Feature

Carlson Composes a Classic

Review of: *Mendel's Legacy: The Origins of Classical Genetics*, by Elof Axel Carlson; 2004; 332 pp., Cold Spring Harbor Laboratory Press (Cold Spring Harbor, NY); <http://www.cshlpress.com/>; ISBN 0-8796-940716

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In teaching molecular genetics, I found *Phage and the Origins of Molecular Biology* (expanded edition, 1992, edited by John Cairns, Gunther S. Stent, and James D. Watson; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY) to be a rich source of good stories and deep insights. For example, I liked to quote “genesis stories” such as Luria’s invention of the Luria–Delbrück fluctuation test while watching his colleagues play slot machines at the Bloomington Country Club and “prepared mind stories” such as Bill Hayes’s accidental discovery of one-way genetic transfer in *Escherichia coli* while doing an experiment intended for quite another purpose. Carlson’s book, *Mendel’s Legacy*, will provide a similarly rich source of anecdotes for teachers of classical genetics—and it has pictures!

Classical genetics, according to Carlson, starts with the rediscovery of Mendel’s work in 1900 and ends with the publication of the double-helical structure of DNA in 1953. These boundaries are fuzzy, of course. Carlson says that the content of classical genetics is

Mendelism, the chromosome theory of heredity, the theory of the gene, the mapping of genes to chromosomes, the genetic consequences of chromosome rearrangements, the genetics associated with polyploidy and aneuploidy, the relationship of genes to expressed characters, the genetics of traits exhibiting a continuous distribution, the study of spontaneous and induced mutations, the relationship of genetics and cytogenetics to evolution, the mathematical description of genes in populations, and the study of gene structure and function at the phenotypic level.

Therefore, the early chapters of this book cover work done in the latter part of the nineteenth century, including Mendel and pre-Mendelian students of hereditary, Darwin, and those who supported or opposed his ideas on evolution, and the cytologists—Flemming, Hertwig, Strasburger, and Boveri—who discovered the details of mitosis, meiosis, and fertilization just before the turn of the century. Part II of the book covers the discovery of sex chromosomes, the rediscovery of

Mendel’s work, and the development of the chromosome theory of heredity. Part III deals with the demonstration of the generality of the Mendelian principles of inheritance, mainly by plant geneticists. Part IV is devoted to the burgeoning of genetics at the hands of the *Drosophila* geneticists, Morgan, Sturtevant, Bridges, and Muller. Part V summarizes the spread of genetics beyond *Drosophila*, including the early history of population genetics and the birth of microbial and biochemical genetics. Part VI briefly reviews social aspects of classical genetics, including the eugenics movement, the Lysenkoist period in the Soviet Union, the Cold War controversy over the genetic effects of radiation, the beginnings of medical genetics, the rise of genetic counseling, the relationship of genetics to ethics and theology, and, at the end, some thoughtful comments on the forces that shaped the history of genetics and of science in general.

At the start, Carlson makes the point that this book is not written in the style of a review article in which “surviving ideas ... are highlighted and ... failures along the way are largely forgotten or omitted.” Accordingly, Carlson tries to present a complete intellectual history of classical genetics in which crippling preconceptions, errors in interpretation, societal and religious influences, and personal foibles are recognized as important elements. Thus, the book is not a distillation of successes. Neither is it a textbook in the sense that it explains the scientific content of classical genetics in sufficient detail for a lay reader to follow the narrative; this is a book for people familiar with the science of genetics.

The value of the book for educators is that it provides so many good stories about how science is done, how scientists interact with one another, and how the slow “winning of the facts” (H.J. Muller’s phrase, which Carlson greatly admires) finally takes the form of a mature and predictive field of science. For example, we learn of T.H. Morgan’s generosity: “without Sturtevant’s knowledge, Morgan arranged for him [Sturtevant] to receive a scholarship that he had secretly funded for him.” And we learn in an extraordinary footnote that “when [Reginald Ruggles Gates’] death was announced at a national meeting of American anthropologists, Mrs. Garret Hardin told me that the audience cheered!” (We learn from the same footnote about Gates’ astonishing ignorance of the mechanisms of human reproduction.) We learn that

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Calvin Bridges was a gifted experimentalist who invented virtually all of the standard procedures for working with *Drosophila*, including the recipe for fly food, the use of ether to anesthetize flies, the counting of flies on a porcelain plate with a small paint brush to push them about, and the use of a water filter to cool the light that illuminates the flies. We also learn that Bridges' love life was scandalous and that because of his reputation for loose morals he was dependent all his life on research support provided by Morgan. H.J. Muller, who was Carlson's thesis supervisor, plays a major role in this history, and we learn that Muller, although he achieved fame and even received a Nobel Prize, always harbored some resentment toward Morgan and the research team in the "Fly Room" because they had not given him credit for all of the intellectual contributions that he had made while working as a member of that team. This book contains a one-page catalogue of ideas that Muller probably wrote between 1932 and 1940, showing which ideas came from whom. A photograph of this list in Muller's own handwriting appears on page 202. The list of his own contributions is roughly twice as long as those for Morgan, Sturtevant, and Bridges. The book is filled with such tidbits, which can be used to remind students that genetics is a human enterprise.

Carlson provides several tabulations that educators and historians will find useful. His "Chronology of Classical Genetics" cites discoveries beginning in 1651 with William Harvey's identification of the egg as the basis for life and ending in 1957 with E.B. Lewis's discovery of developmental regulatory genes at the *bithorax* locus. Readers will find it interesting to compare Carlson's chronology to the one in A.H. Sturtevant's *A History of Genetics* (2001, with an introduction and afterward by E.B. Lewis, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY), which begins *circa* 323 B.C. with Aristotle and ends in 1946 with A.D. Hershey's demonstration of recombination in bacteriophage. Because Carlson is interested in the relative contributions of Americans versus Europeans and the importance of the American graduate school, he provides a useful table summarizing the education of the major contributors to the development of classical genetics. Finally, toward the end of the book, Carlson includes a table showing the fates of the students and technicians other than Bridges, Sturtevant, and Muller who worked in the Morgan lab.

Although the personal stories that reveal the human side of genetics will be useful to teachers of genetics, the pictures may be the most valuable element of this very fine book. In teaching any scientific subject, it is important to remind students that science is a human enterprise—that scientists are ordinary people, like the students themselves, who ask

the questions and tease out the answers that fill up our textbooks. Carlson has collected a trove of portraits of scientists who have contributed to the history of genetics, and, as I turned the pages, I found picture after picture that I wanted to show to my students. There are, I believe, 92 portraits and snapshots in this book, ranging from familiar faces, such as Charles Darwin, Gregor Mendel, Thomas Hunt Morgan, George Beadle, Barbara McClintock, and Oswald T. Avery, to faces seldom seen in textbooks, such as Mathias Schleiden, August Weismann, Carl Nägeli, William Bateson, Nettie Stevens, Clarence E. McClung, Calvin Bridges, Ralph Cleland, and N.I. Vavilov.

More careful editing would have greatly enhanced the impact of this ambitious book. The sequencing of material is sometimes quirky. In a chapter on maize genetics, for example, footnote 5, which is cited on page 142, concerns research by Beal, but Beal and his work are not mentioned in the text until page 143. The reader can only wonder at the mysterious reference when it first arises. In other places, the writing is simply sloppy. Take for example the following confusing passage (p. 191): "After the Bolshevik victory, Muller was a communist in everything but membership. Like Muller, Bridges had no strong commitment to a political change in the world that would establish either socialism or communism, and he did not consider himself an activist as was Muller." And on page 247, there is a multi-dimensional—one might almost call it Freudian—error in attribution: In a passage describing work on a lethal tumor gene in *Drosophila*, Carlson writes, "some 25 years later, Leanne S. Russell (later in mouse genetics) identified its mode of death as a blockage of the intestines." However, the work on these hereditary tumors was really done by Elizabeth S. Russell, not by Liane B. Russell. Elizabeth S. Russell, who died in 2001, and Liane B. Russell, who retired from the Oak Ridge National Laboratory in 2002, both had distinguished careers in mouse genetics. In addition, they were, respectively, the first and second wives of the late mouse geneticist, William L. Russell. As far as I know, there was no Leanne S. Russell.

Opening Carlson's book is, for a teacher of genetics, something like finding a trunk filled with family memorabilia. The pictures, quotations, anecdotes—some only half-remembered, some revealed for the first time—bring to life a past that all of us share. Carlson's tale of the effort to "win the facts" and his thumbnail biographies of the people who labored to win them provides plenty of material to whet the appetites of students. Like the family member who finds the trunk, teachers will want to share the contents of *Mendel's Legacy* with their kids.