

The Royal Society of Edinburgh

Part of the Edinburgh Lecture Series: Extraordinary Feats, Extraordinary People

A Celebration of Women in Astronomy

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Report by Jennifer Trueland

This year's series of Edinburgh Lectures is on the theme of extraordinary feats and extraordinary people. The first was delivered by Professor Dame Jocelyn Bell Burnell, the astronomer who discovered radio pulsars. In a lively and provocative talk, she celebrated the extraordinary achievements of women in astronomy from the 18th Century to the present day. She also discussed the current position of women in astronomy, and science more generally, reflecting on how existing imbalances could be rectified.

There is a rich history of women who, despite many setbacks and difficulties, have made their mark in the field of astronomy. Professor Dame Jocelyn Bell Burnell opened her talk by describing four such women, from an 18th-Century German denied an education, to a 20th Century astronomer and poet. But although life may have improved for the woman wishing to make a career in astronomy or in science, technology and engineering generally, Dame Jocelyn made it clear that equality is years away.

Caroline Herschel was born in Germany in 1750. Being “neither rich nor beautiful”, her lot in life was to be housekeeper to one of her brothers. She was denied the chance to learn to read and write, and was only allowed to learn dressmaking provided she made clothes solely for her brother. Fortunately another brother, William, who had moved to England, asked if she could be housekeeper for him (this was agreed, provided William paid for a maid to take her place). William Herschel was a musician who then turned to astronomy and, from a telescope in his back garden in Bath, discovered Uranus – always working with the assistance of his sister. George III offered him the position of Astronomer to the Court, so the Herschels moved to Slough, where William built a large telescope. Because it takes time for eyes to adapt to darkness – and light is needed to take notes – William would observe while his sister would note what he saw. Her nights therefore involved sitting out of doors in all weather – once she complained the ink was frozen – and, over breakfast, teaching herself geometry and calculus, managing the household all the while.

Although she reflected any praise back to William, it was clear that she knew her stuff, and could give expert demonstrations to visitors, including royal parties. In what little spare time she had, she made use of the telescope to hunt comets – of which she found eight, a remarkable number; she certainly knew the night sky. “She pretended it was all William, but it was clear she knew what was what,” said Dame Jocelyn.

Caroline Herschel was awarded the Royal Astronomical Society Medal at the age of 78, the Irish equivalent aged 87, then the King of Prussia Gold Medal when she was 96 years old. She was written back into history, said Dame Jocelyn. “It was just as well she lived a long time.”

Cecilia Payne Gaposchkin was born in the UK in 1900. Her father was an Oxford don who, as was customary at the time, had had to give up his fellowship on marriage. Cecilia Payne had an aunt who was keen on botany, and she herself became interested in the subject. "It was acceptable for women to do nature study, and botany was 'jumped up nature study'," said Dame Jocelyn. Cecilia Payne was a talented musician – her teacher (Gustav Holst) thought she should take it up professionally. She, however, fought for a science education and went up to Newnham College, Cambridge, in 1919 to study botany. Chance attendance at a lecture by Sir Arthur Stanley Eddington, the astronomer who had led an expedition to observe a solar eclipse and thus provide confirmation for Einstein's theory of relativity, was to change her world. She was so impressed by what she heard that she did not sleep for three nights and had "something very like a nervous breakdown". She fought to change from biology to read physics, getting to know Eddington well. It was he who advised her to go to the US, so she went to Harvard to study for her PhD. Here she discovered something very unusual – so unexpected that she did not actually believe what she was seeing: looking at the spectrum of the sun she saw it was nearly all hydrogen. Although she presented her work she said "it must be wrong" and she was not believed. A number of years later, however, the director of the institute published the same results – without acknowledging Caroline Payne Gaposchkin's work.

Vera Rubin, born in 1928 and still living, is known for establishing the presence of dark matter in galaxies. This is important because it has helped explain why galaxies like our own do not – as would be expected – fly apart, but instead stay bound together. The solution is dark matter, the source of the additional gravity needed to keep the galaxy intact. Likewise, clusters of galaxies stay together, bound, like the galaxies themselves, in a halo or ball of dark matter.

Vera Rubin hadn't had it easy – she had applied to Princeton to study astronomy, only to be told that as they didn't admit women, she wouldn't even be sent a brochure – but she persevered and built a remarkable career. Her calculations of the speed at which galaxies travel showed that they must contain much, much more mass that could be accounted for by stars. "She was not believed – I think a man would have been believed," said Dame Jocelyn, but now is recognised for her achievements.

Rebecca Elson, who was born in 1960, but died from cancer in 1999, studied the evolution of stars; she was also a poet, and wrote poetry about astronomy. She spoke of the isolation she experienced as a female astronomer, saying it "felt like accidentally walking into the men's bathroom". Dame Jocelyn read a poem which Rebecca Elson wrote about dark matter, called *Let There Always Be Light (searching for dark matter)* which described looking for signs of "unseen things":

"To weigh us down.
To stop the universe
From rushing on and on
Into its own beyond
Till it exhausts itself and lies down cold,
Its last star going out."

Now, however, we know there isn't enough dark matter to prevent perpetual expansion – the outlook for the universe is bleak, said Dame Jocelyn.

Turning to the issue of women in astronomy today, Dame Jocelyn demonstrated that there is definite gender imbalance. Examining membership of the umbrella organisation, the International Astronomical Union, she said that an average 15% of members are women. This ranges from 37% in Argentina, to 6% in Japan. The UK and US have below average female representation, at 12%. Italy (25%), France (24%) and Spain (18%) are far ahead of Sweden (13%), the Netherlands (12%) and Germany (10%).

The low numbers of women could be because membership is for tenured astronomers, so larger numbers of younger women aren't counted, said Dame Jocelyn. In addition, women may be overlooked because members have to be nominated by their country's astronomical society – which tends to involve the “white male establishment”, she said. “The reasons must be cultural – it's nothing to do with women's brains,” she added.

The situation with astronomy is similar to that in science, technology, engineering and mathematics (STEM) more generally. Although the numbers are growing, there is still a great imbalance, and any improvement is happening slowly. There are, she said, more women in STEM subjects at undergraduate and postgraduate level, but this falls away the higher you go up the career ladder.

There are issues to be addressed such as work–life balance and the demands of combining a career with family life. But there are also more subtle issues around workplace climate. Women are like canaries, Dame Jocelyn said – they are more sensitive to the friendliness (or otherwise) in a department.

The disparity could be because there are too few women entering science and too many leaving, or because those who stay don't get promoted as quickly as their male colleagues. Or most likely because of all of the above.

A number of initiatives have been introduced to encourage women to study scientific subjects and to take up careers in science, but success has been limited at best. Why, indeed, asked Dame Jocelyn, should women do all the changing? Why should it be assumed that the male norm is “normal”? Shouldn't science move towards women as well as women move towards science?

Long term, the climate of science must change – we must move to fix the system, rather than “fix the women”. What we call science has been named and developed – and interpreted – by men, mostly white men; no wonder people from different backgrounds find aspects of it odd.

In the US, programmes encouraging a better gender balance have changed focus and are now offering grants for institutional change. There are also positive developments in the UK, such as the Athena SWAN charter and awards, which essentially recognise universities and departments for being women-friendly. Dame Jocelyn herself is working on a report for the RSE on how these issues can be addressed in STEM. Much good work is going on locally, she said, but a proper strategy is needed to bring about change. “Watch this space in the near future”. Until this “Nirvana” arrives, however, she recommends that women save up and recount their “stories”, and that management should be improved – women benefit from good management and suffer from poor management to a greater extent than men. And, she concluded, it should be remembered that well-behaved women rarely make history.

Questions

Questions covered topics including single-sex education, national differences, whether women are too polite and the importance of networking.

Asked about whether women flourish more in single-sex educational environments, Dame Jocelyn quoted evidence from the US which shows women who attend prestigious women-only colleges do better (in later life) than women who attend prestigious co-educational colleges. Men, on the other hand, tend to flourish in the latter. Asked why Argentina has such a (relatively) high proportion of female astronomers (27%), Dame Jocelyn said the situation in every country was probably different, but that an astronomer from Mexico (17%) had attributed it to the culture of having a maid, which made it easier for women to have a career.

Are women too polite? Should they be taking more drastic action? It's difficult to know which battles to fight – you can over-protect, said Dame Jocelyn, adding that she had been “exceptionally lonely” in her career because she tended to be the only woman in meetings, so there was nobody to ask afterwards if she'd gone too far – or not far enough. Asked about the importance of networking, she advised women who want a career in science to keep in touch with women they studied with, and not to be put off. “If you have the ability and are interested, then go for it,” she said.

The Vote of Thanks was delivered by Professor Sheila Rowan FRSE.