

**Changing the Demographics  
Recruiting, Retaining, and Advancing Women Scientists in Academia  
Earth Institute ADVANCE Program, Columbia University  
March 24, 2005**

Good afternoon. I am delighted to be able to join you for the launching of your ADVANCE program to strengthen the presence and enhance the experience of female scientists and engineers at Columbia University. I must say, however, that when I accepted this invitation in the fall, I did not foresee that speaking as a university president on the subject of the under-representation of women in science and engineering would become a form of risk-taking behavior that makes bungy jumping and going over Niagara Falls in a barrel seem like child's play.

I want to begin with the images of the women on the first slide. These are among the most successful women working in the fields of science and engineering today – Linda Buck, who received the Nobel Prize in Medicine last year for her work on the molecular basis of olfaction; Jackie Barton, a member of the National Academy of Sciences and a chemist at Caltech; Ingrid Daubechies, a mathematician at Princeton and another NAS member; Barbara Meyer, a NAS member and brilliant geneticist; Barbara Grosz, a computer scientist who works on artificial intelligence and serves as Dean of Science at the Radcliffe Institute; Sharon Long, a NAS member and plant biologist who is Dean of Humanities and Sciences at Stanford; Vera Rubin, an astrophysicist and NAS member; Susan Kieffer, a geoscientist at Illinois and NAS member; Liz Blackburn, a cell biologist whose discovery of telomeres has won her many awards, including membership in the NAS; and Pam Bjorkman, a structural biologist and a very young NAS member at Caltech. While hardly a random sample, this slide could have included dozens of other successful women scientists.

I wanted to have their images in our minds during my address because in our eagerness to find ways to increase the participation of women in science and engineering, we should not lose sight of how far we have come. This slide could not have been constructed 30 years ago when I was completing my Ph.D., and I find the successes of the women it depicts to be a tremendous source of inspiration and guidance going forward. Last spring, the first woman in the history of Princeton University to be granted tenure, Professor of Sociology Suzanne Keller, retired. When describing the Princeton of 1966, when she joined our faculty, she commented, "I really thought I was from Mars. It was as if the men had never seen a woman." Today, within the span of one career, 105 members or just under 20% of Princeton's tenured faculty is female, 28% of the junior faculty are women, and last year 36% of all new appointments to the faculty were female. Two traditionally male domains, the School of Engineering and Applied Science and the Woodrow Wilson School of Public and International Affairs, are currently headed by female deans. Today's Princeton would be unrecognizable to the young Suzanne Keller, and that alone gives me enormous hope for the future.

In thinking about this talk, I concluded that it made little sense for me to review once again the numbers – I suspect everyone in this audience knows them by heart. Instead, I want to begin with developing the rationale for why universities in particular and Americans in general should care about this issue.

First and foremost, the future vitality and prosperity of the United States fundamentally depend upon the scientific and technological creativity and innovation that is nurtured within its research universities. Universities like ours are the research engines of this country, a role that is based on a social contract between the federal government and universities that was forged just after the Second World War. New industries that were born in this country and grew up in the second half of the 20<sup>th</sup> century – like the biotechnology industry, the microchip industry, wired and wireless telecommunications, and internet commerce – all have their roots in the work of faculty and their students and fellows in universities like Columbia and Princeton. For this partnership between universities and government to thrive in the 21<sup>st</sup> century, we will have to attract into science and engineering *more* than our fair share of the best and brightest young minds from all over the world. To restrict the pool, either intentionally or unintentionally, by discouraging women – or under-represented minorities for that matter – from pursuing careers in science and engineering is to guarantee that the outcome, and thus the future prosperity of the United States, will be less than it could be.

The second argument for increasing the participation of women in science and engineering is that the scientific interests of women may not be completely coincident with those of their male colleagues. I am not suggesting that women conduct scientific inquiry differently from men – the scientific method is universal – but it has been my own experience that the problems that intrigue women about the natural world are not always exactly the same as those that attract men. By encouraging women to embrace science, we likely increase the range of problems under study, and this will broaden and strengthen the entire enterprise.

The third argument is unquestionably true. If women continue to be under-represented in science, engineering, and mathematics, these fields will look increasingly anachronistic to students, and we risk losing the most talented among them, who will, after all, have an infinite range of career options from which to choose. As law, medical, and business schools reach gender parity in their student bodies, science and engineering will become increasingly unattractive vis-à-vis those fields. Today the difference is there for all to see. For example, the Association of American Medical Colleges reports that 45.2% of medical school graduates in 2003 were female, whereas, according to the American Society for Engineering Education, only 17.4% of Ph.D. degrees in engineering were awarded to women that year.

I am reminded here of one of the reasons that was offered as to why the schools in the Ivy League became co-educational. It was argued at the time that the schools were afraid that they would lose the most talented male students to co-educational schools. Now, as a reason to admit women, it may not ring with high principle, but it was a realistic concern.

Those schools back in the late 1960s knew that men did not want to be educated any longer only with men.

Finally, it is simply unjust for a profession to exclude – whether by sins of commission or omission – a significant proportion of the population on the basis of gender. For every girl who dreams of becoming a scientist or engineer, there is a moral obligation on our part to do everything we can to even the playing field so her chances rest on her (dare I say innate?) abilities and her determination, just as it does for her male counterparts. It is not sufficient to shrug our shoulders, invoke all the historical reasons for the situation, call upon the leaky pipeline, or bemoan the difficulty of changing culture. As Pogo famously said, “I’ve seen the enemy, and he is us.”

The under-representation of women in science and engineering has many causes, some of which are rooted in childhood, when boys and girls confront divergent parental, scholastic, and societal opportunities and expectations. Indeed, part of our challenge is that universities stand at the *end* of a long and imperfectly constructed pipeline that is partially controlled by others, yet this does not excuse us from fixing leaks – and there are many – in the section of the pipeline that we *do* control. Nor should we forget that universities sit at the pipeline’s terminus and, therefore, add more value to the knowledge flowing through it than any other stakeholder.

When we place a premium on creating an equitable and supportive environment for female students and scholars, when we empower women to fulfill their potential in science and engineering, and when the human face of these fields is diversified, we send a very powerful message all the way back to the wellhead. The message we communicate is this: women *can* and *do* excel in disciplines where men have long predominated.

So if you are persuaded that we have good reasons for making science and engineering more inclusive, the question becomes one of “how do we get there?” There is no silver bullet – no instantaneous solution – but with determination and imagination, universities can surely change the climate for women where they are under-represented. Programs like ADVANCE will help Columbia University and, indirectly, all of us to identify the ways in which universities must change in order to achieve better representation of women in science and engineering. I salute Lee Bollinger, Jean Howard, and Robin Bell for the dynamic leadership they are providing.

The first and most intractable obstacle that many female scientists and engineers confront in our institutions is the sheer fact that they are sometimes overwhelmingly outnumbered by men. For, simply put, numbers really matter. I suspect that most of us, male and female, black and white, young and old, have been in the minority at some point in our lives. As a teacher in Sierra Leone in the late 1960s I learned what it means to stand out in a crowd, but I also knew that my time in Africa was limited and that this was an interlude in my life rather than a state of being. Female scientists and engineers do not have the luxury of going home, at least in a professional context.

Social psychologists have documented the disparate experience of men and women in male-dominated disciplines, particularly in those fields where there is a cultural assumption that women are less able. This can lead to “stereotype threat,” a phenomenon originally identified by Professor Claude Steele of Stanford and his colleagues in which targets of stereotypes perform less well when they are reminded of the possibility that their performance may confirm a negative stereotype about a group to which they belong. For example, psychologists Michael Inzlicht and Talia Ben-Zeev looked at the mathematical performance of male and female undergraduates in mixed and single-sex groups. They found that women performed more poorly in the presence of men than they did when men were absent and that this deficit actually grew as the number of men increased. Men, in contrast, were unaffected by the number of women in the room. Unfortunately, the women most likely to suffer in such circumstances are those with the greatest ability, precisely because they are so intent on disproving the negative stereotype. This may help to explain the fact that the gap between male and female scores on the math SAT is largest in the most gifted population.

Just in case you think that negative stereotypes are beginning to recede from view, consider this exchange between a Rhodes Scholar in mathematics, studying at Oxford University, and the Queen of England:

The Queen turned to me and said “And what about you?” “I’m from California and I’m studying pure math,” I said. The Queen made a little face that was trying to be friendly and uncritical, but showed playful disgust – at least I think that was it. “Ah...pure maths,” she said. “What are you going to do with it?” “I’m going to become a mathematician. I’d like to go into academia and be a professor.” She paused, looked at me, and then looked away, and said, “Not many girls have the head for...” and paused, wiggling her fingers up by her head, “pure maths.” Looking at her, amazed that the Queen of England thought not only that many girls do not do math, but that many girls cannot do math, I said “Well, actually, I think that most women are *told* that they can’t do math, and then they *don’t*.” “Ah...” she said, taking a step backward. Looking at me again, she moved on down the line.

The problem with the numbers game, of course, is that it poses a chicken and egg dilemma. It will not be possible to erase stereotype threat until we enhance the number of women in science and engineering, which we cannot easily do because of stereotype threat. While strategies to combat this vary widely – from exposing the dangers of stereotype threat to those at risk, thereby blunting its effects, to positive reinforcement through mentoring, to single-sex instruction – all should affirm the innate abilities of women while challenging them – indeed, expecting them – to exceed their present level of achievement.

I attribute my own resistance to the stereotypical view that women are not meant to do science to four things: an extraordinary father who taught me that I could do anything I wanted, and “don’t let anybody tell you differently,” highly supportive mentors who happened to have been men, strong and inspirational senior women colleagues at the right

times, and an absolute inability to recognize reality. Let me amplify the last point, which may be the least obvious. It has been my experience that many successful women in science simply fail to perceive that there are obstacles in their path. They are able to go through life with metaphorical blinders on – not that they would deny that there are forces working against the progress of women, but rather that they refuse to acknowledge that those forces apply to *them*. A blunt way to describe such women is to say that they refuse to allow themselves to become victims. They are able to deflect any slings and arrows that come their way. I do think that this is a tremendous survival tool, but one that takes the kind of self-confidence that only comes from strong parents and mentors. As mentors and as parents, we should be encouraging this trait in young women, rather than engaging in a lot of hand-ringing about how tough things are.

The importance of good mentors cannot be over-estimated. In the fall of 2001, I appointed a task force to examine the status of female faculty in the natural sciences and engineering at Princeton University. The task force found overwhelming support for mentoring on the part of male and female faculty alike, but among untenured professors, only 33 percent of women, versus 64 percent of men, reported having had this critical support. Other institutions face similar challenges. In a fascinating survey conducted by Cathy Trower and Jared Bleak in 2002, involving almost a thousand male and female tenure-track faculty at six research universities, women were “significantly less satisfied” than men in terms of 19 of 28 measures of workplace satisfaction, including the perceived commitment of departmental chairs and senior faculty to their success. In no areas were men found to be significantly less satisfied than women.

It is a fair question to ask why women report a greater level of dissatisfaction and a greater need for mentoring than men. One view is that these are signs of weakness on the part of women, signs that they need more nurturing than their tougher male colleagues. I would argue that young women’s dissatisfaction and call for mentoring grow out of their need to have the cultural milieu of science – a culture that was formed when all scientists were men – interpreted for them. To give you one example of what I mean – I attended a Gordon Conference in the early 1980s when my children were quite small. After the evening session a group of us were sitting around, drinking beer and talking about our lives. The men were comparing their travel schedules, bragging about how long they had been on the road and how long it had been since they had seen their families. Longer, in this case, was better. I was having precisely the opposite reaction – fretting about being away for a few days. Imagine the impact of that discussion on the female graduate students and postdocs at the table.

Let me give you another example where the culture – and the image of the stereotypical scientist – works against women. Several years later I was an organizer of a Gordon Conference. With my male co-chair, we put together a list of 45 speakers, a third of whom were women. We did not purposely think about gender, we just talked through names. The next year, that same co-chair organized the same conference – on the same topics – with a male co-chair, and when their list was published, 43 of 45 speakers were men. What had happened in just one year? The difference is that when I close my eyes and think “stellar scientist,” I can imagine a woman in my head. When my colleagues

closed their eyes, they only saw a man. This is not evil, it is human nature. In so many circumstances we have to fight against the natural instinct to associate with people who look and think most like ourselves. This tendency is exacerbated by the fact that the world works by lists, whether they are lists of individuals to hire, individuals to give prominent lectures, individuals to nominate for prizes, or individuals to appoint to important committees, and if women are not involved in making up the lists, it is almost inevitable that they will be overlooked.

I have taken a lot of criticism at Princeton for appointing women to positions of influence in the university. I have argued – *sometimes* successfully – that I did not do this deliberately or with a political agenda in mind. When challenged to explain why other universities have not hired as many women, my answer is always the same – that I have a huge advantage, for when I close my eyes I can *imagine* that a female candidate could actually be the best person for the position. Thus I have a larger pool to choose from.

The lesson that follows from these stories is – in the immortal words of Linda Loman – “Attention must be paid.” For the foreseeable future, we will have to be eternally vigilant to the ways in which the societal image of what constitutes a successful scientist or engineer is working against the goal of increasing women’s participation in these fields. The Linda Loman rule would argue that departments must be reminded by deans to look harder for female candidates for admission to graduate school and, most importantly, when hiring faculty. Deans must be prepared to turn back searches that have not considered any female candidates or have constructed the search in such a way that finding a woman is unlikely. I am not suggesting that a different standard be applied – I am perfectly confident that women scientists and engineers compete effectively when given the chance. Because chairs of departments are so critical in this regard, the choices deans make when filling these positions are also very important.

Finally, it has been my experience over many years that the greatest impediment to hiring a woman today is the two-body problem. Universities that are prepared to be flexible and creative, and willing to put some elbow grease into helping with spousal employment, are going to do better over time. I can tell you that the single most effective thing we did at Princeton to increase the number of women faculty in the last three years was to appoint Professor Joan Girgus, the former chair of Psychology, as a special assistant to the Dean of the Faculty. About half her time is taken up with helping spouses find employment.

It is clearly not sufficient to improve hiring practices. The same vigilance needs to be applied to issues of equity once women are on the faculty. That universities had been unconsciously treating male and female faculty differently became clear when the then President of MIT, Chuck Vest, a man of extraordinary character and courage, responded to Professor Nancy Hopkins’ request for an investigation into conditions for women faculty at MIT. What we all learned from their experience is that the Linda Loman rule needs to be applied on a regular basis to everything from salaries, to space, to resource allocation, to committee assignments. I believe we owe President Vest and Professor Hopkins a huge debt of gratitude for raising the issue and then addressing it in such an

open and forthright way. Their example spurred many other institutions to make positive changes as well.

There is another – and profound – way in which women and men experience careers in science and engineering differently, and that is not inside, but outside the laboratory. Let me give you some statistics to make this point. Over one-third of women scientists and engineers are unmarried, compared to 17% of men. Ten percent of married women scientists and engineers have an unemployed spouse compared to 40% of men. In a survey conducted by the American Chemical Society, 21% of female chemists identified balancing family and work as their *greatest* career obstacle, compared to 2.8% of men. These differences may help to explain a very worrisome trend. In my own field of life sciences women now constitute 50% of the bachelor's degrees awarded and are closing in on 50% of the Ph.D.s. Yet when my department and those at comparable universities advertise an assistant professorship, the applicant pool is composed of only 25% women. The same phenomenon is occurring in chemistry as well – a field that has made tremendous progress in recent years in attracting stellar women to graduate training. We have lost half the Ph.D. pool between the awarding of the doctorate and the first job application.

The underlying causes for this precipitous drop must be better understood if we are to make further progress in bringing more women into the academy in science, mathematics, and engineering. However, it does not take much imagination to recognize that the drop coincides with prime child-bearing years. Princeton's task force on women faculty in the natural sciences and engineering reported that "There is a widespread sentiment among men and women, from junior faculty to department chairs, that it is very difficult for women to succeed professionally and to have children." Indeed, as our task force also noted, "In discussions with both department chairs and individual male faculty, we were disturbed that several stated that childcare is not compatible with success in the Natural Sciences and Engineering."

I thought about naming this talk "Perception vs. Reality" because there is both truth and fiction in these views. It *is* more difficult to have a career as a woman and raise a family; there is no point denying this. Some sacrifices *are* unavoidable, for no one, least of all mothers, can *do* everything and *have* everything. There are books that will remain unread, creative and athletic outlets that will never be pursued, and friendships that will suffer. And there will always, always be late nights and early mornings.

My most inventive coping mechanism as a young mother (actually, I was quite an old mother, if the truth be told) involved my love of the Sunday edition of *The New York Times*. In my desperation for a tranquil moment to read this paper, I used to place my children – who are two years apart – in the car and drive aimlessly until the motion put them to sleep. As soon as they were both asleep I would stop – no matter where we were – and read the Week in Review. I often wonder what people thought of me as I huddled in my car, frantically trying to get through the next section before my children woke up.

There are data that measure the challenge women face in combining science and small children. According to a study published in 2002 and entitled “Do Babies Matter?” Mary Ann Mason and Marc Goulden found that “in the sciences and engineering . . . men who have early babies are strikingly more successful in earning tenure than women who have early babies.” In the context of their research, “early babies” are defined as infants who are born within five years of a parent’s completion of a Ph.D.” This disparity, of course, is precisely what you would expect in a work environment that was not designed for women with children, and one that has done little to accommodate the dramatic expansion of women in the workforce of the last 40 years. The feminist revolution of the 1960s and 1970s that opened so many doors for me proclaimed that women could and should find fulfillment in work, but there is a wildcard in this scenario that both complicates and enriches life. The wildcard is children, whose lives must be advanced as single-mindedly and carefully as our own.

The other wildcard has been the increased national preoccupation with work and the demand for instant results that long hours breed – hours that significantly exceed those of nations such as Germany, France, and Italy. Although the average workweek in this country has remained relatively constant since 1970, many Americans are working longer hours. Between 1970 and 2000, to cite a study by Jerry Jacobs, the proportion of men working fifty or more hours per week rose from 21 to 26.5%, and the number of women from 5.2 to 11.3%. The growth of two-income households has also increased the intensity of the workweek for many Americans. And then there is the rise of single-parent households, typically headed by a woman. Women without partners now head more than one fifth of our nation’s families, more than double the percentage in 1970. Needless to say, the pressure of the workplace on such families is enormous. And, to top it off, all of these shifts have occurred against a backdrop of technological changes that have compressed both time and space, making it easier to feel you are at work even when you are at home.

I firmly believe that universities can change their practices and policies to make it easier for women to balance the demands of family and work. And I do not mean to suggest that universities are unique in this respect – achieving a balance between work and family is fundamental to every workplace that hopes to include women. The first step, to paraphrase the political strategist James Carville, is to recognize “It’s daycare, stupid!” – daycare that is both accessible and affordable. When our task force asked what Princeton University could do to improve the environment for its current and future female faculty, the second most frequent response, after hiring more women, was to improve the state of childcare. This recommendation was also advanced by another task force – one that focused on the health and wellbeing of our university community. It concluded that childcare was the highest priority of faculty and staff. Quality childcare that is close to the workplace, responsive to the constraints of workday schedules and emergencies, and within the reach of a family’s budget is tangible evidence and a powerful symbol that an institution understands the complex lives of its students, faculty, and staff. In response to another recommendation of the health and wellbeing task force, we are hiring an individual who will focus on work/family balance issues for everyone at Princeton.

We have also offered one-year tenure extensions for each child and workload relief to new parents – male and female – but we discovered that men tended to take advantage of the tenure extension more often than women, who were afraid that requesting the extra year would be interpreted as a sign of weakness or lack of confidence. To overcome this problem we have just changed the policy so that the extension is granted automatically. This will not preclude someone from requesting to come up early for review, but it will mean that the extension will have no value judgment attached to it.

The tenure review process itself needs to be carefully monitored to ensure that it is truly rewarding excellence. We need to be wary of the numbers game – so many articles, so many citations, so many dollars – and weigh the true quality of the work produced by our faculty, male and female alike. What advances human knowledge? It is not the bulk of scholarship that crowds the shelves of our libraries or fills our electronic journals, but the seminal books and papers that break new ground and take us to a wholly new level of understanding. There is a natural desire to quantify our output, but this should not be the measure of scholarship.

Balancing family and work has never been easy, and it never will be. Much depends on the creativity and determination of individual parents. But as seats of learning, universities have both a capacity and a duty to shape our national discourse on this subject. By creating conditions where family and work can be balanced, we can serve as a model for other institutions and enterprises, a model that just might be contagious.

I prefaced my discussion of the obstacles that female scientists and engineers confront with the caution that there are no silver bullets. On the other hand, initiatives such as yours will lead to attitudinal and organizational changes that will one day complete the process that has carried women, who could not even vote in federal elections when my mother was born, into the mainstream of professional life. Let me close with the faces on the next slide – young women who are among the next generation of scientific leaders. They, and the thousands of other young women like them, are a source of inspiration for me, and I hope for your ADVANCE program. I wish you every success in this exciting new program.