

## **HH9207/HH207: Science and technology in historical perspective**

### *Syllabus*

Course head: Assistant Professor Hallam Stevens

Academic units: 3 AU

Prerequisites: None

Lecture times: Monday 10.30am-12.30pm

Tutorial times: Monday 2.30pm-3.30pm and 3.30pm-4.30pm

### **Learning objectives:**

- Understand the evolution of major scientific and technological developments and trends in modern history and how these trends have affected human societies and civilizations
- Obtain familiarity with the major historical approaches in explaining scientific and technological evolution
- Critically analyze the interactions between science, technology, and socio-political changes in different historical and cultural contexts

### **Content:**

This course surveys the major scientific and technological developments in various geographical and cultural contexts, including those of Asia, Europe, and the United States. It examines transformations in the study of astronomy, medicine, and natural philosophy, and compares the approaches to knowledge and the cultural values attached to science and technology in different societies. In so doing, it places these developments in their cultural, social, and political contexts. The course also surveys technological innovation since the industrial revolution and how it has increasingly become a powerful force in transforming the human condition.

### **Assessment:**

*Class participation:* (20%)

Assessment will be based on participation in discussions during tutorial meetings.

*Writing assignment:* (30%)

Assessment based on a research paper of 3000 words analyzing primary sources. Topics / questions and sources to be provided. Outside research and reading will be required.

**Due date: 5pm Friday 25<sup>th</sup> February, 2012.**

*Final examination:* (50%)

A 3-hour final written examination will be given, covering the content of the entire course, including all the lectures and reading material.

## **Lectures:**

### *Week 1: Introduction (January 9<sup>th</sup>)*

Lecture 1a: Introducing the course: themes and methods (or: Why should we care about the history of science?)

Lecture 1b: Before 1600

### *Week 2: The scientific revolution (January 16<sup>th</sup>)*

Lecture 2a: What was the scientific revolution?

Lecture 2b: Why was there a scientific revolution?

### *Week 3: Beyond Europe (January 23<sup>rd</sup> - Chinese New Year, lecture may be rescheduled or cancelled)*

Lecture 3a: Islamic science

Lecture 3b: China and the myth of the great divide

### *Week 4: Natural philosophy and the Enlightenment (January 30<sup>th</sup>)*

Lecture 4a: The enlightenment: chemistry, mathematics, and reason

Lecture 4b: Romantic science

### *Week 5: The industrial revolution (February 6<sup>th</sup>)*

Lecture 5a: Steam engines, telegraphs, and Victorian science

Lecture 5b: Energy and empire

### *Week 6: Natural history (February 13<sup>th</sup>)*

Lecture 6a: Geology, time, and natural theology

Lecture 6b: Darwin and his impact

### *Week 7: The rise of the human sciences (February 20<sup>th</sup>)*

Lecture 7a: Measuring the human

Lecture 7b: Freud and the sciences of the mind

### *Mid-semester break*

### *Week 8: Mass production (March 5<sup>th</sup>)*

Lecture 9a: Technological systems

Lecture 9b: Workers, factories, products

*Week 9: A new physics (March 12<sup>th</sup>)*

Lecture 8a: Einstein and relativity

Lecture 8b: From classical to quantum

*Week 10: Science and war (March 19<sup>th</sup>)*

Lecture 10a: From chemistry to physics

Lecture 10b: The cold war and the military-industrial complex

*Week 11: Information / technology (March 26<sup>th</sup>)*

Lecture 11a: The rise of the computer

Lecture 11b: From the ARPANET to the World Wide Web

*Week 12: Asia and 20<sup>th</sup> century technology (April 2<sup>nd</sup>)*

Lecture 12a: Japan's postwar miracle

Lecture 12b: Rise of the 'Asian Tigers'

*Week 13: New frontiers of innovation (April 9<sup>th</sup>)*

Lecture 13a: Biotechnology

Lecture 13b: Nanotechnology

## **Readings:**

*Week 1: Introduction*

- Thomas Kuhn, *The structure of scientific revolutions* (Chicago, IL: University of Chicago Press) ["Introduction: Role for History" (pp. 1-9) and "The Nature and Necessity of Scientific Revolutions" (pp. 92-110)]
- C.S. Lewis, *The discarded image: an introduction to medieval and renaissance literature* (Cambridge: Cambridge University Press), pp. 92-121, 146-152, 169-174, 216-223.
- Nicolas Copernicus (1543) *De revolutionibus orbium coelestium* [Osiander's preface and the author's preface, available at <http://www.webexhibits.org/calendars/year-text-Copernicus.html> ]
- *The Book of Beasts, being a translation from a Latin Bestiary of the Twelfth Century*, trans. T.H. White (Madison: University of Wisconsin Press). See images at: <http://bestiary.ca/index.html>

*Week 2: The scientific revolution*

- Steven Shapin (1996) "What was known?" *The scientific revolution* (Chicago, IL: University of Chicago Press): 15-64.

- Jim Bennett (1986). “The mechanics’ philosophy and mechanical philosophy” *History of Science* 24: 1-28.
- B. Copenhaver (1990). “Natural magic, hermetism, and occultism in early modern science” in *Reappraisals of the scientific revolution*, D.C. Lindberg and R.S. Westman, eds. (Cambridge, UK: Cambridge University Press): 261-301.
- Robert Boyle, “New experiments, physico-mechanicall, touching the spring of the air, and its effects.” [pp. 41-77, available at: [http://echo.mpiwg-berlin.mpg.de/ECHOdocuViewfull?url=/mpiwg/online/permanent/archimedes/boyle\\_exper\\_013\\_en\\_1660&tocMode=thumbs&viewMode=text\\_dict&pn=1](http://echo.mpiwg-berlin.mpg.de/ECHOdocuViewfull?url=/mpiwg/online/permanent/archimedes/boyle_exper_013_en_1660&tocMode=thumbs&viewMode=text_dict&pn=1) ]
- Isaac Newton (1687 [1729]) *Principles of natural philosophy* [Author’s preface (5pp.) and “Axioms or General Laws of Motion,” (pp. 19-21), available on GoogleBooks]

### *Week 3: Beyond Europe*

- Richard Covington, “Rediscovering Arabic science” *Saudi Aramco World* 58 (May/June 2007). <http://www.saudiaramcoworld.com/issue/200703/rediscovering.arabic.science.htm>
- Avicenna [Ibn-Sina] (1025) “The causes of disease” in *The Canon of Medicine [al-Qanun fi al-Tibb]* pp. 173-195.
- Arnold Pacey (1990). “An age of Asian technology, AD 700-1100 in *Technology in world civilizations: a thousand-year history* (Cambridge, MA: MIT Press): 1-19.
- Nathan Sivin, 1982, “Why the scientific revolution did not take place in China – or didn’t it?” *Chinese science* 5: 45-66.
- Benjamin Elman (2006). “The Jesuit Legacy” in *A cultural history of modern science in China* (Cambridge, MA: Harvard University Press): 15-35.

### *Week 4: Natural philosophy and the Enlightenment*

- Jan Golinski (1994). “Precision instruments and the demonstrative order of proof in Lavoisier’s chemistry” *Osiris* 9 (2<sup>nd</sup> series): 30-47.
- Dorinda Outram (1995). “What is Enlightenment?” and “Science and the Enlightenment: God’s order and man’s understanding” in *The Enlightenment* (Cambridge, UK: Cambridge University Press): 1-10 and 93-108.
- Robert Richards (2002). “Introduction: a most happy encounter” in *The romantic conception of life: science and philosophy in the age of Goethe* (Chicago, IL: University of Chicago Press): 1-14.
- Antoine Lavoisier (1798), *Elements of chemistry* [available at Project Gutenberg, <http://www.gutenberg.org/files/30775/30775-h/30775-h.htm> , Chapter 3]
- Alexander von Humboldt (1807) “Essai sur la géographie des plantes,” Paris/Tübingen [selections]

### *Week 5: The industrial revolution*

- Bruce Hunt, “Doing science in a global empire: cable telegraphy and electrical physics in Victorian Britain” (1997) *Victorian science in context*, ed. Bernard Lightman (University of Chicago Press): 312-333.

- Simon Schaffer (1992). “Late Victorian metrology and its instrumentation: a manufactory of Ohms” in *Invisible Connections: instruments, institutions, and science*, Bud and Cozzens ed. (Bellingham: SPIE).
- Frederick Engels (1845). *The condition of the working class in England in 1844* [“Introduction,” pp. 50-65]
- Charles Babbage, *On the economy of machinery and manufactures* [selections]

*Week 6: Natural history*

- Londa Schiebinger (2004). “Voyaging out” in *Plants and empire: colonial bioprospecting in the Atlantic World* (Cambridge, MA: Harvard University Press): 23-72.
- Janet Browne, *Charles Darwin: The power of place* [“Stormy waters,” pp. 3-42]
- Charles Darwin (1859) *On the origin of species* [Chapter XIV: Recapitulation and conclusion, pp. 371-396]
- William Kirby (1835). *The habits and instincts of animals with reference to natural theology* [Chapter 1: The history, habits, and instincts of animals, pp. 1-43]

*Week 7: The rise of the human sciences*

- Diane B. Paul (1995). “Evolutionary anxieties” in *Controlling human heredity*, pp. 22-39.
- Theodore Porter (1988) *The rise of statistical thinking, 1820-1900* (Princeton, NJ: Princeton University Press) [selections]
- Daphne De Maurneffe (1991) “Looking and Listening: The Construction of Clinical Knowledge in Charcot and Freud” *Signs: Journal of Women in Culture and Society*, vol. 17, no. 1 (1991), pp. 71-111.
- Joseph Breuer and Sigmund Freud (1989) “Studies on Hysteria: Anna O., Katherina,” *The Freud Reader*, ed. Peter Gay (New York: W.W. Norton): pp. 60-86.

*Week 8: Mass production*

- Thomas P. Hughes (1983). “Introduction” in *Networks of power: Electrification in Western Society, 1880-1930* (Baltimore, MD: Johns Hopkins University Press): 1-17.
- David Hounshell (1984), *From the American System to Mass Production, 1800-1932* (Baltimore, MD: Johns Hopkins University Press) [“The Ford Motor Company and the rise of Mass Production in America,” pp. 217-262]
- Frederick Winslow Taylor (1967 [1911]) *Principles of Scientific Management* (New York: Norton): 9-29.
- Henry Ford (1926) “Mass production” in *Encyclopedia Britannica*, vol. 30, 13<sup>th</sup> ed. (New York, NY: Encyclopedia Britannica Co), pp. 821-823.

*Week 9: The new physics*

- Peter Galison (2000). “Einstein’s clocks: the place of time” *Critical inquiry* 26(2): 355-389.

- Kraft, P. and P. Kroes. 1984. "Adaption of Scientific Knowledge to an Intellectual Environment: Paul Forman's 'Weimar Culture, Causality, and Quantum Theory, 1918-1927': Analysis and Criticism," *Centaurus* 27: 76-99.
- Albert Einstein (1961 [1916]) *Relativity* (New York: Crown): 25-33.
- Albert Einstein, Boris Podolsky, and Nathan Rosen (1935). "Can a quantum mechanical description of nature be complete" *Physical review* 47(10): 777-780.
- Mara Beller (1999). "The challenge of Einstein-Podolsky-Rosen and the the two voices of Bohr's response" in *Quantum Dialogues: the making of a revolution* (Chicago, IL: University of Chicago Press): 145-167.

#### *Week 10: Science and war*

- John Ellis (1975). "The trauma: 1914-18" in *The social history of the machine gun* (Baltimore, MD: Johns Hopkins University Press): 111-147.
- Richard Rhodes (1986). "Physics and desert country" in *The making of the atomic bomb* (New York, NY: Touchstone): 443-485
- Sir Charles Frank, ed. (1993). *Operation epsilon: the Farm Hall transcripts* (Berkeley, CA: University of California Press): 70-101.
- Raul Hilberg (1961), *The destruction of the European Jews* (New Haven, CT: Yale University Press) [selections]

#### *Week 11: Information / technology*

- Martin Campbell-Kelly and William Aspray (2004) 'Inventing the computer' in *Computer: a history of the information machine* (Westview Press): 79-104.
- Janet Abbate (2000). "Building the ARPANET: Challenges and strategies" in *Inventing the Internet* (Cambridge, MA: MIT Press): 43-81.
- J.C.R. Licklider (1960). "Man-computer symbiosis" *IRE Transactions on human factors in electronics* HFE-1: 4-11.
- Fred Turner (2006). "The shifting politics of the computational metaphor" in *From counterculture to cyberculture: Stewart Brand, the Whole Earth Network, and the rise of digital utopianism* (Chicago, IL: University of Chicago Press): 11-39.

#### *Week 12: Asia and 20<sup>th</sup> century technology*

- Tessa Morris-Suzuki (1994) "Technology and the 'economic miracle,' 1945-1973" in *The technological transformation of Japan* (Cambridge, UK: Cambridge University Press): 161-202.
- Charis Thompson (2010) "Asian regeneration? Nationalism and internationalism in stem cell research in South Korea and Singapore" in *Asian Biotech: ethics and communities of fate*, Aihwa Ong and Nancy N. Chen, eds. (Durham, NC: Duke University Press): 95-117.
- Catherine Waldby (2009) "Singapore biopolis: bare life in the city state" *East Asian Science, Technology, and Society* 3(2-3): 367-383.

#### *Week 13: New frontiers of innovation*

- Sally Smith Hughes (2001) "Making Dollars out of DNA: The First Major Patent in Biotechnology and the Commercialization of Molecular Biology, 1974-1980," *Isis* 92: 541-575.
- Freeman Dyson (2007). "Our Biotech Future" *The New York Review of Books* 54(12 - July 19).
- 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>
- 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>