Books

Thinking About Science

Max Delbrück and the Origins of Molecular Biology

by Ernst Peter Fischer and Carol Lipson

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Delbrück's Phage Group at Caltech in 1949.

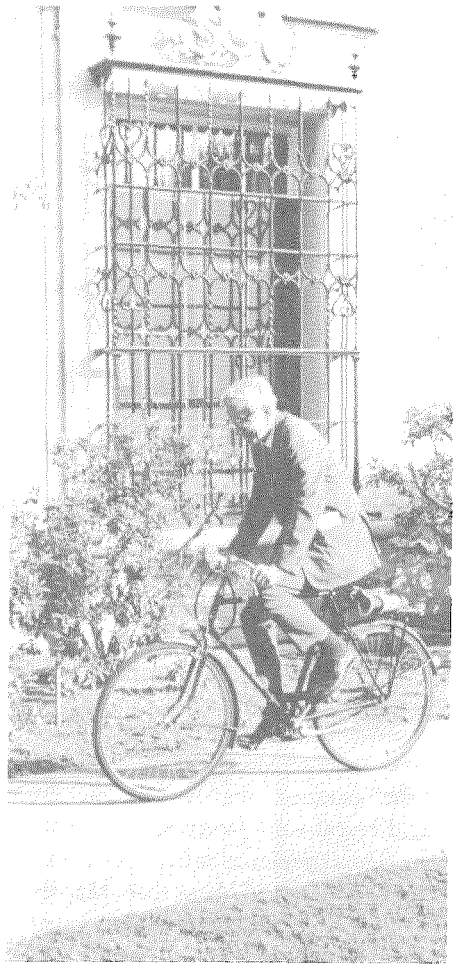
Max Delbrück (1906-1981), professor of biology at Caltech from 1947 until his death, was one of the most influential biologists of our time, and also one of the most interesting. His career spanned two of the greatest achievements of 20th-century science, those of quantum mechanics and molecular biology. He played a minor role in the first, but a major one in the second. For the latter, he won the Nobel Prize in 1969 with Alfred Hershey and Salvadore Luria.

Peter Fischer, the principal author of this biography, has a special right to authorship. He was one of Max's last graduate students. When, near the end of his life, Max decided to write his autobiography, he asked Peter—who by that time had returned to his native Germany—to come to Pasadena to help him. Max died soon after their collaboration began, so the book is essentially Peter's. He, in turn, invited Carol Lipson, who also knew Max and who teaches writing at Syracuse University, to assist him with composing in a foreign language. The result is altogether admirable: an honest, witty, and sensitive book written in flowing English.

Max studied theoretical physics in Göttingen, Berlin, and Copenhagen during the late twenties and early thirties, in the early days of quantum mechanics. He obtained his PhD with Max Born at Göttingen and then took off on post-doctoral peregrinations that brought him to the Institute for Theoretical Physics in Copenhagen. There he came under the influence of Niels Bohr, with whom he developed a lifelong friendship. It was in Copenhagen, in 1932, that Bohr gave a lecture that turned Max into a biologist. In his lecture, Bohr proposed that life might not be reducible to atomic physics, but might stand in a complementary relation to it, analogous to the relation between the wave and particle aspects of light—contradictory, yet both necessary for understanding. Max was fascinated by epistemological questions, and Bohr's argument had a deep effect on him. He became interested in biology and within a few years left physics altogether.

One of the highlights of this book is its discussion of Bohr's complementarity argument, including its physical background, and of Max's unceasing search for the "paradox" that he was convinced would reveal complementarity in biology. The complementarity idea is explained more clearly here than Max ever explained it. The irony in the fact that Max's brilliant career was motivated by the pursuit of a mirage is not lost on the authors. Their treatment of this subject is brilliant.

Max's entry into biology is described by Fischer and Lipson as follows: "Max began his search for complementarity in biology by analyzing how ionizing radiation influenced the genetic material. Genes were stable elements; as a special feature, they could be shifted to a different form, which again was stable. Could the new quantum mechanics explain this, or did biology run into a



paradox right here?" The result was a paper published in 1935 with Timoféeff-Ressovsky and Zimmer in which a quantum mechanical description of gene mutation is presented. It found that the stability and mutability of genes are explicable quantum mechanically if the gene is regarded as a macromolecule.

This paper made Max famous because it was quoted in Erwin Schrödinger's widely read little book, *What Is Life?*. The chapter entitled "Delbrück's Model" was read and admired by a number of people who later joined in the attack on the gene. These included Salvadore Luria, James Watson, Francis Crick, and Seymour Benzer.

By now the Nazis were in power, and Max gladly accepted the offer of a Rockefeller Fellowship to leave Germany. He chose to continue his studies of the gene by coming to what was the world center of genetics: T. H. Morgan's department at Caltech. Max wanted to learn how genes replicate—a goal he pursued singlemindedly until it was solved (by Watson and Crick) in 1953. At Caltech he found the organism—bacteriophage—that he hoped would lead him to that goal. These tiny viruses that prey on bacteria seemed to Max "beyond my wildest dreams of doing simple experiments on something like atoms in biology." Enthralled by phage and its possibilities, Max apprenticed himself to Emory Ellis, a Caltech biochemist who was working with phage at the time, and together—Ellis supplying the techniques and Max the theoretical framework—they founded modern phage genetics. Phage became one of the best understood of all organisms, thanks to Max and the bright group of collaborators and students he gathered around him.

The largest section of *Thinking About Science* deals with the phage period of Max's life. It summarizes the major accomplishments, and it contains fine descriptions of Max's style as a leader. On a personal level, he was the most informal and relaxed of men. But in scientific matters he was a dragon of rigor and purity, standards he applied to himself and to others. He had his failings, too, and they are not whitewashed here. Most notable was his inability to appreciate the importance of chemistry —a failing not rare among physicists. He thought that the fundamental problems of biology could be solved by a combination of genetics and physics. He had no difficulty learning what biochemistry he needed to know, but his biochemical intuition was not strong. He thought Watson was wasting his time when, at Cambridge, he began modeling DNA with Francis Crick.

For Max, the structure of DNA was a disappointment—there was no paradox there. DNA was a simple molecule, and gene replication—the mystery of mysteries—was "a ludicrously simple trick." Max did not avoid the truth, but neither did he give up the search for complementarity. Calling the search one of his "private fantasies," he continued it at higher levels of biological organization. After briefly considering other possibilities, he settled on the light-responses of the fungus *Phycomyces* as the focus of a new research program. He entered the new field with enthusiasm and before long had attracted another group of bright collaborators; but *Phycomyces* never took wing as phage had. Max was interrupted repeatedly by visits to postwar Germany for the purpose, among other things, of helping found research institutes in the image of Caltech at the universities of Cologne and Konstanz. Although Max referred to *Phycomyces* as "the most intelligent primitive eucaryote," it proved to be more intelligent than primitive. It gave up some secrets, but no breakthroughs were made during Max's lifetime. Despite this, these years were not without interest, and Fischer and Lipson record both the science of this period and the personalities with their usual insight and humor.

This is a superlative biography. It is a fine memorial to Max Delbrück, who was my old friend and one of Caltech's great men.

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