Welcome to the Infinite Women podcast, I'm your host Allison Tyra and today we're talking about the unseen contributions of women mathematicians.
Perhaps the best-known example is the so-called Hidden Figures, female NASA computers who helped send Americans into space but went mostly unrecognised until Margot Lee Shetterly's book Hidden Figures: The American Dream and the Untold Story of the Black Women Who Helped Win the Space Race was published in 2016. The bestselling book and its Oscar-nominated film adaptation helped bring to public attention the stories of women like mathematicians Katherine Johnson and Dorothy Vaughn and NASA's first female African-American engineer, Mary Jackson

But the women running calculations at NASA were far from the only overlooked female mathematicians working with scientists in the 1900s. Einstein alone had two - he declared of his first wife, Mileva Maric, "I need my wife. She solves for me all my mathematical problems". Helping him was one of her few options after she gave up a promising career before it really got started when he got her pregnant out of wedlock. That didn't stop him from divorcing her so he could marry his cousin, but he later met Emmy Noether, who took up the position of overlooked collaborator in the 1930s, after the Jewish Noether was forced to flee Nazi Germany. She laid the mathematical groundwork for Einstein's general theory of relativity and made major advances in algebra. In a letter to the New York Times published after her death in 1935, "Professor Einstein Writes in Appreciation of a Fellow-Mathematician", he wrote:

> In the judgment of the most competent living mathematicians, Fräulein Noether was the most significant creative mathematical genius thus far produced since the higher education of women began. In the realm of algebra, in which the most gifted mathematicians have been busy for centuries, she discovered methods which have proved of enormous importance in the development of the present-day younger generation of mathematicians.

Yet despite her brilliance, Noether herself wrote of Princeton University, where she collaborated with Einstein and others, that she was unwelcome at "the men's university, where nothing female is admitted." She also spent years working in academic positions without pay, even after earning her PhD.

Meanwhile, the women of Harvard Observatory and others like it helped map the skies, but were derided for working outside the home and crudely referred to as Pickering's Harem, after Observatory director Edward Pickering. He, meanwhile, explicitly said he hired women because he could pay them less - only 25 cents an hour - getting significantly more labour on a limited budget. When one of the computers, Henrietta Swan Leavitt discovered the period-luminosity relationship, meaning the brighter a star is, the more slowly it seems to pulses, her work enabled astronomers to calculate the distance of stars from Earth, getting a better sense of the scale of galaxies, causing a radical shift in how astronomers looked at the universe. Years after her death, her discovery made it possible for Edwin Hubble to establish his observations that the universe is continuously expanding, known as Hubble's law. He often said Leavitt should have won a Nobel Prize.
Her colleague Annie Jump Cannon devised the Harvard classification system, the first real attempt to organise and classify stars based on their temperatures and spectral types. It is still in use today. These are just two of the major contributions the women, and others like them in observatories around the world, made to astronomy, despite being underpaid, disrespected and overlooked.

In addition to the women called computers, women were the first to program the earliest machine computers. In the 1940s, Kathleen Antonelli, Betty Jean Jennings Bartik, Betty Holberton, Marlyn Meltzer, Frances Spence and Ruth Teitelbaum collaborated to program ENIAC, the world's first programmable, electronic, general-purpose digital computer. They had to learn to program without a programming language or tools, because they simply did not exist yet. But from the first demonstration on 15 February 1946 — which Betty and Betty Jean wrote the program for — they received no recognition. The programmers were not even invited to the gala dinner afterward for "government and scientific men," as reported by The New York Times. Herman Goldstine, who oversaw the project for the U.S. Army, claimed that he and his wife Adele — who was a

programmer and did write the original technical manual for the ENIAC — had programmed that first successful demonstration for the VIPs, which Betty Jean later declared a "boldface lie." Some historical images caption the women as models, rather than actual staff. When the Army used a War Department publicity photo for a recruitment ad, they cropped out the three women in the photo, and the department's press releases credited a vague "group of experts" for the work, naming only Goldstine and ENIAC designers John Mauchly and J. Presper Eckert. This fundamentally ignored that the machine Mauchly and Eckert designed would never have functioned without the work of the programmers.

In the 1980s, Harvard University student Kathy Kleiman came across a photo of the women with ENIAC while researching her thesis, on early programmers and software developers. When she enquired about the images, she was told the women were models, hired to make the image more appealing. Fortunately, Kleiman kept digging, discovered the women's story and launched the ENIAC Programmers Project to get them the recognition they should have received decades earlier.

Join us next time on the Infinite Women podcast, and remember - well-behaved women rarely make history.