system to allow for more decision-making input by labour, yet the Chilean right claimed that 'Popular Unity Controls Us by Computer' (p. 185) and Beer's leftist colleagues (the British Society for Social Responsibility in Science) snidely reported, 'Chile: Everything under Control' (p. 191). Cold War pressures made socialism a wide target and Project Cybersyn was seen as 'Big Brother', exploiting the oppressive potential of cybernetic 'command and control'. Medina's detailed attention to internal and external stresses and judgements of the project is impressive. She also covers complex relationships between key figures, such as Flores's distancing himself from the project, as he took on the burden of the expanding threats of counterrevolution.

Project Cybersyn was never fully implemented. In 1972, however, it effectively helped to put down a crisis when a strike by truck owners and most of the professional class nearly paralysed the country and toppled Allende's regime. Medina offers a fascinating chapter on how the internet of telexes successfully transmitted information (reportedly two thousand messages a day) in near real time, allowing the government to keep goods and fuel moving. Here was evidence of Project Cybersyn's potential. But we know how the story ends. On 11 September 1973 General Augusto Pinochet's military forces storm the presidential palace. Allende dies. Project Cybersyn is abandoned.

In the epilogue, Medina tracks the whereabouts over the last thirty-five years of Project Cybersyn's main actors caught initially in Pinochet's dictatorship. Flores was imprisoned, would later lose interest in cybernetics, and then settled in Silicon Valley. Others end up in the UK, at Imperial College, for example. Beer, we read, 'worked tirelessly to get his friends out of Chile' and 'kept up these efforts until 1976, when the Pinochet government finally released Fernando Flores into exile (p. 225). The epigraph Medina chose for her prologue is taken from Beer's own assessment of Project Cybersyn in 1972: 'One day this will make quite a story' (p. 1). Indeed. With *Cybernetic Revolutionaries*, Eden Medina has provided a compelling analysis of an important chapter in the global history of cybernetics, one linking northern and southern hemispheres, and one that coincided with great political hope, then tragedy.

Nancy Anderson
State University of New York at Buffalo

Sally Smith Hughes, **Genentech: The Beginnings of Biotech**. Chicago and London: The University of Chicago Press, 2011. Pp. xv + 215. ISBN 978-0-226-35918-2. $25.00 (hardback).
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Sally Smith Hughes's *Genentech: The Beginnings of Biotech* is a history of the first academic–industrial 'start-up' firm dedicated to genetic engineering. Over six chapters, Hughes charts how Genentech quickly progressed from a decidedly small-scale enterprise in the late 1970s, with no dedicated location or facilities, to a multimillion-dollar company that enjoyed the fastest first-day gain in Wall Street history when its shares were publicly offered in 1980. Her approach throughout is largely biographical: drawing on oral histories to examine how Genentech's founders and early recruits determined which compounds to synthesize, negotiated federal guidelines on genetic techniques, and tried to combine academic and entrepreneurial values.

Chapter 1 looks at the prehistory of Genentech, detailing how the young biologists Herb Boyer and Stan Cohen were instrumental in the development of recombinant DNA techniques that allowed scientists to isolate, clone and express specific genes in microorganisms. The second chapter looks at Genentech's creation, as Boyer and the venture capitalist Robert Swanson explored ways to commercially exploit these new techniques. Hughes argues here that some younger biologists like Boyer were attracted to industrial collaborations during the 1970s, thanks to declining federal funding for basic research (although she acknowledges that others remained sceptical about 'selling out' to industry). Chapter 3 then outlines how a small

band of scientists, working at university laboratories but contracted to Genentech, set out to prove the efficacy of recombinant techniques by cloning the hormone somatostatin in microbial cells.

Chapter 4 outlines how Genentech's attempts to engineer human insulin in 1978 necessitated the recruitment of more staff and the acquisition of dedicated lab space. Hughes details how Swanson deliberately targeted junior scientists, who were adept in recombinant techniques and, crucially, more likely to take an industrial position than were their tenured colleagues. The successful production of human insulin led to Genentech signing its first major contract, which gave the pharmaceutical firm Eli Lilly the rights to manufacture and market insulin produced using Genentech's technology. Hughes argues that this 'big company–small company alliance', along with the successful production of a clinically relevant hormone, catapulted 'recombinant DNA into the major leagues of the drug industry' (p. 105). Chapter 5 examines how Genentech scientists then sought to clone and market human growth hormone (HGH). Hughes charts how this project entailed further expansion and, in one of the book's most interesting sections, outlines how Genentech embraced a 'recombinant culture' (p. 132) that combined academic values and commercial objectives: where scientists were encouraged to publish in academic journals, but were pressurized to concentrate on commercially viable projects. The sixth chapter details Genentech's Wall Street debut, outlining how Boyer and Swanson toured Europe and the United States to attract investors, and locating the company's historic share offering amidst a broader public and political enthusiasm for biotechnology.

While *Genentech* is clearly written, it is marred by the fact that Hughes is a clear admirer of the company and the many people she interviewed. This results in a failure to confront the many concerns raised by genetic engineering techniques, and to acknowledge the historical roots of biotechnology and the importance of broader political and legal changes in the 1970s and 1980s. Hughes consistently presents federal restrictions on recombinant DNA techniques as 'obstacles' to Genentech's 'freewheeling, can-do culture' (p. x). This overlooks the fact that scientists, politicians, journalists and others raised perfectly legitimate ethical and safety concerns about genetic engineering, and reduces them to little more than scaremongers. It also ignores a growing literature that shows how external guidelines actually function as a safeguard for new techniques by maintaining public and political trust. In constantly presenting Genentech's methods and approach as revolutionary, Hughes also overlooks its debt to earlier work in microbial genetics and antibiotic production, amongst others, and ignores that a good deal of biomedical research was 'applied' in nature before the 1970s. What is more, she presents Genentech as almost solely responsible for recasting 'the aspirations, direction and culture of the life sciences' and setting the 'stage for the formation of the biotechnology industry' (p. xi). The fact remains, however, that neither Genentech nor the wider biotechnology industry would have succeeded were it not for the federal encouragement of academic–industrial collaborations, set out in the Bayh-Dole Act, and the 1980 Supreme Court ruling that genetically modified organisms were patentable 'inventions'. But these crucial factors are given remarkably short shrift: discussed in less than a few pages and clearly deemed secondary to the inventiveness of 'Boyer, Swanson and their young acolytes' (p. 162).

These shortcomings are encapsulated in the brief epilogue, where Hughes notes that 'Genentech itself foundered in the mid-1980s, undergoing profound financial problems and difficult transitions at the executive level' (p. 167), but refuses to discuss these issues in any detail. By ending with Genentech's successful flotation on the stock exchange, and ignoring its inauspicious later history, Hughes's book runs the risk of appearing more as business cheerleading than as serious history.

Duncan Wilson
University of Manchester