

Notes

Prologue

1. Flo Conway and Jim Siegelman, *Dark Hero of the Information Age: In Search of Norbert Wiener, the Father of Cybernetics* (New York: Basic Books, 2005), 392 n. 318.
2. Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York: McGraw-Hill, 1964).
3. Slava Gerovitch, "InterNyet: Why the Soviet Union Did Not Build a Nationwide Computer Network," *History and Technology* 24 (4) (December 2008): 335–350.
4. Viktor Shklovsky, "Art as Technique" (1917), in *Russian Formalist Criticism: Four Essays*, ed. Lee T. Lemon and Marion J. Reiss (Lincoln: University of Nebraska Press, 1965), 3–24.
5. Peter Brown, *The Body and Society: Men, Women, and Sexual Renunciation in Early Christianity* (New York: Columbia University Press, 1988), xvii.

Introduction

1. On September 19, 1990, fifteen months before the Soviet Union collapsed, the Internet Corporation for Assigned Names and Numbers (ICANN) assigned the .su country code top-level domain, and it remains in use today.
2. For more on Akademgorodok, see Paul R. Josephson, *New Atlantis Revisited: Akademgorodok, the Siberian City of Science* (Princeton: Princeton University Press, 1977).
3. The literature on the Soviet Union's role in the cold war is enormous. Readers unacquainted with that literature may wish to start with a primer on the global cold war context, such as Robert J. McMahon, *The Cold War: A Very Short Introduction* (New York: Oxford University Press, 2003), Steven Lovell, *The Soviet Union: A Very Short Introduction* (New York: Oxford University Press, 2009), and a more substantial

work by Orlando Figes, *Revolutionary Russia, 1891–1991: A History* (New York: Metropolitan Books, 2014). Other classics outside the Soviet period or space include Eric Hobsbawm, *The Age of Extremes: A History of the World, 1914–1991* (New York: Pantheon Books, 1994); Orlando Figes, *Natasha's Dance: A Cultural History of Russia* (New York: Picador, 2003); and James H. Billington, *The Icon and the Axe: An Interpretive History of Russian Culture* (New York: Vintage, 1966). For more on the intellectual context, see the politically opposing pair, Isaiah Berlin, *Russian Thinkers* (New York: Penguin Group, 1978), and Richard Pipes, *Russian Conservatism and Its Critics: A Study in Political Culture* (New Haven: Yale University Press, 2005).

4. Robert E. Kohler and Kathryn M. Olesko, "Introduction: Clio Meets Science: The Challenges of History," *Osiris* 27 (1) (2012): 4–6.

5. The literature on the history of computing in the United States context is also significant. For a basic introduction, see Paul E. Ceruzzi, *Computing: A Concise History* (Cambridge: MIT Press, 2012); Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge: MIT Press, 1998); Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine* (Boulder, CO: Westview, 2004); and William Aspray and Paul E. Ceruzzi, *The Internet and American Business* (Cambridge: MIT Press, 2008). The growing literature on the U.S. history of the Internet includes works such as Janet Abbate, *Inventing the Internet* (Cambridge: MIT Press, 1999); Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge: MIT Press, 1996); Finn Burton, *Spam: A Shadow History of the Internet* (Cambridge: MIT Press, 2013); and Thomas Streeter, *The Net Effect: Romanticism, Capitalism, and the Internet* (New York: New York University Press, 2011). See also Jonathan Zittrain, *The Future of the Internet, and How to Stop It* (New Haven: Yale University Press, 2008), and Tim Wu, *The Master Switch: The Rise and Fall of Information Empires* (New York: Atlantic Books, 2010).

6. Scholarship has not yet advanced a deep understanding of the relationship between social justice and computing, although initial inroads are being made in the critical study of gender and computing. A few works of note include Donna Haraway, *Simians, Cyborgs and Women: The Reinvention of Nature* (New York: Routledge, 1991); Jennifer S. Light, "When Computers Were Women," *Technology and Culture* 40 (3) (1999): 455–483; Nathan Ensmenger, *The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise* (Cambridge: MIT Press, 2010); and Mette Bryld and Nina Lykke, *Cosmodolphins: Feminist Cultural Studies of Technology, Animals and the Sacred* (New York: Zed Books, 2000).

7. David E. Hoffmann, *The Dead Hand: The Untold Story of the Cold War Arms Race and Its Dangerous Legacy* (New York: Random House, 2009), 150–154, 364–369, 422–423, 477.

8. *Ibid.*, 153–154.

9. For sample references, see Kevin Kelly, *Out of Control: The New Biology of Machines, Social Systems, and the Economic World, Fourth Edition* (Reading, MA: Addison Wesley, 2004), chap. 4; Eric Raymond, *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary* (New York: O'Reilly, 1999); and Leon Trotsky, *Platform of the Joint Opposition* (1927) (London: New Park Publications, 1973), especially "The Agrarian Question and Social Construction."

10. Manuel Castells, *End of the Millennium: The Information Age—Economy, Society, and Culture* (Malden, MA: Blackwell, 1998), 5–68; Lawrence Lessig, *Code and Other Laws of Cyberspace* (New York: Basic Books, 1999), 3–8.

11. Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2006).

12. Melvin Kranzberg, "Technology and History: 'Kranzberg's Laws,'" *Technology and Culture* 27 (3) (1986): 544–560.

13. For Latour's aphorism, see Bruno Latour, "Technology Is Society Made Durable," in *A Sociology of Monsters: Essays on Power, Technology and Domination*, ed. John Law, Sociological Review Monograph No. 38 (London: Routledge, 1991), 103–132. For an excellent bibliographical bridge between science and technology studies (STS) and the study of information technologies, see P. Boczkowski and L. Lievrouw, "Bridging STS and Communication Studies: Scholarship on Media and Information Technologies," in *The Handbook of Science and Technology Studies*, ed. E. Hackett, O. Amsterdamska, M. Lynch, and J. Wajcman, 3rd ed. (Cambridge: MIT Press, 2007), 949–977.

14. Geoffrey C. Bowker and Leigh Starr, *Sorting Things Out: Classification and Its Consequences* (Cambridge: MIT Press, 1999), 33–50.

15. Eric Hobsbawm, *How to Change the World: Reflections on Marx and Marxism* (New Haven: Yale University Press, 2011), 22–41.

16. The article that made this book possible is Slava Gerovitch, "InterNyet: Why the Soviet Union Did Not Build a Nationwide Computer Network," *History and Technology*, 24 (4) (2008): 335–350. See also Slava Gerovitch, "The Cybernetics Scare and the Origins of the Internet," *Baltic Worlds* 2 (1) (2009): 32–38; Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002); Slava Gerovitch, "Speaking Cybernetically: The Soviet Remaking of an American Science," Ph.D. diss., Program in Science, Technology and Society, Massachusetts Institute of Technology, 1999; Loren R. Graham, *Science, Philosophy, and Human Behavior in the Soviet Union* (New York: Columbia University, 1987); Loren R. Graham, *Science in Russia and the Soviet Union: A Short History* (New York: Cambridge University Press, 1993); and Loren R. Graham, *Lonely Ideas: Can Russia Compete?* (Cambridge: MIT Press, 2013).

17. Classic and recent histories of the Internet and its American milieu include Abbate, *Inventing the Internet*; Edwards, *The Closed World*; Burton, *Spam*; and Thomas

Streeter, *The Net Effect: Romanticism, Capitalism, and the Internet* (New York: New York University Press, 2011). For more popular introductions, see Ian F. McNeely with Lisa Wolverton, *Reinventing Knowledge: From Alexandria to the Internet* (New York: Norton, 2008), whose scholarly breadth and snap counterweight popular accounts such as Katie Hafner, *Where Wizards Stay Up Late: The Origins of the Internet* (New York: Simon & Schuster, 1996), and Walter Isaacson, *The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution* (New York: Simon & Schuster, 2014).

18. I owe a version of this line and much else to conversations with Elihu Katz at the Department of Communication at Hebrew University in the spring of 2011.

19. Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge: MIT Press, 2011).

20. The literature on cybernetics, viewed in its breadth, is considerable and growing. For a brief introduction, see Bernard Geoghegan and Benjamin Peters, "Cybernetics," in *The John Hopkins Guide to Digital Media*, ed. Marie-Laure Ryan, Lori Emerson, and Benjamin J. Robertson (Baltimore: John Hopkins University Press, 2014), 109–112. For more on cybernetics in the United States, see Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21 (1) (1994): 228–266; Geoffrey C. Bowker, "How to Be Universal: Some Cybernetic Strategies, 1943–1970," *Social Studies of Science* 23 (1993): 107–127; Geoffrey Bowker, "The Empty Archive: Cybernetics and the 1960s," in *Memory Practices in the Sciences* (Cambridge: MIT Press, 2006); Lily E. Kay, "Cybernetics, Information, Life: The Emergence of Scriptural Representations of Heredity," *Configurations* 5 (1) (1997): 23–91. Books on the cybernetic context before and during the U.S. cold war include Edwards, *The Closed World*; David Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Baltimore: John Hopkins Press, 2002); Jennifer Light, *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (Baltimore: Johns Hopkins University Press, 2003); and Darren Tofts, Annemarie Jonson, and Alessio Cavallaro, eds., *Prefiguring Cyberspace: An Intellectual History* (Cambridge: MIT Press, 2002). A few biographical works include Steve J. Heims, *The Cybernetics Group* (Cambridge: MIT Press, 1991); Steve J. Heims, *John von Neumann and Norbert Wiener: From Mathematics to the Technologies of Life and Death* (Cambridge: MIT Press, 1982); Pesl R. Masani, *Norbert Wiener, 1894–1964* (Boston: Birkhäuser Verlag, 1990); Flow Conway and Jim Siegelman, *Dark Hero of the Information Age: In Search of Norbert Wiener, the Father of Cybernetics* (New York: Basic Books, 2005); and Hunter Crowther-Heyck, *Herbert A. Simon: The Bounds of Reason in Modern America* (Baltimore: Johns Hopkins University Press, 2005). A few key theorizations and historical treatments include N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999); Jean-Pierre Dupuy, *The Mechanization of the Mind: The Origins of Cognitive Science*, trans. M. B. DeBevoise (Princeton: Princeton University Press, 2000; Cambridge: MIT Press, 2009); John Johnston, *The Allure of Machinic Life: Cybernetics,*

Artificial Life, and the New AI (Cambridge: MIT Press, 2008); Philip Mirowski, *Machine Dreams: Economics Becomes a Cyborg Science* (New York: Cambridge University Press, 2001); Orit Halpern, "Dreams for Our Perceptual Present: Archives, Interfaces, and Networks in Cybernetics," *Configurations* 13 (2007): 283–319; Stuart Umpleby, "A History of the Cybernetics Movement in the United States," *Journal of the Washington Academy of Sciences* 91 (2005): 54–66; Bernard Geoghegan, "The Historiographic Conceptualization of Information: A Critical Survey," *IEEE Annals of the History of Computing* 30 (2008): 66–81. For more on cybernetics in the Soviet Union, see Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002); David Holloway, "Innovation in Science: The Case of Cybernetics in the Soviet Union," *Science Studies* 4 (1974): 299–337; and David Mindell, Jerome Segal, and Slava Gerovitch, "From Communications Engineering to Communications Science: Cybernetics and Information Theory in the United States, France, and the Soviet Union," in *Science and Ideology: A Comparative History*, ed. Mark Walker, 66–96 (New York: Routledge, 2003). Work on cybernetics in France includes, among others, Celine Lafontaine, "The Cybernetic Matrix of 'French Theory,'" *Theory, Culture and Society* 24 (2007): 27–46; Lydia Liu, "The Cybernetic Unconscious: Rethinking Lacan, Poe, and French Theory," *Critical Inquiry* 36 (2010): 288–320; Bernard Geoghegan, "From Information Theory to French Theory: Jakobson, Lévi-Strauss, and the Cybernetic Apparatus," *Critical Inquiry* 38 (2011): 96–126. On cybernetics in Britain, see Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010). On cybernetics in East Germany, see Jérôme Segal, "L'introduction de la cybernétique en R.D.A. rencontres avec l'idéologie marxiste," *Science, Technology and Political Change: Proceedings of the Twentieth International Congress of History of Science* (Liège, July 20–26, 1997) (Brepols: Turnhout, 1999), 1: 67–80. And on cybernetics in China, see Susan Greenhalgh, "Missile Science, Population Science: The Origins of China's One-Child Policy," *China Quarterly* 182 (2005): 253–276. On cybernetics in Chile, see Medina, *Cybernetic Revolutionaries*.

21. I owe the term *knowledge base* to conversations with Richard John in 2010. See, in particular, his related work on the political decisions that have shaped U.S. communication history, *Network Nation: Inventing American Telecommunications* (Cambridge: Harvard University Press, 2010).

22. Stephen Jay Gould, *Life's Grandeur* (London: Vintage, 1997), 7.

23. Under the name "actor-network theory," Bruno Latour has attempted to theorize the concept of *network* as a way of retooling the historian's method of following the linkages across all forms of actors. See Bruno Latour's *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open University Press, 1987). Two decades later, he deemed "the word *network* so ambiguous we should have abandoned it long ago," in Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), 129–130.

24. For more on the historical designator *new media*, see Benjamin Peters, “And Lead Us Not into Thinking the New Is New: A Bibliographic Case for New Media History,” *New Media and Society* 11 (1–2) (2009): 13–30.

25. Aleksandr Ya. Khinchin, “Teoria prosteishego potoka” (Mathematical Methods of the Theory of Mass Service; more literally, Simple Stream Theory), *Trudy Matematicheskogo Instituta Steklov.* 49 (1955): 3–122.

26. János Kornai, *The Socialist System: The Political Economy of Communism* (Princeton: Princeton University Press, 1992); David Graeber, *Debt: The First Five Thousand Years* (New York: Melville House, 2011), 94.

27. The field of institutional economics offers pragmatic approaches to observed irrationalities in individual and group actions. A few standard references in the literature include Thorsten Veblen’s heterodox position in “Why Is Economics Not an Evolutionary Science?,” *Quarterly Journal of Economics* 12 (1898): 373–393; Thomas C. Schelling, *Micromotives and Macrobehavior* (New York: Norton, 1978); Douglass C. North, *Institutions, Institutional Change and Economic Performance* (New York: Cambridge University Press, 1998); Ronald Coase, “The New Institutional Economics,” *American Economic Review* 88 (2) (1998): 72–74; and William Kapp, *The Foundations of Institutional Economics* (New York: Routledge, 2011). For comparison to the quirkiness of individual decisions, see popular introductions to cognitive psychology and behavioral psychology and economics, such as Daniel Kahnemann, *Thinking Fast and Slow* (New York: Farrar, Straus, and Giroux, 2011), and Dan Ariely, *Predictably Irrational: The Hidden Forces That Shape Our Decisions* (New York: HarperCollins, 2008). Compare these to recent works on the informal and violent character of post-Soviet economics, including Alena V. Ledeneva, *Russia’s Economy of Favors: Blat, Networking and Information Exchange* (New York: Cambridge University Press, 1998), and Vadim Volkov, *Violent Entrepreneurs: The Use of Force in the Making of Russian Capitalism* (Ithaca: Cornell University Press, 2002).

28. The English-language literature on tech entrepreneurs is long and popular, including Walter Isaacson, *The Innovators* (New York: Simon & Schuster, 2014), and Peter Thiel, *Zero to One: Notes on Startups, or How to Build the Future* (New York: Crown Business, 2014), but very little of it to my knowledge looks beyond the West (in particular, the west coast of the United States and the eastern Asian rim), such as Eden Medina, ed., *Beyond Imported Magic: Essays on Science, Technology, and Society in Latin America* (Cambridge: MIT Press, 2014).

Chapter 1: A Global History of Cybernetics

1. See note 20 on cybernetic literature in the introduction to this book.

2. See Wiener, *Cybernetics*; Bowker, “How to Be Universal: Some Cybernetic Strategies, 1943–70”; Galison, “The Ontology of the Enemy”; and J. R. Pierce, “The Early

Days of Information Theory," *IEEE Transactions on Information Theory* 19 (1) (1973): 3–8; and especially Ronald R. Kline, *The Cybernetics Moment, Or Why We Call Our Age the Information Age* (Baltimore, MD: Johns Hopkins University Press, 2015).

3. Ronald R. Kline, "Where Are the Cyborgs in Cybernetics?," *Social Studies of Science* 39 (3) (2009): 331–362.

4. Wiener, *Cybernetics*. On the curious father-son circularities between Leo's Slavic studies and Norbert's cold war cybernetics, see Benjamin Peters, "Toward a Genealogy of a Cold War Communication Science: The Strange Loops of Leo and Norbert Wiener," *Russian Journal of Communication* 5 (1) (2013): 31–43.

5. This section draws on my previously published work on cybernetics, including Bernard Geoghegan and Benjamin Peters, "Cybernetics" in *The John Hopkins Guide to Digital Media*, ed. Marie-Laure Ryan et. al. (Baltimore: John Hopkins University Press, 2014), 109–112.

6. Wiener's classic works include his technical masterpiece *Cybernetics*, the popular *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton Mifflin, 1950), and his deathbed lectures *God and Golem, Inc.: A Comment on Certain Points Where Cybernetics Impinges on Religion* (Cambridge: MIT Press, 1964).

7. Wiener, *Cybernetics*, 1–25, 155–168.

8. *Ibid.*, 16.

9. Dupuy, *Mechanization of the Mind*. See also John von Neumann, *The Computer and the Brain*, 2nd ed. (New Haven: Yale University Press, [1958] 2000).

10. Quoted in Claus Pias, "Analog, Digital, and the Cybernetic Illusion," *Kybernetes* 34 (3–4) (2005): 544.

11. Claus Pias, ed., *Cybernetics-Kybernetik 2: The Macy-Conferences 1946–1953* (Berlin: Diaphanes, 2004).

12. Steve J. Heims, *The Cybernetics Group* (Cambridge: MIT Press, 1991).

13. *Ibid.*, 52–53, 207.

14. William Aspray, *John von Neumann and the Origins of Modern Computing* (Cambridge: MIT Press, 1990).

15. David Lipset, *Gregory Bateson: The Legacy of a Scientist* (New York: Prentice Hall, 1980). See also Fred Turner, *From Counterculture to Cyberculture* (Chicago: University of Chicago Press, 2006), 121–125.

16. Jefferson Pooley, "An Accident of Memory: Edward Shils, Paul Lazarsfeld and the History of American Mass Communication Research," Ph.D. diss., Columbia University, New York, 2006.

17. For more on “trading zones,” see Peter Galison, *Image and Logic: A Material Culture of Microphysics* (Chicago: University of Chicago Press, 1997), 44–47, 781–784, 806–807, 816–817.

18. Bill Aspray, “The Scientific Conceptualization of Information,” *Annals of the History of Computing* 7 (2) (1985): 117–140.

19. Claude E. Shannon, “A Mathematical Theory of Communication,” *Bell Systems Technical Journal* 27 (1948): 379–423, 623–656.

20. Mirowski, *Machine Dreams*.

21. Paul Erickson, Judy L. Klein, Lorraine Dastone, Rebecca Lemov, Thomas Sturm, and Michael D. Gordin, *How Reason Almost Lost Its Mind: The Strange Career of Cold War Rationality* (Chicago: University of Chicago Press, 2013).

22. Claude E. Shannon, “The Bandwagon,” *IRE Transactions on Information Theory* 2 (1) (1956): 3. See also Pierce, “The Early Days of Information Theory”; Norbert Wiener, “What Is Information Theory?,” *IRE Transactions on Information Theory* 48 (1956): 48; Ronald R. Kline, “What Is Information Theory a Theory Of? Boundary Work among Scientists in the United States and Britain during the Cold War,” in *The History and Heritage of Scientific and Technical Information Systems: Proceedings of the 2002 Conference*, Chemical Heritage Foundation, ed. W. Boyd Rayward and Mary Ellen Bowden, 15–28 (Medford, NJ: Information Today, 2004).

23. Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow, “Behavior, Purpose, and Teleology,” *Philosophy of Science* 10 (1943): 18–24.

24. Daniel Kahneman and Amos Tversky, “Prospect Theory: An Analysis of Decisions under Risk,” *Econometrica* 47 (2) (1979): 263–291. See also Daniel Kahneman and Amos Tversky, eds., *Choices, Values and Frames* (New York: Cambridge University Press and Russell Sage Foundation, 2000).

25. David Stark, *The Sense of Dissonance: Accounts of Worth in Economic Life* (Princeton: Princeton University Press, 2009), 1–34.

26. The intellectual history of thought on hierarchy and its critics would fill many shelves. That history might combine thinking on technical subordination in mathematics (cardinal numbers, graphs, networks, sets, type theory, programming) and other classificatory systems; individual autonomy (Plato, Locke and Kant, Isaiah Berlin and Charles Taylor) and sociobiological evolution; legal, ethical, and religious thought; and pragmatism and feminism. For a helpful update on modern network discourse, see Daniel Kreiss, Megan Finn, and Fred Turner, “The Limits of Peer Production: Some Reminders from Max Weber for the Network Society,” *New Media and Society* 13 (2) (2011): 243–259.

27. Warren S. McCulloch, “A Hierarchy of Values Determined by the Topology of Nervous Nets,” *Bulletin of Mathematical Biophysics* 7 (1945): 89–93.

28. Ibid., 91.

29. George Dyson, *Turing's Cathedral: The Origins of the Digital Universe* (New York: Pantheon Books, 2012), 196–197, see also 7–10, 56–63.

30. John von Neumann, “Can We Survive Technology?,” *Fortune* (June 1955): 106–108, 151–152.

31. For a lively discussion, see Dupuy, *The Mechanization of Mind*.

32. For a few examples of the French scholarly and popular presses on cybernetics between 1946 and 1952, see Jacque Bergier, “Un plan général d’automatisation des industries,” *Les Lettres françaises* (April 15, 1948): 7–8; Léon Brillouin, “Les machines américaines,” *Annales des Télécommunications* 2 (1947): 331–346; Léon Brillouin, “Les grandes machines mathématiques américaines,” *Atomes* 2 (21) (1947): 400–404; Louis de Broglie, *La cybernétique: théorie du signal et de l’information* (Paris: Edition de la Revue d’Optique Théorique et Instrumentale, 1951); Dominique Dubarle, “Une nouvelle science: la cybernétique—vers la machine à gouverner?,” *Le Monde*, December 28, 1948, in P. Breton, *A l’image de l’homme* (Paris: Seuil, 1995), 137–138; Dominique Dubarle, “Idées scientifiques actuelles et domination des faits humains,” *Esprit* 9 (18) (1950): 296–317. See also Jérôme Segal, *Le zéro et le un: histoire de la notion scientifique d’information* (Paris: Syllepse, 2003).

33. Mindell, Segal, and Gerovitch, “From Communications Engineering to Communications Science.”

34. Ibid. See also Geoghegan, “From Information Theory to French Theory”; Céline LaFontaine, “The Cybernetic Matrix of French Theory”; and LaFontaine, *L’empire cybernétique: des machines à penser à la pensée machine* (Paris: Seuil, 2004).

35. Phil Husbands and Owen Holland, “The Ratio Club: A Hub of British Cyberneticists,” in *The Mechanical Mind in History*, ed. P. Husbands, O. Holland, and M. Wheeler, 91–148 (Cambridge: MIT Press, 2008).

36. Pickering, *The Cybernetic Brain*.

37. Stafford Beer, *Brain of the Firm* (London: Allen Lane, Penguin Press, 1972).

38. Humberto Maturana and Francisco Valera, *Autopoiesis and Cognition: The Realization of the Living* (Boston: Reidel, 1980); Francisco Valera, *The Tree of Knowledge: The Biological Roots of Human Understanding* (Boston: Shambhala Press, 1987); Francisco Valera with Evan Thompson and Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge: MIT Press, 1991).

39. For more on Aleksandr Bogdanov, see his *Tektologia: Vsyebshcheiye Organizatsionnaya Nauka* (*Tectology: Universal Organizational Science*) (Moscow: Akademia Nauk, 1913–1922). See also Nikolai Kremmentsov, *A Martian Stranded on Earth: Alexander Bogdanov, Blood Transfusions, and Proletarian Science* (Chicago: University of Chicago Press, 2011), and J. Biggart, P. Dudley, and F. King, eds., *Alexander Bogdanov and the*

Origins of Systems Thinking in Russia (Brookfield, VT: Ashgate, 1998), and McKenzie Wark, *Molecular Red: A Theory for the Anthropocene* (New York: Verso, 2015).

40. On Stefan Odobleja, see Mihai Drăganescu, *Odobleja: Between Ampère and Wiener* (Bucharest: Academia Republicii Socialiste Romania, 1981); Nicolae Jurcău, "Two Specialists in Cybernetics: Stefan Odobleja and Norbert Wiener, Common and Different Features," *Twentieth World Congress of Philosophy* (1998), accessed October 11, 2011, <http://www.bu.edu/wcp/Papers/Comp/CompJurc.htm>.

41. Peters, "Toward a Genealogy of a Cold War Communication Science."

42. Michael O'Shea. *The Brain: A Very Short Introduction* (New York: Oxford University Press, 2005), 1.

43. For canonic works on Soviet science written during or soon after the cold war, see Zhores Medvedev, *Soviet Science* (New York: Norton, 1978); Alexander Vucinich, *Empire of Knowledge: The Academy of Sciences of the USSR (1917–1970)* (Berkeley: University of California Press, 1984); Graham, *Science in Russia and the Soviet Union*; David Joravsky, *Soviet Marxism and Natural Science, 1917–1932* (New York: Columbia University Press, 1971). For more current materials, see Nikolai Kremmentsov, *Stalinist Science* (Princeton: Princeton University Press, 1996); Paul R. Josephson, *Totalitarian Science and Technology* (Atlantic Highlands, NJ: Humanities Press, 1996); Paul R. Josephson, *Red Atom: Russia's Nuclear Power Program from Stalin to Today* (Pittsburg: University of Pittsburg Press, 2005); and Ethan Pollock, *Stalin and the Soviet Science Wars* (Princeton: Princeton University Press, 2006).

44. Nils Roll-Hansen, *The Lysenko Effect: The Politics of Science* (Amherst, NY: Humanity Books, 2005).

45. For a thorough discussion of the politics of the label "Lysenkoism," see William deJong-Lambert and Nikolai Kremmentsov, "On Labels and Issues: The Lysenko Controversy and the Cold War," *Journal of the History of Biology* 45 (3) (2012): 373–388, and especially Audra J. Wolfe, "The Cold War Context of the Golden Jubilee, or, Why We Think of Mendel as the Father of Genetics," *Journal of the History of Biology* 45 (3) (2012): 389–414. Earlier materials include David Joravsky, *The Lysenko Affair* (Chicago: University of Chicago Press, 1970), and Valery N. Soyfer, *Lysenko and the Tragedy of Soviet Science* (New Brunswick, NJ: Rutgers University Press, 1994).

46. Gerovitch, *From Newspeak to Cyberspeak*, 547–548.

47. *Ibid.*, 120.

48. *Ibid.*, 126.

49. Mikhail G. Iaroshevskii, "Semanticheskii idealizm: filosofiia imperialisticheskoi reaktsii," in *Protiv filosofiia oruzhenostsev amerikano-angliiskogo imperializma*, ed. T. Oizerman and P. Trofimov (Moscow: Nauka, 1951), 100, quoted in Gerovitch, *From Newspeak to Cyberspeak*, 119–121.

50. Gerovitch, *From Newspeak to Cyberspeak*, 119–121.
51. Published under the pseudonym “Materialist,” *Voprosy Filosofii* 5 (1953): 210–219.
52. Gerovitch, *From Newspeak to Cyberspeak*, 124–126. See also *Ocherki istorii informatiki v Russii*, ed. D. Pospelov and Ya. Fet (Novosibirsk: Nauchnyi Tsentr Publikatsii RAS, 1998).
53. Mark M. Rosenthal and Pavel F. Iudin, eds., *Kratkii filosofskii slovar'*, 4th ed. (Moscow: Gospolitizdat, 1954), 236–237; also quoted in Masani, *Norbert Wiener*, 261.
54. Gerovitch, *From Newspeak to Cyberspeak*, 119.
55. Ilia B. Novik, “Normal'naia Lzhnauka” [“A Normal Pseudoscience”], *Voprosy istorii estestvoznaniia i tekhniki* (*Questions of History of Natural Science and Technology*) 4 (4) (1990), quoted in Gerovitch, *From Newspeak to Cyberspeak*, 103.
56. For more reading on Soviet science, see note 43. On Vygotsky in particular, see Alex Kozulin, *Vygotsky's Psychology: A Biography of Ideas* (Cambridge: Harvard University Press, 1990).
57. Sergei N. Khrushchev, *Nikita Khrushchev and the Creation of a Superpower* (University Park: Pennsylvania State University Press, 2000), 94–96, 163–173.
58. George Paloczi-Horvath, *Khrushchev: The Making of a Dictator* (New York: Little, Brown, 1960), 202.
59. Paloczi-Horvath, *Khrushchev: The Making of a Dictator*, 202.
60. *Ibid.*, 80.
61. David Holloway, “Physics, the State, and Civil Society in the Soviet Union,” *Historical Studies in Physical and Biological Sciences* 100 (1) (1999): 173–192; Loren R. Graham, “How Robust Is Science under Stress?,” *What Have We Learned about Science and Technology from the Russian Experience?* (Stanford: Stanford University Press, 1998), 52–73.
62. Ivan Pavlov, *Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex*, trans. and ed. G. V. Anrep (London: Oxford University Press, 1927).
63. Josephson, *New Atlantis Revisited*.
64. Stanislav Boguslavski, Henryk Greniewski, and Jerzy Szapiro, “Dialogi o cybernetyce,” *Mysl filozoficzna* 4 (14) (1954): 158–212, cited in Günther, “Cybernetics and Dialectical Materialism of Marx and Lenin.”
65. Anatoly Kitov, “Chelovek, kotoryi vynes kibernetiku iz sekretnoi biblioteki” [“The Man Who Brought Cybernetics Out of a Secret Library”], interview, *Komp'iuterra* 43 (November 18, 1996): 44–45.

66. Gerovitch, *From Newspeak to Cyberspeak*, 173–175.
67. *Ibid.*, 176–180.
68. Kitov, “Chelovek, kotoryi vynes kibernetiku iz sekretnoi biblioteki,” 44–45.
69. Gerovitch, *From Newspeak to Cyberspeak*, 183.
70. *Ibid.*, 173. See also Sergei L. Sobolev, Anatolii I. Kitov, and Aleksei A. Lyapunov, “Osnovnye cherty kibernetiki” [“Basic Features of Cybernetics”], *Voprosy filosofii* 4 (1955): 136.
71. Edwards, *The Closed World*, 175–208, 275–302.
72. Gerovitch, *From Newspeak to Cyberspeak*, 178.
73. Wiener, *Cybernetics*.
74. I discuss the renewability of new media in Peters, “And Lead Us Not into Thinking the New Is New,” and Benjamin Peters and Deborah Lubken, “New Media in Crises: Discursive Instability and Emergency Communication,” in *The Long History of New Media*, ed. David W. Park et al., 193–209 (New York: Peter Lang, 2011).
75. My thanks to Andriy Ishchenko and an anonymous reviewer for this distinction.
76. Sobolev, Kitov, and Lyapunov, “Osnovnye cherty kibernetiki,” 141.
77. *Ibid.*, 141–146.
78. *Ibid.*
79. *Ibid.*, 147.
80. See Karel Chapek’s play *Rossum’s Universal Robots*, trans. David Willie (Fairford: Echo Library, 2010).
81. Sobolev et al., “Osnovnye cherty kibernetiki,” 148.
82. *Ibid.*, 147.
83. *Ibid.*
84. *Ibid.*
85. *Ibid.*
86. For more on Kolman, see Loren Graham and Jean-Michael Kantor, *Naming Infinity: A True Story of Religious Mysticism and Mathematical Creativity* (Cambridge: Belknap Press of Harvard University Press, 2009).
87. Graham and Kantor, *Naming Infinity*. This fascinating account describes how founding (transfinite) set theorists and religious mystics such as Dmitri Egorov, Pavel Florensky, and Nikolai Luzhin in 1920s Moscow came together around the realization that neither infinity nor God could be defined but both could be named.

88. For more on Lysenko, see deJong-Lambert and Kremmentsov, "On Labels and Issues." Wolfe, "The Cold War Context of the Golden Jubilee," rethinks the accepted positions against Lysenko laid out in Joravsky, *The Lysenko Affair*, and Soyfer, *Lysenko and the Tragedy of Soviet Science*.

89. Graham and Kantor, *Naming Infinity*, 129.

90. Arnosht (Ernest) Kol'man, *My ne dolzhny byli tak zhit'* [We Should Not Have Lived That Way] (New York: Chalidze, 1982), 7, quoted in Graham and Kantor, *Naming Infinity*, 130.

91. Ernest Kolman, "Shto takoe kibernetika?" [What Is Cybernetics?], *Voprosi Filosofii* (Akademia Nauk CCCR Institut Filosofii, Moscow) 4 (1955): 148–149.

92. Ibid., 149.

93. Wiener briefly studied at Columbia under John Dewey in 1915 and worked as a consultant for a National Defense Research Committee-supported Statistical Research Group based there in 1940.

94. Kolman, "Shto takoe kibernetika?," 150–157.

95. Helmut Dahm, "Zur Konzeption der Kybernetik im dialektischen Materialismus," unpublished manuscript, 25, quoted in Günther, "Cybernetics and Dialectical Materialism of Marx and Lenin," 317–332.

96. David Holloway, for example, writes that "the hostile image of capitalist society, which had played an important part in the early attacks on cybernetics, was now turned to its defense," in "Innovation in Science: The Case of Cybernetics in the Soviet Union," *Science Studies* 4 (1974): 316.

97. Gerovitch, *From Newspeak to Cyberspeak*, 180.

98. Ibid.

99. Sobolev, Kitov, and Lyapunov, "Osnovnye cherty kibernetiki," quoted in Gerovitch, *From Newspeak to Cyberspeak*, 180.

100. Erickson et al., *How Reason Almost Lost Its Mind*, 272.

101. Galison, "The Ontology of the Enemy," 228–266. Peter Galison says that "the enemy as human-machine black box becomes us as human-machine black box." In Sina Najafi and Peter Galison, "The Ontology of the Enemy: An Interview with Peter Galison," *Cabinet* 12 (2003), accessed April 10, 2015, <http://cabinetmagazine.org/issues/12/najafi2.php>.

102. John A. Armstrong, "Sources of Administrative Behavior: Some Soviet and Western European Comparisons," *American Political Science Review* 59 (3) (1965): 643–655.

103. Gerovitch, "The Cybernetics Scare and the Origins of the Internet," 32–38.

104. D. G. Malcolm, "Review of *Cybernetics at [sic] Service of Communism*, vol. 1," *Operations Research* 11 (1963): 1012.
105. Conway and Siegelman, *Dark Hero of the Information Age*, 316.
106. CIA Intelligence Memorandum, No. 0757/64, "The Meaning of Cybernetics in the USSR," February 26, 1964, 2, also partially quoted in Flo Conway and Jim Siegelman, *Dark Hero of the Information Age* (New York: Basic, 316).
107. CIA Intelligence Memorandum, No. 0757/64, "The Meaning of Cybernetics in the USSR," 3.
108. *Ibid.*, 3.
109. *Ibid.*, 3. See also Gerovitch, "The Cybernetics Scare and the Origins of the Internet," 35.
110. Gerovitch, "The Cybernetics Scare and the Origins of the Internet."
111. Gerovitch, "InterNyet," 340.
112. Gerovitch, *From Newspeak to Cyberspeak*, 249–251.
113. Yu. Kapitonova and A. A. Letichevsky, *Paradigmi i idei akademika V. M. Glushkova* (Kiev: Naukova Dumka, 2003), 296.
114. Igor' A. Poletaev, "O matematicheskom modelirovnanii," *Problemy kibernetiki* 27 (1973): 147.
115. Igor' A. Poletaev, "K opredeleniiu poniatii 'informatsiia,'" in *Issledovannii po kibernetike*, ed. A. Lyapunov (Moscow: Sovetskoe radio 1970), 212.
116. Gerovitch, *From Newspeak to Cyberspeak*, 216.
117. Simon Kassel, *Soviet Cybernetics Research: A Preliminary Study of Organizations and Personalities* (Santa Monica: RAND, 1971), v.
118. See the titles of Wiener's *Cybernetics, or Control and Communication in the Animal and the Machine* and his *The Human Use of Human Beings: Cybernetics and Society* (Cambridge: MIT Press, 1950).
119. Gerovitch, *From Newspeak to Cyberspeak*, 208.
120. *Ibid.*, 209–210.
121. *Ibid.*, 210.
122. Pospelov and Fet, *Ocherki istorii informatiki v Rossii*.
123. Conway and Siegelman, *Dark Hero*, 316.
124. Norbert Wiener, "Obschestvo i nauka," *Voprosi Filosofii* 7 (1961): 49–52.

125. Dirk Jan Struik, "Norbert Wiener: Colleague and Friend," *American Dialog* 3 (1) (1966): 34–37.

126. Bonnie Honig, *Democracy and the Foreigner* (Princeton: Princeton University Press, 2003).

127. On the one hundred twentieth anniversary of his birth and the fiftieth anniversary of his death, the IEEE held a medium-sized conference in Boston on June 24–26, 2014, titled Norbert Wiener in the Twenty-first Century, including a gathering of biographers, former students of his, and rising scholars interested in his life and work.

128. Conway and Siegelman, *Dark Hero*, 314–316. See also Peters, "Toward a Genealogy of Cold War Communication Science."

129. Gerovitch, *From Newspeak to Cyberspeak*, 154–155, 301, *passim*.

130. James W. Carey with John J. Quirk, "The Mythos of the Electronic Revolution," in *Communication and Culture: Essays on Media and Society*, 113–141 (New York: Unwin Hyman, 1989).

131. For more on feedback in the Western political tradition, see Otto Mayr, *Authority, Liberty, and Automatic Machinery in Early Modern Europe* (Baltimore: Johns Hopkins University Press, 1989), 144; see also Bernard Geoghegan, "The Cybernetic Apparatus: Media, Liberalism, and the Reform of the Human Sciences," Ph.D. diss., Northwestern University, Chicago, 2012.

132. Gerovitch, *From Newspeak to Cyberspeak*, 122.

133. Graham, *Lonely Ideas*, 1–4. For contrasting portraits of the local contingencies and practices that animate laboratory work, see Galison, *Image and Logic*, and Latour, *Science in Action*.

134. Dima Adamsky, *The Culture of Military Innovation: The Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the US, and Israel* (Stanford: Stanford University Press, 2010), 37, 24–57.

135. Medina notes that "Beer was well aware of the Soviet approach to cybernetic management, and he viewed it with open contempt." Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge: MIT Press, 2011), 63.

136. Herbert Spencer, *The Principles of Sociology*, 3rd ed. (New York: Westminster, [1876] 1896), 460–462, 478–545.

137. Charles Horton Cooley, *Sociological Theory and Social Research: Selected Papers of Charles Horton Cooley* (New York: Henry Holt, 1930), 6.

138. O'Shea, *The Brain*, 1.

Chapter 2: Economic Cybernetics and Its Limits

1. Regarding the mutual embeddedness of practice and theory on which this analysis of Soviet economic problems rests, I take for granted (more or less following John Dewey and other early pragmatists) that the two cannot be separated. Without practice, theory is a mere abstraction, a desiccation of thought; without theory, practice is purposeless action. I understand theory as a form of practice, however subdued and meditative its rootedness in modern society may be, and practice as an expression of mental purpose, an exercising of theory in a world that knows only action. C. S. Peirce put the point thus: "Consider what effects, which might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of those effects is the whole of our conception of the object." In other words, to consider an object is to conceive of its practical effects. To conceive, or theorize, an object is, for the early pragmatists, also to understand the full set of its practices and implications. With this in mind, the analysis of organizations and economics that follows assumes that theoretical and practical judgments must be reconcilable. For more, see John Dewey, *Logic: The Theory of Inquiry*, in *The Essential Dewey*, vol. 2 (Bloomington: Indiana University Press, 1999), 169–179; see also Charles Sanders Peirce, "How to Make Our Ideas Clear," in *The Essential Peirce*, vol. 1 (Bloomington: Indiana University Press, 1992–1999), 132.

2. Before 1928, the Soviet Union was an indicative economy, not a command economy, meaning that the state set economic quotas but did not compel them. Richard E. Ericson, "Command Economy," *The New Palgrave Dictionary of Economics*, 2nd ed., ed. Steven N. Durlauf and Lawrence E. Blume (New York: Palgrave, 2008).

3. Engels wrote to Karl Kautsky in Vienna: "In any case, it will be for those people to decide if, when and what they want to do about it, and what means to employ. I don't feel qualified to offer them any advice or counsel in this matter. They will presumably be at least as clever as we are." Friedrich Engels to Karl Kautsky in Vienna, from Karl Marx and Friedrich Engels, *Karl Marx and Frederick Engels: Selected Correspondence* (Moscow: Progress, 1975), accessed July 25, 2013, http://www.marxists.org/archive/marx/works/1881/letters/81_02_01.htm.

4. Stephen F. Cohen, *Bukharin and the Bolshevik Revolution: A Political Biography, 1888–1938* (New York: Oxford University Press, 1971), 93.

5. Much of the vast literature on the Soviet command economy is dated to cold war research concerns. The part that was consulted (and sometimes critiqued) in this work includes Mark Beissinger, *Scientific Management, Socialist Discipline, and Soviet Power* (Cambridge: Harvard University Press, 1988); Peter Blau, *Bureaucracy in Modern Society* (New York: Random House, 1956); Michael Ellman, *Planning Problems in the USSR: The Contributions of Mathematical Economics to Their Solution, 1960–1971* (New York: Cambridge University Press, 1973); Michael Ellman, *Socialist Planning* (New York: Cambridge, 1978); Paul R. Gregory, *The Political Economy of Stalinism: Evidence*

from the Soviet Secret Archives (New York: Cambridge University Press, 2003); Paul R. Gregory, *Restructuring the Soviet Economic Bureaucracy* (New York: Cambridge University Press, 1990); Gregory Grossman, ed., *Studies in the Second Economy of Communist Countries: A Bibliography* (Berkeley: University of California Press, 1988); Gregory Grossman, "Notes for a Theory of the Command Economy," *Soviet Studies* 15 (2) (1963): 101–123; Gregory Grossman, "The 'Second Economy' of the USSR," *Problems of Communism* 26 (5) (1977): 25–40; János Kornai, *The Socialist System*; Alena V. Ledeneva, *Russia's Economy of Favors: Blat, Networking, and Informal Exchange*. New York: Cambridge University Press, 1998; Alec Nove, *An Economic History of the USSR, 1917–1991*, 3rd ed. (New York: Penguin, 1992); Elena Osokina, *Our Daily Bread: Socialist Distribution and the Art of Survival in Stalin's Russia, 1927–1941* (New York: Routledge, 2003); and Alejandro Portes, Manuel Castells, and Lauren A. Benton, eds., *The Informal Economy: Studies in Advanced and Less Developed Countries* (Baltimore: Johns Hopkins University Press, 1989).

6. George M. Armstrong Jr., *The Soviet Law of Property* (The Hague: Martinus Nijhoff, 1983). See also John N. Hazard, *Communists and Their Law: A Search for the Common Core of the Legal Systems of the Marxian Socialist States* (Chicago: University of Chicago, 1969), 171–223; and Karl Marx and Friedrich Engel, "Manifesto of the Communist Party" (1848) in Robert C. Tucker, ed., *The Marx-Engels Reader, 2nd Edition* (New York: W. W. Norton, 1978): "the theory of the Communists may be summed up in the single sentence: abolition of private property."

7. David Dyker, *Restructuring the Soviet Economy* (New York: Routledge, 1991), 7.

8. Mark Harrison, "Soviet Economic Growth since 1928: The Alternative Statistics of G. I. Khanin," *Europe-Asia Studies* 45 (1) (1993): 141–167.

9. Estimates of the number of victims range from roughly 7 million to 14 million. Robert Conquest, *The Harvest of Sorrow* (New York: Oxford University Press, 1986); Timothy Snyder, *Bloodlands: Europe between Hitler and Stalin* (New York: Basic Books, 2012); Miron Dolot, *Execution by Hunger: The Hidden Holocaust* (New York: Norton, 2011).

10. David C. Engerman, *Modernization from the Other Shore: American Intellectuals and the Romance of Russian Development* (Cambridge: Harvard University Press, 2003).

11. Anders Aslund, *How Capitalism Was Built: The Transformation of Central and Eastern Europe* (New York: Cambridge University Press, 2007), 75; Noel E. Firth and James H. Noren, *Soviet Defense Spending: A History of CIA Estimates, 1950–1990* (College Station: Texas A&M University Press).

12. Francis Spufford, in his delightful novel *Red Plenty*, fabricates a relatable incident in which a brake failure sends a tractor hurtling through the wall of a crucial factory and thereby disrupts the production of a specific large piece of machinery for months. The disruption sends a ripple of delays and costs across the national indus-

tries that depend on the factory for the machine that it produces. Francis Spufford, *Red Plenty* (Minneapolis, MN: Graywolf Press, 2012).

13. I. Borovitski, editorial, *Pravda*, October 3, 1962.

14. N. Chesnenko, "'Obshchii iazyk' elektronnykh mashin: Problemy kodirovaniia dannykh," *Ekonomicheskaya gazeta* (47) (1973): 10.

15. Gertrude E. Schroeder, "Organizations and Hierarchies: The Perennial Search for Solutions," in *Reorganization and Reform in the Soviet Economy*, ed. Susan J. Linz and William Moskoff (New York: Sharpe, 1988), 6.

16. Leon Smolinski, "What Next in Soviet Planning?," *Foreign Affairs* 42 (3) (1964): 603–613.

17. Aleksei Kuteinikov, "Pervie proekti avtomatizatsii upravleniya sovetsskoi plano-voi ekonomikoi v kontse 1950-x I nachale 1960-x gg.—'elektronnyi sotsializm'," *Ekonomicheskaya istoriya* (Moscow: Trudi istoricheskogo fakulteta MGU) 15 (2011): 126.

18. Castells, *End of the Millennium*, 17, see also 5–68.

19. Alex Galloway, *Protocol: How Control Exists after Decentralization* (Cambridge: MIT Press, 2004), 2–28, 240–247.

20. E. G. Liberman, "Plans, Profits and Bonuses," *Pravda*, September 9, 1962, quoted in *The Liberman Discussion: A New Phase in Soviet Economic Thought*, ed. M. E. Sharpe (White Plains, NY: International Arts and Science Press, 1965), 000–000.

21. John Marangos, *Consistency and Viability of Socialist Economic Systems* (New York: Palgrave Macmillan, 2013), esp. chapter 5.

22. David Alexander Lax, *Libermanism and the Kosygin Reform* (Charlottesville: University of Virginia Press, 1991).

23. William Taubman, Sergei Khrushchev, and Abbott Gleason, *Nikita Khrushchev* (New Haven: Yale University Press, 2000), 153–154.

24. Karl W. Ryavec, *Russian Bureaucracy: Power and Pathology* (New York: Rowman & Littlefield, 2005), 227–230.

25. Gottfried Leibniz, "The Art of Discovery" (1685), in *Leibniz: Selections*, ed. Philip P. Wiener (New York: Charles Scribner's Sons, 1951), 50–58.

26. Kantorovich and von Neumann were born to middle-class Jewish families in eastern Europe. Roy Gardner, in "L. V. Kantorovich: The Price Implications of Optimal Planning," in *Socialism and the Market: Mechanism Design Theory and the Allocation of Resources*, ed. Peter J. Boettke, 638–648 (New York: Routledge, 2000). Few have satisfactorily described the forces behind the phenomenal scientific output of the generation born between 1890 and 1930 to a tiny Jewish middle class in Hungary.

Members of this group include mathematician and founding computer scientist and game theorist John von Neumann; pan-prolific mathematician Paul Erdős; Nobel laureate and founder of holography Dennis Gabor; Nobel laureate and physicist Eugene Wigner; early supersonic aerospace engineer Theodore von Kármán; discoverer of the linear accelerator, the electron microscope, and nuclear chain reaction Leo Szilard; the primary force behind the hydrogen bomb Edward Teller; codeveloper of BASIC computer programming John George Kemeny; historian Oszkar Jaszi; philosopher Georg Lukacs, economist and philosopher Karl Polanyi; author Arthur Koestler; and composer Bela Bartok. Gabor Pallo, "The Hungarian Phenomenon in Israeli Science," *Bulletin of the History of Chemistry* 25 (1) (2000): 35–42.

27. Independent of Kantorovich, Von Neumann and George Dantzig developed similar methods in the United States after the war.

28. To add some numbers to the basic problem: assume that a square meter of potatoes costs two rubles to grow and sells at six rubles and that a square meter of wheat costs three rubles and sells at seven rubles. Given 100 square meters, the linear programmer might ask, "What proportion of potatoes and wheat will maximize revenue?" In practice, programmers struggled to address massively more complicated programs, factoring into their matrices and algorithms the constraints, costs, and effects of dozens or hundreds of variables from pesticides, fertilizer, and soil degradation.

29. Iosif V. Stalin, *Voprosy leninizma*, 11th ed. (Moscow: Gospolitizdat, 1951), 326.

30. Abraham S. Becker, "Input-Output and Soviet Planning: A Survey of Recent Developments," paper prepared for the United States Air Force Project RAND, Memorandum, RM 3523-PR, March 1963, accessed July 18, 2013, <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=AD0401490>.

31. V. S. Nemchinov, *O dalneishem sovershenstvovanii planirovaniya i upravleniya narodnym khozyaistvom*. Moscow: Ekonomika, 1964: 1–74. V. S. Nemchinov, "Sotsialisticheskoe khozyaistvovanie i planirovanie proizvodstva," *Kommunist* (1964): 5.

32. A. Birman, "Neotvratimost," *Zvezda* 5 (1978): 1–5.

33. Boris Nikolaevich Malinovsky, *Pioneers of Soviet Computing*, ed. Anne Fitzpatrick, trans. Emmanuel Aronie, 2010, accessed April 15, 2015, http://www.sigcis.org/files/SIGCISM2010_001.pdf, esp. "Personal Reminiscences of Viktor Glushkov," 34–59.

34. Adamsky, *The Culture of Military Innovation*, 26–31; Kapitonova and Letichevsky, *Paradigmi i idei akademika V.M. Glushkova*, 164.

35. Stark, *The Sense of Dissonance*, 1–34, see also 35–51, 54–80.

36. Spufford, *Red Plenty*, 208–209.

37. Kornai, *The Socialist System*, 121.

38. Ibid., 121.

39. Ibid., 122.

40. Ibid., 122–123.

41. Castells, *End of the Millennium*, 24.

42. For a basic review of *tolkachy* and other informal mechanisms in the economy, see Mark Beissinger, *Scientific Management, Socialist Discipline, and Soviet Power* (Cambridge: Harvard University Press, 1988); Ledeneva, *Russia's Economy of Favors*; and Alena V. Ledeneva, *Can Russia Modernize? Sistema, Power Networks and Informal Governance* (New York: Cambridge University Press, 2013).

43. Byung-Yeon Kim, "Informal Economy Activities of Soviet Households: Size and Dynamics," *Journal of Comparative Economics* 31 (3) (2003): 532–551.

44. Kim, "Informal Economy Activities of Soviet Households," 532–535; Simon Johnson, Daniel Kaufmann, and Andrei Shleifer, "The Unofficial Economy in Transition," *Brookings Papers on Economic Activity* 2 (1997): 159–221.

45. Ledeneva, *Russia's Economy of Favors*, 12.

46. Zbigniew K. Brzezinski, *The Soviet Block: Unity and Conflict*, rev. ed. (New York: Praeger, 1960), 116, see also 115–124.

47. From *Elet es Tudomány*, December 24, 1952, and *Rude Pravo*, December 21, 1952, quoted in Brzezinski, *The Soviet Block*, 114.

48. David Granick, *Management of the Industrial Firm in the USSR: A Study in Soviet Economic Planning* (New York: Columbia University Press, 1955), 229.

49. Gregory, *Restructuring the Soviet Economic Bureaucracy*, 173. On the sticking power of informal relations in other socially networked economies, see Mark Granovetter, "The Strength of Weak Ties," *American Journal of Sociology* 78 (6) (1973): 1360–1380.

50. Gertrude Schroeder, "The Soviet Economy on a Treadmill of Reforms," *Soviet Economy in a Time of Change*, U.S. Congress Joint Economic Committee (Washington, DC: USGPO, 1979).

51. Castells, *The End of the Millennium*, 24.

52. Loren R. Graham, *The Ghost of the Executed Engineer: Technology and the Fall of the Soviet Union* (Cambridge: Harvard University Press, 1993), 73.

53. Thorsten Veblen, *The Engineers and the Price System* (New York: Huebsch, 1921).

54. Castells, *The End of the Millennium*, 30.

55. Erickson et al., *How Reason Almost Lost Its Mind*, 81–106.

Chapter 3: From Network to Patchwork

1. V. A. Kitov, E. N. Filinov, and L. G. Chernyak, "Anatoly Ivanovich Kitov," accessed May 19, 2010, <http://www.computer-museum.ru/galglory/kitov.htm>; and Vladimir A. Kitov and Valery V. Shilov, "Anatoly Kitov: Pioneer of Russian Informatics," in *History of Computing: Learning from the Past*, vol. 325, ed. Arthur Tatnall (New York: Springer, 2010), 80–88.
2. Slava Gerovitch, *From Newspeak to Cyberspeak* (Cambridge: MIT Press, 2002), 138–139.
3. Richard J. Samuels, *"Rich Nation, Strong Army": National Security and the Technological Transformation of Japan* (Ithaca: Cornell University Press, 1994), 1–32.
4. See Edwards, *The Closed World*, 75–115, esp. 99–100; see also Thomas Hughes's *Rescuing Prometheus: Four Monumental Projects That Changed the Modern World* (New York: Vintage, 2000), esp. chap. 2 on SAGE and chap. 4 on ARPANET.
5. Kitov, Filinov, and Chernyak, "Anatoly Ivanovich Kitov."
6. Gerovitch, "InterNyet," 338–339. See also Theodore Shabad, "Khrushchev Says Missile Can 'Hit a Fly' in Space," *New York Times*, July 17, 1962. Marshal Rodion Malinovsky, the minister of defense, made a similar claim more carefully several months earlier: "the problem of destroying ballistic missiles in flight has been successfully solved" as reported in an unnamed article in *Pravda*, October 25, 1961. For imaginatively named radar networks, see Ashton B. Carter and David N. Schwartz, *Ballistic Missile Defense* (Washington, DC: Brookings Institution Press, 1984), 197–198.
7. Recent technology commentators and scholars have enthused about the analog update of "cognitive surplus" that can be made available over collaborative peer-based computer networks. See, for example, Clay Shirky, *Cognitive Surplus: Creativity and Generosity in a Connected Age* (New York: Penguin Books, 2010), and Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2006), 35–132.
8. Anatoly Kitov, *Electronnie tsifrovie mashini [Electronic Ciphered Machines]* (Moscow: Radioelektronika Nauka, 1956).
9. Charles Eames and Ray Eames, *A Computer Perspective: Background to the Computer Age* (Cambridge: Harvard University Press, 1973), 64, 96–97.
10. Marc Raeff, *The Well-Ordered Police State: Social and Institutional Change through Law in the Germanies and Russia, 1600–1800* (New Haven: Yale University Press, 1983); Jacob Soll, *The Information Master: Jean-Baptiste Colbert's Secret State Intelligence System* (Ann Arbor: University of Michigan Press, 2009).

11. Eduard A. Meerovich, "Obsuzhdenie doklada professor A. A. Liapunova 'Ob ispol'zovanii matematicheskikh mashin v logicheskikh tseliakh" (1954), in *Ocherki istorii informatiki*, ed. D. Pospelov and Ya. Fet (Novosibirsk: Nauchnyi Tsentr Publikatsii RAS, 1998), accessed March 20, 2010, <http://ssd.sssc.ru/PaCT/history/early.html>, 75.
12. Isaak C. Bruk, "Elektronnie vychislitel'nie mashiny—na sluzhbu narodnomu khozyaistvu," *Kommunist* 7 (1957): 127.
13. A. I. Kitov, "Pis'mo zamestitelya nachal'nika VTs Minoboroni SSSR A.U. Kitova v TsK KPSS N.S. Khrushchovu ot 7 Anvarya 1959 goda," Politekhnicheskii museu RF, fond "Kitov Anatolii Ivanovich," f. 228, edinitsa khraneniya KP27189/20.
14. Anatoly Kitov, "Rol' akademika A. I. Berga v razvitii vychislitel'noi tekhniki i avtomatizirovannikh system upravleniya" ("The Role of Academician A. I. Berg in the Development of Computational Technology and Automated Management Systems"), in *Put' v bol'shuyu nauku: Akademik Aksel' Berg [Pathway to Big Science: Academician Aksel Berg]* (Moscow: Nauka, 1988), accessed March 20, 2010, <http://www.computer-museum.ru/galglory/berg3.htm>.
15. Anatoly Kitov, "Letter to Khrushchev," January 7, 1959, 2, Politechnical Museum of the Russian Federation, Collection Kitov, Anatoly Ivanovich, file 228, unit of storage KP27189/20.
16. *Ibid.*, 1–2.
17. Anatoly Kitov, "Chelovek, kotoryi vynes kibernetiku iz sekretnoi biblioteki" ["The Man Who Brought Cybernetics out of a Secret Library"], *Komp'uterra* 18 (43) (1996): 44–45.
18. *Ibid.*
19. Aleksei Kuteinikov, "Pervie proekty avtomatizatsii upravleniya sovetsoi plano-voi ekonomikoi v kontse 1950-x I nachale 1960-x gg.—'elektronnyi sotsializm'?" *Ekonomicheskaya istoriya*, 124–138 (Moscow: Trudi istoricheskogo fakul'teta MGU 15, 2011), 109.
20. For a hagiographic biographical blurb (in Russian) on Konstantin Konostantynovich Rokossowski, see his memorial site, accessed July 25, 2012, <http://www.rokossowski.com/bio.htm>.
21. Lewis Mumford, *Technics and Civilization* (New York: Harvest Book, 1934).
22. Kitov, "Chelovek, kotoryi vynes kibernetiku iz sekretnoi biblioteki."
23. For more on Soviet military, see Roger R. Reese, *The Soviet Military Experience* (New York: NP, 2000), and William E. Odom, *The Collapse of the Soviet Military* (New Haven: Yale University Press, 1998).
24. Kitov, "'Chelovek, kotoryi vynes kibernetiku.'"

25. A sample of Kitov's publications relevant to the EASU can be found here, accessed July 25, 2013: <http://www.kitov-anatoly.ru/naucnye-trudy/perecen-osnovnyh-naucnyh-trudov>.

26. Berg, Kitov, and Lypunov, "O vozmozhnostyakh avtomatizatsii upravleniya narodnym kozyaistvom."

27. Postanovlenie TsK KPCC I Soveta Ministrov SSSR, "Ob uluchshenii rukovodstva vnedreniem vychislitel'noi tekhniki i avtomatizirovannikh system upravleniya v narodnoe khozyaistvo," May 21, 1963, Gosudarstvenni archive (GA RF): f. 5446, o. 106, d. 1324, l. 160–172. This document is published in full for the first time in Aleksei Viktorovich Kuteinikov, "Proekt Obshchegosudarstvennoi avtomatizirovanoi sistemi upravleniya sovetsskoi ekonomikoi (OGAS) i problem ego realizatsii v 1960–1980-x gg."

28. For example, one year earlier, Boris Pasternak was ridiculed in literary circles for being awarded and then declining the Nobel Prize in literature. It is another case of being punished for appealing too successfully to unapproved authorities. For more on the campaign against Pasternak and others, see Solomon Volkov, *The Magical Chorus: A History of Russian Culture from Tolstoy to Solzhenitsyn* (New York: Knopf, 2008), 195–196.

29. Boris Nikolaevich Malinovskii, *Istoriia vychislitel'noi tekhniki* (Kiev: Gorobets, 2007), 197–207, accessed April 15, 2015, <http://lib.ru/MEMUARY/MALINOWSKIJ.htm>.

30. J.C.R. Licklider, "Man-Machine Symbiosis," *IRE Transactions on Human Factors in Electronics* HFE-1 (March 1960): 4–11, see section 5.1, "Speed Mismatch between Men and Computers," accessed July 25, 2013, <http://groups.csail.mit.edu/medg/people/psz/Licklider.html>.

31. This phrase comes from a CIA declassified document that the author received via a Freedom of Information Act request. For the phrase "unified information network," see CIA declassified documents by John J. Ford: A. "The Meaning of Cybernetics in the USSR," Intelligence Memorandum No. 0757/64, February 26, 1964, 1–10, esp. 1. See also B. "The Cybernetic Approach to Education in the USSR," Scientific Intelligence Memorandum No. 464693, May 25, 1964; C1. "The Soviet Applications of Cybernetics in Medicine: 1. Medical Diagnosis," Scientific and Technical Intelligence Report No. 464692, September 15, 1966; C2. "2. Artificial Limbs," Scientific and Technical Intelligence Report No. 464691, May 10, 1967; D. "Major Developments in the SovBloc Cybernetics Programs in 1965," Scientific and Technical Intelligence Report No. 464694, October 3, 1966, 1–33.

32. Robert A. Divine, *The Sputnik Challenge: Eisenhower's Response to the Soviet Satellite* (New York: Oxford University Press, 1993), 104, 111–112, 146–155.

33. Janet Abbate, *Inventing the Internet* (Cambridge: MIT Press, 1999); see also Peter H. Salus, ed. *The ARPANET Sourcebook* (Charlottesville, VA: Peer-to-Peer Communications LLC, 2008).

34. Another “humor-neutic” reading might have God speaking Hebrew through the wires (*lo* means “no” or “not” in modern Hebrew).

35. Abbate, *Inventing the Internet*, 75–77.

36. Audra J. Wolfe, *Competing with the Soviets: Science, Technology, and the State in Cold War America* (Baltimore: Johns Hopkins University Press, 2013), 49–50, *ibid.*, esp. chaps. 2 and 3; Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex* (New York: Columbia University Press, 1993), 203–231.

37. Kristie Mackrasis, *Seduced by Secrets: Inside the Stasi’s Spy-Tech World* (New York: Cambridge University Press, 2014), 23, 133, 139, esp. 112–140.

38. Judy O’Neill, “Interview with Paul Baran,” Charles Babbage Institute, OH 182, March 5, 1990, Menlo Park, CA, accessed April 15, 2015, http://www.gtnoise.net/classes/cs7001/fall_2008/readings/baran-int.pdf.

39. *Ibid.*; see also Stewart Brand, “Founding Father,” *Wired* 9 (3) (1991), accessed April 15, 2015, http://archive.wired.com/wired/archive/9.03/baran_pr.html.

40. Brand, “Founding Father.”

41. *Ibid.*

42. Bradley Voytek, “Are There Really as Many Neurons in the Human Brain as Stars in the Milky Way?,” *Nature* (Scitable blog, May 20, 2013), accessed April 15, 2015, http://www.nature.com/scitable/blog/brain-metrics/are_there_really_as_many.

43. Katie Hafner and Matthew Lyon, *Where the Wizards Stay up Late* (New York: Simon & Schuster, 1996), 64.

44. James Carey describes the process of communication as “models of and for reality that make the world apprehensible” in “A Cultural Approach to Communication,” *Communication as Culture: Media and Society* (New York: Unwin Hyman, 1989), 32.

45. Aleksandr Kharkevich, “Informatsia i tekhnika” [“Information and Technology”], *Kommunist* 17 (1962): 94.

46. *Ibid.* For an example of his earlier and largely technocratic information theory work, see Aleksandr A. Kharkevich, “Basic Features of a General Theory of Communication,” *Radiotekhnika* [Radio Engineering] 9 (5) (1954). For the CIA document, see Conway and Siegelman, *Dark Hero of the Information Age*, n. 318.

47. Shannon, “A Mathematical Theory of Communication.”

48. *Ibid.*, 102.

49. Kharkevich, "Informatsia i tekhnika," 102.
50. Ibid., 94.
51. For the first public formulation of Moore's law, see Gordon E. Moore, "Cramming More Components onto Integrated Circuits," *Electronics* 38 (8) (1965): 114–117.
52. For the first systematic work to treat knowledge as an economic measure and resource and thus to anticipate the accounting of postindustrial information and service sectors, see Fritz Machlup, *The Production and Distribution of Knowledge in the United States* (Princeton: Princeton University Press, 1962).
53. Kharkevich, "Informatsia i tekhnika," 102.
54. Ibid., 102.
55. Ibid., 103.
56. Ibid., 102.
57. N. I. Kovalev, "Doklad o rabote i perspektivakh razvitiya VTs pri Gosekonomsoвете" ["Report about the Work and Perspectives of the Development of Information Technology in the Gosekonomsovet"], July 23, 1962, Rossiiskii gosudarstvennyi arkhiv ekonomiki (RGAE) [Russian State Archive of Economics], Moscow, f. 9480, o. 7, d. 466, l. 77–97, quoted in Kuteinikov, "Pervie proekty," 134 n. 3.
58. Ibid., quoted in Kuteinikov, "Pervie proekty," 134–135.
59. For more on the cultural complications of automation as a Soviet concept, see Slava Gerovitch, "Human-Machine Issues in the Soviet Space Program," *Critical Issues in the History of Spaceflight*, ed. Steven J. Dick and Roger D. Launius, 107–140 (Washington, DC: NASA History Division, 2006).
60. Rasmus Kleis Nielsen, "Democracy," in *Digital Keywords: A Vocabulary for Information Society and Culture*, ed. Benjamin Peters (Princeton: Princeton University Press, under review), accessed April 15, 2015, <http://culturedigitally.org/2014/05/democracy-draft-digitalkeywords>. See also John Keane, *The Life and Death of Democracy* (New York: Simon & Schuster, 2009).

Chapter 4: Staging the OGAS, 1962 to 1969

1. John Lewis Gaddis, *The Cold War: A New History* (New York: Penguin Press, 2005), 78.
2. V. Glushkov, "Kibernetika, progress, budushchee," *Literaturnaya Gazeta*, September 25, 1962, 1–3.

3. "Voprosi Strukturi, Organizatsii i sozdaniya edinoi gosudarstvennoi seti vyichislitel'nikh tsentrov EGSVTs," *Rossiiskii gosudarstvennyi arkhiv ekonomiki* (RGAE), f. 9480, o. 7, d. 1227, l. 82–102, reproduced in full in the appendix to Aleksei Viktorovich Kuteinikov, "Proekt Obshchegosudarstvennoi avtomatizirovannoi sistemi upravleniya sovetskoi ekonomikoi (OGAS) i problem ego realizatsii v 1960–1980-x gg," Ph.D. diss., Moscow State University, 2011.
4. Aleksei Viktorovich Kuteinikov, "Proekt avtomatizirovannoi sistemi upravleniya sovetskoi ekonomikoi (OGAS) i problem ego realizatsii v 1960–1980" ["The project of all-state automated system of management of Soviet economics (OGAS) and the problem of its realization in 1960–1980"], Ph.D. diss., Moscow State University, 2011.
5. Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (New York: Paradigm Publishers, 2014).
6. Gerovitch, *From Newspeak to Cyberspeak*, 283.
7. Gerovitch, "InterNyet," 341; Medina, *Cybernetic Revolutionaries*, 75.
8. Viktor Glushkov, uncollected archives in the closet of the main office, Institute of Cybernetics, room 804, Kiev, Ukraine.
9. Kuteinikov, "Proekt Obshchegosudarstvennoi."
10. Author interview with Vera Glushkov, May 14, 2012.
11. Malinovsky, *Pioneers in Soviet Computing*, 31–34.
12. Kapitonova and Letichevsky, *Paradigmi i idei akademika V. M. Glushkova*, 225–232.
13. Ibid.
14. Ibid., 142–144.
15. Malinovsky, *Istoriya vyichislitel'noi tekhniki*, 92–93.
16. Kapitonova and Letichevski, *Paradigmi i idei akademika V. M. Glushkova*, 316–317, see also 296–317.
17. Ibid.
18. From Glushkov's unpublished memoirs "Vopreki Avtoritetam" ["Despite the Authorities"], accessed April 15, 2015, <http://lib.ru/MEMUARY/MALINOWSKIJ/5.htm>.
19. Unsourced quote on the title screen accessed April 15, 2015, <http://ogas.kiev.ua>.
20. Aleksandr Ivanovich Stavchikov, "Romantika pervykh issledovaniy i proektov i ikh protivorechnaya sud'ba" ["Romanticism of Early Research and Projects and Their Contradictory Fate"], unnamed, unpublished history of Central Economic

Mathematical Institute (CEMI), Moscow, read in person and returned May 2008, chap. 2, 17. See CEMI-RAS Archive in bibliography.

21. Anatoly Kitov, "Kibernetika i upravlenie narodnym khoziastvom" ["Cybernetics and the Management of the National Economy"], *Kibernetiku—na sluzhbu Kommunism (Cybernetics: In the Service of Communism)*, ed. Aksel' Berg, 1 (1961): 207, 216.

22. Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge: MIT Press, 2011), 35, 34–39, 75–76.

23. Malinovsky, *Pioneers of Soviet Computing*, including excerpts of Glushkov's unpublished memoirs, "Vopreki avtoritetam" ["Despite the Authorities"], accessed April 15, 2015, <http://lib.ru/MEMUARY/MALINOWSKIJ/5.htm>.

24. An early mention in English of the "paperless office" can be found in "The Office of the Future," *Business Week* 30 (2387) (1975): 48–70. See also Abigail Sellen and Richard Harper, *The Myth of the Paperless Office* (Cambridge: MIT Press, 2003); Paul A. Marolla et al., "A Million Spiking-Neuron Integrated Circuit with a Scalable Communication Network and Interface," *Science* 8 (345) (2014): 668–673, accessed April 15, 2015, <http://www.sciencemag.org/content/345/6197/668>.

25. Kapitonova and Letichevsky, *Paradigm i idei akademika V. M. Glushkova*, 18.

26. *Ibid.*, 18.

27. Their friendship eventually became a family relationship. In the 1980s, Kitov's son Vladimir married Glushkov's oldest daughter, Olga, who raised a grandson named Viktor. Glushkov's youngest daughter, Vera, also named Glushkov's granddaughter Viktoria.

28. Author's interview with Boris Nikolaevich Malinovsky, April 7, 2012.

29. The title of Glushkov's last scholarly book was *Fundamentals of Paperless Informatics*. Viktor Glushkov, *Osnovi bezbumazhnoi informatiki* (Moscow: Nauka, 1982), 552.

30. Quoted in Gerovitch, "InterNyet," 345; Viktor Glushkov, *Kibernetika, vychislitel'naia tekhnika, informatika. Izbrannye trudy* (Kiev: Naukova dumka, 1990), 92.

31. Gerovitch, "InterNyet," 342–345.

32. Vladislav Zubok, *Zhivago's Children: The Last Russian Intelligentsia* (Cambridge: Harvard University Press, 2009), 275.

33. At least two politically distinct scholars have made this same basic point forcefully in the last decade: Niall Ferguson, *The Ascent of Money: A Financial History of the World* (New York: Penguin Group, 2008); Graeber, *Debt: The First Five Thousand Years*.

34. Glushkov, "Shto skazhet istoria," 3, accessed April 15, 2015, <http://ogas.kiev.ua/history/chto-skazhet-ystoryya>.

35. Author's interview with Vera Viktorevna Glushkov, April 30, 2012.

36. Gerovitch, "InterNyet."

37. Boris Nikolaevich Malinovsky, *Vechno Khranit [Store Eternally]* (Kiev: Gorobets, 2007), 58.

38. These details are summarized from four documents in the archival materials in Viktor M. Glushkov's personal files, box 18, folder 1, documents 12, 119, 122, and 123 inclusive, at the Archive and Special Collections, National Academy of Sciences of Ukraine, Kiev. Nancy Ries also examines the culture of institutional authorities as a form of moral power in *Russian Talk: Culture and Conversation during Perestroika* (Ithaca: Cornell University Press, 1997), 88–89.

39. See the memoir of the leading participants in Lebedev's team: Sergei Lebedev, Lev Dashevsky, and Ekaterina Shkabara, "Malaya elektronnyaya shchyotnyaya mashina" ["Small Electronic Digital Computer"], 1952, accessed April 15, 2015 http://it-history.ru/images/a/af/SALebedev_MESM.pdf; Malinovsky, *Istoria vyichislitel'noi tekhniki v litsakh*, 33–34.

40. See the only known other secondary document on Cybertonia, Vera V. Glushkova and Sergei A. Zhabin, "Virtualnaya strana Kibertonii v Institute Kibernetiki (60–70 gg, XX vek)," in *Ukrainia i svit: humanitarno-tekhnicheska elita ta sotsialnyi progress: tezi dopov [Ukraine and the World: Humanitarian-Technical Elite and Social Progress]*, supplementary theses, International Scientific-Theoretical Conference for Students and Graduate Students, April 4–5, 2012 (Kharkiv: NTU Kharkiv, 2012), 81–83.

41. Personal correspondence with Vera Viktorevna Glushkova, February 28, 2012.

42. Public press on Cybertonia includes clippings from "Vechirnyi Kiiv," 305 (5624) (December 31, 1962): 3, and "Vechirnyi Kiev," 309 (6588) (December 31, 1965): 2–3. In parody of and in the same font as *Vechirnyi Kiev*, the group also issued its own *Vechirnyi Kyber* as the "newspaper of the council of robots" 1 (1) (1966). See also "Podorozh v Krainu Kibertonii" ["Travel to the Country of Cybertonia"], *Kievskii Komsomoltsi* 1 (1014) (August 1, 1963): 2–3, and A. Voloshin, "Kibertonii-65," *Vechirnyi Kiev* (February 16, 1965): 2. All documents are retained in the author's personal archives.

43. Vera Viktorevna Glushkova, "Dorogoi chitatel', dobro pozhalovat' v 'kibertoniiu'," *Cybertonia* 1 (1) (2012): 2, accessed April 15, 2015, http://miratechgroup.com/sites/default/files/documents/press_about_us/kibertonii_n01-2012.pdf.

44. For references on jazz in the Cold War and the Soviet Union, see S. Frederick Starr, *Red and Hot: The Fate of Jazz in the Soviet Union, 1917–1991* (New York: Oxford

University Press, 1994); Lisa E. Davenport, *Jazz Diplomacy: Promoting America in the Cold War Era* (Jackson: University Press of Mississippi, 2009); and Penny von Eschen, *Satchmo Blows up the World: Jazz Ambassadors Play the Cold War* (Cambridge: Harvard University Press, 2004).

45. The citation for the 1965 report is this: "Rukovoditel' temi: incognito ispolniteli: khoteli byi ostat'sya neizvestnyimi, khotya byi dlya knachal'stva," *Otchyot laboratorii chitayushchikh avtomatov za 1964–1965 g.g.* (Kiev: Akademiya Nayk ukrainskoi ssr institute kibernetiki AN USSR, Laboratoriya chitayushchikh avtomatov, 1965).

46. Quote taken from unmarked document in personal archives of Vera Viktoirevna Glushkova, Kiev, Ukraine.

47. Several scholarly works have drawn critical attention to the gendered performance in technical expertise, cyborg imagery, and counterculture, although none to my knowledge have done so in the Soviet context. For more, see Janet Abbate, *Recording Gender: Women's Changing Participation in Computing* (Cambridge: MIT Press, 2012); Donna Haraway, "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century," *Simians, Cyborgs and Women: The Reinvention of Nature* (New York: Routledge, 1991), 149–181; Nathan Engsmenger, *The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise* (Cambridge: MIT Press, 2010); Turner, *From Counterculture to Cyberculture*, 76–77, 300–305.

48. In an unsent October 1961 letter, Nemchinov proposes an "institute of economic cybernetics." H. S. Khrushcheyev, *Doklad na XXII s'esde KPSS 18 Oktober 1961*, RAN archives, CEMI, 1959, 1, 7, 124, 2.

49. Letter from Vasily Nemchinov to the Ministry of Finance: "V ministerstvo finansov SSSR" ["To the Ministry of Finance, USSR"], RAN archives, CEMI, 1959, 1, 7, 125, 11.

50. Ibid.

51. Kassel, *Soviet Cybernetics Research*, 94–96.

52. Nemchinov letter, "V ministerstvo finansov SSSR."

53. Ibid.

54. Yuri Gavrillets, interviewed by author, CEMI, Moscow, August 20, 2008.

55. Nemchinov letter, "V ministerstvo finansov SSSR."

56. Nikita S. Khrushchev, "Doklad na XXII S'esde KPSS" ["Concluding Speech"], *Twenty-second Congress*, October 18, 1961, accessed March 19, 2010, <http://www.archive.org/details/DocumentsOfThe22ndCongressOfTheCpsuVolI>.

57. Letter from V. S. Nemchinov to the Bureau of the Division of Economic, Philosophical, and Legal Sciences, Academy of Sciences, USSR, December 11, 1961, RAN Archives, 1959, 1, 7, 125, 11.

58. Report signed by V. S. Nemchinov, "Dokladnaya zapiska v Otdelenii, XXII s"ezd KPSS" ["Division Report Notes, Twenty-second Congress of the Communist Party"], November 17, 1961, RAN Archive, CEMI, 1959, 1, 6, 106.

59. Document signed by V. S. Nemchinov, "V Byuro otdeleniya ekonomicheskikh, filosofskikh i provavikh nauk AN CCCP" ["To the Office of the Division of Economic, Philosophical, and Legal Sciences, the Academy of Sciences, USSR"] September 17, 1960, RAN Archive, CEMI, 1960.

60. Nikolai Fedorenko, *Vestnik Akademii Nauk, SSSR [Herald of the Academy of Sciences, USSR]* 10 (1964): 3–14.

61. Kassel, *Soviet Cybernetics Research*, 98.

62. Interview with Yuri Gavrilets by the author, CEMI, Moscow, August 20, 2008. Data taken from the report titled "Doklad Akademika N. I. Fedoreko na yubileim zasedankii posvyashennoim 10-leniyu of Ts.E.M.I." ["Report by Academician N. I. Fedorenko on the Ten-Year Anniversary of CEMI"], CEMI archives, RAN, May 1973, 1959, 1, 403, 262.

63. Interview with Yuri Gavrilets by the author, CEMI, Moscow, August 20, 2008.

64. George Simmel's *Philosophie des Geldes* is a classic account of the form, not the value, of economic objects. As Simmel notes, "we may not describe exchangeability as a likeness of value that belongs objectively to things, but we must recognize likeness of value as simply a name for the exchangeability." George Simmel, *Philosophie des Geldes [The Philosophy of Money]* (Leipzig: Duncker & Humblot, 1900), 46.

65. Simmel writes, for example, that "we may not describe exchangeability as a likeness of value that belongs objectively to things, but we must recognize likeness of value as simply a name for the exchangeability." Ibid., 46.

66. Nikolai Fedorenko, *Vspominaya proshloe, vzglyadivaya v budushchee [Remembering the Past, Looking into the Future]* (Moscow: Nauka, 1999), 179.

67. Ibid., 179.

68. David Stark, *The Sense of Dissonance: Accounts of Worth in Economic Life* (Princeton: Princeton University Press, 2009), 19–31.

69. Fedorenko, *Vspominaya proshloe*, 209–214.

70. Informational document by Nikolai Fedorenko, "Istoricheskaya spravka o geyatel'nosti instituta s 1963 po 1966 g. by Director Akad. Fedorenko" ["Historical Information about the Activity of the Institute from 1963 to 1966 by Director Academician Fedorenko"], CEMI archives, RAN, 1959, 1, 101, index 170.

71. Kassel, *Soviet Cybernetics Research*, 87.
72. Homepage for Central Economic Mathematical Institute: "About CEMI" section, accessed April 15, 2015, http://www.cemi.rssi.ru/about/how/?section=about_link.
73. Eric P. Hoffmann and Robbin F. Laird. *Technocratic Socialism: The Soviet Union in the Advanced Industrial Era*. (Durham: Duke University Press, 1985), 116.
74. *Ibid.*, 114.
75. Gerovitch, *From Newspeak to Cyberspeak*, 272.
76. *Ibid.*
77. Unsourced quote, accessed April 15, 2015, <http://ogas.kiev.ua>.
78. The original document proposing the EGSTVs in 1963 can be found here: Postanovlenie Komitet KPCC I Sovet Ministrov SSSR, "Ob uluchshenii rukovodstva vnedreniem vychislitel'noi tekhniki i avtomatizirovannikh system upravleniya v narodnoe khoziaistvo," May 21, 1963, no. 564, Kremlin, Moscow. This document was published for the first time in Aleksei Viktorovich Kuteinikov, "Proekt Obshchegosudarstvennoi avtomatizirovannoi sistemi upravleniya osvetskoï ekonomikoï (OGAS) I problem ego realizatii v 1960–1980-x gg," PhD dissertation, Moscow State University, Moscow, 2011. In addition, the 1967 proposal approving the regional Ukrainian GSTVs Project in 1967 can be found in Postanovleniya soveta ministrov Ukrainian SSR, "O vnedrenii avtomatizirovannikh system upravleniya s premeneniem vychislitel'noi tekhniki," May 21, 1967, no. 338, and established by subsequent order of the Minister of Black Metallurgy, Ukrainian SSR, on March 11, 1968, no. 68.
79. Gerovitch, "InterNyet," 344. See also Iuliia Kapitonova and Aleksandr Letichevsky, *Paradigmy i idei akademika V. M. Glushkova* (Kiev: Naukova Dumka, 2003), 189.
80. Malinovskii, *Istoriia vychislitel'noi tekhniki*, 162.
81. Christopher Felix McDonald, "Building the Information Society: A History of Computing as a Mass Medium," Ph.D. diss., Princeton University, 2011.
82. Letter from the director of the CSA V. N. Starovskii to the director of the GK KNIR K. N. Rudnev, November 2, 1963, published in the appendix of Kuteinikov, "Proekt Obshchegosudarstvennoi."
83. V. P. Derkach, ed. *Akademik V. M. Glushkov—pioneer kiberniki* (Kiev: Yunior, 2003), 324.
84. Kathryn M. Bartol, "Soviet Computer Centres: Network or Tangle?," *Soviet Studies* 23 (4) (1972): 608–618.
85. Malinovskii, *Pioneers*, xxx–xxxii.

86. Ibid., 33.

87. Ibid., 165.

88. Malinovsky, *Store Eternally*, 61–62.

Chapter 5: The Undoing of the OGAS, 1970 to 1989

1. Gerovitch, “InterNyet,” 343.

2. Glushkov, “Shto skazhet istoria?”

3. Malinovksy, *Vechno Khranit*, 61.

4. Gerovitch, *From Newspeak to Cyberspeak*, 280.

5. K. N. Rudnev, “Vyichislitel’naya tekhnika v narodnom khozyaistve,” *Izvestiya*, September 4, 1963, cited in Kuteinikov, “Pervie proekti,” 136.

6. Malinovsky, *Istoriia vychislitel’noi tekhniki v litsakh* [*History of Computing Technology in Personalities*], reproduces a transcription of Glushkov’s dictated memoirs, *Vopreki Avtoritetam* [*Despite the Authorities*], accessed April 15, 2015, <http://lib.ru/MEMUARY/MALINOWSKIJ/5.htm>, and in partial English translation in “Academician Glushkov’s ‘Life Work,’” accessed April 15, 2015, <http://en.uacomputing.com/stories/ogas>.

7. Glushkov, *Vopreki Avtoritetam*.

8. Ibid.

9. Ibid.

10. For more on the proposed structure of the OGAS, see Martin Cave, *Computers and Economic Planning: The Soviet Experience* (New York: Cambridge University Press, 1980), 13–15.

11. Malinovskii, *Istoriia vychislitel’noi tekhniki v litsakh*, 43–44.

12. Viktor M. Glushkov, “Dlya vsei strani,” *Pravda*, December 13, 1981. See also Malinovsky, *Vechno Khranit*, 64, cf. 65. Other bibliographies suggest *strani* or “nation,” not “state,” is correct, although this remains unconfirmed.

13. Kuteinikov, “Pervie proekti,” 97.

14. Gerovitch, “InterNyet,” 345–346.

15. Kuteinikov, “Pervie proekti,” 101.

16. Ibid., 119.

17. The ASUification (or *ASUchivaniye*) of the Soviet Union amounted to, the workers joked in Russian, the bitchification of the country because in Russian *ASUchivaniye* shares the same root as the swearword *suka*.

18. Malinovskiy, *Istoriya vyichisletel'nikh tekhniki v litsakh*, 91, also 84–93.

19. Malinovskiy, *Vechno Khranit*, 66–67.

20. Beissinger, *Scientific Management*, 249.

21. Glushkov, “Vopreki Avtoritetam.”

22. Viktor Glushkov, “Ten Billion Accountants Needed,” *RAND Report on Soviet Cybernetics* 2 (3) (1972): 72–73, accessed April 15, 2015, <http://www.rand.org/content/dam/rand/pubs/reports/2007/R960.3.pdf>.

23. Gerovitch, *From Newspeak to Cyberspeak*, 280.

24. Hughes, *Rescuing Prometheus*.

25. Eric P. Hoffmann and Robbin F. Laird, *Soviet Technocratic Socialism: The Soviet Union in the Advanced Industrial Era* (Durham: Duke University Press, 1985), 115.

26. *Ibid.*, 115.

27. *Ibid.*, 116.

28. *Ibid.*, 116–117.

29. *Ibid.*, 116.

30. Viktor Glushkov, “Zabetniye myislic dlya tekhniki, kto ostaetsya,” January 10, 1982, *Akademik Glushkov—pioneer kibernetiki* (Kiev: n.p., 2003), accessed April 15, 2015, http://www.komproekt.ru/new/zavetnie_m.

31. Aleksandr Ivanovich Stavchikov, “Romantika pervykh issledovaniy i proektov i ikh protivorechnaya sud'ba” [“Romanticism of Early Research and Projects and Their Contradictory Fate”], in an unnamed, unpublished history of the Central Economic Mathematical Institute (TsEMI), chap. 2, Moscow, accessed 2008, 17. (See CEMI-RAS archive in bibliography.)

32. Stavchikov, “Romantika,” 1–2.

33. *Ibid.*, 16–17.

34. *Ibid.*, 17.

35. In *The End of the Millennium*, Manuel Castells blames the incompatibility of a vertical statist hierarchy with horizontal information networks for the collapse of the Soviet Union, even while identifying ways that the Soviet Union did not behave as such a structure. Simultaneously, Gerovitch, in “InterNyet,” claims that “Soviet cyberneticians envisioned an organic, self-regulating system, but paradoxically they

insisted on building it by decree from above.” Although this claim is not wrong, it misses his earlier point that, aside from having no other option, the top-down system did not behave as a self-regulating hierarchy. The argument offered here looks to describe the same administrative challenges by using terms like *heterarchy*, which cuts a middle way through top-down and bottom-up, horizontal and vertical network structural discourse. Castells, *The End of the Millennium*, 26–37, 61–66; Gero-vitch, “InterNyet,” 347.

36. David Edmonds and John Eidinow’s popular *Bobby Fisher Goes to War: How a Lone American Star Defeated the Soviet Chess Machine* (New York: Harper Perennial, 2005).

37. Zvi Y. Gitelman and Yaakov Ro’i, eds., *Revolution, Repression, and Revival: the Soviet Jewish Experience* (New York: Rowman & Littlefield, 2007), 119.

38. Frederic Bozo, Marie-Pierre Rey, N. Piers Ludlow, and Bernd Rother, eds., *Visions of the End of the Cold War in Europe, 1945–1990* (New York: Berghahn Books, 2012), 76–86.

39. Daniel Johnson, *White King and Red Queen: How the Cold War Was Fought on the Chessboard* (Boston: Houghton Mifflin, 2008), esp. chap. 6.

40. Boris Stillman, *Linguistic Geometry* (New York: Springer, 2000), xi.

41. Bruce Abramson, *Digital Phoenix: Why the Information Economy Collapsed and How It Will Rise Again* (Cambridge: MIT Press), 89–90.

42. Johnson, *White King and Red Queen*, chap. 6.

43. Nathan Engsmenger, “Is Chess the Drosophila of Artificial Intelligence?,” *Social Studies of Science* 42 (1) (2011): 5–30. See also John McCarthy, “Chess as the Drosophila of AI,” accessed April 15, 2015, <http://jmc.stanford.edu/articles/drosophila/drosophila.pdf>.

44. E. M. Landis and I. M. Yaglom, “About Aleksandr Semenovich Kronrod,” *Uspekhi Matematicheskikh Nauk* 56 (5) (2001): 191–201, accessed April 15, 2015, <http://www.mathnet.ru/links/1e483992e9f2c42fda4390d0116737a3/rm448.pdf>.

45. Wiener, *God and Golem, Inc.*, 15–25.

46. Jad Abumrad and Robert Krulwich (hosts), “The Rules Can Set You Free,” *Radio-Lab*, National Public Radio, April 9, 2013.

47. Walter Ong, *Orality and Literacy* (New York: Routledge, [1972] 2012), 82.

48. Philip von Hilger, *War Games: A History of War on Paper* (Cambridge: MIT Press, 2012).

49. Viktor Glushkov and V. Ya. Valakh, *Chto takoe OGAS?* (Moscow: Hauka, 1981), 1–160.

50. Malinovsky, *Vechno Khranit*, 57–58.
51. Letter from A. I. Kitov written on November 11, 1985, Politechnicheskii museum Russian Funderation, fond “Kitov Anatolii Ivanovich,” f. 228, box BP 3450/1–2, reproduced in the appendix to Kuteinikov, “Project Obshchegosudarstvennoi.”
52. Ibid.
53. Fedorenko, *Vspominaya Proshloe, Vzgladivaya v Budushchee*, 177.
54. Gerovitch, *From Newspeak to Cyberspeak*, 277.
55. Gerovitch, “Soviet InterNyet,” 346; V. Golovachev, “A Hercules Is Born,” *Soviet Cybernetics: Recent News Items* 5 (1967): 72.
56. Gerovitch, *From Newspeak to Cyberspeak*, 139.
57. Graham, *Lonely Ideas: Can Russia Compete?*
58. Gregory, *Restructuring the Soviet Economic Bureaucracy*, esp. introduction.
59. Kuteinikov, “Proyekt obshchegosudarstvennoi,” 142.
60. Steven G. Medema, *The Hesitant Hand: Taming Self-Interest in the History of Economic Ideas* (Princeton: Princeton University Press, 2010), 6–10. See also Pierre Force, *Self-Interest before Adam Smith: A Genealogy of Economic Science* (New York: Cambridge University Press, 2003), which sees self-interest as a first principle behind what Hume calls the “selfish hypothesis” from the Epicureans through Jean Baptiste-Say.
61. Karl Eugen Wädekin, *The Private Sector in Soviet Agriculture* (Berkeley: University of California Press, 1973), xiv.
62. Dennis O’Hearn, “The Consumer Second Economy: Size and Effects,” *Soviet Studies* 32 (2) (1980): 227, 232.
63. Gregory Grossman, “The Shadow Economy in the Socialist Sector of the USSR,” in *The CMEA Five Year Plans (1981–1985) in a New Perspective: Planned and Non-Planned Economies*, ed. Economics and Information Directorate (Brussels: North Atlantic Treaty Organization, 1982), 108.
64. Gerald Mars and Yochanan Altman, *Private Enterprise in the USSR: The Case of Soviet Georgia* (Aldershot: Gower Press, 1987), chap. 6.
65. David Remnick, “Soviet Union’s Shadow Economy: Bribery, Barter, and Black Market,” *Seattle Times*, September 22, 1990, accessed April 15, 2015, <http://community.seattletimes.nwsources.com/archive/?date=19900922&slug=1094485>.
66. Seth Benedict Graham, “A Cultural Analysis of the Russo-Soviet ‘Anekdot,’” Ph.D. diss., University of Pittsburgh, 2003; Remnick, “Soviet Union’s Shadow Economy.”

67. Two of the most classic cold war critics in the West include Friedrich Hayek, *The Road to Serfdom* (Chicago: University of Chicago, 1944), 4, 9–11, 28–29, 103–112, 143–145, and Milton Friedman, *Free to Choose: A Personal Statement* (New York: Harcourt Books, 1980). My comments here intend to both draw on and cut orthogonally across the conventional defense of free markets.

68. A sampling of popular literature on the informal economic activities in the late Soviet Union includes Yuri Brokhin, *Hustling on Gorky Street* (London: W. H. Allen, 1967); Konstantin Simis, *USSR: The Corrupt Society: The Secret World of Soviet Capitalism* (New York: Simon & Schuster, 1982); David Shipler, *Russia: Broken Idols, Solemn Dreams* (New York: Times Books, 1983); Lev Timofeev, *Soviet Peasants: Or the Peasants' Art of Starving* (New York: Telos Books, 1985). See also Gregory Grossman, ed., *Studies in the Second Economy of Communist Countries: A Bibliography* (Berkeley: University of California Press, 1988).

Conclusion

1. My thanks to Slava Gerovitch, who coined this pun in “InterNyet: Why the Soviet Union Did Not Build a Nationwide Computer Network.” Others, such as Jack Balkin, have discovered it independently in conversation with the author as well. Barbara London named her 1998 video exhibit for the Museum of Modern Art, New York, “InterNyet: A Video Curator’s Dispatches from Russia and Ukraine,” accessed April 15, 2015, <http://www.moma.org/interactives/projects/1998/internyet>.

2. Graham, *Lonely Ideas*.

3. Jeff Weintraub, “The Theory and Politics of the Public/Private Distinction,” in *Public and Private in Thought and Practice: Perspectives on a Grand Dichotomy*, ed. Jeff Weintraub and Krishan Kumar (Chicago: University of Chicago, 1997), 7, 8–16.

4. Arendt, *The Origins of Totalitarianism*.

5. Fedorenko, *Vspominaya proshloe, zaglyadyibayiu v budushchee*, 179.

6. Bonnie Honig, ed., *Feminist Interpretations of Hannah Arendt* (University Park: Pennsylvania State University Press, 1995); Mary Dietz, *Turning Operations: Feminism, Arendt, and Politics* (New York: Routledge, 2002).

7. Jonathan Coopersmith, “Failure and Technology,” *Japan Journal for Science, Technology, and Society* 18 (2009): 93–118; Steven J. Jackson, “Rethinking Repair,” in *Media Technologies: Essays on Communication, Materiality and Society*, ed. Tarleton Gillespie, Pablo Boczkowski, and Kirsten Foot, 221–240 (Cambridge: MIT Press, 2013).

8. Peter Galison, *How Experiments End* (Chicago: University of Chicago Press, 1987), 276.

9. Max Weber, *The Protestant Ethic and the Spirit of Capitalism* (Boston: Unwin Hyman, [1905] 1930); see also R. H. Howe, "Max Weber's Elective Affinities," *American Journal of Sociology* 84 (1978): 366–385; Ludwig Fleck, *Genesis and Development of a Scientific Fact*, trans. Fred Bradley and Thaddeus J. Trenn, ed. Thaddeus J. Trenn and Robert K. Merton (Chicago: Chicago University Press, [1935] 1979).
10. Two researchers have characterized the stereotypical difference between Russian and Chinese informal influence as trending toward a logical-analytic mindset and a holistic-dialectical one. Snezhina Michailova and Verner Worm, "Personal Networking in Russia and China: *Blat* and *Guanxi*," *European Management Journal* 21 (4) (2003): 509–519.
11. For more on technological utopianism in global contexts, see Howard P. Segal *Technology and Utopia* (Washington, DC: American Historical Association, 2006); for more on the Swedish Pirate Party, see Patrick Burkart, *Pirate Politics: The New Information Policy Contests* (Cambridge: MIT Press, 2014).
12. Michael Gordin, Hellen Tilley, and Gyan Prakash, "Introduction," in *Utopia/Dystopia: Conditions of Historical Possibility*, ed. Michael D. Gordin, Helen Tilley, and Gyan Prakash (Princeton: Princeton University Press, 2010), 2, see also 1–6.
13. Cat video scholarship exists. See Jody Berland, "Cat and Mouse: Iconographies of Nature and Desire," *Cultural Studies* 22 (3–4) (2008): 431–454.
14. Jürgen Habermas, *The Structural Transformations of the Public Sphere: An Inquiry into a Category of Bourgeois Society* (Cambridge: MIT Press, 1989).
15. Nicholas John and Benjamin Peters, "Is the End Always Near? An Analysis and Comment on the End of Privacy, 1990–2012," unpublished manuscript; Daniel J. Solove, "A Taxonomy of Privacy," *University of Pennsylvania Law Review* 154 (3) (2006): 477–560.
16. George L. Priest, "The Ambiguous Moral Foundations of the Underground Economy," *Faculty Scholarship Series*, Paper 626 (1995), accessed April 15, 2015, http://digitalcommons.law.yale.edu/cgi/viewcontent.cgi?article=1625&context=fss_papers.
17. Eric Schatzberg, "Technik Comes to America: Changing Meanings of Technology before 1930," *Technology and Culture* 47 (2006): 486–511; see also Martin Heidegger, *The Question concerning Technology and Other Essays*, trans. William Lovitt (New York: Harper & Row, [1954] 1977), 287–317.
18. Raymond Williams, "Base and Superstructure in Marxist Cultural Theory," *New Left Review* 1 (82) (1973): 1–13; Raymond Williams, "Culture Is Ordinary," in *Resources of Hope: Culture, Democracy, Socialism* (London: Verso), 3–14; Raymond Williams, *Television: Technology and Cultural Form* (London: Wesleyan University Press, [1974] 1992): 1–25.