students enrolled between 1988-92. The data used in these calculations were also obtained from the National Science Foundation. Corresponding yield values were determined for men and a parity index was then calculated by dividing the yield for women by that for men.

At the top ten ranked universities, the yield for women physicists was somewhat greater than that for chemists. In both disciplines women graduate students were slightly less successful than men in achieving a doctorate (Figure 2). Expanding the study to the top twenty-five universities showed that the female doctorate yields had substantially decreased: however, women in physics continued to compare well with men in receiving a Ph.D. At the 11-25 ranked universities, female graduate students in chemistry fared more poorly than their male counterparts.

Figure 2. Women Lag Behind Men in Receiving Doctorates

	Physics	Chemistry
At Universities Ranked 1-10:		
Female Ph.D. Yield	79.2 %	68.7 %
Male Ph.D. Yield	88.0 %	78.1 %
Parity Index	0.90	0.88
At Universities Ranked 11-25:		
Female Ph.D. Yield	60.9 %	54.9 %
Male Ph.D. Yield	64.1 %	67.8 %
Parity Index	0.95	0.81

An unexpected but significant finding from this study of graduate school performance was the wide variation in female Ph.D. yields. In physics, the doctoral yield at the top 25 universities for women varied from 108% to 13.3% (Appendix 3), while in chemistry the yield ranged from 85.3 to 28.7%. (The greater than 100% yield can attributed to the transfer of small number of women into a physics department after the first year, or to women completing their doctoral studies in less than five years.)

The wide range in yields within a discipline suggests that institutional environments play a significant role in women's decisions to complete a Ph.D. Coupled with the parity index analysis, it appears that women receive varying degrees of support and/or encouragement in obtaining a doctorate. It would be interesting to see whether the APS site visit program (administered by CSWP) makes a difference in the yield of women Ph.D.'s. There is no such program in chemistry.

All of the above data reiterates the point that gender discrimination continues to persist in academic physics and chemistry. It is past the time to eliminate such unfair treatment.

Appendix 3. Doctorate Yields and Parity Index of Top Twenty-five Ranked Schools in Physics

	Male Grad. Stdts 1988-92	Female Grad. Stdts. 1988-92	Female Ph.D. 1994-98	Male Ph.D. 1994-98	Female Yield (%)	Male Yield (%)	Parity Index
Harvard University	101	20	18	105	0.900	1.040	0.866
Princeton University	110	17	7	123	0.412	1.118	0.368
Massachusetts Institute of Technology	234	33	21	214	0.636	0.915	0.696
University of California-Berkeley	174	16	15	145	0.938	0.833	1.125
California Institute of Technology	113	26	21	108	0.808	0.956	0.845
Cornell University	135	32	27	117	0.844	0.867	0.974
University of Chicago	109	18	17	91	0.944	0.835	1.131
University of Illinois at Urbana-Champaign	215	18	18	170	1.000	0.791	1.265
Stanford University*	80	14	14	127	1.000	—	
University of California-Santa Barbara	110	12	8	70	0.667	0.636	1.048
University of Texas at Austin	287	25	14	159	0.560	0.554	1.011
Columbia University	79	10	10	81	1.000	1.025	0.975
Yale University	80	8	7	74	0.875	0.925	0.946
University of Washington	107	14	9	75	0.643	0.701	0.917
University of California-Los Angeles	138	15	10	109	0.667	0.790	0.844
University of California-San Diego	112	25	12	74	0.480	0.661	0.726
University of Pennsylvania	144	15	2	78	0.133	0.542	0.246
University of Maryland at College Park	261	37	17	134	0.459	0.513	0.895
University of Michigan at Ann Arbor	114	24	26	94	1.083	0.825	1.314
Rutgers	73	9	6	61	0.667	0.836	0.798
University of Wisconsin-Madison	173	18	16	132	0.889	0.763	1.165
SUNY at Stony Brook	161	21	15	116	0.714	0.720	0.991
University of Minnesota - Twin Cities	159	31	21	78	0.677	0.491	1.381
Ohio State University	173	21	11	104	0.524	0.601	0.871
University of Rochester	252	54	23	117	0.426	0.464	0.917

*Not considered in calculations of top ten schools because of ~50% rise in male doctorates

Nominate a Woman for APS Fellowship!

The Committee on the Status of Women in Physics encourages APS members to nominate a woman for fellowship in the American Physical Society. You can easily check and see if someone is already a fellow by searching on their name in the APS online member directory at www.aps.org/memb/enter-directory.html. Fellows are clearly marked "[Fellow]" after their name.

The APS Fellowship program was created to recognize members who made have made advances in knowledge through original research and publication or made significant and innovative contributions in the application of physics to science and technology. They may also have made significant contributions to the teaching of physics or service and participation in the activities of the Society. Each year, no more than one-half of one percent of the then current membership of the Society are recognized by their peers for election to the status of Fellow in the American Physical Society.

All APS Members are eligible to nominate, and all APS members are eligible for nomination.

To Submit Nominations:

- Ensure nominee is a member of the Society in good standing.
- Obtain signatures of two sponsors who are members of the Society in good standing.
- Submit signed Nomination Form, Curriculum Vitae, and Supporting Letters prior to unit deadline as a complete packet to:

  Executive Officer, American Physical Society, One Physics Ellipse, College Park, MD 20740, ATTN: Fellowship Program.

Although there is no required number of supporting letters for each nomination, typically 2-3 letters from individuals outside the nominee' s institution who are familiar with the nominee's work are submitted.

Nomination forms may be obtained by:

- Writing to the above address.
- Sending an email message to: fellowship@aps.org
- Telephoning (301) 209-3268, or faxing (301) 209-0865.
- Downloading the electronic version of the nomination form from http://www.aps.org/fellowship/form.html

Supporting letters should be included with the nomination forms to ensure that they are attached to the correct nomination packet.

Nomination Process:

1 Submit nomination to the APS prior to the unit deadline.
2 Nominations reviewed at the Unit level by the Unit Fellowship Committee **(by July 1, 2002)**
3 Recommendations reviewed by the APS Fellowship Committee **(by September 1, 2002)**
4 Final approval given by full APS Council **(by November 30, 2002)**
5 Notification of newly-elected Fellows as well as sponsors of nominees deferred or dropped.
6 General announcement of new Fellows in March issue of the APS News.

APS Fellowship Nomination Deadlines for 2002

Fellowship nominations may be submitted at any time, but must be received by the deadlines listed below for the next review. All nominations should be sent to: Executive Officer The American Physical Society. One Physics Ellipse, College Park, MD 20740, ATTN: Fellowship Program.

Unit Deadlines: Deadlines are approximate as we go to press. Please check the APS website at for the most current information.

DIVISIONS	
Astrophysics	05/01/2002
Biological Physics	04/01/2002
Chemical Physics	02/15/2002
Computational Physics	04/14/2002
DAMOP (Atomic, Molecular, Optical)	03/31/2002
DCMP (Condensed Matter)	01/30/2002
Fluid Dynamics	02/15/2002
Polymer Physics	04/15/2002
Laser Science	04/01/2002
Materials Physics	02/15/2002
Nuclear Physics	04/01/2002
Particles and Fields	04/01/2002
Physics of Beams	03/15/2002
Plasma Physics	04/01/2002
FORUMS	
Physics & Society	04/01/2002
History of Physics	04/01/2002
International Physics	04/01/2002
Industrial and Applied Physics	02/20/2002
Education	04/15/2002
TOPICAL GROUPS	
Few Body	04/10/2002
Precision Measurement & Fundamental Constants	04/01/2002
Instrument & Measurement Science	04/01/2002
Shock Compression	04/01/2002
Gravitation	04/01/2002
Magnetism and Its Applications	04/01/2002
Statistical & Nonlinear Physics	04/01/2002
Plasma Astrophysics	04/01/2002
APS GENERAL NOMINATIONS	06/01/2002

The American Physical Society 2001-2002 Travel Grants for Women Speakers Program

The APS Committee on the Status of Women in Physics (CSWP) is pleased to announce the 2001-2002 "Travel Grants for Women Speakers" Program. This program is designed to increase the recognition of women physicists.

Funding is Available for the 2001-2002 Academic Year! Apply online at www.aps.org/educ/cswp/travelgrant.html

Purpose

The program is intended to expand the opportunity for physics departments to invite women colloquium/seminar speakers who can serve as role models for women undergraduates, graduate students and faculty. The program also recognizes the scientific accomplishments and contributions of these women physicists.

Grant

The program will reimburse U.S. colleges and universities for up to $500 for travel expenses for one of two women colloquium/seminar speakers invited during the 2000-2001 academic year.

Qualifications

All physics and/or science departments in the United States are encouraged to apply. Canadian and Mexican colleges and universities are also eligible, provided that the speakers they invite are currently employed by U.S. institutions. Invited women speakers should be physicists or in a closely related field, such as astronomy. Speakers should be currently in the U.S. The APS maintains the Women Speakers List which is available online at (www.aps.org/educ/women-speaker.html. However, selection of the speaker need not be limited to this list. Neither of the two speakers may be a faculty member of the host institution.

Guidelines

Reimbursement is for travel and lodging expenses only. Honoraria or extraneous expenses at the colloquium itself, such as refreshments, will not be reimbursed.

Application

The Travel Grants for Women Speakers Application Form (www.aps.org/educ/cswp/travelgrant.html) should be submitted to APS identifying the institution, the names of the two speakers to be invited and the possible dates of their talks. Please note that funds for the program are limited. The Travel Grants for Women Speakers Application Form should be submitted as early as possible, even if speakers and dates are tentative, or if the speakers are scheduled for the spring semester. The application form will be reviewed by APS, and the institutions will be notified of approval or rejection of their application within two weeks. Institutions whose applications have been approved will receive a Travel and Expense Report Form to submit for reimbursement.

For Further Information: ***Travel Grants for Women Speakers Program***

Attn: Arlene Modeste Knowles
The American Physical Society
One Physics Ellipse • College Park, MD 20740-3844
Tel: (301) 209-3232 • Fax: (301) 209-0865 • Email: travelgrant@aps.org

Women Speakers List

The American Physical Society's Women Speakers List (WSL) is an online list of over 3,000 women physicists who are willing to give colloquium or seminar talks to various audiences. This list serves as a wonderful resource for colleges, universities, and general audiences. It has been especially useful for Colloquium chairs and those taking advantage of the Traval Grant Program for Women Speakers. To make the WSL easy to use, we have made the online version searchable by state, field of physics, or speakers' last names.

If you'd like to search the list to find a woman speaker, go to http://www.aps.org/educ/women-speaker.html

Interested women physicists who would like to be listed on the Women Speakers List or those who'd like to modify their existing entries can do so at http://www.aps.org/educ/women-speaker.html/

Gazette/Roster of Women in Physics Enrollment Form

The Roster is the basis for statistical reports on women and minority physicists; mailing lists corresponding to announcements, publications of the APS Committee on the Status of Women in Physics (CSWP) and Committee on Minorities (COM); and confidential searches. The Rosters will not be made available to commercial or political organizations as a mailing list, and all information provided will be kept strictly confidential. Although the Roster is employed to serve women and minority physicists, enrollment is open to anyone interested in issues affecting these groups. Please give a copy of this form to others who might be interested in joining the Roster, or in receiving the newsletters.

Please complete all entries on BOTH SIDES OF THE FORM and indicate changes if this is an update of a previous entry. After completing this form, please return to:

The Roster of Women and Minorities in Physics ◆ The American Physical Society ◆ One Physics Ellipse ◆ College Park, MD 20740-3844

Please indicate whether you are interested in receiving:

❒ **The *Gazette*, CSWP (women's) newsletter**

❒ ***C.O.M....MUNICATIONS* (minorities) newsletter** ❒ **Employment Announcements**

Is this a modification of an existing entry?:

❒ **yes** ❒ **no** ❒ **not sure**

NAME: ____

(last) (first) (middle)

Previous last name (if applicable): ____________________ Date of Birth _____/_____/_____

GENDER:
❒ Female
❒ Male

Ethnic Identification

❒ Black
❒ Hispanic
❒ Native American
❒ Asian or Pacific Islander
❒ Caucasian (Non-Hispanic)
❒ Other (please specify) ____________________

Mailing Label Information (Foreign addresses: Use only the first three lines, abbreviating as necessary.)

In this section, please print information exactly as it is to appear on your mailing label. Where boxes are provided, print one character within each box, abbreviating where necessary.

NAME AND TITLE
ADDRESS Line 1:
ADDRESS Line 2:
ADDRESS Line 3:
CITY/STATE/ZIP
Daytime Phone
Fax or e-mail Number:

			–				–																		

Educational Background

Degrees	Year Received (or expected)	Name of Institution
BA or BS	____________	______________________________
MA or MS	____________	______________________________
Ph.D.	____________	______________________________
Other ________	____________	______________________________

Thesis Title (Highest Degree) (Abbreviate to 56 characters total)

____

PLEASE REMEMBER TO COMPLETE SIDE II OF THIS FORM

Current Employment Information (28 Characters per line)

Employer: ______________________________

Department/Division: ______________________________

Position: ______________________________

Professional Activity Information

FIELD OF PHYSICS

Current Interest	Highest Degree	
(check up to 4 in each column)		
1 ____	1 ____	Astronomy & Astrophysics
2 ____	2 ____	Acoustics
3 ____	3 ____	Atomic & Molecular Physics
4 ____	4 ____	Biophysics
5 ____	5 ____	Chemical Physics
6 ____	6 ____	Education
7 ____	7 ____	Electromagnetism
8 ____	8 ____	Electronics
9 ____	9 ____	Elementary Particles & Fields
10 ___	10 ___	Geophysics
11 ___	11 ___	High Polymer Physics
12 ___	12 ___	Low Temperature Physics
13 ___	13 ___	Mathematical Physics
14 ___	14 ___	Mechanics
15 ___	15 ___	Medical Physics
16 ___	16 ___	Nuclear Physics
17 ___	17 ___	Optics
18 ___	18 ___	Plasma Physics
19 ___	19 ___	Physics of Fluids
20 ___	20 ___	Thermal Physics
21 ___	21 ___	Solid State Physics
22 ___	22 ___	General Physics
23 ___	23 ___	Condensed Matter Physics
24 ___	24 ___	Space Physics
25 ___	25 ___	Computational Physics
26 ___	26 ___	Accelerator Physics
27 ___	27 ___	Superconductivity
28 ___	28 ___	Surface Science
29 ___	29 ___	Non-Physics
30 ___	30 ___	Quantum Electronics
99 ___	99 ___	Other (please specify) ______________________

CURRENT WORK STATUS (Check One)

1 ____ Full-time Studies
2 ____ Part-time Studies
3 ____ Part-time Studies/Employment
4 ____ Post Doc./Res. Assoc.
5 ____ Teaching/Precollege
6 ____ Faculty, tenured
7 ____ Faculty, nontenured
8 ____ Long-term/Permanent Employee
9 ____ Inactive/Unemployed
10 ___ Retired
11 ___ Self-employed
12 ___ Other (please explain)
____
____

TYPE OF WORKPLACE FOR CURRENT OR LAST WORK

1 ____ University
2 ____ College - 4 year
3 ____ College - 2 year
4 ____ Secondary School
5 ____ Government
6 ____ National Lab
7 ____ Industry
8 ____ Non-Profit Institution
9 ____ Consultant
10 ___ Other (Please explain)
____
____

TYPE OF WORK ACTIVITY

Please check four numbers from the list below of the activities in which you engage most frequently.

1 ____ Basic Research
2 ____ Applied Research
3 ____ Development and/or Design
4 ____ Engineering
5 ____ Manufacturing
6 ____ Technical Sales
7 ____ Administration/Management
8 ____ Writing/Editing
9 ____ Teaching - Undergraduate
10 ___ Teaching - Graduate
11 ___ Teaching - Secondary School
12 ___ Committees/Professional Org.
13 ___ Proposal Preparation
14 ___ Other (please specify)
____
____

DEGREE TYPE (Highest)

1 ____ Theoretical
2 ____ Experimental
3 ____ Both
4 ____ Other (please explain)
____
____

APS Membership Information

Are you an APS member?:

❒ No Check here if you wish to receive an application - ❒

❒ Yes Please provide your APS membership number, if available, from the top left of an APS mailing label:
___ ___ ___ — ___ ___ ___ ___ ___ ___

Office Use Only

Date of entry: ______________________

Roster#: ______________________

Initials ______________________

Thank you for your participation. The information you have provided will be kept strictly confidential and will be made available only to CSWP and COM members and APS liaison personnel. Please return this form to the address on the reverse side.

Women Speakers List (WSL)
Enrollment/Modification Form 2001-2002

Additions/Modifications may also be made on the Internet at www.aps.org/educ/cswp.index.html
An online copy of the WSL is also available.

The *Women Speakers List* is compiled by The American Physical Society Committee on the Status in Physics (CSWP). The list is updated continuously online and published each summer. Comments, questions and entries should be addressed to:

Women Speakers List · APS · One Physics Ellipse · College Park, MD 20740-3844 · (301) 209-3232

To enroll or update your current entry, please fill out this form completely and return it to the address above.
Please print clearly or type.

Title/ Name ❒ Dr. ❒ Prof. ❒ Mrs. ❒ Ms. ______________________________ Date __________

Institution ______________________________ Telephone ______________________________

Address ______________________________ Fax ______________________________

______________________________ Email ______________________________

City ______________________________ State ______________ Zip Code ______________

If you have moved out of state, list previous state: __________

❒ New Entry ❒ Modification

For which audiences are you willing to speak? (Please check all that apply)
❒ Middle school ❒ High school ❒ General Audiences ❒ Colloquium

To register a new title, give the title as you want it to appear in the left column below. Then check the section(s) where it is to be inserted. To delete a title, indicate the title and check the appropriate box below. A limit of four total entries will be imposed. You may use additional pages if you are submitting more than four modifications. **PLEASE TYPE OR PRINT LEGIBLY PAYING PARTICULAR ATTENTION TO FORMULAS. WE REGRET THAT WE ARE UNABLE TO INCLUDE ILLEGIBLE ENTRIES.**

TALK TITLE	PHYSICS SUBFIELD (limit 4)
1. ❒ Add this title ❒ Delete this title	❒ Accelerators ❒ Astrophysics ❒ Atomic ❒ Biological/Medical ❒ Chemical/Statistical ❒ Computational ❒ Condensed Matter ❒ Education (pedagogy etc.) ❒ Environmental/Energy ❒ Fluid ❒ General ❒ Geophysics ❒ History ❒ Industrial ❒ Interface/Device ❒ Molec/Polymer ❒ Nuclear/Particle ❒ Optics/Optical ❒ Plasma
2. ❒ Add this title ❒ Delete this title	❒ Accelerators ❒ Astrophysics ❒ Atomic ❒ Biological/Medical ❒ Chemical/Statistical ❒ Computational ❒ Condensed Matter ❒ Education (pedagogy etc.) ❒ Environmental/Energy ❒ Fluid ❒ General ❒ Geophysics ❒ History ❒ Industrial ❒ Interface/Device ❒ Molec/Polymer ❒ Nuclear/Particle ❒ Optics/Optical ❒ Plasma
3. ❒ Add this title ❒ Delete this title	❒ Accelerators ❒ Astrophysics ❒ Atomic ❒ Biological/Medical ❒ Chemical/Statistical ❒ Computational ❒ Condensed Matter ❒ Education (pedagogy etc.) ❒ Environmental/Energy ❒ Fluid ❒ General ❒ Geophysics ❒ History ❒ Industrial ❒ Interface/Device ❒ Molec/Polymer ❒ Nuclear/Particle ❒ Optics/Optical ❒ Plasma
4. ❒ Add this title ❒ Delete this title	❒ Accelerators ❒ Astrophysics ❒ Atomic ❒ Biological/Medical ❒ Chemical/Statistical ❒ Computational ❒ Condensed Matter ❒ Education (pedagogy etc.) ❒ Environmental/Energy ❒ Fluid ❒ General ❒ Geophysics ❒ History ❒ Industrial ❒ Interface/Device ❒ Molec/Polymer ❒ Nuclear/Particle ❒ Optics/Optical ❒ Plasma

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