

medical advances. More fundamentally, a diverse new set of actors, including feminists, animal rights activists, disability advocacy groups, and most importantly, Green parties, proposed counter-narratives that attempted to redefine the policy problematic. Essentially, a new political metanarrative of ecological modernization and sustainable development, set in the context of increased political mobilization, definitively challenged European genetic engineering policy narratives.

This hegemonic crisis was most clearly played out in the struggles over the deliberate release of genetically modified organisms in the late 1980s. The drafting and subsequent controversy surrounding the 1990 German Genetic Engineering Act is of special interest here, clearly illustrating the process by which the political space of biotechnology was partitioned to control disruptive elements. Risk came to be more democratically defined as socio-economic and environmental as well as technological. At the same time that the new policies broke down expert enclosures, they excluded more radical opposition to genetic engineering policies. For Gottweis, this process demonstrates that hegemonic constructions of reality work not by suppressing opposition, but rather by absorbing criticism into “legitimate differences” and marginalizing unacceptable forms of resistance as irrational.

Governing Molecules deserves a wide audience among policy analysts and policymakers as well as among science studies scholars. Historians of biotechnology may find the second half of the book, which addresses biotechnology and genetic engineering policy narratives in the 1980s, particularly useful for expanding research questions beyond intellectual property, venture capital, and risk regulation. Closely argued in the language of poststructuralism, this book requires the careful attention of readers. Those who persevere will be rewarded with rich insights and tools for understanding the contours of science and technology policymaking in the United States and Europe.

Audra J. Wolfe

William C. Summers, *Félix d’Herelle and the Origins of Molecular Biology* (New Haven and London: Yale University Press, 1999), xii + 230 pp., illus., \$30.00.

William C. Summers is a practicing scientist who has often contributed to the historiography of the biomedical sciences. His book is the first biography of Félix d’Herelle (1873–1949), the purported co-discoverer of bacteriophages. It addresses several important themes about the history of microbiology, of tropical biomedicine, and the relationships between science in the laboratory and in the field. Even though this book makes some claims about the origins

of molecular biology, to which I will turn at the end of this essay, it is mainly concerned with the scientific career of Félix d'Herelle, which was, to say the least, quite extraordinary.

Félix d'Herelle, a French-Canadian self-taught in science, remained throughout his life “a vagabond scholar, an outsider in the institutional world of twentieth century science” (pp. 2–3). Indeed, he held posts on four continents and in more than a dozen countries, including Canada, Guatemala, Mexico, Argentina, Algeria, France, the Netherlands, India, Egypt, the United States, the USSR, and Indochina, and traveled to numerous others – at a time when travel was still often an odyssey. In addition to several brief appointments at scientific research institutions such as the Pasteur Institute and Yale University, d'Herelle often worked in governmental offices in charge of practical questions of public health and agriculture. He was engaged in 1901, for example, as the government microbiologist in Guatemala City. He was asked to study, among other subjects, the possibility of producing exportable liquor from fermented bananas as well as methods of controlling yellow fever epidemics and a disease affecting coffee crops.

By working on these questions, d'Herelle developed a very personal style of research, which Summers nicely highlights. Although d'Herelle repeatedly moved between the laboratory and the field, he was always careful to distinguish the difference between phenomena that could be recreated in the laboratory and those occurring outside it. He resisted, for example, the use of animal model systems for the study of therapeutic agents in the laboratory, preferring to work on naturally occurring epidemics. He thus often included ecological and epidemiological arguments in his papers on laboratory research. To give only one example, d'Herelle began to work in Mexico in 1910, and later in Argentina on the destruction of agricultural crops by crickets. After dissecting insects he had found dead, he observed that they seemed to be infected by bacteria. He then was able to isolate in the laboratory the bacterial strain involved, and to show its pathogenicity. Back in the field, d'Herelle subsequently attempted to use these bacteria to prevent – with some success – the invasion of crickets.

The discovery of bacteriophages some years later at the Pasteur Institute followed a similar path. After isolating a dysentery bacillus from French infantrymen in 1915, he discovered an antagonist “invisible microbe” (p. 48) present in the feces of his patients, later to be named “bacteriophage.” First published in 1917, these results rapidly raised a priority dispute between d'Herelle and Frederick W. Twort, who claimed he had observed the same phenomenon earlier. The controversy was eventually resolved by agreeing on a co-discovery, an opinion shared by many contemporaries, who often referred to bacteriophages as the “Twort-d'Herelle phenomena.”

Perhaps the most fascinating part of the book is the one concerned with bacteriophage therapy (chapters 8–11). Indeed, from 1919, d’Herelle tried to apply bacteriophages as a therapeutic agent against infectious bacterial diseases. First concerned with animal diseases, he then moved during the 1920s and 1930s to human diseases, plague and cholera in India and dysentery in Egypt, where bacteriophage therapy seems to have become a standard treatment. D’Herelle then became involved in a commercial venture selling phage preparations for therapeutic use. Whereas treatment by phages has been abandoned in the Western world since the 1940s, it has remained a current practice in Eastern Europe and several countries in the developing world.

The controversies that developed around the efficacy of bacteriophage treatment and, earlier, around the biological control of harmful crickets were concluded in interesting and similar ways. In neither case was closure attained by one party taking the lead. Rather, the introduction of antibiotics in the first case, and of DDT in the second, rendered the controversy obsolete, since the practical goals set out could be attained through other means.

This book tends towards what is sometimes referred to as “the new internalism.” In brief, this approach is no longer exclusively focused on the intellectual dimension of science, but also on experimental systems and practices. In Summers’s book, the latter are clearly described, often including all the substantial details, as well as long quotations from d’Herelle’s scientific papers. Summers is, however, not impermeable to the social and political context of science. He gives a particularly illuminating description, for example, of d’Herelle’s difficulties in implementing bacteriophage therapy in India, where the rise of nationalist movements in the country led to the rejection of foreign interference, including the predominantly British medical establishment.

Félix d’Herelle’s scientific career bears obvious similarities to Pasteur’s. However, by too frequently comparing the two, in addition to d’Herelle’s own self-comparisons, Summers sometimes gives an unnecessarily hagiographic flavor to an otherwise well-balanced narrative. Some additional caution might also have been advisable in handling one of Summers’ frequently cited sources, an unpublished autobiography of d’Herelle written around 1940. In particular, the authenticity of verbatim quotations of phone conversation that took place almost 40 years earlier is more than doubtful, especially when these highlight the comparisons between d’Herelle and Pasteur that were made by his interlocutor (p. 13). Fortunately, Summers has drawn his narrative from a much wider and impressive collection of published and non-published sources, including oral history.

Finally, the title chosen by the editor, claiming that d'Herelle was at the origins of molecular biology, might help, a cynic would say, sell the book, but has little historical support in Summers's story. Of course, bacteriophages were eventually taken up by Delbrück and his fellows of the Phage group, who became one among so many research groups contributing to the making of molecular biology. But it does not follow that because d'Herelle was a co-discoverer of bacteriophages, he can be credited with anything like "launch[ing] the 'molecular revolution' " (p. 48). The war over the origins of molecular biology, mainly between phage geneticists, biochemists, and crystallographers – each group claiming it has founded the discipline – has been going on for more than 30 years. The title *Félix d'Hérelle and the Origins of Molecular Biology* precisely echoes that of the book that initiated this dispute in 1966: *Phage and the Origins of Molecular Biology*. This debate has been critically analyzed by several historians, such as Pnina Abir-Am, who have shown that it was part of the struggle over authority between disciplines attempting to appropriate the past history and present prestige of molecular biology for their own ends. Summers does much better than merely add a claim to doubtful origins. Indeed, his story supports the view that the "molecularization" of biomedicine, far from originating in a particular discovery or research group, was a broad trend crossing disciplinary boundaries that encompassed not only scientific research, but also medical and agricultural practices.

This book contains many other stimulating insights on biomedical science in the twentieth century. It highlights the heterogeneity of experimental practices, the problematic circulation of knowledge between the lab and the field, the difficulties of experimental replication, and much more. It will be useful to all those interested in these questions and, moreover, provide them with a good read.

Bruno J. Strasser

Reinhard Mocek, *Die werdende Form: Eine Geschichte der kausalen Morphologie*, Acta Biohistorica, no. 3 (Marburg an der Lahn: Basilisken-Presse, 1998), 579 pp., DM 165.00.

This hefty book is perhaps best understood as two nested projects, one framing the other. Its heart comprises three long chapters devoted to analyzing the theories and broader philosophical viewpoints of the long-acknowledged classic masters of causal morphology, Wilhelm His (1831–1904), Wilhelm Roux (1850–1924), and Hans Driesch (1867–1941). The (East) German philosopher and historian of biology Reinhard Mocek has devoted his career to studying these men and the problem-complex of causal