Department

Reviews of Recent Publications

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R. R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*. Baltimore, MD, USA: Johns Hopkins Univ. Press, 2015.

The historical literature on cybernetics has ballooned in the last 15 years, as scholars have sought to understand how scientists and engineers studying "control and communication in the animal and the machine" (as Norbert Weiner subtitled his book *Cybernetics*) contributed to Soviet and Chilean computer networks, assistive technologies for the deaf, theories of schizophrenia, and experimental music and cinema, to name just a few of their projects. This range of topics raises anew the question—central to historians' accounts since the early 1990s—of what exactly cybernetics was. As the first book to integrate the many dimensions of cybernetics into a single narrative, *The Cybernetics Moment* presents a new answer to this crucial question.

For Ronald Kline, cybernetics was most critically a site of contestation, and more specifically of what sociologists term boundary work. Practitioners continuously fought over and redrew the borders of cybernetics, demarcating it from adjacent disciplines like information theory, general systems theory, and bionics, and dividing cybernetics itself into subdisciplines like management cybernetics and medical cybernetics. Many of the founders of the field had the ambition to create a universal discipline, but Kline emphasizes their failure to do so, as practitioners disagreed about the content of cybernetics, fractured it into more narrowly defined disciplines, or carried lessons back to traditional disciplines and, thus, abandoned the project of building a new one.

Kline's emphasis on boundary work is supported by his careful attention to shifting alliances, discourses, and research programs. He points out, for example, that the cofounders of cybernetics who attended the Macy Conferences in the 1940s and 1950s focused on feedback and circular causality only in their first meetings; after about 1949, they fixed their attention firmly on the question of how to measure information. Concepts and discourses of information remain a central dimension of the book from that point forward; it devotes a chapter to how scientists constructed information theory as a distinct discipline in the 1950s, and another to how the phrases *information technology* and *information society* became ubiquitous tools for making sense of technology and society in the 1980s and 1990s.

In this account, the Macy Conferences reached a moment of both heated debate and

great insight when participants argued over the meanings of the words *analog* and *digital*, which referred both to the dichotomy between continuous and discrete representations and to the analogical relationship between a physical system and a model of it. "These names confuse people," protested psychologist and computer networking pioneer J. C. R. Licklider. "They are bad names." Nonetheless, the terminology persisted because, as statistician Leonard Savage pointed out, "we have had this dichotomy for four or five years.... There would be some friction for most of us in changing it now."

As much as it was anything else, cybernetics was itself an analogy between humans and machines, an assertion that mathematical techniques and scientific methods designed for studying one could be fruitfully applied to the other. A benefit of Kline's relatively comprehensive approach is that he is able to demonstrate how this analogy worked in both directions. In a chapter on "Humans as Machines," Kline documents efforts by social scientists, including Herbert Simon, Talcott Parsons, and Gregory Bateson, to understand both individual humans and societies as systems of information and feedback. In the following chapter, "Machines as Human," he shows how artificial intelligence and bionics were conversely projects of making machines like organisms, and how some physiologists envisioned integrating machines and humans into cyborgs (a word they coined) capable of surviving space travel.

Scholarship on boundary work has often focused on efforts to demarcate science from pseudoscience, and this too was a concern of cyberneticians. One can thus learn from Kline's research that Weiner's lawyer requested that science fiction writer L. Ron Hubbard stop implying that Weiner endorsed his cybernetics-inspired psychotherapy of dianetics, which became part of his religion of Scientology. Perhaps more surprisingly, information theorist Claude Shannon described Hubbard as a friend and introduced him to neurophysiologist Warren McCulloch, with whom Hubbard carried on a correspondence.

Kline's accounts of the relationships between cybernetics and the fringe are strongest in these accounts of the 1950s, when many of those involved were canonical founders of cybernetics. This side of the cybernetics discourse grew in the 1960s, though, with books like video artist Paul Ryan's *The Cybernetics of the Sacred*, which Kline confronts twice in passing, and cosmetic surgeon Maxwell Maltz's bestselling self-help book *Psycho-Cybernetics*, which is absent from *The Cybernetics Moment*. Although he does not fully make sense of how artistic, countercultural, and New Age appropriations of cybernetics fit into its longer history, Kline concludes—I think rightly—that many scientists took cybernetics less seriously as a result of them, and thus that "legitimacy exchange" between fields, described by Geoffrey Bowker as a crucial factor in cybernetics' success in his 1993 article "How to Be Universal," cut both ways.

Kline comes closest to the bread and butter of the history of computing in his account of the disciplinary development of artificial intelligence, which focuses on the Dartmouth Summer Research Project on Artificial Intelligence that brought researchers together in 1956. Beginning around then, and continuing into the 1960s, AI researchers—several of whom, including Herbert Simon and Marvin Minsky, had come to AI through their interest in cybernetics research programs like McCulloch's neural networks—distinguished their research from cybernetics. If the paradigmatic artifact of cybernetics was an analog model of a brain, they suggested, the ideal result of their new project would be a digital mind created without reference to existing organisms.

Nonetheless, *The Cybernetics Moment* is not a history of computing narrowly conceived. Rather, it is a history of the intellectual context in which digital computation became a pervasive part of our lives. Ultimately, Kline sees cybernetics as a site of debate about not only the nature of information but also its ethics. "The ideas that fill the writings of Weiner and Bateson—," he writes, "the unsuitability of information to be a commodity because of its equivalence to entropy, critiques of secrecy in scientific research, and the unemployment caused by computerization, and that adopting a cybernetic epistemology would eliminate destructive attitudes toward the environment—are no longer part of a broad discourse on

cybernetics and information science." By telling its story, Kline contributes to resparking these contestations.

Matthew L. Jones, *Reckoning With Matter: Calculating Machines, Innovation, and Thinking About Thinking from Pascal to Babbage*. Chicago, IL, USA: Univ. Chicago Press, 2016.

Review by Michael J. Baranay

Adding numbers together must be one of the most persistently underestimated challenges of modern history. Great philosophers and inventors from Blaise Pascal to Charles Babbage and beyond have thought the task straightforward, set out to mechanize it, and found themselves drawn into a technical, social, and philosophical morass of tremendous consequence with few easy answers. *Reckoning with Matter* turns this problem of addition toward a masterful account of the historical philosophy and political economy of creativity.

Set in the period between the first European attempts to build mechanical arithmetical devices in the mid-17th century and such devices' tentative commercial success in the mid-19th century, the book concentrates on the shifting aspirations, contested negotiations, and technical accommodations of philosophers and artisans who repeatedly tried and generally failed to build satisfactory calculating machines. A slim, richly illustrated volume, *Reckoning with Matter* plies close readings of an astounding assemblage of correspondence and records related to these machines' design and manufacture to develop critical interventions in the history and philosophy of intellectual property, genius, and creativity, and technological innovation, with consequences for our understanding of both past and present. Jones does this while maintaining a nuanced skepticism about the historical significance of machine calculation for these fields, challenging numerous anachronisms and out-of-context implications associated with arithmetical devices and arguments about them.

This book comes to us a decade after Jones's first monograph, *The Good Life in the Scientific Revolution* (Chicago, 2006), and returns to two of that book's three animating philosophers: Blaise Pascal and Gottfried Wilhelm Leibniz. They are joined here by a colorful cast of artisans, mechanics, nobles, and savants, reaching across Western and Central Europe and over the Channel to England, including many familiar names from the history of computing and many others that lend new dimensions to this history. Jones cycles repeatedly through a core stable of characters, problems, explanations, and concerns, often reintroducing them as they reenter his narrative. This technique, itself reminiscent of mechanical apparatus under consideration, helps Jones sustain a number of clear themes and subjects with a rewarding complexity.

Time and again, Jones's philosophers and artisans confront the technical challenge of carrying: turning an excess 10 from an addition at one place value into a 1 in the next higher place. Jones explains the engineering difficulty in terms of two basic problems. The problem of "sufficient force" came from the fact that a single carry might have to propagate across a great many digits (think of $9999 + 1$), and the machine needed enough strength and mechanical impetus to follow the carry to its end. The less felicitously named (and advisedly anachronistic) second problem of "keeping-it-digital" referred to the difficulty of ensuring the machine produced motions in precisely the discrete steps needed to display integer results. Jones seems to sense the infelicity, and by mid-book he tends to favor actors' terms such as the problem of "security" that, once explained and contextualized, better serve his narrative and argument. In an exceedingly clever and effective narrative device, Jones follows each of his main chapters with a short "carry" that recapitulates the chapter's theme through a different aspect of the history of Charles Babbage's Difference Engine, often setting up the next chapter in turn—with the fourth carry (on Babbage's claims to novelty) an especially successful implementation of the conceit.

Jones begins his argument by contrasting the devices, methods, and philosophies of production of Pascal, Morland, and Leibniz, using a meticulous analysis of their relationships with skilled artisans to reveal a collaborative and iterative process of design depending on many forms of material and social knowledge. The book's middle chapters focus on the legal and creative status of these philosophical inventions, first for the three previously discussed philosopher-inventors and

then for German Enlightenment inventors Philipp Hahn and Johann Müller and their French counterpart Philippe Vayringe, who together exemplify for Jones the 18th-century values and principles of emulation, the process of imitating and seeking to improve meritorious creations. Jones next synthesizes the foregoing insights in a striking analysis of Stanhope's design process, deftly situated in relation to the political economy of Genevan clockmaking. The last chapter unspools the later history of calculating machines in the philosophy of thinking, and the final carry offers an epilogue that draws the story through the mass manufacture of calculating machines and the advent of electronic computing.

The book's main conceptual and moral thrust comes from Jones's account of emulation, which he argues encapsulates the creative process more honestly than later legal, philosophical, and historiographical frameworks. Jones artfully realizes the multilayered pun in his title—using matter to reckon, reasoning about matter, grappling with matter's difficulties, and so on—with well-posed discussions of calculation's material dimensions that remain trained on their social, political, and philosophical implications. Another distinctive strength is Jones's attention to his characters' theological concerns: the philosophy of creativity was, after all, foremost about reckoning with God, the ultimate creator.

In such a short and wide-ranging book, there are invariably noteworthy omissions. Discussions of sex and gender are conspicuously absent amidst the analyses of household economies, occasional cameos from wives, a couple perfunctory mentions of Ada Lovelace (only as caricatured by Alan Turing), and, most strikingly, the repeated invocations of birth, fetal development, midwifery, and even abortion in Early Modern and Enlightenment conceptions of creation and (re)production. Worked materials matter greatly here, but one misses the political economy of raw materials, mining, and metallurgy at several points. Perceptive analyses of labor relations between philosophers, artisans, and their wealthy patrons refrain from venturing into broader considerations of labor and capital. A similar complaint applies to Jones's insightful theological discussion, which treats his main characters' arguments about creation and imitation with care but leaves aside many higher profile facets of the history of religion and devotional practice. Like the flaws in the machines Jones studies, such defects in the analysis seem rather to indicate the fecundity of Jones's project and to call for virtuous emulation—imitating, reengineering, and improving on an eminently worthy exemplar—by many scholars hence.

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■ REFERENCES

1. R. R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age.* Baltimore, MD, USA: Johns Hopkins Univ. Press, 2015.
2. Matthew L. Jones, Reckoning With Matter: Calculating Machines, Innovation, and Thinking About Thinking from Pascal to Babbage. Chicago, IL, USA: Univ. Chicago Press, 2016.

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