Alfred Henry Sturtevant (1891?1970) [1]

By: Gleason, Kevin Keywords: Thomas Hunt Morgan [2] Drosophila [3]

Alfred Henry Sturtevant studied heredity in fruit flies in the US throughout the twentieth century. From 1910 to 1928, Sturtevant worked in Thomas Hunt Morgan?s research lab in New York City, New York. Sturtevant, Morgan, and other researchers established that chromosomes play a role in the inheritance of traits. In 1913, as an undergraduate, Sturtevant created one of the earliest genetic maps of a fruit fly chromosome, which showed the relative positions of genes [4] along the chromosome. At the California Institute of Technology [5] in Pasadena, California, he later created one of the first fate maps [6], which tracks embryonic cells throughout their development into an adult organism. Sturtevant?s contributions helped scientists explain genetic and cellular processes that affect early organismal development.

Sturtevant was born 21 November 1891 in Jacksonville, Illinois, to Harriet Evelyn Morse and Alfred Henry Sturtevant. Sturtevant was the youngest of six children. During Sturtevant?s early childhood, his father taught mathematics at Illinois College in Jacksonville. However, his father left that job to pursue farming, eventually relocating seven-year-old Sturtevant and his family to Mobile, Alabama. In Mobile, Sturtevant attended a single room schoolhouse until he entered a public high school.

In 1908, Sturtevant entered Columbia University [7] in New York City, New York. As a sophomore, Sturtevant took an introductory biology course taught by Morgan, who was researching how organisms transfer observable characteristics, such as eye color, to their offspring. After taking the course, Sturtevant wrote a paper about how horses inherit their coat colors and submitted it to Morgan. The paper was informed by observations Sturtevant had made as a child on his father?s farm. According to Edward Butts Lewis, a scientist who later worked with Sturtevant, Morgan was impressed with Sturtevant?s article and recommended that Sturtevant submit the article for publication. In 1910, Sturtevant?s article was published and Morgan offered Sturtevant a position in his research lab at Columbia University [7].

Sturtevant accepted the position and began his research in the fall of 1910. Sturtevant, Morgan, and other researchers of the lab studied *Drosophila* [8], or the common fruit fly. Prior to Sturtevant joining the group, Morgan had asked how it was possible for two flies to mate and produce offspring that had a combination of characteristics different than that of either parent. Morgan observed that certain combinations of characteristics were not passed onto offspring as frequently as other combinations. He proposed that a process called recombination caused that observation. Recombination occurs when maternal and paternal chromosomes, the thread-like structures that contain portions of a cell?s genes [4], cross over and exchange genetic information between each other. That results in a new chromosome, called a recombinant chromosome, that is different than both the maternal and paternal chromosome.

Using information about recombination established in the Morgan lab, in 1913 Sturtevant published research results that indicated that genes [4] are arranged in a linear fashion along

the chromosome. Previously, researchers had yet to describe how genes [4] were arranged. He hypothesized that if genes [4] on a chromosome were farther apart from one another, then they would be more likely to be separated during recombination, meaning the genes [4] would be less likely to be inherited together. He measured the frequency of recombination and used that information to determine the distance between genes [4] on a chromosome. Higher recombination frequencies meant that the genes [4] were farther apart on the chromosome. Conversely, the lower the frequency, the closer together on the chromosomes the genes [4] likely were. By analyzing the recombination frequency data, Sturtevant found the distances between each gene. With that data, Sturtevant concluded that genes [4] were arranged in a linear fashion. He also created a map of the chromosome that showed the spatial arrangement of the genes [4] on the chromosome and the relative distances between genes [4]. Sturtevant?s work provided researchers with a method of determining the location of genes [4] on a chromosome, and later researchers use it to identify genes [4] that are involved in diseases.

Sturtevant continued researching recombination and the chromosome?s involvement in heredity at Columbia University [7]. He received his PhD in 1914 with Morgan as his supervisor. The following year, Sturtevant, Morgan, Calvin Bridges, and Hermann Muller, two other researchers in Morgan?s lab, published The Mechanism of Mendelian Heredity [9], a book that described the findings of their research. The book was important to the field of genetics because it claimed that there was a physical basis for heredity. Previously, the theory that chromosomes play a role in heredity was theoretical. In The Mechanism of Mendelian Heredity [9], Sturtevant and the others provided experimental evidence that chromosomes carry heredity factors, factors later called genes [4].

In 1915, Sturtevant began receiving funding from the Carnegie Institution of Washington [10], an institution headquartered in Washington, D.C. that funded scientific research. In 1919, the Carnegie Institution employed Sturtevant as an associate. That funding enabled Sturtevant to continue his research on *Drosophila* [11] in Morgan?s laboratory at Columbia University [7]. In 1922, Sturtevant married Phoebe Curtis Reed, who also worked in the fly lab. They later had three children together. Sturtevant remained at Columbia until 1928.

In 1928, Sturtevant moved to California Institute of Technology [5] to become a professor of genetics. Earlier that year, Morgan had moved there and established a biology division. Upon moving to Pasadena, Sturtevant also became the director of the department?s division of genetics. At California Institute of Technology [5], Sturtevant continued studying *Drosophila* [11] and developed one of the earliest fate maps [6], which tracks embryonic cells throughout development to determine what they become in the adult organism. He did so by observing *Drosophila* [11] gynandromorphs, which are flies that contain both male and female characteristics due to an unequal splitting of the sex chromosomes during early development. He found that when adult tissues of the same sex shared characteristics, they were more likely to be closer in distance in the developing embryo. That result enabled researchers to determine the embryonic lineage of adult cells.

Sturtevant remained at California Institute of Technology [5] for the rest of his career, excluding a year he spent as a visiting professor in Europe. From 1932 to 1933, Sturtevant traveled throughout England and Germany as a visiting professor of the Carnegie Endowment for International Peace. After returning to Caltech, he continued studying the chromosomes of *Drosophila* [11]. In 1934, he began collaborating with George Beadle, a geneticist who later received a Nobel Prize in Physiology or Medicine [12]. Together they studied recombination

and also wrote the textbook An Introduction to Modern Genetics, which was published in 1939. In 1941, Strurtevant and US geneticist Edward Novitski showed that major sections of the *Drosophila* [11] chromosome have remained intact across different *Drosophila* [11] species.

In 1956, Sturtevant published an article in which he discussed a combination of two genetic mutations in *Drosophila* [11] that resulted in death. He found that when either one of the two mutations were present in *Drosophila* [11], they were harmless. However, when both of the mutations were present, he found that the *Drosophila* [11] died during an early stage of development. Sturtevant?s observation provided researchers with a method to determine how two different genes [4] may interact. In 1965, Sturtevant published a book about the history of genetics.

Much of Sturtevant?s research was expanded on throughout the twentieth century. In 1969, scientists working in Spain and the US, Antonio Garcia-Bellido and John Merriam, used Sturtevant?s data from his fate map study to create a more complete fate map of *Drosophila* [11] gynandromorphs. After Sturtevant had created a genetic map of the *Drosophila* [11] genome [13], researchers began to apply the same principles to map the human genome [13]. In 1984, the Human Genome Project, an international research collaboration, started a project to map the entire human genome [13]. On 15 February 2001, the first draft of the human genome [13] was published in Nature. In a National Institute of Health publication, Sturtevant and the Human Genome Project?s contributions were compared to the Wright brothers? first flight and the Apollo moon landing, respectively.

Sturtevant was recognized throughout his career for his scientific contributions. In 1933, after Morgan won a Nobel Prize in Physiology or Medicine [12] for his research group?s work explaining the role that chromosomes play in heredity, he gave some of the prize money to Sturtevant and Bridges. Sturtevant also received the 1965 John J. Carty Award for the Advancement of Science and the 1967 National Medal of Science.

Sturtevant remained at the California Institute of Technology [5] until his death. He died 5 April 1970.

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