While placing South Korean biomedicine within a history of nation building in a postcolonial context, DiMoia skilfully resists the reproduction of a nationalist narrative. In particular, he modifies the overarching framework of Cold War technological transfer in an age of reconstruction and development with much insight. In the decades after 1945, South Korea relied significantly on external actors and international aid for material resources, funding and education in developing biomedicine. DiMoia carefully foregrounds the intentions of local scientific and professional practitioners amid the intersection of multiple and competing interests. His account also engages with the thorny issues of Japanese and US imperialism by listening for the gaps between the perceptions of actors on the one hand, and the implications and outcomes of the colonial, occupation and military regimes on the other, with great sensitivity to what was both said and unsaid. The book is rarely top-down and makes for especially enjoyable reading in the places where it highlights how ordinary people experienced, and at times resisted, the state's biomedical apparatus. The details of the everyday institutional texture of the medical infrastructure are evocative and frequently surprising.

If I have any criticism of the book, it would be that there are a number of errors in the copyediting, and the attention to causal complexity sometimes comes at the expense of narrative streamlining. As a pioneering work, it invaluably opens up new paths in the history of contemporary science in East Asia. For example, the author himself invites further work on what he calls 'traditional Korean medicine' more generally in the period, military reproductive education and psychiatry, and autopsy. The rich chapters suggest strands that are worth exploring beyond the material already covered, including in areas such as international development, pharmaceuticals, and the social sciences and demographic planning. This important and fascinating book should make essential reading for anyone interested in the global history of contemporary science and medicine and post-1945 North East Asia.

Victoria Lee
Max Planck Institute for the History of Science

Nicolas Rasmussen, **Gene Jockeys: Life Science and the Rise of Biotech Enterprise**. Baltimore: Johns Hopkins University Press, 2014. Pp. 264. ISBN 978-1-4214-1340-2. $35.00 (hardback).
Hallam Stevens, **Life out of Sequence: A Data-Driven History of Bioinformatics**. Chicago: The University of Chicago Press, 2013. Pp. 304. ISBN 978-0-226-08020-8. $30.00 (paperback).
doi:10.1017/S0007087415000916

Molecular biology has without any doubt transformed many aspects of biology and medicine. How far-reaching this transformation was and how it will continue are still a matter of debate. The two studies under review here illustrate fairly well the potential range of answers proposed in this debate. The authors put the spotlight on two developments in this discipline which set them allegedly apart from most other research in biology: the deep entanglement of science with business and molecular biology's increasing reliance on virtual spaces in the making of knowledge about life. While Nicolas Rasmussen arrives at a sobering assessment of the 'biotech revolution', Hallam Stevens believes that there are fundamental new ways to do biology and to understand life as a consequence of the computerization of the laboratory.

Nicolas Rasmussen recounts the heady early years of the biotech industry, when a unique conjunction of scientific, economic and political developments created the conditions for a remarkable and creative translation of basic research into the first generation of recombinant DNA drugs. In the first chapter, Rasmussen describes the rise of molecular biology in the context of Cold War 'big science', and in the ensuing chapters describes in detail the academic and corporate setting for the highly competitive races for human insulin, human growth hormone, interferon, Epo (erythropoietin) and tissue plasminogen activator (tPA). Unlike most other studies on the emergence of molecular biology, Rasmussen focuses in these chapters especially on the regulatory and legal developments accompanying the commercialization of the highly dynamic science. Rasmussen shows that initially biologists set the intellectual, legal and regulatory terms, but this changed when drugs such as Epo and tPA began to be seen as potential blockbuster drugs with a multi-billion-dollar value – there was no longer space for the haughty ideals of academic researchers, and business values began to dominate. Despite this conclusion, Rasmussen's book can serve as a welcome corrective to both triumphant and alarmist accounts concerning the entanglement of molecular biology in particular and universities in general with business interests.

Rasmussen confirms some of the criticisms brought forward by Philip Mirowski in *Science Mart: Privatizing American Science* (2011). Mirowski doubts that the so-called 'biotech revolution' did in fact happen – Rasmussen agrees that the innovative capacity of the biotech industry has been vastly exaggerated. Optimistic expectations were shaped by the fact that the initial rapid advances in this area were based on picking the 'low-hanging fruits' – molecules already well known by decades of publicly funded research and with known therapeutic uses. Long-term data shows, though, that the collective business performance of biotech firms from the late 1980s to the early 2000s just equalled that of traditional drug firms. Furthermore, submissions for regulatory approval of new drugs have not increased since biotech firms started producing them. The hype surrounding recombinant DNA drugs had, in addition to a lack of clear benefits, some real costs, as Rasmussen shows for Epo, a drug controlling red blood cell production. Rasmussen is, however, less concerned about the impact of the biotech gold rush on the professional identity of biologists. He does not see the molecular biologist engaged in these first attempts to commercialize their research as compromising their identity as scientists and their professional standards. The working methods, reward structures and quality criteria were transported nearly unchanged from the university to company labs. What did change was that financial rewards became more essential and Rasmussen expresses his understanding that many talented post-docs with precarious academic jobs chose to work in a setting that could at least promise – if not always deliver – better rewards. Rasmussen succeeds in delivering a readable and engaging account of this exciting episode in the history of molecular biology, though some knowledge of molecular biological terms and methods is essential to follow the story fully.

Hallam Stevens adopts a more narrow perspective but arrives at far bolder conclusions than Rasmussen. In a series of ethnographic and historical case studies Stevens charts the rise of the computer in the biological sciences. Stevens also identifies Cold War 'big science' as the context for the emergence of bioinformatics. He shows that the use of the computer in biology was not inspired by specific problems in search of novel solutions, but by a new instrument in search of problems in a new discipline. After providing the historical background, Stevens focuses on the ways knowledge is made in molecular biology and on how virtual spaces become increasingly important. He investigates the architecture of computers and databases, and how this imposes structure on the data, on the organization of virtual and physical spaces where knowledge is made, on hierarchies in the laboratory – where bioinformaticians are often seen as pure 'data producers' – and on the role of visualization techniques. Despite the quite theoretical orientation and no shortage of technical detail, Stevens has produced a clear and readable account of a highly dynamic and exciting field. His bold conclusion is that biology has become ever more 'data-driven' and that this development is reshaping biology in fundamental ways: Stevens claims that the use of computers has dramatically transformed who biologists are, what they do, how they evaluate knowledge claims and how they understand life.

I can agree largely with that conclusion; there are, however, several issues in Stevens's book which caused me some considerable concerns. First, in the entire book 'biology' is used as a synonym for molecular approaches to biological systems and the author appears to take a radical reductionist approach for granted. This is reflected in my main concern with Stevens's study – his lack of engagement with historical and current developments in other biological sciences, which results in far too strong a demarcation of 'old' and 'new' biology. This is not to deny that important changes have taken place: in the past three decades the relationship between theory and data indeed has changed in biology. Developments as described by Stevens have led to a torrent of data, which in many cases cannot easily be subsumed under a common theoretical framework – a hypothesis-driven science may not be sufficient to do justice to the information contained in the data. It supposedly becomes ever more necessary to let 'the data speak for themselves' (this expression, often attributed to R.A. Fisher, is misleading given the heavy statistical processing involved). Although the sheer amount of data might very well be unique to molecular biology from a logistical point of view, on a methodological and epistemological level similar challenges and opportunities also occur in other biological disciplines. For instance, most ecologists would be surprised to read that 'data-driven' approaches relying on statistical methods to extract significant patterns from large data sets are characteristic of bioinformatics and can serve as a criterion to distinguish 'old' from 'new' biology. The author relates how he, during fieldwork in a Harvard lab, was tasked with developing a method to detect patterns in alternative splicing of messenger RNA. He employed what apparently was a statistical resampling technique to assess the significance of the detected patterns, and claims that this experience illustrates that bioinformatics entails new criteria for evaluating knowledge claims. However, in ecology such statistical techniques have been commonly used since the 1980s to detect competition and other complex processes. In addition, the distinction of data production and data 'consumption' (i.e. creating new knowledge from the data) and the resulting conflicts remind me of a number of similar struggles in other biological disciplines. There might be less money and prestige at stake, but in ornithology a lot of data is generated by eminently skilled, knowledgeable and experienced amateurs, yet most of the published science is created by academic researchers. 'Citizen science' is one attempt to overcome this division.

I tend to give Stevens the benefit of the doubt and assume that statements such as that 'data only belong to computers; they are part of a set of practices that make sense only with and through computers' (p. 7) are meant to provoke and should not be taken literally. Data always emerge out of the interpenetration of material aspects and epistemological practices – whether it is a temperature reading from a mercury thermometer or an automated gene-expression microarray. It is an interesting, and as yet unresolved question, whether data quantity on its own leads to new ways of doing science with novel epistemological practices and norms. Stevens appears to promote such a view, but I am not persuaded given the material in his study. Despite these concerns, his book is valuable as an invitation to reflect on these challenges and as a demonstration of how a new, powerful tool can reconfigure work practices, professional standards and hierarchies, as well as fundamental conceptual outlooks.

THOMAS P. WEBER
Independent scholar

KAREN A. RADER and VICTORIA E.M. CAIN, **Life on Display: Revolutionizing U.S. Museums of Science and Natural History in the Twentieth Century**. Chicago and London: The University of Chicago Press, 2014. Pp. xiv + 467. ISBN 978-0-2260-7966-0. $45.00/£31.50 (hardback).
doi:10.1017/S0007087415000928

Visitors to San Francisco's Exploratorium science centre around 1980 were presented with an unusual spectacle. A grasshopper under a small clear dome with wires inserted into its ventral nerve cord would generate oscilloscope motion and amplified clicks when disturbed. The visitor watched the grasshopper; the grasshopper watched the visitor. Except, as one might expect, because the visitors stopped being as interesting to the grasshopper as vice versa, soon the insect ceased to respond at all. Staff had similar problems with unresponsive fauna or flora in other live physiological displays, such as Brine Shrimp Ballet, which featured 'sea monkeys' swimming