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Dos Equis: Since ancient times, it had been believed that the sex of an infant was determined by how much heat a man's sperm had during insemination. Aristotle claimed that the male principle determined sex in the fetus and if the male principle was "insufficient" during reproduction, the fetus would develop as a female.

More than two thousand years of scientific speculation and experiments on how an animal, plant, or human becomes male or female followed. No one had discovered the chromosomal basis of sex determination as to why a female, why a male, or why certain diseases strike either males or females but not both. Then in 1905, a woman told the world why, actually, she told the world X and Y.

Geneticist Nettie M. Stevens, Ph.D. presented her chromosomal research on sex determination in a scientific paper titled, "Studies in Spermatogenesis with Especial Reference to the 'Accessory Chromosome'." It was a Carnegie Institute Report.

The report documented her findings which established that the sex of basically all many-celled biological organisms is determined at the moment of fertilization by the combination of two kinds of microscopic entities, the large X and the smaller Y chromosomes, and that these two chromosomes, responsible for determining the sex of individuals, depended specifically on the presence or absence of the smaller Y chromosome.

Her findings ended a long-standing scientific debate as to whether sex was determined by heredity or other factors. It influenced the entire field of genetics and opened doors for research in science and medicine that continues to this day. It was one of the major 20th century scientific breakthroughs.

Nettie Marie Stevens was born July 7, 1861 in Cavendish, Vermont to a middle-class family that had lived in New England for five generations. She grew up in Westford, Vermont during the post Civil War years when few opportunities other than teaching, nursing, and secretarial work were available and acceptable for women who wanted a profession rather than a man. Nettie wanted to be a scientist and wanted an education.

But even higher education for women was limited, frowned upon, and women were discouraged often criticized. It could be daunting for women to choose to attend the colleges and universities that accepted women rather than to choose marriage. But Stevens' father, a carpenter and handyman, did well enough and could afford to send his children to school at the Westford Academy that accepted men and women.

Nettie was a brilliant student with a penchant for science and mathematics and consistently scored the highest in her classes. She graduated from Westford at age 19 and hungered to further her education. But with middle-class economics challenging higher education expenses, Nettie became a teacher that she could work to earn and save to attend college.

After three terms she had saved enough to attend the Westfield Normal School, a teachers college now Westfield State University, in Massachusetts. Stevens completed the four-year course in two years, graduating at the top of her class. Her pattern of working, saving, and returning to school was to repeat itself. The next time she taught for ten years to earn enough to further her education.

Then, in 1896 at age 35 she traveled west across an early American frontier to

California to attend Stanford University. At Stanford she earned her BA in 1899 and her MA in biology in 1900 while she worked at the Hopkins Seaside Laboratory. Her thesis involved precise microscopic careful detailing of new species of marine life that became a factor in her success with later investigations of chromosomal behavior.

Stevens continued to work her way through college to once again return to graduate school, this time back east at Bryn Mawr College for Women in Philadelphia, the first college to offer Ph.D.s to women. There she earned her doctorate in 1903. She was made a research fellow funded by the Carnegie Institute and she was awarded a fellowship to study abroad.

She traveled to Europe to study in Theodor Boveri's lab at the Zoological Institute at Würzburg, Germany where Boveri was working on the problem of the role of chromosomes in heredity. Likely her interest in the subject developed during this fellowship.

Afterwards, Stevens began to look for a research position and was given an assistantship by the Carnegie Institute, thanks to “glowing” recommendations from Bryn Mawr biology professor Thomas Hunt Morgan, biology department chair Edmund Wilson, and M. Carey Thomas, president of Bryn Mawr. Wilson, a close friend of Boveri, went on to join the zoology department at Columbia University and invited his good friend Morgan to join the Columbia staff as professor of experimental zoology.

Stevens, now age 39, finally was able to begin working as a research scientist through the Carnegie fellowship, and the next eleven years would be the most productive of her life. But the fellowship meant she still had to teach. She wanted a pure research position and wrote to director Charles Davenport to see if it was possible for her to work at his Station for Experimental Biology at Cold Spring Harbor Laboratory. A research professorship was created for her at Bryn Mawr to work with Davenport.

Her discovery paper, when published in 1905, was not without controversy. The chromosomal theory of inheritance was not accepted by many scientists. It was staunchly believed that gender was determined by the mother and/or environmental factors. Most scientists working on sex determination did not embrace Stevens' research immediately, a common practice in early genetic discoveries, especially discoveries by women.

Wilson made a very similar discovery around the same time and submitted his paper ten days prior to Stevens. Despite having read her manuscript, Wilson’s paper hypothesized that in certain cases females have one more chromosome than males and dismissed Stevens’ data that females have two large sex chromosomes, a major fact not noticed by Wilson who only performed tests on the testis.

Wilson eventually reissued his original paper and credited Stevens for this finding. He combined his idea of idiochromosomes with her theory of heterosomes in his future work. Simultaneous discovery is common in science and for Wilson to decidedly cite a competitor, especially a woman, is formidable since her findings were generally considered to have made a larger theoretical leap and were ultimately proven correct.

Morgan also published a paper arguing that specific hereditary traits could not be carried on a single chromosome. Morgan later changed his mind and surmised that chromosomes are responsible for identifiable hereditary traits. Most biology textbooks credit Morgan for mapping the first gene locations onto chromosomes of fruit flies that had become Morgan’s lifetime work. But what often is not credited in textbooks is that it was Stevens who introduced fruit fly chromosomal studies to Morgan in his lab in the

first place. Notwithstanding, his work is considered to have formed the modern day understanding of heredity.

Although Stevens, Morgan and Wilson researched in proximity, in actuality, most of Steven's work was carried out in isolation from the men, also common practice for women in scientific research. Stevens' position in the field of genetics has largely been overlooked. Credit for the discovery of X and Y chromosomes and their role in determining gender generally is given to Wilson and to Morgan who together shared the 1933 Nobel Prize in Physiology for the discovery.

Stevens who published thirty-eight papers in eleven years, was awarded the Ellen Richards Research Prize (given to promote scientific research by women). She continued to do research and teach at Bryn Mawr and Cold Spring Harbor Laboratories for the rest of her life but was unable to occupy the professorship created for her as her life ended much too soon after a brilliant career which started much too late.

The life of Dr. Nettie M. Stevens was taken by breast cancer at age 51 on May 4, 1912. Still, in one decade, this scientist possessing two Xs of her own, contributed more to genetics than scientists possessing one Y of their own and much longer careers. Notably, she left to posterity to research and determine how her discovery of the large X and the smaller Y chromosomes that defined sex determination relegated her to be another noble but not Nobel scientific woman. Y? Dos Equis?

Sources: http://www.geneticstv.org/scientists/stevens.htm, http://en.wikipedia.org/wiki/Nettie_Stevens, http://www.underthemicroscope.com/blog/geneticist-profile-nettie-stevens-puts-the-x-and-y-in-sex-chromosomes, http://www.nature.com/scitable/topicpage/nettie-stevens-a-discoverer-of-sex-chromosomes-6580266

NOTE: Read CountHerhistory-October 2004, Noble But Not Nobel Scientific Women.