Feature Book Review

Living with History

Review of: *Time, Love, Memory: A Great Biologist and His Quest for the Origins of Behavior*, by Jonathan Weiner; 1999; 300 pp.; Vintage Books (New York); ISBN: 0-679-76390-2

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The history of science can be an extremely useful approach for engaging undergraduates with scientific content. For example, students who learn about the context of scientific inquiry and discovery are more likely to retain their content knowledge and apply it across disciplinary boundaries. (See *How People Learn: Bridging Research and Practice* by Donovan, Bransford, and Pelligrino [available from http://books.nap.edu/catalog.php?record_id=9457#toc] for a discussion of the importance of context for learning.) Jonathan Weiner's *Time, Love, Memory: A Great Biologist and His Quest for the Origins of Behavior* provides several opportunities for biology teachers to incorporate important and relevant history into their courses. In particular, I've found three distinct aspects of Weiner's book to be relevant in undergraduate science courses. First, the biographical approach helps students understand the incredible pace of scientific change over the past half century. Second, Weiner's description of the first gene map is an especially compelling account that demonstrates how mapping was initially conceptualized and constructed. Finally, Benzer's work on the genetics of behavior highlights the interdisciplinarity of contemporary life science, including the shift from physics to biology in the early stages of molecular biology. This fascinating history illuminates the nature of some fundamental questions that continue to motivate current research.

On the first point, *Time, Love, Memory* is a compelling biography. Seymour Benzer received his Ph.D. in physics from Purdue University in 1947 and shortly thereafter jumped into the developing field of molecular biology. The story of Benzer's career provides a window into the history of biology in the twentieth century, one that my students have found both intimidating and enticing. Benzer's work was fundamental to the development of phage genetics and responsible for the first detailed genetic maps. In the current era of high-throughput sequencing and comparative genom-

ics, Benzer's early work seems almost quaint. On the other hand, given Weiner's lucid account of the development of these early maps, students are inevitably fascinated by the techniques involved and the elegance of Benzer's experiments. The story of Seymour Benzer's career also highlights the pace of scientific change. In the course of Benzer's career, we have moved from a view of genes as metaphysical objects to an understanding of genes as physical sequences of nucleotides that we can directly manipulate. Of course, what is perhaps most compelling is that despite these advances, the fundamental questions regarding the links between genes and behavior remain, but more on that later.

Another important aspect of this biography is that it also follows the careers of some of Benzer's most important students in their own quests to tackle the behavior of *Drosophila*. Weiner's descriptions of the work of Benzer's students, especially Jeff Hall and Ronald Konopka, demonstrate the way that scientific research creates networks of people, equipment, and model organisms. Indeed, the initial idea for the book came from a 1991 paper on gene transfer that Hall published in *Science*. Further investigation led Weiner from Hall to his former teacher, Benzer, and the book was expanded from its initial focus on the periodicity gene in *Drosophila* to encompass "love" and "memory." Each of these areas was primarily pursued by one of Benzer's students: Konopka on periodicity, Hall on love, and Quinn (together with his postdoctoral fellow Tim Tully) on memory. Here, again, the book helps students become more aware of the ways in which scientific knowledge is developed and disseminated. As a result, science, which they often conceptualize as some abstract search for truth, becomes humanized.

The second use of Weiner's work is found in chapter two, "The White-Eyed Fly." In this chapter, he provides some of the background to Benzer's work by introducing T. H. Morgan and his "boys," Calvin Bridges and Alfred Sturtevant. In the process, Weiner presents the most concise and compelling account of the first genetic map that I've ever encoun-

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tered. In his narrative account of Sturtevant's eureka moment, Weiner provides an excellent opportunity for teaching some of the fundamental ideas of classical genetics in their historical context. Beginning with Morgan's idea of crossing over, Weiner goes on to describe a conversation between Morgan and his 19-year-old student, Sturtevant, which led to "one of the most important eureka moments in twentieth century science . . . The moment [that] would help define both the style and substance of the study of life for the rest of the century." That moment was the creation of the first genetic map, which was completed by Sturtevant the same night as that conversation. According to Weiner's account, Sturtevant's map made clear "genes are real, genes are on chromosomes and genes can be surveyed and explored." Through this narrative, he puts the abstract notion of a genetic map into a concrete historical context. He describes Sturtevant sitting at his desk, ignoring his other assignments and classes, analyzing the records of 21,736 flies to establish the chromosomal distance from the white eye gene to the yellow body gene (1 centimorgan) to the vermilion eye (32 centimorgans). This account helps students become aware of how science connects questions to data sets and wrings new ideas, insights, and answers out of existing information.

Finally, this account of Benzer's research provides a stunning example of the interconnectedness of contemporary research in biology. Weiner's journalistic approach traces out the connections between the physics, chemistry, and

biology that were so important to the founding of molecular biology. However, he also shows that satisfactory answers to basic questions of behavior require the constant flow of information and ideas between neuroscientists, ethologists, geneticists, psychologists, and even philosophers. This is the kind of work that both challenges and inspires students, the kind of work that makes the abstract a bit more concrete, and the kind of work that ultimately helps them to understand the distinctly human, historically contingent, and inherently interesting process of science.

I highly recommend this book to any instructor of a general biology course or an introductory genetics course. In my History of Genetics course, I assign the entire text. However, selections of the text can also be very useful. One of my colleagues used the account of Sturtevant's first map to introduce classical genetics to his introductory biology students. Not only did the students find the history useful for understanding the creation of the linkage maps, some also found the history sufficiently compelling to read the entire book on their own! Although there are doubtless many ways to incorporate the history of science into science curricula, the first step I'd recommend is that the instructors themselves read books like *Time, Love, and Memory*. I have no doubt that the fascinating and very human stories of science described in the pages of such books will catalyze new and creative approaches to teach the science content to their classes.