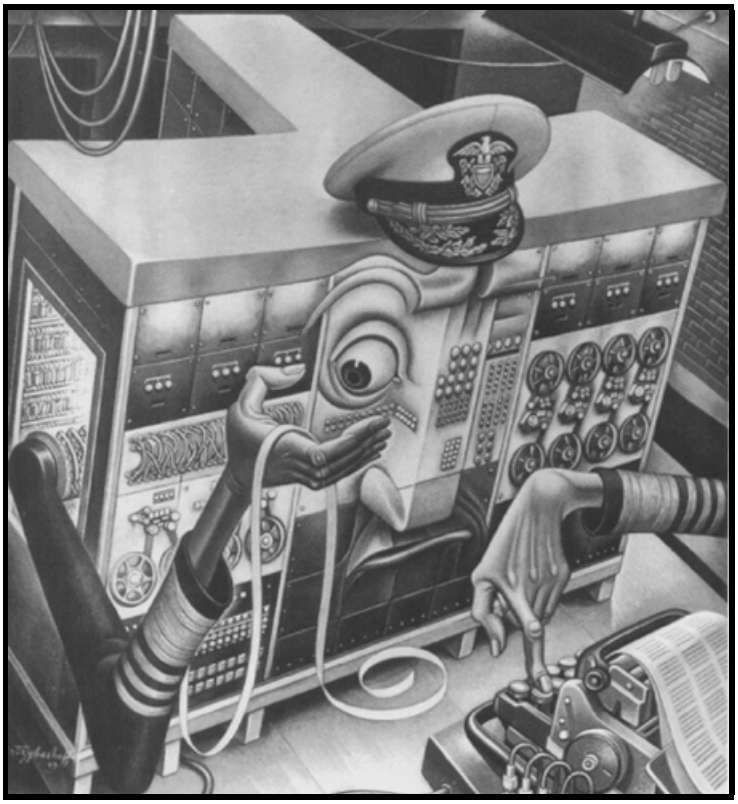
The Information Sciences

HSSC 550 • Fall 2008



This course explores the emergence and widespread adoption in the early Cold War-period of a set of interrelated tools, techniques, and discourses organized around the concept of "information." These emerging information science included not only new disciplines such as cybernetics, information theory, operations research, and ecology, but also some traditional physical sciences – such as biology and chemistry – as well as a broad range of social sciences, including economics, political science, sociology, and urban planning. The focus of the course will be on tracing the important structural changes in post-war science that encouraged the adoption of the rhetoric of information (if not its substance), as well as on extending the relevance of these developments to a wide range of topics in the history of science, medicine, and technology.

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Course Format:

The seminar will meet weekly on Monday afternoons from 12:30-3:30 pm. We will be finished in time for workshop.

In addition to doing the readings and preparing for discussions, each participant will, over the course of the semester, be asked – *twice* – to provide a list of discussion points/questions with which to open the seminar. Students can work in small groups to prepare these discussion agendas, and they must be distributed to the group on the evening *before* the seminar. In addition, each student will select one supplementary readings to review. These short (800 word) reviews will also be distributed to all of the seminar members. A final 10-15 page essay will also required. The type/scope of the final essay will be discussed and negotiated over the course of the semester.

Required Readings:

All of the books for this course are available at the Penn Book Center. All other readings will be made available electronically via the course Blackboard site or will be distributed in-class.

Course Schedule:

I Introduction to the Cybernetic Sciences (Sep 8)

Peter Louis Galison. "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision". In: *Critical Inquiry* 21 (1994). Pp. 228–266

Donna Haraway. "Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century". In: Simians, Cyborgs and Women: The Reinvention of Nature (1991). Pp. 149–181

Geoffrey Bowker. "How to be universal: some cybernetic strategies, 1943-1970". In: *Social Studies of Science* 23 (1993). Pp. 107–127

Supplementary Readings/Report Topics: Shannon and Weaver, *The mathematical theory of communication*; Wiener, *The human use of human beings: cybernetics and society*; Lem, "The Sixth Sally, or How Trurl and Klapaucius Created a Demon of the Second Kind to Defeat the Pirate Pugg"

II The Cybernetics Group (Sep 15)

Steve J Heims. *The Cybernetics Group, 1946-1953: Constructing a Social Science for Postwar America*. MIT Press, 1991

Supplementary Readings/Report Topics: Wiener, *God and Golem, inc.: a comment on certain points where cybernetics impinges on religion*; Hayles, "Designs on the Body: Wiener, Cybernetics, and the Play of Metaphor"; Kline, "Cybernetics, Management Science, and Technology Policy: The Emergence of "Information Technology" as a Keyword, 1948-1985"

III Cybernetics and the Cold War (Sep 22)

Paul Edwards. *The Closed World: Computers and the Politics of Discourse in Cold War America*. The MIT Press Cambridge MA, 1996

Supplementary Readings/Report Topics: Medina, "Designing Freedom, Regulating a Nation: Socialist Cybernetics in Allende's Chile"; Hounshell, "The Cold War, RAND, and the Generation of Knowledge, 1946-1962"; Owens, "Mathematicians at War: Warren Weaver and the Applied Mathematics Panel, 1942-45"

IV Reading the Book of Life (Sep 29)

Lily Kay. *Who wrote the book of life? : a history of the genetic code*. Stanford, Calif: Stanford University Press, 2000

Supplementary Readings/Report Topics: Shroedinger, *What is Life?*; Keller, *Making sense of life : explaining biological development with models, metaphors, and machines*

V Universal Machines (Oct 6)

Jon Agar. *The Government Machine: A Revolutionary History of the Computer*. MIT Press, 2003

Supplementary Readings/Report Topics: Campbell-Kelly and Aspray, *Computer: A History of the Information Machine*; McKenna, *The World's Newest Profession: Management Consulting in the Twentieth Century (Cambridge Studies in the Emergence of Global Enterprise)*

VI Fall Break (Oct 13)

Party on.

VII A Theory of Games (Oct 20)

Philip Mirowski. *Machine dreams : economics becomes a cyborg science*. Cambridge University Press, 2002 [1]

Supplementary Readings/Report Topics: Neumann and Morgenstern, *Theory of Games and Economic Behavior*; Weintraub, *Toward a History of Game Theory*; Ghamari-Tabrizi, "Simulating the Unthinkable: Gaming Future War in the 1950s and 1960s"; Nasar, *A Beautiful Mind*

VIII From Think Tanks to Social Science (Oct 27)

S. M Amadae. *Rationalizing capitalist democracy : the Cold War origins of rational choice liberalism*. Chicago: University of Chicago Press, 2003

Supplementary Readings/Report Topics: Hollinger, "Science, Jews, and Secular Culture: Studies in Mid-Twentieth-Century American Intellectual History"; Jardini, "Out of the Blue Yonder: The Transfer of Systems Thinking from the Pentagon to the Great Society, 1961-1965"

IX Space Program for the Inner City (Nov 3)

Jennifer Light. *From warfare to welfare : defense intellectuals and urban problems in Cold War America*. Baltimore: Johns Hopkins University Press, 2003

Supplementary Readings/Report Topics: Mindell, *Between human and machine : feedback, control, and computing before cybernetics*; Lenoir, "The Manhattan Project for Biomedicine"; Kaplan, *The Wizards of Armageddon*

X The Sciences of the Artificial (Nov 10)

William Aspray. "The Scientific Conceptualization of Information: A Survey". In: *IEEE Annals of the History of Computing* 7.2 (1985). Pp. 117–140

Simon Schaffer. "Fish and Ships: Models in the Age of Reason". In: Models: The Third Dimension of Science (2004)

Esther-Mirjam Sent. "Sent Simulating Simon Simulating Scientists". In: *Studies in the History and Philosophy of Science* 32.3 (2001). Pp. 479–500

Supplementary Readings/Report Topics: Crowther-Heyck, *Herbert A. Simon : the bounds of reason in modern America*; Bloomfield, *Modelling the world: the social construction of systems analysts*; Pagels, *Dreams of reason: the computer and the rise of the sciences of complexity*

[1] There is an excellent website on "The History of Economic Thought" that provides a useful glossary of all of the economic terminology used in the Mirowski and other readings: `http://cepa.newschool.edu/het/schools/lausanne.htm`

XI Systemizing Nature (Nov 17)

Sharon Kingsland. “Designing nature reserves: adapting ecology to real-world problems”. In: *Endeavor* 26.1 (2002). Pp. 9–14

Paul Edwards. “The World in a Machine: Origins and Impacts of Early Computerized Global Systems Models”. In: *Systems, Experts, and Computers*. Ed. by Thomas Hughes and Agatha Hughes. MIT University Press, 2000. Pp. 221–254

Supplementary Readings/Report Topics: Botkin, *Discordant Harmonies: A New Ecology for the 20th Century*; November, “Digitizing life : the introduction of computers to biology and medicine”; Taylor, “Technocratic Optimism, H. T. Odum, and the Partial Transformation of Ecological Metaphor after World War II”; Haraway, “Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century”

XII Cyborgs & Post-Humans (Nov 24)

N. Katherine Hayles. *How we became posthuman : virtual bodies in cybernetics, literature, and informatics*. University of Chicago Press Chicago, Ill., 1999

Supplementary Readings/Report Topics: Thurtle, *Semiotic Flesh: Information and the Human Body*; Boyle, *Shamans, software, and spleens : law and the construction of the information society*; Lenoir, “Shaping Biomedicine as an Information Science”; Gerovitch, “Love-Hate for Man-Machine Metaphors in Soviet Physiology: From Pavlov to ’Physiological Cybernetics’”; Gibson, *Neuromancer*

XIII Darwin Revisited: Information & Intelligent Design (Dec 1)

Michael J Behe. *Darwin’s black box : the biochemical challenge to evolution*. New York The Free Press, 1996. xii, 307 p

Supplementary Readings/Report Topics: Leff and Rex, *Maxwell’s Demon: Entropy, Information, Computing*; Dembski and Ruse, *Debating design : from Darwin to DNA*

Selected Bibliography

Agar, Jon. "British Scientists and the Cold War: The Defence Research Policy Committee and information networks, 1947-1963". In: *Historical Studies in the Physical and Biological Sciences* 28 (1998). Pp. 209–252.

— *The Government Machine: A Revolutionary History of the Computer*. MIT Press, 2003.

Amadae, S. M. *Rationalizing capitalist democracy : the Cold War origins of rational choice liberalism*. Chicago: University of Chicago Press, 2003.

Arrow, Kenneth. *Social Choice and Individual Values*. Wiley, 1951.

Aspray, William. "The Scientific Conceptualization of Information: A Survey". In: *IEEE Annals of the History of Computing* 7.2 (1985). Pp. 117–140.

Behe, Michael J. *Darwin's black box : the biochemical challenge to evolution*. New York The Free Press, 1996. xii, 307 p.

Bell, David, Howard Raiffa, and Amos Tversky, eds. *Decision Making: Descriptive, Normative, and Prescriptive Interactions*. Cambridge University Press, 1988.

Berg, Marc. *Rationalizing Medical Work: Decision Support Techniques and Medical Practices*. MIT University Press, 1997.

Bloomfield, Brian. *Modelling the world: the social construction of systems analysts*. Blackwell, 1986.

Botkin, Daniel. *Discordant Harmonies: A New Ecology for the 20th Century*. Oxford University Press, 1990.

Bowker, Geoffrey. "How to be universal: some cybernetic strategies, 1943-1970". In: *Social Studies of Science* 23 (1993). Pp. 107–127.

Bowles, Mark. "Crisis in the Information Age". PhD thesis. Case Western Reserve, 1999.

Boyle, James. *Shamans, software, and spleens : law and the construction of the information society*. Cambridge, Mass: Harvard University Press, 1996.

Buchanan, James and Gordon Tullock. *The Calculus of Consent*. University of Michigan, 1961.

Buck, Peter. "Adjusting to Military Life: The Social Sciences Go to War". In: *Military Enterprise and Technological Change*. Ed. by Merrit Rowe Smith. MIT University Press, 1985. Pp. 203–252.

Campbell-Kelly, Martin and William Aspray. *Computer: A History of the Information Machine*. Basic Books, 1996.

Capshew, James. *Psychologists on the March*. Cambridge University Press, 1999.

Cellerier, Guy. "The historical genesis of cybernetics: is teleonomy a category of understanding". In: *Nature and System* 5 (1983). Pp. 21–225.

Collins, Harry. *Artificial Experts: Social Knowledge and Intelligent Machines*. MIT University Press, 1990.

Collins, Harry and Martin Kusch. *The Shape of Action: What Humans and Machines Can Do*. MIT University Press, 1998.

Conway, Flo and Jim Siegelman. *Dark hero of the information age : in search of Norbert Wiener, the father of cybernetics*. New York Basic Books, 2004.

Crowther-Heyck, Hunter. *Herbert A. Simon : the bounds of reason in modern America*. Baltimore: Johns Hopkins University Press, 2005.

Davis, Martin. "Mathematical Logic and the Origin of Modern Computers". In: *Studies in the History of Mathematics*. Ed. by Esther Phillips. Mathematical Association of America, 1987. Pp. 137–165.

Dawkins, Richard. *The Selfish Gene*. Oxford University Press, 1976.

Day, Ronald E. *The modern invention of information : discourse, history, and power*. Carbondale: Southern Illinois University Press, 2001. ISBN: 0809323907 (alk. paper). URL: `http://www.loc.gov/catdir/toc/fy02/00047033.html`.

Dembski, William A and Michael Ruse. *Debating design : from Darwin to DNA*. Cambridge ; New York Cambridge University Press, 2004. xiii, 405 p.

Deutsch, Karl. *Nerves of Government*. New York: Free Press, 1967.
Edwards, Paul. *The Closed World: Computers and the Politics of Discourse in Cold War America*. The MIT Press Cambridge MA, 1996.
— *The World in a Machine: Computer Models, Data Networks, and Global Atmospheric Politics*. MIT University Press, 2005. URL: `http://www.si.umich.edu/~pne/models.data.htm`.
— "The World in a Machine: Origins and Impacts of Early Computerized Global Systems Models". In: *Systems, Experts, and Computers*. Ed. by Thomas Hughes and Agatha Hughes. MIT University Press, 2000. Pp. 221–254.
Eglash, Ron. "Cybernetics and American Youth Subculture". In: *Cultural Studies* 12.3 (1998). Pp. 382–409.
Fox Keller, Evelyn. *Refiguring Life: Metaphors of Twentieth-Century Biology*. Columbia University Press, 1995.
Galison, Peter Louis. *Image and logic : a material culture of microphysics*. Chicago: University of Chicago Press, 1997.
— "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision". In: *Critical Inquiry* 21 (1994). Pp. 228–266.
Galison, Peter. "Computer Simulations in the Trading Zone". In: *The Disunity of Science*. Ed. by Peter Galison and David Stump. Stanford University Press, 1996. Pp. 118–157.
Gerovitch, Slava. *From newspeak to cyberspeak : a history of Soviet cybernetics*. Cambridge, Mass MIT Press, 2002.
— "Love-Hate for Man-Machine Metaphors in Soviet Physiology: From Pavlov to 'Physiological Cybernetics'". In: *Science in Context* 15 (2002). Pp. 339–374.
Gerovitch, Slava, David Mindell, and Jerome Segal. "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*. London ; New York: Routledge, 2003.
Ghamari-Tabrizi, Sharon. "Simulating the Unthinkable: Gaming Future War in the 1950s and 1960s". In: *Social Studies of Science* 30.2 (2000). Pp. 163–223.
Gibson, William. *Neuromancer*. Ace Books, 1995.
Hammond, Deborah. "Toward a science of synthesis: the heritage of general systems theory". PhD thesis. University of California, Berkeley, 1997.
Haraway, Donna. "Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century". In: Simians, Cyborgs and Women: The Reinvention of Nature (1991). Pp. 149–181.
— *Simians, cyborgs, and women : the reinvention of nature*. New York Routledge, 1991.
Hayles, Katharine. "Boundary Disputes: Homeostasis, Reflexivity and the Boundaries of Cybernetics". In: *Configurations* 2 (1994). Pp. 441–448.
— *Chaos Bound: Orderly Disorder in Contemporary Literatur and Science*. Cornell University Press, 1990.
— "Designs on the Body: Wiener, Cybernetics, and the Play of Metaphor". In: *History of the Human Sciences* 3 (1990). Pp. 211–228.
— "Simulated Nature and Natural Simulations". In: *Uncommon Ground*. Ed. by William Conon. Norton, 1995. Pp. 409–425.
Hayles, N. Katherine. *Chaos and order : complex dynamics in literature and science*. Chicago: University of Chicago Press, 1991.
— *How we became posthuman : virtual bodies in cybernetics, literature, and informatics*. University of Chicago Press Chicago, Ill., 1999.
— *Nanoculture : implications of the new technoscience*. Bristol, UK ; Portland, Oregon: Intellect Books, 2004.
Headrick, Daniel. *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700-1850*. Oxford University Press, 2000.

Heims, Steve J. *John Von Neumann and Norbert Wiener : from mathematics to the technologies of life and death*. Cambridge, Mass: MIT Press, 1980.

— *The Cybernetics Group, 1946-1953: Constructing a Social Science for Postwar America*. MIT Press, 1991.

Heims, Steven J. *The Cybernetics Group*. MIT Press Cambridge, 1991.

Hesse, Bradford et al. "Returns to Science: Computer Networks in Oceanography". In: *Communications of the ACM* 36 (1993). Pp. 90–101.

Hollinger, David. "Science, Jews, and Secular Culture: Studies in Mid-Twentieth-Century American Intellectual History". In: Princeton University Press, 1996. Chap. The Defense of Democracy and Robert K. Merton's Formulation of Scientific Ethos.

Holloway, David. "Innovation in science: the case of cybernetics in the Soviet Union". In: *Science Studies* 4 (1974). Pp. 299–337.

Hoos, Ida Russakoff. *Systems Analysis in Public Policy: A Critique*. University of California Press Berkeley, 1972.

Hounshell, David. "The Cold War, RAND, and the Generation of Knowledge, 1946-1962". In: *Historical Studies in the Physical and Biological Sciences* 27.2 (1997). Pp. 237–267.

Hughes, Thomas and Agatha Hughes, eds. *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*. MIT University Press, 2000.

Huxley, Thomas. "On the Hypothesis that Animals are Automata". In: *Fortnightly Review* 22 (1874). Found in Mirowski. Pp. 556–589.

Jardini, David. "Out of the Blue Yonder: The RAND Corporation's Diversivification into Social Welfare Research, 1946-1968". PhD thesis. Carnegie Mellon University, 1996.

— "Out of the Blue Yonder: The Transfer of Systems Thinking from the Pentagon to the Great Society, 1961-1965". In: *Systems, Experts, and Computers*. Ed. by Thomas Hughes and Agatha Hughes. MIT University Press, 2000. Pp. 221–254.

Johnson, Stephen. "Insuring the Future: The development and diffusion of systems management in the American and European space programs". Norberg student. PhD thesis. University of Minnesota, 1997.

— *The Secret of Apollo Systems Management in American and European Space Programs*. Johns Hopkins University Press, 2002.

— "Three Approaches to Big Technology: Operations Research, Systems Engineering, and Project Management". In: *Technology & Culture* 38 (1997). Pp. 891–919.

Johnson, Steven. *Emergence : the connected lives of ants, brains, cities, and software*. New York: Scribner, 2001. 288 p.

Kaplan, Fred. *The Wizards of Armageddon*. Simon & Schuster, 1983.

Kay, Lily. "Cybernetics, Information, Life: The Emergence of Scriptural Representations of Heredity". In: *Configurations* 5.23–91 (1997).

— *Who wrote the book of life? : a history of the genetic code*. Stanford, Calif: Stanford University Press, 2000.

— "Who Wrote the Book of Life? Information and the Transformation of Molecular Biology". In: *Science in Context* 8 (1995). Pp. 609–634.

Keller, Evelyn Fox. *Making sense of life : explaining biological development with models, metaphors, and machines*. Cambridge, Mass: Harvard University Press, 2002.

— *Refiguring life : metaphors of twentieth-century biology*. New York: Columbia University Press, 1995.

Kingsland, Sharon. "Designing nature reserves: adapting ecology to real-world problems". In: *Endeavor* 26.1 (2002). Pp. 9–14.

Kline, Ronald. "Cybernetics, Management Science, and Technology Policy: The Emergence of "Information Technology" as a Keyword, 1948-1985". In: *Technology & Culture* 47.3 (2006). Pp. 513–535.

Kohler, Robert. “The management of science: the experience of Warren Weaver and the Rockefeller Foundation program in molecular biology”. In: *Minerva* 14 (1976). Pp. 279–306.
Kolman, Arnost. “The adventure of cybernetics in the Soviet Union”. In: *Minerva: Review of Science, Learning and Policy* 16.416-424 (1978).
Langely, Pat et al. *Scientific Discovery*. Cambridge University Press, 1987.
Leff, Harvey and Andrew Rex, eds. *Maxwell’s Demon: Entropy, Information, Computing*. Princeton University Press, 1990.
Lem, Stanislaw. “The Sixth Sally, or How Trurl and Klapaucius Created a Demon of the Second Kind to Defeat the Pirate Pugg”. In: *The Cyberiad, Tales for a Cybernetic Age*. 1974.
Lenoir, Timothy. “Shaping Biomedicine as an Information Science”. In: *Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems*. Ed. by Mary Ellen Bowden, Trudi Bellardo Hahn, and Robert V. Williams. Information Today, 1999. Pp. 27–45.
— “The Manhattan Project for Biomedicine”. In: *Controlling Our Destinies*. Ed. by Phillip R. Sloan. University of Notre Dame Press, 2000. Pp. 19–46.
Leontif, Wassily. *Essay in Economics*. Oxford University Press, 1966.
Leslie, Stuart. *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford*. New York: Columbia University Press, 1993.
Light, Jennifer. *From warfare to welfare : defense intellectuals and urban problems in Cold War America*. Baltimore: Johns Hopkins University Press, 2003.
Lilienfield, Robert. *The rise of systems theory: an ideological analysis*. Wiley, 1978.
Machlup, Fritz and Una Mansfield. *The Study of information : interdisciplinary messages*. New York: Wiley, 1983.
Mahoney, Michael. “Cybernetics and Information Technology”. In: Companion to the History of Modern Science (1989).
McCarthy, John. “Measure of the Value of Information”. In: *Proceedings of the National Academy of Sciences* 42 (1956). Pp. 654–655.
McCulloch, Warren and Walter Pitts. “A logical calculus of the ideas immanent in nervous activity”. In: *Bulletin of Mathematical Biophysics* 5 (1943). Pp. 115–133.
McKenna, Christopher D. *The World’s Newest Profession: Management Consulting in the Twentieth Century (Cambridge Studies in the Emergence of Global Enterprise)*. Cambridge University Press, 2006.
Medina, Eden. “Designing Freedom, Regulating a Nation: Socialist Cybernetics in Allende’s Chile”. In: *Journal of Latin American Studies* 38.03 (2006). Pp. 571–606.
Mindell, David A. *Between human and machine : feedback, control, and computing before cybernetics*. Baltimore: Johns Hopkins University Press, 2002.
Mirowski, Philip. *Machine dreams : economics becomes a cyborg science*. Cambridge University Press, 2002.
Nasar, Sylvia. *A Beautiful Mind*. Simon & Schuster, 1998.
Neumann, John von. *The Computer and the Brain*. Yale University Press, 1958.
Neumann, John von and Oscar Morgenstern. *Theory of Games and Economic Behavior*. Princeton University Press, 1944.
Newell, Allen and Herbert Simon. *Human Problem Solving*. Prentice-Hall, 1972.
November, Joseph. “Digitizing life : the introduction of computers to biology and medicine”. PhD thesis. Princeton University, 2006.
Owens, Larry. “Mathematicians at War: Warren Weaver and the Applied Mathematics Panel, 1942-45”. In: *The History of Modern Mathematics*. Ed. by David Rowe and John McLeary. Academic Press, 1989.
Pagels, Heinz. *Dreams of reason: the computer and the rise of the sciences of complexity*. Simon & Schuster, 1988.

Patten, Bernard. “An introduction to the cybernetics of the Ecosystem: The Tophic-Dynamic Aspect”. In: *Ecology* 40 (1959). Pp. 221–231.
Pickering, Andrew. “Cybernetics and the Mangle: Ashby, Beer and Pask”. In: *Social Studies of Science* 32.3 (2002). Pp. 413–437.
— “Cyborg History and the WWII Regime”. In: *Perspectives in Science* 3 (1995). Pp. 1–45.
Pylyshyn, Zenon W. *Perspectives on the computer revolution*. Prentice-Hall series in automatic computation. Englewood Cliffs, N.J.: Prentice-Hall, 1970. ISBN: 0136607616.
Quastler, Henry, ed. *Essays on the Use of Information Theory in Biology*. University of Illinois, 1953.
Rau, Eric. “Combat Scientists: Operations Research in the United States during World War II”. PhD thesis. University of Pennsylvania, 1999.
Resnikoff, Howard. “The new science of information”. In: *Mapping the Cosmos*. Ed. by Jane Chance and R.O. Wells. Rice University Press, 1985. Pp. 129–150.
Riskin, Jessica. “The Defecating Duck, or, the Ambiguous Origins of Artifical Life”. In: *Critical Inquiry* 29 (2003). Pp. 599–534.
Schaffer, Simon. “Fish and Ships: Models in the Age of Reason”. In: Models: The Third Dimension of Science (2004).
Schelling, Thomas. *The Strategy of Conflict*. Harvard University Press, 1960.
Sent, Esther-Mirjam. “Sent Simulating Simon Simulating Scientists”. In: *Studies in the History and Philosophy of Science* 32.3 (2001). Pp. 479–500.
Shannon, Claude Elwood and Warren Weaver. *The mathematical theory of communication*. Urbana: University of Illinois Press, 1949.
Shannon, Claude and Warren Weaver. *The Mathematical Theory of Communication*. University of Illinois, 1949.
Shroedinger, Erwin. *What is Life?* Cambridge University Press, 1944.
Simon, Herbert Alexander. *The sciences of the artificial*. MIT University Press, 1969.
Taylor, Peter. “Technocratic Optimism, H. T. Odum, and the Partial Transformation of Ecological Metaphor after World War II”. In: *Journal of the History of Biology* 21 (1988). Pp. 213–244.
Thurtle, Phillip, ed. *Semiotic Flesh: Information and the Human Body*. University of Washington Press, 2002.
Voskuhl, Adelheid. “Humans, Machines, and Conversations: An Ethnographic Study of the Making of Automatic Speech Recognition Technologies”. In: *Social Studies of Science* 34.3 (2004). Pp. 365–393.
Walker, Mark. *Science and ideology : a comparative history*. London ; New York: Routledge, 2003.
Weintraub, E. Roy, ed. *Toward a History of Game Theory*. Duke University Press, 1992.
Wiener, Norbert. *Cybernetics and society*. New York: Executive Techniques, 1951.
— *Cybernetics, or, Control and communication in the animal and the machine*. Technology Press ; John Wiley ; Hermann Cambridge, Mass. New York Paris, 1948.
— *God and Golem, inc.: a comment on certain points where cybernetics impinges on religion*. Cambridge: M.I.T. Press, 1964.
— *The human use of human beings; cybernetics and society*. Houghton Mifflin Boston, 1950.
— *The human use of human beings: cybernetics and society*. Boston: Houghton Mifflin, 1954.
Yearley, Steven. “Computer Models and the Public’s Understanding of Science: A Case-Study Analysis”. In: *Social Studies of Science* 29 (1999). Pp. 845–866.