

Hi everyone, welcome to Infinite Women. I'm your host, Allison Tyra, and today we're talking about a few of the many women who should have won Nobel Prizes in the sciences.

Microbiologist Esther Lederberg was a pioneer of bacterial genetics, but she experienced a common issue for women in the sciences - she worked with her husband, so everyone gave credit for her work to him. Including, in 1958, the Nobel committee, which awarded the prize for physiology or medicine to Joshua Lederberg and two other men they worked with. The only mention of Esther on the Nobel website to this day is at the bottom of Joshua's Nobel bio - "While at Yale, Lederberg married Esther M. Zimmer in 1946. They have no children. Mrs. Lederberg had obtained her M.A. at Stanford with Professor G.W. Beadle during 1944-1946, and her Ph.D. degree at the University of Wisconsin in 1950. She is working full time as research associate." So they acknowledge she has a PhD but can't even give her the respect of calling her Doctor.

Lederberg's accomplishments included discovering the Lambda bacterial virus and the bacterial fertility factor and creating a replica plating process that enabled biologists to reproduce bacterial colonies en masse. This enabled the Lederbergs to more effectively study mutations. Discovering the Lambda bacteriophage also led to her work in specialised transduction, where foreign DNA is introduced into a cell by a virus. Although Lederberg laid the groundwork for much of 20th century microbiology, she was never offered a tenured position at a university. Even modern textbooks often ignore her work and attribute her accomplishments to her husband.

In fact, he likely held her back - she was a grad student when she discovered the F factor and Lambda, and Joshua, as her thesis advisor, stopped her from continuing her work on those discoveries. While we can't say for sure exactly to what degree he reinforced or contradicted the perception of her as only his wife and assistant, when he wrote an autobiographical account of their discovery of genetic recombination in bacteria, he did not acknowledge her work. She also had to fight to stay employed at Stanford after divorcing him in 1968 - he was head of the genetics department.

Physicist Chien-Shiung Wu had many nicknames, including "First Lady of Physics", "Queen of Nuclear Research" and the "Chinese Madame Curie". Unlike Curie, however, Wu never won a Nobel - but her male colleagues did, thanks to her work. In the 1950s, Wu set out to test a theory of Tsung-Dao Lee and Chen-Ning Yang, whether spinning, decaying particles have a preferred direction that they spin in. Wu experimented using Cobalt-60 in the presence of a strong magnetic field - the electrons produced by the radioactive decay of the cobalt showed a preferred direction. In science-y terms, she proved parity is not conserved. So even though the Nobel committee won't give out awards for untested theories, they ignored the fact that Wu proved Lee and Yang's theory and only recognised the men.

Wu also worked on the Manhattan Project, where she helped develop the process for separating uranium into uranium-235 and uranium-238 isotopes through gaseous diffusion and later researched molecular changes in hemoglobin associated with sickle-cell anemia. Of the Wu experiment, she later declared, "These were moments of exhilaration and ecstasy! A glimpse of this wonder can be the reward of a lifetime." Though a Nobel also makes a nice reward.

Nettie Stevens discovered XY chromosomes at the exact same time as E.B. Wilson in 1905. The two scientists were working independently, but each was aware of the other's work. However, when they published their respective results, Wilson was widely acclaimed as the sole discoverer. In retrospect, Stevens' work appears to be higher quality. For example, Wilson claimed environmental factors affected sex, whereas Stevens believed it was only genetic. She was right. In fact, Wilson didn't even bother studying eggs, examining only sperm because he claimed that eggs were too fatty for his staining procedure. After reading the papers describing Stevens' discoveries, Wilson reissued his original paper and in a footnote acknowledged Stevens for the finding of sex chromosomes. She also determined that Clarence Erwin McClung's theory that the X chromosome determines sex was wrong, as sex is determined by the presence or absence of the small (Y) chromosome. Despite this, she was often excluded from speaking at meetings of experts where her own

findings were being discussed. After her death, her own Ph.D. advisor belittled and misrepresented her contributions and even implicitly tried to take credit for her work by excluding her name while bragging about his own lab's work in the field. Although she died only nine years after completing her PhD, Stevens published approximately 40 papers in her short career.

These are just a few of the many women who should have won Nobel prizes in the sciences, so this is part of a series on the topic - check out other episodes for more. **Join us next time on the Infinite Women podcast and remember, well-behaved women rarely make history.**