Barbara McClintock (1902-1992)

Barbara McClintock worked on genetics in corn (maize) plants and spent most of her life conducting research at the Cold Spring Harbor Laboratory in Laurel Hollow, New York. McClintock's research focused on reproduction and mutations in maize, and described the phenomenon of genetic crossover in chromosomes. Through her maize mutation experiments, McClintock observed transposons, or mobile elements of genes within the chromosome, which jump around the genome. McClintock received the Nobel Prize for Physiology or Medicine in 1983 for her research on chromosome transposition. McClintock's work helped explain the behavior of chromosomes in organismal development and identified transposition as a cause of genetic variation.

Barbara McClintock (born Eleanor McClintock) was the third of four children of Sara Handy McClintock and physician Thomas Henry McClintock in Hartford, Connecticut, born on 16 June 1902. McClintock's parents soon changed her birth name, Eleanor, to what they thought to be a less feminine name, Barbara, which in their opinion better suited her character. Biographers described McClintock as being strong and independent since childhood, and she lived for a period with her uncle and aunt due to a difficult relationship with her mother. Her family moved to Brooklyn, New York, in 1908. McClintock attended school there and graduated from Erasmus Hall High School in Brooklyn, New York, in 1919. McClintock then attended Cornell University's College of Agriculture in Ithaca, New York, where she obtained her BS degree in 1923, her MS degree in 1925, and her PhD degree 1927, majoring in botany throughout the course of her education. As a woman, McClintock was not allowed to obtain a degree in genetics, although she studied genetics in her botanical studies. At Cornell University, Rollins Adam Emerson led a group of graduate students who studied maize genetics, including George Beadle, the botanists Marcus Rhoades and Harriett Creighton, and McClintock. In her graduate studies McClintock worked as a research assistant for Lowell Fitz Randolph and later, for Lester W. Sharp.

After completing her degrees, McClintock became both an instructor and a researcher at Cornell University. McClintock studied the location of genes in the maize chromosome using techniques that she had developed. In her research, she described the crossing over interaction between homologous chromosomes, which happens when chromosomes in a cell exchange genetic material during the cell division stage of meiosis. In 1931, McClintock and Creighton published ”A correlation of cytological and genetical crossing-over in zea mays,” which showed that chromosomes physically exchange parts of the chromosome when they exchange genes during crossover. After receiving a fellowship from the US National Research Council in 1931 to further her research, McClintock worked in different institutions such as the University of Missouri at Columbia, Missouri, and the California Institute of Technology in Pasadena, California.

In 1933 McClintock received a fellowship from the Guggenheim Foundation that enabled her to conduct research at the Kaiser Wilhelm Institute in Berlin, Germany, and at the Botanical Institute in Freiburg, Germany. Due to the political tensions in Europe prior to World War II, McClintock returned to the US in 1934 and worked as a researcher at Cornell University until 1936. Then she returned again to the University of Missouri where she worked as an assistant professor until 1941. During her time at the University of Missouri, McClintock studied the effects on maize of radiation, which could cause the chromosomes to break apart during cell division. When the chromosomes reattached after breaking, they often had mutations. McClintock then used these mutated strains of maize in her experiments to study the effects of genetic variation.

In 1941 McClintock moved to the Carnegie Institution of Washington Cold Spring Harbor to work as a researcher in genetics, and she remained affiliated with the institution for the rest of her life.

At the Cold Spring Harbor Laboratory, McClintock conducted experiments on maize kernels, the plant's embryos. In an experiment that she started in 1944, McClintock discovered that certain genes physically moved on the chromosome, a process called transposition. McClintock discovered chromosome transposition after a series of breeding experiments in which she observed unusual physical appearances (phenotypes) plants that developed from mutated maize kernels. The maize offspring did not follow normal genetic inheritance patterns, and McClintock experimentally determined that breakage and transposition were happening in the chromosomes. This breakage and transposition caused novel genetic combinations and thus unusual phenotypes in the offspring.

McClintock first published her results on transposition in 1950 in an article titled, ”The origin and behavior of mutable loci in maize,” which she presented to the scientific community in 1951 at the annual symposium at Cold Spring Harbor. Her discovery of transposable elements proposed that genes are not stationary entities, but can move on the chromosomes. McClintock's work complemented previous research that Emerson had conducted on genetic instability. Her results suggested that the transposition of genetic material occurs during development and is responsible for phenotypic variation.

Between 1957 and 1966, McClintock received funding from the US National Science Foundation and the Rockefeller Foundation and embarked on a series of research trips to Mexico and South America to study different varieties of maize. She published the results of that research in 1981 in a book titled, The Chromosomal Constitution of Races of Maize, which McClintock co-authored with her colleagues, Almeiro Blumenschein and Angel Kato.

McClintock's scientific profile caused some controversy among historians of science. Two books have examined the debate around why she received a Nobel Prize nearly forty years after conducting the original research on chromosome transposition. Evelyn Fox Keller, author of the biography, A Feeling for the Organism: The Life and Work of Barbara McClintock, argues that the scientific community ignored McClintock when she first presented her results at the Cold Spring Harbor Symposia due to McClintock's gender and the marginal position of women in science at that time. Contrary to Fox Keller's interpretation, Nathaniel Comfort, in The Tangled Field: Barbara McClintock's Search for the Patterns of Genetic Control, argues that McClintock's difficult writing style and insufficient data in her publications prevented other researchers from immediately accepting her research. According to Comfort, the scientific community appreciated McClintock's research on transposable elements only after François Jacob and Jacques Monod's studied genetic regulation in France in the 1960s, and after James Shapiro described the phenomenon of transposition in bacteria in the 1970s. Further, in the early 1980s Nina Fedoroff provided more substantial support for the existence of transposable elements by isolating and cloning them. Fedoroff published her research in 1983, the same year McClintock received the Nobel Prize.

Throughout her career, McClintock received honors, such as the Distinguished Service Award from the Carnegie Institution of Washington in 1967, the National Medal of Science in 1971, the Rosenstiel Award for Basic Medical Research from Brandeis University in Waltham, Massachusetts, in 1977, the MacArthur Fellowship in 1981, and the Albert and Mary Lasker Award in 1981. McClintock received the Nobel Prize for Physiology or Medicine in 1983 for her discovery of chromosome transposition and spent the last part of her life giving informal presentations on mobile genetic elements and on the history of genetics for junior scientists. She never married or had children. McClintock died in Huntington, New York, on 2 September 1992.

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