

Workshop on Building Strong Academic Chemistry Departments Through Gender Equity



This report was prepared as an account of work sponsored by the National Science Foundation under Grant CHE-0544616 and partial support from the Chemical Sciences, Geosciences, and Biosciences Division, Office of Basic Energy Sciences, Office of Science, U.S. Department of Energy, and the National Institute of General Medical Sciences (National Institutes of Health). Funding for this conference was made possible (in part) by interagency agreement number Y1GM515801, allowing transfer of funds from the National Institutes of Health. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Introduction: Chemistry for the New Era

Investing Wisely in Human Capital

We are living in the most fast-paced era for science and engineering in human history. Emerging new science—from nanotechnology to bioinformatics, impacting critical national issues such as energy, the environment, national security and human health—makes this a particularly exciting time to be a chemist. The future of the chemistry profession relies on the ability of chemists to convey this excitement and to broaden the participation of all citizens in the scientific enterprise.

Incredible advancements in science, engineering, and technology make this an astonishing time in which to live. These key fields not only provide a lifestyle heretofore not experienced by humankind, but also are critical to both our national security and our standing in the global economy.

The increasing complexity of important societal and technological problems has made interdisciplinary approaches a necessity. Because of its central position bridging physics, materials, and life sciences, chemistry plays a crucial role in a broad range of technologies. Higher living standards and aging populations place growing demands on applications of chemistry for human health. As emerging nations' technologists climb the learning curve, our global economic position is becoming ever more competitive. Yet, in times of increasing needs for scientists and engineers, the workforce pipelines within the United States are woefully inadequate. According to the National Science Board Companion to Science and Engineering Indicators in 2006 [1], there is a troubling decline in the number of U.S. citizens who are training to become scientists and engineers, whereas the number of jobs requiring science and engineering (S&E) training continues to grow.

Creative ideas and the birth of emerging areas of scientific study are generated by fresh approaches and the intellects of people from different cultures and social backgrounds. Nevertheless, a large percentage of the potential science, engineering, and mathematics workforce, consisting of women and underrepresented minorities, remains untapped. Is it not in our best interests to ensure that we fill that workforce with the best talent available?

To keep up with the rapid pace of advances, chemistry departments need to attract the best young minds to chemistry and allied fields. Increasingly, those minds belong to young women. The number of female students at early stages of the research-training ladder has grown steadily for decades. Over the past 25 years, the fraction of women undergraduate and graduate students in academic chemistry programs has climbed from a very small percentage up to today's figures, in which a full one-third of Ph.D. degrees in chemistry are awarded to women. This progress is remark-

able, but commensurate progress in increasing the number of women in faculty ranks at major research universities has lagged. At each successive rung above the Ph.D. level, a further round of attrition ensues, yielding a stubborn underrepresentation of women in chemistry faculties.

The gender gap in chemistry is easily illustrated by National Science Foundation (NSF) statistics indicating that in 2000, 47% and 33%, respectively, of chemistry B.S. and Ph.D. students were female. According to a *Chemical and Engineering News* survey, for the year 2005, only 13% of chemistry faculty were women [2]. (The full C&EN 2005 survey is given as Appendix I.) This disparity was among the largest of all fields surveyed. In fact, only in mathematics was the attrition rate from undergraduate status to the tenure track significantly higher than in chemistry. This is, at the very least, an inefficient deployment of one of the United States' greatest national assets: the widely acknowledged superiority of its research and higher-education establishments. With the estimated cost of training a Ph.D. chemist approaching \$500,000 per person—much of it supplied by Federal government agencies—attrition of high-achieving women from the chemistry profession represents a significant loss of return on human capital investment. Academia's loss of considerable female intellectual talent to industry or other professions suggests that perhaps something about the academic environment is less appealing to women than it ought to be. Indeed, both women and men are increasingly opting out of academic careers in chemistry, resulting in a significant draining of talent.

To begin to address these concerns, officials of the National Science Foundation (NSF), Department of Energy (DOE), and National Institutes of Health (NIH) approached leaders of the chemistry community with the idea of bringing together the chairs of the major research-oriented academic chemistry departments. A year of planning by academic leaders and government agency representatives (see Appendix II) culminated in a workshop titled "Building Strong Academic Chemistry Departments through Gender Equity." Participants included 55 chemistry department chairs and/or representatives from the major research universities and 60 other academic, government, and national chemistry leaders. The workshop, held from January 29 to January 31, 2006, in Arlington, Virginia, began by examining the underlying causes of the gender gap in chemistry departments throughout the country, proceeded through several breakout sessions that discussed and analyzed these factors, and concluded with a set of specific recommendations for action to remedy the problem [3]. Participation by the agency directors responsible for research support for chemistry and department chairs ensured that the people responsible for the future of academic chemistry could participate in coming to a consensus about the nature of the problem and the way toward a solution.

The full list of attendees is given as Appendix II. The speakers, their messages, and their recommendations are described in this report.

Chapter 1: Defining the Issues

Women in Academic Chemistry Departments

The number of women in the chemical workforce continues to be markedly lower than men, especially at and beyond the Ph.D. level. This is particularly true in academia, where faculty play a critical role in training the next generation of scientists. While the percentage of women obtaining Ph.D.s has risen, this progress has been reflected only to a minor extent in the faculty composition of leading chemistry departments.



The research group of Prof. Kendall Houk at UCLA, a Co-Chair of the workshop, reflects the increase in the percentage of women earning a Ph.D. in Chemistry, which rose to 31.3% in the decade between 1993 and 2002 [4].

Denice Denton, Chancellor of the University of California, Santa Cruz, the leadoff keynote speaker, described the strength that diversity of thought and approach can bring to the sciences and other fields. From her viewpoint as an administrator and accomplished engineer, she challenged the workshop participants to create an environment where the creativity and accomplishments of women and men alike could be maximized.

Dr. Donna Nelson from the University of Oklahoma [4] briefed workshop participants on the results of an extensive survey of hiring and retention of women in 14 science and engineering departments at 50 top-ranking research institutions. The statistics for chemists, following a general pattern across the scientific disciplines, show a gradual but uninterrupted increase in the proportion of chemistry B.S.

students who are female—by 2000, the figure was approaching 50%. The percentage of new chemistry Ph.D. recipients who are women has also gradually increased. During the ten years between 1983 and 1992, women received 22.8% of all chemistry Ph.D.s awarded in the United States. By the decade bracketed by the years 1993–2002, this percentage had risen to 31.3%—nearly one in three—marking the highest proportion of female doctorate recipients in all the physical sciences and engineering.

Yet by the academic year 2002–2003, when that latter cohort of women might be expected to appear in faculty ranks, only 12.1% of tenure-track chemistry faculty—fewer than one in eight—were women. The breakdown, by rank, is as follows: Women held 7.6% of full professorships (despite the fact that as long as 20 years ago, 19% of chemistry Ph.D.s were awarded to women), 20.5% of associate professorships, and 21.5% of assistant professorships. Females head fewer than 10% of the top 50 research university chemistry departments today.

In the short run, it is the assistant-professor ranks—the all-important first rung of the tenure ladder—that should be most responsive to changes in gender composition of Ph.D. cohorts. But figures for women assistant chemistry professors in 2002–2003 versus chemistry Ph.D.s granted to women in the previous decade (21.5% vs. 31.3%, respectively) compare unfavorably with those for other physical and life sciences, engineering, and social sciences. For example, in astronomy, civil engineering, and mechanical engineering, the ratio of representation of women in assistant-professor ranks at the “top 50” research institutions vs. their

	Women Asst. Profs. FY02 (%)	Women 1993–2002 Ph.D.s (%)
Astronomy	22.0%	20.6%
Biological sciences	30.2%	44.7%
Chemistry	21.5%	31.3%
Chemical engineering	21.4%	22.3%
Civil engineering	22.3%	18.7%
Electrical engineering	10.9%	11.5%
Mechanical engineering	15.7%	10.4%
Physics	11.2%	13.3%
Psychology	45.4%	66.1%

proportion of recently awarded Ph.D.s actually exceeded parity. In physics, chemical engineering, and electrical engineering, the assistant-professorship/Ph.D. disparity was almost erased, as was also the case in the much more highly women-inclusive fields of sociology and political science. Biology and psychology—two other fields in which women constitute majorities of Ph.D. recipients—showed high but less than proportionate representation. (See Table 1.)

Prior to the workshop, a survey of participants was conducted by the Committee on the Advancement of Women Chemists (COACH). Survey data obtained for the 55 chemistry departments at top-tier public and private research universities represented at the workshop confirmed that chemistry faculties generally have male leadership. For example, of 52 responding institutions, 46 chemistry departments are headed by men and 6 by women.



Professors Valerie Kuck (Seton Hall University), Mostafa El-Sayed (Georgia Tech), and Kristin Bowman-James (University of Kansas) engage in a lively discussion at the conference. Professor Kuck's data show that only 17% of the faculty recently hired in the top 50 chemistry departments are women.

Research by the American Chemical Society (ACS) PROGRESS program under the direction of Dr. Valerie Kuck of Seton Hall University [5] shows that only 17% of recent hires by the top 50 chemistry departments [6] were women. The makeup of academic chemistry departments in the top research institutions at all levels thus continues to lag behind its potential, with the gap most pronounced at the senior levels. One conclusion from the Kuck study is that simply increasing the number of women obtaining doctorates will not automatically increase female participation in academic chemistry.

Beyond these tallies of tenure-track academic positions lies further evidence that women trail men in attaining leadership status in the chemical sciences. For example, in 2006, of the 66 national award recipients, only nine were women, although women are 25% of the ACS membership. Furthermore, a large percentage of ACS awards for research activities have never been granted to a woman. Thus, what is called the premier “reward structure” for American scientists and engineers does not yet seem to be adequately rewarding women chemists and chemical engineers [7]. Through awards, appointments, and promotions, chemists gain the stature that allows them to play an important role in shaping present and future policies for the chemical sciences. Having women attain visible leadership status in

the chemical community will send a powerful message to women coming up the pipeline that they may also have an impact.

Chapter 2: Gender-Related Issues

Understanding the Barriers that Impede Progress in Retention, Hiring, and Promotion of Women Scientists

With increasing numbers of women entering graduate school in the chemical sciences in the past two decades [1], why are so few being hired in academia in the chemical sciences, and why are even fewer progressing into the higher ranks of the academic profession? What is behind this disparity?

The low representation of women at the highest levels in academia can be partly accounted for by the time it takes for an increasingly female population receiving chemistry Ph.D.s to obtain full professorships. But that in no way explains women's current underrepresentation with respect to assistant professorships—the crucial first rung on the tenure ladder. Some hints of structural barriers to women's advancement in academic research institutions emerge from the COACH survey of workshop participants representing 55 top-ranked American chemistry departments, described below. One survey was completed before the workshop, and a second after the workshop.

A. Overcoming the Perception of Scarcity

Despite what should be a healthy increase in the size of the female candidate pool for entry-level academic jobs, COACH survey respondents appear to share a perception of scarcity of female applicants. Responses before the conference indicated that attendees generally believed that factors limiting their ability to hire women were largely beyond their control. For instance, well over two-fifths of the respondents reported that having too few female applicants, losing female candidates to other departments, and not having employment for spouses or partners were at least minor limitations to their department's ability to hire women. The respondents gave negligible weight, in advance of the workshop, to the hypothesis that “current faculty members” were “opposed to hiring women faculty”; they reported almost no “lack of commitment of department faculty members to increase the number of women faculty.” Only a very small minority, less than 12%, indicated that opposition of department faculty to hiring women limited their ability to do so. A majority of attendees saw the only moderately or very important barrier to women's faculty advancement as the difficulty of balancing career and family life (cited by 88% of the respondents). At the same time, over half of the attendees believed that heavier teaching loads, few mentoring opportunities, and discrimination in the peer review process was either “not an issue” or “not important.”

“I have always believed that contemporary gender discrimination within universities is part reality and part perception. True, but I now understand that reality is by far the greater part of the balance.”

—Charles Vest, former President of MIT



Emeritus President Vest (MIT) and Chancellor Denice Denton (UCSC) were keynote speakers and participated in panel discussions.

Interestingly, post-workshop respondents were significantly more likely to perceive that factors under their control limited their hiring of women or served as barriers to women's progress. Comparisons in 13 of the 17 areas examined were statistically significant. For instance, attendees were significantly more likely after than before the conference to report that their department faculty were not committed to hiring women, that some were actually opposed to doing so, that they didn't have enough financing, and that they did not have enough employment for spouses or partners. After the workshop, respondents were also significantly more likely to say that women faced career barriers involving heavier teaching loads, an unwelcoming department climate, few mentoring opportunities, exclusion from important decisions, and subtle biases against women.

Many of these key factors contributing to women's underrepresentation in the academic professions, including chemistry—the workshop's focus—are outlined below.

B. Achieving “Critical Mass” and Role Modeling

With respect to the difficulty of recruiting women for faculty positions, COACH survey respondents expressed only intermediate concern about the problem of “few successful female faculty in the department” (24% saw it as a major problem, 33% as moderate). When the same respondents were queried about obstacles to female faculty *advancement*, on the other hand, the scarcity of female colleagues was cited more frequently (27% characterized this factor as very, 29% as moderately, and 35% as somewhat important).

There is also evidence that recruitment is impeded by the absence of female faculty. A study conducted by Dr. Sally Chapman of Barnard College and her colleagues that was cited at the workshop found that if there are three or fewer women on a department's faculty roster, 22% of begin-

ning female graduate students at that institution say they want to work at a research university, while later on in their career the number drops to 12%. However, if there are four or more women faculty in the department, the initial 26% of beginning female graduate students aiming to work at a research university decays much less, to 23%. Yet the fact is that a full 27% of COACH-responding institutions have no female assistant professors, while 29% have only one, 27% have two, and 12% have three; very few have four or more. Corresponding figures for women associate professors are 24% with no female associate professors, 52% with one, and 18% with two; for full professors, the data indicate 14% with zero full professors, 38% with one, 18% with two, and 10% with three.

As Dr. Charles Vest, Professor of Engineering and former President of the Massachusetts Institute of Technology, told the group that simply having a critical minimum number of female faculty members—“enough so you can just be yourself instead of a representative for an entire group”—may be essential to creating a good working environment for women in general.

C. Recognizing and Removing Discriminatory Biases

Much of human perception—and much of our evaluation of others—occurs non-consciously, rapidly, and automatically. As a consequence, evaluation of candidates for hiring and promotion is not a purely objective process. All of us come to the table with biases. Recognizing when these biases reduce our objectivity, with a commensurate detrimental effect on our goal of diversifying chemistry departments, is the first important step to leveling the playing field.

Guest speaker Dr. Sam Gaertner of the University of Delaware emphasized that prejudices can exist among the most well-intentioned people, who may view themselves as free of prejudice. These prejudices function automatically, he said, without any

Anonymous quotes from women chemistry faculty who participated in COACH workshops at ACS meetings provide examples of discriminatory practices:

"While I was on sabbatical, two people in my department decided to give my research space to a new faculty member and have me move to a space in which I could not have worked. All without discussion with me."

"We were in a faculty meeting and I spoke three times. No one responded to any of these three comments. They just went on talking as though I hadn't said anything. I feel invisible."

"At a recent faculty meeting we discussed whether or not to interview a candidate for a faculty position. Two male faculty members insisted on discussing her marital situation, engendering a heated discussion about what one is allowed to ask a candidate. One man said that we needed to consider her husband because we had 'wasted our time' interviewing another 'girl' who subsequently refused our offer."

"There was an important luncheon. I felt I should have been invited on the basis of my research and teaching accomplishments. I didn't get invited, not even because I am assistant chair or as the token woman. Younger, less deserving males were invited. I was humiliated."

"Recently a male colleague of mine was describing how distraught a female high school student working in his laboratory was about an inappropriate advance that a visiting faculty member in his laboratory made towards her. My colleague said that what was most disturbing about this incident was that he blames our educational system for not doing a better job of teaching young girls how to deal with such behavior rather than complaining to him."

"All of the male professors in my division have taught a Special Topics course more than once, but I have never even been able to offer one. Some of the male professors in my division have been here only half as many years as I have been. This is one way to advertise one's research area to graduate students and helps recruit graduate students into one's research group. One faculty member opposed to my offering the course subsequently tried to dissuade students from taking it once it was listed."

"New graduate students in our department were assigned as research assistants to various faculty at a meeting I could not attend. For the 4th time in 5 years, I was not assigned a student, despite having funding available for 2 students, while some faculty were assigned 3 students. I had previously emphasized to the department chair that graduate students were essential to the conduct of my research, and he had (I thought) agreed that he would do everything in his power to assign students to me."

"Mountains are molehills piled one on top of another."
—Professor Virginia Valian



Professor Virginia Valian (Hunter College), a leading psychologist, pointed out how small disadvantages accumulate throughout the careers of women to result in a major gender gap in opportunity.

intention on the part of those who harbor them. People are unaware that they are discriminating even though stark evidence of this behavior can be teased out in controlled experiments. Dr. Gaertner reviewed several studies showing that it is when candidates' qualifications are not clearly superior or clearly deficient but, rather, when they are comparable that we are most prone to revert to our biases and exercise discriminatory behavior [8].

Another speaker, Dr. Virginia Valian of Hunter College, discussed the key role played by "gender schemas"—the mindsets that are shared by both men and women, often unconsciously, about men and women. Most experiments show no gender differences in these mindsets. Schemas—conceptual grids along which we organize our perceptions—are quite functional, Dr. Valian said: "We actually do know something about people based on the social groups they belong to." One

example of a gender schema, she continued, is the presupposition that men are independent, oriented to the task at hand, purposeful; whereas women are nurturing, expressive, communally oriented. Indeed, collectively men and women do embody these different qualities [9a-b].

Yet our schemas about males and females also include expectations about professional competence and intrude upon our interpretation of individuals' actual performance. Such gender schemas have motivational and emotional consequences for those characterized by them as well as consequences for judgments and evaluations by those who hold them.

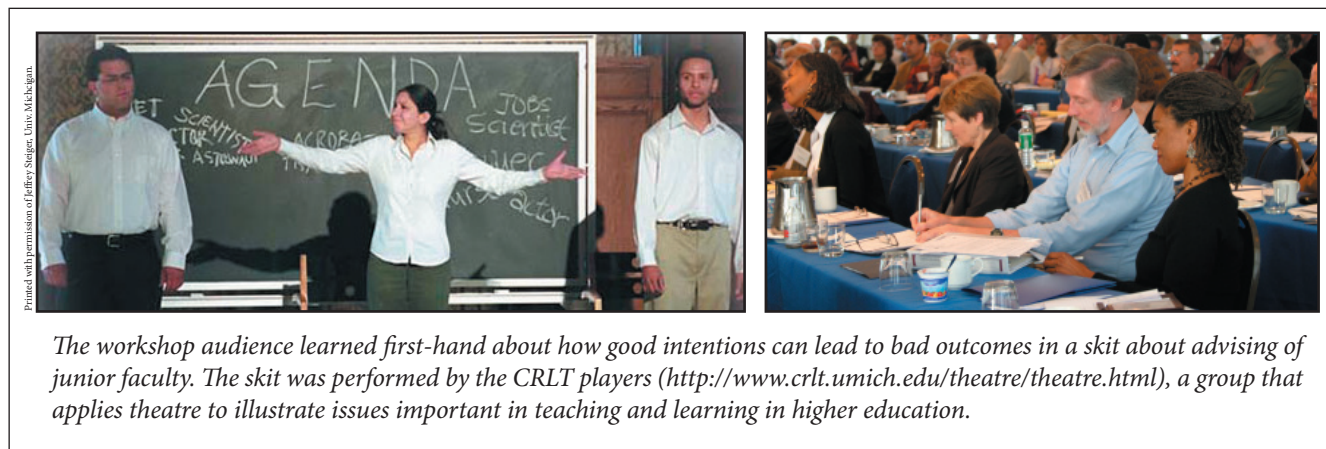
Indeed, gender schemas are so powerful that they influence our judgments even when we're evaluating objective characteristics, such as height. Dr. Valian recounted that in one study, college students were shown photo-

graphs of other students and were then asked to estimate depicted students' height in feet and inches. The photos always contained a visual reference item such as a desk or a doorway, so that height could be accurately estimated. Men on average are taller than women, although this is not always the case. But in this study, the experimenters had matched the photographs so that for every photograph of a male student of a given height there was a female student of the same height. The student judges, both female and male, consistently underestimated women's height and overestimated men's height [10].

Gender schemas can play a bigger distorting role in areas where there is more judgmental ambiguity than is the case with height—for example, evaluations of leadership or competence. In an experiment by Dr. Florence Dyson of the University of Delaware, undergraduates viewed photos of one person sitting at the head of a table and two others sitting around it and were then asked: "Who's the leader?" If a man was at the head of the table or was the only male in a mixed-gender photo, he was likely to be identified as the

evaluators weren't cued as to how well the person was doing in the job—with the other half describing the candidates as "stellar performers." The student evaluators were then asked to judge candidates for competence and likeability. In evaluating candidates of "indeterminate" qualities (i.e., "candidates for performance review"), the undergraduates—both male and female—rated men more competent and equally likeable. On the other hand, those evaluating candidates who had already been pigeonholed as "stellar performers" rated men and women equally competent—but they then rated the men more likeable.

Thus, the observers saw a female candidate as less competent than a similarly-described male, unless there was clear information that she was competent—in which case, they saw her as less likeable than a comparable man! Our gender schemas don't typically assign competence to women, said Dr. Valian, and both men and women undergraduates' gender schemas impede their capacity to see competent women as likeable.



The workshop audience learned first-hand about how good intentions can lead to bad outcomes in a skit about advising of junior faculty. The skit was performed by the CRLT players (<http://www.crlt.umich.edu/theatre/theatre.html>), a group that applies theatre to illustrate issues important in teaching and learning in higher education.

leader. If, however, a woman were at the head of the table in a mixed-gender scenario, half of the student subjects picked the woman—but half picked the man [11].

Dr. Valian noted that if, upon being shown a photo of a woman seated at the head of the table, the students in the above study were asked to identify the "facilitator" instead of "the leader," they chose the woman. In this study by Florence Geis, there were no significant differences in the frequencies with which male and female "perceivers" (i.e., subjects) made these clearly gender schema-influenced selections [11].

In an experiment carried out by Dr. Madeline Heilman and her colleagues at New York University in 2004 [12], undergraduates rated "candidates" of both genders after reading background information about each individual, his or her job description, and the company at which the individual was employed in a male-dominated field. Half the descriptions were of "candidates for performance review"—thus,

But likeability matters. In a follow-up, people rated high in competence and likeability were also rated as worthier recipients for awards, for example. So it's not enough, Dr. Valian concluded, to say: "Don't worry whether people like you, just do your job." The trouble is, being seen as both competent and likeable is a tougher job for a woman.

These gender schemas that we all share result in our overrating men and underrating women in professional settings, but in small, subtle ways: Small disparities—often little matters that we scarcely pay attention to—accumulate over time to men's advantage and women's disadvantage, Dr. Valian concluded.

The gender-schema research described by Dr. Valian was rendered visibly concrete through a highly interactive dramatic presentation by the CRLT Players, a visiting troupe from the University of Michigan's Center for Research on Learning and Teaching. The three actors portrayed, respectively, a tenured male professor; a young and ambitious, but

untenured, female assistant professor who has been relying on the seasoned academic for mentoring; and a young, untenured male academic “rising star.” Striking differences in the well-meaning older man’s demeanor toward his two wards (as well as in their relative deference to him) were evident, and a spirited discussion that involved many audience participants—as well as the actors themselves, still in character—followed the performance.

COACH research involving women chemistry faculty at all institutions indicates that women chemistry faculty believe these gender schemas are present in their departments. A good 37% of women faculty report that male faculty members are taken more seriously than women by undergraduate majors and graduate students, while half feel women faculty are taken less seriously than men by fellow faculty and departmental administrators. Half the female respondents also believe that their male counterparts have higher salaries, with three in ten indicating that they think male faculty members have more or better space allocated for their work and receive more release time for research and other professional activities.

D. Promotion and Retention

1) Attrition

A significant fraction (40%) of COACH survey respondents viewed the rate of attrition in their chemistry departments as the same for male and female faculty, and 96% of respondents reported that no women had been denied tenure within their department in the last three years (with the remaining 4% reporting one such denial), vs. only 62% reported zero denials of tenure for male faculty; 34% reported one denial and 4% reported two. (Of course, the preponderance of male faculty coming up for tenure must be considered here.) Yet, research by Dr. Mary Ann Mason, Graduate Division Dean at the University of California Berkeley, conducted among academics across all fields in the UC system, suggests that once in a tenure-track position, women are 27% less likely than men to reach associate professor within 16 years of attaining the Ph.D.; once attaining associate-professor status, women are 20% less likely than men to make full professor [13].

In the absence of outright tenure denials, why the leakage? Hints as to some of the reasons for female attrition can be found in the COACH survey, in which respondents, when queried about perceived obstacles to female advancement, gave moderate weighting to “subtle biases against women



A study at the University of California, described by Dean Mary Ann Mason (above), shows that women faculty with children do not fare as well as men faculty with children, especially if they are married. Women faculty who are single mothers and women faculty with no children both have a higher tenure rate than married women with children.



Geraldine Richmond, University of Oregon, led a panel that identified opportunities and challenges for institutional leadership. Panel members were Dean Mary Anne Mason (University of Calif., Berkeley), Prof. Carl Lineberger (University of Colorado, Boulder), Dr. Alice Hogan (NSF), Prof. Geraldine Richmond, President Emeritus Charles Vest (MIT), and Chancellor Denice Denton (University of Calif., Santa Cruz).

faculty that accumulate over the years” (24% reported this as very important, 18% as moderately important, and 31% as somewhat important, vs. a mere 16% who thought this factor was “not important”). Relatively few, although still a significant number, felt more blatant factors such as “lack of mentoring of potential women faculty” (6% major, 31% minor) or an “unwelcoming departmental environment for women faculty” (10% major, 20% minor) were significant obstacles to female advancement.

But because gender schemas result in myriad small over- and underestimations that accumulate over time to women’s disadvantage, Dr. Valian told the group, good intentions do not guarantee fairness. She noted that women and men have equal starting salaries, but men advance faster in position and pay. This is true across all professions, she said. Preventing attrition requires intervention at multiple levels, Dr. Valian said.

2) Departmental Climate

Throughout the workshop, women faculty and department heads in attendance shared their frustrations about the unwelcoming climate that exists in chemistry departments around the country. COACH chair Dr. Geraldine Richmond of the University of Oregon reported that the stories she was hearing from women attending the workshop have also been heard repeatedly from the more than 300 women chemistry faculty members from across the country who have attended COACH professional development workshops. Research by COACH as well as by Dr. Kuck of Seton Hall University [6] paints a picture of a climate in many chemistry departments that is not the supportive environment one would hope to observe at academic institutions striving to educate and promote the next generation of scientists. Unprofessional behavior by faculty and harassment is judged to be common—and worse, often condoned. Such unprofessional behavior affects all faculty, particularly those at early, vulnerable stages of their careers.

E. The Academic Lifestyle and the Family

A survey conducted by the University of Western Ontario [14] found that, when asked what was the chief appeal of an academic career, some 80% of graduate students, male and female alike, cited research as the most important factor. However, the academic lifestyle itself or, more specifically, the challenge of combining a family with an academic career was a much greater cause of concern for females than males among graduate students contemplating faculty careers.

The results from the COACH survey were in agreement with this. When asked to what degree they thought various issues made it difficult for many research university chemistry departments to recruit women faculty, a high proportion of respondents specified “concerns of the female faculty candidate about having both a family and a successful career” as a major or a moderate difficulty. As for obstacles

to female faculty advancement, respondents unanimously selected “balancing professional and family obligations” as very important, moderately important, or somewhat important. Not a single respondent characterized this matter as “not important.”

Workshop participants were in full agreement that family issues play a prominent role in discouraging women in all disciplines and at all levels on the academic ladder. Dr. Mason of UC Berkeley found that, on University of California campuses, for example, far fewer permanent faculty and far more adjunct faculty are women than men, and half of all classes are now taught by part-time faculty—disproportionately women and disproportionately women with children.

Dr. Mason presented her analysis of data from an NSF-funded biennial longitudinal survey of the post-degree employment experiences of doctorate recipients in all fields since 1973. This analysis indicates that a woman’s career in academia is far more strongly impacted than a man’s by her marital status, whether she has children, and when she has them.

1) Married vs. Single

It is a general rule in academia that single mothers are more successful than married mothers. Married women tracked by the NSF-sponsored longitudinal study are 21% less likely than single women to enter a tenure-track position within 16 years of earning Ph.D.s, Dr. Mason said, and married women who do achieve tenure-track status are significantly more likely than men to wind up divorced or separated. Women who do get tenure are more than twice as likely as men who get tenure to be single 12 years after receiving their Ph.D.s. “Ladder-rank” women are also more likely to be divorced than women who inhabit the second tier of academe: part-time or adjunct professors and lecturers [13].

2) Do Babies Matter? Yes, They Do

The NSF longitudinal study further shows that women with babies are 28% less likely than those without them to get a tenure-track position, Dr. Mason said. Women who have their babies early on tend to leave academia before getting a first tenure-track job or to slide into second-tier status. The bottom line is that women who have babies earlier in their career are underrepresented among tenured science faculty: only 53% of women Ph.D. recipients with early babies, vs. 65% of women with late or no babies, and 77% of men with early babies, are working in academia 12 to 14 years after getting a Ph.D.

In contrast, men with early babies do quite well—better, in fact, than all other groups, including single men or women. The NSF data indicate that men with early babies are 38% more likely than women with early babies to achieve tenure.

Thus, “no babies” is the dominant success mode for women. Only one of every three women without children who take a fast-track university job ever becomes a mother. However, women with late babies do as well as women without children. This may be a situation peculiar to academia, Dr. Mason noted. Academic women tend to have fewer children, later, than female doctors or lawyers. In fact, 50% of female doctors’ first offspring are born during residency.

3) Time Spent Caregiving

Combining an academic career with children is particularly time-consuming for women, Dr. Mason said. Focusing on a single university system, she reported results from a 4,459-respondent, eight-campus survey she and her colleagues conducted among University of California faculty members in all fields during 2002 and 2003 [13]. The study showed that women with children spend 26.8 hours per week in caregiving roles vs. 53.3 hours per week in their professional capacity; whereas women without children spend only 9.1 hours weekly at caregiving vs. a full 59.3 hours spent within their profession—more hours working, that is, than men without children, comparable figures for whom are 8.1 hours and 58.4 hours. (Men with children spend an intermediate 15.1 hours per week caregiving and 55.5 hours at professional tasks.)

The same UC study found that at their peak age for caregiving (34–38 yrs.), women with children were putting in 43 hours per week at that function vs. about 21 hours for men with children, 10 hours for women without children, and 7 hours for men without children. Presented with the statement, “I slowed down or made sacrifices in my career in order to be a good parent,” 71% of women vs. 49% of men agreed.

More than twice as many women as men acknowledged experiencing a “great deal” of stress in parenting due to specific duties such as attending seminars, colloquia, or departmental

meetings (27% vs. 12%) or attending seminars or giving conference papers (46% vs. 22%). Nearly half of all surveyed women vs. fewer than 30% of men reported stressed parenting as a result of writing and publishing or field work and research away from home.

The conclusion that child care pressures in an academic setting are disproportionately borne by women is inescapable. In Dr. Mason and her colleagues’ UC system study, female faculty were more than twice as likely (38%) as men faculty (18%) to indicate they wished they could have had more children. While this may also be true to some extent in other professional fields, it is clearly an issue of the first magnitude in academia.

One obvious approach to alleviating this job stress is to ease the burden of child care, possibly by increasing the availability of on-campus child care facilities. Workshop participant Robin Garrell of UC Los Angeles noted that demand for child care on her campus exceeds supply by a factor of five. Other steps that can make academic life more manageable for new parents include tenure-clock extensions, paid parental leave, lightened teaching loads, and part-time tenure-track positions. The University of California system’s Active Service-Modified Duties program [13] provides teaching relief for parents with substantial caregiving obligations. The UC system, the Massachusetts Institute of Technology, and Princeton University, among others, have made post-childbirth tenure-clock extensions automatic.

4) The Two-Body Problem

Another factor reported by respondents that makes it difficult for many research university chemistry departments to recruit women faculty was “uncertainty about obtaining employment for partner or spouse” (25% considered this a major problem, 58% a moderate one). In a related question concerning limits on departments’ ability to hire women faculty in the

“These years when my children are young are treasures to be cherished, and the stress I feel from work is actually poisoning my relationship with the children. My compensation mechanism of working nights leaves me tired and short, with them and everyone else.”

“I have been under a lot of stress dealing with expectations after having a child. In the eyes of the departmental administration I was no longer a faculty member but had become ‘pregnant female.’ There was no prior experience with this overlap so the expectations of me were way out of line with how we normally treat faculty.”

“Before my son was born, I negotiated with my department head that I would have a term off from teaching, the term that was to start 2 months after my son was born. (I taught the term that my son was born, missing only one class.) With the start of that term after my baby was born, my department head informed me that he had assigned me a course. When I reminded him of his promise, he claimed that he never agreed to give me time off. When the dean learned of this, he paid the department compensation so that I could be excused from teaching. My department chair cancelled my course but used the money for other departmental expenses.”

past five years, intermediate weight was given to “inability to provide employment for spouse/partner” (19% serious, 40% moderate limitation). Carl Lineberger of the University of Colorado, who is also chair of the NSF Mathematical and Physical Sciences Advisory Committee, highlighted this difficulty by noting that 70% of women in science are married to men in science.

While this long-standing problem, which makes any major move more difficult, requires creative and new solutions, it is not insurmountable. Institutions such as the University of Michigan, the University of Wisconsin, and Ohio State University are making efforts to ease the hiring of married chemistry-faculty candidates by providing funds to help their partners find university jobs. A 28-college consortium, led by Princeton and Rutgers Universities, shares an online jobs database for accompanying spouses.

F. Departmental Barriers to Retention

In a COACH survey question concerning departmental barriers to retention of female faculty, only 6% of respondents viewed “women being excluded from important departmental and institutional decisions” as very important, 4% saw it as of moderate importance, and 16% found it somewhat important, vs. 31% who felt this issue was not important—but then again, this was self-reporting by department chairs, who bear much responsibility for and involvement in such decisions. The low percentage of women department chairs may have skewed this response.

Dr. Valian noted that the standard model for tenure, where the concentrated work of the first five or six years is the basis for the tenure decision, might be replaced with a model whereby the decision is based on the best five, not necessarily consecutive, years of one’s ten-year employment history. Dr. Mason pointed out that departments generally do not even consider the possibility that a woman who drops out for a year or two to have a child might decide to apply to re-enter the system. Departmental easing of the re-entry procedure would increase possibilities for women who have become mothers.

When asked, prior to the workshop, to evaluate the relevance of the statement “women do less self-promoting and marketing of themselves than men” to problems women have in advancing along the tenure track, 14% of COACH survey respondents reported this as a very important obstacle, 28% as moderately important, and 20% as somewhat important vs. 20% reporting that it was of no importance. Workshop participants agreed that the current tenure system requires not only self-promotion, which often does not come as easily to women as it does to men, but also a degree of travel that is inconsistent with the primary child-rearing role many young women academics perform in addition to their careers. Travel is necessary to advertise a researcher’s work and attract collaborators.

G. The Federal Agency Viewpoint

Complementing the points of view expressed by university leaders and those knowledgeable about gender-equity issues, the Federal perspective was represented by Michael Turner, Assistant Director of Mathematics and Physical Sciences of the NSF, Jeremy Berg, Director of the National Institute of General Medical Sciences (NIGMS) of the NIH, and Patricia Dehmer, Director of Basic Energy Sciences at DOE. Each spoke about the programs of their agencies, their commitment to the establishment of diversity in grantees, and their program directions.

Title IX of the Education Amendments of 1972 provides protection against discrimination based on gender for students and employees of institutions of higher education that receive Federal support. The GAO has recommended in a report (<http://www.gao.gov/new.items/d04639.pdf>) that Title IX compliance, best known for the dramatic impact it has had on women’s intercollegiate athletics, be monitored by Federal agencies funding scientific research in academic institutions.

One concrete example of how departments might cultivate a family-friendly environment was related by Dr. Berg who, recalling his days as a junior faculty member when he not infrequently showed up at his lab with his young baby in tow, maintained that “there is a role for male faculty in not hiding their family lives” from their colleagues. Dr. Berg also recommended that mentoring of both young male and female faculty be given a high priority. Dr. Dehmer, noting that 40% of all nuclear physicists—but only 15% of all chemists—in the country’s national laboratories are women, emphasized the need to make chemistry careers in research workplaces more attractive to women.

“The face of the physical sciences does not look like the face of America,” Dr. Turner told the audience. “This is a self-interest issue. We all hold dear, in research and discovery, the importance of diverse approaches and new ideas,” which Dr. Turner suggested might be fostered by greater diversity in hiring. He also held up the NSF’s ADVANCE program, which awards grants to institutions to develop diversity-optimizing and -monitoring strategies, as an excellent template in ensuring a level playing field to researchers.

Several other agency speakers provided insights at the workshop as well. Dr. Alice Hogan, ADVANCE’s director, recalled, “NSF set this program up precisely because of its awareness that women were earning Ph.D.s in the sciences but not winding up on faculties. That was a bad return on

our investment.” Mr. Ron Branch, director of NSF’s Equal Opportunity Office, who addressed workshop attendees on applications of Title IX, praised the ADVANCE program, saying it “goes beyond the letter of Title IX to capture the spirit of the law.”

Dr. Judith Greenberg, Director, Genetics and Developmental Biology Division, NIGMS (NIH), described how new approaches to the solicitation and appraisal of applicants for the agency’s Pioneer Awards, a program Dr. Greenberg oversees, led to greater gender equity among recipients. One change to previous procedures was that candidates were allowed to self-nominate as well as to ask colleagues to nominate them. Second, a strong effort was undertaken to ensure appropriate representation of women on review panels for the award. Third, the program advertised more aggressively, and fourth, it made a point of emphasizing in its solicitations that it truly sought diversity in its applicants. Dr. Greenberg said these changes undoubtedly contributed to an increase in the proportion of women Pioneer Award recipients from 0 out of 9 awardees in 2004 to 6 out of 13 (46%) in 2005.

Chapter 3: Challenges and Opportunities at the Departmental Level

This and succeeding chapters summarize recommendations arrived at through the distillation of suggestions offered at brainstorming sessions held at key points during the workshop. All attendees contributed to these sessions. Thus, the recommendations featured below represent the consensus achieved in each category.

As a first step, the workshop group considered the challenges and opportunities posed at the level of individual chemistry departments: What actions could be taken at the departmental level to improve the successful recruitment, hiring, retention, and professional development of women chemistry faculty members? A key recognition is that the pipeline starts early with graduate students. A continuous thread links undergraduates, postdoctoral researchers, and faculty.

A. Recommendations on Recruitment and Hiring

Double the percentage of women applicants in the applicant pool in the next year (academic year 2006–07 vs. 2005–06) to more accurately reflect the availability of well-trained women Ph.D.s by:

- broadening the search area, e.g., consider hiring outside a narrow area of specialization and consider candidates with degrees earned in allied fields.
- including applicants in nontraditional areas and backgrounds (re-entry, industry, other allied fields, national labs, etc.) in the search



Cynthia Friend, Co-Chair of the workshop, summarized the recommendations and emphasized the need for Chemistry faculty to discuss the best course of action for their institution.

- using faculty as “talent scouts” at meetings and seminars to find promising young scientists who can be mentored toward successful academic job hunts and careers
- supporting the ACS’s Academic Employment Initiative, both by encouraging postdoctoral researchers and graduate students with an interest in academic positions to attend the AEI and by sending “talent scouts” from faculty search committees to meet and encourage potential candidates
- training department chairs and search committee members in gender schemas and proper evaluation of candidates
- letting graduate students know about family/partner-friendly policies
- including more women on search committees
- expanding the number of preliminary telephone interviews in order to broaden the pool of candidates

B. Recommendations on Mentoring, Retention, and Promotion

Establish effective mechanisms for assisting career development of young faculty, especially women, by:

- nominating women for awards
- giving women faculty increased visibility within the scientific community, e.g., through providing opportunities for research presentations, external seminars, etc.
- encouraging women to attend professional development programs, e.g., COACH or programs sponsored on campus
- assisting women, through available mechanisms, in securing research funds from Federal agencies, including connections to new funding initiatives
- providing funding for women, when needed, for partici-



“I don’t mean that Congress needs to pass more laws or impose more conditions on anyone. There is already a law on the books which, when used properly, can be a very effective tool to create good examples and great expectations and to ensure the entire reservoir of talent in this country is being tapped. That law is Title IX, and it is all about making sure that girls and women have the opportunity to live up to their potential.”

—Senator Wyden (Dem., OR), a keynote speaker at the workshop and a leader in science and national security policy.

pation in key scientific meetings in their field

- ensuring transparency in department policies and decision-making processes
- including women in key decision-making processes in the department, especially if it involves them directly, e.g., deliberations concerning teaching assignments or the allocation of space or of other resources

Consider and accommodate personal obligations in academic scheduling and planning by:

- scheduling meetings and other activities at times that maximize attendance
- organizing teaching and seminar schedules with family obligations in mind
- revising, where necessary, faculty evaluation processes to take into account the impact of legitimate family obligations and to provide resources for re-entry strategies

Develop and implement programs that educate all faculty members and students in your department regarding the accumulation of disadvantage of women by:

- establishing a departmental equity-leadership group headed by the chair and key colleagues
- conducting a gender-equity survey on an annual basis
- organizing and supporting workshops that educate the department on issues of gender bias and decision-making, gender schemas, accumulation of disadvantage, professional vs. nonprofessional behavior, etc.
- being aware of gender factors in student evaluations of teaching, frequently an important factor
- building community and establishing mechanisms by which colleagues can listen to each other’s concerns regarding important issues
- instituting a policy of zero tolerance for bullying and/or harassing behavior

- reconsidering the basis of evaluation of faculty candidates for promotion and appointment

Chapter 4: Challenges and Opportunities at the Institutional Level

The group reached a broad consensus on steps for ensuring gender equity that are best taken at the institutional level. This chapter summarizes specific recommendations deriving from that consensus.

A. Institutional Strategic Plan

Develop policies within your institution to facilitate the hiring of women, particularly focusing on couples, by:

- creating policies that will provide employment for spouses within the same institution or community, e.g., create different types of appointments for spouses and/or shared appointments or build a database of jobs available in the local community.
- establishing term-endowed chairs for hiring of female candidates

Recognize the importance of and advocate for institutional support of child care by:

- mandating that a specific percentage of building costs be allocated for child care in capital projects
- designing child care into start-up packages
- institutionalizing and funding policies for family leave for graduate students and postdoctoral fellows

B. Clarifying Procedures

Make diversity an academic priority and develop programs that enhance recruitment and retention of faculty by:

- revising promotion and appointment processes
- establishing term limits on leadership positions, e.g., department chairs/heads
- evaluating departments for success

in diverse hiring through perks to the department and additional positions

- monitoring Title IX compliance

C. Channels for Faculty/ Administration Interaction

Ensure that mid- and senior-level faculty, and women in particular, are participating in leadership roles by:

- monitoring and encouraging women's key participation in research centers
- fostering the interests and talents of faculty within the department and university
- involving women in key decision-making regarding academic priorities, especially when resource allocation is involved

D. Promotion and Tenure

Ensure that policies for promotion and tenure are compatible with needs of candidates who have families by:

- establishing an option for delay of tenure evaluation to account for life changes
- drafting and publicizing a coherent maternity policy
- developing new tenure policies for all faculty, e.g., "best five-out-of-ten-year" concept or revising basis for decision to promote

E. Equal Opportunity Regulations

Ensure that the spirit and letter of Title IX are followed in your university.

Chapter 5. Challenges and Opportunities at Funding Agencies

A key role can be played by funding agencies, whose resources and broad overview can optimize the coordination, calibration, and monitoring of procedures to ensure gender equity in the awarding of research grants. This chapter summarizes recommendations for doing so.

Develop policies to ensure gender equity in proposal review through:

- instituting procedures for training of reviewers and grantees on diversity issues
- modifications of peer review processes where necessary to ensure gender equity
- securing Title IX compliance by accumulating data and tracking, as in NSF's ADVANCE programs, including surveys of lab space and resources
- fostering gender equity in highly visible Federal programs such as national labs, large research centers, and prestigious awards

Chapter 6: Follow-Ups and Conclusions

A. Action Items for Participants

In light of the broad consensus among workshop participants about the importance and urgency of achieving gender equity in chemistry, the steering committee advanced a series of action items. It was agreed that:

- each participating department shall select at least two action items from the lists in Chapters 3 and 4 and make a concerted effort to have them implemented at that department's institution within the next two months. The COACH website (<http://chemchairs.uoregon.edu>) has been developed for department heads to report their selected departmental gender equity action items and to report on their progress in the implementation of these action items.
- all participants shall propose gender-equity action items to their institution's administration
- participants are to work with funding agencies to develop new strategies for funding equity
- a follow-up survey of workshop participants shall be conducted approximately mid-summer 2006 to evaluate progress in implementing these recommendations
- discussions with Federal agencies should be held with the intent to conduct another workshop in 2007 to evaluate progress and chart the next steps to achieve gender equity in chemistry departments

As a further outcome of the workshop, COACH has created an interactive website that provides online resources, follow-up surveys and reports, and a discussion forum for department chairs, with support for creation and maintenance of this website to come from the NSF. It will be at <http://chemchairs.uoregon.edu>

B. Parting Thoughts

For the goal of gender equity in chemistry departments to be met, there is no need to dilute quality, for "preferential hiring," or for the lowering of standards. But there is a need for action. Not only chemistry, but the entire spectrum of scientific, engineering, and mathematics disciplines is confronting a similar problem. The conclusions and recommendations listed above are not exhaustive but rather represent a first step. Consistent, creative follow-up and course correction will be necessary.

Timely and positive results in integrating women into the workforce in chemistry can serve as a template for similar progress in other fields. That progress will surely benefit our national security, health, and economic well-being and advancement.

"All departments are different. We won't find cookie-cutter solutions. Go back and ask your colleagues what they see as the

major problems in your department. And when they tell you, believe them.” —Dr. Donna Nelson, University of Oklahoma

Remembering Denice Dee Denton

As this report goes to press, the news of the tragic death of the leadoff keynote speaker of our workshop, Chancellor Denice Denton of the University of California, Santa Cruz on June 24, 2006, brings enormous sadness to everyone involved in this workshop and to the entire academic community. A person of enormous personal achievement and a wonderful example of the vitality that diversity can bring to science and academic administration, Denice Denton was a powerful and unique spokesperson for the things that this workshop was created to achieve. Her stirring, often provocative, always eloquent, and exciting words, galvanized all of us at the workshop to move ahead toward equity for all scientists as a means of building a stronger educational and research enterprise. Her loss hurts us to the core but stirs us to do more to achieve our shared goals.

References:

- [1] National Science Board (2006). *Science and Engineering Indicators 2006*. Two volumes. Arlington, VA: National Science Foundation (volume 1, NSB 06-01; volume 2, NSB 06-01A).
- [2] Marasco, C. A., “Women faculty make little progress,” *Chem. Eng. News* **83**, 38–39 (2005).
- [3] Morrissey, S. R., “Gender Equity Workshop looks at ways to make academic chemistry department positions more inviting to women,” *Chem. Eng. News* **84**, 65–69 (2006).
- [4] Data from the Nelson survey may be found at: <http://cheminfo.chem.ou.edu/~djn/djn.html>
- [5] Kuck, V., “Refuting the leaky pipeline hypothesis,” *Chem. Eng. News* **79** (47), 71–73 (2001). <http://pubs.acs.org/cen/topstory/7947/7947sci2.html>
- [6] Kuck, V., in preparation for submission to *J. Chem. Ed.*
- [7] ACS National Award Recipients: http://www.chemistry.org/portal/a/c/s/1/acdisplay.html?DOC=awards%5Caward_recipient_arch.html
- [8] Gaertner, S. L.: <http://w3.psych.udel.edu/people/faculty/gaertner.asp>
- [9a] Valian, V. (1998). *Why so Slow? The Advancement of Women*. Cambridge, MA: MIT Press. <http://maxweber.hunter.cuny.edu/psych/faculty/valian/valian.htm>
- [9b] Martin, C. L. and Halverson, C. (1987). *The Roles of Cognition in Sex Role Acquisition*. In Carter, D. B. (Ed.), *Current Conceptions of Sex Roles and Sex Typing: Theory and Research* (pp. 123–137). New York: Praeger.
- Spence, J. T. and Helmreich, R. L. (1978). *Masculinity and Femininity: Their Psychological Dimensions, Correlates, and Antecedents*. Austin, TX: University of Texas Press.
- Spence, J. T. and Sawin, L. L. (1985). *Images of Masculinity and Femininity: A Reconceptualization*. In O’Leary, V. E., Unger, R. K., and Wallston, B. S. (Eds.), *Women, Gender, and Social Psychology* (pp. 35–66). Hillsdale, NJ: Erlbaum.
- [10] Biernat, M., Manis, M., and Nelson, T., “Stereotypes and standards of judgment,” *J. Person. Social Psych.* **66**, 5–20 (1991).
- [11] Porter, N. and Geis, F. L. (1981). *Women and Nonverbal Leadership Cues: When Seeing is not Believing*. In Mayo, C. and Henley, N. (Eds.), *Gender and Nonverbal Behavior*. New York: Springer Verlag. See also Burke, A. S., unpublished paper, 2005, Cornell University, Language Mediation of Gender Schemas in an Investigation of Leadership Perception.
- [12] Heilman, M. E., Wallen A. S., Fuchs, D., and Tamkins, M. M., “Penalties for success: Reactions to women who succeed at male gender-typed tasks,” *J. Appl. Psych.* **89**, 416–427 (2004).
- [13] Mason, M. A. and Goulden, M., “Do Babies Matter?” *Academe*: <http://www.aaup.org/publications/Academe/2002/02nd/02ndmas.htm>; <http://www.aaup.org/publications/Academe/2004/04nd/04ndmaso.htm>; See also <http://ucfamilyedge.berkeley.edu/ucfamilyedge.pdf>
- [14] van Anders, S. M. “Why the academic pipeline leaks: Fewer men than women perceive barriers to becoming professors,” *Sex Roles* **51**, 511–521 (2004).

APPENDIX I: C&EN News 2005 Data on Women in Chemistry Departments

CHEMICAL & Engineering News

EDUCATION
October 31, 2005
Volume 83, Number 44
pp. 38-39
ISSN 0009-2347

WOMEN IN ACADEMIA

Among the top 50 universities, Rutgers has the greatest share of women chemistry professors

	FULL PROFESSOR			ASSOCIATE PROFESSOR			ASSISTANT PROFESSOR			ALL FACULTY		
	TOTAL	WOMEN	%	TOTAL	WOMEN	%	TOTAL	WOMEN	%	TOTAL	WOMEN	%
Akron, U of	11	2	18%	3	0	0%	4	0	0%	18	2	11%
Arizona, U of	22	5	23	4	0	0	6	1	17	32	6	19
Arizona State U ^a	23	2	9	8	1	13	11	4	36	42	7	17
California, U of, Berkeley	34	4	12	5	1	20	9	0	0	48	5	10
California, U of, Irvine	23	1	4	2	0	0	8	3	38	33	4	12
California, U of, Los Angeles ^a	27	5	19	7	2	29	7	3	43	41	10	24
California, U of, San Diego ^a	30	5	17	5	0	0	15	1	7	50	6	12
California, U of, San Francisco ^b	12	0	0	2	1	50	5	1	20	19	2	11
California Inst. of Technology	20	2	10	2	0	0	4	2	50	26	4	15
Colorado, U of ^a	22	4	18	6	1	17	9	1	11	37	6	16
Cornell U ^c	23	2	9	3	0	0	6	0	0	32	2	6
Delaware, U of	16	1	6	8	2	25	8	2	25	32	5	16
Emory U	15	0	0	1	0	0	5	1	20	21	1	5
Florida, U of	24	1	4	11	3	27	8	2	25	43	6	14
Florida State U ^a	16	2	13	9	2	22	11	2	18	36	6	17
Georgia Inst. of Technology ^a	22	1	5	8	0	0	8	0	0	38	1	3
Harvard U ^c	19	1	5	1	1	100	1	0	0	21	2	10
Illinois, U of, Urbana-Champaign	31	3	10	2	0	0	7	2	29	40	5	13
Indiana U	17	0	0	6	2	33	8	0	0	31	2	7
Johns Hopkins U	15	0	0	1	0	0	4	2	50	20	2	10
Louisiana State U	15	0	0	9	2	22	6	2	33	30	4	13
Maryland, U of, College Park ^a	25	5	20	7	0	0	8	1	13	40	6	15
Massachusetts, U of, Amherst	9	0	0	7	2	29	5	1	20	21	3	14
Massachusetts Inst. of Technology	21	3	14	4	1	25	5	2	40	30	6	20
Michigan, U of	21	1	5	5	1	20	11	3	27	37	5	14
Michigan State U	20	2	10	10	1	10	4	0	0	34	3	9
Minnesota, U of	25	2	8	6	1	17	8	2	25	39	5	13
North Carolina, U of, Chapel Hill	24	2	8	12	4	33	2	0	0	38	6	16
Northwestern U	20	1	5	2	1	50	3	1	33	25	3	12
Notre Dame, U of ^a	12	0	0	4	1	25	7	2	29	23	3	13
Ohio State U	20	3	15	7	1	14	6	0	0	33	4	12
Oklahoma, U of ^a	14	0	0	5	2	40	7	2	29	26	4	15
Pennsylvania, U of	26	2	8	6	1	17	4	1	25	36	4	11
Pennsylvania State U	18	2	11	6	1	17	5	3	60	29	6	21
Pittsburgh, U of	11	0	0	8	2	25	7	1	14	26	3	12
Princeton U	18	0	0	2	2	100	4	0	0	24	2	8
Purdue U	36	3	8	9	4	44	8	3	38	53	10	19
Rice U	15	1	7	0	0	nm	5	1	20	20	2	10
Rutgers U ^c	29	6	21	7	4	57	3	0	0	39	10	26
South Carolina, U of ^a	17	1	6	3	1	33	10	2	20	30	4	13
Southern California, U of	18	1	6	6	1	17	4	1	25	28	3	11
Stanford U	15	1	7	4	0	0	3	1	33	22	2	9
State U of New York, Buffalo	23	1	4	3	0	0	7	2	29	33	3	9
State U of New York, Stony Brook	19	2	11	5	2	40	2	0	0	26	4	15
Texas, U of, Austin ^a	31	1	3	6	1	17	9	2	22	46	4	9
Texas A&M U	35	3	9	5	1	20	6	1	17	46	5	11
Utah, U of	21	2	10	3	0	0	7	2	29	31	4	13
Virginia Polytechnic Inst. & State U	15	2	13	13	2	15	2	0	0	30	4	13
Washington, U of	30	2	7	4	1	25	5	0	0	39	3	8
Wisconsin, U of, Madison	27	2	7	2	0	0	10	2	20	39	4	10
TOTAL	1,052	92	9%	264	56	21%	317	65	21%	1,633	213	13%

NOTE: Appointments as of 2005-06 academic year. **a** Chemistry and biochemistry. **b** Pharmaceutical chemistry. **c** Chemistry and chemical biology. **nm** = not meaningful.

APPENDIX II: Attendees at the Workshop

Keynote Speakers

Denice D. Denton, Chancellor, University of California, Santa Cruz
Virginia Valian, Professor of Psychology, Hunter College
Charles M. Vest, Professor of Mechanical Engineering and President-Emeritus, MIT
Ron Wyden, Senator from Oregon

Main Speakers

Ronald D. Branch, Director of Equal Opportunity Programs, NSF
Samuel L. Gaertner, Professor of Psychology, University of Delaware
Mary Ann Mason, Dean of the Graduate Division, University of California, Berkeley
Donna J. Nelson, Associate Professor, University of Oklahoma

Special Guest Panelists

Jeremy M. Berg, Director, National Institute of General Medical Sciences, NIGMS, NIH
Patricia M. Dehmer, Associate Director, Office of Basic Energy Sciences, DOE
Michael S. Turner, Assistant Director, Mathematical and Physical Sciences Directorate, NSF

Department Chairs or their Representatives

Hector Abruña, Cornell
Dean Appling, Texas-Austin
Peter Armentrout, Utah
Mary Barkley, Case Western Reserve
Robert Blankenship, Arizona State
Joel Bowman, Emory
Gary Brudvig, Yale
Bruce Bursten, Tennessee
Charles Casey, Wisconsin
Sally Chapman, Barnard College
David M. Collard, Georgia Tech
James Coward, Michigan
Michael Doyle, Maryland-College Park
Glenn Dryhurst, Oklahoma
Prabir Dutta, Ohio State
Luis Echegoyen, Clemson (also NSF MPS-AC)
Carol Fierke, Michigan
George Flynn, Columbia
Miguel Garcia-Garibay, UCLA
Christine Grant, North Carolina State
Martha Greenblatt, Rutgers
Ian Harrison, Virginia
Joseph Heppert, Kansas
Michael Hopkins, Chicago

Paul Hopkins, Washington
Bret Jackson, Massachusetts
Thomas James, UC San Francisco
Caroline Jerrold, Indiana
Joseph Konopelski, UC Santa Cruz
Julie Kornfield, Cal Tech
Valerie Kuck, Seton Hall
Graham Lappin, Notre Dame
Marsha Lester, Pennsylvania
Katja Lindenberg, UC San Diego
Stephen Lippard, MIT
Michael Marletta, UC Berkeley
Luigi Marzilli, Louisiana State
John McCracken, Michigan State
David McFadden, Boston College
Linda McGown, Rensselaer Polytechnic
Joseph Merola, Virginia Tech
Anthony Rappe, Colorado State
Daniel Reger, South Carolina
David Richardson, Florida
Jeffrey Roberts, Minnesota
Neil Schore, UC Davis
Clarence Schutt, Princeton
Emile Schweikert, Texas A&M
Ayusman Sen, Penn State
Kenneth Shea, UC Irvine
Mark Smith, Arizona
John Toscano, Johns Hopkins
Thomas Tullius, Boston U
Veronica Vaida, Colorado-Boulder
Richard Van Duyne, Northwestern
David Waldeck, Pittsburgh
Robert Waymouth, Stanford
Michael White, SUNY Stony Brook
Kenton Whitmire, Rice
Paul Williard, Brown
Alec Wodtke, UC Santa Barbara
Steven Zimmerman, Illinois
Timothy Zwier, Purdue

Members of NSF-MPS Advisory Committee

Cynthia Burrows, Utah (NSF-MPS)
Larry Dalton, Washington (NSF-MPS)
Mostafa El-Sayed, Georgia Tech

Laboratory Heads

Jeffrey Aube, Kansas CMLD
Michelle Buchanan, Oak Ridge Nat'l Labs
Doon Gibbs, Brookhaven Nat'l Lab
W. Carl Lineberger, Colorado and JILA (also NSF MPS-AC)
Elizabeth Simmons, LBS/Michigan State (also NSF MPS-AC)
Albert Wagner, Argonne Nat'l Lab

Representatives of Societies and Foundations

James Gentile, Research Corp., President
W. Christopher Hollinsed, ACS-PRF, Director
Madeleine Jacobs, ACS, Executive Director
Robert Lichter, Merrimack LLC
Ann Nalley, ACS, President
Carolyn Ribes, ACS Women Chemists Committee

Panelists and Other Invitees

Cathy Drennan, MIT
Gertrude Fraser, Virginia (Vice Provost)
Robin Garrell, UCLA
Judith Greenberg, NIGMS–NIH
Laurel Haak, National Academies
Alice Hogan, NSF
Saundra McGuire, Louisiana State
C. Bradley Moore, Northwestern, VP-Research
Sharon Neal, Delaware
Hannah Reisler, USC
Debra Rolison, Naval Research Laboratory
Abigail Stewart, Michigan

Co-Chairs and Steering Committee

Cynthia Friend, Harvard
Kendall N. Houk, UCLA
Kristin Bowman-James, Kansas
Charles Harris, UC Berkeley
Geraldine Richmond, Oregon
Robert Silbey, MIT

Advisors from Federal Agencies

Linda Blevins, NSF
Henry Blount, NSF
Arthur Ellis, NSF
Janice Hicks, NSF
David Lightfoot, NSF
Debbie Lockhart, NSF
Lee Magid, NSF
Diane Marceau, DOE
Pamela Marino, NIGMS–NIH
John Miller, DOE
Michael Rogers, NIGMS–NIH
Celeste Rohlffing, NSF
Eric Rohlffing, DOE
John Schwab, NIGMS–NIH
Walter Stevens, DOE
Judy Sunley, NSF

Press

Susan Morrissey, C&E News
Karin Jegalian, NIGMS / NIH Record

CRLT Players

Jeffrey Steiger, Director
Devon Dupay, Assistant Director
Chad Hershock
Hugo Shi

APPENDIX III: Workshop Program

Workshop on Building Strong Academic Chemistry Departments through Gender Equity January 29–31, 2006, Arlington, Virginia

Sunday Evening, January 29, 2006:

4:30– 6:00 pm No-host reception with hors d'oeuvres

6:00 pm *Opening Remarks, Introductions, and Goals of the Workshop*

Co-Chairs:

Cynthia M. Friend, Professor of Chemistry, Harvard

Kendall N. Houk, Professor of Chemistry, University of California, Los Angeles

Arthur B. Ellis, Director, Division of Chemistry (NSF)

Walter J. Stevens, Director, Chemical Sciences, Geosciences, and Biosciences Division (DOE)

Michael E. Rogers, Director, Division of Pharmacology, Physiology, and Biological Chemistry (NIGMS, NOH)

Session 1: Defining the Issues

6:15 pm Presiding: **Cynthia M. Friend**
Keynote Speaker: **Denice D. Denton**, Chancellor, University of California, Santa Cruz

6:45 pm Discussion
Presiding: **Kendall N. Houk**

7:00 pm Speaker: **Donna J. Nelson**, Associate Professor, University of Oklahoma
"Demographics of Chemistry Departments"

7:30 pm Discussion

7:45 pm University of Michigan CRLT Players Theatre Performance (NSF ADVANCE has commissioned sketches on mentoring, faculty hiring, and the tenure decision process.)

9:00 pm No-host reception

Monday, January 30, 2006:

Session 2: Equity and Bias

8:00 am Presiding: **Robert Lichter**, Merrimack Consultants, LLC
Keynote Speaker: **Virginia Valian**, Professor of Psychology, Hunter College

8:30 am Discussion

8:40 am Speaker: **Mary Ann Mason**, Dean of the Graduate Division, University of California, Berkeley

9:10 am Discussion

9:20 am Speaker: **Samuel L. Gaertner**, Professor of Psychology, University of Delaware
"Prejudice Can Be Subtle and Insidious—But It Is Not Inevitable"

9:50 am Discussion

10:00 am Break

Session 3: Challenges and Opportunities at the Institutional Level

10:30 am Presiding: **Charles B. Harris**, Dean of the College of Chemistry, University of California, Berkeley
Keynote Speaker: **Charles M. Vest**, Professor of Mechanical Engineering and President Emeritus, MIT
"Women in Science and Engineering: Personal and Institutional Journeys, Obligations, and Opportunities"

11:00 am–
12:00 pm Panel Discussion: Challenges to Institutions
Moderator: **Geraldine L. Richmond**, Professor of Chemistry, University of Oregon
Panelists:
Denice D. Denton, Chancellor, University of California, Santa Cruz
Charles M. Vest, Professor of Mechanical Engineering and President Emeritus, MIT
Alice Hogan, ADVANCE Program Director, NSF
Carl Lineberger, Professor of Chemistry, JILA and Colorado
Mary Ann Mason, Dean of the Graduate Division, University of California, Berkeley

Session 4: Challenges and Opportunities at the Departmental Level

- 12:00–
1:30 pm Breakout Sessions (Working Luncheon Provided)
- 10 small groups will meet, each with a designated leader and reporter. Each small group is charged with identifying challenges that departments/centers face in working towards eliminating biases that negatively impact efforts to recruit, hire, retain, and promote women in the chemical sciences, such as two-body problems, child care, tenure clock, and related issues.
- Breakout Groups I–V: Recruitment and Hiring
Breakout Groups VI–X: Retention and Promotion
- 1:30 pm Summary of Breakout Group Discussions and Panel Discussion
(A reporter from each group will summarize the recommendations of that group)
- 2:00–3:00 pm Panel to Discuss, Augment, and Assist in Prioritizing Recommendations
- Identifying and implementing best practices for eliminating biases that negatively impact efforts to recruit, hire, retain, and promote women in the chemical sciences. This group will address the challenges from the breakout groups.
- Moderator: **Marsha I. Lester**, Professor of Chemistry, University of Pennsylvania
- Panelists:
Chuck P. Casey, Professor of Chemistry, University of Wisconsin-Madison
Carol A. Fierke, Professor of Chemistry, University of Michigan
Mary D. Barkley, Professor of Chemistry, Case Western Reserve University
Kristin Bowman-James, Professor of Chemistry, Kansas and Director of Kansas NSF EPSCoR
Martha Greenblatt, Professor of Chemistry, Rutgers
Catherine L. Drennan, Professor of Chemistry, MIT
- 3:00 pm Break

Session 5: Recommendations for Academic Institutions

- 3:30–4:30 pm Breakout Sessions:
- 10 groups, as before. Charge this time is to develop a set of best practices and recommendations that will increase the recruitment, retention, and promotion of women in academia in the chemical sciences
- Breakout Groups XI–XV: Recruitment and Hiring
Breakout Group XVI–XX: Retention and Promotion
- 4:30 pm Summary of Breakout Group Recommendations
- 5:00–6:00 pm Panel to Discuss, Augment and Assist in Prioritizing Recommendations
- Moderator: **Charles B. Harris**, Dean of the College of Chemistry, UC Berkeley
- Panelists:
Virginia Valian, Professor of Psychology, Hunter College
Robin L. Garrell, Professor of Chemistry, University of California, Los Angeles
Hannah Reisler, Professor of Chemistry, University of Southern California
Robert Lichter, Merrimack Consultants, LLC
Jeffrey T. Roberts, Professor of Chemistry, University of Minnesota
- 6:00 pm No-host reception
- 7:00 pm Dinner

Tuesday, January 31, 2006:

Session 6: Challenges and Opportunities at Funding Agencies

- 8:00 am Presiding: **Robert Silbey**, Dean, School of Science, MIT
Keynote Speaker: The Honorable Senator **Ron Wyden** (Oregon)
"Title IX, Legislative Issues"
- 8:30 am Speaker: **Ronald D. Branch**, NSF, Director of Equal Opportunity Programs
- 9:00 am Discussion

- 9:10 am Remarks and Panel Discussion Featuring Funding Agency Directors:
Jeremy M. Berg, Director (NIGMS, NIH)
Patricia M. Dehmer, Associate Director, Office of Basic Energy Sciences (DOE),
Michael S. Turner, Assistant Director, Mathematical and Physical Sciences Directorate (NSF)
- 10:00 am Breakout Sessions: Recommendations to Funding Agencies
Three Breakout Sessions with groups discussing issues relevant to NIH, NSF, and DOE
XXI. NSF – Leader: **Geraldine L. Richmond**
XXII. NIH – Leader: **Kristin Bowman-James**
XXIII. DOE – Leader: **Charles B. Harris**
- 10:45 am Reports from Breakout Group Leaders
- 11:00 am Panel Discussion of Issues and Findings Relevant to Funding Agencies
Moderator: **Robert J. Silbey**, Dean, School of Science, MIT
Panelists:
Judith H. Greenberg, Director, Division of Genetics and Developmental Biology, NIGMS, NIH
Patricia M. Dehmer, Associate Director, Office of Basic Energy Sciences, DOE
Michael S. Turner, Assistant Director, Mathematical and Physical Sciences Directorate, NSF
Kristin Bowman-James, Professor of Chemistry, Kansas and Director of Kansas NSF EPSCoR
Charles B. Harris, Professor of Chemistry, University of California, Berkeley
Geraldine L. Richmond, Professor of Chemistry, University of Oregon
- 11:45 am–
12:00 pm Concluding Remarks: **Cynthia M. Friend** and **Kendall N. Houk**
- 1:30–2:30 pm Open Session for the Press and Public Summarizing the Results of the Workshop

Co-Chairs Friend and Houk, and Steering Committee Members and Panelists will summarize the workshop and be available to answer questions about the workshop.

APPENDIX IV: Workshop Organizers

Co-Chairs

Cynthia M. Friend, Harvard University

Kendall N. Houk, University of California, Los Angeles

Steering Committee

Kristin Bowman-James, University of Kansas

Charles B. Harris, University of California-Berkeley

Geraldine L. Richmond, University of Oregon

Robert J. Silbey, Massachusetts Institute of Technology

Isiah M. Warner, Louisiana State University

Federal Advisory Committee

Arthur B. Ellis, Director, Division of Chemistry, NSF

Michael E. Rogers, Director, Division of Pharmacology, Physiology, and Biological Chemistry, NIGMS–NIH

Walter J. Stevens, Director, Chemical Sciences, Geosciences, and Biosciences Division, DOE

