

# HPSC1011 History of Modern Science

## Course Syllabus

2013-14 session | Mat Paskins | [m.paskins@ucl.ac.uk](mailto:m.paskins@ucl.ac.uk)

### Course Information

This course provides an introduction to the major themes in the history of modern science, focusing on the 20<sup>th</sup> century. By the end of the course, we will have addressed the following major questions from a range of perspectives:

- 1) **What was the relation between the sciences and the wider world during the twentieth century? What kinds of cultural activity and social institution did scientific theories and practices arise from?**
- 2) **What did it mean to lead a scientific life, or to pursue a scientific vocation, during the twentieth century? Who became scientists? Whose knowledge 'counted' as scientific? What did this mean for everyone else?**
- 3) **How did Twentieth Century sciences depend on political and social (and military) organisation?**

### Basic course information

Course website:	<a href="https://moodle.ucl.ac.uk/course/view.php?id=12555">https://moodle.ucl.ac.uk/course/view.php?id=12555</a>
Moodle Web site:	HPSC1011
Assessment:	One essay (3,000 words) (50%), one exam (3 hours) (50%)
Timetable:	<a href="http://www.ucl.ac.uk/sts/hpsc">www.ucl.ac.uk/sts/hpsc</a>
Prerequisites:	No prerequisites.
Required texts:	Readings are available on moodle. You may wish to obtain a copy of <i>Science in the Twentieth Century and Beyond</i> (Polity: 2013) by Jon Agar
Course tutor(s):	Mat Paskins, Oliver Marsh
Contact:	<a href="mailto:m.paskins@ucl.ac.uk">m.paskins@ucl.ac.uk</a>
Web:	<a href="http://www.ucl.ac.uk/silva/sts/staff/paskins">www.ucl.ac.uk/silva/sts/staff/paskins</a>
Office location:	22 Gordon Square, Room B14
Office hours:	Please email for an appointment

## Schedule

UCL Week	Topic	Date	Activity
6	Overview Scientific Lives in the Twentieth Century Seminar: "Science as a Vocation"	30 September 2 October 3 October	Please see the detailed lecture schedule below
7	Contexts and Working Worlds Relativity Seminar: "Receptions of Relativity"	7 October 9 October 10 October	
8	Sciences and Religions During the 20 <sup>th</sup> c Science and Crisis: Weimar Science "Global Histories of Science and Religion"	14 October 16 October 17 October	
9	Science and Industry Chemistry in the Twentieth Century Seminar: "The Periodic Table"	21 October 23 October 24 October	
10	Big Science The Manhattan Project Seminar: "Essay Discussion"	28 October 30 October 31 October	
11	<b>Reading Week</b>		
12	Science and Agriculture Science and the Soviet Union Seminar: "History of Science in the SU"	11 November 13 November 14 November	
13	Sciences and Empires The Demons of Reason Seminar: "Criticising Science"	18 November 20 November 21 November	
14	Cybernetics and Information Sciences Ecology Seminar: "Essay Clinic"	25 November 27 November 28 November	
15	The Earth From Space Cosmologies and Origins Seminar: "Essay Clinic"	2 December 4 December 5 December	
16	Biotechnology Summation	9 December 11 December	

## Assessments

### Summary

	Description	Deadline	Word limit
<b>Essay 1</b>	Essay – 3000 words including references	11.59pm 18 December 2013	3000
<b>Exam</b>	3 hour Exam	Term Three: TBA	3 hours

## Assignments

Please choose one essay question from the list below. Essays should be 3000 words in length, including references. You should draw on the assigned readings, and the ones recommended during the lectures. There is only one essay for this course and we want you to do well. So please talk with us about your topic and your ideas. We are also very happy to read drafts.

Essays must be submitted via Moodle.

In order to be deemed 'complete' on this module students must attempt one essay and the exam. Affiliate students will complete an additional essay. Details of this will be given during the first lecture.

- 1) What was a 'scientific life' during the twentieth century?
- 2) Why has chemistry often been excluded from histories of twentieth century science? What happens if it is included?
- 3) What (if any) were the connections between ecological science and environmental politics during the twentieth century?
- 4) Critically evaluate the Forman thesis about the connection between Weimar culture and the science which emerged from it.
- 5) What was the effect of Big Science during the twentieth century?
- 6) What were the promises of cybernetics during the twentieth century? Were they fulfilled?
- 7) How would the history of twentieth century science look if it focused on the DuPont corporation?
- 8) What did we learn from the space programme?
- 9) Was Soviet science exceptional?
- 10) What were the major effects of the "Green Revolution"?
- 11) Was there a biotechnological revolution during the twentieth century?
- 12) Why did Arthur Eddington think there could be a 'practical mysticism'? Was he right?
- 13) How was Einstein's theory of relativity received during the early twentieth century? Why was this?
- 14) What was at stake in twentieth-century controversies about cosmology?
- 15) What are the connections between science and empire?
- 16) Was the content of twentieth century science decided by its funders?
- 17) Does the concept of "working worlds" help us to make sense of Twentieth-century science?
- 18) What was the significance of research into nitrates during the twentieth century?
- 19) How did whaling contribute to science in the twentieth century?
- 20) How was science critiqued and resisted during the twentieth century?

## Criteria for assessment

The departmental marking guidelines for individual items of assessment can be found in the STS Student Handbook.

## Aims & objectives

This course provides an introduction to the major themes in the history of modern science, focusing on the 20<sup>th</sup> century. By the end of the course, we will have addressed the following major questions from a

range of perspectives:

- 1) **What was the relation between the sciences and the wider world during the twentieth century? What kinds of cultural activity and social institution did scientific theories and practices arise from?**
- 2) **What did it mean to lead a scientific life, or to pursue a scientific vocation, during the twentieth century? Who became scientists? Whose knowledge 'counted' as scientific? What did this mean for everyone else?**
- 3) **How did Twentieth Century sciences depend on political and social (and military) organisation?**

There is too much modern science, and it is too finely subdivided into separate disciplines, for us to be able to address it comprehensively. We've also been not included topics which are covered in much better in other courses. At the same time, we will pursue cases from certain sciences in detail, especially those which are often overlooked. You are also encouraged to relate the themes of this course to your studies elsewhere.

Many important perspectives – particularly the effects of gender, race and sexuality on scientific knowledge – do not receive separate lectures but will be part of the approach throughout. You are very welcome to write essays on these topics. The scope is international.

## **Reading list and Lecture Schedule**

### **1. Overview**

Monday 30 September 2013, Physics A1/3, 2pm

This lecture introduces the course. We're going to work out what we already know about twentieth century science as a group, and figure out what major questions which are of interest to us.

**No Assigned Reading.**

### **2. Scientific Lives in the Twentieth Century: Vocations and Institutions**

Wednesday 2 October 2013, Central House G01, 9am

Science was practiced by particular people in particular places during the twentieth century: these included corporate research laboratories, universities, tropical islands, and the moon.

#### **Assigned Reading.**

Read the introduction to "Oral Histories of British Science":

<http://www.bl.uk/aboutus/stratpolprog/oralhist/scienceintro.pdf>

Also browse through the blog: <http://britishlibrary.typepad.co.uk/oralhistoryofscience>

are you surprised by who has been included? Do you think there are areas of scientific activity which are under-represented in this oral history?

**Seminar,**

Max Weber, "Science as a Vocation"

Thursday 3 October, 1 or 2pm (depending on your group: these will be allocated)

You can find a copy of this here: <http://anthropos-lab.net/wp/wp-content/uploads/2011/12/Weber-Science-as-a-Vocation.pdf>

Skim the first three pages and start reading in detail on page four of the document, the paragraph which begins "this much I deem necessary". Before the seminars, work out brief answers to the following questions:

- 1) What does Weber think is the role of specialisation of science? Why is it so important?
- 2) What character does Weber
- 3) What is Weber's view of progress in this essay?
- 4) Does Weber give an accurate impression of the vocation of science during the twentieth century?

### 3. Contexts and Working Worlds

Monday 7 October, 2pm, Physics A1/3

Scientific research, and routine scientific activity, relate to particular locations. In this lecture we'll look at how historians understood these interactions, focusing on a critical evaluation of Jon Agar's concept of "working worlds",.

Assigned Reading:

Jon Agar, *Science in the Twentieth Century and Beyond*, pps. 1-6 (on working worlds)

Agar, *Science in the Twentieth Century and Beyond* pps. 15-43 "New Physics" (please note: this is the main reading for both this and the following lecture).

Don't worry too much about the technical details of this chapter (unless that excites you), instead try to follow what Agar is saying about the relations between different areas of activity in science and industry, and how they produced the knowledges associated with the new physics.

### 4. Relativity

Wednesday 9 October, 9am Central House, 14 Upper Woburn Place, room G01.

Albert Einstein's special and general theories of relativity were amongst the most startling developments in early twentieth-century physics. This lecture gives an overview of how they were developed and the reception they received.

**Assigned Reading**

Agar, *Science in the Twentieth Century and Beyond*, pps. 15-43, "New Physics"

**Seminar:**

"Receptions of Relativity", Thursday 10 October, 1 or 2pm

Each member of the group will receive a different short reading about relativity. We'll try and understand why such a range of interpretations arose, and how we can fit them together again. (Readings will be distributed during the week one seminar).

### 5. Sciences and Religions During the Twentieth Century

Monday 14 October, 2pm, Physics A1/3

The world of developing sciences was also one in which religions underwent major shifts. Although the

relationship between science and religion can be characterised as one of conflict, or increasing 'secularisation' in which science replaced religion as a form of authority, detailed study shows a much more complicated pattern of interaction between the two. In this lecture, we'll discuss the major issues and then look at two case studies in some detail: that of the great English physicist and Quaker Arthur Stanley Eddington, and the rise of new religious movements which drew on the rhetoric of science – focusing on the case study of Rudolf Steiner's anthroposophy, which has been described as 'the most successful form of "alternative" religion in the twentieth century'.

**Assigned Readings:**

Arthur Eddington, *The Nature of the Physical World*, chapter 15, "Science and Mysticism".

A copy of which is available here:

<http://archive.org/stream/natureofphysical00eddi#page/n5/mode/2up>

Don't be put off by the long formula on the first page – Eddington is making a joke rather than asking you to understand it! What picture is Eddington giving of physics?

**6. Science and Crisis; Weimar Science**

Wednesday 16 October, 9am, Central House, 14 Upper Woburn Place, room G01.

One of the most important settings for early twentieth century science was the Weimar republic. Studying it allows us to explore the relation between science and other fields of cultural life. As well as discussing the distinctive Weimar-period contributions of rocketry, quantum mechanics, and physiology, we'll evaluate the "Forman thesis" that there was a distinct connection between the crisis of Weimar culture and the sciences practised within it.

**Assigned Readings**

Agar, chapter 6, "Crisis: Quantum Theories and Other Weimar Sciences"

Neufeld, Michael J. "Weimar Culture and Futuristic Technology: The Rocketry and Spaceflight Fad in Germany, 1923-1933." *Technology and culture* 31.4 (1990): 725-752.

**Seminar: "Global Histories of Science and Religion"**

**Thursday 17 October**

Read Suvit Sivasundaram "A global history of science and religion" in Thomas Dixon et. al eds. *Science and Religion: New Historical Perspectives* (University of Cambridge Press, 2010), pp.177-198.

We'll be discussing how a global perspective on science and religion might change the kinds of argument we heard during the lecture.

**7. Science and Industry**

Monday 21 October, 2pm, Physics A1/3

Twentieth Century science was closely connected to industrial research and pursuits. In this lecture, we'll explore some of these settings – including obvious ones like corporate research laboratories, and more surprising ones, like whaling vessels. We'll also evaluate the models of the relation between research and industry, which has been a fraught question of history and policy for more than half a century.

### Assigned Reading

Carlson, W. Bernard, John Krige, and Dominique Pestre. "Innovation and the modern corporation. From heroic invention to industrial science." *Companion to Science in the Twentieth Century* (1997): 203-226.

## 8. Chemistry in the Twentieth Century

Wednesday 23 October, 9am, Central House, 14 Upper Woburn Place, room G01.

Drawing on the insights of the previous lecture, we'll explore the place of chemistry in Twentieth century science, between academic and industrial science – asking why it is so often marginalised in our histories, and what happens if we bring it back.

### Assigned Reading:

David Edgerton: "Not Counting Chemistry: How we misread the History of 20<sup>th</sup> Century Science and Technology", <http://www.chemheritage.org/discover/media/magazine/articles/26-1-not-counting-chemistry.aspx>

Also see what else you can find out about hydrogenation and the history of nitrates.

### Seminar:

Thursday 24 October 1 or 2pm

Each taking a chapter from the Italian chemist and author Primo Levi's book *The Periodic Table* (Trans. Raymond Rosenthal, *Michael Joseph Ltd.*, 1985), we will relate it to the broader themes in the history of twentieth-century chemical science.

## 9. Big Science

Monday 28 October, 2pm, Physics A1/3

In the later twentieth century, we are often told, science got BIG. Big laboratories, money, ambitions. And maybe in the process it lost something too. In this pair of lectures, we'll evaluate some of the arguments which have been made on this subject. Was twentieth-century science really unprecedented in scale? And what are we mourning when we talk about its costs?

### Assigned Reading

Capshew, James H., and Karen A. Rader. "Big science: Price to the present." *Osiris* 7 (1992): 3.

## 10. The Manhattan Project and other Nuclear sciences

Wednesday 30 October, 9am, Central House, 14 Upper Woburn Place, room G01.

One of the most iconic big science projects of the mid-twentieth century was the research and development at Los Alamos which led to the construction of the first American atomic bomb. It's been the subject of novels, operas, and endless historical studies. But why? What is so significant about Los Alamos?

### Assigned Reading:

Jeff Hughes, *The Manhattan Project* (Columbia University Press, 2002), pps. 45-84.

**Seminar** "Essay discussion"

Thursday 31 October, 1 or 2pm

We'll recap what we've learned in the course so far, and discuss ideas for essays.

### **11. Science and Agriculture**

Monday 11 November, 2pm, Physics A1/3

One of twentieth century science's most decisive – but contentious – contributions has been to the practice of agriculture. On the one hand, scientific techniques have been implemented to increase yields and (according to their advocates) stave off starvation. On the other, their uptake requires inputs such as water and pesticides, potentially creating new chains of dependency. Focusing on the cases of plant-breeding and the green revolution, we'll examine this thorny history.

Assigned Readings:

Deborah Fitzgerald, "Mastering Nature and Yeoman: Agricultural Science in the Twentieth Century," in John Krige and Dominique Pestre, eds., *Science in the Twentieth Century*

### **12. Science and the Soviet Union**

Wednesday 13 November, 9am, Central House, 14 Upper Woburn Place, room G01.

In theory, Soviet science was different to that elsewhere – in line with real human needs. In practice, it produced both extraordinary triumphs and murderous scandals.

**Assigned Reading:** Ethan Pollock, "Science under socialism in the USSR and beyond", *Contemporary European History* 10, pp. 523-35

**Seminar:**

Thursday 14 November, either 2pm or 2pm

**"History of Science in the Soviet Union"**

**Read these two articles:**

Boris Hessen: The Social and Economic Roots of Newton's *Principia* (here: [http://webfiles.mpiwg-berlin.mpg.de/rereadingClassics/Hessen.pdf/V1\\_Hessen.pdf](http://webfiles.mpiwg-berlin.mpg.de/rereadingClassics/Hessen.pdf/V1_Hessen.pdf)) (it's long: skim for the argument)

and

The Socio-Political Roots of Boris Hessen: Soviet Marxism and the History of Science, Loren R. Graham: *Social Studies of Science*, Vol. 15, No. 4 (Nov., 1985), pp. 705-722

What insights (if any) can we apply from these approaches to the history of science in the twentieth century?

### **13. Sciences and Empires**

Monday 18 November, 2pm, Physics A1/3

The sciences were (and still are) part of the project of imperialism in many parts of the world. How we might understand this has been a major subject in recent history. This lecture introduces these debates.

**Assigned Reading:**

Kapil Raj "Beyond Postcolonialism ... and Postpositivism: Circulation and the Global History of Science", *Isis*, Vol. 104, No. 2 (June 2013), pp. 337-347

Merson, John (2000) 'Bio-prospecting or bio-piracy: intellectual property rights and biodiversity in a colonial and postcolonial context', *Osiris*, 2nd Series, 15, pp.282-296

**14. The Demons of Reason**

Wednesday 20 November 9am, Central House, 14 Upper Woburn Place, room G01.

How should we understand the relationship between the sciences and the atrocities in which they were implicated during the 20<sup>th</sup> century? For many scholars, especially in the second half of the century, the answer was that traditional rationality itself had troubling aspects, needing to be revised or perhaps even discarded altogether. But how could this be squared with the need to understand how terrible acts could be carried out? This lecture introduces these arguments.

**Assigned Reading:**

van Pelt, Robert Jan. "Auschwitz: From Architect's Promise to Inmate's Perdition." *Modernism/modernity* 1.1 (1994): 80-120.

**Seminar: Criticising and Resisting Science**

Thursday 21 November, 1 or 2pm.

Reading TBA.

**15. Cybernetics and Information Sciences**

Monday 25 November, 2pm, Physics A1/3

One major strand of science of the mid-to-late twentieth century has been that concerned with information. These sciences promised extraordinary transformations, and new relationships between the human and the mechanical. The question of how far these promises were fulfilled is the subject of this lecture – which focuses especially on cybernetics.

**Assigned Reading:**

Eden Medina, "[Designing Freedom, Regulating a Nation: Socialist Cybernetics in Allende's Chile,](#)" *Journal of Latin American Studies* 38 (2006): 571-606.

Agar, *Science in the Twentieth Century* p. 373-387.

**16. Ecology**

Wednesday 27 November 9am, Central House, 14 Upper Woburn Place, room G01.

One of the central sciences of the late twentieth century was ecology – which was involved in new kinds of environmental politics, different ways of seeing the world, and new attitudes towards how nature should be modelled and regarded. But ecology grew up from tangled roots, including military projects...

**Assigned Reading:**

Joel Hagan, *An Entangled Bank: the Origins of Ecosystem Ecology*, chapter six "Ecology and the Atomic Age" (Rutgers University Press)

**Seminar:**

Thursday 28 November, 1 or 2pm

**Essay clinic**

**17. The Earth from Space**

Monday 2 December, 2pm, Physics A1/3

Space projects produced some of the most iconic imagery of twentieth-century science; they were also part of the significant political battles of the cold war. In addition, many sciences were transformed once the earth had been seen from space.

**Assigned Reading:**

Browse the documents at the Eisenhower memorial library relating to the International Geophysical Year, and the launch of the Sputnik Satellite:

[http://eisenhower.archives.gov/research/online\\_documents/igy.html](http://eisenhower.archives.gov/research/online_documents/igy.html)

[http://eisenhower.archives.gov/research/online\\_documents/sputnik.html](http://eisenhower.archives.gov/research/online_documents/sputnik.html)

**18. Cosmologies and Origins**

Wednesday 4 December, 9am, Central House, 14 Upper Woburn Place, room G01.

Some of the most forceful and controversial aspects of late twentieth-century was in cosmology. These findings produced best-sellers and transformed views about the origin of the world. How did this come about? And who were the losers?

**Assigned Reading:**

Helge Kragh, "Cosmologies and Cosmogonies of Space and Time", in *The Cambridge History of Science*, volume 5, eds. Roy Porter, Mary Jo Nye.

**Seminar:**

Thursday 5 December 1 or 2pm

**Essay Clinic**

**19. Biotechnology**

Monday 9 December, 2pm, Physics A1/3

'Biotechnology' is one of the central sciences of the later twentieth century, connected with a transformation in the culture of academic research, the unleashing of transformative technologies, and

hopes of enormously profitable industries. This lecture will track how this came about, and how it relates to familiar stories of the 'race for the prize' of DNA.

### Assigned Reading:

Robert Bud (2009) 'History of biotechnology', in Peter J. Bowler and John V. Pickstone (eds.) *The Cambridge History of Science, Volume 6, The Modern Biological and Earth Sciences*, Cambridge: Cambridge University Press, pp. 524-538

## 20. Summation

Wednesday 11 December 9am

What have we learned from this course?

No seminar this week!

### Course expectations

Lectures take place on Monday afternoons and Wednesday mornings. Attendance is compulsory and if you don't show up, we'll chase you. Persistent failure to show up at lectures may result in your failing the course. There are two reasons for this. First, we want you to come away from the course with the confidence to ask questions about this extraordinary rich area, and to read the wealth of scholarship which has been written about it. This means we have a lot of ground to cover and we need to check that you are understanding what the course is teaching. Second, history of science works best when it is something we do together. You will have skills and experience, academic interests and parts of your background, which other members of the group (including the lecturer and teaching assistant) do not. We can only learn from each other if you are there.

Each lecture is accompanied by an assigned reading. Please do this beforehand: it's expected that you will know the material in it. Most of the readings are quite short: take careful notes, and be prepared to ask if you don't recognise certain terms or quite grasp ideas which are being presented.

The literature on 20<sup>th</sup> century science is pretty huge, and there are very few overviews. The one we'll be using mainly in this course is Jon Agar, *Science in the Twentieth Century and Beyond*, (Polity 2012). It's full of references to other useful works. All assigned readings will be on Moodle; in a couple of cases seminar readings be given out during the lectures.

Each lecture is intended to introduce you to the arguments of specific historians. During the lecture, you'll be given a handout with details of the sources which it's drawn upon. **For the exam, it's crucial that you use these sources – not just the assigned readings.** We're looking for your critical engagement with significant arguments, rather than a regurgitation of chronologies.

Finally: we're delighted that you're joining us for this course. One of our expectations is that it's going to be a very interesting and exciting experience working with you.

### **Important policy information**

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Details of college and departmental policies relating to modules and assessments can be found in the STS Student Handbook [www.ucl.ac.uk/sts/handbook](http://www.ucl.ac.uk/sts/handbook)

All students taking modules in the STS department are expected to read these policies.

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