

(Chris Comer, of the Texas Education Agency) who are hounded out of their jobs because of their support of evolution in school curricula, and have initial nods toward sanctioning the Institute for Creation Research (now located in Dallas) by the Texas Higher Education Coordinating Board, the same state agency that certifies the school I work at, the University of Texas at Austin. That said, I recently was invited to serve on a panel to review the ICR's graduate program, and I was extremely impressed by the professionalism and commitment of the other educators that were invited and by the staff of the agency. This wasn't exactly a revelation, but it was greatly reassuring. I was once privileged to hear Stephen Gould speak on his experiences with court cases involving Creationism, and he talked about sitting down and drinking lemonade with people who disagreed with him, and how they were all quite civil about their disagreements. I think my experiences are somewhat similar, in that while both sides are quite passionate about their interests, dealing with the people involved, the civil network we're all part of, makes it somewhat easier to put the disagreements in perspective.

Well, I'm glad you remain low key about these issues. Are you always so neutral? I would say I'm an equal opportunity curmudgeon. I also find the attitudes of many of my own colleagues to be moderately bewildering (and vice versa). In particular, while we like to talk about how biology is the study of life, we actually have no decent scientific definition as to what life is. In recent years, I've come to believe that this is because there is no such thing, that the term 'life' is more useful to poets than to scientists. We classify a large set of replicators as 'life' based on our experience. In so doing, we also assume that the classification has a fundamental meaning in and of itself, beyond its utility. This is the problem. We tacitly assume the very same notions that the lay public does in talking about life. In my view, many biologists are closet vitalists.

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My word

Women in science — passion and prejudice

Christiane Nüsslein-Volhard

Scientific research requires special talents, just as much as intelligence, passion and diligence. I do not know a single successful scientist who is really lazy, and only very few who are able to pursue at the same time other interests with intensity and success. Reaching a leading position in scientific research is very demanding and requires early independence and perseverance. These truths universally acknowledged hold for both men and women. However, measured by their scientific potential, women, whose intelligence is fortunately no longer disputed, were and still are underrepresented in science, in particular in terms of professorships or leading research positions.

I love being a researcher: it is a great pleasure to discover new things about life, to be able to run a large lab and to support talented young people in their careers. I used to work long hours in the lab while pursuing my own ideas and observations, but I also have come to enjoy having some power, being involved in decisions in scientific organisations or as an advisor in science policy. I am convinced that I would be unhappy without my science. Therefore, I often think about women of similar passion and personality, but facing circumstances that make it extremely hard or impossible to be successful as a scientist. Where are the problems, what can be done to solve them?

Presently, there is general consensus that efforts should be made to increase female contribution to modern science, not least because our society cannot afford to lose so many highly trained talents. After all, not all the males in leading positions are better than all the females in non-leading positions. In Germany, for instance, only about 11% of full professors are women. In the Max-Planck-Society, the leading

German research institution, the fraction of female directors is even smaller, about 7%. When I was elected as a scientific member and director of the Max-Planck society, I was one of only two women, and the only one in natural sciences. Ten years later, in 1995, the society was able to boast that 25% of their female directors had received a Nobel prize. Now, there are 19 female Max-Planck directors among a total of 266. Life as an exception, as a role model has not always been particularly comfortable, but with an increasing number of female colleagues and a general awareness of gender issues, open discrimination is now rarely encountered as a serious problem. It has not always been like that. In my early days, as representative of a small minority, I felt quite awkward, unprotected and often overlooked.

I grew up in Frankfurt in a liberal family. With my family I shared a cultural interest in arts and music, whereas my early passion for animals and plants was not shared by the others. It was nevertheless much supported by my parents, who allowed me to keep pets and bought the right books for me. At the age of twelve or so I knew that I wanted to become a biologist. I went to an excellent girls' high school with devoted teachers and a focus on science. At this school, I never had the feeling of not being taken seriously in my attempts at understanding science; moreover, gender differences and competition with males weren't an issue at that time. Such single sex schools hardly exist anymore, which is probably a mistake as for me this environment was very important and provided a strong support for my early determination to pursue a scientific career. Also, later as a university student, I do not remember having encountered gender problems, and as an ambitious and enthusiastic graduate student I felt generally well respected and appreciated.

My first significant experience with discrimination as a woman in science came while publishing the results of my thesis: The project had been started by a rather fortuneless male graduate student and I had finished it producing all of the data. However, on the three-author letter to *Nature*, which I had written, I was made only second author. The graduate

student, a good friend of mine, had a family — “he needs his career” was the comforting explanation. At the time, however, curiously enough, I even agreed to this! Such things as social considerations exerting an influence in assessing scientific contributions probably do not or at least should not happen any more.

I first encountered open prejudice as a postdoc: My supervisor had the attitude of giving women a chance, but at the same time was expecting them to fail. This made me very angry. It was no fun to work under a boss who openly declared that women in principle cannot do great science — “there is no female Einstein” — but could excel in other professions, such as pottery. At the same time, this made me even more determined to ‘show them’. My boss was glad when I moved on, and so was I. At the EMBL in Heidelberg, I was offered a group leader position, but only after it was clear that a younger male colleague would share the lab with me. A woman alone would have not been entrusted with her own lab.

This, however, turned out well, because the male colleague with whom for three years I shared a discussion microscope and a tiny laboratory was Eric Wieschaus. The fact that we were thrown together to work with one technician made us embark on a fantastically interesting and challenging project which fifteen years later won us the Nobel prize.

When I was appointed a director at the Max-Planck Society in 1984, I regarded this as a great success, until I found out that never before or after had a new director got as little funding and space as I had. But soon fate changed: Owing to very good working conditions and excellent students and postdocs my lab was very successful. Recognition came, which encouraged me to ask the president for an upgrade, and finally I was granted what my male colleagues had received without special merits.

Looking around now, I think the situation for women in science has changed considerably, and the types of open discrimination I experienced are becoming rare. By contrast, in many countries enormous political pressure is being put on universities and research institutions to increase the fraction of female scientists

in high level positions — even though some disciplines, such as chemistry and physics, do not seem to attract many women. This raises the question of what the aims of the policy towards women in science should be. Should there be equality in all respects? Should 50% of all high level positions in all fields be filled with women? Is this aim reasonable, and if so, how can we approach it?

I confess that I do not think that this particular aim is reasonable. I have observed that while many women may admire me for my success, they admit that they “would not want my job”. Men and women are different by nature, not only because of their education or the roles traditionally ascribed to them by society. Of course, I do not think that women are in any way less intelligent than men or do not have the capacity to do excellent science in principle. It is not a matter of skills or talent, but according to my observations the strengths, aims and interests of women differ from those of many of their male contemporaries, at least on average. I know many women who share my disgust for the personal pride, vanity and narrow focus of some successful male colleagues and in turn appreciate the more considerate, broad-minded way some female colleagues do their science. I understand women who hate to push themselves forward, or who are not willing to narrow down their spectrum of interests, including family and friends. I have often experienced that women in my family — much more so than men — have a hard time understanding my passion for science, while they are more interested in social issues, art and music.

Finally, for many women, a leading position is simply not attractive, because it means directing other people’s activities and involves the necessity to exert power, which includes making unpopular decisions. This, in a nutshell, is what leadership means in science: acquiring the power to let other people work for you to support your individual scientific projects, and not those of a supervisor. In many universities and research institutes in Europe, the only independent positions are leading positions,

associated with considerable resources and administrative tasks. Lean independent research positions with few responsibilities outside the running of the research project, which might be more attractive for many women, are rare — or reserved for cases with dual career problems.

Personally, I have pursued broad interests while at school and as a student, but necessarily had to focus considerably during my scientific life. I have no family, which helps avoid a lot of possible conflicts of interest. In my scientific career I have been fortunate and more successful than one is entitled to expect. Nevertheless, not all women trained as scientists would like to be in my position. This has to be respected. However, it is obvious that in our society many gifted women with great potential and ambition do not succeed at a career in science because of a complex set of unfortunate circumstances.

I have already mentioned several obvious discriminatory situations hoping that they belong to the past. Most important of all, the lack of confidence and trust by supervisors or deans of faculty, as I have experienced it, can be very inhibitory. At the same time, I am convinced that care must be taken to not shield women from just and fair criticism — the kind of pressure and challenge that every scientist needs in order to successfully develop her or his career. Well intended protection, which also often means taking away important opportunities to build up your profile, can be as harmful as open hostility. A good rule of practice is to mentally go through a given case and ask if the same expectations and questions would also be applicable to a male scientist.

Frequently, it is the women themselves who lack confidence and are too timid and modest. Also, women often present themselves less convincingly than their male colleagues with equal qualifications. Many men are unable to recognise scientific talent in the disguise of a female phenotype. I have often experienced that women do not have as much of a problem admitting they made a mistake, but this is often held against them. Mistakes and failures are tolerated less than those of male colleagues, who are shielded by a network of loyalty in which women

often are not included. Although this probably reflects a minority issue rather than a gender issue, it may affect all women as they are 'tainted by association'. On the other hand, women displaying attributes that are generally regarded as more masculine, such as a loud voice, dominant, aggressive behavior and an open display of self-confidence are also not appreciated in our society. In addition, a woman singled out as a successful scientist is often sensed as a threat, and awe-inspiring by her contemporaries, both male and female. In our society, features of attractive women traditionally concern beauty or social skills rather than intellectual achievements. In retrospect, I realise that I intuitively shielded my success from my colleagues and friends as much as possible in order to avoid provoking them. It has to be considered that for many men it is much harder to accept the superiority of a female than that of a male colleague.

Career problems that arise when both partners are doing science, such as restrictions in mobility or the difficulty to find equally attractive job opportunities, often affect women more severely than men and frequently lead to the woman working for her male partner. Although this might be suitable in many cases, for the woman it often means giving up an independent career. The problem to combine a family life with a high-level career affects mainly women. Even if the husband does his share of household tasks, the woman will bear the children and will generally be more involved in their care. As a consequence, many women scientists decide not to have children. In other cases, they adopt less ambitious and more dependent positions, often after desperate attempts to combine doing science and having a family. However, positions in science administration, writing or industry, even if well paid and interesting, often provide a painful and difficult compromise for a passionate scientist. Therefore, in our societies we should do all we can to enable talented and ambitious women scientists to pursue a successful, independent scientific career even with a family. The prejudice of some male scientists against women collaborators with

children probably is because they simply cannot imagine how they themselves would have made a career without the steady support of their wives. This is why some successful women hide the fact that they have children. However, ample examples of great woman scientists who have managed to combine family with a successful career have demonstrated that this is possible, provided support and fortunate circumstances.

There are a number of characteristic 'career traps' for women both with and without children: Some women take long maternity leaves and often return on part-time positions. This frequently ends in a 'drop-out' from an independent career in science; in the meantime, the interesting projects may have been taken over by others, because they would take much longer, causing difficulties for lab mates and supervisors. It is very difficult to catch-up lost time, and new investments are required to update the qualification and produce scientific discoveries enabling a career step. Talent, skills and qualifications do not automatically guarantee a scientific career, but to do so, they must lead to the production of some original scientific contributions in the form of publications. This does take time and energy, there is no way out. Concessions may be made to women with children with respect to their age, but not with respect to the quality and impact of their publications.

Women sometimes have great emotional difficulty to hand over parts of the education and caretaking of their children to other people, even if these are professionals. In many European countries, the society's influence leads to the mothers suffering from the situation much more than necessary, causing bad conscience that they do not spend enough time with their children. Provided the day care is of high quality, however, most children actually do enjoy it, and in the company of other children they may get in fact an excellent education. For instance, the campus at my institute hosts a day-care center supported by the Max-Planck-Society, which provides ideal solutions for mothers and small children.

Some women — especially those who have grown up in Austria, Switzerland or Germany — even refuse to accept domestic help in their household. Women scientists should not hesitate to ask for (and pay for) any possible support in household chores to gain time to spend with family or in the lab, rather than having to do laundry. In particular, for women with children household support will be immensely helpful. Obviously, for women at the beginning of their career such help is too costly. To overcome this problem, I am running a foundation (www.cnv-stiftung.de) together with my colleague Maria Leptin, which supports talented young women with children with individual grants for household help. We are still at the beginning, but our first impressions are positive, not the least because of the encouragement and moral support we can give these women.

One other problem concerning women more than men is their readiness to perform what others request of them in terms of organisational matters in their institutions. In addition, because women still represent a minority in science, they tend to be overwhelmed with proposals for memberships in committees, panels and other professional tasks. Too many such duties can easily ruin a promising career. Women must say no to such requests more frequently than men, and they have to endure not being always loved for this. Men should become more aware of gender issues, which would render the obligatory female participant as an observer in commissions unnecessary.

It is probably safe to say that the prospects for woman scientists were never better than they are now, but we are not yet at a stage where women have the same opportunities as men to turn their passion for science into a successful career. I hope that all the efforts that are underway will soon lead to a situation that the topic of women in leading positions in science is no longer an issue that needs to be discussed constantly.

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