

## Invisible women? Scientists people don't see

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Who do people think of when asked to name a woman scientist? It is usually Marie Curie (1867-1934), voted in July 2009 "the most inspirational female scientist of all time", in a poll undertaken by the very odd partnership of the respectable scientific journal *New Scientist* and the cosmetic company L'Oreal. It's rather sad that Madame Curie continues to be *the* iconic, if not the only, figure of the woman scientist in most people's minds. The runner-up was Rosalind Franklin (1920-1958), the Sylvia Plath of science: remembered more as a tragic figure - rip-off of her research findings, early death, and thus failure to achieve recognition in her lifetime for her work forming the basis for Crick and Watson's discovery of the Double Helix of DNA, caricatured as a dowdy bluestocking in Watson's account - rather than for her actual achievements. Ada Lovelace (1815-1852) might also get a mention, given that she is often seen as the mother of computer science because of her work with Charles Babbage on his Difference Engine, and that there is an Ada Lovelace Day for celebrating women's achievements in science and technology, which is all over social networking sites, at least, the ones I frequent. Lovelace, like Franklin, died regrettably young with possibilities unachieved. The tragic note of the costs for a woman of pursuing a scientific career is evoked even in Curie's case with her illness and death caused by the damage sustained through her work with radiation.

Of course, the question arises as to how many male scientists the average person on the Clapham omnibus could name, but I think most people would be able to come up with at least half a dozen. Furthermore, the problem is not just about the gender of the towering figures, it is about the default idea of the scientist as male, almost certainly white, and probably in a lab coat.

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The looped Powerpoint shows just over 100 women of achievement in science, mathematics, technology, engineering and medicine, a somewhat arbitrary number and selection. There's a bit of a bias towards women from the UK because of the various sources I had at my disposal, and possibly towards the biomedical sciences because that's where my professional background lies. It's very far from exhaustive - there are a number of women for whom I couldn't find images at all, though sometimes covers of or pages from the books or articles they published, or images of their scientific drawings, or if there were images they were copyright protected. One or two images are of legendary or at least composite figures: it's generally agreed that Trotula is a composite figure representing several women active in the Salernitan school of medicine in southern Italy during the twelfth century writing works on the diseases of women, and arguably Maria Prophetissa had a similar role vis a vis women's place in the development of alchemy. I've put mothers and daughters, or sisters, who both had scientific careers, together as far as possible. I would have liked to include more group images, since one of my points is that women scientists were not solitary rare birds but part of an underobserved collectivity of women working within these various fields.

When a woman scientist who is not as well-known as Curie or Franklin is mentioned at all it is pretty much the convention to describe her as a neglected and/or obscure figure. I sometimes wonder just how visible a woman actually needs to be before people will stop describing her and her achievements in these terms. In 2006 the author of a book on Emilie du Chatelet claimed that he “stumbled on a footnote about an obscure Frenchwoman of the early 18th century” and was chivalrously led to rescue du Chatelet from her sad position of neglect. I already had sitting on my shelves two books about du Chatelet (1704-1749), a significant Enlightenment figure, who among her scholarly achievements translated into French the works of and disseminated the ideas of Leibnitz and Newton. A quick google

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revealed 42000 hits on her name. I did not check them all: many of these may have merely mentioned her in relation to the French Enlightenment philosopher Voltaire, with whom she had a long-standing liaison, which included collaboration in scientific experiments. But this does suggest a rather unusual definition of the word 'obscure'.

In spite of the evidence, the idea of women as accomplished scientists lags perhaps further behind the recognition of their achievements in other fields, and that can often be laggardly enough. This is not exclusively a problem of scotomata of the male gaze alone. I was rather shocked when reading an eminent female literary scholar's discussion of Virginia Woolf's outline in *A Room of One's Own* of the imaginary novel, *Life's Adventure*. The passage in question is usually brought up for its suggestion that novels might include female friendships: the scholar in question found even more utopian and fantastic Woolf's depiction in 1928 of Chloe and Olivia, the latter married with children, working in a laboratory, mincing liver, a cure for pernicious anaemia. I was aware, from working with the archives of various early C20th scientific institutions, that it was not completely beyond belief to find women in laboratories - even in the Cavendish, the pre-eminent physics laboratory in Cambridge. Woolf's choice of this particular activity for Chloe and Olivia was, in fact, solidly based in her knowledge of the pioneering work of Janet Vaughan, daughter of her girlhood friend Madge Vaughan. Vaughan, a young doctor working as a clinical pathologist at University College Hospital London had heard of the work going on the USA on the use of raw liver to treat pernicious anaemia, and surreptitiously gave this to a patient with great success though no credit. However, this encouraged her to proceed with the work and she started making minced liver preparations at home, trying them on herself, research which led to her doctorate of medicine in 1931.

There remains a good deal of assumption rather than knowledge around positions that  
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women might have claimed in scientific fields in the past. Patricia Phillips in *The Scientific Lady* ably recuperated the work of nineteenth century women in a range of fields but suggested that as science became professionalised, women who obtained the science degrees finally accessible to them by the first half of the twentieth century had no possible career paths except to teach science in a girls' school, citing the pathetic figure of Aggie Sigglesthwaite in Winifred Holtby's novel *South Riding* as the archetype. In fact, Holtby indicates that Aggie coulda been a contender for a research career, but family circumstances had obliged her to take up the more secure profession of school-teaching, for which she was very ill-fitted. Although many women did have to resort to teaching as a reliable support for themselves and possibly dependent relatives, particularly in the aftermath of the Great War, it does not mean that this was the only option available to them. There were other areas besides university research laboratories where we can find women with science degrees, such as working for public authorities or in industry. For example, when Harriette Chick (1875-1977) applied for the Jenner Research Scholarship at the Lister Institute in 1905, she was already employed as Assistant Bacteriologist to the Royal Commission on Sewage Disposal (such a nice, ladylike job for a girl).

These jobs, however, did not always give them scope for pursuing individual or innovative lines of research. Chick specifically stated in her letter to the Director of the Lister that her job did not provide her with facilities to pursue independent research. Even if women were able to engage in research this might be seriously constrained by the conditions of their employment: Mary Walker (1888-1974) was a doctor who discovered the physostigmine treatment for the debilitating muscular disorder myasthenia gravis, her MD thesis on which won the Edinburgh Gold Medal in 1937. However, her research could not advance as she held a salaried post in a general infirmary under the local public health department with

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restrictions as to catchment area and other qualifications for the patients she could see. Other doctors however, with just a little more leeway, were able to build impressive careers in unpromising settings: a number of women doctors associated with the East London Hospital for Children (later the Queen's Hospital), established in the slums of Hackney and thus not an alluring prospect for career advancement, became internationally renowned for their work in paediatrics. Helen Mackay (1891-1965) did important work there on infant and child nutrition and was the first woman to be elected a Fellow of the Royal College of Physicians, in 1934. Winifred Young (1909-1969) was responsible for major advances made there on infant gastroenteritis, coeliac disease, and cystic fibrosis.

Harriette Chick had been encouraged to apply for the position at the Lister Institute by the then Director, C. J. Martin, in spite of certain members of his staff going eeuwww icky gurlzz. There have certainly been numbers of male scientists who acted as mentors of women, encouraging and supporting their careers, and being advocates for them, though a number of those who did so were themselves often rather on the outside of the conventional establishment. There have even been husbands who not merely acknowledged their wives' contribution to their mutual researches, but regarded these as of equal or even superior value, though not always: Clara Immerwahr (1870-1915) was obliged to subordinate her own career ambitions to her husband, Fritz Haber, and the facilitation of his professional activities, until, appalled by his work on gas warfare, she came out in open opposition against him. There have also been husbands and colleagues who have appropriated or taken credit for the work of female researchers: for example, Jerome Lejeune took first credit for Marthe Gautier's discovery of chromosome 21, responsible for the genetic disorder trisomy 21, when she passed her cell cultures to him for photomicroscopy.

Books such as Margaret Alic's *Hypatia's Heritage* and an array of websites endeavour  
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to recuperate women of science in the past from their state of obscurity. However, the significant structural factors in the marginalisation of women's achievements in science need to be taken into account - it is not just about recounting individual stories of triumph or neglect. The positive actions of individual men in aiding women in their scientific careers are commendable but took place within a larger framework within which women's contribution was overlooked or minimised. In her extremely readable study *Pandora's Breeches* Patricia Fara incisively examined the broader context of the narratives of the history of science which exclude women from the picture or lead to their being ignored even when present. She points out that in the narrative of the solitary male scientist engaged on a voyage of discovery, women, as wives, sisters, or patrons, played an indispensable if unsung part, rather as adventurous imperial explorers were supported by a train of porters and the knowledge of their native guides. The iconic figure of the privileged male investigator of the secrets of nature, she points out, also omitted the contributions of the artisans who made the necessary equipment, the assistants in the laboratory, all those who sustained the quest.

In the household economy, which endured well beyond the Industrial Revolution, all members of the family were expected to participate in or contribute to its activities. For example, the wives of factory owners were expected to be able to keep operations running should their spouses have to be absent on business. We see something of this in the case of Caroline Herschel (1750-1848). Herschel moved from Hanover to England to live with her brother William and assisted him not merely by taking care of domestic matters but in what was then his flourishing musical career with her own considerable vocal talents. As he became interested in astronomy, she participated in this as well and developed outstanding skills, including lens grinding and telescope mounting as well as performing laborious calculations on the basis of her brother's observations. Her own passion for the subject also

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developed and she made a number of significant discoveries including several comets.

Eventually she gained the status of a major figure in the field herself and indeed received a salary for her work as assistant to William when he became Astronomer Royal, along with other marks of public recognition of her achievements. The motif of drift into a congenial area of study which becomes an abiding passion and where the woman then does important work is a recurrent one over the centuries.

The popular idea of the lone scientist grappling with the secrets of the universe is very misleading. Even before the twentieth century developments which meant that pioneering research was the product of teams rather than solitary individuals, scientists were part of face-to-face and epistolary networks often far broader than we now realise. Professor Jim Secord of the Darwin letters project has emphasised Charles Darwin's reliance on 'a huge network of amateur botanists and ornithologists and rural vicars and pigeon fanciers... for a good deal of his observational data', and notes that Darwin particularly encouraged female naturalists. Darwin himself was in the strict sense of the word an amateur, someone who was not making a living through his pursuit of science and who did not hold a university position.

However, male sociability, networking, and self-promotion formed a crucial element in facilitating the circulation of theories, the exchange of ideas, and the accrual of reputation. Many of the institutions in which this took place excluded women: notoriously the Royal Society did not admit women to be Fellows until after the Second World War, although it had commissioned a marble bust of the polymathic science writer Mary Somerville (1780-1872) for its premises: Somerville could be counted on to be satisfied by the presence of a marble likeness representing her in the Society's hallowed halls.

Quite apart from the traditional female role of providing a trouble-free domestic environment so that the scientist could pursue his work in peace, the women around him

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could find themselves, like Caroline Herschel, far more actively engaged in supporting his research projects. Few may have gone so far as Agnes Lister, who assisted her husband Joseph Lister's researches in anaesthesia by letting him test dosages on her ('close your eyes and think of science'). But from at least the seventeenth century wives, sisters, daughters, nieces, were helping by employing and supervising the assistants in the task, purchasing the necessary materials and commissioning the production of equipment, and engaging in remunerative activities to support the male's researches. They might also provide linguistic skills, collect specimens, prepare drawings, and undertake all the intricacies of bringing work to published form. This model was perhaps epitomized in Mary, the wife of the nineteenth century geologist Charles Lyell:

She translated foreign works that he could not understand, she illustrated his books because he could not draw, she edited his writing to ensure that it was stylishly written and error-free, she became more expert than him on conchology, and she classified his specimens to save him the trouble.

Similar stories appear in the entries for numerous women scientists of earlier centuries who are finally receiving something of their due in the *Oxford Dictionary of National Biography*.

But even if a woman's contribution was publicly recognised, it might not actually be remunerated. Glancing over the biographies of various women scientists, one repeatedly comes across instances similar to the following:

Mary Bruce (1849-1931), the wife of the distinguished bacteriologist Sir David Bruce, was awarded the Order of the British Empire for her unpaid work as his scientific colleague and her significant contributions to the work of the Royal Commission on Sleeping Sickness (to be fair, Bruce always insisted that her involvement should be acknowledged and she appeared as co-author on a significant number of his scientific



papers: it was less about lack of appreciation by individual men than a miasma of accepted practices and assumptions).

The palaeontologist Dorothea Bate (1878-1951) became one of the outstanding personalities and scientists in the Natural History Museum. For much of that time she was a volunteer, an unofficial scientific worker, paid piece-work according to the number of fossils she prepared, and often having to rely on public grants and the sale of her own fossils to fund her explorations abroad

The mathematician Emmy Noether (1882-1935) was invited by Felix Klein and David Hilbert to the University of Göttingen to collaborate in their work further defining one of Einstein's theories. Many of the faculty did not want Noether there, but she worked hard and was soon given a job as a lecturer, although not, initially, actually paid for her efforts: but for the first time, she was at least teaching under her own name and in her own right, previously having lectured to her sick father's classes as his substitute.

The computer scientist Karen Spärck Jones's (1935-2007) academic promotion was slow: most of her career at the University of Cambridge was as an assistant director of research funded by grant money, her post made permanent only in 1988. She was appointed reader in computers and information in 1994, the year in which she became president of the worldwide society on computational linguistics, the Association for Computational Linguistics. It was only in 1999 that she was awarded a personal professorship.

Women might be respected for their abilities but there has been a remarkable consistency in  
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the reluctance to give them full-time paid jobs in their field, as opposed to benefiting from their unpaid or casual labour.

However important, even essential, the woman's contribution, for example Mary Buckland's 'vital, if now forgotten, role in her husband's meteoric rise as geologist and founder of the Oxford school of geology' as his amanuensis, illustrator, and curator, it was the man who gained membership of influential societies and participated in informal networks around male-only spaces, and who when science became accepted into the academy were the ones appointed to tenured posts, nominated for awards, etc. Women were often to be found at the beginning of new developments, when things were open and unstructured and enthusiasm and ability were more important than ticking the right boxes and having a face that fit. They then became marginalized as the field became recognized and evolved structures and jobs for the boys and institutionalization, to the point that when the history of the area finally came to be written it was turned into a patriarchal genealogy of descent with women written out of the picture. Last year there was a rather ghastly series of programmes on sex research on Channel 4: in one of them, there was a rather condescending and dismissive account of Virginia Johnson (b. 1925), as having joined in William Masters' research when a mere secretary (albeit one with a degree in psychology). It was the 1950s - whatever their abilities and inclinations, people without a Y chromosome were largely being directed into the secretarial pool. The implication that she had sneaked into the field via a back door suggests that there was a front door at the time: at that period, there was no front door, accepted set of standardised qualifications entry into sex research. They were all backdoor men who drifted into it for whatever reason.

Different factors were in play in different cases, depending on personality, field of research, colleagues, and external forces bearing upon their career - Lise Meitner (1878-  
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1968), as a Jewish exile from Germany, was not in a position to put her name to the publications of her German colleagues in nuclear physics, even though she remained in contact with them, and she did not share the Nobel Prize awarded to Otto Hahn for the work on nuclear fission in which she had played a significant role.

We seldom see women who display the flamboyance or the eccentricity associated with many of the more notorious or famous male scientists. In the case of Barbara McClintock (1902-1992), though she has been described as 'whimsical and eccentric', this was largely on the basis of her chosen withdrawal into 'an independent and solitary life' following the scepticism that greeted her work on transposable elements. To some degree this constraint has doubtless been due to social factors which give men, providing they are sufficiently gifted, a pass on ignoring accepted standards and breaking conventional rules of behaviour, which would not be granted to the most talented woman: the widowed Marie Curie's affair with a married though separated colleague attracted vicious scandal, in spite of her two Nobel Prizes and eminence.

It is also seldom that women manifest as early prodigies. Because of the pressures upon them, they often take longer to get started in their careers and to find their field of activity. They may also, like McClintock, only finally achieve the recognition that is their due as a result of longevity and the perhaps overdue concession that their discoveries have come in from the margins and become part of the mainstream.

A far more frequent model is that of good girls who made solid and productive careers by working away with great assiduity and enormous gifts, with quiet yet determined competence, but so focused on the actual content of what they were doing that they failed to play the kinds of networking, career-promoting games that facilitated the visibility of their male peers and lacked the flamboyance that might have got them noticed. Dorothy Hodgkin

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(1910-1994) had a long and distinguished career in what was, when she entered it, the very new field of crystallography. Her mother, Molly Crowfoot, had made herself an expert on traditional weaving methods and ancient textiles of the Middle East and made a remark very pertinent to the trajectories of many early women scientists: "Towards the end of her life she would answer anyone surprised at her lack of academic training that 'if you spend 25 years working on anything you become the world expert'."

Hodgkin had exceptional technical competence as a crystallographer but she also had the ability to see what problems it could be used to solve - she was largely responsible for determining the structures of insulin, penicillin and vitamin B12, all important therapeutic substances - and eventually, probably far later in her career than a man of equivalent accomplishments, received the Nobel Prize. She is quite possibly less well known than women such as Rosalind Franklin and Lise Meitner who did not get it. As with many women, Hodgkin got a foothold in a new and still marginal speciality or subfield or interdiscipline: this could be a strength, since men tended to go for established paths with clear routes of career development, but becoming adept in some suddenly new and vital field, or having skills that were transferrable into it could work in a woman's favour. However, in Hodgkin's case, it also meant that administrators did not know what to do with her, that she did not fit in to existing academic departments and structures, and was generally in a marginal and liminal position. At one point in her career she did not even have an office or lab of her own, working in a curtained off corridor. She was married, had children, and was also committed to a range of political and social campaigns, in particular pacifism, internationalism and nuclear disarmament.

Dame Honor Fell (1900-1986) also made a career characterized by quiet competence and willingness to put in extended hours. Appointed Director of the Strangeways Laboratory  
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Cambridge in 1929, she held this position until 1970: though it might be supposed that this was an unusual distinction for a woman, it may be noted that so much of her time was taken up on administration and the pursuit of funds to continue the work of the constantly under-resourced Strangeways, that she would go into the lab at weekends to pursue her own research - she was not married. She had extraordinary technical expertise in the then very new and innovative technique of tissue culture, and was also (like Hodgkin) very good at seeing the problems that it could be productively be used to analyze. Figures like Hodgkin and Fell perhaps play into the idea that women scientists just plod away, perhaps with superlative technical skills, but without the inspired flashes of insight necessary to concepts of genius. Except that they also had the good ideas, the insights: and were prepared to keep plugging away at seemingly intractable problems, as with Hodgkin's work on insulin, until they were finally resolved. We might also think of Marie Curie tirelessly undertaking the arduous task of processing tonnes of pitchblende in order to extract minute amounts of radioactive elements.

Some women scientists have been not just modest and quiet as they got on with their research: they engage in active self-deprecation. In an interview a few years ago, Professor Jocelyn Bell Burnell, who discovered pulsars when still a research student working towards her Cambridge Ph.D, concedes that this mega-discovery, which opened up a whole new area of astrophysics, shaped her career - even if, as a student, she was not eligible for the Nobel Prize awarded to her supervisor and Martin Ryle for the advance. But even if she had not made that breakthrough, would it really have been likely that 'Without my discovery, I might easily be running the local WI [Women's Institute]'?

Then there are women who challenged existing orthodoxies and as a result were excluded and marginalised - Barbara McClintock has already been mentioned and the *George Hay Memorial Lecture of the Science Fiction Foundation, Eastercon 2012, 9 Apr 2012*

epidemiologist Alice Stewart (1906-2002) is a similar example, who like McClintock owed much of the eventual vindication of her ideas to longevity. She was the victim of clear gender discrimination when instead of her being appointed to succeed John Ryle as professor of social medicine at the University of Oxford, the post was reclassified as a readership. Her discovery of the role of low-dosage x-rays of pregnant women in the causation of childhood leukaemia in their offspring (an insight she gained in the course of asking the bereaved mothers for their experiences during pregnancy and the child's infancy) ran so counter to the received wisdom, and she was so little deferential to established figures in the world of epidemiology, that it was only towards the very end of her exceedingly long life (she continued to lecture and to undertake research into her 90s) that the validity of her findings was ultimately conceded. Even after death, her entry in the *Oxford Dictionary of National Biography* was written (in less than flattering terms) by her long-time adversary Sir Richard Doll.

Dame Janet Vaughan (1899-1993) is perhaps an instance of another reason why we do not have sustaining narratives of women in science: she did too much in too many directions, she did research in several different fields, she was an activist, she was an administrator and organiser, she had several stories rather than just one simple linear one. As already mentioned, she was instrumental in the introduction to UK medicine of minced raw liver as a cure for the previously untreatable condition of pernicious anaemia. She was married, had children, and continued to work throughout her daughters' childhood, though from grant to fellowship to grant without a permanent salaried position, the story of many talented scientific women. She also worked as a general practitioner in the slum districts of Camden Town in the early 1930s, an experience which led her to speak up at a meeting of the Royal College of Physicians, an august body which had at that time yet to elect its first female

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Fellow, to point out that the treatment for many of the conditions being described was decent food and housing rather than medical intervention. A committed socialist, Vaughan was involved in support for the Republican side during the Spanish Civil War, and thus learnt about Dr Durand-Jordan's innovations in storing blood for transfusion. This led her, with colleagues, to be proactive in designing a Blood Transfusion Service with a view to Britain's likely involvement in the international conflict looming at the end of the 1930s. This plan was actually put into operation with the outbreak of the Second World War, and Vaughan became Director of the London Blood Transfusion Service. She was also appointed at this period to the Goodenough Committee on the future of medical education, and it is almost certainly due to her fighting for it that with the establishment of the National Health Service, all medical schools were obliged to admit women students. She was a member of the team which went into Belsen after its liberation to assess the effects of concentrated protein preparations in relieving near-starvation: she described this as "trying to do science in hell". After the War, she took up the post of principal of Somerville College, one of the women's colleges at Oxford University, while maintaining a research career in yet another field, becoming an acknowledged authority on the biological effects of different radioactive elements: again, this was born out in her wider social and political concerns following the development of nuclear weapons.

This diverse career was undoubtedly partly due to factors which militated against women having the kind of linear careers characteristic of their male colleagues. They were unlikely to be appointed to tenured posts, instead having to exist hand to mouth from research grant to research grant, and operate often around the demands of marriage and motherhood. They might also find themselves with administrative duties and service tasks. They often had to take what they could get that would employ their skills. But in Vaughan's case there also

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seems to be a wide range of interests and concerns at play which perhaps made a linear career not very attractive. It is possible also that realising that even if they were practicably feasible, linear careers pursued with singleminded dedication were not likely to bring commensurate rewards or recognition to women, thus liberating them to follow their own paths and to make the choice to engage in research that at least actually interested them.

Eva Crane (1912-2007), sister of the renowned nutritional scientist Elsie Widdowson, provides a very startling example of field-shifting and following a personal line of interest. A brilliant student who won a scholarship to read mathematics at King's College London, one of only two women then reading mathematics in the whole of London University, she completed her degree in two years, followed this with an MSc in quantum mechanics, and a PhD in nuclear physics in 1938. However, although appointed to a post as Lecturer in Physics at Sheffield University, the gift of a beehive as a wedding present led her to become an internationally renowned authority on bees and apiculture.

The stories of the careers of various distinguished women in science remain less than well-known, even during the twentieth century when they were achieving academic posts and a greater degree of institutional recognition, for a variety of reasons. Sometimes it was perhaps about the fields they were in being insufficiently newsworthy. Sometimes the media does not seem quite to have known how to deal with a female scientist: Frances Kelsey brought considerable expertise in pharmacology and track record of experience with toxic drugs to her refusal, at the Food and Drug Administration, to authorise thalidomide in the USA but this became a somewhat ambiguous, if meritorious, 'stubbornness' in the media stories (we may also note in passing that Kelsey obtained her first research post due to her ambiguously gendered first name). Sometimes the women themselves were resistant to media puffery. Honor Fell seems to have been deeply embarrassed by press stories of the 1930s

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about the Strangeways 'creating life in the laboratory' and the prospect of 'tissue-culture babies'. In other instances while the women themselves may have been newsworthy, this was less for their scientific achievements than other factors. Florence Nightingale was a brilliant medical statistician and administrator, but she is remembered as an iconic example of womanly nursing care. Marie Stopes had a distinguished career in palaeobotany and her work on the structure of coal is still recognised, but this fades into the background by contrast with her notoriety for campaigning for birth control and her controversial eugenic beliefs.

Concern for the social impact of scientific discoveries and their implementation has characterised a number of women scientists. Clara Immerwahr and her opposition to gas warfare in the First World War has already been mentioned. Even in her eighties Alice Stewart was actively involved in campaigning for greater awareness of occupational and environmental risks from low-dosage radiation. Lise Meitner, like Curie, took her knowledge of x-rays into practical and humanitarian use during the Great War, and later in life refused an invitation to work at Los Alamos on the development of the atom bomb. Although she remained in Germany after 1933, burying herself in her work and saying nothing about the dismissal of Jewish colleagues (as an Austrian citizen she was personally exempt from this purge), she later stated that she considered this to have been a moral lapse and condemned colleagues and friends who collaborated with the Nazi regime. The tale of the socially concerned and responsible scientist enacted by so many women scientists is, alas, nothing like so sensational as the compelling and implicitly masculine narrative archetype of "The New Prometheus" whose aspirations may bring down death and disaster all around.

The issue is not just discovering women's engagement in scientific activity, but about looking critically at the existing narratives about science as an heroic male endeavour. Fara points out the ways in which Nature was personified as a female to be unveiled and

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penetrated by the determined male scholar, and how the representation of the various forms of knowledge was symbolised by women (goddesses or muses) who were to inspire or be studied by men. She also draws attention to the ways that stories about science have been written using metaphors of warfare and competition, of grappling with the forces of nature, of combat rather than cooperation. All these tend to occlude other possible models or metaphors for the process which might be less masculinist.

As with many other areas of achievement, the question is, still, asked about why women are under-represented in the realm of science, with the implication that it is because they are unfitted for it. When I consider the achievements of women in science, given all the factors ranged against them in entering the field in the first place, the constraints upon them once there in pursuing a productive career, and the tendency to overlook their accomplishments, I am not surprised that there have been so few: I am astonished and encouraged that over the centuries there have been so many women making solid and valuable contributions to the extension of knowledge, and indeed humbled by their dedication and determination.