

WOMEN IN SCIENCE, ENGINEERING AND TECHNOLOGY - AN ON-LINE CONSULTATION

The Parliamentary Office of Science and Technology (POST) has recently completed its second on-line consultation, on the subject of women in science, engineering and technology (SET). The exercise aimed to inform the ongoing wider debate about the role of women in SET and to test the effectiveness of an e-mail based on-line consultation.

This POST Report considers the topics that arose during the discussion and the issues raised by the method of on-line consultation.

A draft of this report was given as evidence to the House of Lords Science and Technology Committee (subcommittee II) inquiry into "Science and Society".

INTRODUCTION

Although there were undoubtedly significant increases in the number of women in science, engineering and technology during the latter half of the 20th century, they are still under-represented compared with their proportion in the general population. In some areas, such as biosciences, as many as 43% of UK university post-doctoral researchers were women in 1997/98. But in physics this figure was only 14%, and 12% in electrical, electronic and computer engineering. In addition, when senior scientific posts are considered, the situation was worse - only 1% of physics professors were women (see **Figure 1**).

The Women in SET on-line consultation was run by POST in collaboration with the Hansard Society and the Women in Higher Education Register. The Athena Project, run by the Committee of Vice Chancellors and Principals (CVCP), co-ordinated an expert panel to focus and inform the discussion.¹

Debate was conducted via e-mail; contributions were also archived and displayed on the World Wide Web. Both the e-mail list and web pages were hosted by the UK Universities' Mailbase system. Any member of the public who had access to e-mail or the World Wide Web was able to join the lists. To

¹ The Hansard Society is an independent educational charity which brings together MPs, Peers, academics, journalists, parliamentary staff and others with an interest in the political process from across the political spectrum to promote effective parliamentary democracy. The CVCP's Women in Higher Education Register collects, analyses and disseminates information on women in higher education. It is open to all women working in Higher Education and provides data and analysis for the Athena Project. The aim of the Athena Project is to encourage strategies, promote good practice and offer incentives to improve the access, participation and promotion of women in SET in Higher Education.



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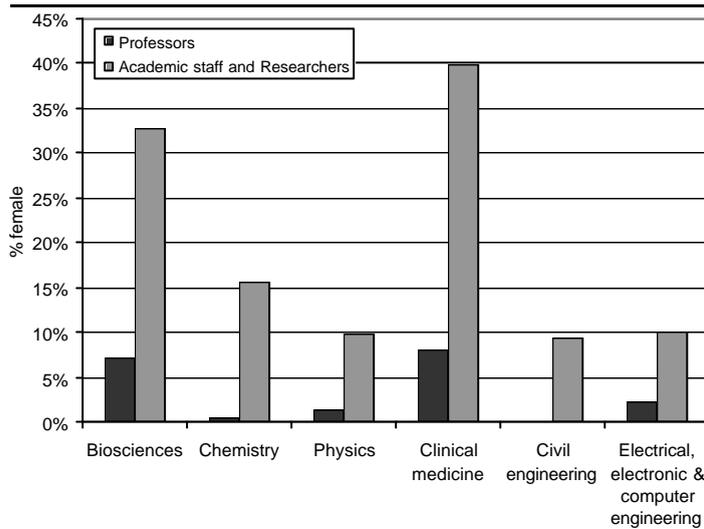
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ensure that the discussion was constructive and relevant, the lists were moderated - each message was cleared by one of the organisers before it was posted to the list.

The discussion took place over the four weeks from 25 October 1999. Each week was dedicated to a specific theme related to women in SET:

- Week one - **Education**: primary, secondary and higher- the first choices, the first constraints and the first barriers
- Week two - **Career**: fulfilling potential and overcoming frustration
- Week three - **Culture**: does science suffer from its gender imbalance?
- Week four - **Policy**: recommendations and an action agenda.

Discussions in the first three weeks were each introduced by a keynote article from a leading figure in the field. All took a few days to get underway, so the education and careers topics were each extended by a week and ran in parallel with other topics. At the end of each week, a summary was written by the list owners and posted to all list members. The discussion was publicised using several e-mail mailing lists, press releases and personal e-mails. The mailing lists covered several thousand women and men in the academic community. Nonetheless, many participants seem to have found out about the list by word of mouth. The number of members increased substantially throughout the four weeks.

FIGURE 1: PERCENTAGE OF SCIENTISTS IN UK HIGHER EDUCATION WHO ARE FEMALE²

The fact that the organisers would present the results of the consultation to members of the House of Lords Science and Technology Committee was mentioned in the publicity. This undoubtedly gave the discussion more weight in the eyes of contributors. The moderator function to bar a person was invoked only once, when an abusive message was sent. A number of contributors had to be asked to shorten their messages, as a (flexible) limit of 500 words per message was set. In the last week, a few contributors were asked to redraft their submissions to ensure they addressed policy recommendations.

PARTICIPATION

In total, 261 people joined the discussion lists and 67 of these made contributions to the debate. 165 submissions were posted. **Figure 2** shows the number of contributions received each day on the four topics. There was extensive interaction between the participants and the quality of contributions was judged by the moderators to be extremely high. Contributors had a wide range of personal experience to relate on all of the topics discussed, and came from a variety of backgrounds, including MPs, professors, scientists from industry and academia and social scientists. The full archive of the discussion can be viewed at www.mailbase.ac.uk/lists/hansard. **Box 1** lists the authors of the keynote contributions.

As with all on-line consultations, there were many "observers" who registered for the discussion but did not participate. In addition to those signed up to the e-mail lists, members of the public were free to view the archives of the discussion on the web site. The

BOX 1: KEYNOTE CONTRIBUTORS

- Baroness Warwick, Chief Executive of the Committee of Vice Chancellors and Principals (week one, education)
- Dr George Poste, then Chief Science and Technology Officer at SmithKline Beecham (week two, careers)
- Dr Phyllis Starkey MP (week three, culture)

web site received several thousand hits during the debate. Although these cannot be translated into numbers of people viewing the site, it suggests that there were observers following in this way. It also became clear that there was a significant amount of e-mail and debate off-line among the scientific community as a result of the consultation. For instance, the consultation was the subject of an article in *The Guardian* newspaper, which led to broadening of the list membership.

The rest of this report considers the conclusions reached during the four weeks of the discussion and the utility of the method. More detail on the topics discussed and technical aspects of the on-line consultation can be found in Annexes A and B.

VALUE OF THE EXERCISE

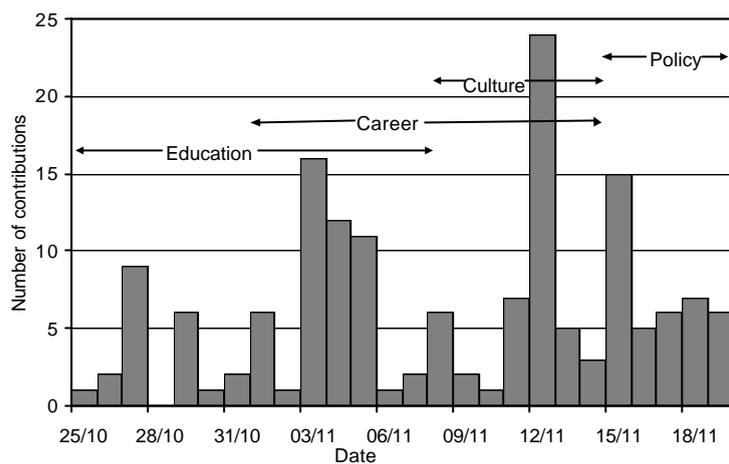
On-line consultation appears to be a useful method of encouraging wider and more interactive participation than is usually possible in Select Committee enquiries. Although the discussion included many prominent figures in the science community, it heard in equal measure from more junior and less outspoken contributors. Academia was disproportionately represented and more contribution from those involved in school-age education and industry would have been helpful - but this probably reflects the wider use of e-mail and the World Wide Web in academia and the means used to publicise the discussion. Publicity targeted specifically at these under-represented groups may increase participation, and running the consultation for longer at a lower intensity could allow those with less continuous e-mail access to contribute.

In terms of method, on-line discussion appears to fall between the face-to-face meeting and the traditional paper-based consultation exercise. More people were able to make their views heard than would be the case at a meeting, and there was more opportunity for considered analysis of the topic and in-depth debate. On the other hand, unlike a traditional consultation, all participants were able to see each other's submissions, respond to or refute points, and become actively involved in discussion.

Those taking part and listening appeared to feel that they had taken a lot from the discussion themselves

² Figures from Higher Education Statistics Agency for years 1997/1998

FIGURE 2: FLOW OF CONTRIBUTIONS



and formed their own community. Indeed, several participants wrote to say how much they had enjoyed the discussion: **Box 2** shows examples of positive feedback sent to the list. Whether those observing were also impressed is difficult to judge, but very few people left the mailing list during the discussion. This suggests that they thought it worthwhile to read the submissions - sometimes more than ten per day (see Figure 2).

The discussion was moderated with a light touch - it may be that no moderation, or more heavy handed moderation, would have resulted in different outcomes.

There were two interesting moments in the discussion when the new medium of communication came into contact with older media. Several contributors regarded the article in *The Guardian* as unfairly reporting the online debate, particularly in its statement that there was a shortage of ideas in exactly how to counter the problem. There followed some discussion about writing to the newspaper and correcting the impression given, although in the event this did not happen.

Towards the end of the debate several contributors reflected upon the quality of the contributions and wondered whether the discussion archive might make an interesting book - perhaps suggesting that new media are not substituting older forms of communication, but providing new tributaries into and from them.

POLICY PROPOSALS

Contributions to the discussion were generally of a very high quality, with a range of experience and points of view. The last week of the discussion in particular brought forward some interesting and novel policy suggestions. Key proposals were to:

BOX 2: POSITIVE FEEDBACK

Members of the Athena Project Steering Group and myself have followed the discussion with interest and welcome the scope, depth and cross-section of views and insights of the contributions. Julia Higgins CBE, FRS, FEng, Professor of Polymer Science, Imperial College, Chair Of The Athena Project Steering Group

Many thanks to all who have contributed to the discussions over the weeks. It has been most enlightening and encouraging. Chris Petrie, Professor of Non-Newtonian Fluid Mechanics, Newcastle University

- Develop mentoring/ role model schemes to encourage women at school, university and work to continue with science. This would be for Education Authorities, the Department for Education and Employment, higher education institutions and professional bodies to promote.
- Encourage institutions to ensure that they have gender-neutral family friendly working policies, including flexibility in their approach to the working week and contracts of employment; or go further and develop a UK Code of Practice such as the U.S. National Academy of Sciences has in place.
- Develop more sophisticated methods of appointment and promotion, so that criteria other than the number of papers published are assessed. These might include team working, communication skills, human resource management and teaching. The criteria should be systematised and published.
- Re-evaluate the means by which higher education and research is funded, so that co-operation and interdisciplinary work are rewarded and to discourage short-term thinking.
- Gather and review data on the recruitment, progression and retention of women scientists in academia and industry, by discipline, to establish the current position and measure the impact of proposals which are implemented.

It would have been interesting to hear from policy makers regarding the action agenda and policy recommendations.

EFFECTING CHANGE

Although the discussion covered a broad swathe of subjects in some depth, little of what was said was entirely new. There are a large number of groups working in this area, such as the Women's Engineering Society and the Association of Women in Science and Engineering. The Promoting SET for Women Unit in the Office of Science and Technology has been working as a focal point for the community since 1994, stimulating and co-ordinating new initiatives.

The problems are of long standing, and there is a view that solutions proposed in the past would have improved the situation significantly had they been implemented. However, it was suggested that there will not be real progress until the issue of women in SET is at the top of the agenda for those who make policy and influence science. This leads back to the recommendation that those who fund higher education and scientific research introduce a requirement in their assessment exercises that the rate of recruitment and progression of women is monitored.

An action agenda

During the final week of debate the **Women in Higher Education Register** put together a suggested list of action points for higher education institutions, professional bodies and research councils. Details are given in **Box 3** This was circulated to various professional institutions. The Women In Science and Engineering Campaign agreed in principle with the idea of such an agenda, but suggested that it should also include points targeted at school children and parents. The response from the Institution of Mechanical Engineers was also positive:

There are many issues outlined in the proposed action plan which the IMechE broadly supports. We would be happy to provide relevant information on our Institution members as required and could help with the identification of role models in industry, particularly of younger members. Martin Northcott, Manager Regional & International Operations, Institution of Mechanical Engineers

The Women in Higher Education Register and the Athena project are currently considering how to take this forward.

CONCLUSIONS

This was the second on-line discussion organised by POST. The first discussion, in July 1998, covered the subject of data protection. Although the contributions to the first discussion were of high quality, of the 94 people invited only fifteen participated and 33 contributions were received in total. The debate on women in SET, in comparison, received 165 submissions. The greater participation in this debate could be due to a number of reasons:

- the discussion was widely publicised, and was not restricted to an invited few
- the topic was of more personal interest to the scientific community
- direct links to a Parliamentary Committee's work
- increasing use of e-mail and the internet

BOX 3: SUGGESTED ACTION AGENDA

Higher education institutions & professional institutions to gather information to compare, to explain and justify the differences in:

- promotion rates, length of time from membership to fellowship
- participation and progression rates of undergraduate, postgraduate, post doctoral and academic faculty, junior and senior
- salaries, nature of contract – fixed term or permanent, resources provided - laboratory space and technical / administrative support for men and women

Involve men in the action and the benefits:

- train them as mentors and members of recruitment/promotion panels
- get their support in identifying and tackling the institutionalised obstacles, unintentional discrimination and insidious behaviours
- develop family-centred policies with flexible working to allow both partners to balance the demands of work and caring responsibilities (elder as well as child care)

Set up networks of women within institutions with positive short term goals to:

- provide role models and support systems
- raise the profile of women - to sit on committees or become department finance directors rather than counsellors
- tell it how it is— success stories and team contributions as well as discrimination and isolation

HE institutions to:

- address the wastage of women between 25 and 65
- provide career and professional development not just for the best women but also for 'the merely very good'
- recognise the increasingly competitive ethos of science and HE reward and funding systems, in particular the Research Assessment Exercise
- develop "get-around" solutions, such as academic age policies rather than chronological age to take account of time out and part time working

HE and the professional institutions should:

Inform themselves of, understand and be aware of the position within their own institution and, on the basis that organisations measure what is important to them, measure their performance and progress in improving their position

Caroline Fox, Project Consultant to the Women In Higher Education Register and the Athena Project

The debate was informed and articulate among a community who are used to e-mail and the World Wide Web. It was a topic high on participants' agendas, and offered the possibility of influencing those making policy. Participants now have some expectation that policy makers will pick up the themes emerging from the debate.

The exercise can be classed as a success in terms of both the method of discussion and the topics raised, and is a useful model for future consultation exercises. The most significant drawback is that the debate was only open to those with access to e-mail. Although this is generally not a problem within the academic and scientific community, other sectors of society may be excluded. However, this difficulty is becoming less significant with the growth of the new media - over a quarter of the UK population are now estimated to have access to the internet.

ANNEX A - SUMMARY OF THE DISCUSSION

DOES IT MATTER?

Reasons for discussing the issue of women in science were set out succinctly in a contribution to the consultation from Judith Glover, Reader in the School of Sociology and Social Policy, Roehampton Institute, London:

It may be useful to try to analyse why the issue of 'women and the sciences' matters. It seems to me that there are at least three possible answers, all of which have been referred to by different contributors.

The first relates to equal opportunities: it is only fair that women have access to and make progress within the same range of occupations as men. Many campaigns to alleviate the 'problem' of women and science are informed by this 'fairness' perspective.

The second answer relates to economic concerns: economic growth is dependent on the existence of a sufficiently large pool of scientific personnel, who are furthermore relatively expensive to educate. This perspective is at the heart of many government and industry responses to the issue.

A third and more controversial answer to why the issue matters seeks to shift the 'blame' from supposed characteristics of women to what is seen as science's male agenda. This is the view that the content of science - the scientific agenda - would be different if scientists were more culturally diverse.

EDUCATION

Education was discussed for the first two weeks of the consultation. By the end of that period, 77 people were registered on the education e-mail list, and 31 contributions had been received.

Stereotypes

Baroness Warwick, Chief Executive of the Committee of Vice Chancellors and Principals, started the debate with a keynote piece entitled **Science Education: first choices, first constraints and first barriers**. She began by discussing scientific stereotypes:

I don't think there is any doubt that society's stereotypes influence the way girls approach their education and careers. The idea of scientists often portrayed in the media as weird, eccentric boffins, does not appeal to young people, and particularly to young women.

This prompted agreement from discussion list members:

I agree that society's stereotypes affect career choices, that bad images of scientists abound, and that "only a genius does science" is a common idea...The myth [that mathematics is a "young man's game"] is a particularly powerful one ... My own personal experience is that many academics believe this myth to the point of active discouragement of women students. Just one example: six months into my PhD (during the late 80's), the Head of Department called me into his office to tell me that I should apply for a job he had heard about in a bank, as I would never get an academic job other than part-time support teaching. Elizabeth Mansfield, Senior Lecturer in Mathematics, University of Kent.

[I] was more (but not much) concerned about the probably mythical, but certainly peer female, attitude at the time that being "clever" and doing "science" were a put-off to boys. Moyra Forrest, Librarian, Edinburgh

Conversely, there was also an argument that stereotypes were not necessarily the problem:

The stage, upon which is set the stereotyping of women as nurses and not as scientists, is due not so much to whether or not women are perceived as able to "do science", but to a cultural ordering of priorities: aggression (bread-winning) versus caring (home-centred). Thus, in N. European culture, what men do is important because men do it, and conversely what women do is unimportant because it is only what women do. Once that spectre is exorcised, then contributions and achievements become important per se, rather than the sort of person who makes them... However,

...Without doubt, society's stereotyping is influential; in fact, the relaxed attitudes in the USA, where women are relatively more numerous in positions of influence and power, demonstrate that once society stops bothering about role models and stereotyping, these latter cease to matter. Elizabeth Griffin, Oxford AWiSE

Image of scientists

Baroness Warwick believed that role models and teachers were extremely important:

I am sure that if there were more women teaching science especially physical science and mathematics, it wouldn't be perceived in quite the same masculine way...It is important that women in [science, engineering and technology] come together to produce active encouragement and role models.

A number of the contributors to the debate expressed similar views. For instance, Sarah Dunkin (Research Fellow, University College London), noted:

I've taken part in many educational activities to promote science to schoolchildren, mainly in the age range 11-19. These have taken the form of talks, visits, open days, and

project work, to mixed and single-sex schools...Many of the teachers tell me how beneficial it is for the pupils (particularly the girls) to see a young, female scientist talk enthusiastically about their subject.

Marilyn Brodie, Senior Lecturer in Science Education at Sheffield Hallam University and Researchers in Residence Co-ordinator for the Pupil Researcher Initiative (explained in the quote below), gave details of a scheme intended to involve students as role models:

More than 1000 Engineering and Physical Sciences Research Council and Particle Physics and Astronomy Research Council PhD students have visited schools as Researchers in Residence. During their time there they have contributed in many ways - offering advice on scientific processes and concepts, providing support during practical/investigative sessions and stimulating pupils' interest in science and engineering by talking about their research work.

I am really pleased to say that in the region of 38-40% of the PhD students who become involved are women and one of their overriding objectives is to show that these are careers for women and that if they 'can do it' so can the girls in the schools they visit. As role models all the PhD students are perfect. Their youth and enthusiasm is contagious and there is some evidence to suggest that they have awakened interest in pupils for subjects previously thought to be difficult and boring.

Parents also had a profound influence, according to Janet Drew, Professor of Astrophysics, Imperial College:

I have found, anecdotally, that a large proportion of the incoming physics female undergraduates I have encountered have fathers and/or mothers (less common, of course) who are scientists or have, through hobbies, passed onto their children a strong positive image of science. Certainly this describes my own origins as a scientist.

Role models could come from unexpected sources. For instance, Dr Jan Harding, Equal Opportunities Consultant noted that:

Science has become an important element in the work of the Women's Institute (WI). WI members are the mothers, aunts, neighbours and grandmothers of young women. Perhaps THEIR changing perceptions of science may influence the younger women's choices.

Schooling

Single sex schools was another issue raised by Baroness Warwick. Although it must be acknowledged that single sex schools are often academically selective, they may have areas of best practice:

Interestingly, all-girls schools seem to have been more

successful than co-educational schools in encouraging girls into the physical sciences.

Contributors to the discussion had direct experience of this - both positive and negative. On the plus side, Bridget Cooper, a Research Officer in the Computer Based Learning Unit, Leeds University, stated:

In the only all girls school in Northampton a few years ago, where I briefly taught A-level computing, we had more girls studying A-level computing in the one group there, than in all of the rest of the town's secondary schools put together. There were few female teachers either. Though single sex education has drawbacks it also has some advantages.

But Emma Gottesman, an R&D engineer in the broadcast industry and mother of two had experienced a downside of single sex schools:

I attended a single sex secondary school. During most of my time there the head of science, a woman physics teacher, openly expressed the opinion that it wasn't worth teaching us girls physics because we'd all go off and have babies and hence waste the knowledge. It was a general viewpoint at the school that motherhood and a technical career were mutually exclusive.

There was some criticism of teaching and the early choice of options in the schools system. For instance:

As many of the correspondents to this list have made clear at the anecdotal level, and as a considerable amount of research confirms, the culture of science and mathematics teaching in schools is not necessarily supportive of women, or indeed of any people who are seen to be alien compared with the 'norm' of white, middle class, maledom. This is despite the public narrative about the boys losing out up to GCSE. Leone Burton, Professor of Maths. & Science Education, Birmingham University

Some contributors thought the system in Scotland was better, as described by Irene Paulton, Secretary, St Andrews University:

I think it is so important not to shut the options down for our children too early on - one reason we moved to Scotland was because of the extra flexibility offered by the education system here. I would urge England and Wales to look long and hard at the way they channel schoolchildren so early on and remember that, like me, some are late developers.

Contributors also saw a contrast between the science studied at school and the aspects of modern science which inspired them. This contribution by Sarah Dunkin (Research Fellow, University College London) typified this contrast:

I am a planetary scientist and astronomer, but found science at school pretty boring and apparently irrelevant to everyday life...Had I not been so determined to enter

science as an astronomer, I am almost certain that science would have been low down on my list of GCSE options, despite being good at them. I wonder how many other children in this country are put off because of "boring", "irrelevant" science classes?

Emma Gottesman (R&D engineer in the broadcast industry) was another who pursued a career in science almost despite her experience of science education:

I took chemistry and physics at O-level because I knew they were necessary to what I wanted to do later on. I read a massive amount of science-fiction as a teenager, particularly Robert Heinlein, and I desperately wanted to be like the people in Heinlein's books. I found school physics at O and A level deadly dull, but I was fascinated by 'real' physics and devoured popular science books on relativity and quantum mechanics. I persevered with the school studies because they helped me understand the interesting physics we weren't taught.

I also studied electronics at O and A level, and that I did because it was fun. Making a working radio in an O level lab session and then being allowed to play it (tuned to Radio 1) during subsequent lab sessions was a major, major kick.

Professor Athene Donald FRS (Physics), from Cambridge University was one of those who felt it was important to relate the science taught to the everyday world:

One point that does not seem to have come up in discussion is why there are far more women entering the life sciences than the physical sciences.. and I think in part this stems from the message conveyed by various contributors, that (physical) science is taught in such a way to seem irrelevant at school. It is seen as a string of facts that have little to do with understanding what is actually happening around us, and certainly doesn't relate to people as humans.

Baroness Platt of Writtle, CBE DL FEng, Member of the House of Lords Select Committee for Science and Technology and Patron of WISE (Women into Science and Engineering) agreed:

There is no doubt that girls need science and maths education to be seen to serve their interests in life. They need to see that science and engineering contribute fundamentally to wealth creation, their quality of life, and sustainable development.

Bridget Cooper (Computer Based Learning, Leeds University) stated that teachers could help:

My PhD study is on empathy in teacher pupil relationships and one thing that comes over clearly is that empathic teachers are very skilled at relating their subject to their pupils lives and interests - they teach in a personal and highly relevant way and they are more interested in

teaching people than the subject for its own sake. The more detached approach traditionally taken in science is a real turn off for many pupils, not just girls I suspect.

Dr Jan Harding, Equal Opportunities Consultant, had evidence of the effect of the curriculum:

When Victoria (Australia) changed the requirements for science in the Victorian Certificate of Education (VCE), requiring physics to be taught in 'context', but also modifying the assessment methods, suddenly girls were very good at physics.

Culture and perceptions

There was also some discussion of the culture of working in science and industry - both its reality and perception. Baroness Warwick stated:

There is still a perception that engineering implies being stuck in a factory on the shop floor with a lot of men. This is, of course, a very old fashioned image, but it still hangs over the whole area of engineering and is bound to be off-putting.

There was agreement from list members:

My experience ... is that perception is King. The nearer that engineering is perceived to be that of dirty boiler suits and oily rags the less women will be interested, and rightly so. Rob Dickson, Electronics Engineer

At 16 I completed a weeks work experience in a manufacturing engineering environment. I was the only female there and pictures of near naked women were displayed prominently about the shop floor. It is pure luck that I already knew what I wanted to do; I am sure that this work experience would actually have put many girls off the idea of ever entering into a science/engineering type degree. Similarly, when I was visiting universities, I cannot recall meeting a single female lecturer, which many girls may find off-putting. Kotska Wallace, remote sensing scientist and Member of the Board of Space School UK (a residential course for older teenagers with an interest in space).

Neither of our children wanted to read science or engineering at university. They felt that science and engineering professions, compared to medicine, dentistry, accountancy and law, are undervalued and underpaid in the UK. If our daughters are intelligent and numerate perhaps it would be unfair of us to encourage them to become scientists or engineers when they are likely to be much better paid in professions such as accountancy or law. Mrs J A Marsh, Research Fellow, Department of Surveying, The Nottingham Trent University

When I was applying for medical school, some 20 years ago, there were few women applying or getting into medical school. Now over 60% of our students are female. Perhaps those wishing to address the issue of attracting women into science and technological careers might look

at what has happened to the career structure in medicine over that time to see why it has now become so popular. I am sure that the presence of good media role models (including those in medical soaps!) and change in working practice has helped. Sarah Burnett, Service Director for Radiology, St Mary's Hospital and Admissions Tutor for Medicine, Imperial College

Some contributors felt that the scientific establishment could do more to overcome these stereotypes. For instance, Janet Drew (Professor of Astrophysics, Imperial College) noted: *I was required to attend a part of the British Association's Annual Festival in Sheffield this year. The predominance of grey-haired gentlemen in jackets and ties depressed even me! What must schoolchildren attending such an event (intended to be PR for science) think?*

Information technology

Baroness Warwick was particularly concerned at the low number of women in IT:

It is an irony that as IT comes to dominate our lives, the number of women in IT is actually declining...The UK has one of the lowest proportions of women studying on maths and computer science courses in the EU.

Some of the contributors to the debate had particular insights in relation to IT:

The culture in information technology can be male dominated, not only in the formal structures but also in the informal structures, which play a huge role in motivating or demotivating people. The language of computing can be used to belittle others and maintain power and this needs to be avoided at all costs. Bridget Cooper, Research Officer, Computer Based Learning Unit, Leeds University

I have undertaken some research looking at those women/girls who do follow a higher education course in computing and comparing their pathways into higher education and their coping mechanisms once there. In general, those whom I interviewed followed a complex path in order to convince themselves and others that this was the right choice for them...They also developed sophisticated ways of dealing with a subculture that they often considered more suited to young, white male students. Tina Waterman-Roberts, Southampton Institute

Overview

A large number of discussion topics were generated during the week, many of which interact. Several interwoven themes emerged:

- the importance of role models
- the need for the science curriculum to reflect girls' interests

- the influence of societal stereotypes.

CAREERS

Discussion of careers in SET took place over the second and third weeks of the consultation. This topic attracted the most interest - 105 people registered on the careers e-mail mailing list, and 53 submissions were posted.

Week two began with a thought-provoking opinion piece by **Dr George Poste**, Chief Science and Technology Officer at SmithKline Beecham, entitled **Science careers: fulfilling potential and overcoming frustration?**. His viewpoint sparked considerable debate and stimulated some constructive ideas.

A non-issue?

Dr Poste remarked:

My view is that the trend of increased representation over time will make this a non-issue. I know there are others who hold the view that there is a glass ceiling, and a subtle or insidious discriminatory barrier. I hope I'm not being delusional in this regard, but I certainly don't see it in this corporation, or in the broader realm of industry.

Some of the contributors to the discussion did not agree:

Statistical analyses of the facts relating to academic employment, retention and research opportunity show prejudice to be rampant. Elizabeth Mansfield, Senior Lecturer in Mathematics, University of Kent

On reading Dr. Poste's remarks on Monday, it struck me immediately that its positive reassuring 'there isn't a problem - let's wait for the ladies to make it to the top' tone was bound to lead to the fierce responses that it has already produced. It demonstrated to me how hard it is for many (WASP) men to really think their way into this one, and to perceive what being in a minority is like. Janet Drew, Professor of Astrophysics, Imperial College

The market

Contributors speculated as to whether market forces could be a major factor affecting women in SET:

Does it take a cynical male to wonder whether the current interest and enthusiasm for encouraging women into science and engineering coincides with a general lack of good quality (university and job) applicants of either sex in these fields and with a pattern of recruitment and career development which takes many...science and engineering graduates into jobs in the city and (in industry) sales, marketing and management - i.e. where the money and/or the power can be found? Chris Petrie, Professor of Non-Newtonian Fluid Mechanics, Newcastle University

I suspect the key-note speech simply reflects a free market, non-interventionist approach which tends to preserve the status quo and existing power structures until the market dictates otherwise. Bridget Cooper, Research Officer, Computer Based Learning Unit, Leeds University

Trends

Dr Poste thought that the position of women in science had improved:

The intellectual legitimacy of the feminist movement in the late 50s and on into the 60s is not disputed, but there are now many rather tired placards and slogans from this era which are irrelevant today. In my opinion, they should be celebrating the successes of their legitimate activism, because we are seeing that success.

There were contributors to the discussion who agreed - at least partly:

Things aren't quite as bad as they used to be; I recall being asked at job interviews (early 70s) if I was planning to get married, and it doesn't seem so long ago that (some) application forms asked for number of children. At least current public encouragement of women to go into science & technology implicitly acknowledges their intellectual equality. Dr MJ Pearson, Department of Clinical Biochemistry & Immunology, Leeds General Infirmary

I am glad to see that the more recent correspondents have moved away from the 'tired feminist rhetoric' that we started with. Things have improved, and if they haven't improved enough we have to consider why and not just keep trotting out the idea that men are determined to keep women out. Things are undoubtedly more subtle. Professor Athene Donald FRS (Physics) Cambridge University

Role models

As in the education discussion, the importance of role models was stressed:

My experience of talking to undergraduates with a view to encouraging them to consider postgrad studies is that it is important for women to have female role models, and to have women staff members showing an interest. Jane Hutton, senior lecturer in Statistics at Newcastle University

The effect of combative, macho practice in academia can be very off putting for women (and I am sure many men) and I am eternally grateful to the women who showed some interest in my studies yet never received any time or pay to do so. Bridget Cooper, Research Officer, Computer Based Learning Unit, Leeds University

Although the education debate had mentioned the importance of parental role models, in some cases the effect of having a scientific parent could be off-

putting, as Elizabeth Griffin (Oxford AWiSE, ex short-term contract researcher) described:

My elder son is extremely able in science, but hates the attitude of universities. Unfortunately he has opted against trying to follow a career in science with the remark, "I don't want to have to drag myself around the world like you do, trying to find little pockets of money here and bits there."

Academia

Dr Poste also suggested that academia was less equal in opportunity than industry:

I think that there is more discrimination in academia, on both sides of the Atlantic. It seems to me that there are still a smaller fraction of women entering tenured academia compared to the middle and senior ranks of industry.

Some specific points on inequality were suggested:

Whilst women account for 51% of all Higher Education staff, they feature disproportionately among the less well-paid groups...Moreover, within all staff groups proportionately more men than women are in high grades, and this is particularly marked among academic staff. Mrs E Lanchbery, Personnel Director, project consultant to the Women in Higher Education Register

If [the discrimination in academia] is true, it points to (i) the almost medieval reliance on personal references (effective patronage), (ii) and the use of easy 'hard' but seemingly women-unfriendly measures such as numbers of publications/citations in academic appointments and promotions. Janet Drew, Professor of Astrophysics, Imperial College

*The glass ceiling is a virtual feature, which only those beneath it can experience. Women preferentially get "employed" on short-term contracts, which carry no status and bear no commitment of long-term protection. When one's grants run out, however prestigious they may have been, that is the end of the career..Elizabeth Griffin (Oxford AWiSE, author of two "Forum" articles on these topics in *New Scientist*)*

Many see the way grants are awarded as discriminatory because of the importance placed on publication rate. At a time when scientific careers are at a crucial point i.e. late 20's early 30's women have to make life choices about children. At this point I see many women leaving science because they feel that once they have children they will no longer be able to compete for jobs/funding because of a dip in their publication rate which may never be put right. Dr Sue Berningham, NERC research fellow, Sheffield University.

Several contributors blamed the Research Assessment Exercise:

The other thing that I'm surprised I haven't heard more about, in the academic context at least, is the RAE. Career breaks are not only viewed negatively at the best of times - they're a disaster these days since recent publications and grants are all that counts. Clare Davies, Research Fellow, Dept. of Psychology, Surrey University

Unfortunately, in times of limited funding, aggression and power playing are even more dominant. It is becoming more common to find distrust rather than trust in many scientific communities. From the perspectives of team building, collaboration, career changes and mentoring the RAE could have been one of the biggest mistakes for UK science. Dr. Brenda J. Topliss, Physical Oceanographer, Department of Fisheries and Oceans, Canada

Career breaks and childcare

In Dr Poste's view, industry might be more appealing than higher education to women who wanted children:

Apart from the additional compensation benefits, private sector research offers a better support framework for women who leave to have children, compared to the public sector.

But:

On the other hand, the dual career partner/spouse family, particularly if matched with a lot of international travel, puts great demands upon relationships.

A number of contributors agreed that family-friendly practices were vital:

In France ...the nationally-subsidized creche system was credited for the far higher percentage of women scientists and engineers at all levels, and in all areas of physical sciences, mathematics and informatics. The men felt it made them more productive too -- as creches provide men with more child-care options, as well. Cheryl Fillekes Ph.D, lead software engineer in New Zealand

What's also needed is a realisation that trivial or unnoticed (false) assumptions - eg that one has to work long hours to demonstrate commitment, or that family commitments are incompatible with scientific competence - disadvantage huge numbers of people (often women) to the detriment of society as a whole. Dr E A Johnson, Condensed Matter Theory, Imperial College

Large, multinational companies should have no problem in providing these [family friendly] conditions. Unfortunately, when I have mentioned this to my employer in the past, my personnel department's response is that this is not a big problem because they don't have many women engineers! Lee Nelson, Software Engineer

There was also a view that family friendly working

should not be just a women's issue:

Currently, the French government is investigating why, when there are so many policies which keep women in the labour force (usually full-time and without career breaks), women are still failing to 'get on'. One explanation under consideration is that, ironically, it is the very existence of these policies - and women's monopoly of their take-up - which has underpinned women's failure to reach the same position as men. It looks as though women who take up these policies become stigmatised as lacking commitment. Judith Glover, Reader in the School of Sociology and Social Policy, Roehampton Institute, London

Why aren't there more and better opportunities for MEN to take time out to look after their families? I speak as one who has done a role swap and yes, it was darned difficult for my husband to be the only one at the Toddler Group but it was also great fun. Irene Paulton, St Andrews University

When children arrive, I believe in the involvement of both parents in their upbringing. The present mentality of "6 days a week, 10 hours a day" duty if you want promotion, I believe, is bad for industry and commerce and bad in the involvement of both parents in happy family life and I hope it changes fundamentally in the 21st century. Baroness Platt of Writtle CBE DL FEng

Some cultures seem to be further advanced than the UK in this respect. Anne-Marie Nuttall, a research associate at Bristol University, had spent some time in Norway. She was impressed by attitudes to parenting there:

My understanding is that parents have a generous amount of paid parental leave which can be shared between them as they choose. Well not quite as they choose - a certain amount of leave has to be taken by the father! When a man is just as likely to take parental leave as a woman, then employers are going to be less prejudiced against employing women of child-bearing age.

Ageism

Towards the end of the debate, the issue of ageism was raised:

Ageism affects both men and women (as my poor husband can tell you) but I feel it is one of the major factors which affects women who are trying to return to a career after a break. Their contemporary males have been publishing papers, making themselves heard and have probably managed to secure a permanent job. Lesley Onuora, formerly senior lecturer in physics and astronomy at the University of Nigeria, currently a Daphne Jackson Fellow at the Sussex University

The effects of ageism exacerbate the situation of short-term contracts. Anyone too good to throw away but too old to be considered seriously (in the stereotypical model) for a

position is encouraged to 'find a grant'. Elizabeth Griffin, Oxford AWiSE

Overview

As with the education debate, there were many issues raised over the week. However, the three most often quoted seem to be the:

- need for family friendly employment policies and childcare taken up by both men and women
- difficulties in academia due to short-term contacts and the emphasis on recent publications
- need for role models.

CULTURE

Week three of the discussion concentrated on the culture of science. Again, interest was high, with 83 people registered on the culture e-mail list. 34 submissions were posted.

Dr Phyllis Starkey MP wrote the keynote article entitled **The culture of science: does science suffer from its gender imbalance?**

The model of science

Dr Starkey argued that:

The model of science that we have in most of Western Europe, as an intensely competitive structure that seeks individual stars, is an essentially masculine construct... Women tend to work in a more co-operative and interdisciplinary manner.

This view had proponents:

The long term, solution-finding, approach she ascribes to feminine culture and which represents advanced levels of empathy is clearly at odds with this short-term, short-contract world we all currently inhabit. Bridget Cooper, Research Officer, Computer Based Learning Unit, Leeds University

There also seems, in management theory, to be an increasing advocacy of the "female" cooperative approach to management, as a valid and highly effective approach, for men to take too, very much along the lines indicated by Dr Starkey. Dr MJ Pearson, Department of Clinical Biochemistry & Immunology, Leeds General Infirmary

...studies relating maturation with science choice, which showed interesting gender differences, and formed the basis for curriculum design. His conclusion was that the way science was presented for teaching/learning tended to attract the emotionally reticent male (not just men!), which may have far reaching effects on the way science is practised, the choice of research topics and the nature of the resulting science. Dr Jan Harding, Equal Opportunities Consultant

But other contributors disagreed:

A friend of mine, a cognitive psychologist by training and by trade told me that he was uninterested in gender-difference research, because the results were almost always weak – no really definitive results, only statistically marginal correlations, everything depending on training, the individual, class – nothing directly attributable to gender. Cheryl Fillekes, Ph.D, lead software engineer, New Zealand

I didn't like the sound of those previous messages asking for less competition so that the women would feel more comfortable. The only reason women feel uncompetitive in a male dominated workplace is because we are effectively outside the hierarchy, being a minority, not because women don't enjoy a good honest race with someone else. Eleanor Blyth, Senior Scientific Officer at the Institute of Hydrology

Everyone has different abilities, skills and experience that they bring to a job, regardless of whether they are a nurturing, sensitive male or a ruthless, domineering female. Kotska Wallace, remote sensing scientist

Trends

Dr Starkey also proposed that, in some ways, the situation for women in science was getting worse: *With the vast expansion of postdoctoral researchers and the lack of job security, I think that science has become more competitive and therefore even more hostile towards women's inclinations.*

Submissions from those working in academia agreed that things had changed, with funding becoming an increasingly important factor:

I think the major problem with attracting and keeping women in science is tied in with the funding squeeze. There is a lack of real money for research opportunity for new PhDs, and abuse of people on short term contracts. Not enough funding brings out the worst in people. Elizabeth Mansfield, Senior Lecturer in Mathematics, University of Kent

It used to be that it was publications that mattered for success in science, now it seems to be research funding obtained and spent. Chemists who are successful in academia now spend all their time writing research proposals; they then employ and exploit postdoc workers to do the science. They do very little science themselves. Dr Mary Masson, Academic Co-ordinator, Department of Chemistry, Aberdeen University

But there were also suggestions that such developments could be good for women:

I'm a totally dedicated believer in the marketplace. Simone de Beauvoir, in "The Second Sex" said that capitalism had done more for the progress of women than anything that

politicians or socialists had ever done. I absolutely concur... I don't think you can persuade women to want to be engineers, or anything else, if they don't see some obvious job opportunity. Teresa Gorman MP

We've covered the ground of the problems with academic science, and one solution posed has been entrepreneurship. The market has been saying loud and clear for many years now that this is the answer. If you've hustled grants, believe me, you can hustle tech transfer funds. If you've developed the skills to deal with competition in academia, you're practically overqualified for dealing with competition in business. Cheryl Fillekes, Ph.D, lead software engineer, New Zealand

Some participants also observed trends in the treatment of women by their male peers:

Although I can think of instances of discrimination, it is often from older men and women. So although I realise that there are pockets of discrimination about, I would suggest it is on its way out. Eleanor Blyth, Senior Scientific Officer, Institute of Hydrology

I agree with Eleanor Blyth's suggestion that attitudes of the men we work with are very different to those of the older (and usually more senior) men in the industry. The younger men (under 40?) I work with expect the women engineers they work with to be engineers, and that's all. Emma Gottesman, R&D engineer in the broadcast industry

Information Technology

Not everyone agreed that things were improving over time - in the field of IT in particular, some thought things were getting worse:

While I would like to accept that discrimination is on the way out I find the evidence unconvincing. My parents' friends said to me when I was an early woman into IBM that we would not face opposition because there was no tradition to overcome in computing - now look at the scene for women in ICTs! Anne Leeming, Director Certificate in Managing Adaptability in Business, City University

In fact, and perhaps not surprisingly, computing, both in academe and in industry became heavily masculinised. I believe that this is probably the only SET area where there was a dramatic drop in the percentage of women entering computing degrees as computing began to be a discipline in its own right. Sadly discrimination is not on its way out. It is alive and kicking and often more subtle - and therefore often harder to battle against. Alison Adam, Senior Lecturer, Department of Computation, UMIST, Chair of Women into Computing

Public Understanding

Dr Starkey also suggested that a greater involvement

of women in science would not only be good for women but would also benefit science. In particular, she felt that it might help science address its current image problem with the general public:

I believe the macho nature of science is part of the reason why scientific lay people are suspicious of it - it has an image of certainty and superiority. It promulgates the assumption that science is too complicated for ordinary people to understand, that is reflected back from the public by the image of the mad scientist - who is always a man!

This issue of the "public understanding of science" was picked up by Dr. Kathleen B Bamford, Imperial College School of Medicine:

Unfortunately there is a tendency to present the negative aspects of many science related stories (is this a male perspective?) particularly by the national media. Many organisations talk of their efforts in the area of 'the public understanding of science' Is this rather condescending? Surely what we should be striving for is accessibility and demonstration of relevance.

Discouragement

Another strand of the discussion focussed on unconscious (and conscious) discrimination.

I don't think there's any doubt that science loses out by the invisible discouragement to women to take up scientific careers. The effect is masked by the fact that determined top-flight people of both genders and all backgrounds have often been able to overcome prejudice and discouragement. Nick Palmer MP (Broxtowe), previous occupation (to 1997): Internet Manager, Novartis (Switzerland)

Over the last few years I have been involved in a number of Engineering and Physical Sciences Research Council's (EPSRC) panels to assess grants and fellowship applications in mathematics. The number of applications coming from women is depressingly small... At the same time my perception is that proposals from women tend to be of a higher quality and tend to do disproportionately better (though again this is a personal view). It seems therefore that women are less confident about applying, and probably receive less encouragement from their institutions. Prof. Jaroslav Stark, Centre for Nonlinear Dynamics and its Applications, University College

Overview

There was significant disagreement among the contributors as to the influence which women have on the process of science. The main points were:

- women may work in a more collaborative, interdisciplinary style
- a less arrogant and self-assured style of science could help with "public understanding"
- discrimination still exists, although it is often

now covert rather than overt

- market forces have had a profound impact on science - for both good and bad.

POLICY AND ACTION

During the first three weeks of the discussion, a number of interesting policy suggestions had been made. The article in the *Guardian* towards the end of week three had proposed that there was no consensus on the action to be taken following the discussion. This was strongly denied by the discussion participants, who by this time seemed to have a clear sense of themselves as a community.

Therefore, it was decided to extend the discussion for a further week to concentrate on policy recommendations and an action agenda. 39 submissions were posted to the discussion list during this final week. The next part of this report looks at some of the suggested policy ideas.

Education

Nancy Lane, (Chair, The Rising Tide Committee, Deputy Chair, Athena Project), proposed three action items for improving the participation of girls in science at school and for higher education institutions:

- *...Women science undergraduates and postgraduates should develop strong links and liaisons with local schools and should be welcomed by the schools.*
- *Careers advisers should go into higher education and industry laboratories to find out more about careers in science and its excitement. As few careers advisers have backgrounds in science they have little knowledge of scientific careers.*
- *Science in schools is boring in part because there is a lack of specialist science teachers. There is a need to get more women into teaching science. Teaching should be a career that appeals to women scientists because it is family friendly, but may not be sufficiently lucrative. Industry (perhaps working with LEAs) should sponsor science teachers, maybe by giving them extra salary during their teacher training. Industry should also make connections with schools.*

There were also recommendations for the curriculum:

Including beneficial and relevant applications of physics - in medicine is an obvious example but there are many others - all the way through school may help to encourage girls to see science as a subject worth pursuing for 'fun' as well as moving towards a job. Professor Athene Donald FRS (Physics) Cambridge University

Jenny Gristock (Sussex University) drew attention to

the particular difficulties faced by pregnant students: *Would policy makers please consider changing (i) the Research Council funding eligibility criteria with regard to the support of postgraduates with children and (ii) the system of financial and maternity leave support for undergraduates facing pregnancy?*

Career

There were a large number of policy suggestions under the "career" banner - presumably because most of the contributors to the debate were currently professional scientists. Dr MJ Pearson of Leeds General Infirmary gave a general comment on the need for economic evidence to policy makers:

The way to policy-makers' hearts is through the wallet, I'd cynically suggest. Clear economic evidence about the wastage of skills, abilities, experience, and professionally specific training is needed. Put parent leave and other family-friendly policies into this context to show that they are not just desirable on a human level, but on an economic one too.

Short-termism

Short term contracts were seen as a major problem, particularly in academia:

It would seem a far better option for Universities to employ researchers in permanent jobs, maybe in research institutes and then find funding to support them, rather than jobs being directly tied to project funding. This way people could develop their careers and more effective research by more committed researchers would be the result. Ann Apps, Electronic Publishing Researcher, Manchester University.

A new set of mixed-staff laboratories, uncluttered with tradition, should create the very atmosphere in which women's contributions would flourish particularly well. What a challenge for a new millennium of research! Elizabeth Griffin, Oxford AWiSE

Substantially reducing scientific institutions' usage of short-term contracts, and establishing clear criteria to ensure that financially and scientifically productive staff are moved onto open-ended employment contracts as soon as such productivity is demonstrated. Clare Davies, Research Fellow, Dept. of Psychology, Surrey University

Contributors also felt that reform of university funding arrangements could encourage more equal treatment of female staff, and may even lead to longer term planning:

Consider the impact of making the demography of any RAE/HR assessment panel match the social demography of the current generation of academic student intake (the future). Dr. Brenda J. Topliss, Physical

Oceanographer, Fisheries & Oceans, Canada

Some thought that formal measures such as league tables of the number and status of female staff should be published:

Perhaps some measure like (or included within?) the RAE needs to be devised to make public how various universities are doing [in relation to women]. Barbara Smail, Director for Regions and Membership, British Association for the Advancement of Science.

HE Institutions will respond if there are any carrots to be won, such as League Tables for women friendly policies ... Setting up active mentoring and networking for ALL female (and minority) members could score points in League Tables. Dr I Mueller-Harvey, Department of Agriculture, Reading University

Retention

Although significant numbers of women were being encouraged to think of science as a career, too little attention was being paid to ensuring that they stayed in the field:

It is perhaps time to move away from the feminist rhetoric and slogans, through to quantitative analysis of the retention rate and career progression. I would also encourage the policy makers to shift their bias away from encouraging ever-increasing numbers of women into science and engineering and to ensuring that the existing valuable resource is managed along the career path from 25 to 65. Dr. E. A. Taylor, Senior Engineer, Matra Marconi Space

I think retention is the key aspect to be tackled; if enough women stay and their careers grow with a university or firm it acquires a 'halo' and attracts more; the organisation acts as a corporate role model and the cycle repeats itself. Anne Leeming, Director Certificate in Managing Adaptability in Business, City University

...that there be an investigation into how the problem of retention and advancement (of women AND other minorities) be tackled positively within the academic world. At this stage, this is more important than worrying about increasing e.g. degree level entry. Janet Drew, Professor of Astrophysics, Imperial College

Family-friendly employment

The issue of childcare and family friendly working was referred to many times during the discussion. Contributors had some innovative solutions:

Ameliorate the unequal burden of child-care on the mother-scientist with:

- *a creche system: widespread availability of low-cost, high-quality child-care*
- *gender-neutral parental leave, fully half of which*

must be taken by the father

- *part-time work available for parents of preschool children, with no career penalty...*
Cheryl Fillekes Ph.D. Lead Software Engineer, New Zealand

There was general agreement with these points, although some discussion on the detail:

Forcing men to take paternity leave may be seen by some people as liable to cause antagonism... There have been one or two hints about backlashes in the discussion I think? Clare Davies, Research Fellow, Dept. of Psychology, Surrey University

We need policies which favour the family, and treat men and women equal in all but child bearing. Professor Athene Donald FRS (Physics) Cambridge University

The reason that I think that some paternity leave should be compulsory is that despite the fact that many new fathers are initially quite keen to become involved in the care of their children, there is such strong discouragement from all sides not to do so. Professor Jaroslav Stark, Centre for Nonlinear Dynamic and its Applications, University College London

The belief that scientists must work 168 hrs a week to hold down their job must change. Formally endorsed "family fellowships" which allowed people to take part-time sabbaticals during their children's early years and get back into the system later could ensure that the next generation of scientists get good parenting. Barbara Smail, Director for Regions and Membership, British Association for the Advancement of Science.

My workplace has a nursery but as I soon discovered it provides places for only NINE children under the age of 2 years.(Glasgow University has over 5000 staff and over 17000 students!)...If institutions offer workplace nurseries they should provide realistic chances of getting a place or an alternative route could be offered - e.g. assisted places at private nurseries (as many companies offer). Jane Magill, Lecturer in Electronics and Electrical Engineering, Glasgow University

I do believe that modern teleworking offers some solutions to the challenge of combining work and family life... While teleworking does exist unofficially for many, formally introducing it in companies and HEIs could help more families. There are very few jobs where quiet thinking time away from the hurlyburly of the workplace is not essential. Anne Leeming, Director Certificate in Managing Adaptability in Business, City University

Advancement

A number of the contributors suggested that steps should be taken to ensure that appointment and promotion were available to all:

There is a clear case for politicians to take pro-active measures and move society further enabling all its members to make their fullest contribution (not just men). Target quota for % female staff members, grant holders etc would appear to be an excellent catalyst for change. Dr I Mueller-Harvey, Department of Agriculture, Reading University

Helen Walker, Head of UK ISO Support Group at Rutherford Appleton Laboratory, reported the outcome of previous discussions in this area:

At a meeting of women in astronomy last year (report in the ... journal Astronomy & Geophysics, June 1999), we discussed the general situation and came up with several suggestions to improve things.

The four recommendations were aimed to address our main concerns

- *Post-Doctoral Research Assistants to be allowed to apply for their own salary on research grants (so the money follows the person if relocation, due to spouse's work, is necessary),*
- *mandatory equal opportunities training for placement/promotion panels,*
- *a professional (non-personnel) woman on all recruitment/promotion panels,*
- *advance publication of criteria for recruitment and promotion, and the use of these criteria in assessing the applicants.*

A specific need to improve the processes of interview and appraisal was identified:

[We need] training for the interview panels, still very sketchy in most academic institution. The research councils could help here by insisting that grant-holders show evidence of undertaking training. People who don't do the training shouldn't be given another grant until they do... The most effective way I can think of at the moment to change the culture of the work-place is to start training managers, group leaders, heads of departments, deans, grant holders much more effectively to deal with human resources issues. Maureen Cooper, Chemistry lecturer at Stirling University

Academic appraisal is by a closed 'one to one' interview between head of department and staff. I would suggest that such a structure in a competitive male environment is unlikely to support women's promotions and should be changed to a more open appraisal, certainly with an agreed mediator. Dr Anita Holdcroft Reader in Anaesthesia, Hammersmith Hospital and Imperial College School of Medicine

Julia Higgins CBE, FRS, FEng (Professor of Polymer Science, Imperial College, Chair Of The Athena Project Steering Group) felt that women also needed to think about their own training and

development needs:

Within the next 5-10 years many recruits to HE from the late 1960's growth period will be retiring. This will provide opportunities at recruitment and promotion stages. However, women must ensure they have the necessary skills and confidence to benefit from these opportunities. Mentoring and opportunities for gaining the necessary experience will have to be sought from and provided by institutions.

Elizabeth Mansfield, Senior Lecturer in Mathematics, University of Kent, and others, noted that the criteria for promotion and recruitment should also be reconsidered:

Another policy decision might be to force universities, research councils etc to widen criteria for promotion and grant opportunities, and to adopt initiatives, so as to keep people who are capable of seeing the wider scientific and social issues, who can build and participate in a research team, work interdisciplinarily, be inclusive not exclusive.

Published papers are a major criterion for recruitment and promotion in my area of research (astronomy). I think we need to get other areas of activity considered as seriously as papers in print, such as team-working, helping the next generation of scientists, etc, but these jobs are more difficult to quantify, so they get ignored. Helen Walker, Head of UK ISO Support Group, Rutherford Appleton Laboratory

Code of practice

Dr Nancy Lane, moderator of the *Nature* debate on Prospects for Women in Science, made a suggestion which would cover many of these topics, in a letter to Lord Jenkin of Roding, Chairman of subcommittee II of the House of Lords Science and Technology Committee:

This involves setting up a "Code of Practice" for UK scientific laboratories such as the U.S. National Academy of Sciences has in place. If adequately set up and backed, this code would cover issues such as the promotion of equal opportunities and the freedom to question, would legislate against cronyism, patronage, and male chauvinism as well as sexual and racial discrimination, and would support the establishment of helpful schemes such as mentoring. This would prevent unjust discrimination in the lab and might well relieve some of the problems that women face in gaining advancement in SET.

Networks

For some participants, the discussion list was seen as leading the way for a network of women in science:

I would welcome if one of the results from this discussion would be the start for a Mentoring Network by e-mail. This might help in overcoming physical and mental

barriers or isolation. As I get older, I become increasingly aware of the fact that one can become quite 'isolated' in an all-male professional environment. Dr I Mueller-Harvey, Department of Agriculture, Reading University

I echo those voices that propose an ongoing network for women in SET. To weaken the stereotypes maybe you will feel able to welcome men in the network. Chris Petrie, Professor of Non-Newtonian Fluid Mechanics, Dept of Engineering Mathematics, Newcastle University

In fact, the Association for Women in Science and Engineering is already considering this:

We are now planning a MentorRing network, working with the Women's Engineering Society, the Medical Women's Federation and others, pairing girls or women seeking career advice with people who can help them (professional scientists and engineers in industry, education and research...). Dr Joan Mason, Cambridge AWiSE

There was specific concern about women in IT:

Perhaps one way to [encourage more women into IT] is to create a bank of real world examples of women who have surmounted the barriers and also examples of the real world problems that are faced on a daily basis so that they can be addressed and remedied Bridget Cooper, Research Officer, Computer Based Learning Unit, Leeds University

Culture of Science and Society

Some policy suggestions concerned science in the wider world. Hilary Burrage, an early researcher into women and science, felt that more attention should be paid to the history and sociology of science:

I suggest a core input into any serious science course should include the history and study of science itself... the issue of entitlement in science remains: many critical decisions are made in the name of science. Everyone is entitled to understand at whatever level they are capable the bases of these decisions.

Tying in with the proposals mentioned above concerning criteria for promotion, Clare Davies, (Research Fellow, Dept. of Psychology - Chair, University of Surrey Research Staff Forum) applied this more widely to the institutions themselves:

One recommendation which would benefit research in general, as well as women researchers (who'd be less intimidated and at less of a prior disadvantage), would be to set research funding policies (both from the RAE and the Research Councils, and for that matter all other funders including joint schemes with industry) that

actively encourage co-operation, sharing of ideas, and collaborative work.

Wider Dissemination

It was proposed that contributions to the debate be made into a book:

The written word gets noticed, especially if it is well constructed and readable. A report as fat as a book will be hard to ignore, and can be plonked down in front of a relevant Government minister.... The Report would take the form of many contributions from participants in the debate, each addressing a particular aspect.... What I am in fact proposing is a scientific study of all the different aspects that bear upon the Problem, with schematized solutions that may or may not in reality be related. Elizabeth Griffin, Oxford AWiSE

This suggestions obtained significant support from many of the contributors:

I would like to say that Elizabeth Griffin's idea of a response - a collation of evidence - to the UK Government based on the discussions in the list sounds like an excellent idea. Ms Jennifer Gristock, Assistant Manger, Engineering Policy, Royal Academy of Engineering

I would like to add my support for Elizabeth Griffin's idea. It is clear we each see our own problems in depth. A document which gives the range of voices for each subtopic would give breadth. Elizabeth Mansfield, Senior Lecturer in Mathematics, University of Kent

There are already researchers looking at this area. For instance, Patricia Ellis, School of Sociology and Social Policy, Roehampton Institute, contacted the group to tell them of her work:

I would like to inform you about research I am carrying out for a doctoral thesis which I hope will improve understanding of this area. I am investigating obstacles to women's retention and progression in the scientific workplace by observational studies of work practice and in-depth interviews with men and women scientists in the work environment.

The organisers of the consultation are currently exploring possibilities for taking the publication of a longer report forward with researchers and other interested groups.

ANNEX B - EVALUATION OF THE CONSULTATION METHOD

New information and communication technologies (ICTs) hold out the opportunity of connecting citizens to their representatives in novel ways. They also offer potential channels for public deliberation which can be more inclusive than that possible within the sphere of press or broadcasting.

Several assumptions have been made by commentators about the likely effects of ICTs upon political discussion. Leeuwis³ has identified eight ways in which electronic forms of debate have potential advantages over conventional forms. These include the possibility of:

- including a larger number and wider range of participants, taking part on a more equal basis;
- more time for discussion to take place, for arguments to be stated fully and for the agenda to be broadened;
- the greater availability of information for participants to consider; and
- more opportunities for those outside the decision-making elite to participate.

Hill and Hughes⁴ have analysed data from a wide number of electronic discussions and their methodology and interpretation will be of value to future research. There has been little work done by researchers to assess government-based electronic consultations, although the lead here is being taken by some local authorities which have become pioneers in this area, e.g. Birmingham, Walsall, Knowsley, Newham, Cambridge.

At the level of represented legislatures, where one would assume that the relationship between citizens and representatives is most meaningful, there has been no significant experimentation or evaluation of using ICTs as channels of deliberation. Surprisingly, in the USA, where most of the political innovations in the uses of ICTs have so far occurred, online discussions linking citizens to the legislative process have been tried neither at state nor Congressional

level. Some European legislatures have web sites on which citizens can forward comments (e.g. the German Bundestag) and some have even initiated online public discussions (e.g. the French National Assembly and the Dutch and Finnish parliaments.) None of these initiatives has involved linking citizens to the deliberations of legislators.

The Hansard Society has set out to run a series of online discussions involving groups of citizens and legislators. This has called for much work in explaining the process to members of parliamentary committees and in recruiting citizens to participate in the discussions. The 'Women and Science' online discussion was the first in the series. It has been followed by an online discussion linking citizens with relevant experience and expertise into the House of Commons Public Administration Committee's inquiry into new forms of public participation, including e-democracy. Early in 2000 the informal All-Party Domestic Violence Committee will be taking evidence online from women victims of domestic violence.

There will also be several online discussions linked to the parliamentary examination of specific pieces of draft legislation. These discussions will be evaluated and recommendations for future practice in this area will be made. As an independent, non-partisan body, concerned to promote effective parliamentary democracy, the Hansard Society has taken upon itself the role of organising, moderating and evaluating this process, often in collaboration with other appropriate bodies, such as POST.

Discussion Method

Online discussions can be open to any member of the public or 'closed', in the sense that only selected people who have registered and been issued with a password can enter. There are values in both forms of discussion, but the latter is likely to be more appropriate for a parliamentary inquiry where specific experience and expertise is sought. In the case of the Women and Science discussion entry was open to all, but the specific group targeted for recruitment were women scientists and engineers. These were approached via existing databases comprising several thousand names, mainly academic scientists. There was a recognition that male scientists and engineers could contribute valuably to the discussion, as might non-scientists, so there was no bar on entry to the discussion.

Online discussions can take place via e-mail lists or via web sites, or both combined. In this instance the discussion was e-mail-based, which meant that all

³ Leeuwis, C., 'Policy-Making and the Value of Electronic Forms of Public Debate' in d'Haenens (ed), *Cyberidentities: Canadian and European presence in Cyberspace* (Carlton University Press, 1999)

⁴ Hill, K.A. and Hughes, J.E., *Cyberpolitics: Citizen Activism in the Age of the Internet* (Rowman & Littlefield, 1998)

participants, once they had registered with Mailbase, could receive all contributions to the discussion. However, others could also view the archive of the debate on the web. There was also an option for participants to receive only a summary of the discussion. Participants had a choice of joining all strands of the discussion (education, career and culture) or any one or more of them. The summary discussion used the Hansard list and the three strands were known as sub-lists, see **Figures 6-8**. The final week of policy discussion took place on the careers sub-list.

In all, 261 people registered for the discussion during the course of the four weeks. 116 registered for the Hansard list, 77 for the education sub-list, 105 for the career sub-list and 83 for the culture sub-list. (Some registered with more than one list.) 67 people contributed to the discussion sub-lists, sending 157 contributions between them. By comparison with face-to-face public meetings the ratio of active contributors to observers (or 'lurkers' as they are known in online discussions) was high, although it is not known how many followed the discussion on the website.

Several hypotheses were made at the outset about the value of this kind of discussion and we are now in a position to evaluate these on the basis of data we have collected. These hypotheses were:

- i) Even though anyone could register for the discussion, the targeting of women scientists and engineers as participants would ensure a high level of involvement from women scientists
- ii) Participants would have more time to deliberate and make their points than they would at most physically-based meetings
- iii) Participants would be able to contribute their view across greater distances than would be possible at most Parliament-based meetings
- iv) There would be an opportunity for participants to be informed by keynote contributions (the equivalent of platform speeches at physically-based meetings) and to interact with such information, i.e. not just to hear it, but to comment upon or to challenge it
- v) There would be an opportunity for participants to consider one another's views and respond to them
- vi) Participants would not merely state opinions, but would share experience
- vii) Participants would feel it worthwhile to make

FIGURE 3: GENDER OF PARTICIPANTS

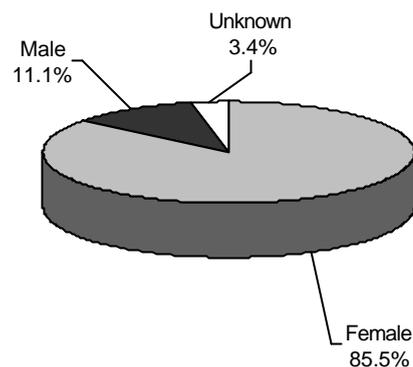
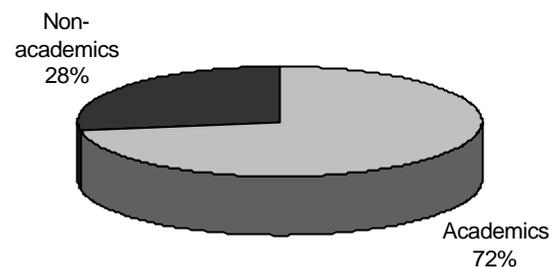


FIGURE 4: ACADEMIC/NON-ACADEMIC PARTICIPANTS



policy proposals, in the knowledge that this is not merely a chat amongst themselves but a connection to a real political process

How valid were these hypotheses?

1. *Appropriate participants*

Although participants were self-selected, 85.5% were female and the vast majority were scientists or engineers, see **Figure 3**. Because recruitment took place mainly via an academic database, 72.4% of participants were associated with academic institutions, see **Figure 4**.

2. *More time for discussion*

Physically-based meetings, such as those which take place within Parliament every day of the week, are usually limited by time. Speakers are given set times to have their say and, if there is input from the audience, most people are called upon to speak briefly and only once. The online discussion was set to run for three weeks, but a fourth week was added, without any great procedural difficulty, to allow even more time for the active discussion and for proposals to be made. Anyone who wanted was free to speak. The average length of contributions was 436 words - about the length of a one-page article in the *New Statesman* or *Spectator*. It would be very unlikely for many contributions of that length to be permitted in traditional face-to-face meetings. Approximately one fourth of the contributors sent more than one message in the course of the

discussion, thus allowing them the opportunity to move beyond their original positions.

3. Greater distances

Had all of the contributors from outside the UK (who constituted approximately 5% of all) been flown over to London to participate in the discussion there would have been a cost of over £10,000. Most of the contributors came from outside London and nearly all participated while doing full-time jobs. The likelihood of such a group gathering together for a meeting is slight, and the possibility of such a gathering lasting four weeks remote. One of the discussion's moderators, a specialist in the field of women and science, reported that she had heard of less than half of the contributors to the discussion before it began and had prior communication with less than 10% of them.

4. Interaction with keynote contributors

For the first three weeks the discussion of a new strand was started by keynote contributions which were intended to be informative and agenda-setting. 15.9% of all contributions to the discussion included responses to these contributions. This was markedly smaller than the number of responses to contributions made by other list participants. The keynote contribution at the beginning of the second week was controversial and somewhat provocative and did receive several robust rebuttals, but, interestingly, the other, less controversial keynote contributions received a similar of responses, perhaps indicating that online interaction is more concerned with light than heat, see Figure 5.

5. Interaction between contributors

Over half of all contributions included responses to previous contributions (54.8%). The level of internal interactivity was high. Many contributors began by referring to a previous comment, or using the e-mail protocol of quoting a relevant passage from a previous contribution by copying it (see Figure 5). Most of these interactions involved endorsement of previous points - but rarely simple endorsement, usually development of the point. In this way one saw a community of views emerging, rather than a series of fragmented 'letters to the editor'.

6. Contributors' shared experience

38.2% of contributors shared experience as part of their evidence, see Figure 5. Electronic discussions provide unique scope for relatively safe testimony to be given in public. Over half of those contributing to the strand on education referred to their own experiences, as shown in Figure 6. But the discussion was by no means anecdotal; 73.9% of all contributors

FIGURE 5: CONTRIBUTION TYPE

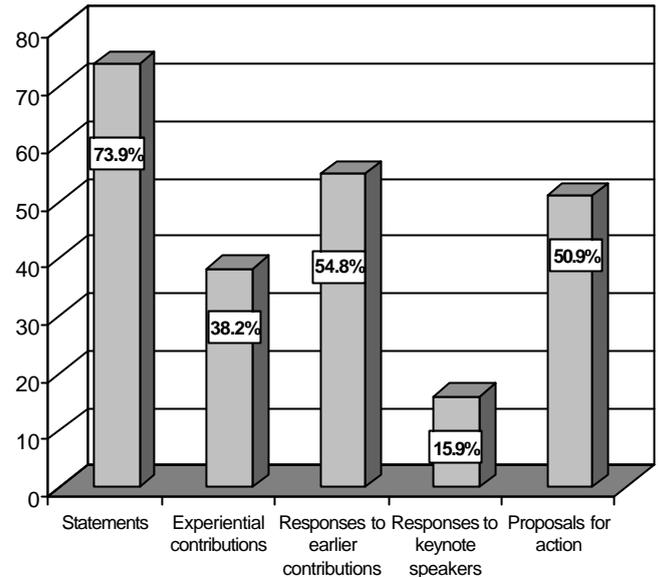


FIGURE 6: CONTRIBUTION TYPE ON HANSARD-EDUCATION DISCUSSION LIST

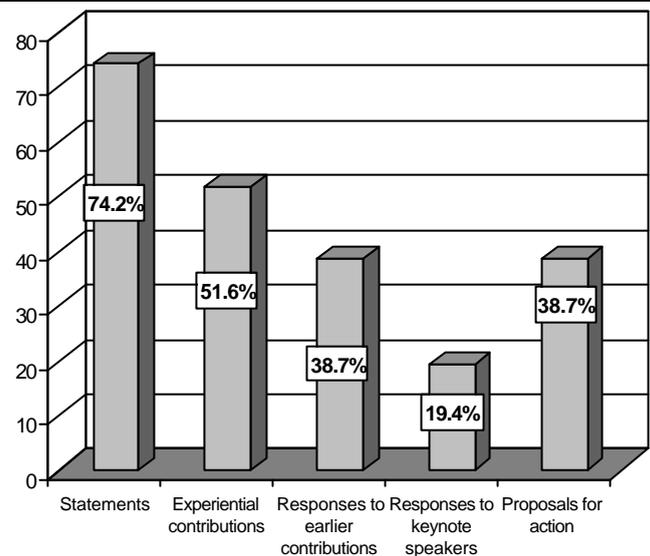


FIGURE 7: CONTRIBUTION TYPE ON HANSARD-CAREER AND POLICY DISCUSSION LIST

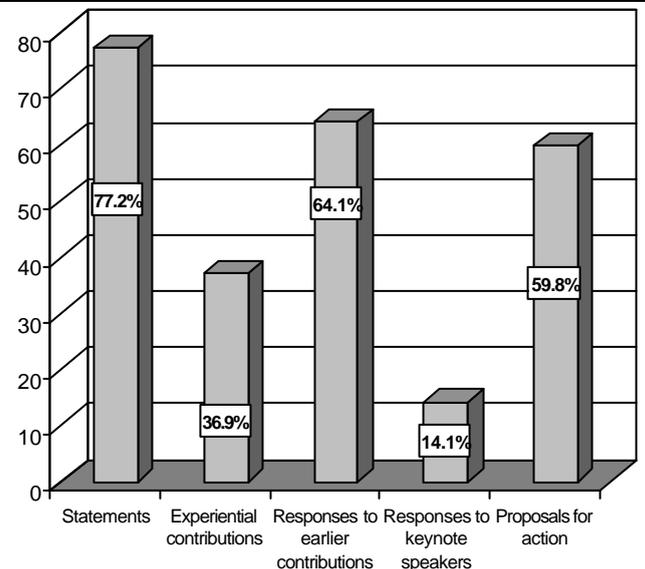
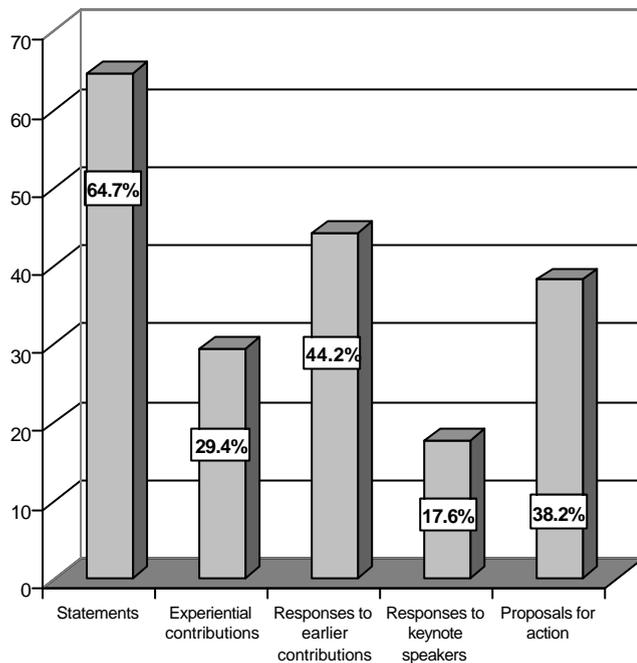


FIGURE 8: CONTRIBUTION TYPE ON HANSARD-CULTURE DISCUSSION LIST

made statements, i.e. they offered an independent point of view.

7. Policy proposals

A primary purpose of linking citizens to parliamentarians must be to enable the former to feed in to the policy process. In many online political discussions, citizens feel unmotivated to debate policy because they assume that their own discussion will have little effect, so they tend to concentrate on broader issues of values. In parliament-linked online discussions participants are urged to offer constructive ideas about policy. There is no suggestion that they are making policy, but they are aware that they have an opportunity to influence those who do. Contributors responded to this, with over half of all contributions including some form of policy proposal, see Figure 5. The quality of these proposals, in terms of their rational articulation and connection to previously discussed information, was high.

The discussion can be regarded as a success in terms of most levels of measurement. The data presented here will be added to data collected from the other online discussions in the series and will contribute to an overall evaluation of this new method of linking citizens with the parliamentary process.

Thanks to all those who participated, in particular Anne Leeming, Julia Higgins and Judith Glover who reviewed this report.

FURTHER INFORMATION

Full archive of the Women in SET discussion

www.mailbase.ac.uk/lists/hansard

Athena project

www.athena.ic.ac.uk

Women in Higher Education Register

www.where.ic.ac.uk

Hansard Society

www.hansardsociety.org.uk

Mailbase

www.mailbase.ac.uk

Promoting SET for Women Unit

www.set4women.gov.uk

Nature debate on Women in Science

<http://helix.nature.com/debates/women/>

Association for Women in Science and Engineering

www.awise.org

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Parliamentarians should contact the Parliamentary Office of Science and Technology, 7 Millbank, London SW1P 3JA, tel: [020] 7219 2840.

For sale to the public from the Parliamentary Bookshop tel: [020] 7219 3890, price, £4.

See also www.parliament.uk/post/home.htm