MIGUEL GARCÍA-SANCHO. 2012. *Biology, Computing, and the History of Molecular Sequencing; From Proteins to DNA, 1945-2000*. London: Palgrave McMillan.

This recent book provides a much needed historical perspective on the topic of DNA sequencing—the core of biology's 'big science' or 'omics' projects (primarily genomics, but also proteomics, which came to command large public attention and budgets since the early 1990s). The book also links its main topic of 'sequencing', which it views primarily as a 'form of work' (as opposed to emphasizing it as 'merely' a technique, funding strategy, or conceptual priority) to other key issues in modern biology, such as computing and software, database creation and usage, automation, and commercialization of customer oriented instruments, most notably the 'sequencer'.

The book is divided into three parts, beginning with the historical origins of sequencing in the 1940s in the then key sub-discipline of protein chemistry, a field relying on concepts, methods, and laboratory practices from organic chemistry, chemistry of natural products, and macromolecular chemistry. Proteins' macromolecular status, previously denied during the 'dark age of biocolloidology' (roughly the first three decades of the 20th Century) had been rehabilitated in the 1930s and rose to the supreme status of the "secret of life". Conducted in the international arena under the auspices of the Rockefeller Foundation, protein structure research attracted the attention of many top scientists, from various countries and disciplines, who all believed that protein structure would shed light on most biological functions, including respiration, digestion, and reproduction. The author is aware of the centrality long held by protein structure research, but does not explore whether or how that consuming preoccupation may have delayed the scientific community's interest in sequencing, whether of proteins or nucleic acids, (DNA and RNA) before as well as after WW2.

The author's historical effort focuses on the inventor of protein sequencing in the 1940s, and the co-inventor of DNA sequencing in the 1970s, Frederick Sanger (1918-2013) of the Department of Biochemistry at the University of Cambridge (and after 1962 of the Medical Research Council's Laboratory of Molecular Biology in Cambridge, UK, hereafter MRC-LMB). Sanger twice received a Nobel Prize for his share in each of these seminal feats (a sole Nobel for protein sequencing in 1958 and a shared Nobel with Wally Gilbert for DNA sequencing in 1980).

The book strives to correct the current historiography of DNA sequencing, much of it as the author emphasizes being retrospective, produced by practising scientists who cannot imagine that the roots of sequencing, a major activity largely associated with DNA in the present, may be found outside DNA research. This approach is well taken and much needed since, as the author reminds us, DNA's current centrality is taken for granted, even though DNA, whether as a sequence, a structure, or a substrate, was a late comer to scientific attention. Though the author discusses societal pressures of commercialization in Part III in connection with automation and marketing of the DNA sequencer, his discussion of Sanger's transition from protein to DNA sequencing does not consider the large social forces that may have influenced such a transition in the 1970s. For example, the ending of the post-WW2 steady economic growth, reduction of governmental funding for science, and the rise of a private biotech industry.

Though most of the commercialized products of the biotech industry are proteins, the rhetorical hype that sustained that industry as a culturally and politically prominent endeavor at the local, national, and global level, had gravitated toward DNA, especially DNA sequencing. The author is well positioned to shed light on these larger questions, but he prefers to examine the rising interface between sequencing, whether of protein or nucleic acids (RNA and DNA) and computing. Focusing on the challenges posed by collaboration in biocomputing, the book reminds us that any such collaboration must integrate the diverse skills and values of the distinct communities of information technologists (software engineers and computer scientists) and molecular biologists.

This well meaning effort at historicity in Part I could have benefited from situating Sanger's initial focus on protein sequencing in the research context of his mentors N. Pirie and A. Chibnall, other colleagues in and out of Cambridge biochemistry, physiology, and chemistry, and especially A. Martin and R. Synge. The latter two's discovery of partition chromatography in the early 1940s, recognized by the 1952 Nobel Prize in chemistry, had, as the author emphasizes, a decisive influence on reorienting Sanger toward protein sequencing as a more ambitious goal. The reader would have also liked to know more on how Sanger related to the leaders of the discourse on protein structure, such as J.D. Bernal, D.C. Hodgkin, L. Pauling, M. Perutz, among others. In the period between 1930-1960, all of these well known scientists, Sanger included, ignored DNA and remaining wholly captivated by proteins.

Part II is particularly valuable in clarifying the rise of computation in molecular biology and the contrast between structure and sequence projects in deploying and changing the use of both software and hardware. The author emphasizes how all European initiatives facilitated these historical transitions via international workshops, the rising ethos of interdisciplinarity as a policy agenda, and the rising need for new algorithms to cope with biology's growing problems of data management, whether in specimen collections or databases of complex macromolecules such as proteins and nucleic acids.

Part III contrasts American and European approaches to the automation of sequencing. It examines the role of the private high tech industry in the US, an industry created by former academic scientists who saw the money making potential of new sequencing technologies. This occurred at a time, most Europeans, Brits included, still believed in data and protocol sharing. Perhaps, because governmental support was guaranteed in UK and Europe for reasons of national/ regional pride, those scientists had lesser incentive to become entrepreneurs and high tech managers whose instrument based companies could easily reach market values in the billions of dollars. By contrast, in the US, private companies such as Celera managed to compete with governmental consortia, completing circa 2000-2001 the Human Genome Project in parallel.

The comparison between the Caltech (California Institute of Technology) based tradition of commercialization of scientific instruments in the US (dating to pre-WW2 Beckman Instruments) which led to the creation of Applied Biosystems, a company which successfully commercialized the DNA sequencer in the 1990s and captured the

world market, is compared to the Sanger Center in Cambridge (UK), which opted for a non-commercial approach. That rivalry is fleshed out in terms of institutional, national, and automation levels. In addition to covering timely and important topics, in an accessible and jargon free manner, this book also makes considerable methodological contributions in the areas of historiography, history of technology, and business history.

This book enriches our knowledge of a spectrum of key topics in the history of molecular biology, many of them not yet tackled by historians. Included among these topics are the author's theorizing of sequencing as an emerging 'form of work' (I.1) able to transcend disciplinary traditions; (such as protein chemistry in the case of protein sequencing and molecular biology in the case of DNA sequencing) a concept skillfully adapted from J. Pickstone's comprehensive historicization of science, technology, and medicine. (2000, 2011) For this reason, the author concludes that "the history of sequencing cannot be fully captured by the [disciplinary] standard narratives of biochemistry, molecular biology, or biotechnology—or by a rigid distinction between science and technology. It necessitates our putting ways of knowing, working, and regulating into historical action" (p. 13; see also p. 19). Still, it is surprising that the overlap of DNA sequencing and computer science with the late Cold War is barely alluded to.

The book has an impressive research apparatus, including 22 pages of often very detailed notes; a rich bibliography that includes sources not only in English but also in Spanish; 27 pages of appendices on oral histories and archival sources; a most helpful dual index; (general and 'persons/institutions') and useful diagrams and illustrations.

A few minor caveats remain: the diagrams' mostly unimaginative layout retains the look of an afterthought. References to secondary sources are sometimes too few, e.g. only four books (p. 3) are cited on the human genome project though there are dozens, including in languages other than English (e.g., B. Jordan's *Voyage Autour du Genome*).

It is also not always obvious how the author's arguments relate to those of other scholars who are cited as having previously addressed closely related subjects, e.g. S. Chadarevian on Sanger's research program in sequencing in the context of MRC-LMB in the mid-1990s and early 2000s; J. November on the rise of biomedical computing in the US (2012); B. Strasser on the creation and use of databases in biology (2010, 2011); and E. Suárez-Díaz on the use of protein sequences in molecular evolution (2007) and the growth of bioinformatics at the interface of evolution and genomics (2010).

Along these lines, T. Soderqvist's edited volumes on the wide range of methodological challenges posed by the writing of the history of recent science (1997 and 2006, the latter co-edited with R. Doel) have unfortunately not been cited as relevant. Possibly, the author's background in science journalism led him to underestimate how very troubled historians of science do remain with regard to successfully addressing the challenges of recent science.

Still, this book addresses a unique combination of major interlocking developments in recent molecular biology in a concise, informative, and refreshing manner. As such, it deserves the widest possible audience.

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MANUEL GARCÍA-CARPINTERO & MAX KÖLBEL, eds. 2012. *The Continuum Companion to the Philosophy of Language*. London: Continuum Publishing.

The Continuum Companion to the Philosophy of Language, edited by M. García-Carpintero (Universitat de Barcelona) and M. Kölbel (Universitat de Barcelona), aspires to offer an up-to-date introduction to several relevant areas of research in the philosophy of language. The book, therefore, does not intend to provide a detailed historical account of all the developments in the discipline, or an exhaustive exposition of its many subfields—something that would lie far beyond the scope, and the space limitations, of this volume. The editors have chosen to concentrate instead on some central topics that are currently the object of intense study.

The contributors to this book are international leading experts in each of the areas covered. As a result, all of its chapters constitute an excellently informed and accurate presentation of the topic in question. Although original contributions to the debates only take place occasionally, most of the chapters manage to offer a high-level and insightful overview of their subject area. Thus, this book will be of interest not only for newcomers, but also for those with previous knowledge in the field. On the contrary, it will perhaps be too advanced to serve as a basic manual for undergraduates. This companion is probably best suited for graduate students, and in general for researchers looking for an introduction to the contemporary landscape of the philosophy of language—or at least, to some of its main sights.

The editorial introduction, written by Garcia-Carpintero consists of a brief outlook of the historical background of the discipline, and of how the central issues emerging from such background have been projected to the more recent debates. The author himself acknowledges that his presentation is idiosyncratic: where the orthodox choice would be to start with Frege's seminal contributions, Garcia-Carpintero prefers to focus on Wittgenstein's *Tractatus* and the way it synthesises several Frege's and Russell's insights. From here, he extracts various fundamental questions that would have paved the way for the main future developments of the discipline. This historical perspective provides a sophisticated and unusual introduction to the themes treated along the book—although, of course, it is not the only possible historical approach.

The following chapter (by J. Higginbotham) is entitled 'On the Nature of Language: a Basic Exposition'. One might have expected a discussion of general features of language such as communication and signalling, but what we find instead is a com-