George Wells Beadle (1903-1989) [1]

By: Chhetri, Divyash Keywords: one gene-one enzyme [2]

George Wells Beadle [3] studied corn, fruit flies, and funguses in the US during the twentieth century. These studies helped Beadle earn the 1958 Nobel Prize in Physiology or Medicine [4]. Beadle shared the prize with Edward Tatum for their discovery that genes [5] help regulate chemical processes in and between cells. This finding, initially termed the one gene-one enzyme hypothesis, helped scientists develop new techniques to study genes [5] and DNA as molecules, not just as units of heredity between generations of organisms. By inducing mutations in organisms while they were in different embryonic stages, Beadle's work on *Drosophila* [6] and *Neurospora* [7] led to the analysis of the cell cycle and embryonic development processes.

Beadle was born on 22 October 1903 in Wahoo, Nebraska, to Hattie Hendee Albro Beadle and Chauncey Elmer Beadle. At the age of four, Beadle's mother died. He, his brother, and sister were separated and raised by different housekeepers. Growing up on his father's forty-acre farm, Beadle often worked as a gardener and beekeeper. He attended Wahoo High School, and his father expected him to take over the farm once he finished school. However, upon encouragement from his science teacher Bess MacDonald, Beadle attended the University of Nebraska College of Agriculture in Lincoln, Nebraska, in 1922. He received his BS degree in Biology in 1926 and obtained his Master's degree in 1927.

Influenced by Franklin D. Keim, whom Beadle worked with for his master's degree, Beadle studied genetics and entered graduate school at Cornell University [8] in Ithaca, New York, in 1927. There as a PhD student, Beadle studied the ecology and genetics of maize. He married Marion Hill, a botany graduate student at Cornell, in 1928. Their son David was born in 1931, the same year Beadle graduated from Cornell with a PhD for his work on traits in *Zea mays* [9] that didn't follow the laws of inheritance proposed by Gregor Mendel in Austria in 1865. Beadle worked with the guidance of professors Rollins A. Emerson and L.W. Sharp. Also in 1931, Beadle received a US National Research Council [10] Fellowship to do postdoctoral work at the California Institute of Technology [11] (Caltech) in Pasadena, California.

At Caltech, Beadle focused on the implications of crossing over, or the exchange of genetic material between paired chromosomes within a cell such that the resulting chromosomes have genetic material from each of the original paired chromosomes. Through the examination of X chromosomes in the fruit fly *Drosophila melanogaster* [12], Beadle demonstrated how the paired chromosomes cross over while also showing the absence of chromatid interference, or when any two nonsister chromatids cross over and affect the chance of those chromatids being involved in other crossovers during the same meiosis [13]. Beadle used triploids, or organisms with three homologous sets of chromosomes, to introduce markers into crossed over sex chromosomes.

In 1934, Boris Ephrussi at the University of Paris [14] in Paris, France, traveled to Caltech to study *Drosophila* [15] genetics. Ephrussi and Beadle collaborated to study how genes [5] caused the traits and phenotypes of organisms to develop. By utilizing Beadle's expertise in genetics and Ephrussi's ability in the techniques of transplanting tissues, the two explored the influences of the cells that surrounded embryos as the embryos developed.

In 1935, Beadle and Ephrussi went to Paris to work in Ephrussi's laboratory at the Institut de Biologie Physico-chimique (The Institute of Physico-Chemical Biology) in Paris, France. The pair developed a technique to transplant discs from one *Drosophila* [15] larva to another, which they reported in "A Technique of Transplantation for *Drosophila* [15]," published in 1936. At the end of the paper, they developed a hypothesis to account for the differences in eye colors that they observed among their fruit flies. Beadle and Ephrussi suggested that development of traits and phenotypes in organisms could be attributed to an independent series of gene-controlled chemical reactions.

When he returned from Paris in 1936, Beadle worked as an assistant professor at Harvard University [16] in Cambridge, Massachusetts. He left Harvard the following year and became professor of biology at Stanford University [17] in Palo Alto, California. From 1937 to 1939, Beadle worked with Alfred Henry Sturtevant on the textbook *An Introduction to Genetics*.

After he abandoned *Drosophila* [15] as an organism in which to study how genes [5] controlled metabolic reactions, due to the complexity of *Drosophila* [15] traits, which were difficult to analyze biochemically, in 1940 Beadle turned to the *Neurospora crassa* [18], a type of fungus called red bread mold. In collaboration with biochemist Edward Tatum, who was a professor of biochemistry at Stanford University [17], Beadle devised a method to induce mutations through x-ray [19] treatment in *Neurospora crassa* spores to see if the cells could then grow in a minimal culture medium [20] that contained limited nutrients. Beadle and Tatum's

experimental results, published in 1941, showed that mutations to single genes [5] affected specific chemical reactions, and that mutant strains differed from normal strains of *Neurospora crassa* only in the ability to produce a specific metabolite. From those results Beadle and Tatum argued that each mutation of a gene affected the ability of a specific enzyme, which are produced in cells from genes [5], to function as a catalyst for a chemical reaction. This theory came to be called the one gene–one enzyme hypothesis. Over time, this theory, coupled with the discovery that genes [5] were composed of DNA, and that proteins were made up of polypeptides, evolved into the one gene-one polypeptide theory.

Beadle returned to Caltech in 1946 and accepted a position as chair of the biology department. During his time there, he continued to publish scientific papers, but he focused on building the department. The intellectuals he recruited, among them Norman Horowitz, Herschel Mitchell, Max Delbruck, and Renato Dulbecco, would eventually earn five Nobel Prizes. Beadle traveled to England as a visiting professor for Oxford in 1958, where he stayed until 1959. While there, he, along with Ed Tatum and Joshua Lederberg, received the 1958 Nobel Prize in Physiology or Medicine [4] for showing that genes [5] regulated chemical reactions.

In the years following the award, Beadle focused on public service and public communication of genetics. In 1961, Beadle served as the president of the University of Chicago [21] in Chicago, Illinois, a position he held until 1968. He retired at the age of sixty-five, but he continued to live in Chicago with his second wife, Muriel Barnett, a writer, whom he married following his divorce with Marion in 1953. When he was eighty, Beadle was diagnosed with Alzheimer's disease. He died six years later on 9 June 1989 in Pomona, California.

Sources

1. Beadle, George Wells "Genétical and cytological studies of Mendelian asynapsis in Zea mays."*Memoirs of the Cornell Agricultural Experiment [22] Station (1930): 129* http://chla.library.cornell.edu/cgi/t/text/text-idx?c=chla;idno=7251474_8569_002 [23] (Accessed March 10, 2014).
2. Beadle, George Wells. "A possible influence of the spindle fibre on crossing-over in Drosophila [15]." *Proceedings of the National Academy of Sciences [24] of the United States of America* 18 (1932): 160–165. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1076180/pdf/pnas01730-0028.pdf [25] (Accessed March 10, 2014).
3. Beadle, George Wells, and Edward Lawrie Tatum. "Genetic Control of Biochemical Reactions in *Neurospora*." *National Academy of Sciences [24]* 27 (1941): 499–505. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1078370/pdf/pnas01634-0009.pdf [26] (Accessed March 10, 2014).
4. Ephrussi, Boris, and George Wells Beadle [3]. "A Technique of Transplantation for *Drosophila [15]*." *The American Naturalist* 70 (1936): 218–25.
5. Ephrussi, Boris, and George Wells Beadle [3]. "The Differentiation of Eye Pigments in *Drosophila [15]* as Studied by Transplantation." *Genetics* 21 (1936): 225–47.http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1208671/pdf/225.pdf [27] (Accessed March 10, 2014).
6. "George Beadle - Biographical". Nobelprize.org. Nobel Media AB 2013. Web. 5 Jul 2013. http://www.nobelprize.org/nobel_prizes/medicine/laureates/1958/beadle-bio.html [28] (Accessed July 4, 2013).
7. Horowitz, Norman H. "George Wells Beadle [3]." *Proceedings of the National Academy of Sciences [24] of the United States of America* 27 (1990): 27–42.
8. Mendel, Gregor Johann. "Versuche über Pflanzen-Hybriden" [Experiments Concerning Plant Hybrids]." *Verhandlungen des naturforschenden Vereines in Brünn* [Proceedings of the Natural History Society of Brünn] IV (1865): 3–47. Reprinted in *Fundamenta Genetica*, ed. Jaroslav Kříženecký, 15–56. Prague: Czech Academy of Sciences, 1966. http://www.mendelweb.org/Mendel.html [29] (Accessed March 10, 2014)
9. Sturtevant, Alfred Henry, and George Wells Beadle [3]. "The relations of inversions in the X chromosome of Drosophila [15] melanogaster to crossing over and disjunction." *Genetics* 21: 554–604. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1208722/pdf/554.pdf [30] (Accessed March 10, 2014).
10. Sturtevant, Alfred Henry, and George Wells Beadle [3]. *An Introduction to Genetics*. Philadelphia, PA: W.B. Saunders Company, 1939.
11. Waters, C. Kenneth. "What was Classical Genetics?" *Studies in History and Philosophy of Science* 35 (2004): 783–809.

George Wells Beadle studied corn, fruit flies, and funguses in the US during the twentieth century. These studies helped Beadle earn the 1958 Nobel Prize in Physiology or Medicine. Beadle shared the prize with Edward Tatum for their discovery that genes help regulate chemical processes in and between cells. This finding, initially termed the one gene-one enzyme hypothesis, helped scientists develop new techniques to study genes and DNA as molecules, not just as units of heredity between generations of organisms. By inducing mutations in organisms while they were in different embryonic stages, Beadle's work on Drosophila and Neurospora led to the analysis of the cell cycle and embryonic development processes.

Subject
Beadle, George Wells, 1903-1989 [31] Genetics [32]

Topic
People [33]

Publisher
Arizona State University. School of Life Sciences. Center for Biology and Society. Embryo Project Encyclopedia.

Rights

Format
Articles [34]

Last Modified
Wednesday, July 4, 2018 - 04:40

DC Date Accessioned
Friday, March 14, 2014 - 16:07

DC Date Available
Friday, March 14, 2014 - 16:07

DC Date Created
2014-03-14

- Contact Us

- The Embryo Project at Arizona State University, 1711 South Rural Road, Tempe Arizona 85287, United States

---

Source URL: https://embryo.asu.edu/pages/george-wells-beadle-1903-1989

Links
[1] https://embryo.asu.edu/pages/george-wells-beadle-1903-1989
[2] https://embryo.asu.edu/keywords/one-gene-one-enzyme
[3] https://embryo.asu.edu/search?text=George%20Wells%20Beadle
[4] https://embryo.asu.edu/search?text=Nobel%20Prize%20in%20Physiology%20or%20Medicine
[5] https://embryo.asu.edu/search?text=genes
[6] http://eol.org/pages/12058802/overview
[7] http://eol.org/pages/16673/overview
[8] https://embryo.asu.edu/search?text=Cornell%20University
[9] http://eol.org/pages/1115259/overview
[10] https://embryo.asu.edu/search?text=National%20Research%20Council
[11] https://embryo.asu.edu/search?text=California%20Institute%20of%20Technology
[12] http://eol.org/pages/733739/overview
[13] https://embryo.asu.edu/search?text=meiosis
[14] https://embryo.asu.edu/search?text=University%20of%20Paris
[15] https://embryo.asu.edu/search?text=Drosophila
[16] https://embryo.asu.edu/search?text=Harvard%20University
[17] https://embryo.asu.edu/search?text=Stanford%20University
[18] http://eol.org/pages/189527/overview
[19] https://embryo.asu.edu/search?text=x-ray
[20] https://embryo.asu.edu/search?text=culture%20medium

[21] https://embryo.asu.edu/search?text=University%20of%20Chicago
[22] https://embryo.asu.edu/search?text=Experiment
[23] http://chla.library.cornell.edu/cgi/t/text/text-idx?c=chla;idno=7251474_8569_002
[24] https://embryo.asu.edu/search?text=National%20Academy%20of%20Sciences
[25] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1076180/pdf/pnas01730-0028.pdf
[26] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1078370/pdf/pnas01634-0009.pdf
[27] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1208671/pdf/225.pdf
[28] http://www.nobelprize.org/nobel_prizes/medicine/laureates/1958/beadle-bio.html
[29] http://www.mendelweb.org/Mendel.html
[30] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1208722/pdf/554.pdf
[31] https://embryo.asu.edu/library-congress-subject-headings/beadle-george-wells-1903-1989
[32] https://embryo.asu.edu/medical-subject-headings/genetics
[33] https://embryo.asu.edu/topics/people
[34] https://embryo.asu.edu/formats/articles