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BOOKSHELF

'What Stars Are Made Of' Review: A Life in Eclipse

Cecilia Payne-Gaposchkin cracked the secret of the stars' composition but got scant credit for years.

Payne-Gaposchkin at the Harvard College Observatory, which she joined in 1923.

PHOTO: ALAMY STOCK PHOTO

By Marcia Bartusiak

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Edwin Hubble, architect of the modern universe, called her "the best man at Harvard," a decided compliment for a woman in the 1920s. Indeed, if Cecilia Payne-Gaposchkin had been born the opposite sex, she would surely have been offered a professorship shortly after completing her exceptional Ph.D. dissertation in astronomy. Instead, Harvard officials waited more than three decades before bestowing that honor.

But Payne-Gaposchkin belongs in the scientific pantheon. She was one of the first astronomers to apply the new laws of atomic physics to astronomical bodies and in 1925 uncovered the first hint that hydrogen is the most abundant element in the universe. This was an astounding discovery that echoes down the corridors of astronomy to this day. Here is the fuel for a star's persistent burning; here is the gaseous tracer that enables radio astronomers to probe a long-hidden universe; here is debris from the first few minutes of the universe's creation in a big bang.

WHAT STARS ARE MADE OF

By Donovan Moore
Harvard, 298 pages, $29.

That is why “What Stars Are Made Of” is a welcome addition to the astronomical literature. Other histories have included a chapter or two on Payne-Gaposchkin’s work; her daughter, Katherine Haramundanis, had her mother’s memoir published nearly 40 years ago. But Donovan Moore, a former newspaper reporter and television producer, has produced the first full-length biography, a beautifully written and well-researched study. Handling the science with a light but deft touch, Mr. Moore primarily focuses on this astronomer’s personal life, the office politics and the struggles one woman of science faced in the first half of the 20th century.

Born in 1900, the eldest of three siblings, Cecilia Helena Payne grew up in the Buckinghamshire village of Wendover and later London. Tall, broad-shouldered and often dowdily attired, she was teased for being the smartest student in the class, years ahead of her peers. Her school’s chemistry lab became her chapel, “where she would steal away, alone, to conduct her own worship service,” writes Mr. Moore. Though painfully shy, she was still immensely curious, stubborn and willful. Kicked out of one school, she found another that encouraged her scientific interests and helped her gain a scholarship to Cambridge University.

Cambridge, then the world’s mecca of science, had always been her goal, and the year she arrived on campus—1919—was crucial to her fate. Originally intending to major in botany, Payne chanced upon a ticket to hear British astronomer Arthur Eddington announce the results of his historic solar-eclipse expedition, which confirmed Einstein’s general theory of relativity. The event, she later recalled, was a “thunderclap” that encouraged her to switch majors to physics.

As she neared graduation, though, she knew that her only career choice in Great Britain would be school teaching. A sympathetic Cambridge astronomer suggested she go to the female-friendly Harvard College Observatory, where a bevy of women—called “computers”—were cataloging and analyzing astronomy’s greatest collection of photographic plates. Payne wrote a heartfelt letter to the observatory’s director, Harlow Shapley, and secured a fellowship. It didn’t hurt that one of her letters of recommendation stated that “she would not want to run away after a few years training to get married.”

In the fall of 1923, she arrived in Massachusetts with a plan: She would use Harvard’s hundreds of thousands of plates to verify a new equation, developed by Indian physicist Meghnad Saha, that related a star’s temperature and pressure to the wavelengths of light it radiates. More than that, she wanted to compute the relative abundances of various elements found in the atmosphere of stars.

It was grueling and tedious work, with her chain-smoking all the way. She pored over the photos for months, "collecting and classifying the celestial flora" and trying to interpret smeary spectral lines, while Shapley pressured her to produce results. Silicon was her savior; she was able to make out how this element ionized in four stages, allowing her to calculate the temperature of hotter stars. From there, she began to work on abundances, which led to an infamous snag.

Helium appeared to be a thousand times more plentiful in the stars than expected. Worse than that, hydrogen was a *million* times more abundant than predicted. "She was treading on treacherous ground," writes Mr. Moore. "The astronomy establishment at the time held a common strong opinion that the composition of all celestial bodies was similar. . . . that the sun and stars were composed of the same elements on earth, with the same relative abundance." On our world, free hydrogen and helium are very scarce.

Reviewing her manuscript, Princeton astronomer Henry Norris Russell, then the dean of American astronomy, said her conclusion was "impossible." To save her career, she backed down, editing her dissertation to say that her hydrogen and helium results were likely "spurious." Ironically, it was Russell, using another method, who finally convinced the astronomical community four years later that hydrogen was indeed the prime element in the cosmos (and long got the credit for it).

Even though Payne had written what has been described as "the most brilliant thesis ever written in astronomy," Shapley promoted Payne merely to technical assistant with little pay. And yet she was still required to teach like a professor. She acquiesced because she wanted to stay at Harvard, for it was there that this shy woman began to broaden her horizons both professionally and socially.

In 1933, during a trip to Europe, she met the Russian astronomer Sergei Gaposchkin, then stateless and living under the threat of Nazi persecution. Taking pity, she campaigned to get him a job at Harvard. Three months after his arrival, they married. And by 1940 they had three children, who were often found running through the observatory offices. Together the couple worked on variable stars, although there were no more great breakthroughs for her. Sergei, flamboyant and quirky, was far less accomplished, so, as Mr. Moore notes, "she was holding down two jobs—hers and his."

Her final triumph occurred in 1956, when she became the first woman to rise to a full professorship at Harvard. Payne-Gaposchkin recognized what it meant. Before her death in 1979, she made remarks that still resonate with women today: "I have reached a height that I should never, in my wildest dreams, have predicted 50 years ago. It has been a case of survival, not of the fittest, but of the most doggedly persistent."

—Ms. Bartusiak is the author, most recently, of "Dispatches from Planet 3: Thirty-Two (Brief) Tales on the Solar System, the Milky Way, and Beyond."