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Why are there so few women in science?

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Increasing attention has been drawn to the problems faced by women in science, engineering and technology (SET). Women are unequally represented in science and their career progression is not comparable to their male colleagues. The growing interest in this topic may partly be because of the growing awareness of the huge untapped economic potential that women represent.

Introduction

Much of the groundswell behind the current debate on the small numbers of women in science was sparked by a 1997 study of research funding by the Swedish Medical Research Council (MRC)[1]. The study discovered gender bias in the way in which research awards were made -- a finding that startled the scientific community because it was the first clear evidence of discrimination -- showing that women had to be about 2.2 times more productive than their male counterparts to be as successful in securing financial support. The study galvanized many other institutions into action, and in the following years studies on gender bias in funding mechanisms were initiated in the UK[2,3], Denmark[4] and Finland[5].

The Swedish study marked a turning point in Europe: research organizations, universities, charities and government could not ignore documented proof of discrimination, where previously claims of such discrimination had been suggested as being anecdotal. It was no longer possible to assume that an absence of women in science was due to women themselves, rather than the institutions to which they belonged.

An international issue

The issue crosses national borders but seems likely to be best tackled at a variety of levels from local and regional to national and international. The European Union, for example, has recently set up a 'Women and Science' sector to gather statistics (of which few are currently available) and has created a network for women in these fields, actions that are in accord with its general principles regarding equal opportunities. (When the Community was set up, the concept of equal opportunities was limited to the principle of equal remuneration. Equality of opportunity is now enshrined in the Treaty of Amsterdam as one of the European Union's objectives. The Treaty's more recent Articles will enable appropriate measures to be taken against discrimination, and provides the specific legal basis for equality of treatment between men and women.) But in the USA the gathering of such statistics has been practised since 1981, with the director of the National Science Foundation regularly reporting to Congress and government officials on the number of women in employment and training in science and engineering.

At a European level it has been recognized that statistics can produce valuable comparisons and that a network of member states and organizations might have significant political weight[6]. The EU is aware of the need to encourage women to take part in their research and is making significant efforts towards greater participation in the Fifth Framework Programme[7,8], especially on expert committees.

Data from Canada and the USA show that far fewer women are successfully engaged in scientific enterprises than would have been expected given the increasing numbers of women in the workforce. The problem is not limited to the difficulty that women have in obtaining grants but also extends to their salaries, office space and access to research resources and positions of responsibility[9,10] in comparison with male counterparts. In response, the National Academies for both Science and Engineering in the USA are now

planning investigations into the data on women employed in science and engineering[11]. Similarities also exist in Latin America and the Caribbean[12], and in Africa[13] -- where women have difficulty in accessing education and are rarely found in hierarchical posts or at decision-making levels. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has recognized the issue of women in science as a global challenge, an issue that was reflected in the documents adopted within the World Conference on Science[14,15].

Before Sweden The absence of women from science, and the realization that this implies an underused human resource[16], brought increased attention throughout the 1980s and 1990s in the UK to the issue of why this might be so. In figures that are by no means unique to the UK it was shown that, although roughly equal numbers of male and female UK undergraduates read biological sciences, the proportion of female undergraduates studying the physical, mathematical and computer sciences is far from equal[17]. The proportion of women at a graduate level is smaller than at undergraduate level, and continues to decline as one progresses through the ranks to professorial grades. At this final level as few as 3-4% of UK professors in any branch of SET are women[18], a figure echoed in similar data for other countries. Government-funded research councils and ministerial departments fare no better. And the numbers of women who have been elected to Fellowships of the Royal Society, the Royal Academy of Engineering or even the Institute of Biology are well below 10%.

At a European level there is little information except on the numbers of women in different areas of higher education, and averages currently conceal real and interesting geographical differences. For example, in mathematics and computer science and in engineering and architecture, women tend to be better represented in Italy, Portugal and Spain than in other European countries. But it is clear that, as in the UK and the USA[18], there are small numbers of women in European research, they encounter career obstacles, and this results in their under-representation in senior posts[19,20].

Why so few?
Hard facts on the crucial stages of a woman's career in science are fragmentary, but mounting evidence and anecdotal reports tend to agree. Those remaining in science often face discrimination, being employed on a less secure footing and receiving lower grants than their male colleagues[10,21-25]. Meanwhile, women that leave science for alternative careers can fare little better[26]. Although there may be only a handful of studies, they increasingly lend weight to the suggestion that gender bias is still alive and well, and indeed kicking!

An interesting observation is that UK universities making the most progress at improving the position of women are those that have been recently transformed from technical colleges. This fact, which is embarrassing for the older, long-established universities, might be revealing, in that it suggests that a male-dominated culture exists in the traditional centres of higher education that can militate against women's achieving seniority or even equality. Such an 'establishment' atmosphere does not prevail to the same extent in the 'new' UK universities.

The male orientation of science?
The male orientation of science is unlikely to be the sole explanation for women's under-representation. Widespread acceptance of a stereotyping of scientists and engineers as stolidly male from school to university level is likely to be important. The dearth of senior women scientists in the public arena means that girls have few role models with whom to identify, and few female mentors to encourage them. A further, deeply ingrained problem is that a lack of self-confidence is often a feature of young women aspiring to be scientists or engineers. School Careers Advisors are themselves often ill-prepared to extol the virtues of a career in SET for girls, and primary school teachers giving the science lessons are all too frequently themselves unfamiliar with

science and are therefore ill at ease in communicating its excitement to both girls and boys.

There is no doubt that, as in all other professions, women as the child-bearers carry the 'burden' of child care (as well as the care of ageing parents), and unless family-friendly policies are in place in any given work place, the women employees are likely to be distracted from their career in SET, or indeed even perhaps taken away from it, for sometimes considerable periods. Returning to the laboratory then becomes an increasingly difficult task: time away from the lab leads to unfamiliarity with novel technologies and current 'state-of-the-art' equipment. Retraining is an expensive and time-consuming affair, and finding the necessary financial support and laboratory facilities can prove difficult. Cost can be a crucial issue, as higher education institutions lack the awareness of the costs of staff training, in contrast with industry, where it is deemed cost-effective to retrain staff and encourage returners.

What should be done?

If these are some of the reasons why women are not to be found in greater numbers in SET, what further can be done to address the under-representation? Action can be taken at different levels; schools, universities and the work place have seemed the three major areas to consider.

With the growing awareness of the under-representation of women in the scientific community and the need for new strategies to be put into place, several policies have been introduced, including quantitative objectives, new administrative structures and, more recently, positive action. In higher education, government and industry, it is clear that it is imperative for equal opportunities and female-friendly policies to be in place to produce the highly desirable 'level playing field'.

Increasingly, establishments funding research and education are beginning to argue that the inclusion of women is simply best practice in human resources, because women constitute 50% of the talent available. The representation of women on decision-making bodies, such as national commissions and appointment committees, is also vital. Equal pay for all and recognition of 'time out' for child-rearing (most effectively by using 'academic', rather than chronological, age) are crucial too. The inclusion of women in the networking circles of the men at the centre of power would be of further great benefit. Some or all of these actions are recognized as important, as is demonstrated by the schemes set up in countries around the world; some key actions are given in Table 1.

Where next?

At the end of the twentieth century, women remain a minority in the scientific disciplines. We have waited for women to trickle up through the system for at least a decade and we seem to be no closer to equality. All we do know now is that there is some hard evidence that gender bias exists.

What measures do you think could profitably be taken to improve the current position of women in SET? Are any of the schemes being put in place in the UK or Europe likely to be particularly valuable? How can we obtain a 'better deal' for women? Is only lip-service being paid to the current under-representation? What do you think we should do? Your views are sought.

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