

DINNER/DISCUSSION SUMMARY

Lifting barriers for career paths for women in Science, Technology, Engineering and Mathematics (STEM)

Held at The Royal Society of Edinburgh on 27th October, 2011

The Foundation is grateful for the support for this meeting from
BP, The Institute of Physics and The Royal Society of Edinburgh

Chair: **The Earl of Selborne KBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **Professor Dame Jocelyn Bell Burnell DBE FRS FRSE FRAS FInstP**
Chair, The Royal Society of Edinburgh Inquiry into Women in STEM
Dr Ellen Williams
Chief Scientist, BP
Sir Adrian Smith FRS
Director General, Knowledge and Innovation, The Department for Business, Innovation and Skills

DAME JOCELYN BELL BURNELL outlined the position of women in Science, Technology, Engineering and Mathematics (STEM) in Scotland. Although there had been great advances since 1955, even now 52% of women STEM graduates were not in employed in jobs requiring STEM skills. It was not enough that women outnumbered men at student entry in STEM; at Ph. D level the position was reversed. At senior professor level it was outrageous - there very few women professors. Brains were not the issue - it was social and institutional structures that had to change. Why was it that Argentina had 37% women astronomers; while the UK had only 12%? The key was cultural. Unacknowledged prejudice and discrimination was rife; bias could be tackled only with difficulty because it was hidden in many ways in which language was used and paper material was presented. Why, for example, did M always precede F on gender requirements on forms? Why should gender knowledge be required at all? The use by orchestras of blind auditions had shown that women appointments markedly increased. Why not make recruiting advertisements gender free and applications anonymous? Women were like canaries in mines - if they were unhappy in institutions, that showed that the atmosphere was wrong. All funders should follow the example of the National Institute of Health Research in requiring those accepting funds to be holders of an Athena Swan Charter¹. The salient draft recommendations of for which the inquiry seeks comments are:

1. Scottish government should commit to a national strategy, using procurement opportunities, working with stakeholders and with a cabinet minister responsibility;
2. UK government should legislate to ensure equal gender parental responsibility;
3. Industry should introduce more part time working;
4. Heads of organizations should take responsibility for changing culture;
5. Funders should insist on recipients having Athena Swan charter (as do the NIHR);
6. HEIs should ensure that women's research did not suffer because of excess committee work;
7. Professional institutes should state that women are encouraged and able to join.

DR WILLIAMS outlined her career and interests in the USA before she joined BP in 2009. She had been a pioneer as a woman in science at the California Institute of Technology and had become very aware of the problems women faced. She had then worked to raise the status of women in STEM, by meeting older scientists who had faced often worse problems, establishing networking groups, visiting institutions where problems were occurring, such as recruiting or retaining women

- often occurring because of unwelcoming attitudes towards women - and targeting girls at middle schools to make them aware of the scope and advantages of STEM subjects and careers. BP had some of the same problems as academia, but had good codes in place for career breaks, excellent training programmes and useful networking groups for women. Training was essential because neither men nor women understood hidden assumptions and how they were expressed. Cultural understanding was crucial - communication often failed between the genders, and efforts must be made to counteract social pressures - from the family who might think a woman's role is in the home, or from work colleagues and administrators. Recognition of merit must be based on outstanding quality work, but could be enhanced for women by developing sponsors and networks. Work with girls at school was necessary to help them later make the choices that were right for them and the economy, and not take the easy options. Recruitment and promotion timetables should be flexible to get the best results and avoid the "there are good women, but, alas, none have applied this year" syndrome.

SIR ADRIAN SMITH outlined the serious problems for engineering. Not only was there an overall shortage of engineers, but only 7% of them were women. There had been some good news recently: increase in the numbers of pupils taking A level maths (but not physics); and in STEM university entrants, but the pipeline must be made more secure. We did not know why children made choices, but we knew they made them at an early age, promoted by images of what future career paths might contain. They could be influenced by occasions such as The Big Bang Fair² - and it was a hopeful sign that attendances had gone up from 5,000 in 2009 to 25,000 in 2011. He welcomed the STEMNET programme, where 29,000 volunteers (3,000 in Scotland) went out to schools to promote STEM. We should work to improve the public engagement with science, not only through festivals but through "public dialogues" on such issues as synthetic biology and wellbeing. The GM food debacle was the result of poor communication of the balance of risk to benefits. Public science surveys showed that while science was viewed favourably, a scientific career was not. There was a marked gender difference in STEM choices; women went for life sciences - biological science, veterinary work - while men went for more mathematically based science. We did not know why. If we did not get more women into STEM careers, and retain them, talent would be lost, training costs wasted and merit unrewarded. But failure to use and retain women was not exclusive to STEM. Lord Davies's report on FTSE boards showed that boards had only 14.2% women on them. Although the public sector and

¹ www.athenaswan.org

² www.thebigbangfair.co.uk

government policies were helpful, we needed to do much more. He strongly welcomed the Royal Society of Edinburgh to undertake their inquiry into women in STEM.

A central theme in the ensuing discussion was the importance of culture. There were many unacknowledged biases and implicit prejudicial actions which could only be modified or removed over the long term and with consistent pressure. "Zero tolerance" policies, though desirable, were not enough; they could deal only with inappropriate behaviour which should be evident to the perpetrator. Codes of conduct were useful, but only if women themselves actively demanded that they be observed and brought breaches of them to management attention. Marginalizing women in discussions by not allowing sufficient time or priority in speaking, using language demeaning to the other gender such as the use of the word "girls" for women, could only be dealt with by proper training and changes in social and business attitudes. The NIHR practice of requiring fund recipients to have Athena Star Charter status, was welcomed, but it should be extended to other funding organizations. Even that could not cover all areas. A US study had shown that male names got more favourable attention than female names in considering applications. Why should there not be a requirement that all submissions of manuscripts for publication or Ph.D awards should be anonymized? Similarly perhaps for job or promotion applications. But, there were substantial difficulties in the way of such a requirement. A personal interview of the applicant for a job was inevitable, and in the small world of specialist scientific studies, all judges would know who was the author of a manuscript. However, speakers acknowledged that we need not despair. There had been progress, with the acknowledgement that women should have the same rights as men to careers in STEM subjects, and have the same chances of reaching the top. The impediments to getting these rights implemented were large but could be overcome. Further progress depended on many things, but at the heart of it was sensitising all members of institutions and businesses to the problems, particularly those of unacknowledged bias, and showing how to overcome them. New ways of bringing the lessons home were needed. A US idea, using actors to convey vividly how people express attitudes and biases, could be tried.

Cultural change happens only slowly, and there was a danger that, by the time it had made significant progress in the UK our economy would have been overtaken by the dynamic economies in Asia, such as of India or China. They were dynamic because they sought to use all the talents available in their workforces. If we continued to fail to use all the talents, we would be left behind. We could not risk taking 50 years to resolve these questions. We must seek to move faster - does this mean compulsion, or dictated quotas, or can we rely on business and the professions understanding what was happening, and their natural competitiveness driving them to speed matters up? There was a sense of insufficient urgency in recognizing the issue. It might be desirable to set a goal - say 50/50 gender participation in careers in business and professions and work towards it. Institutions could work towards it, and required to explain why they were failing to meet it. At least that would give a sense of direction.

At the heart of the issue was recognizing and judging merit. Anything that stood in the way of that could be counterproductive - quotas and compulsion might well slow progression on merit. But they might, in the long run, be a lesser evils than a slow advance.

Meanwhile there was strong support for better training and maternity/paternity arrangements, and better support for those of either gender taking career breaks. But particularly important considerations for women were the costs of child care - which could easily exceed a single salary - and the differential impact the current financial crisis is having on women. Universities need to provide more crèches for both staff and students. They must recognize the need to support staff on career breaks, and ensure they return to work as well qualified and as effective as those who have remained behind.

The benefits of increased diversity in academia and business should be stressed. Research showed that mixed groups produced better results. Businesses fared better if their staff reflected the diversity of their customers. But the issue is not just one of economics; it is enabling people to get on with their lives in a way which meets their wishes. Neither men nor women - particularly women - should have to decide whether their choice is a career or children. Organisations and society as a whole should provide the background so that, in most cases, the choice does not have to be made, with careers pursued and children properly cared for. It should be exceptional for the choice to have to be made. The legislative and other recommendations in the RSE report would go some way to realizing this aim.

Sir Geoffrey Chipperfield KCB

The speaker's presentations and an audio file of what they said can be found on the Foundation website at www.foundation.org.uk.

Useful web links:

Big Bang Fair
www.thebigbangfair.co.uk

BP
www.bp.com

Cogent
www.cogent-ssc.com

The Department for Business, Innovation and Skills
www.bis.gov.uk

EngineeringUK
www.engineeringuk.com

The Athena Swan Charter
www.athenaswan.org

The Foundation for Science and Technology
www.foundation.org.uk

The Institute of Physics
www.iop.org

The Royal Academy of Engineering
www.raeng.org.uk

The Royal Society
www.royalsociety.org

The Royal Society of Edinburgh Inquiry into women in STEM
www.royalsoced.org.uk/877_WomeninStem.html

The Science Council
www.sciencecouncil.org

Science, Technology, Engineering and Mathematics Network
www.stemnet.org.uk

A round-table discussion was held in the afternoon on the same theme. The report is on the next page.

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ROUND-TABLE DISCUSSION SUMMARY

Lifting barriers for career paths for women in Science, Technology, Engineering and Mathematics (STEM)

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Chair, The Royal Society of Edinburgh Inquiry into Women in STEM
Dr Ellen Williams
Chief Scientist, BP
Mr Paul Jackson
Chief Executive, EngineeringUK

DAME JOCELYN BELL BURNELL introduced the draft inquiry report of The Royal Society of Edinburgh that she is chairing - "Tapping Women's Talent in STEM subjects in Scotland". Scotland was a cohesive unit with a separate market, and could do things which the UK as a whole could not. But the figures for Scotland were as bad, and on a par with, UK figures - only 9% of women were either professors or engineers. The report had focussed on post-graduates and excluded medicine. It built on past initiatives, many valuable, but they had not been implemented and there was no measure of efficiency or sustainability. The issues were complex and here was no magic bullet. The salient draft recommendations of for which the inquiry seeks comments are:

1. Scottish government should commit to a national strategy, using procurement opportunities, working with stakeholders and with a cabinet minister responsibility
2. UK government should legislate to ensure equal gender parental responsibility
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6. HEIs should ensure that women's research did not suffer because of excess committee work
7. Professional institutes should state that women are encouraged and able to join.

DR ELLEN WILLIAMS outlined her career in academia in the US. She had been a pioneer in science at California Institute of Technology and had engaged in activities to raise the status of women in STEM subjects - meeting older scientists, talking to staff and students in HEIs where there were problems - often caused by unwelcoming attitudes towards women - and targeting children at middle school age. In 2009 she moved to BP, where some of the same problems for women arose as in HEIs - although there was a good network for women, and good maternity leave programmes and good training programmes. Training was particularly important. Problems were communication - women don't talk the same language as men. Women gained recognition through excellent work, networking and sponsorship (but should be beware of becoming a "Girl Friday"). There should be flexible recruitment and promotion timetables, to avoid the "there are good women out there, but, alas, not this year" syndrome.

PAUL JACKSON said engineering was a shining example of failed diversity - only 2 to 3 % of vocational engineering

apprenticeships were female; only 15% women studied engineering at degree level.

The schools curriculum was a major problem - pupils were required to take career decisions too early, when they did not begin to understand the world around them and opportunities - decisions should be taken at 20, not 16. Public understanding and careers advice depended on teachers, but although eight out of ten STEM teachers gave advice, for nine out of ten it was based on their own subject experience. 20% of STEM teachers didn't even consider a STEM career desirable. Engineering institutes were too didactic in defining requirements, hindering students ability to develop creatively their own enthusiasms. But there were signs of hope - 10,000 girls went to the last Big Bang Fair - an exhibition of what science and engineering was all about.

The following points were made in discussion.

1. Changing men's attitudes was crucial - but possible. A Foundation seminar in 2003 brought a group of senior research managers to meet with Patricia Hewitt, then Minister for Women. This had led some of the participants to say that the seminar had totally changed their perception of the issues of women in STEM.
2. While it was right to encourage girls to do STEM subjects, it was fraudulent unless they were warned of glass ceilings, and problems about career breaks. Business and institutions must make more efforts to ensure merit is recognized and excuses - such as time breaks - were not used to degrade it.
3. Communication is often the key. To be a sole man in a female environment, and then observe women in a male environment provided vivid examples of how communication failed because of underlying assumptions and different ways of expression.
4. Although the report focussed on post-graduates, it was equally important to look at the pipeline - from nursery to PhDs - for STEM women. This meant getting at girls in school, where, unless teachers and families actively influenced them, they would be inclined to want to go into "glamorous" trades, such as hairdressing and beauty, rather than the boring, difficult, but ultimately much more rewarding STEM based careers. The danger was that they may feel pressure to become second class men,

rather than first class women. Women are different, in communication signals (both in verbal and body language - hence neutral signals - such as raising a flag to speak, rather than shouting louder) was important. We need to know, for example, why life sciences have an attraction for women while other sciences do not.

5. Unacknowledged prejudices and assumptions lurked in language. Why, in forms, did M always precede F? Why is he, not she, used in job descriptions?
6. Career breaks should not be an impediment to progress for either men or women - but women are more likely to need them because of bearing children. So they must be managed to give help to those having them - help to maintain, and possibly improve their professional expertise, and ensure that when they return to work they can "hit the deck running". They must have sufficient confidence that they can hold their own; that their career break time has given them wider horizons and views, and that those who did not have the break have some advantage over them. Professional bodies can help in this.
7. Many of the recommendations in the Report apply across all professions, such as lawyers and in business.
8. We should promote the skills that women have more often than men, and which are different. - but the key is better relationships between the sexes and that each recognizes the other's strength. It was misleading to suggest that it was only men who needed to adapt. Moreover, we should recognize that women often stress problems rather than opportunities, although they will be just as likely to succeed.
9. We do not know, and need to find out, why so many STEM graduates change direction and either cease working or work in other areas. This is not necessarily disadvantageous to the economy - STEM graduates in non-STEM sectors can give great value.
10. There were different views about the desirability of quotas. They could be useful if properly structured to make use of diverse talents, but dangerous if they stood in the way of merit, or of seizing opportunities. Any quota system should have as its aim to make businesses or organizations work better, and not just be a box-ticking exercise. A better way of pushing forward progress might be through using bonuses for managers who did more for equality - either gender or race. But without quotas progress might be too slow. How can we change a system where 75% of STEM women graduates but don't use their degree, but only 50% of men do?
11. There are other countries which do things better - Finland, for example, requires men to take three months of the maternity leave. This demonstrates the importance of equal parenting. Argentina succeeds in keeping women astromeners in place. Estonia, luckily, does not even have a language which recognized human gender.'
12. We should develop clusters of interests where women contribute importantly. Everyone feels happier when they can belong to a group and there will be better opportunity for role models. Crystallographers are a good example of best practice.

Sir Geoffrey Chipperfield KCB

The statistics quoted by Paul Jackson come from these reports by Engineering UK:

EngineeringUK 2011

www.engineeringuk.com/what_we_do/education_&_skills/engineering_uk_11.cfm

Gender report:

www.engineeringuk.com/_db/_documents/Int_Gender_summary_EngineeringUK_04_11_.pdf

Brand Monitor:

www.engineeringuk.com/_db/_documents/EngineeringUK_EEBM_2011_Executive_Summary_-_FINAL.pdf

Useful web links:

Big Bang Fair
www.thebigbangfair.co.uk

BP
www.bp.com

Cogent
www.cogent-ssc.com

The Department for Business, Innovation and Skills
www.bis.gov.uk

EngineeringUK
www.engineeringuk.com

The Athena Swan Charter
www.athenaswan.org

The Foundation for Science and Technology
www.foundation.org.uk

The Institute of Physics
www.iop.org

The Royal Academy of Engineering
www.raeng.org.uk

The Royal Society
www.royalsociety.org

The Royal Society of Edinburgh Inquiry into women in STEM
www.royalsoced.org.uk/877_WomeninStem.html

The Science Council
www.sciencecouncil.org

Science, Technology, Engineering and Mathematics Network
www.stemnet.org.uk