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**Response to the Science and Technology Committee Inquiry on Women in STEM Careers, prepared by the London Mathematical Society (LMS) Women in Mathematics Committee on behalf of the Council for the Mathematical Sciences (CMS).**

**3<sup>rd</sup> September 2013**

**Executive Summary:**

- A comprehensive analysis of the issues surrounding women's careers in STEM appears in the report 'Tapping all our Talents' produced by the Royal Society of Edinburgh in 2012.
- The International Review of the Mathematical Sciences (2010) recommended that urgent action be taken to address the low proportion of women mathematicians in the UK.
- In 2013, the London Mathematical Society produced a report identifying examples of good practice in advancing women's careers in mathematics following the first benchmarking survey of UK mathematics departments.
- In mathematics, there is a particularly dramatic drop between the proportion of undergraduates who are women and the proportion of PhD students who are women, particularly for UK domiciled students where the proportion halves.
- Women are much less likely than men to be promoted to professor; currently only 6% of maths professors are women and so there is a serious lack of role models.
- Promotion is primarily based on research and many women mathematicians are on teaching only contracts.
- Many mathematicians have partners who are also mathematicians leading to the so called 'two body problem'.
- Following maternity leave, many women value the flexibility of an academic career but find it very hard to achieve the long periods of quiet uninterrupted periods of time that are essential for research, and also find it hard to travel in order to network and maintain visibility.
- The RCUK statement on equality and diversity has had a dramatic effect and the threat of losing research funding has forced departments to take these issues seriously. This has led to a surge of interest in the Athena SWAN Charter.
- The Government should make other types of university funding conditional on actions being taken on equality and diversity.
- The Government should provide increased funding to the Athena SWAN Charter to allow this to provide an increased level of service and cope with the new levels of interest.
- The Government should provide funding to provide teaching cover during and after maternity leave to enable women to get their research back on track.

- The Government should require universities to fund extra childcare costs incurred alongside travel and subsistence costs and should make these exempt from tax.
- The Government should require the Research Councils to use a certain proportion of their funding for schemes specifically aimed at addressing issues around equality and diversity and to ensure that their strategic policies do not inadvertently have a negative effect on women's careers.

## **1. Background:**

- 1.1 This response comes from the Council for the Mathematical Sciences (CMS) and therefore concentrates on issues that are particularly relevant to the careers of women in mathematics. The CMS was established in 2001 by the Institute of Mathematics and its Applications (IMA), the London Mathematical Society (LMS) and the Royal Statistical Society (RSS). They were joined in 2008 by the Edinburgh Mathematical Society (EMS) and the Operational Research Society (ORS). The CMS provides an authoritative and objective body that exists to develop, influence and respond to UK policy issues that affect the mathematical sciences in higher education and research, and therefore the UK economy and society in general.
- 1.2 The London Mathematical Society (LMS) has a longstanding concern about the loss of women from mathematics and established its Women in Mathematics Committee in 1999. The Committee now has representatives from all of the constituent societies of the CMS and has been particularly active over the last few years.
- 1.3 The International Review of the Mathematical Sciences (2010) which was commissioned by the EPSRC identified the low proportions of women in mathematics in the UK as an issue of real concern and recommended that urgent action should be taken to address this. Partly in response to this, the LMS commissioned the first ever national survey of UK mathematics departments to identify examples of good practice in advancing women's careers in mathematics and to enable departments to benchmark themselves against other UK departments. The report of the survey was launched at the House of Commons in February 2013 and can be found here <http://www.blitzadv.co.uk/LMS-BTL-17Report.pdf>. It is referred to frequently in this response.

## **2. Why do numbers of women in STEM academic careers decline further up the career ladder?**

- 2.1 There is a wealth of documentation on this issue and a comprehensive analysis appears in the report 'Tapping all our Talents' [http://www.royalsoced.org.uk/cms/files/advice-papers/inquiry/women\\_in\\_stem/tapping\\_talents.pdf](http://www.royalsoced.org.uk/cms/files/advice-papers/inquiry/women_in_stem/tapping_talents.pdf) produced by the Royal Society of Edinburgh in 2012. Although the report concentrates particularly on Scotland, the majority of the findings apply to the whole of the UK.
- 2.2 Within mathematics, the decline is particularly serious. The proportion of undergraduate students in the UK studying mathematics who are female has been rising steadily and is now over 44%. In contrast, the proportion of mathematics professors in the UK who are female is only 6%. The recent survey commissioned by the London Mathematical Society showed that there are two points in the pipeline that are particularly problematic.

- 2.3 The first major drop in the proportion of women occurs in the transfer from undergraduate to postgraduate study and only around 25% of PhD students in mathematics in the UK are female. It is particularly concerning that this proportion has essentially remained steady for a number of years and that the proportion of UK domiciled PhD students in mathematics is only around 19%. This is less than half of the proportion of UK domiciled undergraduates in mathematics who are female and it is notable that over 30% of overseas domiciled PhD students in mathematics in the UK are female.
- 2.4 The reasons for the particularly sharp drop at this point in the pipeline are not well understood but the striking difference between the UK and overseas figures suggests that some of the issues must be cultural and specific to the UK. It is notable that the proportions of women undergraduates in mathematics at some of the most highly regarded universities are much lower than the national average. The very low numbers of female professors of mathematics in the UK also means that there is a lack of role models – and again, this is particularly true at some of the top universities. There could well be a problem with a lack of confidence at this stage and also a failure to appreciate that the skills required for research are not necessarily the same as the skills required to succeed in examinations.
- 2.5 Within mathematics, there is a surprisingly small drop in the proportions of women from postgraduate to postdoc to lecturer, and in fact nearly 30% of lecturers/senior lecturers in mathematics in the UK are women. This apparent discontinuity in the pipeline is due to the large numbers of women on teaching only contracts: if teaching only roles are not included then the proportions of postdocs and lecturers/senior lecturers who are women are both about 20%.
- 2.6 Within mathematics, the other significant place in the pipeline where there is a significant drop in the proportion of women is in the promotion from lecturer/ senior lecturer to professor, and only 6% of professors are women. This figure is steadily rising but is still a cause for concern. The LMS report contains a further analysis which shows that the low number of women professors is not simply a consequence of the fact that the proportion of lecturers who are women was lower in the past. The analysis shows that, for mathematicians aged between 50 and 60 who hold academic posts, men are nearly three times as likely as women to have been promoted to professor.
- 2.7 A key factor here would seem to be the fact that promotion is primarily based on achievements in research. Surveys of women mathematicians show that many women feel that they are often asked to take on teaching and pastoral roles which they carry out well (and indeed often enjoy) but at the expense of their research and their promotion prospects. There is a delicate balance here between recognising teaching as well as research in promotion and ensuring that those women who are good at research are enabled and encouraged to fulfil their true potential.
- 2.8 Mathematics research does not require much equipment but does require long periods of quiet uninterrupted time. Many women have commented that they have found this particularly difficult to manage when they return from maternity leave, particularly if they return to work part time. The flexibility of an academic career is valued by many but the reality is that much mathematical research is carried out at evenings and weekends and this can be very hard to combine with a young family. Furthermore, it

can often be very difficult for women to travel when they have small children and this makes it hard for them to maintain their visibility and to network.

- 2.9 There are also issues around the different ways that men and women tend to work with women being more likely to value collaborative working – it is not clear that promotion committees are always very good at dealing with these differences or making full allowance for the impact of maternity leave and part time working.
- 2.10 A recent survey of women mathematicians showed that a very large proportion of them had partners who are also mathematicians. Finding one lectureship in mathematics is very difficult but finding two in universities that are geographically close and have research groups in the right areas is incredibly difficult. The so called ‘two body problem’ is not currently addressed at all in the UK and it remains the case that it is the woman’s career that is most likely to suffer. In mathematics it seems that many of these women either leave academia or end up on teaching only contracts or in a university where their research is not supported. This situation is further exacerbated by the drive to concentrate research funding in a few universities.
- 2.11 The LMS is also concerned by the disproportionately low numbers of women who are nominated for prizes and invited to speak at conferences. It seems highly likely that this is not intentional but is rather a result of the fact that those doing the nominating and inviting tend to be men who do not tend to think of the small number of eligible women unless encouraged to do so. Giving such awards and invitations to appropriately qualified women is not only highly beneficial to individual’s careers, it also helps to inspire women at an earlier stage in their careers.

### **3. When women leave academia, what careers do they transition into? What are the consequences of scientifically trained women applying their skills in different employment sectors?**

- 3.1 Female mathematicians enter a wide range of careers in private and public sectors across many industries. Those that leave academia at higher levels tend to move into industry as independent consultants focusing on their academic specialisms. The transition process itself can be quite challenging, as industry does not employ mathematicians in its purest sense, although employers are always keen to apply mathematical skills across a variety of roles. Unfortunately, similar issues of progression arise in industry and the number of women in senior roles is worryingly small.
- 3.2 The consequence of scientifically trained women applying their skills in different employment sectors is in the noted increase of cultural diversity and perspective that leads to an improved culture of good governance and best practice standards of scientific management applied to common industry problems.
- 3.3 The fact that many skilled women enter these careers is to be welcomed. The concern is that a disproportionately large number of women are leaving academia compared to men and it seems likely that many are leaving for the wrong reasons.

**4. What should universities and the higher education sector do to retain women graduates and PhD students in academic careers? Are there examples of good practice?**

- 4.1 Many organisations have been working to improve working practices in universities in the UK. In particular, there are now over 90 institutions who have signed up to the Athena SWAN Charter <http://www.athenaswan.org.uk/>.
- 4.2 Interest in the scheme and in the issues surrounding women's careers rose dramatically following an announcement by the Chief Medical Officer in 2011 that in future all medical schools applying for certain types of funding would be expected to have an Athena SWAN silver award. This was the first time that funding has been directly linked to action on equality and diversity issues and was followed in January 2013 by the RCUK's statement on equality and diversity <http://www.rcuk.ac.uk/documents/researchcareers/EqualityStatement.pdf> which caused many departments to take these issues seriously for the first time.
- 4.3 As identified by the International Review of Mathematics in 2010, there has traditionally been a worrying lack of awareness of the issues surrounding women's careers in mathematics and the need to take action and many departments are now on a sharp learning curve.
- 4.4 In recognition of this, the LMS has established a Good Practice Scheme <http://lms.ac.uk/women/good-practice-scheme> with the aim of supporting mathematics departments interested in embedding equal opportunities for women within their working practices and to provide specific support to those departments working towards Athena SWAN awards. The scheme enables departments to share good practice in a number of ways including through workshops.
- 4.5 The most significant activity of the scheme has been to commission a national benchmarking survey of UK mathematics departments as described above. As part of this, thirty departments from a range of institutions filled in a comprehensive questionnaire giving detailed information about their working practices in ten areas. The findings made sobering reading but the resulting report contains numerous examples of good practice and departments who scored particularly highly will be invited to speak at workshops.
- 4.6 Detailed examples of good practice are described in the report. Some of the best of these include university schemes to support the research careers of those returning from extended breaks for maternity leave or other reasons. Some institutions offer a sabbatical at this point and in the very best instances these schemes are properly funded to provide teaching cover rather than sharing the load around others in the department. This is an example of making a short term investment for a long term gain.
- 4.7 Examples requiring minimal amounts of funding are the organisation of regular networking events for women in the department, perhaps over lunch or tea and cake, specific welcome sessions for new women undergraduates and sessions for final year women undergraduates to discuss options for postgraduate study.

4.8 The LMS Council issued a statement on women in mathematics in 2008 [http://lms.ac.uk/sites/lms.ac.uk/files/Mathematics/wim\\_statement.pdf](http://lms.ac.uk/sites/lms.ac.uk/files/Mathematics/wim_statement.pdf) summarising some of the key issues surrounding the careers of women in mathematics and identifying a number of practical steps that it would take to try and address these in its own procedures. The second part of this statement is reproduced here:

4.9 “The Society recognises the need to give active consideration to ensuring that men and women are treated equally in their prospects, recognition and progression. Such disadvantages as do occur are often the unintentional outcome of the formulation of regulations and procedures which do not give adequate attention to the needs of people in such positions. Accordingly, the Society will:

(a) be aware of and seek to ensure an appropriate gender balance on its committees and working groups, and encourage the Nominating Committee to give similar attention in its proposals for election;

(b) keep under review the regulations governing its membership, prizes, awards and grants to ensure that they do not inadvertently deter or fail to recognize people with non-standard career patterns;

(c) actively encourage and facilitate the nomination of women for its prizes and awards, and ensure that it considers women when it is proposing nominees for external prizes and positions;

(d) actively seek to include women speakers in its meetings and workshops;

(e) expect that the organisers of conferences and activities who are seeking grants from the Society will: invite both male and female speakers, or explain why this is not appropriate or possible; and give consideration to the provision of mechanisms to enable participation by people with children or family responsibilities;

(f) collect data and thereby monitor trends in the above.”

## **5. What role should the Government have in encouraging the retention of women in academic STEM careers?**

5.1 There are a number of ways in which the Government could help. Given the current momentum behind the Athena SWAN scheme, it seems sensible to use this as one of the main instruments for bringing about change. It is, however, important to note that the preparation of an application for such an award is a major task and it must be ensured that this task is not imposed on junior women in a department. The scheme is currently running on small amounts of funding with minimal staffing and it is essential that the operation is properly funded by the Government to enable it to meet the huge surge in demand and to provide an increased level of service.

5.2 It is striking that many departments only began to take these issues seriously when it became apparent that they might otherwise lose valuable research funding. The Government could add to the pressure on universities and departments to take action by making other types of funding conditional on action being taken on equality and diversity issues.

- 5.3 One of the key areas requiring more funding and policy changes is around maternity/paternity leave. Best practice would be for universities to provide properly funded teaching cover both during and after maternity leave so that colleagues do not suffer from an increased teaching load and the woman can have some time to get her research career back on track. The Government could play an important role in bringing this about – especially if it was to provide funding specifically for this purpose.
- 5.4 The Government could also change regulations to allow paternity leave and maternity leave to be shared much more equally.
- 5.5 Taking part in conferences and research visits is an important part of academic life and is often difficult to do with small children. Universities and conference organisers could help by providing video links. The LMS offers a childcare grant scheme to help with extra expenses incurred as a result of such activities but, ideally, these expenses should be met routinely by universities alongside travel and subsistence claims. The Government could encourage this and also change the current situation where such expenses are taxable.
- 5.6 To encourage women to be ambitious and to seek senior posts, universities could be required to run "Women in Leadership" courses and also courses on assertiveness.
- 5.7 There have been many studies showing that both men and women tend to rate identical applications for jobs or promotion differently if they are told the gender of the applicant. Unfortunately there are many practicalities that would make it difficult to ensure that application processes in academia were gender blind. Those involved in selection panels and grant review panels could, however, be required to undergo training on unconscious bias.
- 5.8 The Research Councils have played a key role in putting pressure on universities to take action but there are a number of measures which they could introduce which would make a huge difference. For example, they could offer new competitive Fellowship schemes specifically aimed at academics who have had to relocate in order to follow a partner (thus addressing the two body problem) or who have returned to work from a long period of maternity or sick leave (thus enabling the best researchers to concentrate on research at a time when many find this difficult). Research Councils could also increase the flexibility of all their funding to allow researchers to switch to part time working following maternity leave and extend grants accordingly.
- 5.9 Given that the drop-off from undergraduate to postgraduate is so significant in mathematics, Research Councils could play a key role by insisting that Centres for Doctoral Training take specific steps to attract women students and to support such students through their studies. They could even set minimum targets for the proportions of women students although these would have to be carefully agreed for each centre taking the subject area into account. They could also insist that both men and women should be involved in the leadership of such centres. The CDT application process could require statistics to be provided on the current gender breakdown of the department (for undergraduates, postgraduates and academic staff),

together with a description of what actions the department proposes to take to improve matters if the proportion of women is low.

- 5.10 Although such schemes would be run by the Research Councils, the Government could help by insisting that a certain proportion of the Research Council's funding is spent on schemes specifically aimed at addressing issues related to equality and diversity.
- 5.11 It is also important that strategic decisions taken by Research Councils do not inadvertently affect women – for example, by concentrating funding in universities with relatively low proportions of women. Again, the Government has a key role to play in requiring Research Councils to take such issues into account.