Introduction

The field of science and technology studies (STS) was born well into the era of computation. One would be hard-pressed to find an investigation from the 1970s or 1980s of a contemporary scientific or technological site that did not include a recognizable computational artifact: a machine in the corner of a lab, an instrument dependent on algorithms, an expert system at center stage. Studies of infrastructure, such as the work of Thomas Hughes or Susan Leigh Star, were inflected by systems theory, cybernetics, and even the budding milieu of artificial intelligence. Some of STS's early central concepts originate from intellectual movements entangled with computation: Thomas Hughes and Bruno Latour's black box (a systems theory concept), Leigh Star's boundary object that she described as influenced by "both its computer science and pragmatist senses" (Leigh Star 2010, 603), or Donna Haraway's Cyborg Manifesto (1991).

If STS has long been (in some way) digital, then why should this volume call for a digitalSTS? Since another long-standing intellectual commitment of STS is "situatedness" (Suchman 1987; Haraway 1988), we must admit that our situations have changed. To paraphrase Latour and Woolgar (1979), rats are no longer being turned (only) into paper; now they are transformed into PowerPoint files and archival document placeholders. Laboratory work today involves distant collaborations enacted through communication tools, incompatible file formats, and a dizzying array of software analytic tools. Lay-expert groups find solidarity on online fora or social network sites, coordinate via Twitter feeds, and deploy bots for community management and mediation. Microchips are no longer confined to hefty machines in the corner of the laboratory or even the workplace desktop: they are in our homes, our pockets, our clothing, sometimes under our skin. In short, the textures of scientific and daily life at the beginning of the 21st century are suffused with online platforms and heterogenous informational environments.

Scholars drawing from STS are well placed to analyze this contemporary turn of events and to inspect their long-arc historical trajectories. The field maintains a commitment to unpacking the layered, social, and gradual aspects of scientific and technical change, undermining common accounts of revolution, disruption, or inevitable progress. STS scholarship provides tools for locating the politics in technical and scientific decision making, for examining the global yet unevenly distributed tools of computing, and for unearthing the power-laden absences and silences in small and large-scale systems alike. Examinations of science and technology written from the STS perspective have long focused on topics like quantification, standardization, classification, and representation—all themes that sustain an importance to the digital—and have done so with close attention to the practical, local, situated elements of knowledge construction and technological development. STS scholarship ultimately addresses how what we consider to be universal,

ubiquitous, or inevitable—such as a contemporary digital lifestyle—is accomplished in a certain time and place, by specific actors and with particular materials at hand.

The chapters in this volume sustain these commitments and bring them to the encounter with the digital anew. They do so through exploring once-familiar sites reconfigured by digital technologies, by investigations that grapple with novel tools, and through efforts that tackle design and making rather than treating technology as (only) an object of social and humanistic investigation. In doing so, these essays pose new questions for scholarship in STS. What is revealed about laboratory life when the "shop floor" goes digital? What can we learn about expertise when new constituencies of laypeople come together online at great distances? How do we incorporate computational artifacts like bots, algorithms, and hidden taxonomies into our extant concepts of distributed or hybrid agency? And how do our theories of materiality map onto digital objects and practices, and vice versa?

Responding to these questions, the chapters in this volume examine digital field sites and mediated interactions as opportunities for theory building, speaking to the field's core assumptions about the construction, shaping, or hybridity of knowledge, objects, and expertise. The authors deploy the emerging tools of digital scholarship, such as critical making and large-scale data analytics, to enhance the analysis of core concepts like representation, quantification, and materiality. The volume as a whole aims to populate our scholarly toolkit by adding contemporary examples to our field's repertoire of cases, theories, and methods. These examples aim to sit alongside, rather than replace, the classic "evocative objects" (Turkle 2007) of our field in our course syllabi and beyond: for instance, the bicycle (Pinch and Bijker 1987), the speed bump (Latour 1992), or the reactor beam (Traweek 1988). They also complement several already-influential studies of digital systems in STS such as the DVD player (Gillespie 2007), the trader's screen (Knorr Cetina and Bruegger 2002; MacKenzie 2006), the configured user (Woolgar 1990), or the "always on" worker (Wajcman 2015).

digitalSTS as Departures

Calling something digitalSTS does not denote a standalone branch of STS, or a bracing theoretical departure, but it does mark a series of disruptions for STS scholarship, even while sustaining intellectual continuities. Let us examine the differences first.

The study (and sometimes making) of digital systems is alive and thriving in sister fields: certainly from the engineering and information sciences, but also always already in sociology and anthropology, communication, and the digital humanities. Classic STS theories and cases have played a role formulating many of these approaches as our concepts and exemplary objects have traveled. For instance, information scientists use "boundary objects" (Star and Griesemer 1989) or "infrastructural inversion" (Bowker 1994) to describe the social work of data management, while studies of algorithmic inequality among Internet researchers have frequently been inspired by Langdon Winner's (1986) account of how the Long Island Expressway overpasses prohibited bus-riding access by poorer citizens. This speaks to an existing exchange of ideas across these disciplines.

But an imbalance persists with STS ideas influencing "outward" rather than welcoming concepts, topics, and framings "inward." This, despite the fact that there is much to learn from how digital scholarship, artifacts, and systems are

evolving, changing, and challenging assumptions in sister fields. If there is novelty in the concept of a digitalSTS, it is in **bilateral bridge building between STS and fields that have embraced digital studies and making**. Some of these fields are already known to STS: prior studies of public understanding of science established ties with communications and media studies (Lewenstein 1995; Kirby 2011), while classic ethnographies of machine work engaged with computer-supported cooperative work and other design-oriented enterprises (Orr 1996; Suchman 1987). Other fields are new configurations, such as the digital humanities (Gold 2012), digital sociology (Daniels et al. 2017; Marres 2017), and scholarship in the emerging information schools.

This volume therefore extends this conversation and broadens our field's scope to include voices from scholars engaged in digital studies across many fields. The chapters combine approaches, topics, artifacts, and literatures from multiple disciplines to demonstrate their relevance for STS scholarship, embracing them as subjects for STS analysis. At the same time, however, the volume is grounded in the core concepts and literature of STS. The authors herein not only address digital topics as core matters of concern but also speak back to classic concepts and cases as they do so, developing new theoretical tools for further analysis. The essays therefore demonstrate a way forward for digital studies writ large that take the primary tenets of STS seriously. We hope that this perspective will prove valuable to scholars engaging with digital topics within, across, and beyond STS.

Second, **digital methods are animating scholarship across the academy**. STS has been slow to take up these techniques largely due to our resistance to the unreflexive use of systematizing or formal tools and methods (e.g., Law 2004; Lury and Wakeford 2012). Another goal for this volume is to provide examples of a kind of reflexive, digital methodological inquiry. Inspecting how such systems are constitutive and destructive, revealing and blinding, or powerful here but weak there is an essential feature of STS work. In sum, the sentiment is that STS cannot incorporate the configurations of epistemic tools and methods offered by digital media—from network analysis to data mining and topic modeling—without some (even if inevitably incomplete) archaeology of these tools' assumptions, methods, and roles in situated knowledge production. The contributions herein deploy such tools while inspecting with care the emerging technique, technology, internal logic, rhetoric, or broader milieu of digital methods. They also describe connections and challenges to classic STS theories, to inspire the next generation of critique.

Another thread of contributions has taken on **the challenge of "making"** by combining the design and use of digital tools, artifacts, or methods in tandem with explicit reflection and inquiry on the approach itself. When we began our explorations of the relationship between STS, making, and design in 2012, the field had only the most tenuous of spaces dedicated to these modes of inquiry. We assert that design techniques not only have a place in STS: they are an important locus for the exploration of concepts and analysis, and a site for scholarly intervention with technologists and publics. An online curated collection of notable STS maker projects accompanies this volume to stimulate the scholarly imagination with examples of objects, experiences, or software tools designed with the intention to "make durable" STS concepts through design, participation, and critical making. These contributions demonstrate what is possible when we embrace digital methods of knowledge production—not as revolutionary or straightforwardly objective, but rather as a matter of inquiry involving varying doses of agnosticism, reflexivity, symmetry, and critical perspectives on knowledge construction itself.

Finally, the reader may notice that we do not offer any singular definition or criteria for "the digital" in the volume. Throughout this project, we purposefully suspended any propositions for a universal definition or methodology for the digital. Participants in the workshops that led to this volume were especially concerned not to draw rigid boundaries or produce residual categories by enforcing strict definitions. The volume therefore embraces a dynamic and grounded approach to the study of digital systems, treating the category of the digital as an emergent feature among communities of users, designers, and maintainers, and inspecting sociotechnical architectures in long-arc development trajectories. In essence, the category "digital" as it appears here was also itself emergent through the process that led to the volume (see the preface). Although this may appear disruptive for a collection of papers about digitality, the collected papers demonstrate **the methodological value of digital agnosticism, pluralism, or symmetry** as a point of departure for STS studies of digital phenomena.

digitalSTS as Continuities

In addition to new ground, the volume sustains important continuities. Arguably, what sets this volume apart is its continued commitment to core STS principles as deployed in the analysis of digital systems and interactions, broadly construed. Such commitments will be familiar to STS scholars; their novelty lies in their considered, thorough application to the digital spheres of action, and vice versa. However, these principles may be less familiar to the wider group of scholars who explore digital topics, especially those who may be newcomers to STS. We therefore review these animating commitments here for both sets of readers, outlining their contours for those who may be unfamiliar with STS themes and intellectual traditions, and demonstrating their connection to digital topics for those grounded in these traditions. This list is not exhaustive, but taken together, these renewed commitments demonstrate the unique voice that STS writ large brings to digital scholarship.

First, the contributions in this volume examine **digital objects and practices in sociohistorical context**, locating them in time and place and demonstrating their grounded, emergent contingencies. In line with foundational scholarship by Thomas Kuhn, Ludwig Fleck, and others, STS scholars do not embrace any notion of drastic social change effected by a "digital revolution" (Kuhn 1962; Fleck 1979; see also Shapin 1996). Instead, scholars look for historical continuities and attend to everyday cultural practices, revealing the "normal science" side of digital and technical work. This also means turning away from lofty "great man" stories, teleological narratives of discovery (aka Whig histories), and discussions of the exceptional nature of scientific or technical work. STS scholars of the digital continue to advance the field's claim that knowledge and technology alike are responsive to, in dialog with, and reflective of social and political context—but that they do not, on their own, drive social or political change.

Further, digitalSTS contributors remain committed to the principle that there is no equal contest of ideas in which the best ideas or inventions win out because they are true. Truth is a consequence rather than an antecedent. STS studies scholars in the 1980s adopted **the principle of "symmetry"** to underline that "truth" and "falsity" are not determining inputs or preconditions, but are rather outcomes of the work called science, research, scholarship, and so on (Bloor 1991; Collins 1985;

David 1985; Cowan 1984). This same sense of symmetry and historicism must illuminate any STS analysis of digital systems—today the site of considerable hyperbolic rhetoric about their transformational, disruptive, and revolutionary potential—if we are to uncover the social and historical mechanisms that give rise to ubiquitous systems, devices, and infrastructures.

In tandem with this commitment to contextual and historically grounded factors is our continued investigation of the **practical, situated, local, and grounded nature of digital work**. This commitment animated the accounts of sociologists and anthropologists who first ventured into laboratories to observe the work of scientists and engineers for themselves. STS scholars do not hold scientific and technical work in isolation from the pressures of society or cultural norms, but instead show how fields "advance" stepwise due to their messy work, culturally laden communities, practical activity, and everyday achievements. Whether in the preparation of protein gels or papers for publication (Lynch 1985; Latour and Woolgar 1979), or the local temporalities that govern scientific activity (Traweek 1988), contingent social practices are the order of the day (Collins 1985; Pickering 1995), with scientists responding to pressures of funding, publication, and reputation instead of lofty ideals such as replicability or skepticism (Merton 1942; Mitroff 1974). This sensibility also suffuses technology studies, where approaches such as the Social Construction of Technology (SCOT) program, social shaping (MacKenzie and Wajcman 1999), and theories of technological politics (Winner 1986; Jasanoff and Kim 2015) investigate the culturally situated and power-laden battles over knowledge and artifacts alike. While STS theories have certainly been elaborated since these early days of the field, the work herein reflects commitments that tie knowledge production and technical achievement to observable action and interaction. Contributions to this volume, then, frequently rely on ethnographic experience and attenuation to lived, enacted, embodied work with digital systems on the ground, whether the mundane software tools of coordination work (Vertesi), the transformation of reefs into bits (Parmiggiani and Monteiro) or the simple act of navigating via GPS (Singh et al.).

An increasing number of studies of digital technologies and online life deploy the tools of the social construction of technology or social shaping to show the grounded nature of technical artifacts. But perhaps more unique to STS is the sensibility toward **networked agency** that we bring to our digital objects (and subjects!) of study. Not to be confused with theories of digital networks or networked publics, this line of thinking instead stems from several related strands of STS theory related to materiality and its intersection with the social world. A formative instance is actor-network theory (ANT; see Latour 2005), which posits that agency does not arise from singular objects, devices, or individuals but rather that people, technologies, and scientific objects act by virtue of being embedded in a network composed of humans and nonhumans (Callon 1986). This makes digital devices or software tools inherently unstable and unable to act or circulate freely on their own; indeed, a small shift in the network can affect an object's—or an individual's!—ability to act. In a classic case, a light bulb kit made in France for deployment in West Africa cannot follow its "script" and reliably provide light when placed in the local contexts of, say, village generator ownership or taxation through electric bills (Akrich 1992). This lesson continues to hold in the context of digital device ecosystems, whether in the favelas of Brazil or the One Laptop Per Child project in Peru (Nemer and Chirumamilla; Chan). As networked thinking takes hold in a variety of academic fields (e.g., social network analysis and networked publics among them),

this also raises methodological questions about the overlaps with actor-networks (Venturini et al.).

Objects are also fluid and hybrid when considered through the lenses of feminist theory and new materialism. These prominent theoretical approaches reject any clear line between "the social" and "the technical" (or between "science" and "technology"), and instead look to where and how such objects and categories are constructed in action (Haraway 1997; Barad 2007; Suchman 2011). Scholars who work in this vein resist dichotomous vocabulary, preferring portmanteau words such as "sociotechnical" or "technoscience" or hybrid figures such as the cyborg (Haraway 1991) to denote their analytical inseparability. They also describe how practices "enact" objects into being and "entangle" both matter and meaning (Moll 2002; Barad 2007). This strand of thinking is influential in this volume. It animates our own editorial agnosticism about the nature of digital materials and bounded nature of digitality as a concept. It is also present in essays that examine where actors themselves draw the boundaries around "the material" and "the digital," for instance in the case of digitizing musical recordings (Camus and Vinck), data or specimens (Ribes), or locally encoded software ontologies as representational taxonomies (Allhutter). And it is present in provocative "maker" products in this volume that inspire contemplation on our place in the environment (Calvillo, Winthereik et al.) or our interaction with archival data (Loukissas).

Boundaries themselves are long-standing themes for STS scholarship that have developed tools for **investigating the production and maintenance of closed spaces** like laboratories or expert communities, and the circulation between and across these sealed spaces. Boundaries can be a source of strength, though they always exact costs. Classic STS studies of laboratories and experiments, for instance, noted that it was only within the effortfully ordered spaces of a laboratory that anthrax could be isolated from cows (Latour 1988), genomes from organisms (Lynch 1985), plans from actions (Suchman 1987). To this end, much of the work herein is not concerned with public spheres—e.g., use of social media or search engines writ large—but examines particular groups and their use of digital tools to effect or efface boundaries. Not only the objects but also the subjects of such spaces are inspected: scientists and technologists may cultivate particular and changing forms of objectivity (Daston and Galison 2007), cast divides between basic science and applied engineering (Gieryn 1999), or distinguish findings from policy concerns (Jasanoff 1987). This boundary work may generate useful products such as the vaccine and the treatment, but the isolation involved can also produce myopic overgeneralization such as the standard human (Epstein 2007), or facilitate distancing the design of technologies from their consequences in use (Abbate 2012). Similarly, pieces herein examine the boundary work of drawing women in and out of computing (Kerasidou, Dunbar-Hester; see also Light 1999; Ensmenger 2010; Abbate 2012), circumscribing migrant use of digital systems (Hawthorne), and identifying system "misuse" in opposition to innovation (Latzko-Toth et al).

One result of boundary drawing is the **inclusion and exclusion** of different groups in the production of objects or knowledge, a process that also accompanies socially produced categorization and standardization regimes. For instance, Steve Epstein (2007) has tracked the coalitions that formed in the 1980s and 1990s to overturn the white male as the standard human for biomedical investigations in favor of studies inclusive of women, racial minorities, the elderly, and the young. The specter of exclusion animates branches of STS, including both infrastructural

categories (Bowker and Star 1999) and the systematic production of ignorance (Proctor and Schiebinger 2008; Oreskes and Conway 2010), as well as how such systematic un-incorporations often take place along existing lines of power. The initiative to surface the excluded reverberates across the volume, but especially animates studies of digital systems in transnational, racialized, or gendered contexts: for instance, the distributed invisible laborers in the Global South for whom voice technologies that standardize accents become part of their embodied practice (Poster) or the software workers who craft boundaries around source code, thereby excluding and occluding female participation (Couture).

Inclusions, exclusions, boundary making, and boundary crossings also actively draw the line around **sanctioned forms of expertise** as credible knowledge. This long-standing thread of work in STS has inspired scholars to take stock of lay knowledge as well as its productive and antagonistic intersections with professionals and other experts (Wynne 1992; Collins and Evans 2009). For instance, Ruha Benjamin (2013) and Alondra Nelson (2016) describe complex intersections between race and medicine in the context of sickle cell anemia or DNA ancestry, describing the fraught participation of racialized medical subjects in research and practice. Benjamin argues for a radical, participatory approach to scientific and medical work: an approach resonant with work in critical design that invites lay publics to participate in knowledge making and analysis (see Balsamo 2011; Vertesi et al. 2016). Such concerns are visible in this volume too, such as with the making of digital tools for visualizing controversies and publics (Munk et al.) or coordinating activists via digital tools (Ilten and McInerney).

Finally, inclusion, exclusion, and expertise recall the importance of **visibility and invisibility to technopolitics.** Infrastructure scholars like Paul Edwards (2013), Christine Borgman (Borgman et al. 2014), and Susan Leigh Star (1999) have been keen to retrieve the otherwise invisible architectures of the digital—software, servers, cables, technical laborers, crowdworkers, data points—all of which are the products of human labor in their creation and maintenance but otherwise backgrounded, rendered as infrastructure ready to hand. Recent work has also surfaced the role of algorithms in the production of social control (Schüll 2017; Noble 2017; Eubanks 2018). Several chapters in the volume therefore follow Geoffrey C. Bowker's call for infrastructural inversion (1994), seeking to re-reveal the work, debates, and decisions that subtend digital action, as well as the accompanying role of visibility in the workplace. Scholarship in this volume also plays with the relationship between the visible and the invisible, surfacing the work of keeping systems up and running effectively (Cohn, Sawyer et al.), deploying digital systems to visualize and trace interactions or experience energy lines (Cardoso Llach, Salamanca, Winthereik et al.), or revealing the work of scholarly tools such as affect (Stark) or algorithms (Seaver). This theme, especially relevant to the study of infrastructures, continues to play a key role in digital knowledge and object production today.

How to Read This Volume

This volume is organized into six sections, each of which analyzes a different topic that speaks to long-standing issues in STS: infrastructure, gender, global inequalities, materiality, visualizing the social, and software. An editorial essay at the start of each section lays out the continuities and departures in that section,

situating the contributions among relevant literatures. As an effort to mitigate the dangers of residual categories, the essays themselves are also tagged in the online volume according to different cross-categorizations, some related to theories in use and others topics of interest: the mobility of objects, standardization, expertise, hybridity, or the role of instrumentation, to name a few. The print volume offers one pathway through the book, the online version others; we welcome readers to forge their own.

In addition to these thematic sections, the chapters align with a typology that emerged from the workshops that led to this volume. These different types of essays were each curated by a different group of editors and speak to a different set of concerns. This includes **case studies** that develop robust theoretical insights (edited by Janet Vertesi and Steve Jackson), research that brings reflexive perspectives to **digital methods** (edited by David Ribes and Daniela Rosner), and examples of critical **making** (curated by Laura Forlano, Yanni Loukissas, Carl DiSalvo, and Hanna Rose Shell). Among the last category, an online gallery complements the essays in the volume. Annotated in the text, each of these types of contributions stakes out a different approach to the question of how digital studies meets STS and collectively offer a "fieldguide" to the diversity of approaches that enliven the field today.

Far from abandoning our commitments to STS or calling for a reenvisioning of the field, then, the present volume argues that paying explicit attention to digital sites, environments, and methods requires returning to STS's classic orienting theories and scholarship, while developing new articulations. Bringing information technologies into view as they are embedded in multivariate contexts of use, of practice, of development, and of knowledge making presents an exciting opportunity to bring the agenda of the field forward, to continue our productive conversation with emerging disciplines, and to develop new pedagogical tools. Ultimately, the moniker of digitalSTS reminds us that there are many, many opportunities in the analysis of digital systems to return to our core commitments, while at the same time pushing the boundaries of our field.

Works Cited

Abbate, Janet. 2012. *Recoding Gender: Women's Changing Participation in Computing*. History of Computing. Cambridge, MA: MIT Press.

Akrich, Madeline. 1992. "The De-scription of Technological Objects." In *Shaping Technology/Building Society*, edited by Wiebe E Bijker and John Law, 205–24. Cambridge, MA: MIT Press.

Balsamo, Anne. 2011. *Designing Culture: The Technological Imagination at Work*. Durham, NC: Duke University Press.

Barad, Karen Michelle. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham, NC: Duke University Press.

Benjamin, Ruha. 2013. *People's Science: Bodies and Rights on the Stem Cell Frontier*. Palo Alto, CA: Stanford University Press.

Bloor, David. 1991. *Knowledge and Social Imagery*. 2nd ed. Chicago: University of Chicago Press.

Borgman, Christine L., Peter T. Darch, Ashley E. Sands, Jillian C. Wallis, and Sharon Traweek. 2014. "The Ups and Downs of Knowledge Infrastructures in Science: Implications for Data Management." In *Proceedings of the 14th ACM/IEEE-CS Joint Conference on Digital Libraries*, 257–66. Piscataway, NJ: IEEE Press. http://dl.acm.org/citation.cfm?id=2740769.2740814.

Bowker, Geoffrey C. 1994. *Science on the Run: Information Management and Industrial Geophysics at Schlumberger, 1920–1940*. Inside Technology. Cambridge, MA: MIT Press.

Bowker, Geoffrey C., and Susan Leigh Star. 1999. *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press.

Callon, Michel. 1986. "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay." In *Power, Action and Belief: A New Sociology of Knowledge*, edited by John Law, 196–233. London: Routledge & Kegan Paul.

Collins, Harry. 1985. *Changing Order: Replication and Induction in Scientific Practice*. London: Sage.

Collins, Harry, and Robert Evans. 2009. *Rethinking Expertise*. Chicago: University of Chicago Press.

Cowan, Ruth Schwartz. 1984. *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave*. New York: Basic Books.

Daniels, Jessie, Karen Gregory, and Tressie McMillan Cottom. 2017. *Digital Sociologies*. Chicago: Policy Press.

Daston, Lorraine, and Peter Galison. 2007. *Objectivity*. New York: Zone Books.

David, Paul A. 1985. "Clio and the Economics of QWERTY." *American Economic Review* 75 (2): 332–37.

Edwards, Paul N. 2013. *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming.*

Ensmenger, Nathan. 2010. *The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise*. History of Computing. Cambridge, MA: MIT Press.

Epstein, Steven. 2007. *Inclusion: The Politics of Difference in Medical Research*. Chicago Studies in Practices of Meaning. Chicago: University of Chicago Press.

Eubanks, Virginia. 2018. *Automating Inequality: How High-Tech Tools Profile, Police and Punish the Poor*. New York: St. Martin's.

Fleck, Ludwig. 1979. *Genesis and Development of a Scientific Fact*. Edited by T. J. Trenn and Robert K. Merton. Chicago: University of Chicago Press.

Gieryn, Thomas F. 1999. *Cultural Boundaries of Science: Credibility on the Line*. Chicago: University of Chicago Press.

Gillespie, Tarleton. 2007. *Wired Shut: Copyright and the Shape of Digital Culture*. Cambridge, MA: MIT Press.

Gold, Matthew K., ed. 2012. *Debates in the Digital Humanities*. Minneapolis: University of Minnesota Press.

Haraway, Donna J. 1988. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14 (3): 575–99. https://doi.org/10.2307/3178066.

———. 1991. *Simians, Cyborgs, and Women*. New York: Routledge.

———. 1997. *Modest_Witness@Second Millenium. FemaleMan_Meets_OncoMouse: Feminism and Technoscience*. New York: Routledge.

Jasanoff, Sheila. 1987. "Contested Boundaries in Policy-Relevant Science." *Social Studies of Science* 17 (2): 195–230.

Jasanoff, Sheila, and Sang-Hyun Kim, eds. 2015. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: University of Chicago Press.

Kirby, David A. 2011. *Lab Coats in Hollywood: Science, Scientists, and Cinema*. Cambridge, MA: MIT Press.

Knorr Cetina, Karin, and Urs Bruegger. 2002. "Global Microstructures: The Virtual Societies of Financial Markets." *American Journal of Sociology* 107 (4): 905–50. https://doi.org/10.1086/341045.

Kuhn, Thomas S. 1962. *The Structure of Scientific Revolutions*. Vol. 2, 2nd ed. Foundations of the Unity of Science. Chicago: University of Chicago Press.

Latour, Bruno. 1988. *The Pasteurization of France*. Cambridge, MA: Harvard University Press.

———. 1992. "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts." In *Shaping Technology/Building Society*, edited by Wiebe E. Bijker and John Law, 225–58. Cambridge, MA: MIT Press.

———. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Latour, Bruno, and Steve Woolgar. 1979. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.

Law, John. 2004. *After Method: Mess in Social Science Research*. New York: Routledge.

Leigh Star, Susan. 2010. "This Is Not a Boundary Object: Reflections on the Origin of a Concept." *Science, Technology, & Human Values* 35 (5): 601–17. https://doi.org/10.1177/0162243910377624.

Lewenstein, Bruce. 1995. "Science and the Media." In *Handbook of Science and Technology Studies*, edited by Sheila Jasanoff, Gerald Markle, James Peterson, and Trevor Pinch, 343–60. Thousand Oaks, CA: Sage.

Light, Jennifer. 1999. "When Computers Were Women." *Technology and Culture* 40 (3): 455–83.

Lury, Cecelia, and Nina Wakeford, eds. 2012. *Inventive Methods: The Happening of the Social*. Culture, Economy and the Social. New York: Routledge.

Lynch, Michael, ed. 1985. *Art and Artifact in Laboratory Science: A Study of Shop Work and Shop Talk in a Research Laboratory*. Studies in Ethnomethodology. London: Routledge & Kegan Paul.

MacKenzie, Donald A. 2006. *An Engine, Not a Camera: How Financial Models Shape Markets*. Inside Technology. Cambridge, MA: MIT Press.

MacKenzie, Donald A., and Judy Wajcman, eds. 1999. *The Social Shaping of Technology*. 2nd ed. Buckingham: Open University Press.

Marres, Noortje. 2017. *Digital Sociology: The Reinvention of Social Research*. Malden, MA: Polity.

Merton, Robert. 1942. "The Normative Structure of Science." In *The Sociology of Science: Theoretical and Empirical Investigations*, edited by Norman W. Storer, 267–78. Chicago: University of Chicago Press.

Mitroff, Ian. 1974. "Norms and Counter-norms in a Select Group of the Apollo Moon Scientists." *American Sociological Review* 39:579–95.

Moll, Annemarie. 2002. *The Body Multiple: Ontology in Medical Practice*. Durham, NC: Duke University Press.

Nelson, Alondra. 2016. *The Social Life of DNA: Race, Reparations, and Reconciliation after the Genome*. Boston: Beacon.

Noble, Safiya Umoja. 2017. *Algorithms of Oppression: How Search Engines Reinforce Racism*. New York: New York University Press.

Oreskes, Naomi, and Erik M. Conway. 2010. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. London: Bloomsbury.

Orr, Julian E. 1996. *Talking about Machines: An Ethnography of a Modern Job*. Ithaca, NY: Cornell University Press.

Pickering, Andrew. 1995. *The Mangle of Practice: Time, Agency, and Science*. Chicago: University of Chicago Press.

Pinch, Trevor, and Wiebe E. Bijker. 1987. "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other." In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Trevor Pinch, Wiebe E. Bijker, and Thomas P. Hughes, 17–50. Cambridge, MA: MIT Press.

Proctor, Robert, and Londa Schiebinger, eds. 2008. *Agnotology: The Making and Unmaking of Ignorance*. Palo Alto, CA: Stanford University Press.

Schüll, Natasha. 2017. *Keeping Track*. New York: Farrar, Straus and Giroux.

Shapin, S. 1996. *The Scientific Revolution*. Chicago: University of Chicago Press.

Star, Susan Leigh. 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43 (3): 377–91. https://doi.org/10.1177/00027649921955326.

Star, Susan Leigh, and James R. Griesemer. 1989. "Institutional Ecology, 'Translations,' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39." *Social Studies of Science* 19 (3): 387–420.

Suchman, Lucy. 1987. *Plans and Situated Actions: The Problem of Human-Machine Communication*. Cambridge: Cambridge University Press.

——. 2011. "Subject Objects." *Feminist Theory* 12 (2): 119–45. https://doi.org/10.1177/1464700111404205.

Traweek, Sharon. 1988. *Beamtimes and Lifetimes: The World of High Energy Physicists*. Cambridge, MA: Harvard University Press.

Turkle, Sherry, ed. 2007. *Evocative Objects*. Cambridge, MA: MIT Press.

Vertesi, Janet, David Ribes, Laura Forlano, Yanni A. Loukissas, and Marisa Cohn. 2016. "Engaging, Making, and Designing Digital Systems." In *Handbook of Science and Technology Studies*, 4th ed., edited by Ulrike Felt, Rayvon Fouché, Clark A. Miller, and Laurel Smith-Doerr, 169–94. Cambridge, MA: MIT Press.

Wajcman, Judy. 2015. *Pressed for Time: The Acceleration of Life in Digital Capitalism*. Chicago: University of Chicago Press.

Winner, Langdon. 1986. "Do Artifacts Have Politics?" In *The Whale and the Reactor: A Search for Limits in an Age of High Technology*, edited by Langdon Winner, 19–39. Chicago: University of Chicago Press.

Woolgar, Steve. 1990. "Configuring the User: The Case of Usability Trials." *Sociological Review* 38 (S1): 58–99. https://doi.org/10.1111/j.1467-954X.1990.tb03349.x.

Wynne, Brian. 1992. "Misunderstanding Misunderstanding: Social Identities and Public Uptake of Science." *Public Understanding of Science* 1 (3): 281–304.