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Review of *George Beadle, An Uncommon Farmer: The Emergence of Genetics in the 20th Century* By Paul Berg and Maxine Singer

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BOOK REVIEWS

George Beadle, An Uncommon Farmer: The Emergence of Genetics in the 20th Century. By Paul Berg and Maxine Singer. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2003. ix + 383 pp. Photographs, illustrations, notes, index. \$35.00 cloth, \$19.95 paper.

George W. Beadle—1958 Nobel Prize winner, giant of the order Isaac Newton had in mind when he wrote of standing on the shoulders of scientific predecessors—provided the first compelling evidence that the units of inheritance we call genes perform their function in sustaining life by encoding information to produce myriad biochemical catalysts called enzymes. The story of Beadle's life and his development of the "one gene—one enzyme" hypothesis is elegantly laid out by Paul Berg and Maxine Singer in this scholarly and engrossing biography. Through the authors' nimble guidance, we discover an "uncommon farmer" indeed, one whose talent and tenacity provided exceptional service to science, education, and his country.

The explosion of scientific inquiry and discovery in the biological sciences following the end of World War II was possible only because of discoveries by such giants as Gregor Mendel, Thomas Hunt Morgan, and George Beadle. Practicing life scientists are dependent on the discoveries of these individuals who laid down principles of genetics that form the cornerstone of modern medicine, agriculture, and biotechnology. Most school children learn about Mendel's experiments with round and shriveled peas and different colors of flowers, from which he formulated the basic laws of genetic inheritance. Few people, however, know of the next major steps made by Morgan and Beadle in revealing the mechanisms of genetic inheritance and the function of the gene, respectively. Morgan and his cadre of exceptional students at Columbia University used the lowly fruit fly, *Drosophila melanogaster*, with its incredibly short life span, to bring to light facts about units of inherited material composed of completely unknown substances and called "genes" for want of a better name. The Morgan lab established that individual genes were linked together in linear arrays on the chromosomes of the fruit fly—and, indeed, on the chromosomes of other organisms that at that time were amenable to genetic manipulation and cytogenetic analyses (i.e., examination of cellular structures, and

particularly chromosomes, under the microscope). But the question, "What is a gene and how does it work?" had no answer until George Beadle's hard-honed mental skills and confident demeanor provided an important part of the answer. In so doing, Beadle accelerated our understanding of how we and other organisms faithfully pass along genetic traits to our progeny.

George W. Beadle was born on a farm near Wahoo, Nebraska, on February 22, 1903, to Hattie Albro Beadle and Chauncey Elmer Beadle. In the years before George's birth, the hard-working, hard-nosed Chauncey Beadle had developed a relatively prosperous vegetable farming business sufficiently noteworthy to be highlighted in a report from the U.S. Department of Agriculture in 1908. Chauncey, a stern and demanding taskmaster, expected young George to perform a host of farm chores from dawn to dusk in the summer and before and after school during the remainder of the year. The ability to work long, strenuous hours at demanding tasks remained with Beadle all his life, as did the honesty and modesty nurtured by his rural upbringing. His mother, supportive of George, his older brother Alexander, and his younger sister Ruth in ways their father apparently was not, died when George was a five-year-old, leaving the boy to face the prospects of a tough life in a small community with few role models other than his father. Five years later his brother Alexander died from being kicked by a horse, and George's support mechanisms became even more fragile.

Three people in Beadle's youth were instrumental to his becoming a dominant contributor to the world communities of science and education. Bess McDonald, George's high school science teacher, saw in him exceptional intelligence and drive and strongly encouraged him to pursue a college education. Beadle's father, who earlier had refused Alexander's request to attend college, saw no need for a man who would be a farmer to go off and waste four years on book learning. Nonetheless, Bess McDonald was able to convince Chauncey that college would make George a much more productive individual, and he was allowed to enroll at the University of Nebraska in Lincoln in the fall of 1922.

It was there that Beadle came under the influence of Frank Keim, who headed the Agronomy Department. Keim had an exceptional ability to recognize talented students and foster their growth. In the case of Beadle,

he went so far as to recruit him to perform research for his ecological field studies. It was about this time that the science of genetics was emerging both as an academic pursuit as well as a method to improve crop and livestock breeding. Keim encouraged Beadle to explore his curiosity regarding the realms of genetics and ecology, providing him free access to his personal library of current books and journals and demanding that he show scholarly devotion and professionalism in his research projects. After earning his bachelor's degree, Beadle stayed on to complete his master's with Keim, having by then erased all notions of returning to the farm.

Roland Emerson, an agronomy professor at Cornell University, became Beadle's mentor during graduate studies in Ithaca, New York. Emerson, who had earlier been a faculty member in the University of Nebraska's Agronomy Department, kept in close contact with Frank Keim, who shuttled several students, including Beadle, to Cornell for graduate training. Emerson's well-deserved reputation as an excellent geneticist and mentor resulted in four exceptional students being drawn to his Cornell laboratory at one time: Charles Burnham, Marcus Rhodes, Barbara McClintock, and George Beadle. Ultimately, all four would be inducted into the prestigious National Academy of Sciences, and two, McClintock and Beadle, would be awarded Nobel prizes (McClintock for her "jumping genes" hypothesis and Beadle for his "one gene—one protein" hypothesis).

Singer and Berg are exceptional storytellers. Not only do they accurately reveal Beadle's step-by-step ascent through university ranks, they also present in a precise, yet fully comprehensible, manner the science that surrounded Beadle's discoveries. They highlight Beadle's genius in choosing just the right organism with which to answer specific questions. They chronicle his genetic encounters first with corn (*Zea mays*), then fruit flies (*Drosophila melanogaster*), bread mold (*Neurospora crassa*, which proved the key organism in developing the "one gene—one enzyme" hypothesis), and finally back to corn. Singer and Berg document the scientific relationships Beadle fostered, the terrific tensions between the demands of science and the obligations of family life, his trials and successes as president of the University of Chicago in the tumultuous 1960s, and his agonizing decline wrought by Alzheimer's disease. Most importantly, they capture the essence of the man and his contributions to the worlds of science and education, masterfully describing how his life's work hastened the emergence of biochemical genetics, molecular biology, and biotechnology as sciences that have extended life and the quality of life for countless individuals around the globe.

Life scientists, students of biology, and technologists of all sorts will enjoy and appreciate this book for its clarity of presentation and its exceptional documentation of historic events and personalities. The general public will find in it the compelling story of a person struggling to be the best he could under circumstances that would test the honesty, humanity, creativity, and tenacity of any individual. **Donald P. Weeks**, *Department of Biochemistry, University of Nebraska—Lincoln*.