Must We Embody Context?

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FORUM: THE PAPER TECHNOLOGIES OF CAPITALISM

Must We Embody Context?

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ABSTRACT: The essays in this forum brace this meditation on the historiography of technology. Understanding devices incorporates the context of any particular hardware, as John Staudenmaier showed by quantifying the contents of the first decades of *Technology and Culture*. As contextualist approaches have widened from systems theory through social construction and into the assemblages of actor-network theory, the discipline has kept artifacts at the analytical center: it is the history of technology that scholars seek to understand. Even recognizing that the machine only embodies the technology, the discipline has long sought to explain the machine. These essays invite consideration of how the history of technology might apply to non-corporeal things—methods as well as machines, and all the worldly phenomena that function in technological ways even without physicality. Materiality is financial as well as corporeal, the history of capitalism reminds us, and this essay urges scholars to apply history-of-technology approaches more broadly.

Historians of capitalism and historians of technology both want to know how things work.[1] To put the two into conversation with one another, however, is to ask just what we mean by "things." Perhaps ironically, the history of capitalism's interest in the material world here suggests that the

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1. Seth Rockman, "What Makes the History of Capitalism Newsworthy?"; Jeffrey Sklansky, "The Elusive Sovereign"; Kenneth Lipartito, "Reassembling the Economic."

methods used by historians of technology—our approaches to understanding what technology is, why it works, and how it changes—can be applied to things other than the physical world. Readers of this journal recognize that the machine is not itself the technology—that the machine or tool is the device humans use to do things and the technology is the process of doing them.[2] In looking beyond the machine to understand how it works, historians of technology have learned that artifacts have politics; that technologies which have an impact are themselves shaped by the contexts of their origins; that the systems which both compose and surround technologies begin in social construction but mature to determinism that can shape human behavior.[3] These foundational understandings can be applied as much to business calculations and to paper money's power as to a steam engine.

Of course, expanding the investigation beyond the physical machines of technology is not new. By the 1980s, the field had shifted from internalist to contextual analysis as part of the rejection of technological determinism. Then systems theory admitted that technologies do indeed shape the world around them but insisted that their origins were more contingent. At the beginning a technological system bears the marks of surrounding politics and law, economics and business structures, and society and culture, but the system eventually matures in ways that make it more resistant to change so that it influences the world around it.[4] From there, the field began to focus on those origin points. Influenced by the sociology of scientific knowledge, it adopted social construction methods and adapted them from knowledge to artifacts.[5] Following this track has led some scholars in the field to use actor-network theory (ANT), which assembles humans and the institutions they build and the objects they make and use in order to understand the social world people create and recreate every day, including their technologies.[6] In doing so, ANT collapses the wall between technological determinism and social construction. Nowadays some historians of technology, by studying maintenance rather than innovation, move away from the origins of new devices and toward understanding how much work and capital is required to keep existing systems working.[7]

Not all practitioners have followed these trends; most historians pick

2. Alex Roland, "Technology."

3. John M. Staudenmaier, *Technology's Storytellers*; Langdon Winner, "Do Artifacts Have Politics?" Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems*; Thomas P. Hughes, "Technological Momentum."

4. Staudenmaier, *Technology's Storytellers*; Thomas P. Hughes, *Networks of Power*.

5. Bijker, Hughes, and Pinch, eds. *Social Construction of Technological Systems*; Wiebe E. Bijker and John Law, eds., *Shaping Technology / Building Society*.

6. Bruno Latour, *Reassembling the Social*; John Law and John Hassard, eds., *Actor Network Theory and After*.

7. Lee Vinsel, "The Maintainers."

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and choose from among the theories offered by the social sciences. Historians of technology are a disparate group. The field includes both scholars and members who are not historians but instead identify as sociologists, anthropologists, engineers, economists, and buffs. Scholars from other disciplines write history at the same time that they participate in their own disciplines. As a result, the methodological basis of the field is multidisciplinary and the field itself is interdisciplinary. Nonetheless, these practitioners know things in common and cohere into a single professional identity. Systems theory remains a popular mode of understanding developing technologies, while internalist analysis can be used to understand how particular devices were once socially constructed.[8] However, the direction of the historiography has been to include more than hardware in the explanation of what works, and the context that aids these explanations keeps widening: from the adjunct technologies such as the relationship between lightbulbs and turbines run by waterfalls to the ever-enlarging network of people and institutions, social and economic relations, cultural meanings, assumptions about what is natural or appropriate, and personal purposes, which are part of deciding that a device is worth using.

Yet as Seth Rockman points out in this forum, the association of technology with machinery is long-standing—just consider the popular understanding of "technology" as smartphones or computers. Capitalism suffers from this same confusion of the physical embodiment with the real thing. Capital is often defined as machinery or other investments in productive capacity.[9] But in these essays and more generally, the word "material" applies to financial as well as physical things. Meanwhile, historians of capitalism ask familiar questions of their topic of study: What is capitalism and how did it develop? It appears inevitable, but its history must be contingent—if so, when did it move from something conditional to something determinative? These are questions historians of technology also ask of our own topic.[10] Since at least the social construction era, the discipline has often presented the devices it describes as anything but inevitable, while the new historians of capitalism likewise aim to denaturalize and historicize the economic system they study. They incorporate physical things the way historians of technology have incorporated contextual things: to explain how the whole system works and why it developed when it did. It is at this juncture, between the corporeal and the contextual, that the history of capitalism and the history of technology may work together.

At the same time, to many observers, the two subjects are intrinsically

8. Carry van Lieshout, "Droughts and Dragons"; Ivan Paris, "Domestic Appliances and Industrial Design."

9. John Black, *A Dictionary of Economics*, s.v. "capital."

10. Ruth Oldenziel, *Making Technology Masculine*; Eric Schatzberg, "*Technik* Comes to America"; Barbara Hahn, "The Social in the Machine"; Francesca Bray, "Science, Technique, and Technology."

linked—technological progress and economic growth seem to fit together either naturally or historically.[11] Since Marx wrote "the hand-mill gives you feudalism, the steam mill gives you industrial capitalism," technology has been implicated in changing economic systems, even if historians of technology reject the determinism implicit in the phrasing.[12] That historians of technology usually avoid such assumptions of progress fits well with the new history of capitalism that is as interested in the costs of growth as in its achievements.[13] Historians of both technology and capitalism know that their subjects are products of particular times and places. Capitalist activity does have a technological component, from the machinery of production to the systems of distribution. As these essays demonstrate, however, the tools that make the physical possible are sometimes themselves incorporeal. They can, however, invite the sort of analysis we apply to machinery.

The essays collected here demonstrate how practitioners in this new field historicize capitalism. They show the contestation at the origins of capitalist behavior. They define technology expansively, by adding computations and representations to the machinery of production and the systems of distribution that express capitalist behavior. In doing so, these historians of capitalism indicate that methods which explain technology may be used to illuminate the way value is embedded in physical currency and the way certain computation methods make capitalism work, from a useful humble reckoning skill to the calculation of a financial outlay that hopes to receive a return at a future date. In other words, these essays invite historians of technology to consider capitalism as if it were a technological system.

Can the history of technology stretch to the nonphysical methods and meanings that are covered in the papers that preceded this one? Two of them study methods of mathematical calculation, rather than physical devices. Another examines how paper money expressed fears and uncertainties precisely in its detachment from physical reality. Yet thinking about these works as histories of technology may explain what the discipline offers to other scholars who might benefit from its methods. Scholars of technology may be able to see our own reflections in the mirror field that studies capitalism. Both subjects have histories, and linking the two expands the impact of them both.

Rockman's paper introduces the origins of this forum. The authors first delivered their papers in 2012 at the opening of an exhibit of business ephemera. Entitled *Mind Your Business*, the John Carter Brown Library in Rhode Island presented records from early American commerce, including shipping records, orders, payments, invitations, and account books

11. Robert Heilbroner, "Technology and Capitalism"; Walt Mossberg, "On Capitalism and Technology."

12. Karl Marx, *The Poverty of Philosophy*; Leo Marx and Merritt Roe Smith, eds., *Does Technology Drive History?*

13. Rockman, "What Makes the History of Capitalism Newsworthy?" 463.

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owned by the library.[14] Contemplating these ephemera in technological terms inspired the authors to consider the "paper technologies of capitalism"—a phrase that evokes trade, the paper artifacts of economic activities, devices for handling paper, and the calculations used to transact in the course of doing business. In linking these essays and the exhibit together, Rockman introduces the historiography of capitalism—its embrace of "the material turn"—to the history of technology.

Rockman's discussion of materiality reminds readers that "scholars are now giving *things* a far greater capacity to act on people." This turn toward incorporating nonhuman actors joins writers in science and technology studies who accord objects a role symmetrical with that of humans.[15] One need not venture all the way down the path to technological determinism to recognize that technologies and the objects that embody them shape the methods with which they are used, and vice versa. Rockman's version of materiality argues that this is "not a world of infinite possibilities made possible by abundant stuff, but rather a world of limits" because objects shape behavior—and can even contain scripts for human behavior. Bruno Latour's depiction of the Berliner key in "Where Are the Missing Masses?" is an excellent example: it required its users to lock the door closed behind them, but if used incorrectly it could lock the door open, working against its designers' intentions. It required users to perform a specific action in order to fulfill its purpose.[16] Many devices do. Is this determinism?

The machine is not the entirety of the technology, nor are the devices that dictate our actions all machines. Bureaucracy is "rule by a piece of furniture," Rockman reminds us. Likewise, the layout of letterbooks and checkbooks shaped commercial behavior and activity: they led to a process, they embodied a technique. Also likewise, rules and laws and language shape our behavior. Recognizing this, historians of capitalism borrow from New Institutional Economics an interest in rules and how they embed (if not embody) the seemingly natural urge to maximize, to buy low and sell high. In this they are like standards though they can be entirely incorporeal.[17] Rockman's introduction argues that capitalism is embodied in these objects, "the materials and instruments that undergird its ways of seeing and knowing." The paper technologies in this forum integrate exchange, much as the intermodal shipping container does.[18]

Market mechanisms have that name for a reason. Markets have quali-

14. Readers can access the rationale and some of the items at *Mind Your Business*.

15. Latour, *Reassembling the Social*.

16. Bruno Latour, "Where Are the Missing Masses?"; and Madeline Akrich, "The De-Scription of Technical Objects"‘ both in Bijker and Law, eds., *Shaping Technology / Building Society*.

17. Martha Lampland and Susan Leigh Star, *Standards and Their Stories*; Jonathan Coopersmith, *Faxed*; Andrew Russell, *Open Standards and the Digital Age*; John R. Commons, "Institutional Economics"; Richard R. John, "Why Institutions Matter."

18. Marc Levinson, *The Box*.

ties that make them seem like machines: set them in motion and expect a particular outcome. However, both markets and their mechanisms developed in the imperatives of particular moments before beginning to function in automatic ways. A large body of scholarship in historical sociology of finance addresses this phenomenon.[19] Like language and laws, markets function in many of the same ways that technologies do. They shape and are shaped by their contexts. Similar claims could be made about paper money.

How Can Paper Be Money?

Jonathan Senchyne scrutinizes a pair of fictional stories to delve into a conceptual difficulty of capitalism: the interactions between the physical world and the more fungible exchange device of cash money. The method is familiar. Literary analysis has long ranked as part of the equipment used by historians of technology, and it widens the influence of the specialty into distant territories, beyond specific artifacts or case studies. Leo Marx's study of American literature remains a foundational work in the discipline, and Rosalind Williams's scholarship continues the tradition. Exploring the historical discourses about technology that appeared in fiction or essays remains one heart of the field.[20] In studying these stories, Senchyne excavates a problem with materiality for both historians of capitalism and of technology—a problem about the relationship between physical things and the value or purpose attached to them. Paper money is a physical thing, but its value does not reside in its physicality. As a machine embodies a technology, paper money is an embodiment of value. The paper is material but not the real thing; the material basis of money is in its exchange value—what it can buy.

When Senchyne writes that "paper was a technology of capitalism" he indicates that physical paper was a contrivance or mechanism that embodied an ideology, a worldview, a goal or purpose. By plumbing these tales he uncovers some of the meanings attached to paper money in the nineteenth-century universe in which those stories circulated. This was a world where the boom-and-bust cycle of capitalism still had the capacity to surprise participants in the market economy. It was perhaps for this reason that the authors of both these stories employed the device of relating money to rags, the emblem of poverty. In one account, a ragpicker finds a "real" fortune—a gold coin—in the trash he is collecting to turn into money. In the other, paper money is discounted the further one gets from its point of origin, and this financial practice of the period makes the trust-

19. Michel Callon, ed., *Laws of the Markets*; Michel Callon, Yuval Millo, and Fabian Muniesa, eds., *Market Devices*; Donald MacKenzie, Fabian Muniesa, and Lucia Sur, eds., *Do Economists Make Markets?*

20. Leo Marx, *The Machine in the Garden*; Rosalind Williams, *Notes on the Underground*.

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ing user of the technology poorer and poorer as the story and his travels progress. In Senchyne's analysis of these narratives, paper money may be material, but it was not in its materiality that its worth resided. For this reason, its value could disappear in an instant. This created the anxiety reflected in these stories.

The questions around valuing and the material nature of paper money still arouse anxiety in the twenty-first century, in capitalist economies that have passed through industrialization and entered a postindustrial phase. Around the world, most paper money is untethered from essentialist coin, and as a result it is a commodity whose value is set by the market—by the emotion-driven herd mentality of supply and demand. This causes discomfort for many people who do not know that gold is the same. People who advocate a gold standard to back paper currencies express similar fears. Some of them disapprove of capitalism and therefore emphasize the way paper money seems untethered to any value except the worth determined in a marketplace. Others are dedicated to free markets and wish for specie to back currencies to make exchange easier—they may not recognize the power of governments in linking the two. For both groups, paper money raises questions about reality and representation: What is real and what has value and how do we know? Such questions can be tied to the subjects studied by historians of technology: If a technology is not the machine used to accomplish the task, then how can it be identified? Where does the value of money or the purpose of technology actually reside?[21] How to distinguish between the device and the process it performs or the goals it embodies, between technology and technique?

Senchyne invites us to consider a particular moment in capitalist development and characterizes paper money as a technology in order to understand the relationship between corporeality and value. The other two essays in this forum likewise remind us that the material world is sometimes not physical but financial. Both authors study methods rather than machines. The immateriality of their subjects may help historians of technology see that our methods and approaches can be applied to the process parts of technology as much as to the machines that embody them. The calculations and computations studied in these two papers allow techniques to receive the same treatment as technologies. By dealing with the abstractions of economic materiality rather than its physical component, Caitlin Rosenthal and William Deringer offer scholars of technology the opportunity to expand their grasp.

21. Bray, "Science, Technique, and Technology," 320.

Pricing the Future

Deringer's essay studies the mathematical difficulties of judging today the value of a property that pays off sometime in the future. Examples of such property include financial instruments such as bonds that will mature at some specified date; others are insurance policies, rental properties, and shares in joint-stock companies that return the investment in parts, over time. It is worth noting that only rental properties, among these examples, are physical things—though all are material. In the 1600s there were several methods of calculating the value today of such articles that promised future returns. The quick and easy years' purchase reckoning method was widely understood but did not reflect the increasing value of the article being reckoned. While simple-interest discounting did and was also simple to use, it resulted in mathematical quandaries—its harmonic series or musical progression of numbers was beyond the reach of even skilled mathematicians. Meanwhile, the counterintuitive compound-interest computation required significant skill. It contradicted what people felt about future value, and it needed expertise to apply or understand. It nonetheless eventually carried the day and became common practice in British accounting by 1730. In this way, theoretical mathematics was tied to commercial practice, and capitalism thrived in these circumstances.

Deringer presents these three computation methods as competing technologies even though they were not in any way physical. For this reason, the essay reminds readers that methods and techniques often function in technological ways even when they are not embedded in hardware. The possible ways of computing value from potential earnings were shaped by the practices and needs of their users. They were in competition with one another, and as one became the common practice it matured in the ways that technological systems do and then became "the way things are done," obdurate to change. The author questions these techniques the way that historians question technology: What defines best? Which method wins, and why? The answer lies partly in the institutions and trained personnel that assembled around this method. As nontechnological elements gathered into the assemblage that makes this method the one that works, they added contingency to a not entirely rational or linear solution.

The eighteenth-century triumph of compound-interest accounting as part of the equipment of rational economic behavior reminds us that capitalism itself is a product of human activity. Compound interest expresses the idea at the heart of capitalism—that an investment may bring a return. It reifies the notion that capital increases, that wealth can be grown. It is a method or technique more than a technology; it has little to do with the physical world, yet it yields to history-of-technology analysis.

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Finally, the middle paper of the forum also deals with a computational technique that may function in a technological way. In this essay, Rosenthal examines the Golden Rule or Rule of Three. Just as in Deringer's computations of the worth of future value, this method is incorporeal. However, the common reckoning or accounting method was much more an "everyday" or rule-of-thumb sort of calculation, one that ordinary people used and needed in their transactions. It allowed people to make a calculation of costs or payments. If they knew the price of any number of articles, and they wanted or were owed for a different number of those things (eight eggs rather than a dozen, or two-and-a-half hours of work beyond the established quitting time), they could calculate the amount of the transaction. The rule of three replaced various tables and ready reckoners as a method of basic numeracy. In a world of multiple currencies, valuations, and articles, it was a tool that allowed ordinary people to engage in a commercial economy.

Once upon a time, social historians decried the transition from a face-to-face society to one more mediated by market relations.[22] In these more anonymous transactions, the rule of three provided even the "innumerate," to use the author's depiction, with the necessary calculating device for negotiations. It is in this transition from a local, reputation-based society to one of more anonymity that this essay finds its footing. The rule of three was the endpoint of basic arithmetical education; the indentures that bound apprentices required they be taught the rule in addition to more simple figuring. Rosenthal's analysis of the rule opens a window into a world of complicated transactions, in which the Golden Rule provided an "entry-level competency for commercial exchange." The market economy in which people were operating was larger and more complicated than the local version from which they had emerged. The rule was useful because it aided the integration of local into global economies, with the resulting difficulties of converting one currency or unit of value into another. Studying the Golden Rule alongside the contestation of compound-interest accounting reminds us that this was not an abstract process but a practical one—that capitalism is about physical exchange, even when it is financialized, and it is therefore well suited to history-of-technology approaches.

"Numbers traveled well," Rosenthal reminds us, and it is possible that the financialization of transactions—even at the simplest level of putting a price on them, in a particular currency—is one of the things that defines capitalism. After all, the whirling engines so closely associated with capitalism were investments of capital, which is more abstract as a category

22. John Lauritz Larson, ed., "The Market Revolution"; Craig Muldrew, "Interpreting the Market"; Karl Polanyi, *The Great Transformation*.

than the machines it has purchased. Such capital is the real and mysterious thing, but the physical things that embody it may provide an avenue to understanding its operations—as devices have been the means for historians to explain technology. After all, these calculations performed fundamental acts of trade. As in Rockman's example of the merchant whose activities in his countinghouse performed movements of goods and people around the world, calculations such as the rule of three allowed for easy exchanges on the basis of value. By abstracting time, work, and objects into costs, this calculation facilitated the equation of both physical and incorporeal things. If methods of calculation could be devices for translating value, then methods function in technological ways, even without bodies.

Conclusion

It is not hard to imagine the subjects explored in these papers as technologies. Paper money is a device that does the work of exchange as it represents value, but whether or not it works is contingent upon context, just as Edison's early lightbulbs depended on waterfalls. A vast assemblage of institutions and individuals and objects are necessary to make paper money do its job. In another essay, three computational methods compete; one surpasses the others to become common practice that reified capitalism's promise. As in the history of technology, the alternatives failed to satisfy certain needs, from complexity and flexibility to comprehensibility, including users' expectations about what future value was worth. One can imagine discovering who preferred which method, identifying the stakeholders and the networks they formed that used their preferred method—an actor-network-theory version of mathematical computation just as if it were a technology as much as a technique. In the third paper of this forum, another method of calculation served its purpose for its daily users in their everyday arithmetical transactions. In those quotidian applications, the calculation helped integrate the world economy through these daily trades and the actions of the multitude of individuals who used the rule.

Rockman introduces the history of capitalism to historians of technology by way of materiality, but the material things in the essays are not the capitalism that they make possible. In this, they are like machines, which are not quite technologies. These essays indicate that history-of-technology methods may help us grasp even things other than technologies. From the systems theory and social construction generation, the scholars of technology have moved from systems to networks, in which people and institutions and artifacts all play a role in assembling the social.[23] Now historians of technology are moving past social construction and beyond the

23. Latour, *Reassembling the Social.*

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moment of closure to examine technologies in use and the long-term maintenance of standards and infrastructure.[24] Applying these methods and understandings to matters on the margins of technology—to methods and allegories—shows just how well they work in the wider world of historical study.

It may be Whiggish to see these historiographical developments as a progression, but the history of technology discipline has nonetheless built upon itself, elaborating new methods from older understandings, and—despite the usual disagreements—the scholarship has achieved greater coherence and relevance to more and more cases as a result. Systems theory, social constructivism, and actor-network theory carry investigators deeper into understanding the mysteries of technological change and continuity. And they have carried the subdiscipline back to the beginning, when internalism fostered technological determinism, because we can recognize the role of technologies in shaping the world around them as well as the way context shapes hardware. This means that the history of technology is well poised to investigate the central questions historians ask: What causes what? How do objects act? In what way does technology, created by humans, begin to shape our behavior? Answering these questions incorporates both social construction and technological determinism because the technology that shapes what people do was itself shaped by human actions. Understanding the two together, their interplay and its effects, is the central accomplishment of the historiography of technology. Moreover, it applies to parts of the human experience that are not explicitly technological: methods of computation, representations of value, legal systems, language, and economic conventions and structures—capitalism included.

Bibliography

Akrich, Madeleine. "The De-Scription of Technical Objects." In *Shaping Technology / Building Society: Studies in Sociotechnical Change*, edited by Wiebe E. Bijker and John Law, 205–24. Cambridge, MA: MIT Press, 1984.

Bernstein, Robin. "Dances with Things: Material Culture and the Performance of Race." *Social Text* 27, no. 4 (winter 2009): 67–94.

Bijker, Wiebe E., Thomas P. Hughes, and Trevor Pinch, eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 1984.

Bijker, Wiebe E., and John Law, eds. *Shaping Technology / Building Society: Studies in Sociotechnical Change*. Cambridge, MA: MIT Press, 1992.

Black, John. *A Dictionary of Economics*. 2nd ed. New York: Oxford University Press, 2002.

24. David Edgerton, *The Shock of the Old*; Andrew Russell, "Nothing Special"; Vinsel, "The Maintainers."

Bray, Francesca. "Science, Technique, and Technology: Passages between Matter and Knowledge in Imperial Chinese Agriculture." *British Journal for the History of Science* 41, no. 3 (Sept. 2008): 319–44.

Brown, John K. "Louis C. Hunter's *Steamboats on the Western Rivers*." *Technology and Culture* 44, no. 4 (October 2003): 786–93.

Callon, Michel, ed. *Laws of the Markets*. Oxford: Wiley-Blackwell, 1998.

_____, Yuval Millo, and Fabian Muniesa, eds. *Market Devices*. Malden, MA: Blackwell, 2007.

Commons, John R. "Institutional Economics." *American Economic Review* 21, no. 4 (Dec. 1931): 648–57.

Coopersmith, Jonathan. *Faxed: The Rise and Fall of the Fax Machine*. Baltimore: Johns Hopkins University Press, 2015.

Cowley, Robert, and Geoffrey Parker, eds. *Reader's Companion to Military History*. New York: Houghton Mifflin, 1996.

Edgerton, David. *The Shock of the Old: Global History since 1900*. New York: Oxford University Press, 2007.

Hahn, Barbara. "The Social in the Machine: How Historians of Technology Look Beyond the Object." *AHA Perspectives on History*, March 2014. https://www.historians.org/publications-and-directories/perspectives-on-history/march-2014/the-social-in-the-machine (accessed 5 March 2017).

Heilbroner, Robert. "Technology and Capitalism." *Social Research* 43, no. 3 (fall 1997): 1321–25.

Hughes, Thomas P. *Networks of Power: Electrification in Western Society*. Baltimore: Johns Hopkins University Press, 1983.

_____. "Technological Momentum." In *Does Technology Drive History?* edited by Leo Marx and Merritt Roe Smith, 101–14. Cambridge, MA: MIT Press, 1994.

John, Richard R. "Why Institutions Matter." *Common-Place* 9, no. 1 (Oct. 2008). www.common-place-archives.org/vol-09/no-01/john (accessed 25 September 2016).

Lampland, Martha, and Susan Leigh Star. *Standards and Their Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life*. Ithaca, NY: Cornell University Press, 2009.

Larson, John Lauritz. "The Market Revolution in Early America: An Introduction." *OAH Magazine of History* 19, no. 3 (May 2007): 4–7.

Latour, Bruno. "Where Are the Missing Masses? The Sociology of a Few Mundane Objects." In *Shaping Technology / Building Society: Studies in Sociotechnical Change*, edited by Wiebe E. Bijker and John Law, 225–58. Cambridge, MA: MIT Press, 1984.

_____. *Reassembling the Social: An Introduction to Actor-Network Theory*. New York: Oxford University Press, 2007.

Law, John, and John Hassard. *Actor Network Theory and After*. Malden, MA: Blackwell, 1999.

Levinson, Marc. *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*. Princeton, NJ: Princeton University Press, 2016.

Lipartito, Kenneth. "Reassembling the Economic: New Departures in Historical Materialism." *American Historical Review* 121, no. 3 (Feb. 2016): 101–39.

MacKenzie, Donald, Fabian Muniesa, and Lucia Sur, eds. *Do Economists Make Markets? On the Performativity of Economics*. Princeton, NJ: Princeton University Press, 2008.

Marx, Karl. *The Poverty of Philosophy*. Orig. pub. Paris and Brussels, 1847, available at https://www.marxists.org/archive/marx/works/1847/poverty-philosophy/ch02.htm#s2 (accessed 5 March 2017).

Marx, Leo. *The Machine in the Garden: Technology and the Pastoral Ideal in America*. New York: Oxford University Press, 1964.

_____, and Merritt Roe Smith, eds. *Does Technology Drive History? The Dilemma of Technological Determinism*. Cambridge, MA: MIT Press, 1994.

McCusker, John J., and Russell R. Menard. *The Economy of British America, 1607–1789, with Supplementary Bibliography*. 2nd ed. Chapel Hill: University of North Carolina Press, 1991.

Mind Your Business. http://www.brown.edu/Facilities/John_Carter_Brown_Library/exhibitions/business/index.html (accessed 8 February 2016).

Mossberg, Walt. "On Capitalism and Technology." *Big Think*. 13 September 2007. http://bigthink.com/videos/on-capitalism-and-technology (accessed 26 September 2016).

Muldrew, Craig. "Interpreting the Market: The Ethics of Credit and Community Relations in Early Modern England." *Social History* 18, no. 2 (May 1993): 163–83.

Oldenziel, Ruth. *Making Technology Masculine: Men, Women, and Modern Machines in America, 1870–1945*. Amsterdam: Amsterdam University Press, 1999.

Paris, Ivan. "Domestic Appliances and Industrial Design: The Italian White-Goods Industry during the 1950s and 1960s." *Technology and Culture* 57, no. 3 (July 2016): 612–48.

Petroski, Henry. *To Engineer Is Human: The Role of Failure in Successful Design*. New York: Vintage, 1992.

Polanyi, Karl. *The Great Transformation: The Political and Economic Origins of Our Time*. New York: Farrar & Rinehart, 1944.

Rockman, Seth. "What Makes the History of Capitalism Newsworthy?" *Journal of the Early Republic* 34, no. 3 (fall 2014): 439–66.

Roland, Alex. "Technology." In *The Reader's Companion to Military History*, edited by Robert Cowley and Geoffrey Parker, 464–66. Boston: Mariner Books, 2001.

Russell, Andrew. *Open Standards and the Digital Age: History, Ideology, and Networks*. New York: Cambridge University Press, 2014.

_____. "Nothing Special: Standards, Infrastructure, and Maintenance in the Great Age of American Innovation." *Platypus: The Castac Blog*. 28 Apr. 2015. http://blog.castac.org/2015/04/nothing-special (accessed 9 February 2016).

_____, and Lee Vinsel. "Hail the Maintainers." *Aeon* 7 (April 2016), available at https://aeon.co/essays/innovation-is-overvalued-maintenance-often-matters-more (accessed 5 March 2017).

Schatzberg, Eric. "*Technik* Comes to America: Changing Meanings of Technology before 1930." *Technology and Culture* 47, no. 3 (July 2006): 486–512.

Sklansky, Jeffrey. "The Elusive Sovereign: New Intellectual and Social Histories of Capitalism." *Modern Intellectual History* 9, no. 1 (Apr. 2012): 233–48.

Staudenmaier, John M. *Technology's Storytellers: Reweaving the Human Fabric*. Cambridge, MA: MIT Press, 1985.

Stern, Philip J., and Carl Wennerlind, eds. *Mercantilism Reimagined: Political Economy in Early Modern Britain and Its Empire*. New York: Oxford University Press, 2014.

van Lieshout, Carry. "Droughts and Dragons: The Impact of Geography, Rainfall, and Technology on the Expansion of Eighteenth-Century London's Water Supply Networks." *Technology and Culture* 57, no. 4 (Oct. 2016): 780–805.

Vinsel, Lee. "The Maintainers: A Call for Proposals." 25 Feb. 2015. *Taming the American Idol*. http://leevinsel.com/blog/2015/2/25/the-maintainers-a-call-for-proposals (accessed 26 Sept. 2016).

Volti, Rudi. *Society and Technological Change*. 7th ed. New York: Worth, 2014.

Williams, Rosalind. *Notes on the Underground: An Essay on Technology, Society, and the Imagination*. Cambridge, MA: MIT Press, 2008.

Winner, Langdon. "Do Artifacts Have Politics?" In his *The Whale and the Reactor: A Search for Limits in an Age of High Technology*, 19–39. Chicago: University of Chicago Press, 1989.