

March 2023



Dear Club Members,

It's 100 years since Cecilia Payne-Gaposchkin was offered a fellowship at Harvard College Observatory in the UK. She had previously studied at Cambridge University having gained a scholarship to attend Newnham College in 1919.

Whilst at Cambridge she was taught by Ernest Rutherford, who at the time was doing work to understand the structure of the atom. In her biography she wrote "At every lecture [Rutherford] would gaze at me pointedly. . . and would begin in his stentorian voice: 'Ladies and gentlemen.' All the boys regularly greeted this witticism with thunderous applause [and] stamping with their feet. . . at every lecture I wished I could sink into the earth. To this day I instinctively take my place as far back as possible in a lecture room."

Despite this hostile environment she passed all her final exams, but at the time, degrees were not awarded to women, she later recalled that women were given a certificate that basically stated "if you had been a man you would have got a BA". Cambridge didn't award degrees to women until 1948. Without that degree, further research opportunities weren't available to her in the UK, so she moved to America.

Payne-Gaposchkin's area of study was astronomy, specifically looking at the composition of stars. She was inspired to follow this line of interest after attending a lecture by Arthur Eddington, sharing the work done on his 1919 expedition to the island of Príncipe in the Gulf of Guinea off the west coast of Africa to observe and photograph the stars near a solar eclipse as a test of Albert Einstein's general theory of relativity. She later said of the lecture "The result was a complete transformation of my world picture. [...] My world had been so shaken that I experienced something very like a nervous breakdown."

At Harvard Observatory she was in the company of a surprisingly large number of women. Women had long been employed as computers. These women performed the role in the original sense of the word, they were paid to do calculations. The observatory was collecting mountains of data and it all had to be analysed and processed by hand. Women were thought to be more patient than men for this type of work involving fine detail, and they would also work for as little as 25-50 cents an hour, even if they had a college degree. They were not independent researchers, they were simply assistants with assigned tasks, but despite this, the group of women computers in the 1920's made some of the most significant contributions to early observational astronomy. Working in the Observatory at the same time as Payne were Henrietta Swan Leavitt - famous for her discovery of the period-luminosity relationship of Cepheid variables - and Annie Jump Cannon, who was internationally recognised for organising stellar spectra.

In 1925 she published her PhD thesis proposing that stars are mostly made of hydrogen and helium, and that we could classify them according to their temperatures. She also concluded that hydrogen must be the most abundant element in the universe. Originally her research struggled to

gain acceptance, but further observations confirmed her work. It was later described as “the most brilliant PhD thesis in astronomy” by astronomer Otto Struve.

Harvard had the world’s largest archive of stellar spectra on photographic plates. If you attach a spectroscope to a telescope then the instrument spreads out the light to form a rainbow of the colours that make up visible light. When this is done with the light from a star you get thin black gaps, where light of a particular wavelength is missing. The gaps happen because different elements absorb light at different wavelengths. Decoding these gaps tells us the elements that are present in a star, and also how abundant they are.

It took far longer for her to achieve the success she earned purely because she was a woman. Even her groundbreaking thesis was published with an addendum saying that the results indicating that Hydrogen and Helium were the most abundant elements in stars must be an error purely because Henry Russell, director at the Princeton Observatory refused to accept her conclusions, instead remaining with the long held consensus that the sun and earth had the same basic composition. In 1929 he published his own work, which cited Payne-Gaposchkin, and indirectly confirming her results. After gaining her PhD she remained at Harvard, employed as a technical assistant to Harlow Shapley, the director of the Observatory. She was put to work measuring the brightness of stars, and tasked with teaching graduate courses in his name. Harvards President Abbot Lawrence Lowell said that she “would never have a position in the University as long as he was alive”. For the next 30 years Payne\_Gaposchkin remained in a career twilight. Her work was globally recognised, her teaching sought-after, but she was underpaid and lacked the formal recognition of a much deserved academic position.

That changed when Donald Menzel became the new director of the observatory, he immediately doubled her salary, and was finally able to get her appointed as a professor in 1956, the first woman to do so at Harvard. A few months later she was appointed the first female chair of a department.

To celebrate she hosted a party in the Observatory library and invited all the female astronomy students. She taught and mentored mentored many people who have since made huge contributions to the world of astro-physics

She seems like a woman I would have loved to have known. Her daughter described her as "an inspired seamstress, an inventive knitter, and a voracious reader". She died on December 7, 1979, aged 79.

Happy Spinning

Katie

Fibre Content- In case your parcel is missing the label

62.5% Superfine Merino

25% Linen

12.5% Sari Silk

Further Reading-

<https://www.amnh.org/learn-teach/curriculum-collections/cosmic-horizons-book/cecilia-payne-profile>

<https://physicsworld.com/a/cecilia-payne-gaposchkin-the-woman-who-found-hydrogen-in-the-stars/>

<https://www.aps.org/publications/apsnews/201501/physicshistory.cfm>

<https://www.youtube.com/watch?v=2CD48phR6rY>

Talk by Donovan Moore, Author of "What Stars Are Made Of: The Life of Cecilia Payne-Gaposchkin"

<https://www.youtube.com/watch?v=BiNAAbRaFYQ>

Henrietta Swan Leavitt

<https://www.aavso.org/henrietta-leavitt---celebrating-forgotten-astronomer>

Annie Jump Cannon

<https://www.womenshistory.org/education-resources/biographies/annie-jump-cannon>

The relation among temperature, the quantum states of hot atoms and their spectral lines had been derived in 1921 by the Indian physicist Meghnad Saha, but he lacked knowledge of the quantum energy levels of each element-

<https://physicstoday.scitation.org/doi/10.1063/PT.3.3267>

Understanding Spectroscopy-

<https://webbtelescope.org/contents/articles/spectroscopy-101--introduction.html>

[https://www.youtube.com/watch?v=n\\_KyYFYNvpl](https://www.youtube.com/watch?v=n_KyYFYNvpl)