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.

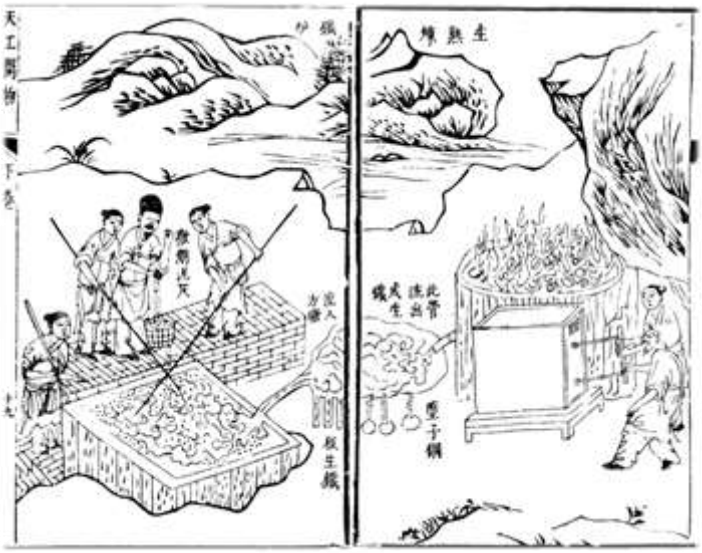
Tues, Jan 21: Astronomers, astrologers, artisans, and alchemists

- *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.

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, and relativity

- *Primary*: Einstein, "On the Electrodynamics of Moving Bodies" (1905), 123-139

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.*

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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. Big science, people's science

Tues, Mar 17: Big bombs, big science, big data

- *Primary*: Scott, "My Work with Chemical Abstracts" (1938), 271-275; Bush, "As We May Think" (1945)

Thurs, Mar 19: Molecules, information, and scientific credit

- *Secondary*: Creager and Morgan, "After the Double Helix" (2008), 239-272

***** Historian's Memo due by 5pm, Friday Mar 20, via Sakai *****

Tues, Mar 24: Global environment

- *Primary*: Carson, *Silent Spring* (1962), Ch. 1-3; IPCC, "Global Warming of 1.5°C: Summary for Policymakers" (2018)
- *Secondary*: Edwards, *A Vast Machine* (2010), 251-285

Thurs, Mar 26: Getting our hands on some primary sources
*****This class session will meet in the Rubenstein Rare Book & Manuscript Library*****

Tues, Mar 31: Economics, evidence, and statistics

- *Primary*: Ostrovitianov, "The Result of the Discussion of Statistics" (1954), 322-331; Anderson, "The End of Theory: The Data Deluge Makes the Scientific Method Obsolete" (2008).

Thurs, Apr 2: Origin stories

- *Primary*: Hawking, "Questioning the Universe (TED Talk)" (2008); Kimmerer, *Braiding Sweetgrass* (2013), 3-10, 205-215; LaPier, "Why Native Americans do not separate religion from science" (2017); "The Science Behind the Thirty Meter Telescope" (2019); Alegado, "Opponents of the Thirty Meter Telescope fight the process, not science" (2019)

******For students choosing to do Final Projects, project proposals (1-2pp) are due to the instructors, via email, by 5pm on Friday April 3******

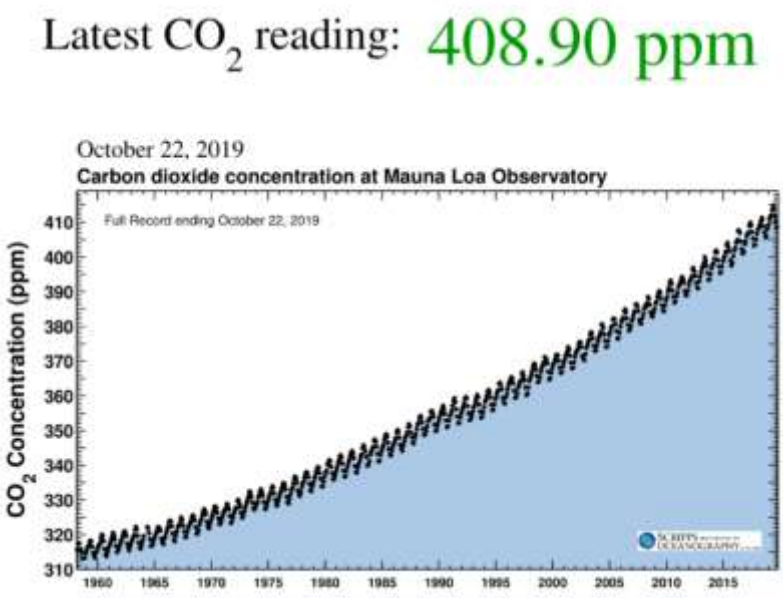
V. Scientific virtues

Tues, Apr 7: Methods, money, politics

- *Primary*: Popper, *The Logic of Scientific Discovery* (1935), 10-20; Rhine, *Extra-Sensory Perception* (1934), 35-46, 109-116, 161-169; Brown & Williamson, "Smoking and Health Proposal" (1969)
- *Secondary*: Shapin, "Is There a Crisis of Truth?" (2019)

Thurs, Apr 9: Identity

- *Secondary*: Daston and Galison, *Objectivity* (2007), 35-42; Subramaniam, *Ghost Stories for Darwin* (2014), 180-199.



The "Keeling Curve" as of October 22, 2019

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

Tues, Apr 14: Ethics

- *Primary*: UNESCO Statements on Race (1950, 1951), 30-43; March for Science Mission & Values (2017); He Jiankui et al., "Draft Ethical Principles for Therapeutic Assisted Reproductive Technologies" [retracted] (2018)
- *Secondary*: Stevens, *Biotechnology and Society* (2016), 207-219.

Thurs, Apr 16: Wrapping up

Tues, Apr 21: *What is science (revisited)?*

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

Final Exam on Weds Apr 29, 2-5pm *(for students choosing the final exam)*

Final Papers due Weds Apr 29, 5pm *(for students choosing the final paper + presentation)*

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/.