The Glass Ceiling: The Why and the Therefore.

The careers of women in science in the third World reflect a curious intermingling of the societal conditions and contradictions. While the rhetoric of development/modernization etc, has certainly opened up the portals of education for women; the extent of their integration and progress as scientists is still governed by patriarchal and archaic mores. This not only determines their position in society/workplace but also, colours their perceptions of science as a career. Women's ambitions are low because cultural process of socialization fosters a low self-image.

A socially inclusive knowledge society empowers all members of society to create, receive, share and use information and knowledge for their economic, social, cultural and political development. A knowledge society emphasizes people. It focuses on their skills and capacities. But in the same way that many women — particularly those in the developing world — are on the wrong side of the digital divide, so too are women on the wrong side of the knowledge divide. Even highly-educated, well-respected professionals, women in S&T careers who should have been among the most privileged, are by and large a not- so- large group marginalized by a patriarchal society.

Historical background

Historically, it is pretty well documented that the education of women has always lagged behind that of men...except for some exceptional individuals. During the early Vedic period, the names of a few prominent women stand out. Leelavati, the mathematician and Gargi, the philosopher are two such women. *Atharvaveda* emphasised the importance of education of women for a happy home. It was only in Mediaeval India that political and social transformation lowered the status of women and consequently their participation in educational activities. This state of affairs persisted till the eighteenth century when education was opened up again. By the late 19th century, social customs amongst the anglicized elite coupled with resurgence in social reform movements proved to be a

catalyst for women's education. Female literacy crawled from 0.2 per cent in 1881 to 1.8 per cent in 1921. Science and technology in India witnessed expansion in the post-Independence era. The Educational Commission (1964-1966) emphasized that Mathematics and science are important subjects and adequate preparation therein is essential to gain admission to significant courses at the university stage. It recommended that special efforts should, therefore, be made to encourage girls to study mathematics or science at the secondary stage and special efforts should be made to prepare women teachers in these subjects.

The prevailing idea in Europe and everywhere was that education would distract women from their natural roles as mothers. In England, during Queen Victoria's time the prevailing thought process was that a woman could not fill her preordained place in society if she wasting her time gaining knowledge. In USA, it was not till 1833 that Oberlin College was founded as the first university to accept women.

A look at Cambridge University's history shows just how long the struggle for inclusive education was. It was not till 1881 that women gained the right to take the Tripos examinations. Even though Cambridge was one of the first universities to encourage women to study they did not award women the same degrees as men upon completion of the same tests. Still women were willing to study despite sub-par compensation upon completion of school. It was not till 1921 that women were given the titles of degrees and women undergraduates were given the right to attend University lectures. Yet they were still denied associated privileges (ie. no participation in University government…this came in 1947). In 1987 The University formally adopted an equal opportunities policy.

This legacy of history is a burden we still carry. Science and especially, technology, has been considered 'masculine' for a long time and gender gap in science is still observed in most societies. The very First Five Year Plan (1951-56) of the Government gave some attention to women but, as a subject of 'welfare'. The shift in the approach from 'welfare' to 'development' of women could take place only in the Sixth Plan (1980-85).

The social norms, societal structure, relationship between family and work, and the organizational processes of scientific institutions, have created a series of interrelated problems for women in science. This has led to what is called the “Glass Ceiling” an invisible barrier to progress. It is a solid barrier even though it cannot be seen!

FUNCTIONAL GLASS BARRIER

Women Scientists measured against Awards and Prizes: the Yardstick of Success

The Inter Press Service News Agency published a report in 2009 that revealed that women scientists are sidelined by male-centric selection committees for awards and for appointments to R&D positions in government funded organisations. A gender-wise breakup of data related to three important national awards - SSB, Young Scientist and National Bio Science award - shows a consistent marginalization of female scientists and technologists.

There were very few females among the recipients of the Young Scientist awards since it was instituted in 1987. Of the total 133 people who won the award up to 2009, only 17 were females. Between the years 1999-2003, only two women scientists have received the National Bio Science award instituted by DBT. There are just a dozen or so women scientists in the 443 scientists who have received the prestigious Shanti Swarup Bhatnagar award (instituted in 1958 by CSIR) in the last 50 years. Between 1999-2003, not a single woman has received this award.

Very few women are elected as fellows of Science Academies. The INSA report shows that:

- Out of 744 Indian National Science Academy Fellowships only 3.2 % went to women
- Out of 841 Indian Academy of Sciences Fellowships only 4.6 went to women.
- Out of 395 National Academy of Agricultural Sciences Fellowships only 4 % went to women.
- Out of the 502 awards and medals given by INSA only 14 (2.8%) have gone to women.

The INSA report (2004) had also pointed out similar findings. It also says that women seldom receive awards open to both sexes.

However, gender composition of the Indian Academy of Sciences Fellowships during the period 1995 to 2007 shows that the number of female fellows has increased from 2.98 % to 5.25%.

This is not the case just in India. It is a global malaise.

The Nobel Prize and Prize in Economic Sciences have been awarded to women 41 times between 1901 and 2009. Only one woman, Marie Curie, has been honoured twice, with the 1903 Nobel Prize in Physics and the 1911 Nobel Prize in Chemistry. This means that there are only 40 women Nobel laureates out of the 806 Nobel Prizes that have been awarded between 1901 and 2009.

Pay Discrepancy

In 2010, a report in Nature has shown that on every continent, in every country, where adequate data exist, , 6–10 years after completing PhDs, women scientists are paid less than men, and the gap widens over time.

ROOTS OF THE PROBLEM

Although girls seem to consistently outperform boys in the Board examinations, the enrollment of women in higher education, particularly in science has not kept pace with the promise of the first Board exams. Since 1951 there has been a steady growth in universities /university-level institutions in India. The participation of girls at all stages of education has also been increasing steadily through the years. But the wide gap between women and men entering University persists.

Attrition

Relatively more women tend to persist with studies after graduation though some attrition occurs at the level of Ph.D. This interesting finding differentiates India from many other developed countries. (At MIT, USA a survey found continuous attrition as one moved from undergraduate to graduate to post-doctorate and faculty positions.) This has led to some speculation that in India, if the “leaky pipeline’ is plugged at school level (stopping school dropouts) the presence of women in higher education, including science may increase.

Gender difference in Enrollment

Enrollment of boys and girls also varies regionally. Urban women are more likely to gain access to higher education as compared to their rural counterparts. So while the caliber may be the same; timely motivation and grooming make the difference. This is evidence that the attitude of parents/teachers influence academic decisions. The INSA Report of 2004 found that in states such as Goa, Kerala, Punjab and Pondicherry more than 50 % women enrolled in colleges (2000-2001) but in states such as Arunachal Pradesh, Bihar, Jharkhand, Orissa and Rajasthan less than 35 per cent women did. The enrolments in the other states were between these two extremes.

Gender Stereotyping of Subjects in S&T

Another problem, similar to the trend in western countries relates to the disciplines in which women enroll. The highest representation of women is in education. Education, to a larger extent, is considered to be most apt subject for women as it is compatible with other responsibilities of women as mother and wife.

This is followed by disciplines like arts and medicine. It is only in the past 15 years that their enrolment has shown an increase in the trend. Though medicine has been a favorite discipline among females, the rate of growth of male-access to it is larger and faster. Even in Medicine, women tend to take up radiology, pathology and anesthesiology much more as compared to say, neuro-surgery. The INSA report says that there is clustering in obstetrics/gynaecology, pediatrics and pathology. Few enter the more lucrative male-dominated orthopedics.

The participation of women in engineering remained almost negligible till the early 1980s.

The INSA report quotes a 2002 finding that there is 32 % enrolment in Physics in India. This is quite high as compared to 36% in Poland and 6 % in the Nederlands.

In a report published by NISTADS it appears that there are 61,050 women employed in R&D establishments, which is 15.6% of the total manpower employed in the country (DST, 2008). By the nature of activity, 12% women are primarily engaged in R&D activities, 11.5% in auxiliary activities and 17.4% in administrative activities. 84% of the total women were employed in the institutional sector. The majority of them were engaged in administrative activities (Research and Development Statistics, 2007).

Globally, women tend to go in for the natural sciences more as compared to the perceived to be “harder” disciplines such as Mathematics. So deeply entrenched is this supposed aversion that even Barbie doll was once made to utter the words that mathematics class was tough. This is an example of how gender stereotypes are reinforced from an early age…even while a girl child is at play. Today of course there is a lap-top carrying Barbie in pink, which hopefully will carry a subliminal message of equality and empowering technology.

Post -Education Scenario

Paradoxically, even after having obtained higher education, societal pressures and family obligations affect a woman’s chances of getting a job of her choice. Interestingly, a survey of professional women’s attitudes towards education, employment and family situations has revealed that most women retain traditional values. This means that economic empowerment does not necessarily translate into independence in other spheres of life. And when they do find employment, most women scientists struggle in a male – dominated workplace that often marginalizes them.

The Struggles of the Pioneers

- Even Marie Curie had to face discrimination. Marie Curie was denied a place at Kraków University merely because she was a woman. In 1911 the French Academy of Sciences refused to abandon its prejudice against women, and Marie Curie was denied admission as Member by two votes. It would be Marguerite Perey, a doctoral student of Curie, who would become the first woman elected to membership in the Academy — over half a century later.
- *Kamala Sohonie (1912-1998) was the first Indian woman to get a PhD in a scientific discipline. She carried out detailed biochemical studies on three major groups of food items consumed by the rural poor and established their nutritive value. When Kamala Sohonie applied for postgraduate degree at IISc, after completing her graduation from Bombay University in 1933, C.V. Raman summarily dismissed her application despite her having topped the university merit list that year. And the reason? Sohonie happened to be a woman! “I am not going to take any girls in my institute,” said Raman. But Sohonie went all the way to Bangalore to confront the Nobel laureate and demand the reason for being

refused admission despite her outstanding academic record. “Though Raman was a great scientist, he was very narrow-minded. I can never forget the way he treated me just because I was a woman,” she said later (1997) at a meeting of the Indian Women Scientists' Association. After much hesitation she got admission, the first women to be admitted by Raman. “Even then, Raman didn't admit me as a regular student,” she recalled. After a year Raman was satisfied with Kamala’s sincerity and allowed her to do regular research in biochemistry. From then on he started admitting female students to the institute. This was a landmark victory for Kamala. Her struggles made life considerably easier for other aspiring women scientists.

- Anna Mani (1918-2001) distinguished Indian meteorologist; former Deputy Director General of the Indian Meteorological Department made significant contributions in the field of meteorological instrumentation and pioneered research in the areas of solar radiation, ozone and wind energy measurements. She was another of Raman’s students and recalls that he maintained a strict separation of sexes in his laboratory. The crucial practice of discussion and debate about scientific ideas among peers was denied to women, rendering them peripheral to the scientific enterprise. Casual, informal association with male colleagues was strictly out of bounds. Raman frowned upon any interaction between men and women. It is a reflection of the loneliness and professional seclusion forced upon the women. However, Anna Mani is a success story to which few women (or men) could aspire. She transcended the delimited cultural and physical spaces available to her…although the University of Madras denied her a formal PhD degree.

Social Barriers

There are social as well as institutional barriers to the continuing education of women especially when it comes to S&T and engineering. Discrimination component is much higher in scientific and technical fields in India than among social sciences and other fields. Women in all professions perform a double role of managing job and domestic responsibilities, which has been commonly referred to as a ‘dual burden’. In science, the dual burden is combined with various problems that are specific to scientific profession.

The prevailing socio-cultural systems in India result in a 'triple burden' for women in academic and scientific careers.

Social role and prevailing mindsets

A woman is primarily still seen as a home maker. Marriage, not career is perceived to be the primary goal of women. A degree that is appropriate in enhancing her prospects of making a good match and for a career in case of widowhood/divorce is the degree she is encouraged to pursue.

- Women's employment is increasingly accepted in society; but there is lingering expectation that they should primarily shoulder the household/domestic duties particularly, the care of children. This impinges on her career in different ways depending on the nature of her profession as well as the stage at which her career is poised.
- Some women scientists, but not all, incur breaks in career for child bearing and rearing. Age-related, re-entry difficulties exist for those who take such breaks, so most women scientists try to rejoin as soon as possible. Paradoxically again, there is overt and not-so-overt societal assumption that this is actually leading to neglect of the child…and places extra burden on the woman's shoulders.
- The responsibilities of parents, in India at least, do not get over when the children grow up. Older children, particularly girls are considered just as serious a responsibility as very young children. The dual responsibilities faced by professional women are thus quite heavy; some problems are chronic and others acute at certain periods of the careers.
- Science calls for long and uncertain hours and this often discourages women from taking it up as a profession.
- Then again, women scientists with children are often not eager about field work for extended periods.
- Women scientists may find it difficult to live under field conditions, particularly if the areas do not have basic facilities.
- They may find it difficult to go on tours except for a limited extent. Often they are unable to attend conferences or workshops for special trainings.

- Many women are not comfortable traveling on their own and thus senior administrative/management positions that entail traveling may pass them by. In one Indian survey it was found that on average a male scientist traveled 4 times as much as his female counterpart.
- Most women also do not socialize with their male colleagues…partly because of gender socializations as well as because of social restrictions. Personal interactions of women scientists with male colleagues are deeply constrained by standard patriarchal cultural barriers of so-called morality
- Women scientists are therefore unable to meet and establish personal camaraderie or network/lobby well or to jockey for positions. This inability often leads to women being overlooked. Perhaps the evolution of e-networking can compensate to a certain extent.
- Then again, many older women scientists admit that they have self-imposed certain restrictions upon themselves and ambition-wise are content to take the backseat to their husbands. Interestingly, the younger scientists are comparatively more ambitious and have definite career plans.

Institutional barriers

Institutional barriers include paucity of financial aid, a male-oriented curriculum, lack of in-campus residences. General insensitivity compounds the problems that women face.

- Scientific institutions in India carry essentially masculine ethos and exhibit vertical as well as hierarchical segregation in terms of gender. Women's participation has been limited and confined to comparatively junior positions.
- Women were, for example, denied entry to C.V. Raman's laboratory (see *Kamal Sohonie) and allowed little interaction with peers not of the same sex.
- Unequal treatment and subtle discrimination against women scientists and engineers in the behavioural and interpersonal relations also prevail. *Nature* (2010) has reported common incivilities that reflect subtle sexism. At scientific meetings, women scientists do not get the microphone to speak and, when they do, they are interrupted sooner than loquacious male colleagues.
- *Nature* reports that Women are expected to be 'office wives', organizing social events and running lab administration. Although each such slight may seem

trivial, overall these micro inequities are corrosive to women's careers. They can impair job performance, damage self-esteem and prompt a literal or a figurative withdrawal from the workplace. Their effects on salary and advancement are real and detrimental**.**

- Not many institutes provide crèche facilities and the quality of care in facilities available is often not up to par. A survey at the Bhaba Atomic Research Centre in as early as 1975 by Begum and Balaram concluded that women had to work harder than men to progress in their careers and that this was both due to the socialization of the women and the lack of child care facilities.
- Also, in S&T women tend to be engaged in “pure research” as compared to Administration and Management. This actually means that women have less involvement in decision making process of the institution. In many cases the “pure research” is mostly compilation, collection and review as opposed to being more analytical and creative. However, while this may not mean much difference in terms of books or papers written; it does mean a sizable difference in the numbers of patents and inventions that men and women file.
- Insensitivity, and patronizing attitude overt is rampant in the scientific milieu dominated by males and the final end of the spectrum is sexual harassment. This has its roots in societal gender inequality.
- The bias against women continues even to the way they are presented in the media. For example, in the American science series called *Evolution,* female scientists were profiled differently in the series compared with male scientists. The show used the standard approach of using "scientific personalities" as an authentic source of scientific information. A scientist was profiled, and then he or she described their research. In the *Evolution* series, the amount of time given per scientist varied significantly by their gender, with the average male scientist given 200 seconds of air time and the average female scientist given 124 seconds. This discrepancy of 76 seconds is long by broadcast standards. The bias toward male scientists during the series was consistent across all the episodes. The disparity between the sexes was most evident in the minimum and maximum amount of time a scientist was allowed to speak. Male scientists were given a minimum and

maximum time of 53 and 739 seconds, respectively. This far exceeded the female scientists' exposure, where the minimum time was 22 seconds and the maximum time was only 215 second. Female scientists were consistently given only 62% of the airtime compared with their male counterparts.

Employment of Women scientists

Gender has figured in important ways in shaping the careers of scientists for centuries. Statistics/data availed from major R&D institutions showed that gender disparity in male-female staff selection process was continuing, and females were marginalized in recruitments.

The INSA report 2004 shows that DBT followed by ICMR are the best employers of women. DBT had almost 32 %and ICMR 27% women scientists. DAE had about 17% . In most cases, institutions included less than 15% women in its Advisory Committees.

Out of the total of roughly 4350 Scientists employed by the Council of Scientific and Industrial Research, only 753 are women. Out of 37 institutes of CSIR, not a single laboratory is headed by a woman and never in its history (established 1942) has it had a lady Director for any of its labs or a lady Director General.. No woman has become INSA President either.

The Inter Press Service News Agency report, though somewhat dated now, points out that though many women have reached top positions in the Indian Space Research Organisation (ISRO), under the Department of Space, the percentage of women scientists is very low; the percentage of women employees in the administration is 17.6 percent, while strength of women in scientific/technical positions is 7.18 percent only. The percentage of women scientists employed at the Indian Institute of Science in Bangalore is also less than 20. According to the data, 15,338 people are working at the Bhabha Atomic Research Centre in Mumbai, where the percentage of women scientists/engineers is less than five. Women's representation in government constituted research advisory bodies also worries women scientists; data shows a range between 0-21 percent.

Unanswered Important Issues

In western countries, gender questions in science have been extensively raised. This has ranged from discussions about women in science to philosophical analyses of the

gendered nature of science itself. In India the status of women in science has still not drawn adequate attention. There are only a few reports and studies on gender and science in India. Empirical research specifically on women scientists are scarce and their research productivity has not been particularly dealt with in detail. The scattered information about the participation of women in science in the developing countries refers to their access to education and career; very little is known about the contribution of female researchers to scientific production.

Questions that need answers backed up by statistics are:

- Feudal, authoritarian values and hierarchy have characterized Indian society. Are these reflected in Indian science as well?
- What makes women opt for scientific careers?
- What are the constraints faced by women in pursuing science education?
- Do their career paths change after education?
- Is the prevailing organizational culture of scientific research and development institutions suitable to women scientists?
- How far have the existing government policies of higher/science education been gender sensitive and do they promote female science education in the country?
- Are women equally represented in top-tier institutions?
- Are the few women who do make it to senior decision-making positions able to impact the essentially masculine ethos of these institutions?

We may thus conclude that gender plays an important role in shaping of scientific careers in India. Major attitudinal and institutional changes in the structure and procedures of Indian science, are probably required. In recent years, however, the Government of India (the Department of Science & Technology and UGC) is giving enormous attention to the importance of women's education and is making serious attempts at imparting high level skills to women. Special scholarships and awards have been instituted to attract students in general and women in particular to the science and technology stream. *Nature* (2010) says countries wherein the salaries of scientists are rising rapidly — for example, Brazil, China and India — are those where job satisfaction is rising. These nations are also stemming the brain drain and increasing their publications in peer-reviewed scientific journals. Most importantly, these countries have made enormous economic progress over

the past two decades, showing a correlation between science, salaries and sustainable development. The gender disaggregated statistics confirm the scandal of which we are all aware: all around the world, women researchers earn significantly less than their male colleagues. These gaps are particularly alarming for leading industrial nations such as Japan and Germany. It remains to be seen whether, with rising salary levels for researchers in China and India, the same gender gap will open. Hopefully, more balanced conditions will emerge in the 'Asian century' ahead.

NOTE

Probably the first data on Indian women scientists was collected in 1975 when the Indian Women Scientists Association was formed; employment status, job satisfaction and obstacles to careers were studied. However, the information available on the status and position of Indian women scientists, in the respective work spheres is not adequate. More research of empirical nature along with gender de-segregated data is essential. But certain things are still clear. The extant data does indicate that there exist high wastage ratio of women S&T personnel and wide gap exists between percentage of women studying science and percentage of women doing science.

Dr Sukanya Datta. TRSA 70, NPL Colony
New Rajinder Nagar
New Delhi 110 060