

Women in Science: A Social and Cultural History

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In the introductory chapter to her engaging book, Ruth Watts remarks on the 'dissonance' between women and science and the seeming paucity of scholarly literature on the subject. Upon deeper investigation, however, Watts soon discovers that she is mistaken. Resulting from her comprehensive reading, review and research, this study brings together the work of scholars of gender and science from the 1980s to the present, and displays their ideas in a form that is lucid and accessible to a wider audience. But the book goes beyond synthesis in a number of important ways too, extending the discussion and asking new questions of the connections between scientific knowledge, power and gender. Of special significance in this context is her case study on women and medicine in 20th-century Birmingham which features in chapter eight.

Watts has set herself a very ambitious task. Not only does she chart the contributions of women to science, taken in its broadest sense to encompass medicine, mathematics and many levels of female participation; she also explores the antagonisms between femininity and science, and the social and cultural antecedents to the masculine colouring of the scientific enterprise which is still with us today. It is difficult to impose order on such a vast amount of subject matter without it appearing arbitrary or forced. It is testimony to Watts's skill that she manages to combine her text into a coherent whole, largely through using education as an organising principle. Around this theme, Watts weaves discussions concerning the access of girls and women to scientific education and the implications of gendered curricula. She also gives examples of how natural philosophy and science have produced changing understandings of the female body and intellect which have had serious consequences for scientific women. All too often these theories of female inferiority have resulted in the closing of doors to women although, as Watts emphasises, women have always found cracks through which to negotiate a way in. Indeed, the book is particularly convincing when discussing the ways in which women have participated in science as a part of informal networks from within the domestic

sphere, or have found a role at ease with their femininity as writers, translators, educators and popularisers of science.

Watts illustrates how women's personal circumstances have been an important variable in their access (or lack of access) to science. The implications of class, family, faith and attitudes to education are teased out alongside descriptions of the strategies that women used to succeed. These often required them to settle for part time or junior roles, sometimes pursuing a job or research without adequate pay or recognition. The way in which biography is interweaved skilfully into the text illuminates the theoretical discussions with immediacy, and sometimes, intimacy. Alice Stewart, from a privileged background and holder of a Cambridge Natural Sciences degree, became a consultant physician in 1935. Nonetheless, she had to be content with low paid jobs which she combined with care of her family, until the Second World War changed everything. As a woman with children, Stewart could not be called up; instead, a temporary job at the Oxford Radcliffe Hospital led to a post as senior assistant at the Nuffield Hospital - an important teaching institution. Because she was part of the war effort she received help with her children and was enabled 'to leap over barriers that would otherwise have blocked my way as a woman'. Success on research projects allowed her, in 1946, to become the first woman elected to the Association of Physicians; while she also helped found the *British Journal of Industrial Medicine*. Despite the professional respect she had earned, especially for her significant work on cancer, once the war had ended she was not awarded the chair that was the usual next step up. A chair was finally awarded to her by the University of Birmingham when she was 90 years of age. Watts records her remembering that being a woman had allowed 'her to "slip through the cracks", accepting low pay and bad prospects but able to go her own way since nobody took her seriously. A man, she thought, with his "eye on the prize" would never have stood it' (p. 176).

A pervasive question throughout the book is not just who makes science, but who owns science and why? Answers are explored in chapters that are presented chronologically, albeit arranged around specific themes. The focus is on Britain, especially England, although within the European context and with reference to America. The time period covered extends from the ancient Greeks through to the middle of the 20th century.

The introductory chapter sets out the theoretical ideas and debates which underpin scholarship in this area with an overview of the literature to date. Here Watts provides explorations and definitions of her key concepts: science, gender and education, all of which are interpreted very broadly to ensure maximum inclusivity. The latter is important for a study with the partial aim of recovering the involvement of women who were, for the most part, operating from the margins of science. Chapter two takes us 'From the fifth century CE to the sixteenth: Learned celibacy or knowledgeable housewifery', presented within the context of changing understandings of gender and science produced by Aristotle, Plato, Galen and less familiar philosophers. Here we find measured discussions of women such as Hypatia, the philosopher and mathematician of ancient Alexandria, and the 12th-century abbess Hildegard of Bingen. Watts places particular emphasis on the history of medicine which she identifies as 'both the oldest and the most common form of scientific activity for women' (p. 191). Women's association with medicine, herbalism, healing and midwifery is introduced here and remains a strong theme throughout the book. In the 15th century, however, such medical knowledge and skill (and the presumption to authority that it implied) could place a woman in danger of being accused of witchcraft.

The 17th century was pivotal in the development of scientific thinking; chapter three, 'Dangerous knowledge: Science, gender and the beginnings of modernism', examines the flux of revolutionary ideas surfacing at this time and assesses their implications for women. Watts debates the various ways in which these changes created spaces for women in science, yet at the same time heralded a conception of science as inherently, and self-consciously, 'masculine'. For example, Descartes's separation of mind from body seemingly refuted any argument that women's power of reasoning was inferior due to her weak body, yet previous assumptions about women's incapacity for profound or abstract thought proved spectacularly tenacious. Despite the new thinking, a stress on women's passive nature and slow intellect came to dominate, in contrast to the perceived active nature of the new science and virile understandings of the men who were engaged in laying its foundations. However, some women questioned these conceptions; Watts discusses, among others, the contributions to natural philosophy of Margaret Cavendish, duchess of Newcastle, and

Anne Finch, viscountess Conway. Although less familiar within the context of science, she also introduces the ideas about gender present in the work of dramatist Aphra Benn and the early 'feminist' writer on education Bathsua Makin. Watts is persuasive in describing the informal settings in which women pursued their scientific interests to whatever extent they were able. Mary Evelyn, for example, was known for her education (including mathematics) and her household skills; she also had access through her husband to Oxford scholars who held her in admiration, yet she was still excluded from more profound learning and science. Her husband was a member of the Royal Society, but as a woman, she was excluded, despite joint work with him and her taste for the new experimental philosophy. Empirical science was jealous of its standing and even the emerging institutions strove to obtain and retain masculine credibility and status.

Chapter four continues this theme with an exploration of 'Education in science and the science of education in the long eighteenth century'. Watts begins with an analysis of the intersections of science, culture and gender with reference to the work of scholars including Ludmilla Jordanova, Patricia Faro and Londa Schiebinger. In the 18th century, visual imagery in medicine and science was gendered to delineate the masculine and feminine in complex ways precisely because of new thinking which put so-called natural differences and sex roles into a state of fluidity. So, for example, astronomer Caroline Herschel is pictured serving tea while her brother, William, polishes a mirror in a lithograph of the siblings working together. With the masculinisation of natural philosophy came an apparent exclusion of the feminine from Western science; woman became associated with nature and the scientist's muse, not the scientist. Watts illustrates how these assumptions intersected with education and impacted on the lives of individual women, including botanists, mathematicians and natural philosophers such as Émilie du Châtelet and Laura Bassi.

'Radical networks in education and science in Britain from the mid-eighteenth century to c. 1815' is the subject of the following chapter. Watts demonstrates how women from dissenting backgrounds, such as Quaker or Unitarian, whose families were typically more engaged with scientific thinking and reforming educational ideas, were often advantaged in receiving an education equal to their brothers. This gave such women the learning to engage with science; as teachers and writers, they could combine intellectual enquiry with womanly and religious ideals of service. Within this tradition, Watts provides a detailed discussion of Jane Marcet, in particular her *Conversations on Chemistry in Which the Elements of that Science are familiarly Explained and Illustrated by Experiments*. Directed explicitly to the ladies, this gave women the knowledge to appreciate and understand the public lectures on science which were becoming fashionable among the upper classes. The analytical strength of this chapter is that Watts engages with issues of class and masculinity too. Marcet belonged to the upper class yet could only advance a limited way in science because of her sex. Men of the lower to middle class, however, or men from the provinces, could find it equally difficult to gain a toehold in science, especially as scientific credibility and authority increasingly became associated with a manly, metropolitan masculinity.

Chapter six continues in chronological sequence with 'An older and a newer world: Networks of science c. 1815-1880'. During these decades a new map of science was emerging in Britain as new educational initiatives took root and learned institutions, such as the British Association for the Advancement of Science (BAAS) became established. Watts investigates the opportunities for women within this changing landscape, illustrating her conclusions with reference to the lives of individuals. There is comprehensive discussion of Mary Somerville, the mathematician and astronomer best known for translating La Place's astronomical work into English, extending it and adding her own examples. Somerville won the acclaim of scholars at Cambridge and elsewhere for making La Place's difficult, inaccessible mathematical thinking clearer, and ensuring that French advances in mathematical analysis and the application of the laws of gravity to astronomy became known in an England still adhering to Newtonian physics.

The late 19th century to the early 20th century is the focus of chapter seven: 'Science comes of age: Male patriarchs and women serving science?' Close attention is paid to educational developments in England and Wales from 1880 onwards, including elementary, technical, further and higher education. Watts argues that at best these initiatives produced only uneven progress for scientific women, although the emergence of new, as yet developing specialisms such as crystallography and biochemistry seemed to offer more opportunities for women. This chapter is based on meticulous, detailed research and contextualised with reference to the

American experience. There is also a table detailing the achievements and brief life histories of women who achieved the highest honours in science in the first two-thirds of the 20th century, including three Nobel prize winners and other women who, controversially today, were not awarded this accolade.

In chapter eight Watts goes beyond a synthesis of the scholarly literature on gender and science to offer a detailed examination of 'Medicine, education and gender from c. 1902 to 1944 with a case study of Birmingham'. Professionalisation is a reason often cited as to why women became excluded from science in the late 19th and early 20th centuries. However, this is a term that requires unpacking, and in her case study Watts has managed to expose in detail the assumptions and formal and informal structures (and sometimes luck) that facilitated women's access or not. In Birmingham at least, networks of middle-class women, some of whom were engaged in local government, actively promoted educational and medical ventures which employed women. Nevertheless, Watts concludes that women had to be ready to take advantage of special circumstances and were largely appointed to gender stereotyped roles.

Chapter nine, 'Asking questions of science: The significance of gender and education', weaves together the themes of the book by way of conclusion. Watts effectively refutes the notion that 'girls and women don't do science. They have always been involved in the scientific activities of the day, albeit in varying degrees and numbers' (p. 193). She concludes that women have often contributed most to science when they were involved in activities not yet of a sufficiently high status or pay to exclude them. Women have frequently been teachers and disseminators of scientific knowledge and, from the French salons of the 18th century, to 20th-century Birmingham, membership of a formal or informal scientific network was vital. Historiography is also guilty of ignoring women; the history of science has all too often been written as the story of 'great men', neglecting not only women but also men who were among the teams of people increasingly needed to pursue 'modern' science.

In a book this extensive in scope, it would be unreasonable and ungracious to expect that all topics of relevance to women and science could be addressed. There is little discussion of the significant number of women active in the 19th-century scientific and medical instrument trade, women inventors and technologists, or the women mathematicians who earned a living as 'computers' before such things were invented. Similarly, there is more to be said about women's relationship with learned societies. Women published in Royal Society journals as lone or co-authors with relative frequency at the beginning of the 20th century. In addition, the growth of specialist scientific societies was in part fuelled by the exclusivity of the elite institutions and the need of women and other amateurs to find an alternative outlet for their work. But this is in no way a criticism of this book.

Selection is all, and with *Women in Science* Watts provides an expertly crafted, comprehensive introduction to the subject, which readers can use as a platform for further research, while also highlighting much of interest for scholars investigating women, femininity and science. There is a short glossary at the front of the book, the contents of which are highlighted in the main text so that novices to the subject can easily refer back. The extensive bibliography, which includes a variety of sources, such as websites, will be particularly valuable to those new to the subject. Watts has provided an invaluable resource that could be of interest to students of history, education, women's studies, philosophy and science. She synthesises the significant literature, adds new knowledge and makes the whole accessible to a wide audience. This was sorely needed.

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