

Charles Otis Whitman (1842-1910) ^[1]

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Charles Otis Whitman was an extremely curious and driven researcher who was not content to limit himself to one field of expertise. Among the fields of study to which he made significant contributions were: embryology; morphology, or the form of living organisms and the relationships between their structures; natural history; and behavior. Whitman served as director of several programs and institutions, including the Biology Department at the University of Chicago, where he helped establish a new style of biology and influenced the work of many researchers of his generation, as well as future ones. He also served as first director of the Marine Biological Laboratory (MBL) in Woods Hole, MA. Besides his considerable achievements with his own scientific research, Whitman was a tireless mentor who had many students who went on to achieve great success in the field of embryology.

Whitman was born in North Woodstock, Maine, to parents Marcia and Joseph Whitman on 14 December 1842. He grew up on a farm and developed an interest in natural history, particularly that of pigeons, at an early age. Whitman's family was typical of the rural area where he grew up, and he was educated in the public school system, but despite his family's lack of money he was highly motivated to receive a college education. Whitman earned money by teaching and tutoring in private schools, and in 1865 he began attending Bowdoin College in Brunswick, Maine. Whitman was enrolled in the accelerated program and finished his degree in 3 years, graduating in 1868 with a BA. After graduation from Bowdoin College, Whitman took a position as Principal of Westford Academy in Massachusetts, where he remained for four years. He then moved to Boston to accept a position as instructor in natural science at English High School. This move was one of great importance, as it was in Boston that he became aware of Harvard University Professor of Zoology Louis Agassiz and enrolled to become one of fifty participants in the first session of the summer marine biology program at the Anderson School of Natural History on Penikese Island in 1873. This experience had a profound impact on Whitman as well as on other of Agassiz's students. In 1874 Whitman joined the Boston Society of Natural History and, after a second summer at Penikese, he decided to dedicate himself to the full-time study of zoology.

In 1875 Whitman went to study in Europe under Anton Dohrn at the Stazione Zoologica in Naples. After working with Dohrn in Naples, Whitman and his fellow Penikese Island student Charles Sedgwick Minot moved to Leipzig, Germany. There, under the direction of parasitologist Rudolf Leuckart, he learned the modern methods of embryology and microscopy. Whitman received his PhD from the University of Leipzig in 1878. His dissertation was "The Embryology of *Clepsine* (*glossiphonia*)?", with an emphasis on the direct role of cleavage in histogenesis, or the differentiation of cells into specialized tissue and organs during growth. This research was instrumental in laying the groundwork for future studies of cell lineage. Whitman found evidence that leech egg development was completely predetermined. This finding supported the regulative theory of embryo development, according to which the whole embryo regulates the development of each cell, in contrast to the mosaic theory in which each cell develops independently, like a mosaic tile. His

discoveries while working with the leech were instrumental to future taxonomical and morphological studies.

In 1879 he was offered a postdoctoral fellowship at the Johns Hopkins University but turned it down when he was invited to become Professor of Zoology at the Imperial University of Tokyo. He only spent two years there, but his short tenure was extremely influential. Eight of Whitman's students there went on to become prominent zoologists, including four who held major chairs, affording him the informal title "father of zoology" in Japan. From November 1881 until May 1882, Whitman returned to the Stazione Zoologica to study the embryology, life history, and classification of the dicyemids which led to the publication of a standard reference work on the parasite in 1883. From 1882 through 1886 Whitman worked as an assistant to Alexander Agassiz at the Museum of Comparative Zoology at Harvard University. During this time Whitman also served as the editor for the Department of Microscopy at the *American Naturalist Magazine*. After Harvard, Whitman took the job of tutoring amateur zoologist Edward Phelps Allis, Jr., in Milwaukee, Wisconsin. In addition to tutoring Allis, he took on the task of directing the very short lived Allis Lake Laboratory. While there, Whitman oversaw the work of many researchers, including William Morton Wheeler, who went on to become a prominent figure in the study of social insects.

During the summer of 1888 Whitman was invited to direct the newly established Marine Biological Laboratory in Woods Hole, a position he held until 1908. In 1889 Whitman left the Allis Lake facility to take the position of Chair of Zoology at Clark University in Worcester, Massachusetts. In 1892 Whitman moved again to become head of the biology department at the newly founded University of Chicago. There Whitman had several students who went on to make names for themselves in embryology. One of the most prominent was Frank Rattray Lillie, who took over as director at the MBL after Whitman and succeeded Whitman at the University of Chicago, as well. Whitman had many embryologist colleagues at Chicago, including Frank Rattray Lillie, Jacques Loeb, Franklin Paine Mall, Albert Davis Mead, Shosaburo Watase, and William Morton Wheeler. Whitman remained at the University of Chicago until his death on 6 December 1910.

Whitman's study of sexual dimorphism, the morphological differences between male and female organisms of the same species, was an influence on Oscar Riddle and his endocrinological research. Whitman's 1898 paper "Animal Behavior" contains many examples of innate, non-learned, behavior. In his later work, he analyzed the relation between innate and learned behavior and the ability of animals to adjust their behavior to new experiences. Whitman saw a similarity of variation in related species, and the trends of evolutionary change in all species from the simplest of organisms to the most advanced. In 1900, when researchers were torn between the theories of mutation and selection, Whitman was a strong proponent of selection.

Whitman published papers and journal articles on every aspect of his work, but is probably best known for his posthumously published three-volume work *The Orthogenic Evolution in Pigeons*, considered to be the first extensive study in comparative ethology. Whitman was instrumental in the founding of several journals and academic institutions, including the *Journal of Morphology*, the *Biological Bulletin*, and the American Morphological Society which, through a merger with the Western Branch of the American Society of Naturalists (known as the Society of American Zoologists in 1901 and 1902), became the American Society of Zoologists in 1902.

Whitman's work significantly impacted the field of embryology. It greatly influenced the

researchers of his generation as well as future generations. Whitman made significant contributions in the fields of embryology, morphology, taxonomy, and ethology. He published numerous books and papers in all of these subjects. Whitman was a mentor to biology students in several institutions around the world. Many of the institutions and publications he founded continue to be at the top of the field of embryology today.