

IS 212. Early Modern Science: The Invention of Nature - Spring '23

Course Times: Tu/Th 10:45–12:15; 15:45-17:15; Mo/Th 15:45-17:15

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

Guest Lecturers: Lorraine Daston (MPWIG), Peter Galison (Harvard) – **to be confirmed**

Office Hours: Set by individual instructors

Description

What is nature? Although the answer to this question may seem obvious, it should not be taken as self-evident. We are used to thinking of nature as something outside of ourselves; as a stable, non-human order that is to be feared, cherished, and/or exploited. However, contemporary pressures including biodiversity loss, resource scarcity, and global warming have made this view seem increasingly absurd. In the same measure that the geological concept of the Anthropocene challenges us to insert human history into the natural world, so should we recognize that the concept of nature is anything but natural, but has been conditioned by a sequence of historical developments and discursive shifts that go back centuries. This course will inquire into the historical and cultural origin of our inherited concept of nature, focusing on the early modern period in which it took shape. Examining the principles, methods, and frameworks of modern natural science, we will inquire into the philosophical foundations, practical procedures, and political and cultural ramifications of the modern separation of nature from culture.

Our efforts will be divided into four units: First, we will consider the earliest philosophical reflections on nature and science and their reception in medieval Islamic and Jewish thought. Then, by turning to Bacon and Descartes, we will ask how these heterogeneous strands of pre-modern “natural philosophy” were consolidated into the modern scientific paradigm. The third unit explores how Galileo’s and Newton’s new understanding of space, matter, and motion generated tensions with the Catholic Church and promoted secular ideas and ideals. Finally, in the closing unit, we will consider how the phenomenon of life challenged the early modern mechanistic concept of nature, focusing on the 19th century biological 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 mid-session 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 11, April 15 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. To learn how to observe plants on Sat, Apr 28 there we'll take a field trip to Berlin's Botanical garden. This will replace the first May session.

You will write one substantial final essay (ca. 2500 words in length) at the end of semester, due on May 19. 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 6.

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 4
- Graded logs: 1) Saturday, 11 March; 2) Saturday, 15 April; 3) Sunday, 14 May
- Field trip: Saturday, April 28
- Final essay proposal: Saturday, May 6
- Final Essay deadline: Friday, 19 May

Course Schedule

Note: While seminars will be held during two different time slots, students are expected to attend all joint sessions in bold. Please mark your calendars accordingly!

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

Week	1 st session	2 nd session	Notes
1: Jan 30-Feb3	Joint session: on Genesis and Lucretius Tue, Jan 31 @ 19:30	Lucretius, <i>De Rerum Natura</i>	trial entry
2: Feb 6-10	<u>Contesting nature in Islamic Aristotelianism</u> * Aristotle, <i>Physics</i> * Al Farabi, <i>The Book of Letters</i>	*Al-Ghazali, <i>Incoherence of Philosophers</i> , Introductions; Discussions 10 & 17	
3: Feb 13-17	*Ibn Rushd, <i>Incoherence of the Incoherence</i>	*Ibn Rushd, <i>Decisive Treatise</i>	
4: Feb 20-24	<u>Modern Scientific Method or how to study nature</u> *Francis Bacon, <i>The New Atlantis</i> *Selection of maps and images	Bacon, <i>New Organon</i> , Front Matter (pp. 2-13)	
5: Feb 27-Mar 3	Bacon, <i>New Organon</i> , I.1-68 (pp. 14-56)	Bacon, <i>New Organon</i> , I.69-end (pp. 56-101)	
6: Mar 6-10	Bacon <i>New Organon</i> , II.1-21 (pp. 102-36) [*Lorraine Daston, "The Empire of Observation"]	*Robert Hooke, <i>Micrographia</i> , Observations 1, 2, & 54 *Margaret Cavendish, <i>Observations upon Experimental Philosophy</i> , Front Matter	1 st log
7: Mar 13-17	Special event: Lorraine Daston on nature? Descartes, <i>Discourse on Method</i> , Parts 1-2 Mon, March 13 @ 19:30	Descartes, <i>Discourse on Method</i> , Parts 3-4	Groups rotation
8: Mar 20-24	Descartes, <i>Discourse on Method</i> , Parts 5-6	*Galileo, <i>A Sidereal Message</i> (SW 1-32) Include endnotes	
9: Mar 27-31	*Galileo, <i>The Assayer</i> (SW 115-121) *Galileo, <i>Two World Systems</i> , two letters dedicatory,	*Galileo, <i>Two World Systems</i> , Selections two letters dedicatory, and pp. 106-133 of Day Two	

	SPRING BREAK		
10: Apr 10-14	The Galileo Affair: *Galileo, <i>Letter to Castelli</i> (SW 55-61) *Bellarmine, <i>Letter to Foscarini</i> (SW 94-96)	Bertold Brecht, <i>Life of Galileo</i> (film)	2 nd log
11: Apr 17-21	Joined session: Maria Avxenevskaya (MPWIG) on Francesco Algarotti's <i>Sir Isaac Newton's Philosophy Explain'd For the Use of the Ladies</i>	Algarotti, <i>Newton for Ladies</i>	
12: Apr 24-27	<u>Nature and the Life Sciences</u> Goethe, <i>Metamorphosis of Plants</i> (Poem; §§1-83) *Linnaeus, "Regnum Vegetabile" *Goethe, "On Linnaeus"	Goethe, <i>Metamorphosis of Plants</i> (§§84-123) * Goethe, "The Experiment as Mediator of Subject and Object"	FIELD TRIP Sat, Apr 2
13: May 1-5	NO CLASS	Darwin, <i>On the Origin of Species</i> , ch. 3-4, pp. 49-71 * Lamarck, <i>Zoological Philosophy</i> , chs. 3 and 7, 35-7, 106-123	Proposal
14: May 8-12	Special event: Peter Galison (Harvard) on Black Holes?	* Arendt, "The Conquest of Space and the Stature of Man"	3d log
15: May 15-19	Final Essay due: Friday, May 19, 23:59		

Course Overview with Study Questions

1. The Historical Origins of Nature

In this first unit, we take our first steps by exploring religious and philosophical ideas about nature and knowledge that existed before the rise of early modern science, together with the epistemological, metaphysical, and theological commitments that came along with the old Aristotelian model. Particular emphasis will be given to the Arabic tradition, which was not only essential for the survival and transmission of Greek thought, but anticipated and developed many of the debates that would again be explored in the early modern period.

Study Questions: add a question for Al Farabi

- 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? How does the ancient understanding of nature differ from ours?
- 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”: or how to study nature?

Following upon our engagement with the natural philosophy 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 and Newton: The “First Modern Scientists”?

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*. We conclude with a discussion of Francesco Algarotti’s “*Sir Isaac Newton’s Philosophy Explain’d For the Use of the Ladies*,” a popular representation of the Newtonian system that both exposes and seeks to mitigate the highly gendered status of scientific inquiry.

Study Questions:

- Why did Galileo pursue science? How do his stated motivation compare to what Bacon and Descartes thought science was for?
- What were the main challenges of the Copernican “revolution” in planetary theory?
- 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?
- What does the transition from Descartes’ “system” to Newton’s “facts” imply about the status of nature and the possibility of natural science?
- What does the transition from Descartes’ “imaginary system” to Newton’s “facts” imply about the status of nature and the possibility of natural science?

- What did gendering of scientific practices look like in the early modern period? What role did translators and translations played in this process?

4. Nature, 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. To this end, 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:

- 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?