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Life after the helix

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How Jim Watson saw the structure of DNA transform biology.

Watson and DNA: Making a Scientific Revolution
by Victor K. McElheny
Perseus/John Wiley: 2003. 400 pp. $27.50/£18.99

Victor McElheny's biography of Jim Watson captures the growth of molecular biology and the creation of two major institutions that Watson has led: the Cold Spring Harbor Laboratory and the Human Genome Project. It is a vivid portrait of a man who is himself an institution in our science. Covering Watson's childhood in Chicago, the discovery of the structure of DNA with Francis Crick in Cambridge, UK, and his creation of a major laboratory of molecular biology at Harvard, the book contains many insightful comments and quotations. It describes well the development of Cold Spring Harbor from a sleepy, minor research institution to an active centre whose courses, books and meetings have driven the pace of scientific research in modern biology.

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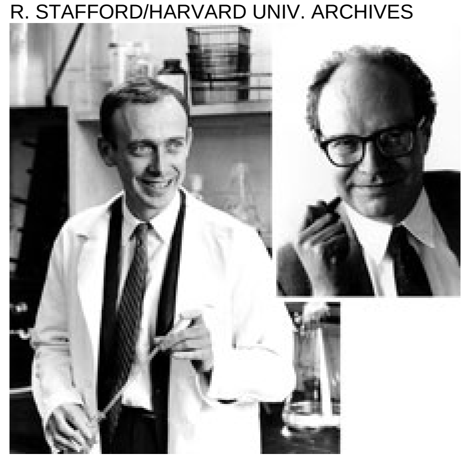

Meeting of minds: Jim Watson and Walter Gilbert (inset) ran a lab together at Harvard in the 1960s.

The past half-century has truly been the era of DNA, with the publication by Watson and Crick of a model for its structure in 1953, the identification of the genetic code in the 1960s, recombinant DNA and DNA sequencing in the 1970s, biotechnology and the polymerase chain reaction in the 1980s, and the Human Genome Project in the 1990s. The vision that molecules could explain life, and that the most important molecule was that which carries the genetic information from parent to daughter cell, has transformed not just biology but also the world around us. Every organism on Earth is assembled by a set of instructions carried as a linear string of information in a set of DNA molecules, which have an unbroken line of ancestor molecules going back to the first cells that arose upon the Earth.

Watson has been blessed by founding this field, growing the science and shepherding the Human Genome Project in its early days. He is a brilliant, acerbic man, who was amazingly successful not just in his science, but also in leadership and management roles. Although he has a reputation of never suffering fools and likes to shock, he could accommodate himself as needed. McElheny describes how Watson "carefully bends down and unties his shoes and musses up his hair" before going to see wealthy people who might support Cold Spring Harbor.

I met Watson at a party in Cambridge, UK, in the autumn of 1955. We became friends and, in the spring of 1960, when we had both had gone to Harvard, Watson as an assistant professor, he invited me to join him and Francois Gros to work on the messenger-RNA experiments. I was a student of theoretical physics, but in the simpler state of science then I could read six papers, follow Watson and Gros around for a day, and then join in the experiments. We sought an unstable intermediate molecule that could carry the information from DNA to the cytoplasmic factories, the ribosomes, which synthesized the proteins. The three of us did the experiments together — one shaking a large flask of bacteria, one holding the stopwatch, and one pouring in 20 mC of radioactive phosphate to label the RNA for 20 seconds before the litres of culture were poured over ice. We worked day and night throughout the summer. We were seeking an elusive target, which many people did not believe existed, and which we would often compare, when speaking to each other, to the search for the neutrino. However, our experiments were ultimately successful (*Nature* **190**, 581; 1961).

For the next decade, Watson and I ran a laboratory together at Harvard. Although he did not have great experimental skills, he had an unusual insight for phrasing important questions and an intuition for the essential new element. We were both driven by a fascination with the new, the flood of discoveries that characterized that period of molecular biology. McElheny's book describes this period vividly through the reminiscences of the students and postdocs involved. When we returned to the laboratory at night after dinner, Watson would look up at the lit windows of our labs standing out against the darkened building, and exult that the laboratory was active. We would talk to the students and postdocs late into the night.

The students were all set different problems. They were not in competition with each other, but did compete (and collaborate) with other laboratories around the world working on the same problem. In a traditional lab, questions of technique or principle often rise through a hierarchical structure to the boss. The boss then speaks to his friends, generally the boss of another laboratory, the question passes down a chain of command to the actual experimenter, and the answer, probably distorted by rumour, comes back over the peaks. Watson always tried to cut through this pattern, encouraging his students to make direct contact with the person in the other lab doing the experiment — thus avoiding the hierarchy — to get the answer. He believed that science is done best by independent minds solving problems and interacting directly with other scientists as peers, equals in the passion to understand nature. The students published independently. During the 1960s and early 1970s, Watson did not put his name on papers unless he had personally participated in the experiments.

It was a heroic age, in which the science was done by a few people around the world. Small, informal meetings in broken-down gymnasiums characterized the phage-group or the nucleic-acid Gordon research conferences in the 1960s. Today, each of these fields has expanded: where there were 100 people, today there are up to 4,000. Each experiment that was done by students in the lab in the 1960s has become an entirely separate field of science, and there are now gigantic factories, armies of automatic machines, churning out data that cry out to be understood.

Has our science lost its soul? Has molecular biology, which sought basic answers to how life works in terms of the molecules that made life possible, begun to drown as the new systematics (simply the collection of data) lists all of the different genomes, and now proteomes, solely because they are there? Is the world one of infinite complexity?

One simplifying explanation is evolution: how the individual patterns arose over history. But the contingent nature of evolution means that many of the final patterns in organisms are accidental. However, we must understand the full details of our particular state if we are to have effective medicine. We see the biological exploration of all the genes and the gene variants of the individual human, the record of the ancestors, migrations and kinships, as relevant to our ability to cure, to prescribe drugs tailored to the individual, or to enhance function.

It seems to me that molecular biology is dead. DNA-based thinking has penetrated the whole of biology, and the separate field no longer exists. Also gone is the attempt to answer broad fundamental questions — how does DNA work? what controls a gene? — by single individuals. However, in fractal fashion, new sciences appear in the details as we continue to learn. Science is both an individual and a collective endeavour. Like the artist, the creative individual finds new discoveries — most often manifest at the moments of breakthrough when an idea reveals a new field of knowledge — that characterize its forefront. Watson was such an individual, and he has stimulated that character in others.