

IS212 Early Modern Science

Instructors: Ian Lawson; Aaron Tugendahft; Michael Weinman

Guests: Faysal Bibi; Lorraine Daston; Laura Sumrall; Rodolfo Garau

Course Times: Tuesdays and Thursdays, either 9:00–10:30 or 10:45–12:15

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Office Hours: Set by individual instructors

Description

What is science? When and how did it come to be considered the royal road to truth? This course examines the meaning and history of modern science by looking closely at its beginnings and evolution in the early modern period. Retracing the developments that defined the principles, methods and frameworks of natural science as it exists today, we shall explore its philosophical foundations, practical procedures and their political and cultural ramifications.

Our efforts will be divided into two units. The first unit examines the emergence of the so called “scientific method.” Here, we have two foci: first, reading Bacon and Descartes, we discuss the intellectual debate between the positions that solidified as “rationalism” and “empiricism.” Next, we contextualize this debate within the longer intellectual horizon from which it arose, through a discussion of the reception of classical, especially Aristotelian natural philosophy in Islamic thought and an examination of the material culture of emergent scientific method, with a focus on scientific instruments and the experimental method. In the second unit, we examine the emergence of modern disciplinary scientific knowledge, centrally focusing on Galileo. Here, we concentrate on the new understanding of space, matter and motion deriving from the cosmologies and mechanical theories of this era, the basis of modern physics. After tracing this development from its sources in Copernicus and Kepler, through Galileo and to Newton’s epochal triumph in accounting for universal gravitation, this unit closes with a reflection on the (less rapid) development of “exact” sciences dedicated to the human animal, attending to the body (anatomy) and the soul or mind (psychology or psychiatry).

Throughout the course, we will also attend to theoretical debates regarding the relationship between philosophy, science, and their histories: the connection between experience, experiment, and knowledge; the unity or plurality of the sciences themselves; and the historical development of such seemingly straightforward terms and practices as ‘observation’, ‘description’, and ‘fact.’ Included in the course are special sessions and visits to exhibitions and collections in Berlin, which will help us ponder the preconditions of scientific inquiry, and the extent to which scientific practices are necessarily embedded in a particular political and cultural horizon and/or physical reality.

Readings

Bacon, F (Jardine, ed.). 2000. *The New Organon*. Cambridge University Press.

Descartes, R (Cress, tr.). 1999. *Discourse on the Method*. Hackett Publishing.

Galileo (Drake, tr.). 2001. *Dialogue Concerning Two Chief World Systems*. Modern Library.

Course Reader (printed edition)

Library and Book Purchase Policies

Students are expected to have at their disposal a hard copy of all required texts. A limited number of the required books are available on loan from the library. Students on financial aid have a priority in requesting library books. All other readings will be in the course reader.

Requirements

Seminar Attendance and Preparation

Regular attendance and class preparation are essential to the success of this course. Preparing for class means reading thoughtfully and engaging with the course materials, for instance, by taking notes while reading and thinking through the argument in a particular reading assignment, or by looking over in advance the description of an exhibition we will visit. To aid your preparatory effort, this syllabus includes short blurbs and study questions for the course readings. Do read and use them! Please note: coming late or leaving in the middle of the sessions will count as absence. Absences beyond two reduce your course grade one step.

Writing Assignments (see also “Essay Deadlines” and “Grade Breakdown”)

You will write one substantial final essay (ca. 2500 words in length) at the end of semester. In order to help you “build up to” this substantial reflection on the course material, you will be required to keep a “learning journal” throughout the semester. This document will be your space to record your immediate reactions to the reading assignments and the seminar conversations. It should consist of 1-2 dated entries (up to 300 words) per week. Included within this journal will be a series of “field reports.” Each of these will call for giving an account of how you did something: for instance, how you came to understand an argument in a guest lecture; how you saw something in a practicum; what you observed in a practical session or exhibition visit. The journal will be collected three times throughout the semester, near the end of each of the three course units. You will also be expected to meet with your seminar leader in Week 13 or 14 to discuss your final essay.

Policy on Late Submission of Papers

Please note the following policy from the Student Handbook on the submission of essays: essays that are up to 24 hours late will be downgraded one full grade (from B+ to C+, for example). Instructors are not obliged to accept essays that are more than 24 hours late. Where an instructor agrees to accept a late essay, it must be submitted within four weeks of the deadline and cannot receive a grade of higher than C. Thereafter, the student will receive a failing grade for the assignment.

Grade Breakdown

Learning journal (3 x 15%): 45%; Final essay (ca. 2500 words): 25%; Seminar grade: 30%.

Essay Deadlines, at a glance

Journal submission deadlines: 1) Friday, 1 March; 2) Friday, 5 April; 3) Friday, 3 May
Final Essay deadline: Thursday, 16 May

Course Overview, with study questions

1. Knowledge: When and how did the “scientific method” emerge?

Our goal in this course is to try to tell ourselves a consistent story about what has been called “early modern science” or more provocatively and problematically “the scientific revolution.”

We begin by exploring: (1) the kind of scientific knowledge that existed before the rise of early modern science; (2) the epistemological and metaphysical commitments that came along with this old Aristotelian model; (3) the ways in which the concept of “science” changed with the rise of early modern thought; (4) the ways in which early modern thinkers such as Bacon and Descartes believed it was possible to arrive at “scientific facts” or truth; (5) the epistemological and metaphysical commitments on which their approaches rested. We will study these questions by comparing and contrasting the old Aristotelian science, as it was received, preserved, and extended in the Islamic tradition, to the two new scientific models as put forth by Bacon and Descartes.

Study Questions:

- What was the essence of the old Aristotelian model of scientific knowledge? What counted as “scientific knowledge” according to this model and what were its limits?
- What are the precise elements of difference between this old scientific model compared to the new models found in Bacon and Descartes? What was it about these new ways of thinking that made the tremendous advances in scientific knowledge possible in the second half of the 16th and first half of the 17th century?
- How do Descartes and Bacon importantly agree? Where do they meaningfully differ?
- What relationship does Descartes posit between humans and nature in the *Discourse*? How does it show itself in his more “technical” discussion of how science ought to proceed?
- In what ways does the project of (self-)knowledge described by van Helmont accord with Bacon’s project of a new science? And which ways do they differ?
- How are observations made? Are they technologically, textually, socially, or otherwise mediated? How do authors bring their observations in line with theoretical commitments?

2. Human/Nature: The emergence of disciplinary scientific knowledge

The second unit begins with a discussion about the geocentric worldview and its usefulness independently from the astronomic developments. Our primary source is Galileo’s defense of heliocentrism and terrestrial motion in the cosmological *Dialogue Concerning the Two Chief World Systems* (1632). We will discuss his attitude towards the Ptolemaic-Aristotelian worldview and assess three aspects of the Copernican debate: the mathematical, the physical (or natural philosophical) and the theological-scriptural. One meeting will be dedicated to Galileo’s famous Inquisition trial and condemnation, in particular to the early-modern mechanisms of censure and control as well as to the early-modern conflict between religious orthodoxy and natural inquiry. Finally, we turn to the “human context” of the scientific efforts investigated throughout term. Beginning with Harvey’s *De Motu Cordis*, we here find complicated mixtures of observation and theory, calling into question a habit of opposing textual and material ways of engaging with the natural world, prompting a reconsideration of our basic intuition concerning what we learn directly (from the senses, from experience) and what we learn through textual and other forms cultural mediation. The final sessions, where we read Hobbes’s philosophy of man in the context of exploration, colonization and imperial domination that raised fundamental questions about natural diversity and natural sameness alongside question of (in)equality and the political consequences of the opinions proffered in natural philosophy. This conclusion allows us to reflect on the course as a whole, asking how it is possible to communicate scientific knowledge and the material conditions—individual, and institutional, political and economic—that are necessary to support it.

Study Questions:

- What is the historical context of Galileo’s Inquisition trial and condemnation?
- How did cosmology and practical knowledge relate in the early modern period?
- What were the main challenges of the Copernican turn in planetary theory? What was Galileo’s attitude toward tradition and natural inquiry?

- How do the observational methods espoused by Harvey, Hooke and Leibniz differ from what came before them? What scientific practices are actually at work in life science texts we've read?
- What facilitates scientific communication and what seems to obstruct the easy exchange of ideas and information? What audience do our authors presume? How do you know?
- Do you see evidence of individual and institutional supporters of the work we are reading about? How does this matter?
- Is there truth in science?

Course Schedule

Week of	Tuesday	Thursday
Unit 1. Knowledge: When and how did the "scientific method" emerge?		
28 Jan	Emergent scientific method: Empiricism? Bacon, <i>New Organon</i> , Plan/Preface (pp. 2-31)	MW Lecture on Induction: Ancient and modern Aristotle, <i>Post. An.</i> , I.2, 18, 31; II.5, 19 Bacon, <i>New Organon</i> , Plan, I.1-68 (pp. 33-56)
4 Feb	Emergent scientific method: Empiricism? Bacon, <i>New Organon</i> , I.69-end (pp. 56-101)	Emergent scientific method: Empiricism? Bacon, <i>New Organon</i> , II.1-21 (pp. 102-36)
11 Feb	Emergent scientific method: Rationalism? Descartes, <i>Discourse on Method</i> , Parts 1-2	Raine Daston Lecture Observation/Experiment Special time: 12:20 – 13:50 Daston, <i>Hist. Scient. Observ.</i> (1-13, 81-113)
18 Feb	Emergent scientific method: Rationalism? Descartes, <i>Discourse on Method</i> , Parts 3-4	Emergent scientific method: Rationalism? Descartes, <i>Discourse on Method</i> , Parts 5-6
25 Feb	Emergent scientific method: Is causation coherent? Al-Ghazali, "Incoherence of the Philosophers"	Emergent scientific method: Science and faith? Averroes, "Incoherence of the Incoherence"
4 Mar	Emergent scientific method: Experimentation Boyle, <i>Considerations of Experimental Philosophy</i>	Natural philosophy and divine revelation Averroes, <i>Decisive Treatise</i>
11 Mar	Laura Sumrall Lecture on Natural Magic van Helmont, <i>Oriatrike, Or Physick Refined</i>	Natural philosophy and natural history Hooke, <i>Micrographia</i>
Unit 2. Human/Nature: The emergence of modern cosmology and life sciences		
18 Mar	RG Lecture on Aristotle/Ptolemaic System Aristotle, <i>Physics Book 4</i>	Galileo: Celestial and earthy mechanics Galileo, <i>Two World Systems</i> (123-53)
25 Mar	Galileo: Celestial and earthy mechanics Galileo, <i>Two World Systems</i> (188-201)	Galileo: Celestial and earthy mechanics Galileo, <i>Two World Systems</i> (222-41)
1 Apr	Science on Trial Letters: Bellarmine's to Foscarini; Galileo's to Christina	Galilean mechanics: Pendulum experiment Galileo, <i>Two World Systems</i> (263-8, 316-19)
8 Apr	Universal Gravitation Hooke – Newton Correspondence	Leibniz-Clarke: Chance; Change; Cause Leibniz-Clarke Correspondence
15 Apr	No Class; Spring Break	
22 Apr	Faysal Bibi Lecture on Paleontology Leibniz, <i>Protogea</i>	Emergence of modern life sciences: Anatomy Harvey, <i>Circulation of Blood</i>
29 Apr	The institutionalization of science: Early critiques Cavendish, <i>Blazing World</i>	RG Lecture on Early Modern Anthropology Hobbes, <i>Leviathan</i> Chs. I-III La Casas/Sepulveda Controversy
6 May	Emergence of modern life sciences: Psychology Hobbes, <i>Leviathan</i> Introduction Chs. IV-VI	Science and Its Limits Shelley, <i>Frankenstein</i> , Volume I
13 May	Final Essay due Thursday 16 May	

Pink=Joint sessions; Green = Course text; Turquoise = Course Reader; Grey = Recommended, on Reserve in Library