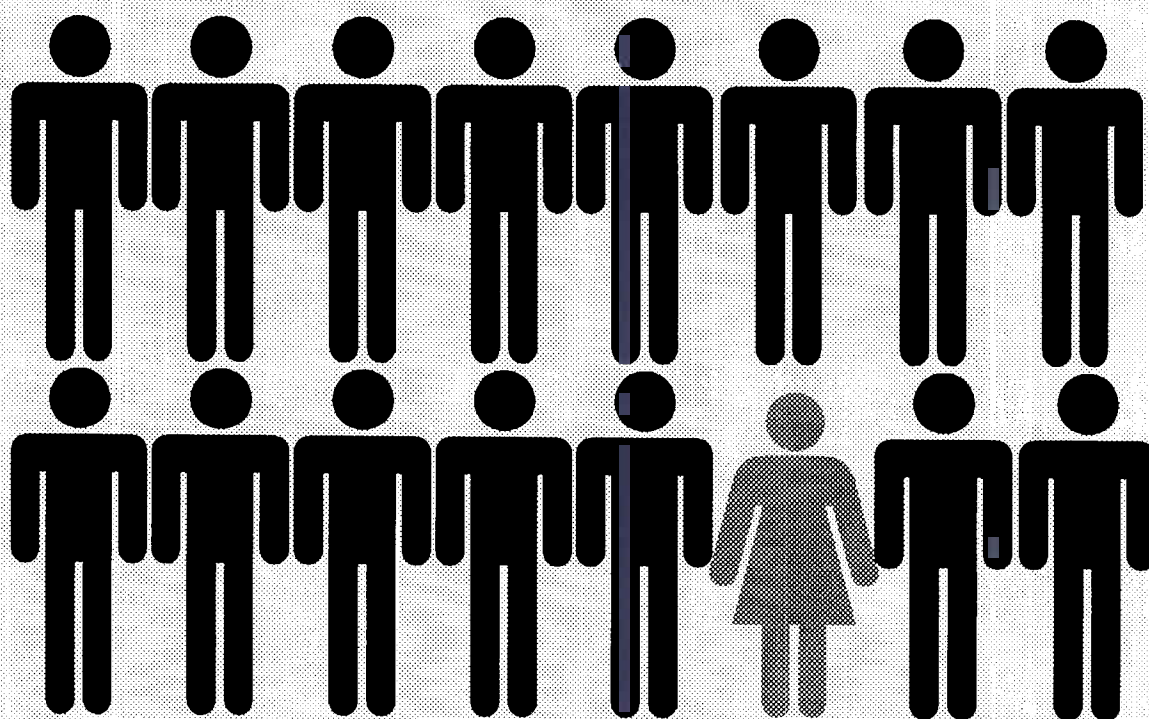


THE 3Rs

Recruitment Retention Returning

A report following a debate about why there aren't more women
in the physical sciences, engineering and technology



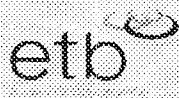
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Introduction

This report is drawn from an informal and lively debate held during the British Association (BA) Festival of Science at the University of Salford on 8 September 2003. The debate focused on the three main factors generally blamed for the small number of women physical scientists and engineers:

- Recruitment:** fewer women than men train or pursue careers in science, engineering and technology (SET);
- Retention:** a significant proportion of women leave SET, either to pursue alternative careers or to start a family;
- Returning:** it is not easy to return to SET disciplines after a career break.

Four keynote speakers gave short presentations stressing practical approaches to the “3Rs” problem. These talks were taken as starting points for wider discussion among a predominantly (but not exclusively) female audience of approximately 100 people. Few attendees left without having contributed an anecdote, opinion or idea (occasionally after proactive cajoling by the chair, writer and broadcaster Vivienne Parry).

This report summarizes the proceedings of the session, drawing on the speakers’ presentations and the resulting discussion. It highlights key issues underpinning present initiatives to increase the number of women opting for careers in SET disciplines, and it outlines constructive steps that could redress the gender imbalance and maximize women’s potential in the scientific workforce.

*A debate
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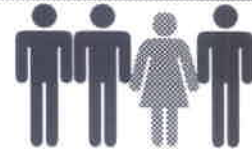
Panellists and chair (left to right):
Sir Peter Williams, chairman of the Engineering and Technology Board (ETB)
Dr Helga Ebeling, national expert at the Women and Science Unit of the European Commission
Professor Frances Bagenal, professor of astrophysical and planetary sciences at the University of Colorado
Dr Gill Samuels, senior director of science policy and scientific affairs at Pfizer
Ms Vivienne Parry, journalist and broadcaster



Recommendations

The following key points arose from the debate, and it is recommended that these are taken into account by the JIVE Consortium, which has been chosen by the Department of Trade and Industry to host a new Resource Centre for Women in SET for the UK.

- ◆ Hard facts get results: gender data from UK industry need to be made available and visible so that any inequalities in the system can be addressed.
- ◆ Industry and business leaders need to be involved in developing measures to tackle gender imbalances to make them effective.
- ◆ Solutions need to be implemented at all points where people can opt in or out of SET careers.
- ◆ Children should know what kind of career options there are in SET so that they do not rule them out unknowingly.



Pragmatic approach

The "women in science" debate has moved on. Earlier initiatives designed to redress the gender imbalance in science, engineering, and technology focused on helping women who were being left out of a man's world, said Frances Bagenal, professor of astrophysical and planetary sciences at the University of Colorado, Boulder. Attitudes have now changed in academia, where institutions are anxious to boost flagging levels of home-grown technical brainpower. Training, hiring and hanging onto women scientists and engineers are regarded as crucial to this wider issue.

Prof. Bagenal presented data from the US to illustrate the relatively small proportion of women training in science and engineering, and the growing need for the US to recruit into these disciplines. In the US five times as many men as women qualify with a PhD in science or engineering, though the number of women studying degrees in science, computing or engineering is gradually increasing.

Meanwhile the total number of first degrees awarded in physics in the US has fallen significantly over the past 30 years, while the total number of first degrees awarded in any subject has risen. The number of foreign students embarking on physics and astronomy degrees in the US has steadily increased, while the number of US nationals enrolling in these courses has dropped. The former group outnumbered the latter in 2001. "You now have an immediate issue that the US must diversify to meet its workforce needs," Prof. Bagenal said. "To have more people in science you need to bring in the under-represented."

Economic imperative

The lack of women entering (and staying in) SET in Europe is similarly regarded as part of a general manpower problem, said Dr Helga Ebeling, national expert at the European Commission's Women in Industrial Research project. Strategic decisions taken by the EC to bolster Europe's knowledge economy mean that the recruitment and retention of trained scientific personnel has become a top priority. Boosting (and keeping) numbers of women scientists and engineers, especially in industrial R&D, is regarded as an essential part of this strategy.

The EC agreed at the Barcelona summit in 2002 that the EU should increase the proportion of GDP spent on R&D from 1.9% to 3% by 2010. This requires the share of R&D investment from European industry to rise from 56% to 63% over the same period. "This really means that the industrial research sector, which at the moment accounts for 50% of the one million researchers in Europe, has to double that number, and that won't be possible without perhaps quadrupling the number of women," Dr Ebeling said. "At the moment only 15% of industrial researchers [in the EU] are women."

The EC has good reason to pin its hopes on women as a source of its future scientific and engineering workforce. Women now form the majority of graduates in Europe, and they collect more than 40% of the PhDs awarded in Europe, Dr Ebeling said. However the proportion of these female scholars opting for scientific and engineering courses – the "passport" to a career in industrial R&D – is still woefully low.

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The under-utilization of women in SET clearly has important economic implications.

In some European countries, notably Italy and Ireland, more than 50% of university graduates in science and mathematics are female, Dr Ebeling said. Data are less encouraging in other countries, and the numbers of women taking engineering disciplines are particularly low across the EU. "On the one hand, the number of women graduates is growing, but only 25% of all graduates in Europe are in science and engineering. This percentage has to increase and the gender balance be addressed," she said.

Targeted investment

The underutilization of women in SET clearly has important economic implications. Intervention from national government to address this is not only relevant but perhaps also essential. The UK government has already taken some steps in this direction by commissioning Baroness Susan Greenfield to investigate the under-representation of women at all levels of science and engineering.

The resulting report, *SET Fair*, was published in November 2002. This contained three major recommendations, the first being that a dedicated centre for women in SET be set up. This centre would provide a focus or hub for activities targeted at women scientists and engineers. More than 70 such projects are currently in operation. This fragmentation inevitably results in duplication of effort and confusion about who is doing what. Resources are consequently wasted, and initiatives that could support women scientists and engineers are underexploited.

In its response to *SET Fair*, announced in April 2003, the UK government welcomed the report's findings and pledged £1.5 million. A significant portion of this grant (£0.8 million) is intended to set up and run the resource centre, while the remaining money will be directed towards additional initiatives. In December 2003 the government announced that the JIVE Consortium had been chosen to run the resource centre, with funding of £0.8 million a year for three years.

"*SET Fair*, as an initiative, is really great and it is welcome. It's the competitiveness of the UK we're talking about. As a nation we're wasting 50% of our intellectual resource," said Sir Peter Williams, chairman of the ETB. "One should welcome the government putting any financial input into the programme, but I know from my own experience how little £1.5 million is. So, quite frankly, my response is that this sum of money is wholly inadequate."

A useful comparison can be made with the situation in Germany, where three resource centres for women are either in operation or in the process of being set up – one each for scientists, IT professionals and entrepreneurs. The centre for women in IT was started with a grant from the German government, and it subsequently attracted additional funding from the private sector, according to Dr Ebeling. The centre recorded an annual turnover of €5 million last year. This figure is two-and-a-half times the total sum that the UK government initially pledged in response to *SET Fair*. "I just hope that the steering team appointed to realize the initiative is bold enough to go back to the government and talk about recurrent funding," Williams said.

Since the 3Rs debate took place, the government has announced that it will commit £1.5 million a year for three years to its women in SET initiatives.



Audience members questioned the likely impact of any investment (however large or small) from the government, professional societies, charitable bodies or other organizations. What if roles for men and women are too deeply entrenched in society that throwing money at worthy schemes does no good at all? All agreed that the will for change must reach far beyond female-friendly debates (such as this one) if initiatives are to have any effect. Drawing more men into the argument, and focusing on men's activities as well as women's, is critical for further, constructive progress. A group of proactive female scientists and engineers may well agree on the merits of certain steps designed to redress the gender balance in SET, but what's the point of their discussion if colleagues in more senior posts, and with decision-making power, disagree?

Back to the chalkface

Panellists and audience members agreed that solutions to the 3Rs problem must be implemented at every point where women have the choice to opt in or out of SET. This means starting in schools, where girls can rule out careers as scientists or engineers by dropping physics, chemistry or mathematics in favour of the humanities or modern languages. Girls who are interested in science are also likely to choose medicine as a degree, which is perceived as a more "caring" profession. Children who have no scientists or engineers among their close friends and family may simply not know what being a research chemist or electrical engineer, for example, might entail. Parents' misconceptions about SET careers can also have a negative influence on their children's career choice.

Suggestions from the floor included the introduction of women scientists and engineers to schoolchildren as role models, ensuring a good supply of well qualified science teachers, improving the quality of careers advice, changing the image of scientists in the media and modifying the school curriculum to make science seem more "relevant" to society. Many universities should also take a long, hard look at the content of their science course, Dr Ebeling said. "More than 50% of female school leavers have the potential to start degree courses in mathematics, physics, chemistry and engineering, but universities are losing a lot of these candidates. The culture and curriculum is not taking the interests of women into account."

One of the few men in the audience questioned the relevance of women-only physics groups at university. Women students in the audience noted that he was failing to appreciate their feelings of isolation, and the genuine antipathy from some male students or members of the scientific community. Instances of outright hostility may be infrequent, but they still occur. A representative from the Institute of Physics noted that any men wishing to become involved in women in physics initiatives would be more than welcome to contribute.

Flexibility rewards investment

The second and third of the 3Rs, "retention" and "returning", can be tackled with a more innovative and flexible approach to career management, both in academia and in industrial R&D. The adoption of policies that make it easier for women to stay in science, thereby plugging the "leaky pipeline", again has economic benefits. "People in whom there has been huge investment of training and resources to get them through a PhD are then opting out and leaving. So this is a national waste of resources," Prof. Bagenal said.

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Many US academic institutions are now implementing spousal hiring policies, given the large number of couples in the science and engineering communities, according to Prof. Bagenal. Affirmative action is also being employed to ensure that good female candidates are not overlooked when it comes to tenure or promotion. "The US National Science Foundation has many policies, which we could call carrots, that are promoting women in science. But without some sticks behind these carrots then little activity will happen," Prof. Bagenal said.

Flexible working practices can also be employed in industrial R&D to good effect, said Gill Samuels, senior director of science policy and scientific affairs at Pfizer's Global R&D laboratories in Sandwich, and co-author of *SET Fair*. The report's second recommendation to the government highlights the need to keep women attached to the workforce during the early years of child rearing. Schemes to retrain women returners and incentives for employers to create more part-time working and job-share agreements would prevent companies from losing key personnel.

"Why can't we invest more in R&D? We can't invest because we haven't got the people to invest in," Dr Samuels said. "We're taking large numbers of people in, putting them through layers and layers of evaluation and training, and we're just not keeping them. It's a costly business, and when you lose people in their 30s and 40s, you've lost a lot of experience and intellectual capital."

The introduction of flexible working policies has already been successful at Pfizer, according to Dr Samuels. However the approach has to be supported at very the top of the organization. "It is possible and it does make a difference, but you've got to have the will to do it," she said. "When we do these things, it really does make a difference. Three of Pfizer's six R&D site heads are now women. More than 50% of our workforce is female in several departments. We've got very talented women who are progressing well. We cannot afford to lose them, nor can the UK, nor can Europe."

Dr Samuels is keen to point out that the flexible working schemes in operation at Pfizer are benefiting male employees too. Sir Peter Williams agrees that initiatives addressing the 3Rs should be open to the whole scientific and technical workforce, noting: "The more that women can espouse measures that are gender neutral, but very definitely gender friendly, the faster change comes through." For example, a scheme to fast-track graduates through to chartered engineers would no doubt be welcomed by women, who may want to complete their professional development before they start a family, he said. However many male engineering graduates may also see the wisdom of reaching chartered engineer status sooner rather than later. At present, most engineers do not attain their CEng qualification before the age of 37, whereas adoption of a more intense programme could lead to qualification before the age of 30.

Audience members and panellists also discussed the ability of women to "have it all". Some women opt not to have children and focus on their career in SET, which can be incompatible with family life. They may feel rightly resentful if their female colleagues, who do have children, then benefit from flexible working arrangements or returners' incentives that are not available to childless women. The observation that generous salary structures would help to retain qualified staff – of both sexes – as well as attracting those returning to the field received widespread assent.



Hard facts get results

Panellists were united in their call for more concrete data on women in SET, which can be used as a "naming and shaming" tool to instigate change. The collation of statistics on the numbers of women studying science compared with the number of female faculty members in science departments has forced some US universities to change their hiring policies, Prof. Bagenal said.

In 1995 a detailed internal study in the Faculty of Science at the Massachusetts Institute of Technology (MIT) revealed aspects of bias that would likely have otherwise gone unnoticed and unaddressed. A serious pay discrepancy was uncovered, and women in some departments were found to have been allocated less laboratory space and resources than their male colleagues. Women were also less likely to have been included on panels and committees, or to have been given awards of merit and distinction. These are just a few of the issues revealed. Presentation of these hard facts to the dean of the faculty resulted in immediate action, and a follow-up report published in 1999 revealed that in that year alone there had been a 40% increase in the percentage of tenured women in the faculty.

An audience member pointed out that information about grant applications to UK research councils, sifted by gender, already exists. This shows that women are equally successful in being awarded grants, but they apply less frequently than men do.

Statistics on the recruitment and remuneration of women in industrial R&D are notoriously difficult to collect. Women working in industrial research are largely invisible at present, said Dr Ebeling. Members of the European Commission's Women in Industrial Research project are trying to assess the strength of Europe's female industrial R&D workforce. To date the UK has been unable to supply information on the gender divisions in its industrial R&D workforce. The Institute of Physics has now set up an Industry Working Group to address this issue.

SET Fair's third major recommendation is that companies publish detailed information about gender and diversity in their R&D workforce. The effect of policies aimed at keeping key staff and encouraging women to return after career breaks can then be assessed. A starting point should be the inclusion of gender and diversity measures on the R&D scoreboard, Dr Samuels said.

Sir Peter Williams notes that the introduction of a disclosure standard would force UK companies to publish detailed data on their workforce, separated according to gender, annually. The statistics could then be pulled together and compared. "Data do exist, and if they are published in the right format, boy do they have an effect," he said. "That will produce more change, particularly in rewards for women working in industry, than anything else I can think of."

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Notes

This briefing document was prepared by Paula Gould on behalf of the Institute of Physics.

The 3Rs debate was organized by the Institute of Physics, the Daphne Jackson Trust, the Royal Academy of Engineering, the Engineering and Technology Board (ETB) and the Science Council.

Further information:

- ❖ DG Research, Women in Industrial Research Project
www.europa.eu.int/comm/research/wlr
- ❖ International Women in Industrial Research Conference
www.wlr-conference.de
- ❖ The Greenfield review of recruitment and retention of women in SET (*SET Fair*)
www.set4women.gov.uk/set4women/research/the_greenfield_rev.htm
- ❖ MIT study on the status of women
web.mit.edu/fnl/women/women.html
- ❖ The Gender Equity project for women in academia
www.hunter.cuny.edu/genderequity/
- ❖ Diversity statistics at US university science departments
ChemInfo.chem.ou.edu/faculty/djn/diversity/top50.html
- ❖ Diversity in Physics
diversity.iop.org
- ❖ The Daphne Jackson Trust, returning engineers and scientists to work after career breaks
daphnejackson.org
- ❖ UK SET Resource Centre for Women
www.womensetresource.org.uk

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