The Case for Climate Change: STEM Women in the Academy

CCAS Presidential Address*

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Introductory comments

I'm pleased to have this opportunity to speak with you today, and I feel very privileged to be in the position to do so. By my count, this is my fifteenth CCAS Annual Meeting – and fifteenth Presidential Address – that I will have experienced. Having recently reviewed the addresses of past Presidents that are posted on the CCAS website, I am humbled – and not a little daunted – to find myself among that impressive company.

I have to confess that I am not one who leaps at the opportunity to provide this kind of address. However, preparing for this presentation has provided me with some unexpected benefits. For example, it allowed me to relive a part of my youth and that unmistakable feeling I experienced as a college junior, in a class in my geology major, when presented by my professor with the assignment for a research project he called "The Opportunity." The Opportunity was the stuff of legend among Colgate University's geology alumni, and all of us in class on that fateful day knew this assignment was one worthy of our respect and, just as certainly, fear. The professor himself, with a kind of histrionic flourish worthy of Barrymore, instructed us to think of The Opportunity as a length of rope, from which we could either construct for ourselves a safety net…or a noose.

I was reminded of that episode when discussing the role of CCAS President with our wonderfully talented Executive Director, Anne-Marie McCartan. Shortly after my election to the position, she commented that many in our membership would not wish to take on the role. Thinking that she was referring to the workload associated with the presidency, I agreed, saying, "Well, the position does require a good amount of effort." Anne-Marie laughed and then quickly demurred, saying, "Oh, I'm not talking about the workload – they don't want to have to give that speech!" Anne-Marie, I thank you once again for those well-timed and encouraging words.

Another unanticipated benefit of preparing for this presentation was the chance to learn more about the organization and its priorities through reviewing those past Presidential Addresses. Their variety is striking, ranging from the history and origins of CCAS as an organization, to reflections on the evolving role of the dean, and fundamental questions about the purpose and future of higher education. In retrospect, those varied themes and messages were powerful because they emerged from the particular passions and expertise of the presenters. In my comments today, I will seek to do the same, focusing on a topic of particular as well as personal interest – the status of women scientists and mathematicians in the academy and the important role that we as deans play in that regard.

Review of the status of STEM women in the academy

The title of my presentation references the groundbreaking research undertaken by Roberta Hall and Bernice Sandler, who used the phrase "chilly climate" in the early 1980's to describe the differing classroom environments experienced by men and women (Hall and Sandler, 1982) and, in their subsequent work, to characterize the experiences of female faculty members and administrators (Sandler and Hall, 1986). Hall and Sandler noted both overt and inadvertent discriminatory behaviors by higher education faculty and students, such as devaluing women and their contributions; having lower expectations for their abilities and performance; using alienating language, nonverbal behavior, and personal interactions; and providing inequitable access to professional growth and development opportunities. Among the negative consequences the authors reported among female students were reduced self-confidence, disengagement, and lowered professional goals, factors that may contribute to student attrition. Although it is tempting to believe we in academia now live in an enlightened time and place, where differential treatment of men and women is a thing of the past, an ample body of research documents a distinct reality, particularly when it comes to the science, technology, engineering, and mathematics – or STEM – fields. Consider the following:

- The National Science Board reports regularly on the state of the STEM disciplines in its report, "*Science and Engineering Indicators*" (National Science Board, 2008). That publication documents that, among U.S. citizens earning doctorates in science and engineering in 2005, fully 46% were women. Moreover, of the full-time junior faculty in science and engineering - junior faculty defined as those holding Assistant Professor or Instructor rank - some 42% are women. The similarity in these percentages is a promising sign. However, that same report notes that there are substantial differences by sex across the STEM disciplines, so while the percentage of male and female junior faculty in the life sciences approaches parity, male junior faculty outnumber the women by approximately 3:1 in the physical sciences and computer sciences, and nearly 4:1 in engineering. The picture is more disparate at the advanced ranks. Among the full-time senior science and engineering faculty – those at the rank of Associate Professor and Professor – approximately one-quarter are women, with male senior faculty outnumbering the women by about 4:1 in computer science, 7:1 in the mathematical and physical sciences, and 13:1 in engineering.

The discrepancies are particularly pronounced when we consider gender distribution among the faculty in research universities.

- A 2004 national study (Nelson, 2004) of diversity among faculty members at the "Top 50" science and engineering departments - those identified by the National Science Foundation as having the greatest amount of research fund expenditures - documented a profound difference in the representation of women among the senior ranks. For example, women made up fewer than 5% of the full Professors in mathematics, chemical engineering, civil engineering, electrical engineering, and mechanical engineering, and fewer than 10% of the full Professors in chemistry, computer science, astronomy, and physics. Only in the biological sciences did the percentage approach 15%.

Hearing these statistics, it may be tempting to attribute the disparities at the more advanced academic ranks to what researchers have called "demographic inertia," or the very slow rate of change in reaching a gender distribution like that of recent Ph.D. recipients due to demographic factors, such as the age characteristics of faculty and faculty turnover patterns. For example, if the full professors of chemistry on your campus were hired, on average, 20 years ago, then one would not expect to find among them a gender distribution that reflects that of recent chemistry Ph.D. recipients. One might speculate that, once sufficient faculty turnover has occurred, the percentage of women among the faculty will reach that among Ph.D. recipients. However, research on this phenomenon indicates otherwise. Mathematical modeling by Marschke et al. (2007) of data from an actual Research Extensive university indicated that, if current patterns of faculty hiring, advancement, attrition, and retirement at that institution continue, the percentage of women will never equal that among new Ph.D. recipients, owing to women's lower retention rates among the faculty. In fact, in that example, calculations indicated that the institution would reach its maximum of just 34% women faculty after about 40 years.

Disparities between male and female faculty are also evidenced in their rates of advancement and compensation. Studies of tenure and promotion patterns among men and women have shown modest differences in tenure rates; however, promotion is a different story. In general, women scientists require more time to achieve promotion than their male colleagues and are less apt to attain the rank of full Professor (Committee on Science, Engineering, and Public Policy, 2007). Full-time female faculty members across all academic ranks receive lower salaries than their male counterparts (West and Curtis, 2006; Trower and Chait, 2002). This disparity is observed across all institutional types, although it is most pronounced in doctoral institutions (West and Curtis, 2006). In its report, AAUP Faculty Gender Equity Indicators 2006, the AAUP noted that women full Professors across all institutional types earned on average 88% of that of men at that rank. At the ranks of Associate and Assistant Professor, the average was slightly higher, at 93%. Notably, those figures were actually worse than those recorded 30 years previously (West and Curtis, 2006).

Not only are there disparities in the representation by sex among the faculty, but data indicate that women and men have different experiences outside of their employment as well. A 2006 analysis by the National Science Foundation (Burelli, 2008) showed that only 67% of women science and engineering doctoral faculty were married, in contrast to 84% of their male counterparts. As well, they were less likely to have children in their households than were their male colleagues, at 42% and 50%, respectively. At the most senior ranks, women had higher representation among unmarried full professors in science and engineering fields than among married full professors. They were also a higher percentage of full professors with no children in the home than of those with children in the home.

One might postulate that a causal relationship exists between these family attributes and academic employment patterns and, in fact, a 2004 study by the National Science Foundation (National Science Foundation, 2004) found evidence that family characteristics had a role in the differential success of male and female STEM faculty, concluding, "We find evidence that female scientists and engineers are less successful than their male counterparts in traveling along the academic career path. Some of this disparity appears to be related to differences between the

sexes in the influence of family characteristics. Typically, married women and women with children are less successful than men who are married and have children."

As compelling as the data on gender-based disparities are, those associated with under-represented minorities are even more striking. I should note that my decision to focus today on STEM women is not intended to minimize the issues faced by members of racial, ethnic, and other minority groups, whose under-representation in the sciences is particularly acute.

The need for change

Perpetuation of the *status quo* comes at a high cost. Women now earn the majority (National Center for Education Statistics, 2009) of our country's undergraduate and master's degrees and make up about half of the overall workforce (Committee on Science, Engineering, and Public Policy, 2007). The attrition of women from the STEM fields represents a loss of talent from these key disciplines, limiting their access to respected, well-paid jobs and affecting our technological competitiveness as a nation. As well, the under-representation of women among the STEM faculty and leadership positions deprives students of both sexes of adequate female role-models, which may in turn impact the STEM pipeline and culture. Women offer distinctive scholarly talents, interests, and perspectives that, if not represented, may otherwise go untapped. Studies suggest that having gender-diverse groups may positively impact team processes and the quality of problem-solving (Kochan et al., 2003; Hoffman and Maier, 1961). Moreover, research indicates that organizations that treat equitably their female members foster the well-being of all employees (for example, see Miner-Rubino and Cortina, 2004). For all of these reasons, as well as legal and moral considerations (Handelsman et al., 2005), climate change in the academy is imperative.

Barriers to STEM gender equity

In order to effect this change, we must first understand the barriers to attaining STEM gender equity.

While the academic environment has clearly shifted in the nearly three decades since Hall and Sandler's report, climate issues persist. In its 2007 report, *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*, the Committee on Science, Engineering, and Public Policy concluded that "women are very likely to face discrimination in every field of science and engineering." Research has documented that climate considerations are important in the attrition of women from the sciences at the undergraduate and graduate levels and into the professoriate (Committee on Science, Engineering, and Public Policy, 2007). Factors such as a sense of isolation, inability to gain full participation in social and professional networks, insufficient respect by one's colleagues, and the dearth of female role models at the senior ranks can render the academic environment an unwelcoming and dissatisfying one for women.

In addition to the issues of "chilly" climate and explicit bias, research has shown that implicit bias continues to be an important factor in the differential treatment and slower advancement of women in STEM. Virginia Valian (1998) has described the profound impacts of gender

schemas, the unconscious hypotheses that each of us holds regarding the sexes and their differences. These schemas enable the differential accumulation of advantage by individuals whose success is favored in a particular set of circumstances. In academia, males may over time accumulate multiple small advantages over their female colleagues, advantages that ultimately result in sizable disparities. For example, studies have documented that merely identifying the gender of an applicant as female can lead to lower ratings of the same *curriculum vitae* (Steinpreis et al., 1999).

Inequitable access to resources is another consideration in the success of women faculty. Factors such as implicit or explicit bias may result in STEM women who have lower salaries, research space of lesser quantity and/or quality, more limited research assistance and funding, and less access to professional mentoring and development opportunities than their male counterparts (Committee on Science, Engineering, and Public Policy, 2007). For example, the well-known MIT study by Nancy Hopkins and her colleagues (Massachusetts Institute of Technology, 1999) identified inequities between women and men faculty in a variety of important areas, including salaries, space, teaching and committee assignments, and awards. The causes of resource disparities are not limited to external factors, however, as the research indicates that women themselves may contribute to this phenomenon. In their book, "*Women Don't Ask*: *Negotiation and the Gender Divide*," Linda Babcock and Sara Laschever documented the greater tendency of men to negotiate than women, leading to sizeable differences in areas such as the establishment of starting salaries, a single event that may produce lifelong consequences (Babcock and Laschever, 2003).

Institutional structures, policies, and practices may also contribute to a lack of persistence of women STEM faculty. In their 2007 book, *Rethinking Faculty Work, Higher Education's Strategic Imperative*, Gappa et al. (2007) note the historic importance in academe of the "ideal worker" construct. The ideal worker represents the traditional, stereotypical faculty member who secured a tenure-track job subsequent to completing his academic studies. If married, the ideal worker's spouse was the primary caregiver for the children, an individual who enabled the faculty member to work late nights in the lab, spend extended time periods at a remote field location, and travel to present at a professional conference. In general, this ideal worker was middle-class, white, and male. While the ideal worker model no longer reflects the reality in academe, many institutional artifacts of this earlier time remain, and these artifacts can prove a formidable barrier for both women and men. Unforgiving promotion and tenure clocks, lack of employment accommodations for partnered academics, and inflexible work practices, such as an inability to move between full-time and part-time status and remain on the tenure-track, all can contribute to disillusionment with an academic career.

The ability to strike a balance between one's personal and work life is important to faculty of both genders, but biological and cultural considerations lead to greater impacts on women when it comes to family responsibilities. Disproportionately more women than men assume primary responsibility for childcare and eldercare activities (Williams, 2000; Gappa et al., 2007), efforts that decrease their time available for professional pursuits. A recent study (Leslie, 2006) documented the disparate effects on male and female faculty members' work activities as a function of the presence of dependents in the household. Not surprisingly, the number of hours worked per week, as well as the number of hours per week spent on research, decreased for

female faculty with dependents; the trend for their male colleagues was distinctly different, however, as workweeks and time spent on research actually increased for men in the presence of dependents.

One final barrier to STEM gender equity that I'll mention today is the pipeline issue. Clearly, the dearth of women in many STEM fields and at the senior academic ranks has been an impediment to achieving equity. However, as we have discussed, the pipeline itself is a function of multiple other factors, and it is no longer acceptable to assume that greater "intake" of women at one end will eventually result in sufficient "outflow" at the other. Ample numbers of scientifically talented women are available; the question is, how do we facilitate their full participation and success in the academy? And more specifically, what role can we, as arts and sciences deans, play in that regard?

Facilitating change

Over the past several decades, countless reports, grounded in STEM gender equity research, have examined mechanisms for facilitating the success of women faculty. When one examines that scholarly research, as well as federal funding priorities, through time, what emerges is a shifting philosophy regarding effective intervention strategies. Early strategies tended to focus on what Sue Rosser (Rosser, 2004) has called "solutions for the individual," featuring interventions directed at individual women scientists, such as personalized professional development and mentoring, and grants focused on the career development of a particular woman researcher. While such efforts have yielded some positive outcomes for the participating scientists, the female-focused intervention model implies the inadequacy of women, an implication that is at odds with their retention and success. More recently, gender equity scholars have concluded that there exist in the academy systemic barriers that contribute to the under-representation of STEM women, and that the answers lie not in individual change, but rather, in institutional transformation. Federal funding agencies have responded by implementing grant programs that seek to promote such institutional change, such as NSF's ADVANCE program, the goal of which is to "develop systemic approaches to increase the representation and advancement of women in academic science, technology, engineering and mathematics (STEM) careers, thereby contributing to the development of a more diverse science and engineering workforce."

Academic deans can play a fundamental role in facilitating such institutional change. We guide the development and enforcement of our colleges' policies and procedures, including those that pertain to faculty recruitment, retention, evaluation, and advancement. We are also key decision makers in those personnel actions. Among our responsibilities is the allocation of resources that support faculty success, whether in the form of start-up packages, research and office space, reassigned time for scholarship, or salary increases. We deans direct college-level planning and priority-setting, and we help to establish our units' cultures and climates. At the institutional level, we can influence the development and implementation of innovative personnel policies and practices, such as partner accommodation, position-sharing, extensions of the tenure clock, and part-time tenure-track appointments. And at the unit level, we are responsible for the selection and leadership development of department chairs and directors, individuals who, in turn, have a key role in fostering faculty achievement.

The recent award by NSF of a CCAS-focused ADVANCE grant recognizes the pivotal role that we deans play in the recruitment, retention, and advancement of female STEM faculty. The CCAS ADVANCE Initiative also extends the earlier-referenced shift in intervention strategies by moving beyond transformation of individual institutions and utilizing our higher education association as the means by which to promote transformative change among our nearly 500 member campuses. Because I seek to enlist your participation in this endeavor, I'd now like to take a few moments and provide an overview of the CCAS ADVANCE Initiative.

CCAS ADVANCE Initiative

The project we will undertake is funded through the Partnerships for Adaptation, Implementation, and Dissemination track of the ADVANCE program. The $1.2 million grant supports a partnership between CCAS and the University of Washington, whose ADVANCE-funded program, Leadership Excellence for Academic Diversity, or LEAD, we seek to adapt. LEAD is a series of national leadership workshops for unit- and mid-level STEM administrators – that is, department chairs and deans – as well as emerging STEM leaders. LEAD workshops are not designed as gender equity programs, but rather, as leadership development sessions that address topics of broad interest to unit- and mid-level administrators throughout which gender equity concepts are infused. Like CCAS's professional development programs, LEAD is highly interactive and utilizes case studies as a means of applying concepts and problem-solving. With LEAD's project period nearing completion, CCAS, with its well-established and self-supporting professional development programs, is in an excellent position to sustain the University of Washington's successes through this adaptation effort.

In addition to infusing gender equity content and activities into our professional development programs, a second project goal is to maximize opportunities for positive impacts of the CCAS ADVANCE Initiative on individuals underrepresented in STEM disciplines. Efforts in this regard will focus on minority-serving institutions, institutions that tend to have higher percentages of faculty and administrators from under-represented populations than do non-minority-serving institutions (MSIs). Specifically, the grant provides support for individuals from MSIs to participate in CCAS's New Deans and Department Chairs Seminars. This support is in the form of registration fee waivers and modest travel support for as many as five seats in each 40 seat seminar. It is hoped that increased representation in CCAS seminars by individuals from MSIs will enhance the programs' diversity in terms of institutional type and racial and ethnic diversity of participants, leading to a richer learning environment. Such an approach also supports the recruitment of these institutions – institutions currently under-represented among the CCAS membership – into our organization, bolstering diversity within the association.

The third goal of the CCAS ADVANCE Initiative is to develop, utilize, and make widely available a set of robust case studies that incorporate gender equity elements. Those of you who are seasoned CCAS members know that case studies are an important tool in our programming. Many successful ADVANCE programs have also found case studies of great utility in their leadership development efforts. The generation of case studies that integrate gender elements, accompanied by discussion guides, will provide us with materials that will not only support CCAS's programming but resources for leadership development that we can undertake on our own campuses.

The project's leadership team will oversee the initiative and consists of Anne-Marie McCartan, CCAS Board member Carmen Cid, and me serving as PI. We are recruiting a Program/Research Manager who will manage the day-to-day operations of the project and play a key role in our adaptation of LEAD's best practices. Providing essential guidance to our ADVANCE efforts will be internal and external advisory bodies. The CCAS ADVANCE Initiative Standing Committee will include several members of the Board as well as CCAS member deans. In-person meetings of this committee will occur annually, coinciding with the CCAS Annual Meeting. We are currently soliciting expressions of interest in serving on this committee, and I encourage you to contact me if you would like to serve. As well, we will be assisted in our efforts by an external advisory board, the assembling of which is now underway. This board will consist of individuals with expertise in STEM gender equity, faculty work-life issues, and organizational change. If you have nominations for this group, please let me know.

Evaluation will be an important part of the project and inform our efforts as it progresses. We are fortunate to have secured the services of the University of Washington's Center for Workforce Development, under the direction of Suzanne Brainard, for this work. In that this Center carried out evaluation of the LEAD project, its personnel are uniquely qualified to assess our adaptation of it.

In all, I believe we are assembling a well-qualified team to carry out our project plan, and I look forward to working with the CCAS membership to realize our goals. With this ADVANCE award, we have a singular opportunity to address STEM gender equity in a fundamental way. I urge you to join with my colleagues on the project leadership team and me to effect some badly needed – and long-overdue – climate change.

Concluding words

I will close today by expressing my gratitude for the opportunity to serve CCAS in the role of President. This organization has been a constant source of information, support, and camaraderie for the fifteen years in which I have participated, and I feel privileged to have been able to serve in this way. Thank you for that honor, as well as your attention.

This document represents the text of the Presidential Address delivered by Denise A. Battles at the 2009 Annual Meeting of the Council of Colleges of Arts and Sciences. Please do not reproduce or distribute without Battles' permission.

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