PART IB PAPER 06: PHILOSOPHY OF SCIENCE

SYLLABUS

Realism, for and against: underdetermination of theory by data, the pessimistic induction, constructive empiricism, structural realism, incommensurability.

Confirmation: the hypothetico-deductive model; the paradoxes of confirmation; Bayesianism; falsificationism.

Scientific explanation and laws: what, if anything, distinguishes scientific explanation?; the deductive-nomological model of explanation and its rivals; 'best system' vs anti-reductionist views of laws.

Concepts of probability: subjective probability; logical probability; frequency interpretation; propensity interpretation.

Introduction to philosophy of physics: spacetime and relativity; time and thermodynamics; puzzles of quantum theory.

OBJECTIVES

Students taking this paper will be expected to:
1. Acquire an introductory overview of debates on method, the status of theories, the nature of explanation and laws, and concepts of probability.
2. Critically engage with texts by some key authors in analytical philosophy of science in the last half century.
3. Acquire a more detailed understanding of some particular debates within the listed areas.
4. Develop their ability to think independently about philosophical problems by critically assessing arguments in these areas.

PRELIMINARY READING


CHALMERS, Alan F., What is This Thing Called Science?, 2nd ed. (Milton Keynes: The Open University, 1982).

READING LIST

The philosophy of science is an area particularly well supplied with readable and reliable introductions. The following are particularly recommended:


CHALMERS, Alan F., What is This Thing Called Science?, 2nd ed. (Milton Keynes: The Open University, 1982).


LADYMAN, James, Understanding Philosophy of Science (London: Routledge, 2002).


Bird’s is an excellent and accessible introduction. Ladyman’s book has a different emphasis: e.g. there’s less on laws and more on Popper vs. Kuhn. Papineau’s very clear essay deals primarily with issues about explanation, laws, confirmation etc, while Chalmers concentrates more on Popper’s falsificationism, and the responses of Kuhn and Lakatos. Godfrey-Smith’s book is longer and more comprehensive, but very lively, clear, and accessible.
Other introductions worth mentioning are:


Of these, Kosso’s book is the most introductory (useful perhaps for preliminary orientation or if you are transferring into philosophy). The Hempel volume is a short classic introduction. And Hacking’s book is particularly interesting giving a newer take on some old issues.

Earlier classics include the following:


This presents very clearly a developed version of some ‘traditional’ lines in the philosophy of science on laws, explanation, the observation and theory distinction, etc. It very useful to read Nagel to get a sense of what quite a few of the later writers are reacting against.


Enormously influential and highly readable, this is the book that introduced the paradigm in philosophy of science.


Going even further than Kuhn, Feyerabend argues against the very idea of a scientific method (claiming that ‘anything goes’ is as good a methodological rule as anything suggested by mainstream philosophy of science). Controversial and again, highly readable.

**Useful Collections of Articles**

The following collections will be found particularly useful:


**Pre-amble on the Selected Readings**

Think of IB work on a topic as having two stages. (A) Getting a grounding in a problem area, writing a supervision essay, and getting feedback (to confirm that you have grasped the basics, and to suggest problems to think about, further lines to pursue etc.). (B) Additional reading and work on the topic (perhaps to be further discussed in Easter term additional supervisions, revision classes etc.). If you get stuck at stage (A) you won’t do particularly well in Tripos!

Some of these readings are divided into (A) and (B) lists below: some attempt is made to put material in the basic (A)-lists in a sensible reading order. (B)-lists are in alphabetical order, and for dipping into (no-one expects you to read everything).

**REALISM, FOR AND AGAINST**

**General**

For an introductory survey of some of the issues about realism in the philosophy of science, see:


And for another survey, at a slightly more sophisticated level, try:


For a rather deflationary approach to issues about realism, much referred to, you should read:


For an excellent book-length treatment, see

For an important critical perspective on the notion of objectivity sometimes associated with scientific realism, see:


For an earlier classic, still very much worth reading, see:


**Underdetermination of Theory by Data**

Theory is underdetermined by data (i.e., in principle, different theories are compatible with the same data). Does that observation show that we shouldn’t take a realist attitude, even to our best theories?

**A**


LADYMAN, James, *Understanding Philosophy of Science* (London: Routledge, 2002), sect. 6.1. [Another introduction]


**B**


**The Pessimistic Induction**

In the history of science, time and again scientists have got things badly wrong. Should we pessimistically infer that our current best theories are also (probably) wrong, for all we know?

**A**


**B**


Constructive Empiricism

The most influential non-realist theory of science in the last two decades and more is van Fraassen's constructive empiricism. For van Fraassen's own presentation and criticism see:

(A)


(B)

Recent debate on constructive empiricism has focused upon the specific epistemological framework in which van Fraassen advances his empiricism, and upon the appropriate epistemological framework for the philosophy of science in general:


VAN FRAASSEN, Bas C., *The Empirical Stance* (New Haven, CT: Yale University Press, 2002), Lecture 2 'What is empiricism and what could it be?'. Also available online at: http://lib.myilibrary.com/browse/open.asp?id=172986.

Structural Realism

A recently popular form of realism, advertised as avoiding some of the problems of older forms of scientific realism.

(A)


(B)


Ladyman's SEP article, above, provides a rich guide to the further literature for enthusiasts.

Incommensurability

A theme in Kuhn and Feyerabend is the supposed 'incommensurability' of (sufficiently different) rival theories. The idea is that observation-sentences embedded in sufficiently different theories can't be directly compared. For some background on observation/theory issues, you need to look at e.g.:

Two other useful background introductions are:

CHALMERS, Alan F., What Is This Thing Called Science?, 2nd ed. (Milton Keynes: The Open University Press, 1982), ch. 3 'Experiment'.


And for the debate about incommensurability, see:

(A)


KUHN, Thomas, The Structure of Scientific Revolutions (Chicago, IL: University of Chicago Press, 1962), ch. 10 'Revolutions as Changes of World View'. Also available online at: http://lib.mylibrary.com/?id=243761.


KUHN, Thomas, The Road since 'Structure' (Chicago, IL: University of Chicago Press, 2000), ch. 2 'Commensurability, Comparability, Communicability'.

BIRD, Alexander, Thomas Kuhn (Chesham: Acumen, 2000), ch. 5 'Incommensurability and Meaning'. Also available online at: http://doi.org/10.1017/UPO9781844653065.007.

(B)


CONFIRMATION

Hypothetico-Deductive Model, and Bayesian Responses

A classic view (a.k.a. 'deductivism', 'the hypothetico-deductive model') is that a scientific theory is a body of hypothesized laws from which observational consequences are deduced, and a theory is tested by checking how the observational consequences tally with reality, and is confirmed by positive outcomes. For some initial orientation, see:


(If it will do no harm at all to read Howard Sankey's piece on 'Scientific Method' while you have the Companion off the shelf). Hempel and Nagel give classic outlines in:

The H-D model of confirmation can seem so compelling that it is difficult to conceive of alternatives. So for a different sort of model, see:


Finally, to round out the Hájek/Joyce discussion of Bayesian views, see:

HOWSON, Colin, and Peter URBACH, *Scientific Reasoning: The Bayesian Approach* (La Salle, IL: Open Court, 1989), ch. 4 'Bayesian versus non-Bayesian approaches'.

The paradoxes of confirmation

i) The 'Ravens' Paradox

Since 'all ravens are black' is equivalent to 'all non-black things are non-ravens' does that mean that observing white shoes is a way of confirming that indeed all ravens are black?

(A)


HOWSON, Colin, and Peter URBACH, *Scientific Reasoning: The Bayesian Approach* (La Salle, IL: Open Court, 1989), ch. 4 'Bayesian versus non-Bayesian approaches'.


(B)


ii) The 'Grue' Paradox

Define 'Grue' to mean 'Either green and observed before midnight on 31.12.2010 or blue and not observed before midnight on 31.12.2010'. Then all observations to date equally well support e.g. 'all emeralds are green' and 'all emeralds are grue'. What's to choose?

(A)


(B)

BLACKBURN, Simon, *Spreading the Word* (Oxford: Clarendon Press, 1984), ch. 3 'How is meaning possible? (2)'.


The Stalker collection contains enough other papers to keep the most gruesomely enthusiastic satisfied!
Bayesianism


Falsificationism

(A)


Papineau's classic *The Logic of Scientific Discovery* is highly readable; but for a brief introduction to his views in their mature form see:


For initial discussion, see:

CHALMERS, Alan F., *What is This Thing Called Science?*, 2nd ed. (Milton Keynes: The Open University Press, 1982), chs. 4-7.


BAYESIANISM


(B)


MILLER, David, *Critical Rationalism: A Restatement and Defence* (Chicago: Open Court, 1994). [Especially chs. 1-3]


Also available online at: [www.dawsonera.com](http://www.dawsonera.com).

SCIENTIFIC EXPLANATION AND LAWS

What, if Anything, Distinguishes Scientific Explanation?

For a general introduction, see:


Also available online at: [http://lib.myilibrary.com/?id=42876](http://lib.myilibrary.com/?id=42876).

And for a longer treatment, see the excellent:


Also available online at: [www.dawsonera.com](http://www.dawsonera.com).
See also:

Also available online at: [http://doi.org/10.1093/0198247044.001.0001](http://doi.org/10.1093/0198247044.001.0001)


### The Deductive-Nomological Model and Its Rivals

On the Deductive-Nomological Model, see:

(A)


PSILLOS, Stathis, *Causation and Explanation* (Chesham: Acumen, 2002), ch. 8 'Deductive–nomological explanation'. Also available online at: [www.dawsonera.com](http://www.dawsonera.com).

(B)


The causal model of explanation is argued, inter alia, to avoid the problems of the DN model. On the causal and related methods of explanation, see:

(A)


(F)


Best System vs. Anti-Reductionist Views of Laws

Are laws just universal generalizations with some special feature? What makes the difference between a law and a mere accidental generalization? Armstrong’s review of ‘Humean’ views, preparatory to giving his own preferred account, is exemplary.

(A)


(B)


CONCEPTS OF PROBABILITY

Background on the Probability Calculus

A good introduction to the probability calculus for philosophers is still:

KYBURG, Henry E., Probability and Inductive Logic (New York: Macmillan, 1970). Also available on Moodle. [Part I, especially ch. 2]
See also:

HOWSON, Colin, and Peter URBACH, *Scientific Reasoning: The Bayesian Approach* (La Salle, IL: Open Court, 1989), ch. 2 'The probability calculus'.


The Interpretations

(A)

For brief introductions, see:


See also:


It is worth looking at some of the historical sources:


(B)


INTRODUCTION TO PHILOSOPHY OF PHYSICS

(A)

KOSSO, Peter, *Appearance and Reality: an Introduction to the Philosophy of Physics* (Oxford: Oxford University Press, 1998). [Good short introduction, covering most of the material that will be in the lectures, in all three sections]


PENROSE, Roger, *The Emperor's New Mind* (Oxford: Oxford University Press, 1989), chs. 5, 6 and (especially) 7. [Highly readable introduction to the central philosophically significant parts of modern physics, relevant to all three sections]


(B)


SKLAR, Lawrence, *Time and Spacetime* (Berkeley, CA: University of California Press, 1974). [Classic and readable book on the spacetime and relativity material, in much more detail than we will deal with it]