History 106: Science and the Modern World

Prof. Evan Hepler-Smith
Spring 2020
Tuesdays & Thursdays, 10:05–11:20am // East Duke 204B
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This course surveys the history of science from the 16th century through the present day. It addresses science not just as a body of knowledge and methods but as a cultural activity that has shaped and been shaped by modern global history. Topics will range across physical sciences, life sciences, earth and environmental sciences, and social sciences. This course takes a global perspective, with emphasis on parallels, differences, and interconnections among ways of knowing nature in different places and times, as well as the role of specific materials, environments, technologies, and practical problems in the development of modern science.

Left: Scenes from demonstrations by Native Hawai'ians opposing construction of the Thirty Meter Telescope observatory on Mauna Kea, Hawaii, 2014

Right: Scenes from the 2017 "March for Science," Pittsburgh, PA

Sources: https://www.flickr.com/photos/occupyhilo/with/15325707619/; Mark Dixon, https://www.flickr.com/photos/9602574@N02/34163353576/.

It is easy to take the features of modern science for granted. But gaining reliable knowledge about nature hasn't always involved laboratories, universities, government funding, journal articles, testing hypotheses, doing experiments, gathering data, making mathematical models, and the like. We will follow their historical emergence and development, along with alternative ways of knowing nature and society that emerged (and persist) alongside

them. We will find that, notwithstanding the tendency to define science in opposition to religion, politics, and commerce, science has never stood apart from religious, political, and commercial concerns, and in fact has often grown out of them. We will seek to understand how it is that, notwithstanding these entanglements, scientific methods and knowledge have become so reliable, accurate, and powerful (most of the time).

This introductory course is designed for students with interests in the humanities, natural sciences, social sciences, or engineering. No special background in science or in history is necessary.

STEM-focused students: This course provides both an introduction to the study of History and historical perspective on STEM fields and their social implications.

Humanities and social science students: By subjecting science to historical analysis, this course shows how you can use methods from the humanities and social sciences to ask informed questions about science and technology—questions crucial for responsible participation in present-day society.

Learning Goals: Students taking this course will learn to…

- relate present-day physical, life, environmental, and social sciences—and scientific controversies—to political projects, power, and alternative ways of knowing the world (past and present), through historical comparisons and historical genealogies.
- read scientific texts both as *sources of evidence* about their historical contexts and as historical artifacts whose meanings are *shaped by* their contexts and are to be interpreted in light of them.
- recognize, assess, and construct historical arguments, through reading responses, writing assignments, and feedback from instructor(s).
- evaluate how human civilizations shaped and have been shaped by historically-specific scientific endeavors, through reading and discussing scientific texts within their cultural contexts (Civilizations Area of Knowledge).
- scrutinize the social and economic roots of modern science, through analysis of the complex historical interconnections linking science with colonialism, anti-colonialism, capitalism, socialism, nationalism, internationalism, and other political, economic, and social developments (STS Mode of Inquiry).
- investigate how science has both reflected and informed socially salient conceptions of race, gender, class, ability, and other dimensions of culture and identity, through historical and cross-cultural comparisons of what counted as science and who was deemed trustworthy as a scientist (Cross-cultural Inquiry Mode of Inquiry).

Grading: *Participation (discussion + responses + attendance)* (20%) • *Take-home midterm* (20%) • *Historian's Memo assignment* (25%) • *Final exam OR final project* (35%)

Readings: Our readings include both *primary sources* and *secondary sources*. To make the most of our lectures and discussions, please read the assigned texts for each class before

our meeting. *Do not worry if you're not quite sure what's going on!* That's what our lectures and discussions are for. All readings will be accessible via Sakai.

Responses: Most weeks, we'll ask you to do a little historically-minded noticing—either within our readings or outside the classroom—and to submit a response of approximately 200 words (you are always welcome to write more) via Sakai by 6pm the evening before our class meeting. Feel free to write in an informal, exploratory style. The purpose of these responses is to raise questions for discussion, not necessarily to answer them.

Discussion and attendance: You are responsible for all material covered during all of our class meetings. (All slides from each lecture will be posted on Sakai.) Since learning to ask and discuss historical questions is a central goal of our class, attendance is required. But things come up! You are permitted three "personal day" absences, no questions asked. Additional absences will be excused provided you a) submit a note from a physician or documentation of required university activities and b) complete a make-up exercise.

Midterm Exam: Our take-home midterm will be due on Friday, Feb 14. Details to come.

Writing Assignments: In addition to this take-home midterm, we will have one more short paper, due on Tuesday, Mar 24. The premise: Protesters are planning on speaking out for/against a scientific project at our university, based on a historical analogy (e.g. critiquing a proposed research program in human gene editing as "neo-eugenics"). Your job: write a historian's memo advising either protest leaders, university administrators, or scientists whose work the protestors support or oppose. Your memo should advise the recipient on how to make and/or critique this argument in a historically sound manner. What aspects of this present-day issue, the historical case, and their respective contexts make this a telling or a misleading comparison? (4-5 pages double-spaced)

Final Exam / Final Project: For our end-of-term evaluation, *you may choose **either** a final exam **or** a final project*. The final exam will be cumulative, inclusive of material covered in all readings and lectures.

Final projects should comprise the intellectual equivalent of an 8-10 page paper. However, they may take other forms (e.g. digital presentations, image-based historical arguments, historical analysis of quantitative or geospatial data, …). All projects must include at least 2 pages of written historical analysis and a bibliography. Students opting for the final project must **submit a short proposal by 5pm, Friday, April 3**. Ideas:

a) rewrite one of our primary source texts, updated for the present, along with a key explaining and defending your historical analogies;

b) present a historical analysis of some aspect of science in our present-day community, including an argument making a historical comparison and/or drawing a genealogical connection to past scientific practice illustrated in one of our sources; or

c) present a historical argument comparing, contrasting, and/or connecting two sources in their historical contexts and commenting on how your analysis helps us better understand some aspect of science and/or the modern world

Collaboration, academic integrity, and collegial respect: You are warmly encouraged to consult with one another and with others outside of class in studying for exams, on your writing, and (if applicable) on your presentation. All work that you submit for evaluation should reflect your own reading, thinking, and writing about the topic. If you have any questions about appropriate collaboration, ***please ask!***

We will grapple with some challenging and disturbing ideas, events, writings, and images. I will do my best to make sure you know what's coming; if you have concerns, please let me know. Please maintain respect for your colleagues and the perspectives, experiences, and identities that they bring to this class, including by asking questions and making sincere arguments. Personal attacks are out of bounds.

This course is subject to the Duke Community Standard—make sure you're familiar with it.

Electronics: You are welcome to use laptops and tablets in class to access readings and take notes. You may use mobile devices for online in-class exercises only; otherwise, please silence mobile devices and put them away. *Only course-related uses of electronics are permitted during class time*. Repeated non course-related uses of electronics may negatively impact participation grades. If you need to attend to an urgent matter during class, by all means do! Just please step outside to do so.

Accommodations and accessibility: I want to do all I can to ensure that this class is accessible, inclusive, and equitable for all students. Please notify me within the first two weeks of class (or as soon as possible thereafter, for concerns arising mid-semester) with information about accommodations that we can provide to ensure accessibility, per the Student Rights and Responsibilities of the Duke accessibility office. If you have other concerns about classroom inclusiveness, please let me know. I will work with you!

Duke University is committed to providing equal access to students with documented disabilities. Students with disabilities may contact the Student Disability Access Office (SDAO) to ensure your access to this course and to the program. There you can engage in a confidential conversation about the process for requesting reasonable accommodations both in the classroom and in clinical settings. Students are encouraged to register with the SDAO as soon as they begin the program. Please note that accommodations are not provided retroactively. More information can be found online at access.duke.edu or by contacting SDAO at 919-668-1267, SDAO@duke.edu.

Unforeseen conflicts*:* If you anticipate trouble, speak with me as soon as possible. If you can inform me of serious adverse circumstances in advance, we can make accommodations that are fair to you and your fellow students. It is more difficult to do so after the fact.

I: Introduction

Thurs, Jan 9: What is science? What is history?

Tues, Jan 14: What is the modern world? Where are we?

- *Secondary*: Raj, *Relocating Modern Science* (2007), 1-21; Subramaniam, *Ghost Stories for Darwin* (2014), vii-xii, 1-8, 20-23; Somsen, "A History of Universalism" (2008), 361-379

II: Natural philosophy, useful knowledge

Thurs, Jan 16: *Plants, empires, and exchange*

- *Primary*: Lawson, *A New Voyage to Carolina* (1860 [1709]), 93-99, 353-361; Boudreau et al., "Why the World Will Never Be Tobacco-Free: Reframing "Tobacco Control" Into a Traditional Tobacco Movement" (2016), 1188-1195.
- *Secondary*: Schiebinger, *Plants and Empire* (2004), 73-104.

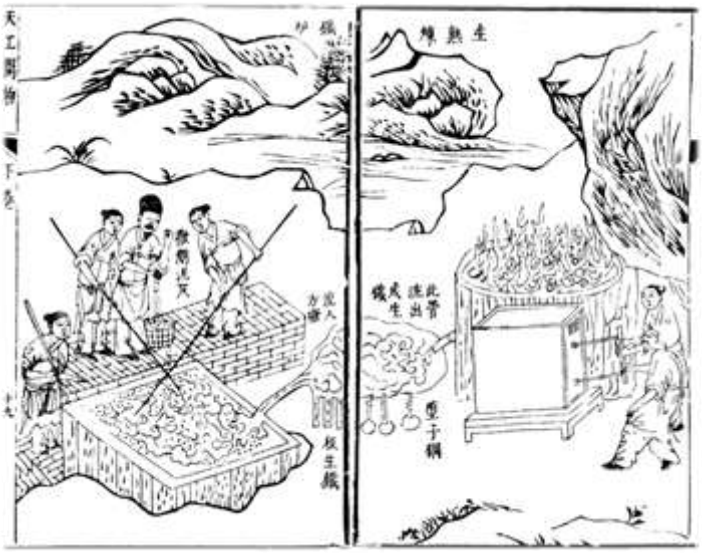
Tues, Jan 21: Astronomers, astrologers, artisans, and alchemists

- *Primary*: Al-Birjandi, *Sharh al-Tadhkira* (Commentary on the *Tadhkira* of al-Tusi) (early 16th c.), in *Arabic Astronomy in Sanskrit*, ed. Pingree and Kusuba (2002), 15, 17, 19, 21 (these are the pages of the English translation; in addition, see what you can figure out about the Arabic and Sanskrit versions, with the help of the editors' annotations)
- *Secondary*: Principe, "The Connected World" (2011), 21-38; Schäfer, *The Crafting of the 10,000 Things* (2011), 1-19.

Thurs, Jan 23: Interpreting primary sources from the history of science

- *Primary*: Song Yingxing, *Tiangong Kaiwu* (*The Works of Heaven and the Inception of Things*) (1966 [1637]), "Metals," 235-259.

Prof. Nicole Barnes will lead a primary source interpretation exercise.



Smelting iron in late Ming China (early 17th century)

Source: Song Yingxing, Tiangong Kaiwu *(1637),* http://donwagner.dk/MingFe/MingFeFigs/MingFeFig10.jpg.

Syllabus subject to change at instructor's discretion. Please check Sakai for up-to-date version.

Tues, Jan 28: Enlightenment natural philosophy

- *Primary*: Émilie du Châtelet, *Foundations of Physics* (2009 [1740]), Preface & Ch. IV (116-124, 147-155).

For this session, we will join up with* Philosophy 242, Problems in Philosophy of Science *for a joint meeting.

Thurs, Jan 30: Intellectuals debate progress

- *Primary:* Condorcet, *Progress of the Human Mind* (1802 [1795]), 209-231; Malthus, *Principle of Population* (2018 [1798]), Ch. I (34-39).
- *Secondary:* Trouillot, *Silencing the Past* (1995), 70-95.

The continents offer gifts to seventeenth-century Amsterdam

Source: Jacob van Meurs, frontispiece to Historical Description of Amsterdam (1663), https://archive.org/details/historischebesch00dapp.

Tues, Feb 4: Coal, energy, and empire

Thurs, Feb 6: Darwin and Darwinism get around

- *Primary*: Darwin, *The Origin of Species*, 6th ed. (1872), "Historical Sketch on the Progress of Opinion on the Origin of Species" (Preface) + Introduction + Chapters III-IV.
- Secondary: Elshakry, *Reading Darwin in Arabic* (2013), 1-23.

Tues, Feb 11: Universities, libraries, labs, and books

- Blair, *Too Much to Know* (2010), 1-9.

Thurs, Feb 13: ***No class meeting*** *-- work on midterm*

Take-home midterm due by 5:00pm on Friday, Feb 14

III: Scientific futures

Tues, Feb 18: Chemicals from coal tar

- *Primary*: Schweitzer, "The Influence of Sir William Henry Perkin's Discovery Upon Our Science" (1906)
- *Secondary*: Lee, "The Microbial Production of Expertise in Meiji Japan" (2018), 171-190.

Thurs, Feb 20: Alternative sciences and alternative modern worlds circa 1900

- *Primary*: Hossain, "Sultana's Dream" (1905); Gajjar, The Industrial Conference: Welcome Address," (1907), 1-21; Gandhi, *Hind Swaraj or Indian Home Rule* (1909), 29-34, 68-83.

All are invited to attend a 12:00pm presentation on West Campus by Dr. On Barak, senior lecturer at Tel Aviv University, speaking about his new book* Empowering Empire: How Coal Made the Middle East and Sparked Global Carbonization*. (Lunch provided.) Details to come.

Statue of Rokeya Sakhawat Hossain, Begum Rokeya Memorial Center, Pairaband, Bangladesh

Source: NahidSultan, https://commons.wikimedia.org/wiki/File:BirthPlace_of_BegumRokeya_(11).jpg

Tues, Feb 25: Knowing bodies

- *Primary*: Bernard, *An Introduction to the Study of Experimental Medicine* (1949 [1865]), 15, 87-105.
- *Secondary*: Mavhunga, *The Mobile Workshop* (2018), 29-48 (plus Glossary, as needed)

Thurs, Feb 27: Eugenics

- *Primary:* Brown, *Eugenical Sterilization in North Carolina* (1935); Reich, "How Genetics Is Changing Our Understanding of 'Race'" (2018); Kahn et al., "How Not to Talk about Race and Genetics" (2018)
- *Secondary:* Johanna Schoen, "Reassessing Eugenic Sterilization: The Case of North Carolina," (2010), 141-160

Tues, Mar 3: Trains, clocks, relativity, radioactivity

- *Primary*: Einstein, "On the Electrodynamics of Moving Bodies" (1905), 123-139; Meitner and Frisch, "Disintegration of Uranium by Neutrons: A New Type of Nuclear Reaction (1939), 239-240.

Marie Curie, Albert Einstein, and other attendees at the 5th Solvay Conference on Physics ("Electrons and Photos"), 1927

Source: Benjamin Couprie, Institut International de Physique de Solvay, http://doi.org/10.3932/ethz-a-000046848.

Thurs, Mar 5: ***No class meeting*** *-- work on Historian's Memo assignment.*

S p r i n g B r e a k

Source: jgs, ASCII Art Archive, https://www.asciiart.eu/nature/beach.

Syllabus subject to change at instructor's discretion. Please check Sakai for up-to-date version.

IV. Taking it online

Lectures: Lectures will be recorded and posted on the Sakai syllabus page by the beginning of each week.

Discussions of readings: We will meet via Zoom on *Tuesdays* during our normal class time of *10:05-11:20am, Eastern Daylight Time*. *These meetings are optional (and encouraged!).* We will focus on discussion of the week's readings. We will record these meetings, in case students who are unable to attend would like to check them out. (All recordings are for our use only and will be deleted after the end of the term, for the sake of privacy.) Zoom links will be posted on the Sakai syllabus page.

Sakai Forums: Each week, we will ask you to post a response to a prompt asking you to *notice* something happening around us and *connect* it to one of our readings for the week. We expect many of these will involve covid-related happenings, but non-covid responses are entirely appropriate, too. You are warmly invited (but not required) to read and respond to each other's posts. You may post more than one entry in a forum, if you wish.

Lunchtime chats: We will meet via Zoom on *Thursdays* from noon-1:30pm(ish) for open-ended conversations over lunch (or breakfast, or dinner, or midnight snack, depending on your time zone). *These meetings are optional.* The idea is to create a space for all who are interested to come together and, with the subject matter of our readings and lectures as a jumping-off point, share stories and wrap our heads around what we see going on around us at present. Zoom links will be posted on the Sakai syllabus page.

Grading, final assessments, Science & Covid Journal: Per Duke policy as of March 18, "Spring 2020 courses will transition to a default S/U grading option. If students choose to receive a letter grade for any class, they can do so by submitting a form to the registrar's office no later than April 22 at 5:00 pm EST. Courses taken for S/U grades during Spring 2020 will count towards curricular, major, continuation, and graduation requirements. Grades of S and U are not factored into a student's grade point average."

In light of this decision, there will be no final exam for our course. All remain warmly invited to undertake Final Projects, as described on pp. 3-4 of this syllabus. (If you wish to receive a letter grade for the course, the Final Project is required.) In addition to the options described on pp. 3-4, you may be interested in the following Final Project option:

Science, the Modern World, & Covid-19 Journal: This is quite a time to be a historian. We encourage those who are interested to assemble a journal made up of their own Sakai forum posts, responses to each other's posts, links/screenshots/photographs/other records of noteworthy stuff happening around us, and additional journal entries discussing things we notice happening or not-happening around us along with connections to sources, arguments, and themes from our class.

Those who wish to submit this as a graded Final Project should meet the following requirements: a) at least eight entries of at least 1 page, double-spaced (these may include your own Sakai Forum posts, including b) at least two are responses to other class participants' Sakai forum posts (please include both the original post and your response with your Journal submission).

Online Week 1 (Mar 22-28): Big science, macromolecules, and information explosions

- *Primary*: Scott, "My Work with Chemical Abstracts" (1938), 271-275; Bush, "As We May Think" (1945); Medina, "The Politics of Networking a Nation" (2016)

Sakai Forum: Governments

Discussion of readings: Tues, March 24, 10:05-11:20am, Eastern Daylight Time (EDT)

Lunchtime chat: Thurs, March 26, 12pm-1:30pm(ish), EDT

- *Optional reading*: Jones, "History in a Crisis — Lessons for Covid-19" (2020)

***** Historian's Memo due by 5pm, Friday Mar 27, via Sakai *****
***** If an extension would be helpful, please let us know! *****

Online Week 2 (Mar 29-Apr 4): Economics, development, and data

- *Primary*: Rosenstein-Rodan, "The International Development of Economically Backward Areas" (1944); Ostrovitianov, "The Result of the Discussion of Statistics" (1954), 322-331.
- *Secondary*: Murphy, The Economization of Life (2017), 47-54, 95-104.

Forum topic: Economies

Discussion of readings: Tues, March 31, 10:05-11:20am, Eastern Daylight Time (EDT)

Lunchtime chat: Thurs, April 2, 12pm-1:30pm(ish), EDT

Online Week 3 (Apr 5-11): Global environment, outer space

- *Primary*: Carson, *Silent Spring* (1962), Ch. 1-2, 7; Hawking, "Questioning the Universe (TED Talk)" (2008); Kimmerer, *Braiding Sweetgrass* (2013), 3-10, 205-215.
- *Secondary*: Edwards, *A Vast Machine* (2010), 1-8.

Forum topic: Environments

Discussion of readings: Tues, Apr 7, 10:05-11:20am, Eastern Daylight Time (EDT)

Lunchtime chat: Thurs, Apr 9, 12pm-1:30pm(ish), EDT

- *Optional reading*: Anand "The Banality of Infrastructure" (2017); Nixon, "Slow Violence and Environmental Storytelling" (2011)

******If you are planning to do a Final Project other than the Journal described above, be sure to talk over your plans with Evan and/or Shahrazad by Friday April 10******

The "Keeling Curve" as of October 22, 2019

Source: Scripps Institution, https://scripps.ucsd.edu/programs/keelingcurve/.

Online Week 4 (Apr 12-18): Ethics, facts, and alternatives

- *Primary*: Popper, *The Logic of Scientific Discovery* (1935), 10-20; Rhine, *Extra-Sensory Perception* (1934), 35-46, 109-116, 165-169; Brown & Williamson, "Smoking and Health Proposal" (1969)
- *Secondary*: Shapin, "Is There a Crisis of Truth?" (2019).
- *Optional:* Stevens, *Biotechnology and Society* (2016), 207-219; Franklin, "Ethical research — the long and bumpy road from shirked to shared" (2019).

Forum topic: Facts

Discussion of readings: Tues, Apr 14, 10:05-11:20am, Eastern Daylight Time (EDT)

Lunchtime chat: Thurs, Apr 16, 12pm-1:30pm(ish), EDT

Online Week 5 (Apr 19-22): What is science (revisited)?

- *Primary*: *Jurassic Park* (film) (1993)
- *Secondary*: Daston, "The History of Science and the History of Knowledge" (2017)

Wrap-up discussion: Tues, Apr 21, 10:05-11:20am, Eastern Daylight Time (EDT)

****** Final Projects (for those who chose to submit them) due Weds Apr 29, 5pm ******

Top & bottom left: Scenes from demonstrations by Native Hawai'ians opposing construction of the Thirty Meter Telescope observatory on Mauna Kea, Hawaii, 2014

Bottom Right: Scenes from the 2017 "March for Science," Pittsburgh, PA

Sources: https://www.flickr.com/photos/occupyhilo/with/15325707619/; Mark Dixon, https://www.flickr.com/photos/9602574@N02/34163353576/.