Spring 2020

HIST 373-002: The Rise of Modern Science (Revised for Remote Learning)

Karl Schweizer

HIST 373 002
The Rise of Modern Science

Spring 2020	Instructor: Dr. K.W. Schweizer
Office Hours:	Federated Dept. of History, NJIT/Rutgers
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Mondays and Wednesdays 1 pm – 2:20 pm
Faculty Memorial Hall 319

Course Description: The term "Scientific Revolution," signifying a discrete object of historical analysis, was initially coined by Alexandre Koyré in 1939 and first became a book title in Rupert Hall's The Scientific Revolution (1954), covering the period 1500-1700, an era in which the techniques and major precepts of modern science were first established. Implicit in this "traditional" scholarship was the notion of a cataclysmic if not climatic event, a conceptual revolution involving far-reaching changes in ways of thinking about and relating to nature. Here scientific advances were viewed in terms of autonomous ideas—disembodied mentalities—divorced from their wider geo-cultural contexts; if there was a geography of thought it was imprinted on maps that were metaphysical, *metaphorical*.

Revisionist scholarship in recent years has challenged this viewpoint, tending to be skeptical of both the novelty and coherence of what had previously been understood as a "revolution" and questioning if there ever was a single cultural entity called "science" in the 17th century to experience revolutionary change. There was rather, it is contended, a complex array of cultural practices aimed at understanding, explaining and controlling the natural world, each with different characteristics and each experiencing different modes of change. Such work has also given attention to new frameworks of intellectual production, extra scientific influences, the concrete *human* practices by which ideas are fashioned, as well as agencies and personalities hitherto marginalized in the historiography of early modern science. It also has stressed influence of philosophical, spiritual and social conceptions on the direction of scientific research.

This course consists of **four components**.

The first examines the historical dimension of science: specifically how history illuminates the role of science in human cultural development.

The second focuses on the nature of scientific inquiry: its genesis, defining characteristics, varieties and place in the modern world. It will also examine the conditioning factors outside science itself that played a pivotal role in the production of new knowledge as well as the development of key reasoning processes in cultural historical contexts. These factors include political upheavals, economic developments and intellectual forces—variables that illuminate the nature of all scientific revolutions, the stages by which they occur, their time scale, and the creative conditions that foster revolutionary new ideas.

The third looks at the achievements of major scientists in relation to the visionary displacement underlying their creative enterprise and in relation to the societies in which they lived. Venturing outside the structures of Aristotelian physics, and other conventional paradigms, scientists during this period produced innovations not so much by new observations or additional evidence but by new, challenging ways of looking at old problems adopting a psycho-biographical over purely disciplinary perspective. In both celestial and terrestrial physics, change was brought about by transpositions that were taking place inside minds of the scientists themselves. This course seeks to explain why.

The forth component will look at the crucial role of classical/medieval traditions in the formative stages of modern science and the importance of the Christian world view in the shaping of scientific knowledge and conceptions.

Finally, time permitting; the course will explore the complex relationship between the development of scientific knowledge and the variable climate of ideologically diverse political structures, specifically Communist Russia, Fascist Italy, and Nazi Germany. A number of topical issues—including nuclear power, bio technology, and genetics—will also be examined within the same context.

Course Goals**:** By the end of the course, students will be able to:

- Understand that science is not self-germinating but intrinsically related to the overall historical process: the history of civilization.
- Appreciate the wider context of science and technology in the modern world.
- Better understand the complexity behind scientific creativity and formulation.
- Have a greater ability to think, write, and read in a critical/analytical fashion—the defining measure of a university education.

Assignments and Marks:

Book Review	20%	Due Monday, March 2
Mid Term	20%	Wednesday, March 11
Research Paper	30%	Due Wednesday, April 22
Wrap-up Quiz	20%	Monday, May 4
Class Participation	10%	

Grading Scale for Assignments and Participation:

A = 85 – 100	B+ = 80 – 84.5	
B = 75 – 79.5	C+ = 69.5 – 74.5	
C = 65 – 69.5	D = 50 – 64.9	F = 49.9 - 0

Texts: (required readings)

Thomas Kuhn, The Structure of Scientific Revolutions (Chicago, 2012)

J.B. Cohen, Revolutions in Science (Cambridge, MA, 1985)

H. Butterfield, Essays on the History of Science (edited by K.W. Schweizer) (Lewiston, NY, 2005)

William Lawrence, Modern Science and Human Values (Oxford, 1985).

Semester Schedule:

Jan. 22: Introduction

Jan. 27 and Jan. 29: The Scientific Revolution and the Historiography of Science.
Readings: Cohen, ch. 2; Kuhn, ch. 1

Feb. 3 and Feb. 5: Early Modern Science: External or Internal Factors.
Readings: Butterfield, ch. 2, 3; Kuhn, ch. 3; Cohen, ch. 3

Feb. 10 and Feb. 12: Tradition and Innovation in 16th Century Science.
Readings: Cohen, ch. 5; Butterfield, chs. 4, 5; Lawrence, ch. 1

Feb. 17: Science, Humanism and the Christian Church.
Readings: Butterfield, ch. 5; François Russo, Catholicism, Protestantism and Science (handout).

Feb. 19 and Feb. 24 and Feb. 26: Paradigms, Anomalies and Scientific Discovery.
Readings: Kuhn, ch. 5, 6; Cohen, ch. 6

Mar. 2: ***Review for Mid-term Quiz***
Book Review due.

Mar. 4: ***Mid-term Quiz***

Mar. 9 and Mar. 11: The Great Synthesis: Descartes and Newton.
Readings: Kuhn, ch. 9; Cohen, ch. 10, Butterfield, ch. 7

March 15 – 22: ***Spring Break***

Mar. 23 and Mar. 25: Science, Technology and Society (18th and 19th Century) New Directions.
Readings: Lawrence, chs. 2, 3, 4: K.W. Schweizer, Science and its Discontents (handout)

Mar. 30 and Apr. 1: Evolution and the Great Chain of Being.
Readings: Butterfield, ch. 7; Cohen, chs. 8, 9

Apr. 6 and Apr. 8: Social Darwinism and its Social/Political Implications.
Readings: Cohen, ch. 19; plus handouts.

Apr. 13 and Apr. 15: Einstein, Relativity and Quantum Theory.
Readings: Cohen, chs. 27, 28

Apr. 20 and Apr. 22 and Apr. 27: Science and Totalitarism: Stagnation or Growth?
Readings: handouts
Research paper due on April 22

Apr. 29: ***Review for wrap-up quiz.***

.**May 4:** ***Wrap-up Quiz***

Suggested Books for Book Review:

W.R. Shea, Galileo in Rome: The Rise and Fall of a Troublesome Genius (Oxford, 2003).

R.S. Westfall, Never at Rest: A Biography of Isaac Newton (Cambridge, 1983).

P.J. Bowler, Charles Darwin: The Man and His Influence (Cambridge, 1996).

W. Isaacon, Einstein: His Life and Universe (NY, 2007).

H. Kesten, Copernicus and His World (NY, 1945).

P. Sears, Charles Darwin (NY, 1950).

E. Curie, Madame Curie (London, 1938).

A. Pais, Subtle is the Lord: The Science and Life of Albert Einstein (NY, 1982).

P. Schilpp, Albert Einstein Philosopher-Scientist (NY, 1949).

F. Manuel, Portrait of Isaac Newton (Cambridge, 1968).

R. Clarke, Einstein: The Life and Times (NY, 1971).

D. Adamson, Blaise Pascal (NY, 1973).

H. Butterfield, The Origins of Modern Science (NY, 1965).

A.R. Hall, The Scientific Revolution, 1500-1800 (NY, 1974).

H. Hargreaves, Visions and Discoveries: Reflections on the Nature of Scientific Inquiry (Laoham, MD, 1990).

D. Lindberg, When Science and Christianity Meet (Chicago, 2003).

A. Koyré, From the Closed World to the Infinite Universe (NY, 1957). [Classic exposition of the Scientific Revolution as an intellectual construct].

B. Stephenson, Kepler's Physical Astronomy (Princeton, 1994).

S. Shapiro, The Scientific Revolution (Chicago, 1996).

A.C. Crombie, Styles of Scientific Thinking in the European Tradition (London, 1994).

B. Goodwin, The Evolution of Complexity (NY, 1994).

H. Margolis, Paradigms and Barriers: How Habits of Mind Govern Scientific Beliefs (Chicago, 2000).

Gale, Christiansen, Isaac Newton and His Times (NY, 1984).

Course Requirements:

- **ONE BOOK REVIEW**
- 5-6 pages
- Based on a book relating to the themes of the course
- Autobiographies, memoirs and novels are not acceptable
- Chosen by student (suggestions in list above) and approved by professor
- Book review guidelines will be provided
- Hard copy with notes due on Monday, March 2
- Worth 20 % of final grade

- **RESEARCH PAPER**
- 12-15 pages
- Topic chosen by student relevant to the course and approved by professor
- Hard copy with notes due on Wednesday, April 22
- Worth 30% of final grade

- **MIDTERM QUIZ AND WRAP UP QUIZ**
- Each quiz is worth 20%

Policies:

- Class attendance will be taken via a student-signed attendance book.
- Absences will be accepted only from the Dean of Students.
- This is an intellectually demanding course. Students are expected to read all assigned readings and it is highly suggested that work on written assignments be started as soon as the book and later the research subject has been approved.
- A sign-up sheet will be circulated in class weeks prior to when the book review and later the research paper are due. Please check the sheet to make sure that your choice has been approved by the professor.
- Assignments MUST be completed on time and will be due at the beginning of class.
- Assignments will only be accepted on the due date OR at the beginning of the next class and not after that. They CANNOT be left under my office door or in the History office.
- Hard copy with research notes are to be turned in and email attachments are not accepted.
- One grade per day late will be applied to final assignment grade.
- There will be no "make-up" exam. If you miss either quizzes and cannot provide documentation to the Dean of Students' office, you will receive an F.
- There will be no "re-writing" of book reviews or research papers. Students having problems with written English should consult the Humanities Dept. Writing Center.
- Plagiarism in any written assignment will result in an automatic failure and will be reported to the Dean.
- All submitted work must contain the following signed statement: **I have fully complied with the NJIT Honor Code. Signed: Your Name.**

Amended Syllabus for Tele-Learning via Canvas

Each week there will be a written lecture on Canvas. Besides reading the lecture, students will access links and also read assigned readings from the course texts. These readings may not necessarily correspond to the original assigned readings on the syllabus. After completing the readings, students will answer a question provided at the end of the lecture and this work will be submitted on Canvas via the Discussion link.

Students will not write a research paper or take a final quiz. The weekly written work will take the place of the paper and quiz and will be worth 50% of the final grade.

The following are the titles of the new written lectures that will appear on Canvas.

Week 1: March 23: Science, Technology and Society: 18th and 19th Century: New Directions

Week 2: March 30: Evolution and the Great Chain

Week 3: April 6: Social Darwinism and its Social/Political Implications

Week 4: April 13: Einstein, Relativity and Quantum Theory

Week 5: April 20: Science and Totalitarianism: Stagnation or Growth?

Week 6: April 27: Science and the Modern World

I did not provide a new syllabus to the class. At the start of the tele-learning phase of the semester, I sent an email to each student explaining how the rest of the semester would be structured, what I would provide for them in terms of instruction, and what would be expected of them.