Murray Edwards College
University of Cambridge

WOMEN IN SCIENCE
SYMPOSIUM

Murray Edwards is a college for women in the University of Cambridge. We know that female students in the University are grossly under-represented in the STEM subjects, particularly Computer Sciences, Physical Sciences, Engineering and Maths (see below). For us, as for others, it is important to understand what is happening to female students at school and how we can make sure that the young women who do come to this University, and others, are enabled to achieve their best. However, we cannot ignore what happens to women in science in the workplace. If there are few role models, especially at the most senior levels, this feeds back to the choices young women make very early in their school and academic careers, despite the fact that our economy needs more scientifically trained people.

In September 2014, we hosted a symposium to consider the issues: what happens to young women at school, at University, and in the workplace? We were keen to understand the research evidence, not only about the numbers, but also about what works to encourage women into STEM subjects, and then to stay in them. We also wanted to learn from students themselves what makes them want to study and work in science and what puts them off. We wanted to learn from teachers, lecturers and those in industry what they think is necessary and what could help.

This short report summarises the key findings from the symposium and the ideas and suggestions made for improvement. We will build these ideas into the work in our own College and we look forward to working with the schools, scientific institutes and bodies to do this. We also hope this symposium will give further stimulus to the many men and women who are trying to make a difference in the numbers and experience of women in science.

UNIVERSITY OF CAMBRIDGE INTAKE

	2012/13 Admissions Round Across all colleges	
	Applications % Female	**Acceptances % Female**
Computer Sci	11	14
Engineering	20	22
Maths	25	16
Natural Sci	40	38
Medicine	51	47
Vet Med	80	74

We started the symposium with agreement about two key assumptions:

1) The UK economy needs more scientifically and numerically trained people. Companies value scientific and analytic skills and most science degrees provide a substantial wage premium – for men (10%) but particularly for women (15%), as cited by Professor Anna Vignoles.

2) All people are capable of developing their abilities in maths and science. The myth needs to be dispelled completely that boys do well at maths and science and girls do not. The mind-set has to be about growth and development, not a fixed view about who can do what.

It is clear we need to challenge cultural assumptions, which start very early, that girls do not do maths and science. The key development that speakers and students felt was needed was more role models of women in science. These role models should be widely visible (eg. through the media) and represent the breadth of science roles and opportunities arising from scientific training. Initiatives encouraging inspirational role models to visit schools are valuable. It was also clear that we need to understand the way science is made interesting to female students, which may be different to male students. Of course, teachers play a key part in both setting the culture as well as good teaching, responsive to the ways of learning of both young women and men. One teacher (Jane Crawshaw) described what girls say in answer to why they are not studying physics at 'A' level even though a number of them were doing maths. The answers are that it is seen as:

'Too difficult'
'A boy's subject'
'Physics will not be useful to me'
'It wasn't fun at GCSE'

It was also recognised that these negative impressions are aggravated by peer pressure which is particularly influential in the key mid-teen years.

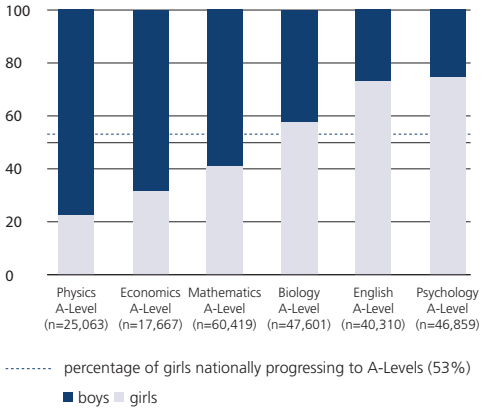
Yet in physics lessons girls are very good at:

- Applying their knowledge of maths to physics
- Applying their literacy skills to extended writing in physics
- Organisation
- Listening
- Persevering with understanding
- Following instructions
- Acting on feedback
- Completing tasks
- Achieving high grades!

However they are not so good at taking a risk or making a guess.

That there is much to be done is shown in this figure.

Figure 1: National ratios of male and female entries to the six selected A-Level subjects averaged over the years 2010 to 2012 in England (JCQ)



Speakers raised specific issues which are problematic in keeping girls in science:

1) Very early curriculum choice in the UK compared to many other countries. This seemed to be taking students out of science, particularly girls, at a very early stage. It was suggested that maths and science should remain as a core part of the curriculum for much longer.

2) There was discussion of single sex teaching. The evidence is that girls in single sex schools are more likely to take science 'A' levels (girls in single sex schools are 2.5 times more likely to take physics, for example). The question was raised about whether single sex classes in mixed sex schools would be advantageous, but much thought needed to be given to why exactly it was being done and the results properly assessed. Nevertheless, it is very clear that the school a girl attends influences her likelihood of taking science beyond 16. If girls are not taking physics at 'A' level this not only means that a physics degree is out of the question, but that engineering degrees are also discounted. Beyond the work of enthusiastic teachers in schools there are a number of national bodies working to increase the number of girls in STEM subjects, for example the Institute of Physics with its teaching resources and Action Learning Programme for teachers through the Stimulating Physics network.

3) There was also a call for much better careers advice in schools, though an understanding that this was very hard to do and could not be expected of very busy teachers.

4) It is clear just how much the school matters and concern was expressed that we do not have enough good teachers in maths and physics in every school.

In subjects where the proportion of women is low, there seems to be a downward spiral effect. When women are in a minority group they experience feelings of being different and there may even be covert discrimination. That can lead to women feeling alienated, lacking in confidence in understanding the 'language' and having the skills. This was noted by Denise Morrey, a Professor of Engineering, Oxford Brookes University, who noted that some aspects of engineering (eg. mechanical design) are considered as 'black arts' and heavily male dominated.

Exploring engineering further, she noted that few women came onto undergraduate courses with practical experience and exposure to engineering. Lots of knowledge is tacit and empirical in engineering. University teachers therefore should not make any assumptions about prior knowledge or about understanding of the language that is used. It is important to go back to basics, provide additional support when needed and to make more of women's skills, for example in managing themselves and their time. And once again, role models are key.

There was also discussion about what the Athena Swan charter for women in science in universities can do to help. In applying for Athena Swan awards, departments have to undertake a thorough assessment of the data about women undergraduates, including degree outcomes. The initiative also asks about career development for women students. It encourages departments to 'cluster' women if there are very few of them on a course. It encourages mentoring, the right to a tutor of a particular gender (if wanted), making sure there is a woman staff member on field trips, etc. In many universities, including Cambridge, there is the need to encourage undergraduates to get involved in Athena Swan and help shape the future in their own departments.

WOMEN IN THE WORKPLACE

It is not inevitable that women should be underrepresented in the scientific workforce. For example, in the English speaking world the percentage of women in engineering is about 10–15%, yet it is 30% in Latvia, 26% in Sweden and 40% in China, cited by Professor Morrey. There is no reason to imagine then that 'women can't do science', though of course many studies of stereotyping suggest that is exactly what we do believe. And the stereotyping is not just by men but by women too. The depressing part is that this is a vicious circle, without more role models young women don't see that STEM subjects are interesting and available to them, once more reinforcing the stereotypes.

The career trajectories of female scientists employed within the University of Cambridge mirror the same issues as those observed more widely across scientific careers.

In biological sciences, women outnumber men in the early stages of an academic career. However, fewer of them progress beyond lecturer level, so at this point men begin to outnumber women. This also happens in chemistry, where the number of women starts out equal to men but gradually declines. In maths and physics, meanwhile, the number of women starts lower than men and only drops further.

In all areas of the scientific workplace, in higher education and in the private sector, there is a huge amount of talent lost.

As Athene Donald, a stalwart champion of women in science put it, at any stage in careers there are subtle difficulties put in the way of women, at each stage a reduction in support for women. Of course, women can do some things to help themselves, for example, make themselves better known through networking, eg. at conferences. But this is not a women's problem, it is society's problem. If half the population feel they lack confidence in the workplace it cannot be just a problem for women, individually or collectively.

That a systematic approach to improving the experience of women in the workplace is possible was illustrated by Angela Symington from BP. The expectations set for team leaders, engineering managers and similar leaders in projects show that a very large part of what is needed is simply good practice in management:

- Good communication and an open culture
- Technical coaching
- Expecting the team leader to develop the team
- Protecting and encouraging their staff

These are the practices that are good for all staff but particularly encourage women to stay in an environment they would otherwise find very male dominated.

Ending the symposium, Maggie Aderin-Pocock spoke about her own career. A scientist who has designed missile warning systems, hand-held landmine detection instruments and a high resolution spectrograph, Maggie has become a well-known TV presenter on *The Sky at Night*. The sixth form students at the conference found her particularly inspiring.

WHERE DO WE GO FROM HERE?

There is now a clear picture, from a wide range of studies, about what is happening to women in STEM subjects at schools, university and in science careers in the UK. There is also considerable evidence about why this is happening, from the issues about early curriculum choice through to the reported views of young women and their teachers about how choices get made. We know quite a lot about the problem but it seems to be very hard to crack it, not least because at its heart are deep cultural issues about who can do what and a lack of acceptance that diversity really matters and really makes a difference in the workplace. Because selection and promotion have largely been established by men, our criteria may be systematically disadvantaging women, even when ostensibly only merit is being considered.

These challenges will take time to change; meanwhile we need to draw out the role models, encourage the teachers and lecturers who are trying to respond, and to engage and enthuse young women.

We need:

- To improve the number, range and visibility of role models for women choosing science.
- To encourage a sharing of best practice in the learning environments and approaches which are most effective in motivating and enabling young women.
- To be aware of the importance of confidence and resilience for progress and the extent to which this is about the culture in which an individual works as well as their own personal qualities.
- To recognise the overlap between the specific concerns which affect women in science and more general concerns about the value of diversity and the blocks to this which can exist through our systems and our language.
- To engage with those who can contribute to change; this includes many supportive male colleagues and many leaders (female and male) who are committed to progress in this area.

Speakers and Panel Members *(in alphabetical order)*

Dr Maggie Aderin-Pocock
Research Fellow, Department of Science & Technological Sciences, UCL

Dr Hilarie Bateman
Admissions Tutor, Murray Edwards College

Dr Jane Crawshaw
Assistant Leader of Science Faculty, Hertfordshire & Essex High School

Professor Dame Athene Donald
Professor of Experimental Physics, University of Cambridge

Ms Sarah Dickinson
Manager, Athena Swan

Dr Juliet Foster
Senior Tutor, Murray Edwards College

Professor Dame Julia King
Vice-Chancellor, Aston University

Professor Denise Morrey
Professor of Mechanical Engineering, Oxford Brookes University

Dr Ros Smith
Director, Basteir Investments

Dame Barbara Stocking
President, Murray Edwards College

Dr Alice Sullivan
Reader in Sociology, Institute of Education, University of London

Dr Angela Symington
Production Chemist, BP

Mrs Clare Thomson
Curriculum and Diversity Manager, Institute of Physics

Professor Anna Vignoles
Professor of Education, University of Cambridge

Ms Olivia Walker
PhD Student, Murray Edwards College

Participating Schools

- Chelmsford County High School, Chelmsford
- Da Vinci Studio School, Stevenage
- Herts & Essex High School and Science College, Bishops Stortford
- Priory Academy, Lincoln
- Saffron Walden County High School, Saffron Walden
- St Mary's School, Cambridge
- Sherborne School for Girls, Dorset
- The Ellen Wilkinson School for Girls, London
- The Perse School, Cambridge
- Thomas Deacon Academy, Peterborough

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