

## IS 212. Early Modern Science - Spring '22

**Instructors:** Ewa Atanassow (coordinator), Maria Avxentevskaya, Anastassia Kostrioukova, Katalin Makkai, Ross Shields

**Guest Lecturers:** Aaron Tugendhaft (Ramaz), Lorraine Daston (MPWIG), Menakshi Menon (MPWIG)

**Course Times:** Tues/Thurs 10:45–12:15 or Mon/Thu 15:45-17:15

**Office Hours:** Set by individual instructors

### Description

What is science? How does it inform our relationship to the world around us? What role does it play in living a good human life? 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. We will attend to theoretical debates regarding the relationship between science, religion and politics; the connection between experience, experiment, and knowledge; the unity or plurality of the sciences themselves; and the historical development of such terms as “observation,” “description,” and “fact.”

Our efforts will be divided into four units: First, we will encounter the basic principles of Aristotelian science and study how their reception in medieval Arabic thought generated debates about the relationship between philosophy and divine revelation. Next, through Bacon and Descartes, we will consider the early modern rejection of Aristotle and discuss the intellectual debate between the positions that solidified as “rationalism” and “empiricism.” The third unit focuses on how Galileo developed a new understanding of space, matter, and motion, and why this generated tensions between him and the Catholic Church. Finally, in the closing unit, we consider how the phenomenon of life challenges the early modern mechanical philosophy and its view of the natural world, focusing on practical medicine, Goethe’s botanical work, and the 19<sup>th</sup> century debate about the meaning and evolution of species.

### Readings

Bacon, Francis. 2000. *The New Organon*. Edited by Lisa Jardine and Michael Silverthorne. Cambridge University Press. (ISBN: 978-0521564830)

Descartes, René. 1998. *Discourse on Method*. Translated by Donald A. Cress. Hackett Publishing. (ISBN: 978-0872204225)

Goethe, Johann Wolfgang von. 2009. *The Metamorphosis of Plants*. Introduction and photography by Gordon L. Miller. MIT Press. (ISBN: 978-0262013093)

Course Reader (printed edition)

### Library and Book Purchase Policies

**Students must have a hard copy of all required texts.** A limited number of the required books are available from the library; students on financial aid have priority. Other readings will be in the reader.

## Requirements

### Seminar Attendance and Preparation

Regular attendance and class participation are essential to the success of this course. You must come prepared by having read the assigned materials carefully. To aid your preparatory effort, this syllabus includes numerous study questions. Use them!

Please note: Coming late or leaving in the middle of the sessions will count as half an absence. Absences beyond two will reduce your seminar grade for the second rotation.

### Writing Assignments

You will be required to keep a **Study Log** throughout the semester comprising at least one dated entry of ca. 300 words per week. This will be your space to keep a continuous record of your responses to readings and seminar conversations, and try out ideas in preparation for the final essay. Here you may reflect on a passage of text, connect course material to contemporary events, or ponder how a newly encountered idea may force you to reconsider your previous opinions. While less formal and exploratory, the log entries must demonstrate serious engagement with the material and be composed with rigor and precision. A first ungraded entry must be submitted to your instructor by the end of the first week of each rotation. The Study Log will be collected and graded three times over the semester: **on March 12, April 8 and May 14**.

In conjunction with the study of Goethe's *The Metamorphosis of Plants*, you will be required to complete a **plant observation worksheet** and submit it as part of the final installment of the study log. Possible outings to local parks in order to observe plants together will be organized if conditions allow.

You will write one substantial **final essay** (ca. 2500 words in length) at the end of semester, due on May 20. The paper will be on a topic of your choice made in consultation with your seminar leader. Successful essays often develop an idea first articulated in the study journal. You must submit a **one-page proposal** to your seminar leader by May 7.

### Academic Integrity

Bard College Berlin maintains the staunchest regard for academic integrity and expects good academic practice from students in their studies. As such, instances in which students fail to meet the expected standards of academic integrity will be dealt with under the Code of Student Conduct, Section 14.3 (Academic Misconduct) in the Student Handbook.

### Policy on Late Submission of Papers

Please note the following policy from the Student Handbook on the submission of essays: written work that is up to 24 hours late can 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. Thereafter, the student will receive a failing grade for the assignment.

### Grade Breakdown

Seminar participation: (2x15%) 30%

Study Log, including plant observation worksheet and final essay proposal (3 x 15%): 45%

Final essay (ca. 2500 words): 25%

### Submission Deadlines, at a glance

- Ungraded entries: Saturday, February 5; and Saturday, March 19 (to your seminar leader)
- Graded logs: **1)** Saturday, 12 March; **2)** Friday, 8 April; **3)** Saturday, 14 May (on google classroom)
- Final essay proposal: Saturday, May 7 (to your seminar leader)
- Final Essay deadline: Friday, 20 May (on google classroom)

### Course Schedule

**Note:** While seminars will be held during two different time slots (Mo/Th 15:45- 17:15 and Tu/Th 10:45-12:15), students are expected to attend all **joint sessions in bold**. Please mark your calendars accordingly!

Week of	First session (Mo 15:45-17:15//Tue 10:45-12:15)	Second session (Th 15:45-17:15 //Th 10:45-12:15)
Jan 31	<b>Joint session: Tue, Feb 1 @ 19:30 on zoom</b> *Genesis 1-3	*Aristotle, <i>Posterior Analytics</i>
Feb 7	*Al-Ghazali, <i>Incoherence of Philosophers</i> , Introductions; Discussions 10 & 17 [*Ragep, "Islamic Culture and the Natural Sciences"]	*Ibn Rushd, <i>Incoherence of the Incoherence</i>
Feb 14	*Ibn Rushd, <i>Decisive Treatise</i>	<b>Joint Session: Aaron Tugendhaft on Maimonides Th, Feb 17 @ 19:30-21:00 on zoom</b> *Rabbis of Provence, <i>Queries on Astrology</i> *Maimonides, <i>Letter on Astrology</i>
Feb 21	*Francis Bacon, <i>The New Atlantis</i> *Selection of maps and images	<b>Joint Session: Lorraine Daston on Bacon Th, Feb 24 @ 19:30-21:00 on zoom</b> Bacon, <i>New Organon</i> , Front Matter (pp. 2-13)
Feb 28	Bacon, <i>New Organon</i> , I.1-68 (pp. 14-56)	Bacon, <i>New Organon</i> , I.69-end (pp. 56-101)
Mar 7	Bacon <i>New Organon</i> , II.1-21 (pp. 102-36) [*Lorraine Daston, "The Empire of Observation"]  Tuesday, March 8 holiday	*Robert Hooke, <i>Micrographia</i> , Observations 1, 2, & 54 *Margaret Cavendish, <i>Observations upon Experimental Philosophy</i> , Front Matter
Mar 14	Descartes, <i>Discourse on Method</i> , Parts 1-2	Descartes, <i>Discourse on Method</i> , Parts 3-4
Mar 21	Descartes, <i>Discourse on Method</i> , Parts 5-6	*Galileo, <i>A Sidereal Message</i> (SW 1-32)
Mar 28	*Galileo, <i>Two World Systems</i> , Selections	*Galileo, <i>Two World Systems</i> , Selections
Apr 4	*Galileo, <i>The Assayer</i> (SW 115-121) *Galileo, <i>Letter to Castelli</i> (SW 55-61) *Bellarmine, <i>Letter to Foscarini</i> (SW 94-96)	Brecht's <i>Life of Galileo</i> (film)
Apr 11	Spring Break	
Apr 18-	*Harvey, <i>Circulation of Blood</i> [+ film]  Monday, Apr 18 holiday	<b>Joint Session: Maria Avxentevskaya Th, Apr 21 @ 19:30-21:00 on zoom</b> *Agnodice (1680) *The compleat doctress (1656) *Hannah Wolley, <i>The Queen-like Closet</i> (1672)

Apr 25	<p><b>Joint event: Menakshi Menon</b>  <b>Tu, Apr 26 @ 19:30 on zoom</b>          Indigenous Knowledges and Colonial Sciences</p>	<p>*Linnaeus, "Regnum Vegetabile"          *Goethe, "On Linnaeus"          Goethe, <i>Metamorphosis of Plants</i> (Poem; §§1-83)          [*Goethe, "Metamorphose der Pflanzen"]</p>
May 2	<p>Goethe, <i>Metamorphosis of Plants</i> (§§84-123)          * Goethe, "The Experiment as Mediator of Subject and Object"</p>	<p>* Lamarck, <i>Zoological Philosophy</i>, ch. 7, 106-123</p>
May 9	<p><b>Joint event: Anastassia Kostrioukova</b>  <b>Mo, May 9 @ 19:30 on zoom</b>          Darwin, <i>On the Origin of Species</i>, ch. 3-4, pp. 49-71</p>	<p>*Hannah Arendt, "The Conquest of Space and the Stature of Man"</p>

Items marked with an asterisk (\*) are in the Course Reader; those in brackets [ ] are suggested.

## Course Overview with Study Questions

### 1. Method in Aristotle and Abrahamic Aristotelianism

In this first unit, we take our first steps by exploring the sort of scientific knowledge that existed before the rise of early modern science and the epistemological, metaphysical, and theological commitments that came along with this old Aristotelian model, through a particular focus on the "Abrahamic Aristotelianism" of the medieval period.

#### 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 is at stake in the debate about the putative "incoherence" of natural philosophy between al-Ghazali and Ibn Rushd?
- What does Ibn Rushd want to accomplish with his *Decisive Treatise*? Who is it for?

### 2. Modern "Scientific Method": Empiricism and/or Rationalism

Following upon our engagement with the Aristotelianism that had become orthodox science in the late medieval period, we turn to examine the ways in which the concept of "science" changed with the rise of early modern thought and how thinkers such as Bacon and Descartes believed it was possible to arrive at "scientific facts" or truth. We will be interested in the epistemological and metaphysical assumptions on which their approaches rested, but also the practical aims they set for science. We will study these questions by comparing and contrasting the old Aristotelian science, as it was received, preserved, and extended in the medieval period, with the two new scientific models as put forth by Bacon and Descartes.

#### Study Questions:

- Why did Bacon think human beings could gain by pursuing science according to his method? Why have they failed to accomplish this in the past?
- What relationship does Descartes posit between humans and nature in the *Discourse*?
- How do Descartes and Bacon importantly agree? Where do they meaningfully differ?
- What did Hooke claim to accomplish with his microscopic observations? What are Cavendish's main objections to Hooke and the new science generally?

### 3. Galileo: The “First Modern Scientist”?

The third unit begins with a discussion about terrestrial motions and the geocentric worldview. Our primary sources will be Galileo’s telescopic observations announced in *A Sidereal Message* (1610) and his defense of heliocentrism in *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. We will also consider Brecht’s rethinking of the relationship between science and politics in his *Life of Galileo*.

#### Study Questions:

- What was Galileo’s reason for doing science? How does it compare to what Bacon and Descartes thought science was for?
- What were the main challenges of the Copernican “revolution” in planetary theory? What was Galileo’s attitude toward tradition and natural inquiry?
- What lessons about individual and institutional supporters of scientific work can be gleaned from the letters written by and around Galileo? How or why does this matter?

### 4. Reason and Experience in the Life Sciences

In the final unit we consider the phenomenon of life and the challenge it presents to the mathematical and mechanistic explanations that are often equated with science in the contemporary sense. After a week on early modern medical practice, we will turn to Goethe’s work in botany, which was criticized by his contemporaries for reintroducing final causes. Following Goethe’s suggestion that nature should be observed under an open sky, and not reproduced in a laboratory, students will be asked to get outside and carefully observe plants in their environment. We’ll dedicate the final weeks to evolutionary biology, considering various ways of imagining how species changed over time that produced major challenges to Aristotle’s and creationist idea of species as permanent and to Linnaeus’ rigid taxonomical ordering. We’ll conclude Hannah Arendt’s ruminations on modern science’s contribution to living a good life.

#### Study Questions:

- Is medicine a science? What methods and practices are at work in the Harvey’s experiments and early modern medicine?
- What was the role of women in early modern medical practices? What types of care did they usually offer? How did that compare with practicing medicine by men?
- How, if at all, does Goethe's poem contribute to his work in *Metamorphosis of Plants*?
- Does the *Metamorphosis of Plants* follow the methodology proposed in "The Experiment as Mediator of Subject and Object"? How does this method differ from the methods proposed by Bacon and Descartes?
- What are the major differences between Lamarck and Darwin in how they imagine the mechanisms of evolution?
- What implications does the process of natural selection and Darwin’s notion of “struggle for existence” have for ideas of divine creation, progress, teleology, will, and habit?
- How according to Arendt has modern science influenced our ability to live a meaningful human life?