Walter Stanborough Sutton (1877-1916) [1]

By: Mishra, Abhinav Keywords: Chromosomla Theory of Inheritance [2] grasshopper [3] Eleanor Carothers [4]

Walter Stanborough Sutton studied grasshoppers and connected the phenomena of meiosis [5], segregation, and independent assortment with the chromosomal theory of inheritance in the early twentieth century in the US. Sutton researched chromosomes, then called inheritance mechanisms. He confirmed a theory of Wilhelm Roux [6], who studied embryos in Breslau, Germany, in the late 1880s, who had argued that chromosomes and heredity were linked. Theodor Boveri [7], working in Munich, Germany, independently reached similar conclusions about heredity as Sutton. Later scientists named the theory The Sutton-Boveri Theory, or The chromosomal theory of inheritance.

Sutton, the fifth of seven brothers, was born in Utica, New York, on 5 April 1877 to Agnes Black and William Bell Sutton, who soon moved their family to Kansas. Sutton grew up on a farm, where he repaired farm equipment and attended schools in Russell County, Kansas. In 1896, he entered the engineering school at the University of Kansas [8] in Lawrence, Kansas. While Sutton's brother was sick in 1897 of typhoid fever, Sutton took care of him and his other infected family members. His family and friends convinced him to change his educational direction to medicine, because he was, according to his family, so adept at caring for them.

In the fall of 1897, Sutton started his pre-medical studies. Sutton completed his undergraduate degree in 1900. A year later he received a master's degree, also at the University of Kansas [8] with the mentoring of Clarence McClung. For his master's thesis in 1901, Sutton published the first of his works, "The Spermatogonial Division of *Brachystola magna* [9]" about chromosomes in *B. magna*, a type of grasshopper. The testes [10] of these grasshoppers were large enough for Sutton to observe meiotic divisions of the chromosomes, which allowed Sutton to describe what was occurring in the cells.

Instead of applying to medical school, McClung convinced Sutton to do doctoral work at Columbia University [11] in New York, New York. Sutton traveled to Colombia to work with cell biologist Edmund Beecher Wilson in the fall of 1901. Wilson had previously observed X-linked inheritance, or traits that offspring seemingly inherited from their parents' X-chromosomes. Sutton continued to research *B. magna*, eventually encapsulating his chromosome theory in two papers he published titled "Morphology of the Chromosome Group in *Brachystola magna*" in 1902 and "The Chromosomes in Heredity [12]" in 1903.

Sutton's 1902 paper examined sperm [13] production, cell division, and synapsis in *B. magna*. In this paper, he described a cellular basis for genetics. First, somatic cells contain one of each of the parents' chromosomes. The offspring receive one chromosome from each of the parents to make a set of chromosomes. Sutton's theory differed from other contemporary theories in that Sutton argued that the offspring received a random group of traits after the parents' traits mixed together in the paired chromosomes of the offspring. For Sutton, the individual chromosomes retained their integrity when passed from the parents to the offspring, that is each chromosome remains together as a whole.

Sutton's second point in the paper argued that somatic cells have pairs of chromosomes. Sutton's third point was that each chromosome codes for a specific set of traits. Further, a fourth point was that chromosomes are predetermined in what traits they code for. Fifth, chromosomes separate independently of each other, which means that each part of the chromosome will remain separate from a different set of genes [14] on a different chromosome. The chromosomes migrate to different poles of cells when they pull apart from each other, which enables many different combinations of the genes [14] that can occur in offspring. Finally, chromosomes can code for different forms of a trait, but only one will be expressed as a physical characteristic. The different forms of a trait will either be dominant or recessive. The sixth point supports Mendel's theory that one parent's trait will be expressed in an offspring while the other's will be hidden.

Sutton makes four points in the 1903 paper. The first is that each chromosome in a cell is different from the others in composition. Second, chromosomes come in pairs. Both halves of a chromosomes pair are the same size, and each half is derived from one of the organism's parents. Third, the chromosomes, which are located in the nucleus [15], pair up before meiotic divisions. Finally, the paired chromosomes separate in meiosis [5]. While not widely read at the time, later scientists cited the paper as central in chromosomal research.

Sutton argued that chromosomes are the mechanism of how traits are passed on from parents to offspring. Furthermore, he supported Gregor Mendel's 1865 theory of independent assortment and segregation of hereditary factors. Sutton argued that each parent passes on a half set of chromosomes to their offspring. Sutton's theories explained the variance in and the

combinations of traits in Mendel's works.

Another scientist, Theodor Boveri [7], independently from Sutton developed similar theories about the role of chromosomes in heredity while working with sea urchins in Germany in 1900. Scientists credit both Sutton and Boveri with the theory of inheritance, also called the Sutton-Boveri Theory. Though many contemporaries did not agree with Sutton and Boveri, later work by Eleanor Carothers at Pennsylvania State University in University Park, Pennsylvania, helped support the law of independent assortment of chromosomes from parents to offspring and in crossing over in homologous chromosomes in the parents.

In the summer of 1903, Sutton stopped studying developmental biology to work in the Kansas oil fields to earn money for medical school. In 1905, he returned to Columbia to attend medical school. Sutton received his MD degree in 1907 and began an internship at Roosevelt Hospital in New York, New York. After two years, he began practicing medicine in Kansas City. From 1907 to 1915, Sutton became associate professor of Surgery at University of Kansas [8] with an affiliation at Bell Memorial Hospital. While at Bell Memorial Hosptial, Sutton developed the technique of using ether as anesthesia during surgery.

In 1915, the military hired Sutton as part of the surgical staff for the Mrs. Harry Paine Whitney Unit during World War I [16]. He became to the chief of the surgical staff by the end of his tour. On 6 November 1916, his appendix ruptured while he was in the US, and four days later he died at the age of thirty nine. In 1917, Sutton's family released a biography that many of his colleagues, friends, and family put together, called *Walter Stanborough Sutton*, which included several essays about Sutton's life and work.

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Subject

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Topic

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