

## Early Modern Science (Spring 2017)

Instructors: Ewa Atanassow, Andreas Blank, Rodolfo Garau, Ian Lawson

Guests: Lorraine Daston; Richard Boyd, Matteo Valleriani, Jens Reich

Course Times: Tuesdays 9-10:30 and Thursdays 11:00-12:30

### Description

What is science? When and how did it come to be considered the royal road to truth? This course inquires into 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 three units. Focusing on Bacon and Descartes, in the first part of the course we examine the emergence of the so called “scientific method” from the philosophical debates between rationalism and empiricism, and the larger context in which they played out. In the second unit, whose central figure is Galileo, 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). In part three, we consider the development of the life sciences: human and animal biology, and what has come to be called psychology.

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 historical horizon 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.

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. More than two absences will result in a reduction of one full grade for participation.**

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

You will write one substantial final essay (of up to 3000 words) 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 an exhibition. The first of these, due at the end of week 1, will be ungraded, so that you can practice the model before you are assessed in it. 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 (up to 3000 words): 25%; Seminar grade: 30%.

## Essay Deadlines, at a glance

Ungraded submission of first “field report”: **Saturday, 4 February**

Journal submission deadlines: 1) **Friday, 3 March**; 2) **Friday, 7 April**; 3) **Friday, 5 May**

Final Essay deadline: **Thursday, 18 May**

## Course Overview, with study questions

### 1. What is “Early Modern” science? What preceded it? How did the new 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 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 16<sup>th</sup> and first half of the 17<sup>th</sup> century?
- \* How do Descartes and Bacon importantly agree? Where do they meaningfully differ?
- \* What is the relationship between humans and nature that Descartes posits in the *Discourse on Method*? How does it show itself in his more “technical” discussion of how science ought to proceed?

### 2. Reason and experience in the “new science,” 1: Cosmology and mechanics

The second unit begins with a discussion about the geocentric worldview and its usefulness independently from the astronomic developments. The relation between cosmology and navigation in the late Middle Ages and early modern period are the focus of the first four meetings. Particular attention will be devoted to the relation between practical and theoretical knowledge. The unit’s second part abstracts from the useful aspects of science to explore the theoretical and cultural paths along which science developed during the same period but influenced by different constraints. In this part we will address the Copernican turn in planetary theory (after 1543), focusing on 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.

**Study Questions:**

- \* How do Bacon's *New Atlantis* and *New Organon* differ? How are they similar?
- \* 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?

**3. Reason and experience in the "new science," 2: Biology and psychology**

In our final unit, we turn to the "human context" of the scientific efforts investigated throughout term. Beginning with a comparison between the (medieval, Aristotelian) approach to life sciences and that in Harvey's *De Motu Cordis*, the readings in this unit display complicated mixtures of observation and theory. In so doing, they call into question a habit of thinking we might have concerning some sort of opposition between 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 will afford an opportunity to reflect back on the course as a whole, asking how it is possible to communicate scientific knowledge and the material conditions—both individual and institutional—that are necessary to support it.

**Study Questions:**

- \* How do the scientific methods espoused by Vesalius, Harvey, Topsell, Hooke and Burton differ from what came before them?
- \* What scientific *practices* are actually at work in these life science texts? How are observations made? Are they technologically, textually, socially, or otherwise mediated? How do authors bring their observations in line with (existing) theoretical commitments?
- \* 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 the individual and institutional supporters of the work we are reading about? How does this matter?
- \* Is there truth in science?

SCHEDULE

Week Beginning	Tuesday 9:00 – 10:30	Thursday 11:00 – 12:30	Assignments
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Unit 1. What is (early modern) science? When and how did the scientific method emerge?

30 Jan	Plenary session: Introductory, Genesis 1-3	Guest lecture: 10:45 -12:15 Lorraine Daston Bacon, <i>New Organon</i> (2-31; 222-238)	First Report due Saturday February 4
6 Feb	Aristotle, <i>Physics</i>	Condemnation of Aristotle <u>or</u> Bacon, <i>New Organon</i> (2-31; 222-238)	
13 Feb	Bacon NO, Book I, I- LXXXIII (33-68)	Bacon NO, Book I, LXXXIV- end (68-101)	
20 Feb	Descartes, <i>Discourse</i> , parts 1-2	Descartes, <i>Discourse</i> , parts 3-4	
27 Feb	Descartes, <i>Discourse</i> , parts 5-6	Guest lecture: Fri at 17:00 Richard Boyd, Early modern science and behavioral economics FRIDAY, March 3 at 17:00	First Journal Friday March 3

Unit 2. Cosmology and Mechanics

6 Mar	Bacon, <i>New Atlantis</i>	Science on Trial: Bellarmine vs Galileo	
13 Mar	Plenary event: Matteo Valleriani Cosmology and Exploration	Galileo, <i>Dialogue on the Two Chief World Systems</i> , Day Two (123-153)	
27 Mar	Galileo, <i>Dialogue</i> , (154- 191)	Galileo, <i>Dialogue</i> , (192-231)	
27 Mar	Galileo, <i>Dialogue</i> , (232-263)	Practicum: Pendulum Experiment	

3 Apr	Galileo, <i>Dialogue</i> , (269-319)	<b>Plenary event:</b> <b>Matteo Valleriani</b> Alchemy and Cosmology	Second Journal Friday April 7
10 Apr	SPRING BREAK		
Unit 3. Biology and Human Sciences			
17 Apr	Vesalius, <i>On the Human Brain</i> , chs. i-v	Harvey, <i>Anatomical Exercises</i> , chs. ii-viii	
24 Apr	Topsell, <i>Bestiary</i>	Hooke, <i>Micrographia</i>	
1 May	Burton, <i>Anatomy of Melancholy</i> , 1:1	<b>Museum Visit</b>	Third Journal Friday, May 5
8 May	<b>Plenary : May 9, 19:00</b> Jens Reich on fact, experiment, theory and truth in science	Concluding session: wrapping up	
15 May	COMPLETION WEEK: Final essay due <b>Thursday May 18</b>		