



The Linnean Society of London first admitted women in 1905.

## CAREERS AND CONTROVERSY BEFORE THE FIRST WORLD WAR

For decades after *Nature's* launch in 1869, women's contributions to science were played down by both the journal and wider society. **By Claire Jones**

In its 150 years of existence, *Nature* has witnessed the emergence of science as a profession. But as research moved from a domestic to an institutional setting, women became increasingly invisible, and the historical narrative became resolutely male.

I aim to redress the balance by identifying the barriers that women faced and how they worked around them, gaining access to scientific education and chipping away at societies, journals and universities. Gradually, they widened the corridors of power for those who followed.

My focus is narrow – the United Kingdom in the late nineteenth and early twentieth centuries – but this was *Nature's* heartland in its first 50 years. And, for better or for worse, the

British Empire provided a backdrop for scientific research in that era.

Wherever we look, women have been mostly absent from the story of science. To retrace the steps of these workaday women – not all heroines – of science is to understand how far we have travelled towards equity in the scientific workforce.

You could be forgiven for thinking that

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there was no such thing as a career in science for women before the mid-twentieth century. Our popular understanding of science as an essentially female-free zone for most of its existence is seldom challenged.

Yet women adopted various scientific guises before *Nature* was founded, and even occasionally appeared on its pages in its early years. This is not to say that science was a female-friendly career; serious prejudice and discrimination severely limited women's opportunities. However, recognizing the women who contributed to the enterprise despite these barriers debunks the myth that science was (and is) inherently male.

Early in the nineteenth century, women used spaces seen as more appropriately 'feminine' to

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negotiate a way into science. Science writing, especially for children or popular audiences, scientific illustration and translation were all comfortable niches in which women could participate without threatening male pre-eminence or ideals of femininity.

Michael Faraday famously credited British science writer Jane Marcet's *Conversations on Chemistry* (1805) for inspiring him to take up science. Marianne North was a noted botanical illustrator, scientist and discoverer of plants. Later, astronomer Agnes Clerke negotiated a successful career as a writer of popular books on astronomy in the 1880s and 1890s, winning the Royal Institution's Actonian Prize in 1893.

### Learned societies

At the time of *Nature's* launch, most learned societies were male-only. In 1991, science historian Londa Schiebinger at Stanford University in California noted that for 300 years, the only permanent female presence at the Royal Society was a skeleton preserved in the anatomy cupboard<sup>1</sup>. In common with other elite scientific bodies, the society resisted admitting women as fellows until 1945, 26 years after the Sex Disqualification (Removal) Act 1919 was passed. Among other things, the act decreed that “a person shall not be disqualified by sex or marriage ... for admission to any incorporated society (whether incorporated by Royal Charter or otherwise)”.

*Nature* was quick to rebuke the French Academy of Sciences<sup>2</sup> when it denied admission to physicist and chemist Marie Curie in 1911 – even though she had won a Nobel prize eight years previously. “It is incomprehensible ... on any ethical principles of rightness and justice,” *Nature* wrote, “that because Curie happens to be a woman she should be denied the laurels which her pre-eminent scientific achievement has earned for her.”

Women fought back, too. Around 1900, there was a concerted effort by a group led by evolutionary botanist Marian Farquharson, to gain admission to scientific societies. After strong debate between the fellows, 11 women were admitted to the Linnean Society in 1905. The society got its own back on Farquharson, however, by rejecting her application. She had to wait until 1908, when objections had died down, to be elected.

Acrimony was not unusual when the question of women's admission to societies was raised. When the Royal Geographical Society considered the issue in the decades around 1900, heated argument between fellows and members of the society's council broke out in the letters page of *The Times*. Exclusion from learned societies hindered women's access to networks, libraries, grants and collaboration, and made the career landscape very different for women than for men.

Why the raw antipathy to women? One reason was that science itself often taught ideas – now

discredited – that there were innate differences in intelligence between the sexes that would limit women's suitability for science. Darwin argued that evolutionary competition led to the higher development of male brains and of female emotions.

As a result, people saw the admission of women as threatening to dumb down proceedings and harm the status of elite

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societies. Thomas Henry Huxley, a biologist and anthropologist who earned the sobriquet ‘Darwin's bulldog’ for his advocacy of evolution, worked to prevent women's admission to the Geological Society and the Ethnological Society of London, explicitly to preserve society status and prestige<sup>3</sup>. Ideologically informed theories of male and female brains

and resulting intellectual deficit are remarkably persistent, as neuroscientist Gina Rippon demonstrates in her 2019 book *The Gendered Brain*, which uses science to demolish these ideas. Rippon criticizes, in particular, modern evolutionary psychology and brain studies that look for differences between the sexes and, when they find it, consider only biological explanations.

However, the impact of these views – on women who were (and have been) internalizing them, and on the scientific community at large – cannot be ignored. Mathematician and astronomer Mary Somerville, widely celebrated in her time, remarked in entries in *Personal Recollections, from Early Life to Old Age, of Mary Somerville*, published posthumously in 1874, that she had “no originality ... that spark from heaven is not granted to the [female]”. A review<sup>4</sup> of her book in *Nature* identifies Somerville's genius as “wholly exceptional”, because “women are not by nature adapted for studies which involve the higher processes of induction and analysis”. Despite her unique scientific bent, the review takes pains to point out that



Elizabeth Brown was a founding member of the British Astronomical Association in 1890.



In the early 1900s, Marie Stopes received a grant from the Royal Society.

Somerville was still “beautifully womanly”. Somerville had not only translated Pierre-Simon Laplace’s notoriously difficult *Traité de Mécanique Céleste* (as *Mechanism of the Heavens* in 1831), she had also extended it with explanatory notes and her book was adopted as the standard text for higher mathematics at the University of Cambridge, UK. Indeed, the term ‘scientist’ was coined for Somerville in the 1840s by Cambridge don William Whewell, as an alternative to ‘natural philosopher’ or ‘man of science’.

Newer learned societies were not so choosy. These sprang up in large numbers towards the end of the nineteenth century as science specialized and associations emerged for amateur enthusiasts, teachers and women. Indeed, some women took key roles in these societies. For example, several were active in the British Astronomical Association, participating in expeditions, serving on its council and editing its journal. Elizabeth Brown was a founding member of the association: she headed the Solar Section of the Liverpool Astronomical Society, formed in 1881, which evolved into the British Astronomical Association in 1890.

Astronomy provided particular opportunity for women, arguably because practitioners remained in the field when other sciences professionalized and moved from the home to institutional spaces that excluded women. Botany, too, with its history as a feminized pursuit from the eighteenth century, proved welcoming, as did palaeobotany, which was strongly female-oriented in the first decades of the twentieth century<sup>5</sup>. Female palaeobotanists researching and publishing at this time include Margaret Benson at Royal Holloway College, University of London; Agnes Arber,

who graduated from Newnham College in Cambridge; Henderina Scott, who researched and collaborated in a domestic setting; and Marie Stopes at the University of Manchester.

### Collaboration sans compensation

Elite societies might have baulked at having female fellows, but women still managed to find a way in, and participated in research in other ways, too. Between 1880 and 1914, some 60 women contributed to the Royal Society by authoring or co-authoring published papers or by demonstrating at the annual *soirée*, a highlight of the London social season that continues today<sup>6</sup>.

Some women, including palaeontologist Dorothea Bate and Stopes (who is best known for her later work on birth control and notorious for her later endorsement of eugenics), even received grants from the Royal Society to fund their research. Stopes’ scientific career saw her travel widely for research, accept government commissions, publish nearly 40 scientific papers and produce important insights into coal-forest ecology. She earned doctorates from the University of Munich in Germany and from University College London, and became the first woman to join the science teaching staff at the University of Manchester.

Our modern understanding of a salaried science professional did not become completely valid until the second decade of the twentieth century, although men (and some women) did assume such roles from the 1870s onwards, often on the back of emerging technologies and industries, such as electrical engineering. Even when they had university training, women tended to secure low-status, routine roles such as research assistants and human

calculators at, for example, the Royal Observatory in Greenwich in the 1890s and at Imperial College London from its establishment in 1907.

However, it was far from unusual for women scientists to work alongside salaried men yet receive no remuneration for their labours. Bate, for instance, worked with the Natural History Museum in London from 1898, but was never paid and nor was she made a member of staff until 1948, when she was in her late 60s. The idea of a middle-class woman receiving payment violated all ideals of respectable femininity.

Earlier in the century, this concept also affected Eleanor Ormerod, who provided economic advice on agricultural problems and pests. It was easier for a middle-class woman of means to carry out research or to do so alongside teaching, one of the few respectable careers for women. However, working-class women could find a pathway into science from a business direction. Nautical-instrument maker, inventor and navigation writer Janet Taylor ran a nautical academy in the East End of London in the 1860s and 1870s, with the Admiralty as one of her clients.

Ormerod was a pioneering technological scientist who was instrumental in establishing the discipline of economic entomology in Britain, in particular through her annual reports published from 1877 to 1901. Although Ormerod was self-taught and possessed no formal qualifications – something not unusual for women or men at the time, given the amateur tradition in science – she advised and lectured on training at various colleges and was an examiner at the University of Edinburgh, UK.

Ormerod also participated in international collaborative research, acted as an expert witness in legal cases and was commissioned as a consultant entomologist to the Royal Agricultural Society in 1882. However, she was not paid, and received only occasional expenses, despite giving her expertise for free for the next ten years.

One route into science for women at this time was through collaboration with a husband or other male family member. Yet, even for the most egalitarian of scientific partnerships, it was the man who tended to get the kudos, with his female collaborator cast in the role of assistant.

Many women accepted this. Two examples are astronomer Margaret Huggins and Scott, a pioneer slow-motion filmmaker, botanist and palaeobotanist. Both women were independent researchers, but bought into the era’s perceptions about wives being ‘helpmeets’ to their husbands.

Yet Scott’s husband was a strong supporter of women scientists, unlike Huggins’s, who complained that illness had prevented him blocking the award of the Royal Society Hughes Medal for original research to electrical engineer and physicist Hertha Ayrton in 1906. When

Ayrton died in 1923, an obituary in *Nature* asserted that, instead of pursuing her own scientific interests, she should have looked after her husband, and “put him in carpet slippers when he came home”, so that he could have better devoted his efforts to his scientific work<sup>7</sup>. Ayrton might have succeeded as a scientist but, according to her obituarist at least, she did not succeed as a wife.

Some of the research for which Ayrton was honoured had been done in her husband’s laboratories at the Central Institution in Kensington, London. This included work on her book *The Electric Arc* (1902) which became the go-to resource on the subject and had been serialized in *Nature* in 1899.

When her husband died, Ayrton lost access to this institutional space and so turned her living room into a laboratory. Her confinement to the domestic sphere at a time when emphasis was being placed on precise measurements and instrumentation prompted questions over her research and the credibility of her science.

Women had to tread particularly carefully when they entered the laboratory, which was seen as a space for masculine display. Women’s presence there could prompt scepticism, if not outright hostility, especially when access was for research rather than educational purposes. This antagonism often led to the development of parallel facilities, such as the Balfour Biological Laboratory for Women at the University of Cambridge in 1884.

As the new century approached, more women were accessing a university education in science, and the idea of a professional female researcher was no longer an oddity. The

University of London was a key player here, opening up its degrees to women and men on an equal basis (except for medicine) from 1878.

Science was particularly strong at London’s Royal Holloway and Bedford women’s colleges. When Royal Holloway opened its doors in 1886, it did so with well-equipped chemical and biological laboratories.

Women were allowed to graduate from Scottish universities after the passing of a special act in 1889 (apart from degrees in medicine, which were not conferred on women until 1916).

But the battle for women’s higher education was not wholly won. That year, physician William Withers Moore used an address to the British Medical Association to warn against university education for women owing to the “dangers” it posed to female reproductive health and mental well-being.

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Undaunted by his warnings, some women graduates began to take on research posts and embark on higher degrees in the United Kingdom, Germany and the United States. For example, mathematician and biostatistician Karl Pearson employed a number of women at Galton Laboratory, established in 1904 at University College London. Alice Lee, who had studied mathematics at Bedford College, went on to become a doctor of science under

his supervision. Women were not awarded degrees at Cambridge until 1948 (27 years after Oxford began conferring them), but they did study natural sciences and made contributions to research. Between 1902 and 1910, female researchers at Newnham College were instrumental in founding the science of genetics<sup>8</sup>, working alongside biologist William Bateson.

A more acceptable route into science was teaching in one of the colleges or high schools for girls that were being established at the end of the century. Many of the female graduates found their scientific niche in teaching, including Cambridge mathematician Sara Burstall, who became head of Manchester High School for Girls in 1898.

However, not everyone was pleased with this development. Chemist William Armstrong used his report for the 1904 Mosely Education Commission to emphasize the “mental disabilities” that evolution had bestowed on women and to issue dire warnings about the “ruinous” effects of allowing them to “contaminate” boys by teaching them science.

The important work of female scientists during the First World War – stepping up to run laboratories while men were away at the front – is only just now being given due credit<sup>9</sup>. Stopes was recruited to the war effort by the UK government’s Industrial Research Department, where she collaborated on research into the constituents of coal. Hilda Phoebe Hudson, like other female mathematicians, joined the Air Ministry to research problems in aeronautical engineering.

The popular history of women in science tends to celebrate romantic ‘heroines’ such as Ada Lovelace (who, later in her short life at least, used her mathematical prowess mostly to gamble) or two-time Nobel-prizewinning Curie, rather than the workaday women who made their way in science as best they could – often very successfully.

Remembering the breadth of female participation will not only end science’s ‘disappearing woman’ trick, it might also illuminate the current gender imbalance by making the point that science is, and always has been, for women as much as for men.

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Botanical illustrations by Marianne North made their mark in the mid-nineteenth century.