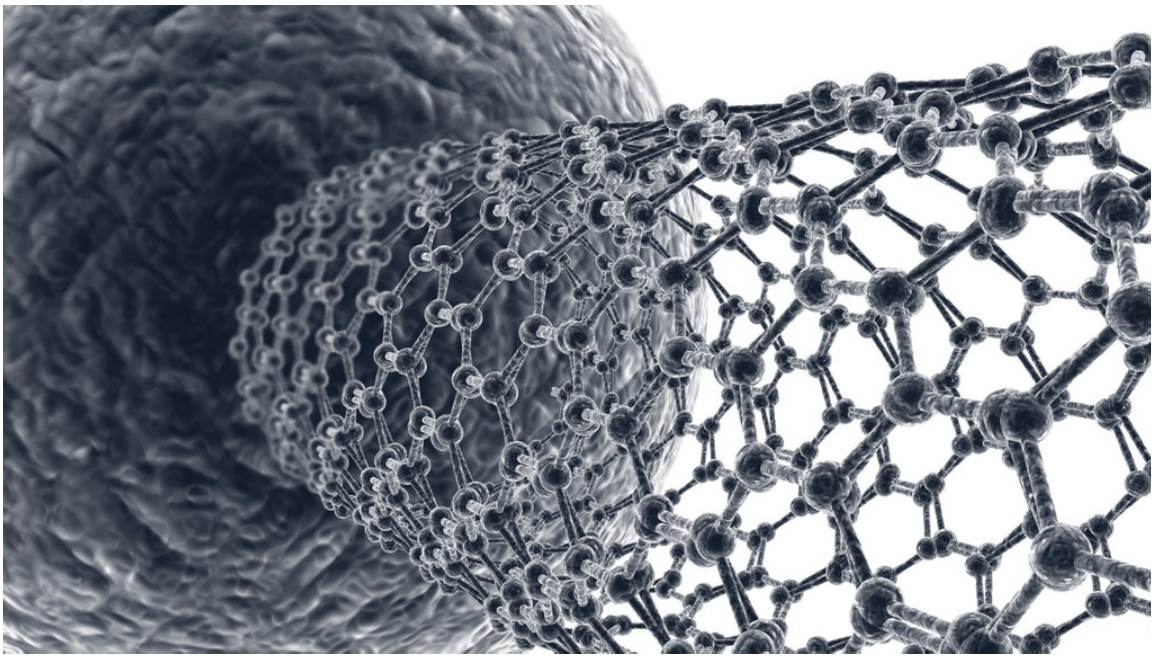
Department of History of Science
Faculty of Arts and Sciences
Harvard University

Nanocultures

Spring 2011



Course staff:

Instructor: Hallam Stevens
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Course description:

Beginning with the history of miniaturization, this course analyzes the cultural impact of the increasing smallness and invisibility of devices that play an important role in our lives. From the first computers to nano-technology we have experienced the continual shrinkage of devices of increasing power and significance. This course will examine the role of tiny technologies in communication, surveillance, warfare, medicine, and engineering, examining their social, cultural, political, environmental, legal, and economic impacts. In analyzing the history of smallness, we will come to a fuller

understanding of how human perceptions of space, time, and scale are being transformed by technologies.

Meeting times:

Lectures:

There will be two lectures per week:

Monday 12-1pm, Sever 306
Wednesday 12-1pm, Sever 306

Sections:

In addition there will be a 1 hour section at a time and place to be arranged.

Field trips:

There will be two 'field trips' during the semester. It is very important that you are able to participate. We will let you know as soon as possible when these are arranged. Please be prepared to be flexible and rearrange your schedule in order to attend.

Assessment

In-class midterm: 20%
Mini-projects: 3 × 15% = 45%
Take-home final: 25%
Section participation: 10%

Midterm:

The midterm will take place early in the term on Wednesday March 9th. It will be a 50 minute exam to be taken during class time.

You will be required to write two short essays based on thematic questions that will require you to integrate material from different lectures and readings.

Mini-projects:

Through the course of the semester, you will be required to complete three mini-projects. The topics for these mini-projects will be related to the various weeks of the course and posted on the course website early in the semester.

Two of the projects will be written assignments, and one will consist of a presentation during section. The amount of work involved in each mini-project should be approximately the **equivalent of a carefully constructed five-page paper**.

Some of the projects will consist of more in-depth accounts of technical subjects touched upon in lectures and readings, while others will require more creative thinking. Collaboration and group-work is encouraged for the mini-projects (although, of course, the scope of the project should increase accordingly: eg. a group with three people should do the equivalent of 15 pages worth of work).

The mini-projects will be due in sections in the weeks to which they correspond. Late mini-projects will be heavily penalized (see the guidelines below).

Final:

The take-home final will be similar in format to the midterm. The questions will ask you to draw together material from different weeks of the course and integrate it in ways which resonate with the key themes.

You will have 48 hours to complete the exam, although it is expected that you would spend betweenthree and four hours working on it. The exam will be open book and open note, but collaboration of any sort is not permitted.

The examination will take place during reading period:

Noon on Tuesday May 3rd to Noon on Thursday May 5th

Sections:

Section participation will be a crucial component of the course. There will be ten section meetings during the term. In order to obtain any credit for section attendance and participation, you must attend at least eight of these sections. Attending fewer than eight sections will result in an automatic zero for section attendance.

Attendance at eight sections is a minimum requirement: a good section grade will reflect active participation in discussions and engagement with the readings.

Policies and expectations:

Late work:

Any written work or presentations that are late will be penalized at a rate of 10% per day (including weekend days).

Collaboration:

As noted above, collaboration on either the midterm exam or the final take-home exam is strictly forbidden. Collaboration and groupwork on the mini-projects is actively encouraged, although such collaboration must be fully acknowledged in all cases.

Week by week:

Week 1: Introduction

Lecture 1 (Monday January 24): Size matters
Lecture 2 (Wednesday January 26): Methods and themes

Week 2: The science of small

Lecture 3 (Monday January 31): Quantum worlds
Lecture 4 (Wednesday February 2): Master molecules

Week 3: Computers

Lecture 5 (Monday February 7): The invention of computers
Lecture 6 (Wednesday February 9 – Guest Lecture, Stephanie Dick, Department of History of Science): The Mainframe

Week 4: Miniaturization

Lecture 7 (Monday February 14): The transistor
Lecture 8 (Wednesday February 16): The integrated circuit

Week 5: Computing power for the rest of us

Monday February 21, Presidents' Day Holiday

Lecture 9 (Wednesday February 23): Minicomputers and microcomputers

Tour of Collection of Historical Scientific Instruments.

Week 6: Personalization

Lecture 10 (Monday February 28): Personal computers revolution
Lecture 11 (Wednesday March 2): Wearable technologies

Week 7: Cyborgs

Lecture 12 (Monday March 7): Wireless world

Midterm examination (in class): Wednesday March 9.

Spring break (March 12 to March 20)

Week 8: Nanotechnology

Lecture 13 (Monday March 21): The origins of nanotechnology
Lecture 14 (Wednesday March 23 – Guest lecture, Dr. Eric Martin, FAS Center for Nanoscale Systems): Approaches and applications

Tour of FAS Center for Nanoscale Systems

Week 9: Safety and regulation

Lecture 15 (Monday March 28): Health and safety

Lecture 16 (Wednesday March 30) – Guest lecture, Professor Sheila Jasanoff, Kennedy School of Government: Regulation of nanotechnology

Week 10: Big brother small

Lecture 17 (Monday April 4): Surveillance and control
Lecture 18 (Wednesday April 6): Terrorism and warfare

Week 11: Bionano

Lecture 19 (Monday April 11): Synthetic biology, genomics, and information
Lecture 20 (Wednesday April 13):Nanomedicine

Week 12: The future of computers

Lecture 21 (Monday April 18): Molecular and quantum computing
Lecture 22 (Wednesday April 20): Artificial intelligence and robotics

Week 13: Nanofutures

Lecture 23 (Monday April 25) – Guest lecture, Professor Henry Smith, Department of Electrical Engineering and Computer Science, MIT: Nanotechnology: the hype, the potential, and the road to disruptive applications.
Lecture 24 (Wednesday April 27): Nanotechnology and visions of the future

Readings:

Week 1: Introduction

Edward Tenner (2004) 'Technology, technique, and the body' in *Our Own Devices: How Technology Remakes Humanity* (New York: Vintage): 3-29.

Donna Haraway (1991) 'A cyborg manifesto: science, technology, and socialist-feminism in the late twentieth century' in *Simians, cyborgs, women: the reinvention of nature* (New York: Routledge): pp. 149-181.

Week 2: The science of small

David Mermin (1981) 'Bringing home the atomic world: quantum mysteries for everyone' American Journal of Physics 49: 940-943.

Richard P. Feynman (1960) 'There's plenty of room at the bottom: an invitation to enter a new field of physics'*Engineering and science.* Available at: http://www.zyvex.com/nanotech/feynman.html

Harmke Kamminga (1998). 'Vitamins and the dynamics of molecularization: biochemistry, policy, and industry in Britain, 1914-1939' in *Molecularizing Biology and Medicine: New practices and alliances,* Soraya de Chadarevian and HarmkeKamminga, eds. Harwood Academic: 78-98.

Week 3: Computers

Martin Campbell-Kelly and William Aspray (2004) 'Inventing the computer' in *Computer: a history of the information machine* (Westview Press): 79-104.

Aiken Computer Laboratory (1985) *A manual operation for the automatic sequence controlled calculator,* Charles Babbage Institute reprint series for the History of Computing, vol. 8 (Cambridge, MA: MIT Press): 1-52 [skim]

John von Neumann (1945) 'First Draft of a Report on the EDVAC' Michael D. Godfrey, ed.

Week 4: Miniaturization

Nick Holonyak (1992) 'John Bardeen and the point-contact transistor' *Physics today* 45 (April): 36-43.

G.E. Moore (1965) 'Cramming more components onto integrated circuits' *Electronic magazine* 38(8 – 19 April). [4pp.]

Christophe Lécuyer (2006) 'Revolution in silicon' in *Making Silicon Valley: Innovation and the growth of high tech, 1930-1970* (Cambridge, MA: MIT Press): 129-167.

Week 5: Computing power for the rest of us

W.A. Clark and C.E. Molnar (1964) 'The LINC: a description of the laboratory instrument computer' *Annals of the New York Academy of Sciences* 115:653-668.

Joe November (2004) 'LINC: biology's revolutionary little computer' *Endeavour* 28(3): 125-131.

Tracy Kidder (1981) *The soul of a new machine* (New York: Avon): Chapters 1 and 2 (pp. 8-48).

Martin Campbell-Kelly and William Aspray (2004) 'New Modes of Computing' in *Computer: a history of the information machine* (Westview Press): 207-229.

Week 6: Personalization

Ted Nelson (1977) *The home computer revolution* (Published by the author): 10-31.

Paul Freiberger and Michael Swaine (2000) 'Homebrew' in *Fire in the valley: the making of the personal computer* 2nd ed (New York: McGraw-Hill): 109-136.

Steven Levy (2006) 'Personal' in *The Perfect Thing: How the iPod Shuffles Commerce, Culture, and Coolness* (New York: Simon & Schuster): 53-80.

E. Cabell Hankinson Gathman (2008) 'Cell phones' in *The inner history of devices,* Sherry Turkle, ed. (Cambridge, MA: MIT Press): 41-48.

Week 7: Cyborgs

No reading.

Week 8: Nanotechnology

Hyungsub Choi and Cyrus C.M. Mody (2009) 'The long history of molecular electronics: microelectronic origins of nanotechnology' *Social studies of science* 39: 11-50.

Bill Joy (2000) 'Why the future doesn't need us' *Wired* (August 4) 8.04. Available at: http://www.wired.com/wired/archive/8.04/joy.html

David M. Berube (2006) 'Exagerration, hyperbole, and hype-steria' in *Nano-Hype: the Truth Behind the Nanotechnology Buzz* (Amherst: Prometheus Books): 29-47.

Week 9: Safety and regulation

W. Patrick McCray (2005) 'Will small be beautiful? Making policies for our nanotech future' *History and Technology* 21: 177-203.

Langdon Winner (2003). Testimony to the Committee on Science of the U.S. House of Representatives on 'The Societal Implications of Nanotechnology', April 9. http://www.rpi.edu/~winner/testimony.htm

Elise McCarthy and Christopher Kelty (2010) 'Responsibility and nanotechnology' *Social Studies of Science* 40(3)*:* 405-432.

L.B. Lave (2001) 'Lifecycle/sustainability implications of nanotechnology' in *Societal implications of nanoscience and nanotechnology*, Mihail C. Roco and William S. Bainbridge, eds. (NSET Workshop Report): 162-168.

Week 10: Big brother small

Michael Mehta (2002) 'On nano-panopticism: a sociological perspective' Available at: http://chem4823.usask.ca/cassidyr/OnNano-Panopticism-ASociologicalPerspective.htm

Jeroen van den Hoven (2007) 'Nanotechnology and privacy: instructive case of RFID' in *Nanoethics: the ethical and social implications of nanotechnology*, Allhoff, Lin, Moor, Weckert, eds. (Wiley): 253-266.

Daniel Moore (2007) 'Nanotechnology and the military' in *Nanoethics: the ethical and social implications of nanotechnology*, Allhoff, Lin, Moor, Weckert, eds. (Wiley): 267-276.

Explore online: Institute for Soldier Nanotechnology (http://web.mit.edu/isn/)

Week 11: Bionano

Nadrian C. Seeman (2004) 'Nanotechnology and the double helix' *Scientific American* 290(6): 64-75.

Explore online: Registry of Standard Biological Parts (http://partsregistry.org/Main_Page)

Yaakov Benenson et al. (2004) 'An autonomous molecular computer for logical control of gene expression' *Nature***429** (6990): 423–429.Available at: http://www.wisdom.weizmann.ac.il/~lbn/other_links/ShapiroNature2004.pdf.

Robert A. Freitas, Jr. (2005) 'Current status of nanomedicine and medical nanorobotics' *Journal of computational and theoretical nanotechnology* 2: 1-25.

Week 12: The future of computers

Leonard Adelman (1994) 'Molecular computation of solutions to combinatorial problems' *Science* 266(5187 – November 11): 1021-1024.

Melina Kramer et al. (2008) 'Coupling of biocomputing systems with electronic chips: electronic interface for transduction of biochemical information' *Journal of physical chemistry C* 113: 2573-2579.

Neil Gershenfeld and Isaac L. Chuang (1988). "Quantum computing with molecules" *Scientific American* (June).

Jean BaptisteWaldner (2007) 'The computers of tomorrow' in *Nanocomputers and swarm intelligence* (Wiley).

Sherry Turkle (2006) 'A nascent robotics culture: new complicities for companionship' AAAI Technical Report Series(July). Available at: http://web.mit.edu/sturkle/www/nascentroboticsculture.pdf

Week 13: Nanofutures

Eric Drexler (1986). *Engines of Creation: the coming era of nanotechnology.* New York: Doubleday: Chapters 1, 2 and 11.

Vernor Vinge (1993) 'Technological singularity' *Whole earth review* 81: 88-95.

Sherry Turkle (1984) 'Thinking of yourself as a machine' in *The second self: computers and the human spirit* (New York: Simon & Schuster): 247-278.