



UNITARIAN UNIVERSALIST

CONGREGATION OF FREDERICK
Spirituality · Community · Justice

**What Stars Are Made Of:
The Life & Legacy of Cecilia Payne-Gaposchkin**
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This sermon is part of our annual Mother's Day series on "Founding Mothers of Unitarian Universalism":

- Quite a few years ago, we began with [Margaret Fuller](#) (1810-1850), who along with Emerson and Thoreau is one of our three most important Transcendentalist forebears. Her 1845 pamphlet *Women in the Nineteenth Century* was a significant contribution to the women's equality movement.
- Next, we moved to the three [Peabody Sisters](#), especially Elizabeth Peabody (1804 - 1894), an author herself, who published many Transcendentalists under her own imprint, and also become the celebrated founder of kindergartens in America.
- Then we explored the life of [Julia Ward Howe](#) (1819-1910) about whom it is said that she "had six children, learned six languages, and published six books." She was most famous for writing the lyrics to the "Battle Hymn of the Republic," and helped found Mother's Day itself through her famous Mother's Day Proclamation for Peace.
- We have also focused on [Mary Moody Emerson](#) (1774-1863), Ralph Waldo Emerson's aunt, whom he called his "earliest and best teacher,"
- as well as [Louisa May Alcott](#) (1832-1888), best known as the author of *Little Women*. At the time of her death in 1888, "she was the country's most popular author, and had earned more from writing than any male author of her time."

- And **Olympia Brown** (1835 - 1926), a Universalist who in 1863 became the first woman to be ordained with full denominational recognition.
- Last year our focus was on **Lydia Maria Child** (1802 - 1880), a pathbreaking activist for social justice in the nineteenth century.

In future years, I look forward to telling you about some of our other founding mothers, such as:

- **Judith Sargent Murray**, an early American advocate for women's rights, who was married to John Murray, the founder of the Universalist half of our movement;
- **Sophia Lyon Fahs** who revolutionized twentieth-century UU Religious Education;
- **Sarah Ripley**, an American educator and noted scholar at a time when women were rarely admitted to universities; and
- **Frances Harper**, one of the first African American women to be published in the United States.

My intent with this quick summary is not to overwhelm you with names and dates. Rather, I hope your takeaway will be that as Unitarian Universalists, we are lifted up “on the shoulders of giants,” many of whom were pathbreaking women. Retelling these stories of our UU ancestors allows their lives to inspire us to live our UU values today.

In that spirit, for our 8th installment in this “Founding Mother’s of UU” series, we are going to explore the life and legacy of **Cecilia Payne-Gaposchkin** (1900 – 1979). She was “a woman of many firsts: the first to receive a Ph.D. in astronomy from Radcliffe College [the sibling institution to Harvard College, when it was all-male], the first [woman] promoted to full professor at Harvard, the first [woman] to head a department there. And, in what has been called ‘the most brilliant PhD. thesis ever written in astronomy,’ she was the first to describe what stars are made of.” I did not know much about Payne-Gaposchkin prior to reading a biography published last year by Harvard University Press, and I happened to think: “I wonder if she was a Unitarian.” It turns out she was!

Let me tell you a little of the origin story behind the recent first full-length biography of her, *What Stars Are Made Of: The Life of Cecilia Payne-Gaposchkin* by Donovan Moore. The author was flipping through some handouts related to a course being taught at Princeton University on “The Universe,” and one of the slides had three unnamed photographs. He immediately recognized the first two as Aristotle and Newton, but he wondered: who is this third person, who is “literally on the same page as these great men of science?” Digging more deeply into the presentation, he discovered her name, but he still didn’t know much about her. Upon further investigation, it turns out that picture alone has quite the story behind it.

It is an oil portrait by Patricia Watwood, painted in 2002, more than two decades after Cecilia’s death. She based it on twenty-five photographs of Cecilia along with an overall visual allusion to Vermeer’s 1668 painting “The Astronomer” that hangs in the Louvre. This portrait of Cecilia was commissioned by Dudley Herschbach, a Nobel Prize-winning chemistry professor at Harvard as part of an effort to have more portraits of women hanging on the university’s walls which had historically included only men (xv).

When Cecilia’s portrait was hung, the Dean of the Harvard Faculty of Arts and Sciences quoted these words:

Every high school student knows that Newton discovered gravity, that Darwin discovered evolution, even that Einstein discovered relativity. But when it comes to the composition of our universe, the textbooks simply say that the most prevalent element in the universe is hydrogen And no one ever wonders how we know. (xvi)

But at this point we’re getting ahead of the story, so I invite you to come with me back to the beginning to more properly share with you more about Cecilia Payne-Gaposchkin’s quite remarkable life.

She was born in 1900 in Wendover, England, the oldest of three children, and her earliest childhood memories were idyllic: “Everyone knew everyone else. Neighbors were a bicycle ride away. No highways, no cars, shining stars in a black sky. It was a happy home” (11).

And although her siblings also went on to live successful lives, it was clear from a very young age that Cecilia was different. Her parents said that if you boiled down the central characteristic about her that was different to one word, it was *curious*. Cecilia was extremely, “relentlessly” curious (12).

The great tragedy of her childhood was her father’s death of an unidentified medical emergency when Cecilia was only four years old. This meant not only the loss of a beloved parent, but also a major financial impact on the family due to the loss of her father’s income as a lawyer (16).

Despite these hardships, Cecilia persisted in doing well in school. I’ll give you just one example of her early achievements. Her elementary school held an annual general knowledge examination in which every student in every grade level took the same test. In her first year, in the youngest grade level, she earned the second highest grade in the entire school (25). In the short run, this sort of success led to both resentment and harassment from her peers (25). In the long run, however, her studiousness earned her a full scholarship to Cambridge University, the only way that she would have been able to afford to attend (40).

I’ll give you one more example from her early years that has parallels to the way that Cecilia would often find herself swimming against the current throughout her life. As a scholarship student at a private high school, her classmates were almost all from aristocratic families and were being groomed to take their place in that world. Several would become successful actresses. Others would go on to a finishing school, where the curriculum focused on how to dance, how to enunciate clearly, how to comport oneself at banquets, and, most importantly, “how to enter or retire from a room with a degree of elegance and assurance.”

In contrast, Cecilia spent her free time teaching herself calculus and coordinate geometry (31).

In addition to these class struggles, Cecilia also faced a tremendous amount of sexism throughout her life. At the same time, it is also true that if she had begun her career any earlier, what she accomplished may have been not merely difficult, but perhaps impossible due to the even greater degree of sexism that existed in England

prior to World War I. Cecilia arrived at Cambridge University in the fall of 1919, less than a year after the end of the first World War. During the war, it had become much more commonplace for women and men to work together, for women to have short hair cuts, to wear knee-length shorts, etc. (46). These subversions of traditional gender norms aided Cecilia's ambitions. Unfortunately, many Victorian gender norms continued. For instance, many people at that time still believed that a woman's role was to be a subservient helper to men and that the hard sciences were no place for the so-called "fairer sex" (55).

Now, there is so much more to Cecilia's story than we will have time to explore, so let's move now to a major turning point in her early days at Cambridge. In early November 1919 in the fall semester of her freshman year, *The New York Times* published this headline about the findings of Sir Arthur Eddington, one of the professors at Cambridge:

LIGHTS ALL ASKEW IN THE HEAVENS;

Men of Science More or Less Agog Over Results of Eclipse Observations. EINSTEIN
THEORY TRIUMPHS

Stars Not Where They Seemed or Were Calculated to be,
but Nobody Need Worry. (68)

Dr. Eddington had provided evidence that Albert Einstein's 1915 paper on "The General Theory of Relativity" was correct (65).

In early December when Cecilia had the opportunity to hear Dr. Eddington lecture in person about his findings, she said that, "For three nights I did not sleep. My world had been so shaken that I experienced something like a nervous breakdown." The seriousness with which she took Eddington's findings was an indication of the passion and commitment that she would bring to her own search for scientific discoveries (62).

And although Cecilia went above and beyond in every aspect of her academic pursuits at Cambridge, it remained the case in the early 1920s that a woman could at most be awarded a "title of a degree" and not the degree itself, even though women completed the exact same academic requirements as men (118). Cambridge would not award degrees to women until 1947, more than two decades after Cecilia left the

university. This level of systemic misogyny made it clear that her opportunities for a career in science would be severely limited if she remained in England. Fortunately she had impressed Eddington and other Cambridge professors so much that they were able to help her get a job at the Harvard University Observatory (124). So in the fall of 1923, the twenty-three year old Cecilia Payne left her home country, boarded a ship, and sailed to America—exchanging Cambridge University for Cambridge, Massachusetts (133).

When she arrived at the Harvard Observatory, she found that there were more than a million photographs from telescopes that had been catalogued, but not interpreted (154-155). After logging an immense number of hours crunching that data, her calculations arrived at an astonishing conclusion. If her math was correct, then hydrogen was a “*million* times more abundant” than the reigning scientific theories held to be the case. Looking back, it can be difficult to appreciate what a universe-shaking claim that was. As one historian of science has written: “At the time the possibility that hydrogen was the primary constituent of the universe was not a welcome thought at all. Even though hydrogen was the most persistent line feature in the spectra of stars, and sometimes the most prominent, astronomers felt strongly that it could not be the major constituent of the stars” (173-174).

Keep in mind that at the time she made this discovery, Cecilia was a twenty-five year old woman trying to operate in a world of fairly extreme misogyny. I mean, it wasn't *The Handmaid's Tale*, but it was bad. Indeed, her supervisor and many other established male scientists made it clear that if she did not include a caveat about her claims, her findings would be dismissed out of hand, and her dissertation would be rejected (182-183). Given these circumstances, when she published her results she both showed her work and included the caveat that the results ‘almost certainly not real’ (182).

The good news is that she was awarded Harvard's first doctoral degree in astronomy, but her daughter reports that she regretted this concession the rest of her life. And scientists now agree that Cecilia's calculations were correct all along. She was the first to determine what “stars are made of, one of the most fundamental discoveries in the science of astronomy” (185).

A few years later, when a male scientist, Henry Norris Russell, published similar conclusions, he included an acknowledgement of Cecilia's earlier results in passing, but "he was somewhat less than willing to indicate to his readership that he had made a significant reversal...and he never admitted that he was one of the ones who convinced Cecilia to characterize her result as 'almost certainly unreal'" (204). Honestly, it's some pretty classic gaslighting.

And for far too many years, even though she was a popular teacher of graduate classes at Harvard, she was paid a paltry sum as a "technical assistant" because women were not allowed to hold the official titles of either Instructor or Professor (193). By the early 1940s, she had both written a second book and published "seventy-eight papers on stellar spectra, and another fifty-eight papers on stellar photometry"; nevertheless, for many years to come she would receive a "regrettable salary," and have to endure the insult of her name never being listed in the Harvard course catalogue. A male colleague at Yale described her as "the most brilliant and at the same time most discriminated-against [person] at Harvard College Observatory" (230).

In 1956, more than three decades after her arrival at Harvard, when her original supervisor retired, his replacement finally began to remedy her unjust treatment. He not only "raised and then doubled her salary," he also granted her the official title she had long been denied. The even deeper truth is that she should have been the one to get that supervisor job—and she almost definitely would have if she had been male—but what did happen remained momentous.

As reported in *The New York Times*: "Harvard University announced today the appointment of Dr. Cecilia Payne-Gaposchkin as Professor of Astronomy. She is the first woman to attain full professorship at Harvard through regular faculty promotions" (241). Within months she also became "the first woman at Harvard to chair a department." In her words, "I have reached a height that I should never, in my wildest dreams, have predicted fifty year ago" (242).

And although it would have been remarkable enough had her career peaked with her initial landmark discovery of what stars are made of, she went on to publish multiple books and more than 284 articles (250). And in 1976, three years before her death from lung cancer in 1979 at the age of seventy-nine, she became the first woman

to receive the lifetime achievement award from the American Astronomical Society, given to one person annually “on the basis of a lifetime of eminence in astronomical research.” Ironically, this award continues to be known as the “Henry Norris Russell Prize,” the namesake of its first recipient. Russell, you may recall, was the person responsible for gaslighting Cecilia and the truth of her discovery about stars, and for convincing her that what the data and her calculations showed was incorrect.

Nevertheless, she persisted, and her contributions are increasingly recognized today. I also mentioned that she is one of our Unitarian forebears. Cecilia and her husband were members of First Parish Lexington, a Unitarian congregation near Harvard. And she regularly volunteered as a Religious Education teacher for nine-to-twelve year olds:

Her daughter...tells a story about her mother donning heavy woolen slacks and walking more than three miles to teach [an R.E. class] one bitterly cold winter morning when the family car would not start. The story reveals a great deal about her character. In her autobiography she described her attitude in the face of slow promotions and low pay: “I simply went on plodding, rewarded by the beauty of the scenery, towards an unexpected goal” ([UU World](#)).

Along those lines, I will leave the final words to Dr. Cecilia Payne-Gaposchkin herself. She would offer the following advice to aspiring scientists:

Do not undertake a scientific career in quest of fame or money. There are easier and better ways to reach them. Undertake it only if nothing else will satisfy you; for nothing else is probably what you will receive. Your reward will be the widening of the horizon as you climb. And if you achieve that reward you will ask no other. (253)