

HS-203: Science in the Twentieth Century

Instructor: Toshihiro Higuchi

TA: Melissa Charenko

3 credits. Humanities or Social Science. Counts for Liberal Arts and Science credit. Elementary. Open to Freshmen.

Time: M and W: 1:20 pm – 2:10 pm (lecture)

R: 12:05 – 12:55; 1:20 – 2:10; 2:25 – 3:15; F: 9:55-10:45 (discussion)

Place: Microbial Sciences Bldg 1420

Office hours: M and W: 2:20 pm – 3:20 pm or by appointment @ Bradley Memorial, #214

Course Description:

In 1900, Lord Kelvin proclaimed that “there is nothing new to be discovered in physics now.” Since then, however, scientific discoveries revolutionized our notion of and practice with matter, life and self at a breathtaking speed. Physicists have modeled the structure of the atom, zeroing in on the world of subatomic particles, while astronomers are exploring the origin of the universe. Chemists understand the nature of chemical bonds, creating new compounds that have never existed in nature. Life is also studied in its full scale as an ecological and even terrestrial system—or in a microscopic scale down to the information code stored in DNA. Medicine, once considered as an art, has also become a science of its own, geared toward the ambitious goal of curing all ills through intervention with the body and its surroundings. Even the mind and its biological, societal and developmental dimensions are a subject of research from behavioral, psychological and neurological points of view. Theoretical principles and technological advances in information science are increasingly blurring the line between humans and nonhumans.

Why and how did these scientific achievements take place in the twentieth century? It is often said that science has nothing to do with the human world; it is all about nature, and nature seems to reveal itself to the gifted individuals capable of observing nature “as it is,” following its “inner logic,” and moving toward “truth.” From this naturalistic and individualistic perspective, scientific achievements seem to have little to do with the twentieth century other than for the fact that it happened to be the latest stage of the linear progression. In contrast to this ahistorical view, this course will explore the unique contexts of the twentieth century that radically altered the direction of scientific research. Instead of discussing scientific geniuses and their ideas, we will focus on “networks,” or webs of relations among human and nonhuman components in scientific research, such as scientists, objects, tools, standards, concepts, questions, funds, institutions, and even ambition. Throughout the course, arranged chronologically as well as thematically, we will see how these networks that made scientific achievements possible shifted over time and across space. To understand this shift and its causes, we will discuss some of the key scientific findings in the twentieth century and relate them to the “working world” of political administration, economic activities, social control, and cultural norms, all sliding into the contradicting promise of total annihilation and total well-being.

Textbook

Jon Agar, *Science in the Twentieth Century and Beyond* (London: Polity, 2012).

Course Requirements

Attendance (mandatory – see Attendance Policy for detail)

1 network drawing exercise (15 point)

1 sci-fi film review (20 point)

Discussion Participation (25 point)

Term paper (40 point)

The numerical equivalents of final grades (letter) are as follows: A=>93; AB=92-88; B=87-83; BC=83-79; C=78-74; CD=73-69; D< 68

Attendance Policy

Attendance is mandatory for all students. Any scheduled absence during the semester due to, for example, religious holidays, extra-curriculum activities, GRE/GMAT/LSAT exams, job interviews or familial affairs, must be reported to your instructor by September 16 by email. Additional information regarding your requested leave may be asked for. Please note that this course is coupled with a discussion class for a small number of students. As such, no class can succeed without your active participation.

After September 16, no unreported absence is acceptable, except for the allowance of one (1) unscheduled absence. Every absence in addition to the one (1) allowable unscheduled absence will result in a 5-point penalty against the total score. This penalty can be avoided if such absences accompany the prompt submission of the Dean's letters or doctor's notes.

Writing Assignments

You are required to submit ONE drawing of a network, ONE sci-fi film review (800-1,000 words), and ONE term paper (1,500-1,800 words). Please note that the word limit excludes footnotes and bibliography.

It is strongly encouraged to consult with your instructor during office hours, before and after class. The students are also advised to visit the writing resources center in order to develop an idea for the paper, polish writing skills, and ensure proper grammar and syntax.

For a history paper, the indication of sources is essential. You must follow Chicago Manual of Style for your writing assignments. Visit <http://www.libs.uga.edu/ref/chicago.html#docnote> and check "Documentary-Note Style." DO NOT use an in-text reference or endnote system. Use the footnote function that should be available in your word-processing software. An incorrect format will result in a deduction of 2 out of the total 15 points for the first exercise, 3 out of 20 for the second assignment, and 4 out of 40 for the term paper.

1. The first assignment is the drawing of a network. This is a teamwork—you will be paired with two peers attending the same discussion session. Your team should choose one of the following leading scientists in the early twentieth century that we will discuss up to Week 5:

Pierre and Marie Curie, Albert Einstein, and Niels Bohr (physics)

William Lawrence Bragg, Linus Pauling, and Fritz Haber (chemistry)

Thomas Hunt Morgan, J.B.S. Haldane, and Theodosius Dobzhansky (biology/genetics)

Christiaan Eijkman and Ronald Ross (tropical medicine)

Arthur G. Tansley and Charles Elton (ecology)

Lewis Terman and Robert Yerkes (psychology/education)

George Ellery Hale and Edwin Hubble (astronomy)

Ivan Pavlov, Etienne-Jules Marey, and Frederick Taylor (physiology/human motion).

Collect biographical information about the scientist of your choice (we will distribute a list of suggested sources plus Internet). Identify one of the accomplishments that the scientist concerned is most famous for. Draw a network surrounding her/her accomplishment, with a focus on 1) persons; 2) equipment; and 3) institutions. Then each of you should individually write one double-spaced page explaining one of the three components, providing 1) a brief biography of one of the identified persons, equipment or institutions; and 2) a brief explanation of how this person/equipment/institution contributed to the scientist in question and his/her accomplishment. Make sure that your explanatory note is properly footnoted.

The first assignment is due at the beginning of class on Monday, October 7. It must be submitted in hardcopy.

2. The second assignment is to watch a Cold War science-themed film and write a review.
Choose one of the following films:

Destination Moon (1950); The Day the Earth Stood Still (1951); War of the Worlds (1953)

Godzilla (1954); Them! (1954); Invasion of the Body Snatchers (1956); The Time Machine (1960)

Dr. Strangelove: Or How I Learned to Stop Worrying and Loving the Bomb (1964)

Fahrenheit 451 (1966); Planet of the Apes (1968); 2001: A Space Odyssey (1968)

THX-1138 (1971); The Stepford Wives (1975); Star Trek: The Motion Picture (1979); Tron (1982)

Blade Runner (1982); The Day After (1983); Nineteen Eighty-Four (1984); Akira (1988)

The review must be historical, not aesthetic or technical, which means that it should discuss contents in the context of the time when the film was made. It can still discuss aesthetics and techniques, but only in this historical context. It should discuss the representation of scientists/engineers, discoveries/tools, and society at large in the film.

The second assignment is due at the beginning of class on Monday, November 11. It must be submitted electronically to both the instructor and TA.

3. The term paper will discuss one of the following questions by drawing together the semester's readings, lecture, and discussion:

- 1) Science and State
- 2) Science and Business
- 3) Science and Truth
- 4) Science and Ethics

A detailed instruction will be given separately after the first assignment due. The term paper is due at 5:00 pm, December 16. It must be submitted electronically to both the instructor and TA.

Extra Requirements for Honor Students

Students who take this course for honor credits are required to submit a more detailed final paper. Instead of choosing two cases from each period, the honor students need to discuss three cases. The length of paper should be longer accordingly (2,000 to 2,300 words).

Late Papers Policy

You are given two grace days. You may use them whenever necessary. You can turn in two assignments one day late or one assignment two days late without penalty. In case of the first assignment, you are asked to put it in my mailbox at Bradley Memorial on Tuesday or bring it to Wednesday class. For the term paper, late submission means either December 17 or 18 (by 5:00 pm). After the use of the grace days, 3 points will be deducted from the total 15 points for the first assignment; 4 points from the 20 points for the second assignment; and 8 out of 40 for the term paper. If the paper is submitted later than a week from the due date (regardless of grace days), the points for that assignment will be reduced by 50 percent unless there is a note from the Dean explaining the reasons you could not complete the work.

Academic Honesty and Plagiarism

It is your responsibility to review the Honor Code, to know the definition of plagiarism, and to know how to use proper attribution (including citations for internet sites, should you use them) in your written assignments. If you are uncertain about the limits of collaboration on assignments, please contact me at any time. Academic honesty is not only a standard to which all of you have pledged yourselves, but is also the foundation of any intellectual exchange, and thus of any intellectual community such as a University. Academic honesty does not consist simply in the avoidance of outright cheating on exams, but more generally represents a set of standards all of us must follow in our academic work in order to protect the integrity and effectiveness of that work, and to preserve the ideals and essence of teaching, learning, and research. This implies, for instance, never submitting as our own scholarly work which we have not personally produced in its entirety, not collaborating with others on assignments and projects that are not specifically designed as collaborative efforts, and learning how to acknowledge properly all sources we may use in our written work. The latter includes not only proper documentation style for direct citations, but also references when we paraphrase sources and acknowledgements when we employ or develop ideas we have found in the work of others. These practices apply to sources of any type, from books to newspapers, from lectures to materials available on the Internet, and so on.

Learn@UW

All students in the class are automatically registered for this course on Learn@UW. When you log on to Learn@UW and access the site for this course, you will find all course documents (including this syllabus and the course assignments). Please familiarize yourselves with the course site, and let me know if you encounter any problems accessing it or the materials.

Course Schedule:

UNIT I: New Sciences in Rise

Week 1 (9/4): Introduction

Week 2 (9/9; 9/11): New Physics (1900-1930s)

Lecture Reading: Agar, 15-36 [From "Waves, rays and radioactivities" to "Einstein and Bohr"]

PBS, "The Fabric of the Cosmos: Quantum Leap" (2011). Watch 6:30 to 25:55.

Discussion Reading: Peter Galison, "Einstein's Clocks: The Place of Time," *Critical Inquiry* 26:2 (2000): 355-389

Focus in lecture:

9/9: Discovery of radioactivity

9/11: Theory of relativity and quantum mechanics

Week 3 (9/16; 9/18): New Sciences of Life (1900-1930s)

Lecture Reading: Agar, 44-60, 202-210 [From "New Sciences of Life" to "Making and circulating *Drosophila* genetics"; and from "The fortunes of Soviet genetics" to "The Evolutionary Synthesis"]

Discussion Reading: Robert E. Kohler, "Drosophila: A Life in the Laboratory," *Journal of the History of Biology* 26:2 (1993): 281-310.

Focus in lecture:

9/16: Rediscovery of Mendel and Thomas Hunt Morgan's *Drosophila* studies

9/18: Origin of life and the evolutionary synthesis

Week 4 (9/23; 9/25): Science and Total War (WWI)

Lecture Reading: Agar, 89-117 [the entire Chapter 5: Science and the First World War]

Discussion Reading: Movie, "Haber" (34 mins, 2012).

Focus in lecture:

9/23: The role of state in the age of total war

9/25: Sciences of life and death

Week 5 (9/30; 10/2): Science and Empire

Lecture Reading: Agar, 142-155 [From "Science and Imperial Order" to "Colonial management, disease and vitamins"]

Discussion Reading: TBA

Focus in lecture:

9/30: Tropical medicine

10/2: Ecology

Week 6 (10/7; 10/9): Science and Business

Network Drawing Due on 10/7

Lecture Reading

Agar, 161-174, 180-183 [From "Expanding Universes" to "Elites: philanthropic funding"; and the section "Sciences of the working world of industry"]

Discussion Reading

Robert Kanigel, "Taylor-made," *The Sciences* 37, no. 3 (1997), 4 pages plus the movie, "Stopwatch."

Focus in lecture

10/7: Role of Philanthropy

10/9: Role of Industrial Research

Week 7 (10/14; 10/16): Science and Totalitarianism

Lecture Reading

Agar, 186-193, 196-202, 211-221 [From "Revolutions and Materialism" to "New Soviet science?"; the section "The purges"; and from "Nazi Science" to "The mutual support of science and Nazi values"]

Discussion Exercise: Medicine and ethics

We will do a debate. Resolved: "We should use Nazi human experimentation data for medical research and practice." Please read the study guide for this week carefully.

1) Agar, 221-225 [Section "Doctors, science and the 'Jewish Question']

2) Go through U.S. Holocaust Museum, "Nazi Medical Experiments." Also click "Josef Mengele" for further detail

3) Read Baruch C. Cohen, "The Ethics of Using Medical Data from Nazi Experiments," *Jewish Law* (online)

Focus in lecture

10/14: USSR

10/16: Nazi Germany

UNIT II: Age of Big Science

Week 8 (10/21; 10/23): Science and the Second World War

Lecture reading

Agar, 263-275, 282-294 [From "Science and the Second World War" to "Radar sciences"; and from "The atomic bomb" to "Lessons learned"].

Discussion exercise: Scientists and decision to use the atomic bomb

We will do a simulation. Please read the study guide for this week carefully.

- 1) Niels Bohr's Memorandum to President Roosevelt (July 1944)
- 2) Petition Request from Szilard to Teller (July 1945)
- 3) Edward Teller's Reply to Szilard (July 1945)
- 4) Szilard's First Draft Petition (July 1945)
- 5) Szilard's Petition to the President (July 1945)
- 6) J. Robert Oppenheimer, Speech at Los Alamos (November 1945)

Focus in lecture

10/21: Permanent mobilization of science

10/23: The atomic bomb

Week 9 (10/28; 10/30): The Cold War and Big Physics

Lecture reading

Agar, 330-346, 359-372 [From "Cold War Spaces" to "From upper atmosphere to outer space"; from "Quantum electrodynamics" to "Radio astronomy"]

Discussion reading

Fermilab, "Science at Work" (2012)

Focus in lecture

10/28: Physics for war (nuclear fusion, laser, electronics)

10/30: ... and for peace (particle accelerator and astrophysics)

Week 10 (11/4; 11/6): Life Sciences Go Big

Lecture reading

Agar, 354-356, 387-395 [Section "Radiology"; section "Code Science: DNA"]

Discussion reading

NOVA, "Secret of Photo 51" (2007), 55 mins

Gunther Stent ed, *The Double Helix* (1980), 43-46, 95-99, 122-126 (Watson's account of R. Franklin), 204-207 (C.H. Waddington's criticism), 207-211 (Perutz and Wilkins' reactions)

Focus in lecture

11/4: Turning life into data

11/6: Modeling of DNA

Week 11 (11/11; 11/13): Earth and Environmental Sciences

Film Review Due on 11/11

Lecture reading

Agar, 348-351, 356-359, 395-399, 481-488 [Section "Global projects and the Cold War"; section "Tracer sciences"; from "Global science (1): Plate tectonics" to "Global science (2): Global warming"; from "The sciences and politics of global climate change" to "Biodiversity and bio-collecting"].

Discussion reading

Joseph Masco, "Bad Weather: On Planetary Crisis," *Social Studies of Science* 40, no. 1 (2010): 7-40.

Focus in lecture

11/11: Geophysics

11/13: Ecosystem ecology

Unit III: Toward Nano-science

Week 12 (11/18; 11/20): Science and Democratization (1960s)

Lecture reading

Agar, 403-432 [the entire Chapter 17: Transition: Sea Change in the Long 1960s]

Discussion reading

Jonathan Allen ed. *March 4: Scientists, Students, and Society*, xxii-xxiii, 15-29, 32-56.
Read "Faculty Statement," W.G. McMillan, "The Scientist in Military Affairs," V.F. Weisskopf, "Intellectuals in Government," R.F. Probst, "Reconversion and Academic Research," M.C. Grignetti, "Some Proposals to Aid Reconversion," D.S. Dayton, "Problems and Possibilities in Reconversion," L.W. Gruenberg, "Reconversion within Government Laboratories," and "Discussion"

Focus in lecture

11/18: Criticisms on weapons research

11/20: Criticisms on non-weapon research related to war

Week 13 (11/25; 11/27): Information Science: For Control or Liberation?

Lecture reading

Agar, 373-387, 450-453 [sections from "cybernetics" to "the work of computing"; section, "networks, computers and science"]

Discussion reading

Nathan Ensmenger, "Is Chess the Drosophila of Artificial Intelligence? A Social History of an Algorithm," *Social Studies of Science* 42, no. 1 (2012): 5-30.

Bill Joy, "Why the Future Doesn't Need Us," *Wired* (2000): 1-18.

Focus in lecture

11/25: WWII, the Cold War, and the birth of computers and cybernetics

11/27: Artificial intelligence, robots, and cyborgs

Week 14 (12/2; 12/4): Engineering of Life

Lecture reading

Agar, 436-450, 453-465 [sections from "The biotech boom" to "systematic biology"; sections from "Sequencing and multiplying" to "Public vs. private?"]

Discussion reading

Film, "Gattaca," directed by Andrew Niccol (1997).

Michael D. Bess, "Icarus 2.0: A Historian's Perspective on Human Biological Enhancement," *Technology and Culture* 49 (2008): 114-126.

Focus in lecture

12/2: Commercialization of life science

12/4: Ethics of genetic engineering

Week 15 (12/9; 12/11): Conclusion

Class activity scheduled for 12/9 (TBA)

Term paper due on 12/16