

Michel Morange, *The Black Box of Biology: A History of the Molecular Revolution*

Cambridge, MA: Harvard University Press, 2020. Pp. 528. ISBN 978-0-6742-8136-3. £40.95 (hardcover).

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Molecular biology is an intimidating subject; it is technical, and its scope is daunting – it now affects all of the life sciences. Any attempt to survey its entire history is therefore commendable. This book, which represents an expanded version of *A History of Molecular Biology* (1998; first French edition 1994) represents the best entry point for engaging with this history. It chronicles the experiments that paced molecular biology, from Oswald Avery's work on *Pneumococcus* up to its expansion into territories as varied as developmental biology, evolutionary theory and gene therapies.

The first edition of this book comprised three sections, dealing respectively with the origins of the field, the study of DNA structure and the deciphering of the genetic code, and the growth of 'genetic engineering' based on recombinant-DNA techniques. An excellent review was provided by Bruno Strasser ('Molecular biology, macroscopic History', *BioScience* (1999) 49(11), pp. 929–31). The main addition to this second edition is a fourth section containing ten chapters, comprising 150 pages in total, on a series of recent developments: the 'Molecularization of biology and medicine', 'Protein structure', 'The rise of developmental biology', 'Molecular biology and evolution', 'Gene therapy' (with a lucid description of the CRISPR system), 'The central place of RNA', 'Epigenetics', 'Sequencing the human genome', 'Systems biology and synthetic biology', and 'Images, representations and metaphors in molecular biology'.

This list of subjects is an index of the new contributions made by this edition of the book, whose breadth is staggering. In each chapter, the major relevant experiments are described, and adequate mention is made of the historiography, when it exists. This makes it an indispensable resource for anyone interested in this history. The treatment also stands out for the author's command of the literature. As a practitioner, Morange understands the science, and he explains it very well. When he discusses experiments, debates or scientific results, there is no room for vagueness. On these matters, his discussion can be considered authoritative. Another contribution is to draw attention to potential research subjects. The chapters on genetic engineering (Chapter 16) and the polymerase chain reaction (Chapter 19) give useful guiding threads for further historical work on sequencing methods. Although the argument on 'the central place of RNA' in contemporary developments (Chapter 25) is not particularly compelling, it clearly represents an interesting subject. A stimulating chapter (Chapter 29) deals with visualizing tools in molecular biology. The discussion of the diagrams devised by Jane S. Richardson to illustrate the structure of proteins is particularly suggestive. Given the importance of illustrations in molecular biology, I was surprised by their absence in this book. The reader will need to consult the original papers to get a sense of the work being done in this area.

The general problematic of the *Black Box of Biology* concerns revolutions and continuities. In what sense was molecular biology a revolution in biology, or not? In what sense were conceptual and technical developments such as the double-helix model, rDNA and many others revolutionary within molecular biology? This way of framing issues, which is narrow at times, reflects the field's preoccupation with its own progress. Contemporary molecular biologists perceive their field as being regularly revolutionized by

technologies, and they train students to view things this way. Indeed, few disciplines in the life sciences have experienced such a frantic pace of technical achievement as molecular biology. Progress since 1953 has been such that the lack of major discovery between 1965 and 1972 was perceived as a phase of crisis (p. 439 n. 33); the main breakthrough that followed (DNA sequencing) was permitted by technical developments, the fashioning of the methods of recombinant DNA. Hence technological innovation permeates the way actors perceive the history of their field and its future. This rhetoric provides the main foil of the *Black Box of Biology*. A recurring theme in Morange's treatment is that striking developments such as polymerase chain reaction methods are usually the extension of older experimental lines, whose earlier history he duly charts (which is probably what he means by his claim to focus on 'normal science' on p. 9). Similarly, when discussing intellectual developments in evolutionary (Chapter 23) or developmental (Chapter 22) biology, he tends to highlight continuities. Overall, *The Black Box of Biology* is a healthy antidote to overstatement.

Morange wanted to provide an account 'that is as complete as possible' (p. 5). Considering the sheer breadth of topics, he has largely succeeded in this ambition of reaching textbook comprehensiveness. Of course, completeness depends upon how one delimits one's area of inquiry. He is not particularly interested in the institutional, social or economic contexts of the developments under consideration and he limits himself to mentioning them when they are documented by other historians. The focus is on laboratories and achievements made in the United States, the United Kingdom and France; the reader will learn little about the settings and the spread of molecular-biology methods in other countries or geographical areas. One cannot take issue with their absence; they would have required another book, and another author. Other omissions are more relevant to the author's focus on experimental work. The new sections chronicle experimental lines of research as documented by the publication of important (or neglected) papers, with general comments on their novelty or continuity with earlier practices. However, this history of molecular biology gives little information on the training of scientists and technicians, on the timescale and hidden work involved in the design of experiments or on other material aspects of this experimental science. I for one regretted that the author did not draw more upon his practical experience as a biochemist and as a teacher to illuminate the material and social settings of these laboratories, which, he claims, are the same everywhere (p. 88).

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Johan Alfredo Linthorst, *Research between Science, Society and Politics: The History and Scientific Development of Green Chemistry*

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Research between Science, Society and Politics examines the international rise of 'green chemistry'. First emerging in the early 1990s, green chemistry, in the words of one of