That there is a ‘problem’ with women and science is a truth universally acknowledged. According to statistics provided by the UK organization WISE (Women in Science and Engineering) female participation in science, technology, engineering and mathematics begins to decline at A-level and accelerates downhill fast thereafter. In 2012 only 13% of all jobs in Science, Technology, Engineering and Mathematics in the UK were held by women. This phenomenon is not restricted to the UK, but is also a matter of recorded concern in both the USA and the European Union (EU). According to the European Platform for Women Scientists, female scientists continue to be significantly under-represented, especially in decision-making positions and particularly in the private sector.

Another EU source, ‘Science in Society’, has published data which show that although women constitute 40% of science, maths and computing graduates, they represent only 32% of researchers in these fields, and occupy only 11% of senior academic jobs in these disciplines. In some countries and disciplines, these percentages are even lower. The plethora of organizations across the globe dedicated to promoting the role of women in science further reinforces the notion that there is something awry and that this is an international problem. This imbalance translates into women’s limited participation in professional scientific networks of all kinds, including learned societies; women comprise, for example, only around 5% of the Fellowship of the Royal Society in 2014 and approximately 10% of members of the prestigious US society, the National Academy of Sciences. If we move from contemporary to historical considerations, women of science and their achievements barely pierce our scientific imagination in the way that men of science do. There are, of course, a few women—Marie Curie and Rosalind Franklin, for instance—who dominate scientific memory, but the landscape of science remains resolutely male.

Identifying a problem with women and science is one thing; understanding it is quite another. Men may make up the majority of scientific practitioners, but this does not fully account for the strong and persistent masculine hue that has attached itself to science since its origins in the late seventeenth century. This, it can be argued, owes more to social and cultural constructs than it does to numbers of participants of either sex, or to differential ability. Similarly, asserting that women’s exclusion is primarily to do with discrimination or misogyny is equally simplistic. Although any predominantly male (or female) discipline tends to replicate itself and recruit in its own image, more productive explanations will look to cultural, sociological and historical factors in the search for understanding. These are the factors that influence the formation of individual female and male identity and so affect personal choices, our ideas of what activities are suitable or appropriate for each sex—and even our ability to fully recognize the past when it does not conform to our modern stereotypes. A good example of this latter phenomenon is

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demonstrated by work on Caroline Herschel in which some historians have portrayed her as being restricted unfairly from receiving an education equivalent to that of her brothers, by her harsh mother who could see her only as unpaid household labour. Such historians fail to consider the realities of life in eighteenth-century Europe for a young unmarried daughter who, according to accepted norms of the time (however repugnant we find them today) was expected to sacrifice her own ambition to help and support her mother in running the household.6

The articles collected here consider these issues and others in an attempt to uncover and understand women’s historic relationship with science. There are a range of connected themes and questions identified that echo throughout the texts. Were women excluded from science, or are they simply invisible? When we focus on gender and Fellowship of the Royal Society for instance, we fail to pay attention to other types of participation more accessible to women. Although the first female Fellows were not elected until 1945, some 60 women contributed from the periphery by submitting papers, publishing articles and receiving grants in the years between 1880 and 1914 alone.7 And perhaps by privileging prestigious organizations such as the Royal Society, we are overlooking the participation of women in smaller, less well-known societies, which may well have been more welcoming to them. The archivist from the Freshwater Biological Association, for instance, produced a list of six women members of note, whose contributions spanned the mid twentieth century.8 This special issue of Notes and Records engages with such issues through the contributions of authors who take a variety of historical and sociological perspectives.

The ways in which women stepped up during World War I to fill the places in factories and public services of men leaving for the frontline are well known; however, the war work of female scientists who assumed key roles in laboratories and in the field at this time of national emergency is a story far less familiar. In our opening article, Patricia Fara addresses this by identifying and analysing the significant contributions of women professionals in science, engineering and medicine and asking why they have been forgotten. One reason may be that stereotypical narratives of science tend to portray women’s work as secondary and women themselves as assistants and so less central to the story of science. Another is that women simply do not embody our idea of a scientist or inhabit the same educational/learned networks and conventions as men. Emily Winterburn illustrates this process with reference to the eighteenth-century astronomer Caroline Herschel. Although Caroline gained some public recognition, her personal achievement is overshadowed by her persona as assistant to her brother, the astronomer William Herschel. However, Caroline was adept at navigating her way through contemporary understandings of female learning and using them to her advantage. She was careful to be outwardly modest about her astronomy, recognizing that to claim too much significance for her work would have been counterproductive and might have threatened her femininity in the eyes of others as well as herself. As Winterburn discusses, Caroline’s participation in science began, perhaps, as a strategy for survival, in a world where unmarried women had to make themselves indispensable to male relatives to be assured of a roof over their heads.

This tension in the identity and self-identity of women engaged in science is something still recognizable in the twentieth century. In ‘White coats and no trousers’, J. M. Hartley and E. M. Tansey use oral history as a vehicle to assess the contribution of female laboratory technicians who, despite their expertise and importance to the success of research, are rarely acknowledged. Of course, this is as much a question of class as it is of gender, and
male assistants and technicians have typically been absent from the historical record too; however, being female adds another dimension and prompts questions about women’s perceived alienation from technology. Hartley and Tansey found that female technicians themselves were often prone to downplay the significance of their contribution to the research undertaken in their laboratories. Is this because our understanding of what counts as science is dominated by epistemological outcomes at the expense of the physical process of producing scientific knowledge (the process that these women were intimately involved with)? As Hartley and Tansey demonstrate, this framework of understanding serves to marginalize the work of technicians and female technicians in particular.

The difficulty of fitting female scientific investigators into the frameworks of science commonly used to understand the past is a theme also taken up by Mary Orr and Sophie Waring. Orr discusses the problem of a model of female participation that has become almost orthodox in the history of science: that women could only access science through a relationship with a male mentor with scientific connections, and that they operated as ‘assistant’ collaborators or in other secondary roles as popularizers, translators or illustrators.9 Sarah Bowdich (Lee) was a peer alongside her male scientific contemporaries and engaged in an expert collaboration with Georges Cuvier. To cast her in a lesser role is to misunderstand the practice of science in the first half of the nineteenth-century and to superimpose a modern hierarchy upon it. A similar point is made by Waring, in the context of the late nineteenth and early twentieth centuries, in her case study of the lepidopterist Margaret Fountaine. The mystery surrounding the sealed box that Fountaine left to the Castle Museum in Norwich, with strict instructions that it was not to be opened until 1978, has proved too much for popular biographers who have interpreted her life via romantic tales of eccentricity, with very little understanding of the landscape of science or class and social roles at the time. Waring demonstrates, in this first scholarly account of Fountaine, that Margaret’s scientific investigations were completely conventional at a time when there was no strong distinction or hierarchy between amateur and professional. Furthermore, far from being aberrant or an oddball, Margaret Fountaine was keen to conform to the feminine role prescriptions of her time.

Martin Goodman’s case study of Mabel Purefoy FitzGerald illustrates the strategies open to a woman once the professional–amateur hierarchy in science had begun to consolidate in the first decades of the twentieth century. Mabel managed to study at Oxford University at a time when the School of Physiology was closed to women; she went on to have a noteworthy career as a researcher, including working with the physiologist J. S. Haldane on the 1911 Pikes Peak expedition to Colorado. Despite this, Mabel’s contributions had, until recently, been rendered largely hidden by the inevitably masculine narratives of high-altitude scientific research. Rather than being a ‘heroine’, Mabel Purefoy FitzGerald was a researcher no different from her male peers and she carried on her important work with little fanfare or attention. Perhaps this is another reason why women’s contributions to science are little recognized or understood? If the stereotypical narrative of any female scientist is that she is a ‘heroine’—that is, ‘special’ and ‘exceptional’—then this has serious implications for our ability to recognize ordinary women of science from the past, and for women seeking examples to emulate today.

Does the exclusion of women from science and the history of science (for whatever reason) matter? Well, yes. The continued assumption that women were absent from scientific endeavour, or that they only participated in a secondary capacity or in certain more ‘feminine’ scientific disciplines, distorts the past and raises obstacles for the future
recruitment of women into science. The absence of female role models helps perpetuate the masculine colouring of science, especially ‘hard’ sciences such as physics, and is a feature of our cultural understandings of science in the West at least.\textsuperscript{10} Indeed, the use of the word ‘hard’ for certain branches of science may be part of the problem: difficult to define and arguably gendered itself, does ‘hard’ attribute male cultural characteristics—of strength and physicality for instance—to science and in so doing serve to highlight the inappropriateness of such activities for women? What is certain, however, is that this loss of female talent to science has a detrimental impact on economic prosperity and makes women and girls ill-equipped to participate in some of the increasingly important knowledge-based industries of today. The solution to this requires not only schemes to help women into science, but also strategies to change the masculine image and practice of science, which creates a more subtle barrier to women’s participation. By rendering women visible in the history of science, this special issue hopes to contribute in a small way to that project.

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\section*{Notes}


4 The Royal Society, ‘Fellowship’, https://royalsociety.org/about-us/fellowship/ (accessed 7 October 2014). It is noted there that ‘Over the last 10 years about 10 percent of new Fellows elected to the Royal Society have been women.’ The US National Academy of Sciences recently congratulated itself on its 2012 recruitment, of which 31% were women, although in the previous year this figure was a less impressive 13% (see http://www.interacademies.net/Academies/UnitedStates/13155.aspx (accessed 12 October 2014)).


9 Caroline Herschel has been labelled as merely a ‘translator’ of her brother’s work in many accounts.

10 In other cultures such as that in Palestine, the perceived antipathy of women and physics does not apply; see the presentation ‘Women in physics in the Palestinian Territories’ by Kate Shaw at the Women in Science Research Network (WISRNet) Conference ‘Revealing Lives: Women in Science 1830–2000’, London, 22 and 23 May 2014, http://womeninscience.net/?page_id=741#Physics (accessed 7 October 2014).