

Women scientists: A contradiction in terms?*

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There are many problems in education today and in science education in particular. Outdated curricula, lack of sufficient infrastructure in laboratories and classrooms, too few qualified and interested teachers and unmotivated students, among other things, are responsible for this sad state of affairs. Since several people have already talked about many of these points, I will concentrate here on one particular aspect that is of interest to me as a scientist and a feminist—the failure of the system to attract sufficient women (who are half the population of the country!) into science.

It does not require a great deal of effort to see that women are under-represented in the scientific and technological community in the country. In fact, this under-representation is a global problem with almost the same state of affairs even in the technologically and materially advanced western countries. All over the world, women have not found opportunities to participate equally either in the pursuit of science as an abstract truth or in the development of technology. Generically, they have been seen as consumers and the end-users of technology.

This problem of inequity in the participation of development of science and technology has been addressed by some feminists who, however, question the very nature of science as it is pursued today as an attempt to dominate nature and as patriarchal. Among many Indian feminists, science is more and more being seen as 'western-dominated'. While some of these criticisms may be true and should be thought through, many of these debates themselves get confined to feminist or intellectual magazines and are not generally easily available not only to the lay public, but even to working scientists. Even the language used is such that it is difficult for a working scientist used to reading papers in physics, maths, biology or chemistry, to plough through these articles.

Although I do think that working scientists should be aware of these issues, and that there should be a forum where such issues are debated, here rather than go on to global issues, which I may touch upon at the end, I wish to give my own perspective on why there are so few women scientists in our country and my ideas on how to improve this state of affairs. As a working theoretical physicist—I started my research career in particle physics, but now I work more on condensed matter systems—who has been trained in the US and has been working in research institutes in India for the last ten years, my experience at the grass-roots levels of teaching and even of women's problems in schools, colleges and universities is clearly limited. However, from my own experiences as well as experiences of other women who are continuing in science and those who have dropped out, I do have some ideas, which I would like to share with you.

In India, discrimination against women has never been too subtle. Besides direct attacks on women such as female infanticide and burning brides for dowry, patriarchal attitudes and the conviction that women are inferior, prevail at homes, schools, colleges, universities and even research institutes. But this is a societal problem, which is far too big to address directly, and perhaps here we had better limit ourselves to looking more at specific education-related problems.

To start with of course, primary school education itself is denied to a large fraction of girl children. It goes without saying that this state of affairs has to change and perhaps incentives need to be given to encourage poor families to send their daughters to school. But my concern here is more with school-going girls, who are still 'less equal' than school-going boys. Many young girls have more household chores than boys simply because the family has not been educated enough to realize the importance of education for girl children. Besides, often, the standard of science and maths teaching is much lower in girls' schools than in boys' schools. So even at very early stages, selections for academically and scientifically oriented bright kids work against girls.

But even in the more privileged section of society, girls are often not encouraged to study maths and science, which are generally considered hard subjects. Subtly and not so subtly, they are shunted towards humanities as being more suitable for girls. The subject material in science subjects including examples and problems is often gender-biased and the role models and images of women that are presented are often subordinate—for instance, as nurses instead of doctors or as assistants or subjects with males as the scientists or observers. In many co-educational schools, teachers only talk to the boys in the class, expecting them to be smarter. Since achievement so often depends on expectations, the fact that society and even teachers expect the girls to be less capable in these subjects affects their achievement, which in turn affects their self-esteem and hence they are turned off these 'hard' subjects. There is yet another subtle issue at play again both at school and in the homes, during the formation of these young minds. Girls, much more than boys, are subject to an enormous social pressure to conform. Even in middle class families, boys are allowed much more freedom to be different and to question elders and teachers. In a boy, an exceptional talent in a particular subject, is tolerated, if not encouraged, even if the child is not good in other subjects or is socially inept. That freedom is certainly not available for young girls. She is told in much more strict terms to obey her elders' and not question things. She is allowed to study, but only on condition that she otherwise conforms socially. This hampers the creation of an inquisitive and questioning mind, which is one of the essential prerequisites for doing science, right from the very beginning. Not only is it just that conforming to the rules set by parents and society is much easier than rebelling and getting punished, for girls in particular, the punishments for rebellion are always far more severe. This is why, even though boys who are interested in non-standard subjects (for males) such as music or the fine arts are discouraged, more of these non-conformist boys manage to escape.

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In this context, I should mention that today, on the eve of a new millennium, when all over the world, there is a special and concerted effort to remove gender bias in education, things are getting even worse in India. According to a recent *Times of India* report, the human resources development ministry has set forth a most backward looking proposal for educational reform. They are proposing different curricula for boys and girls with subjects like 'home-keeping' for girls! This is a most dangerous and regressive trend. They also advocate moral and spiritual education with emphasis on studying old texts and the present government version of history and civics, rather than science and maths. This is an exceedingly misguided idea and can only lead to even more polarization than currently exists, in the educational system. We will have elite schools which will teach modern science and modern subjects and government schools, where only ancient texts are taught and the difference between the western-educated ruling elite and the masses will only increase. I do hope that bodies such as this (the National Academy of Sciences) are aware of these highly backward-looking, counter-productive policies and will take sufficient action to prevent them from ever being implemented.

Coming back to the subject at hand, at the college or University level, the girls are subject to even more pressures. Besides, the not-so-subtle pressures of sexual harassment outside the home and the pressures of impending marriage in the home, she again suffers from low expectations, both at home and in the college. Again at this stage, she is denied the freedom of movement allowed to her male class-fellows to go exploring their own interests be it botany, astronomy or taking apart a motor-cycle. Besides, even in purely theoretical pursuits, the questioning mind questions everything including religion, traditions and social mores. If limits are placed on some forms of questioning by a patriarchal society, how is the mind free to create? Some of this reasoning applies to young men as well. This, in my view, is one reason why older cultures have a harder time producing creative and innovative people than newer cultures like the US, where the average person is certainly more creative and innovative, even if often, his or her idea is just plain wrong! However,

more young men, simply on account of the time they spend away from home, are able to escape the confines of conditioning and tradition bound stereo-typed thinking than reasonably intelligent young women.

In the realms of higher education, the problems of women only become worse. The pursuit of science requires a lot of discipline and hard work and dedication to the subject and is not particularly remunerative. The rewards in science are from the pleasure of the work itself, the sense of achievement from being the first to do something and the appreciation of fellow scientists, if one is sufficiently successful. Since a lot of the joy in being actively involved in science comes from the pleasure of discussion and interaction with fellow students, women post-graduate and PhD students, particularly in universities, being very few in number and often housed in 'girls' hostels which are faraway from the 'boys' hostels, miss out on this informal interaction where a lot of learning and teaching takes place. Besides, for most women, the years of dedication to research imply that she has to forego the standard pleasures of marriage and family. This is not a sacrifice that has to be made by her male counterpart. If she does get married, she (and her husband) have to deal with the problem of finding jobs in nearby places, or deal with a commuting marriage. If she has children, her divided responsibility during the early years of her children may drive her out of the competitive job market. With all these problems, is it any wonder that so few women opt for a career in science?

A valid question at this stage may be to ask why do we want to have women in science at all? What can participation in science do for women? For one thing, a career in science encourages rational thinking and that is a quality which everyone, man or woman, needs to cultivate. Besides specific benefits like eradicating superstitions and improving health, it actually changes ways of thinking and interacting with society. Rather than depending on authority figures, it teaches people to think and make their own conclusions, not just about the scientific work they are engaged in, but about the society they live in. In fact, if rational thinking is needed for society, the more women who can think rationally, the more society gets affected, because as is usually said,

if you educate a boy, you educate him alone, whereas if you educate a girl, a whole family gets educated. Moreover, science is an activity funded by society and women as well as men have the right to take part in it.

The million dollar question of course, is how to get more women into science. I have no easy solutions to offer on this issue. A lot of the problem is societal and without an overthrow of the patriarchal society that we live in, perhaps complete parity is hard to achieve. However, even at the grass-roots level, sufficient awareness can be spread through the media (which is a very powerful organ of social change) that it is a good idea for families to treat boys and girls on par, and that boys should also be taught to accept 'home-keeping' as one of their duties. (In fact, this is what an enlightened human resources development ministry would have done—realized that 'home-keeping' is a skill that everyone needs to learn! However, perhaps, that kind of enlightened and visionary approach is far too much to expect of this government, or indeed, of any government.) But this change can only genuinely happen in many families, when side by side, society recognizes that both sons and daughters are equally responsible for looking after their parents in their old age.

At the educational system level too, there do exist a few positive efforts that can be made. I am not in favour of reservation, (though there are other feminists who are in favour of it) because at least in India, it has generally led to more biases. Often a stigma gets attached to the recipients of a quota system and they lose out in self-esteem. More importantly, it appears to lead to a violent backlash by the dominant community which will definitely be counter-productive for women in the long run. But there are other measures which can be taken to interest and encourage bright young women in scientific careers. These days, girls often outperform boys at school-leaving exams. What happens to all those bright young girls? Many of them are just not allowed to go for higher studies, or they are shunted off into subjects with a higher market value in the 'marriage market', even if they are interested in subjects like science and technology. To prevent this, perhaps there has to be institutionalized counselling of families

of girl children by the school. School teachers in particular, need to be specially trained to be sensitized to the gender problem, provide encouragement to young girls and perhaps provide them with familiar and positive role models such as ex-school girls from the same school who may have done well. Regarding confidence building in young girls, there has to be more encouragement and scope for girls to compete in quizzes and debates. At college levels, men have to be explicitly taught to get over their sexist biases. Since women are the victims of social bias, many women learn to think and analyse social issues, but for most men, this is not a need, and except for the few who come in contact with enlightened women, the others are content to remain ignorant and sexist. Other specific things that can be done include special awards and special fellowships for women in colleges and universities and also perhaps at higher levels of Ph D and post-doctoral fellowships. Regarding problems like marriage and children, perhaps leave rules can be relaxed so as to give a woman a choice to take unpaid breaks in the middle of her career, whether as a student, a post-doctoral fellow or a faculty member. Taking this into consideration, perhaps age-limits can also be raised for various fellowships and so on.

Another important point in India is that the special problems faced by women in entering male-dominated areas have not yet been acknowledged. In countries like the USA, where to an extent, the establishment has been sensitized to the question of women's participation in science, the issue has been on how to make science 'women-friendly', and how to encourage and increase the number of women participating in science, through affirmative action programmes and special awards. These have been seen as serving to correct for white, male biases in the establishment and to make sure that the best people are selected, irrespective of sex, race and colour. Now perhaps the time has come to study these things specifically in an Indian context and evolve strategies to improve the women to men ratio in scientific and technological institutions in India. At least to me, it is clear that some sort of affirmative action

is needed to counter biases by the predominantly male 'old guard' in science. This is not a trivial point. I have been at selection meetings where people often make decisions on hiring by deciding that A will not come for the job because her husband has a job elsewhere, and hence deciding to hire B, who was second on the list, but a man. Perhaps we also need some sort of consciousness raising activity to teach the male establishment to be less sexist. This again is not a trivial point. The more men there are who are sensitive to these issues, the more 'women-friendly' and less alienating the atmosphere becomes.

Finally, at the end, I would like to take the opportunity to raise yet another point. Are science and technology as pursued today inherently sexist?

I do think that the application of science has often been to dominate nature, without worrying about long-term effect on environment, etc., whether it has been the green revolution or the development of the bomb. Long-term use of fertilizers and pesticides to increase productivity has led to ecological disasters in various parts of the world and there is still no safe way to dispose of nuclear wastes. It has also certainly been true that third world countries like India have just taken over western technologies without a thought for local problems. I think that it is extremely important to take local people, feminists and scientists who study effects of technology into confidence, when large-scale technological planning is done. I am not advocating throwing out technology, but dialogues between various groups of people who think differently, would be the way to evolve new or alternative technologies.

But for pure sciences, I must confess that I see no 'alternative' science. In fact, I do not see science or understanding nature as patriarchal or value-based at all. The language and metaphors of the understanding or even the choice of problems or ways of approaching problems can be culture or value-based. But understanding finally is not culture-based, because it appears to be the same all over the world now. What is more, understanding as such, or scientific methodology was no different even in

ancient times. However, one must keep in mind that I have also gone through the same selection procedures and have been trained in the dominant scientific culture of the day like all the other male physicists. As someone who has been successful to a certain extent in the male domain, my way of thinking is no different from that of my other male colleagues. The only difference is that I am not dogmatic and sometimes wonder not only whether women are missing something by not pursuing science as a career in greater numbers, but whether science is missing out on many discoveries by not having more women!

In fact, although I am approaching this topic from the women's point of view, a similar argument can be made for other marginalized groups. In India, in particular, science is very much an upper caste activity. And it is likely to remain so, as long as the exams and selections remain the way it is. As long as one thinks that the kind of linear, logical thinking that one is now testing for and in which given the educational differences, more men than women excel, is the only skill needed for science, then at least at present, men will dominate. But the question I have is this. Do we really know that the kind of selections we make and the kind of scientific training we give is the only way to bring about the best or fastest possible progress in science? It seems to have been working for many years and all over the world. But how do we know how many new discoveries we have missed, because no one has ever thought to ask the appropriate question? New ways of looking at things could certainly lead to new and exciting science which perhaps today, we cannot even dream about. It is difficult to give examples, because we are now trying to guess what no one has thought about and perhaps not much can and should be said about it until the disadvantaged groups themselves, be it women or other marginalized classes, come up with appropriate new ways of dialogues with nature.

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