Women scientists in India: Nowhere near the glass ceiling*

Vineeta Bal

Despite the increase in the number of women scientists in biology, gender-based disadvantages in a patriarchal culture continue to be the order of the day. Establishment of gender-unbiased, transparent criteria for approval of project proposals, selection of candidates for jobs, and nomination to decision-making positions may go some way towards correcting this situation.

WOMEN scientists form not only a very small proportion of women in India, but also a minor proportion of all Indian working women. Despite their education and class advantages, prevalent patriarchal notions affect the work and career of women scientists as much as that of women from unorganized sectors, or indeed from other professional streams such as doctors or lawyers, since a woman is looked at primarily in the family context as daughter, wife or mother. However, perhaps unlike women who have to work hard only to make ends meet in their daily lives, women from the middle classes have begun to have aspirations to career development. Whatever little data is available in India today indicates that women who choose careers as scientists tend to come mainly from this class of society. It is therefore instructive to look at the situation of women scientists in the country from the perspective of career development.

Women entrants to natural sciences

Higher education in the natural sciences involves long hours of college because of theory and practical classes. Higher studies in humanities or social sciences, on the contrary, can involve fewer hours of mandatory college attendance every day. Despite this difference, in urban middle class India, families have now begun expecting women not only to continue with higher education, but also to pursue any interests they may have in the natural sciences. In this context, some studies from the west indicate that during their school days girl students make up their minds not to continue studying mathematics or other natural science subjects[1,2]. Various social reasons including discouragement by teachers have been cited for the girls' decision to opt out of natural sciences despite being good at them. But there are hardly any surveys from India that have tried to look at the mentality of girl students regarding their interests and the decision-making process for the choice of specific areas of higher education. On the other hand, there is evidence of an absence of role models for women in scientific careers. Analysis of illustrations drawn in the latest high school textbooks of 'science and technology' show men being portrayed as engineers, doctors, scientists and other professionals, whereas women's roles are only as housekeepers and nurturers, mothers and nurses[3]. Data available from 1981 onwards shows that, of the total enrolment for undergraduate studies, women constituted about 28 per cent in 1981 and 34–37 per cent from 1991 to 2000. Interestingly, at the postgraduate level, the enrolment proportions were no different – 29 per cent in 1981 and 38 per cent in 2000 (Manpower Profile India Yearbook 2000, 2001). There is no specific data available on the numbers of women obtaining Ph D degrees in the natural sciences in recent years, but based on data for Ph Ds in general and trends in postgraduate enrolment in the sciences in particular [*ibid*], it can be estimated that women may constitute about a third of the total national enrolment for doctoral studies as well. These frequencies are somewhat lower than, say, in the UK. In the UK, women constituted 40 per cent and 60 per cent of the graduates in chemistry and biology respectively in the year 2000 (ref. 4). At the doctoral levels, the UK proportions are 30 per cent and 48 per cent for the same year. However, even from the Indian data, it can still be expected that after spending some two decades of their lives studying and obtaining the highest degrees in the field of natural sciences, these women would be interested in using their knowledge productively, and that women should therefore show a substantial presence in the scientific profession. Here is an informal attempt to take a look at what the reality is.

Most of the data and information collected to make an argument here is based on the broad field of biological sciences, for two reasons. Firstly, as a working biologist in India, I am more familiar with the area of biological research. Secondly, many more women are found in the field of biological sciences than in physics, chemistry or mathematics – the other major branches of natural sciences – providing a somewhat larger sample. These comments take into account women as scientists rather than college teachers, and therefore, I am looking at information about the national

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laboratories and central universities. Also, while the biotechnology and the pharmaceutical industries certainly form a part of the research arena in biological sciences, their research output is measured in terms of product development and is seen in the context of the marketplace, with different parameters being involved in career development in such situations.

Perceived goals for academic research biologists

In pursuing a career in academic research in the biological sciences, certain specific steps and goals are essential for career advancement. Obtaining a stable job is obviously a basic pre-requisite for having a career. An appointment as a post-doctoral scientist may provide a 3–5 year working period, but a 'permanent' job is necessary for a stable career. The qualifications needed for getting a permanent job are different from those needed for a post-doctoral position. A proven record of achievements in the form of publications in highly reputed journals is one major criterion for getting even shortlisted for biologist faculty positions in India today. In contrast, while a publication record is an advantage for obtaining a post-doctoral position, it is by no means mandatory.

The ability to do and to direct research depends on the ability to think of a research project, to obtain the facilities needed to carry it out and the wherewithal to execute the research programme. In some cases adequate institutional infrastructure makes the beginnings easy, but more commonly competition with peers begins at this stage itself for national and/or international funding. Once a research programme is in place and running, the next step is to seek peer approval in the form of publishing results in professional peer-reviewed journals (and/or, more rarely, filing patents). Actually, peer acceptance begins even earlier, at the level of sanctioning of funds to carry out research, although it does not end there. Peer opinion also influences the future course of the career positively or negatively in a variety of ways. For example, peer recommendation, formal or informal, is necessary for promotions in the job, for nominations to various reviewing bodies and committees making funding decisions, for being appointed on the editorial boards of professional journals, for getting elected to prestigious institutions and clubs such as the science academies or the Guha Research Conference, and for bagging awards. Many of these 'achievements' pave the way for climbing towards further echelons such as vice-chancellorships of universities, directorships of institutions, for 'founding' new institutions and possibly even higher targets. How do women biologists in India fare in comparison with men in achieving these kinds of career targets?

Getting academic research positions

The baseline for comparison here is the data on science education mentioned earlier. Since there is no gender-based positive discrimination for employment, women would be expected to compete with men for post-doctoral appointments and further for faculty appointments. Since women constitute a third of all doctoral degree holders over the past decade, the expectation would be that women would also constitute about a third of all junior faculty members in national laboratories and universities where academic biology research is carried out. What is the reality?

In order to get a feel of the numbers and proportions of women scientists in permanent employment in biology research organizations, let us look at data from a few representative national laboratories and central universities. While selecting examples funded by various government departments, the emphasis here has been on selecting those biology research institutes with the largest numbers of faculty members from among those supported by each funding agency. This has meant including some of the oldest institutions in the country, such as the National Institute of Nutrition (NIN) and ACTREC (known till recently as the Cancer Research Institute), as well as some new institutions, such as the National Centre for Cell Sciences (NCCS), Pune. This might help in looking at changes in hiring practices, if any, over a period of years. The numbers and proportions in Table 1 show that women form 20–31 per cent of the total faculty (with the exception of ACTREC which has 55 per cent women faculty). There is no correlation between the age of the institute and the proportion of women employed in it.

So it appears that women's representation as permanent faculty members is somewhat less than their presence at the point of obtaining doctoral degrees. What could be the reasons for this? People are about 22–23 years old at the time of obtaining a masters degree and at least 26–27 years of age by the time their Ph D is completed. Most biology researchers who have been appointed as permanent faculty in the past 10–15 years in India have had a brief to prolonged (2 to 10 years) experience as post-doctoral scientists in the West, most commonly in the US. Thus individuals in their thirties join as junior faculty members in biological sciences in national institutions and central universities in India. Most men and women are married by the time they are in their thirties. Decisions about child bearing and child rearing inevitably affect women far more severely than men in conventional households with patriarchal cultures. It is quite plausible that women's ambitions to pursue careers take a back seat at this point, with women taking short or long breaks to attend to the 'family's needs'. In subsequent years this would translate into having poorer professional achievements than men of the same age and basic qualification. So, when it comes to finding a permanent job after finishing post-doctoral training, fewer women scientists may try, and fewer may be able to compete successfully with men for the same post.

The overall percentage of women faculty in national laboratories is less than might be expected (20–31 per cent excluding ACTREC). The next point was to look at the relative proportions of women at senior and junior positions within a set-up. The criteria used for counting faculty members as 'senior' are listed in the footnote of Table 1. Except

Table 1. Proportion of senior and junior women faculty members in national institutions funded by government

Name of funding agency*	Name of institute**	Total number of faculty	Total		Senior faculty#			Junior faculty##		
			Men (per cent)	Women (per cent)	Total	Men	Women (per cent)	Total	Men	Women (per cent)
CSIR	CDRI	193	147 (76.2)	46 (23.8)	67	50	17 (25.3)	126	97	29 (23.0)
CSIR	CCMB	70	48 (68.6)	22 (31.4)	13	12	1 (7.7)	57	36	21 (36.8)
DAE	ACTREC	33	15 (45.5)	18 (54.5)	8	4	4 (50.0)	25	11	14 (56.0)
DBT	NII	38	29 (76.3)	9 (23.7)	22	18	4 (18.2)	16	11	5 (31.2)
DBT	NCCS	25	20 (80.0)	5 (20.0)	5	4	1(20.0)	20	16	4 (20.0)
DST	Bose institute	61	47 (77.0)	14 (23.0)	25	21	4(16.0)	36	26	10 (27.8)
DST	Agharkar institute$	39	27 (69.2)	12 (30.8)	–	–	–	–	–	–
ICMR	NIN	48	33 (68.8)	15 (31.2)	13	10	3 (23.1)	35	23	12 (34.3)
ICMR	NICED	33	26 (78.8)	7 (21.2)	13	11	2 (15.4)	20	15	5 (25.0)

*CSIR – Council for Scientific and Industrial Research, DAE – Department of Atomic Energy, DBT – Department of Biotechnology, DST – Department of Science and Technology, ICMR – Indian Council for Medical Research.

**CDRI – Central Drug Research Institute, Lucknow; CCMB – Centre for Cellular and Molecular Biology, Hyderabad; ACTREC – Advanced Centre for Treatment, Research and Education in Cancer, Navi Mumbai; NII – National Institute of Immunology, New Delhi; NCCS – National Centre for Cell Sciences, Pune; NIN – National Institute of Nutrition, Hyderabad; NICED – National Institute for Cholera and Enteric Diseases, Kolkata.

#Faculty are counted as 'senior' if the employment is at E2 or higher levels as per CSIR rules, or deputy director or above in ICMR rules, or equivalent.

##Those not fitting in the 'senior' faculty category but listed as 'scientists' (excluding post-doctoral scientists) are included as 'junior' faculty.

$Details of seniority could not be ascertained.

Table 2. Proportion of senior and junior women faculty members in central universities

University	Departments and Division included*	Total number of faculty	Total		Professors			Others		
			Men (per cent)	Women (per cent)	Total	Men	Women (per cent)	Total	Men	Women (per cent)
Indian Institute of Science#	Division of Biology	63	51 (81.0)	12 (19.0)	31	26	5 (16.1)	32	25	7 (21.8)
Jawaharlal Nehru University (JNU)	SLS, SES, CBT	50	39 (78.0)	11 (22.0)	30	24	6 (20.0)	20	15	5 (25.0)
Delhi University (DU)	Bt, Zo, Bc, Gn, PMB, Micro, Env	63	57 (90.5)	6 (9.5)	31	31	0 (0.0)	32	26	6 (18.8)
University of Hyderabad	Bc, PlSc, AnSc	29	24 (82.8)	5 (17.2)	17	16	1 (5.9)	12	8	4 (33.3)

*SLS – School of Life Sciences; SES – School of Environmental Sciences; CBT – Centre for Biotechnology; Bt – Botany; Zo, Zoology; Bc – Biochemistry; Gn – Genetics; PMB – Plant Molecular Biology; Micro, Microbiology; Env – Environmental Sciences; PlSc – Plant Sciences; AnSc – Animal Sciences.

#A deemed university.

in the case of ACTREC, the proportion of senior women faculty members is uniformly less than 30 per cent, ranging from 7.7 to 25.3 per cent. However, women constitute a larger proportion at the junior faculty level in three out of eight national laboratories, at 34, 37 and 56 per cent respectively. These data may reflect some interesting possibilities. Firstly, on a positive note, many more of those young qualified women mentioned in the preceding section may actually be seeking jobs and getting them without any gender-based discrimination, resulting in their proportionate representation. Secondly, women who were employed as junior faculty may not be getting promoted at the same speed as their male colleagues may be. Thus, higher numbers of women at junior levels may result from a combination of these factors.

Representative data for some central universities is given in Table 2. Only biology-related departments from these universities are taken into account. The proportions of women faculty range from 10 to 22 per cent here. Similar to the picture seen in national laboratories, there are proportionately more women at the junior level than at the senior level. In Delhi University, women's representation is the poorest (at 10 per cent) among all national laboratories and university departments included for analysis here and there are no women professors at all. In contrast, in JNU 20 per cent of the professors are women. However, 18 to 33 per cent of junior faculty in these universities are women. The same arguments as made for their numerically larger presence at the junior level in the national laboratories may be applicable here.

Together, these data suggest that fewer women seem to be getting permanent jobs even at the lowest rung than the proportions of potential educationally qualified candidates would lead one to expect. It is possible that their 'experience' and 'achievements' may not be commensurate with their age due to layoff years, but there appears to be no proposal to

consider their 'academic age' rather than actual age for employment.

Productivity of women biologists

The next question is how well women scientists compare with men in terms of their scientific output. As mentioned earlier, researchers in biology normally publish their work in professional peer-reviewed journals. If peers approve of the work done, the standing of the scientist goes up in the community. In biological sciences, most work is done as a team, and the convention is that the senior investigator/s as the originator/s and developer/s of the idea will be the 'corresponding' author/s of the paper, while the person/s contributing the actual hands-on experimentation is/are normally the first author/s. Thus, the interest here would be to look at women biologists as corresponding authors.

The second relevant issue is which publications should be used for estimating the standing of scientists in their peer community. In biological sciences, one way to estimate the extent of peer approval is by looking at where a scientist is able to publish her/his papers. Since publishing in prestigious journals is competitive, papers published in such journals become a measure of peer approval. For this, journal impact factor (IF) is used as a criterion, and it estimates the reputation of the journal based on a variety of parameters. Papers published in journals with higher IF by and large indicate more credit and peer approval than papers published in journals with low IF. IFs for journals are calculated and published every year by the Institute for Scientific Information. Thus, for the year 2002, the journal with the maximum IF in the field of biological sciences was *Nature Genetics* (IF 29.6). IF values for many journals published from India are also available, and the topmost journal in biological sciences in this category is the *Indian Journal of Biochemistry and Biophysics* (IF 0.294). The list of journals considered for the present analysis excludes purely review journals such as *Annual Review of Immunology*, and also excludes journals primarily publishing data from clinical work and case reports, such as the *New England Journal of Medicine*. The final criterion of exclusion is to omit any journal with an IF of less than 5 (with 2002 as the reference year). This means that publications in only the 'top' 5 per cent or so of the total journals published worldwide are being considered. Use of these criteria means that only original experimental biological research work (as against reviews or case reports) published by Indian corresponding authors in journals considered 'respectable' by their global peers is included.

The freely accessible database PubMed was used. In all, 56 journals were included in the search, of which Indian authors had published papers in only 41. Work of authors of Indian origin but not working in India was not included. In the search, papers published between January 1994 and April 2004 were analysed. There were two reasons for restricting the analysis to the past 10 years. Firstly, publication records over the past 10 years would provide the means to judge the most recent performances of scientists who are highly productive today, excluding performances of the older generation of biologists who, however good they were in their more active days, should not be considered active researchers if they have not published well in recent years. The second consideration was practical – the ease of identification of the gender of authors. Since many publications do not write complete names of the authors but only the initials and a family name, it was necessary to identify the person before including her or him as the corresponding author. This could be done only for currently working and easily identifiable biologists.

Table 3 lists the journals considered and the summary of productivity of Indian biologists. During the period of our study, Indian biologists published a total of 669 papers in journals with IF > 5. Only 14.5 per cent of these papers can be credited to women biologists, indicating that the high-quality productivity of women scientists is not commensurate with their proportion of representation in employment. Why is this so?

One possibility is that the women scientists who are being hired are not as 'good' as their male counterparts, in terms of their ability to formulate and execute research programmes. It would be interesting to examine the records of men and

Table 3. Research output of high quality from Indian women scientists over past decade

	Publications in journals* with IF > 5 from India from Jan 1994 to Apr 2004	Publications by men scientists	Publications by women scientists
Total number	669	572	97
Proportion (Per cent)	100	85.5	14.5

*The following journals were considered for the analysis in decreasing order of IF: *(Nature Genetics#), Cell, Nature, Nature Medicine, Science, (Genes and Development), Immunity, Nature Immunology, (Behavioural and Brain Sciences), (Molecular Cell), (Nature Neuroscience), Journal of Experimental Medicine, (Nature Cell Biology), (Journal of the National Cancer Institute), Neuron, Journal of Clinical Investigation, Journal of Cell Biology, EMBO Journal, (Nature Biotechnology), (Plant Cell), Proceedings of National Academy of Sciences USA, American Journal of Human Genetics, (Nature Structural Biology), Molecular and Cellular Biology, Human Molecular Genetics, Blood, (Antiviral Therapy), (Circulation Research), FASEB Journal, Development, Genome Research, Cancer Research, Journal of Neurosciences, Cell Death and Differentiation, Molecular Biology of the Cell, Current Biology, Journal of Biological Chemistry, American Journal of Pathology, Journal of Immunology, Oncogene, (Journal of Cognitive Neurosciences), (Molecular Endocrinology), Molecular Microbiology, Nucleic Acids Research, Journal of Cell Sciences, Chemistry and Biology, Gene Therapy, Journal of Molecular Biology, Plant Journal, Natural Products Reports, Journal of Virology, Developmental Biology, (Journal of Neuropathology and Experimental Neurology), Journal of Allergy and Clinical Immunology, Molecular Pharmacology, Plant Physiology.*

#Journals in brackets are ones in which no papers were published from India in the period studied.

Web address for PubMed: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed).

women recently hired as faculty in these institutions to see if this was so. However, if this were to be the case, it would be expected that such hiring would be driven by a 'positive discrimination' in favour of women scientists. This would have led to a major increase in their proportions among the junior faculty, which does not appear to be the case.

Other factors could be related to woman-specific environmental issues. High-quality output can be hampered by infrastructure facility-related factors such as small lab spaces, lack of necessary equipment and lack of supporting human-power. While Indian data is not available, in case studies of women from the Massachusetts Institute of Technology published many years ago, it was documented that women of comparable seniority and productivity as their men colleagues were provided with poorer facilities[5]. There is also the issue of getting extramural funding for research activities. Whether women and men of comparable records and/or seniority are likely to get comparable funding will depend on many factors. For example, whether they submit comparable numbers of grants for funding to begin with, whether the success rate of these grants is different and if gender plays any role in this. These, too, would be issues worth exploring in the Indian context. In an elegant study on the role of peer review in the advancement of the career of post-doctoral scientists in Sweden Wenneras and Wold[6], argue that 'peer reviewers cannot judge scientific merit independent of gender'. Anecdotally, conversations with women biologist colleagues certainly do give the frequent impression that they tend to underestimate their abilities, which may be related to their social upbringing and context. Such a diffidence, a factor that can contribute to lesser productivity, can manifest itself in many ways – not applying for extramural funding as frequently, or asking for less funding than a male colleague would ask for the same work, not sending out research work in journals with higher IF, and not arguing the case for revisions in the event of apparently critical reviews from the referees on submitted manuscripts.

Members of prestigious groups

Even for those women who may be as productive as their male colleagues, there are likely to be hurdles at another level of seeking peer approval from immediate colleagues. Achievements have to be publicised for peers, and the ability (or not) to do so can affect career prospects. This is because there are other areas in the career of a scientist where her/his colleagues have a very significant impact on her/his progress and achievements. Becoming a fellow of national science academies in India is considered a stepping stone to further achievements. These academies are situated in Delhi, Bangalore and Allahabad, and becoming a fellow of each of them is a highly desired goal. The procedure to be a fellow involves first getting nominated and then elected. Though academic merit is supposed to be an important factor that makes a person eligible for nomination as a fellow of the society, many unwritten considerations operate, and knowing the members of the decision-making bodies personally is one such factor. When personal connections matter in achieving targets, women scientists can easily lose out, since personal interactions of women scientists with male colleagues would be deeply constrained by the standard patriarchal cultural barriers of so-called morality. Thus, it would not be surprising to find that women are awarded academy memberships far less frequently. Is this indeed the case?

Membership of any of these academies is for life. Thus, once elected, one remains a fellow until one dies. As a result, there are many fellows of the academies who are retired and not working today. In order to get a true picture of active members of the academies, let us look at fellows who were elected in one representative national science academy over the past decade. This election should, in principle, correlate with the quality and quantity of research output of scientists, since research performance is supposed to be the main criterion for these academy fellowships. Table 4 shows the numbers from the membership list of the Indian Academy of Sciences, Bangalore, a representative national science academy. In all disciplines of natural sciences, medicine and engineering taken together, a very small share has come women's way in the past 10 years. The situation in biological sciences – which include plant, animal and general biology here – is somewhat better for women. While they are still substantially under-represented in comparison with their presence in the faculty, their under-representation with regard to the performance index as measured by publications is less glaring.

Another indicator of the rising status of a scientist in the community is getting nominated on government-constituted advisory bodies. This may mean being a part of the committees that make decisions about accepting or rejecting projects for extramural funding from CSIR, DAE, DBT, DST or ICMR. It can also mean being a member of the research advisory board, scientific advisory committee or research council for various national institutions. There are no defined criteria for achieving such a status. If somebody is considered 'good' by influential peers s/he gets nominated on a committee. How frequently do women biologists seem to possess this nebulous desirable attribute? Table 5 shows the proportion of women members of advisory bodies of five institutions out of the nine listed in Table 1. Women's representation ranges at 0–21 per cent, and for many other institutions for which data are not shown, the percentages fall in the same range. In addition, DBT as a funding agency has its own advisory board, which has only two women in a group of 25 (8 per cent). Thus, women's representation appears to be poorer in committee membership, where personal rapport with peers and their recommendations are useful for nomination.

A further laurel for anyone who claims to be an achiever in biological sciences is bagging prestigious prizes. Only two prizes are considered here which are awarded to mid-career

biologists, that is, those who are not over 45 years, the Bhatnagar awards and the National Bioscience awards. The age-limit means that only actively working scientists will get the prizes for their ongoing performance. Significant contributions to science are measured in terms of research output while working in a laboratory based in India. This way, scientists of Indian origin working primarily outside India are not entitled to compete for the prize. Young faculty rather than full professors and senior scientists as listed in Tables 1 and 2 will thus be eligible in principle for these prizes. The Bhatnagar awards were instituted by CSIR in 1957 and by 2004 there were a total of 387 winners in subjects as varied as biology, chemistry, earth sciences, engineering, mathematics, medicine and physics. The National Bioscience awards were instituted by DBT in 1999, and by 2003 a total of 24 scientists had received these awards. The gender distribution of the recipients of these awards is shown in Table 6. In the entire history of the Bhatnagar awards, very few women have been considered worthy of the prize award in any field of science, as shown by the sorry figure of 2 per cent. In the areas of biology, the figure creeps up to 3 per cent. Even more striking is the data over the past 10 years. There is only one woman recipient of the Bhatnagar award in medicine in the past 10 years and none in biology.

Table 4. Under-representation of women as fellows of National Science Academies*

Members appointed during 1994–2004	Male	Female	Per cent male members	Per cent female members
Members in all disciplines	236	17	93.3	6.7
Members in plant, animal and general biology section	57	8	87.7	12.3

*Data collected from the Web site of the Indian Academy of Sciences, Bangalore. http://www.ias.ac.in/php/fell_all.php3?alpha=A.

Table 5. Presence of women scientists in Research Advisory Committees of Research Institutions in India

Agency	Institution	Male	Female	Per cent male members	Per cent female members
DBT	DBT	23	2	92	8
DBT	NII	18	1	95	5
CSIR	CDRI	11	1	92	8
CSIR	CCMB	10	0	100	0
ICMR	NIN	20	3	87	13
ICMR	NICED	15	4	79	21

Table 6. Women biologists do not receive prestigious awards!

Award (subject)	Years under consideration	Total no. of prizes	For men	Per cent men	For women	Per cent women
Bhatnagar (all)	1958–2004	387	379	97.93	8	2.07
Bhatnagar (all)	1994–2004	107	106	99.06	1	0.94
Bhatnagar (biology alone)	1958–2004	68	66	97.06	2	2.94
Bhatnagar (biology alone)	1994–2004	19	19	100	0	0
National Bioscience	1999–2003	24	22	91.67	2	8.33

The data provide basis for some speculation. It appears that few women were working as research biologists in India in the early post-independence period and that their numbers have increased only very slowly over the years. If there were proportionately fewer women present in the field it is only to be expected that their representation in the award-winners' list would be low. This may also be reflected as a cumulative phenomenon when the list of all Bhatnagar prize winners is viewed as is done here. However, the proportion of women scientists has gone up in all the fields in natural sciences for which these prizes are awarded, and yet the percentage of women prize-winners is, in fact, worse in the last decade than in earlier years. This is true regardless of whether all fields of natural sciences are taken together or only the life sciences are looked at. The percentage of women scientists working in biology is the second highest, second only to the medical sciences. Based on the data mentioned above, there are at least 6 per cent of women in senior faculty positions, and another 14–15 per cent at more junior levels in biology. A reasonable guess would be that this 6 per cent is mostly in the 45+ age group and obviously none of them were considered worthy of Bhatnagar awards in the past decade. (In fact, the institutions to which the two women who received Bhatnagar awards in biology belong are not included in the present analysis.) The record of the National Bioscience awards looks somewhat less gender-biased, but the awards have only a five-year history and hence it may be premature to talk about trends.

What do these analyses indicate? Clearly despite the increase in the number of women scientists in biology, gender-based disadvantages continue to be the order of the day, even in academic performance-based competition. In this connection, the establishment of gender-unbiased, transparent criteria for approval of project proposals, selection of candidates for job appointments, and nomination to decision-making positions might go some way towards reducing the burden of the problem.

This issue is made even more pressing by the fact that academic research in the basic natural sciences, while considered respectable, is not thought of as a high-paying profession. This is likely to result in fewer and fewer young men entering the field as they prefer to become IT or management professionals instead. On the other hand, since women's incomes are still seen as 'second' incomes in the family, they are likely to become more and more prominent in academic scientific research. It may be beneficial to start treating women as professional colleagues with somewhat lesser gender bias than appears to be the case currently.

Women biologists and others

Are there any unique circumstances in this context in the workplace situation of women biologists? Being experimentalists, biologists work as part of a team in their professional careers. They may be leaders, or junior or not-so-junior partners in the team. For optimal work output, it is necessary for experimentalists to form a team with overlapping interests and individual specialised skills. Both in order to get adequate funding to carry out research and to publish in reputed journals, it is necessary that teamwork be optimal. Cultural upbringing often makes it difficult for a man to work under a woman or take orders from her. Such a situation for women biologists may thus be different from, say, that of theoretical physicists or mathematicians, who can work as individuals and achieve professional stature. Even women science teachers or doctors may have to depend less on their colleagues in this sense for survival in their fields.

One factor common to many professions affecting women adversely is long working hours. While keeping strictly to standard working hours is possible in some kinds of jobs, academic research in biology needs longer hours beyond the 9 to 5 routine if success is to be achieved. With family responsibilities being culturally their burden, it becomes difficult for women faculty to spend long hours at work. In fact, this issue affects the ability of women both to find and keep faculty positions. Women who complete their Ph D in their late twenties are usually likely to be under pressure to get married during the course of their doctoral work, or immediately after. They also end up taking career breaks of a few months to a few years for child-bearing and child-rearing. Taking time off always affects careers adversely, and even more so where the work needs a lot of infrastructure and teamwork, as for biologists. If a working scientist loses touch completely for a couple of years, coming back becomes that much more difficult. Employment rules frequently tend to have upper age limits for positions. Many institutions have a convention of not offering jobs to husbands and wives together, and inevitably, women suffer more from these practices than do men. Gaps in careers can haunt women for the rest of their professional lives even if they manage to make a comeback.

Thus, in a patriarchal culture, even those women who try to break weak gender barriers in order to provide better living conditions for their families while pursuing their interest in the field are faced with many career difficulties. Many lose out in the pursuit of their profession in the early phases. Even for those who cross this hurdle successfully, the profession can make them invisible – not rising far enough to step into leadership roles, and not getting recognition. Rumbler strips on the road function as more efficient controllers of speed than a single speed-breaker bump, a situation depressingly familiar to women biologists.

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