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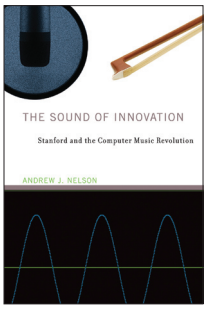
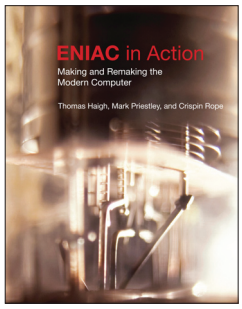
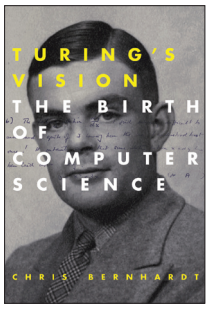
Book Reviews / Comptes rendus

Past Calculations: New Histories of Computing Technology

by David Theodore, McGill University







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Imagine for a moment a computer. Now imagine you're going to use it to get something done. Anything. Make a proof in mathematics; book an airline ticket; compose, record, or play music; calculate artillery trajectories. Can you do what you want to do without considering the technical details? Do you have to know how a computer works to get that work done? The answer, for most of us most of the time, is "no." We don't have to know what goes on inside the black—or beige—box. However, *someone* has to know—otherwise, computing couldn't help us do anything at all.

The same conundrum holds for scholars telling the history of the computer. Most of the time, what we really want to explore concerns the roles computers play in our lives. We want to study how computation fits into social, economic, political, and cultural history, and to understand the people involved: the computer designers and architects, the coders and software programmers, the engineers and sales teams and, of course, the users. But some of us also want to know about the contingencies and

exigencies delineating the hardware and software. We want a tale of technology organized around technical and mathematical concepts and the physical characteristics of the machines themselves. How do these two stories, the social and the technical, mesh?

The idea of merging these two approaches under the aegis of the technosocial came of age with Paul Edwards' 1996 book *The Closed World: Computers and the Politics of Discourse in Cold War America*, published by MIT Press. Edwards proposed links between the development of digital computing and a wide range of other fields, including artificial intelligence, cinema, and politics. Moreover, he approached "the computer" simultaneously as a technical artifact, as a location of social and political practices, and as a metaphor. This made computers fair game for literature and media studies, and opened up ways of integrating computers into an array of scholarly work. In short, even though the history of computing has maintained its own themes, questions, and literature, it has, at the same time, overflowed its own boundaries.

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Indeed, the inevitable has happened. The tension between the technical and the social is now slightly old-fashioned. Scholars have enlivened the literature by engaging new concepts in technology studies, by positing nuanced sociological frameworks for analyzing hardware and software engineering, and by developing (and critiquing) the hypothesis that since the digital computer first appeared we have been living in a networked, digital age. The computer artifact remains connate to the field, yet it is no longer the protagonist of the story. It's no accident, for instance, that one of the most cited history of computation articles is Jennifer Light's 1999 essay "When Computers Were Women." Its popularity manifests a widespread scholarly desire to intertwine the computer (and its cognates the digital, the digital age, and so on) with non-technical topics, themes, and disciplinary conventions.

Edwards' publisher, MIT Press, has been a catalyst for the technosocial turn. A penchant for promoting book-length studies of computing might be expected from a press linked to an institution itself intertwined with all things digital. It is not surprising, then, that the MIT Press catalogue manifests the vivaciousness and breadth of the field. Yet it is an expanded field. One sign of how much computers are now inextricable from disparate scholarly approaches is that the four recent books reviewed here appear in four different series: Platform Studies; Science, Technology, and Society; the Inside Technology series; and the History of Computing series. At their best, these histories detail the emergence of new scholarly approaches in which the complexities of hardware and software are inextricable from concepts, scientific objects, and social goals.

Take for instance Alison Gazzard's *Now the Chips Are Down*. Published in MIT's Platform Series, edited by Ian Bogost and Nick Monfort, the book

dives into the history of the short-lived BBC Micro. This personal computer was built by Acorn Electronics and sold in Britain from around 1982 to 1986 as part of the British Broadcasting Company's Computer Literacy Project. The Micro is a perfect protagonist for the series. Bogost places platform studies as the media studies equivalent of looking at computer architectures. Authors in the series rely on technical analyses of both hardware and software, but with an eye to seeing how creativity and culture connect to devices. Video game platforms are especially useful for understanding how the mixture of popular computing and creativity evolved both for game designers and producers and for players.

Gazzard foregrounds the way communities formed around the Micro, moving deftly between the executives of a media company (the BBC), the decision-makers at a hardware company (Acorn), and institution-specific users, mostly students at British schools, but also television audiences. One part of her project is to limn some of the roots of virtual communities, beginning with the BBC's Teletext-based attempt to supply computer content at a distance. The idea was that hobbyists could use so-called telesoftware to download games or educational programming (typically at night given the slow transfer rates) and allow home computer enthusiasts to exchange programs. Overall, Gazzard makes a convincing argument that multi-platform computing was prefigured by the Micro. Gazzard also links the Micro to the Domesday project, a pioneering collaborative project that integrated the Philips Laserdisc player for multimedia files. And she includes an insightful discussion of how the Micro led to other computer projects, especially today's ever-popular Raspberry Pi.

If Gazzard makes a platform the hero of her story, Chris Bernhardt centres *Turing's Vision* on a publication. The book celebrates British mathematician Alan Turing's famous 1937 paper "On Computable Numbers, with an Application to the *Entscheidungsproblem*," which, as Bernhardt's subtitle calls out, is a key document of the "birth of computer science." This article introduced the Turing Machine, a simple theoretical model meant to help study ideas of computability. Turing argued that if a computation is impossible for his theoretical machine, it would also be impossible for a physical computer. Famously, he was able to show that the decision problem (*Entscheidungsproblem)*, a challenge about algorithms issued by mathematician David Hilbert in 1928, could not be solved by a computer.

Bernhardt pitches his book for computer science undergraduate; he believes, as a bedrock educational principle, that it is important for students to know about founding principles and founders of their discipline. He explains Turing's paper eloquently, teaching the reader in a sequence that clearly comes from having successfully taught this material many times. The only downside for scholars is the hagiography. Bernhardt enshrines Turing's life and the paper's place in the history of ideas in the potted form you might expect to find say, outlining the life a composer in the notes of an opera program. No matter. Turing's life—radical mathematician,

war hero, gay martyr—has made for easily accessible engaging dramatic renditions: Andrew Hodges's 1980 biography *Alan Turing: The Engima* and Hugh Whitemore's 1987 play "Breaking the Code," to name only two. Bernhardt's book is ideal not only for the target audience, but also for historians and STS scholars who may be newly introducing themselves to the history of computation. It is well suited to any non-mathematically oriented reader who wishes to gain a clear understanding of computational concepts. They will need to find the critical historiography elsewhere.

Andrew J. Nelson's *The Sound of Innovation* moves computing history onto the terrain of management and institutional history. For Nelson, neither the artifact nor the social construction of computing is the focus. Instead, he gives a close account of the origin and development of an institution, Stanford University's Center for Computer Research in Music and Acoustics. Nelson makes an intellectual argument for the mutual support of industry, musical composition and performance, and academic research, all based on the varied interests several actors invest in and around particular digital technologies. He frames his study around three ideas: radical interdisciplinarity, open innovation, and the commercialization of university research. Specifically, the central technology that made CCRMA viable was frequency modulation synthesis (FM), a technique invented by composer John Chowning. Yamaha Music Corporation licensed FM in 1975, and used it as the basis of the DX7 synthesizer, one of the all-time best selling musical instruments. FM synthesis, also the technology at the core of cellphone ringtones and multimedia soundcards for personal computers, remains one of Stanford's most profitable licences. And profit is key to Nelson's account: digital technologies develop simultaneously with the institutions and humans who design, deploy, and promote, and profit from them.

Nelson's book reveals an interesting moment in historiography. In his telling, some of the ideas around computing—innovation, simulation, interdisciplinarity—are imitated in the way that he writes the history of computing. He argues that the relationship between music performance, academic training, and entrepreneurial development—mediated, specifically, by computer technology—is a formula that other business and research centres interested in innovation can learn from. He includes the ups and downs of the CCCRMA's long life—it opened in the 1960s and is still a major player—but nevertheless he assesses the institution' longevity and influence as an unequivocal success. This enthusiasm for technology does not seems well modulated, especially compared to engaged critiques of Silicon-Valley boosterism from the likes of Alexander Galloway (*Protocol: How Control Exists after Decentralization*, 2006) Evgeny Morozov (*The Net Delusion: How Not to Liberate the World*, 2011) and Tom Slee (*What's Yours is Mine: The Dark Side of the "Sharing Economy,"* 2015).

If *The Sound of Innovation* adds a new plotline, *ENIAC in Action* self-consciously revisits one of the

foundational stories of the technosocial narrative. Thomas Haigh, Mark Priestly, and Crispin Rope reevaluate ENIAC's renown as the first "general-purpose programmable electronic computer." The authors take that designation as an entry point into the machine's history, instead of the triumphant conclusion. They re-examine the idea of the digital computer as a war machine. One of ENIAC's first jobs, after all, was to simulate atomic fission for the physicists working on the Manhattan Project. The authors also add sections on the life of the machine after it was shut down, both tracing the re-use of the machines physical parts and its reception in scholarly, popular, and technical literatures. In their retelling, Haigh, Priestly, and Rope demonstrate how the ENIAC is not one thing, but an aggregate of object and idea, assembled, disassembled, changed, and cannibalized.

The authors renew the stories and methodologies of computer history relying instead on consolidation and nuance—which is pretty much the sweet spot for a study of computing. In a scholarly and professional world that fetishizes innovation, resisting the urge to present a rethink as a revolution is salutary. In the introduction the authors state that they aim at a "re-integration of technical detail into history influenced by the perspectives of science studies, labor history, institutional history, memory studies, and gender history" (14). That's a tall order, but the book achieves it. For the authors are well aware of the limitations and advantages of the genre (academic monograph). For instance, they enlist a familiar array of frameworks derived from Science and Technology Studies (mostly Bruno Latour's idea of science in action), social constructionist models, and platform-studies, and add up-to-date references to computer history scholarship. The authors have wide swathes of secondary literature seemingly at their fingertips, and carefully tweak it with incremental updates based on both old sources newly considered and new documents. What makes the book sophisticated, in particular, is the integration of technical material with an astounding quantity of archival research.

In all four of these books somehow the physicality of computing machines remains absent from the story. Indeed, it's a critique, not merely of these particular books, but also of some of the unnecessarily imposed limitations of scholarly publishing more generally —limitations felt most strongly in the history of computing/digital history. Scholars of material culture and the "visual turn" in the humanities just don't seem to have made much headway in computer history. In *ENIAC in Action*, the authors include hand-drawn flow diagrams as well as re-drawn diagrams that they analyze in the text. There are also some striking photos of machines, such as a US Army photo of the ENIAC set up in Aberdeen in 1948. These images help convey the texture of computing. But the others are woefully under-illustrated. The exception proves the rule. Likewise, why no sound for a book on computer music? If ever a book needed hyperlinks to websites: a book about computer music without any associated audio means that the authors have also not made the "sound studies turn." Why so little "code," given

the importance to code raised in media studies. They miss important chances to give readers a better idea of the experience of computing.

So how might these books map the field of computer history today? Albeit conservative, these four books manifest the vivacity of computer history today. They demonstrate how the expanding scholarly literature has forged a range of answers to the historiographic problems posed by the technosocial research-industrial complex that computing emerged from. It is at the same time surprising that while these texts collectively cover so much ground, they nonetheless show how much exploration still needs still to be done. The relevance of the scholar press's imprint is remarkable, here, too, that points to good editorial work at MIT Press. Gazzard's work on the Micro is a fine addition to Platform studies, and Nelson's text on computer music at Stanford hints at the complexity of the computer in the history of the university. Graduate students or scholars coming to the field of computation will find Bernhardt's work on Turing's ideas very helpful. And *ENIAC in Action* is definitive enough to move scholarly interest away from the quest for "firsts" and on to more thoughtful analyses—at least for a while.