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Philosophy and Science in the Greco-Roman World

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Course directors: **István Bárány**, University ELTE, Budapest
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Katerina Ierodiakonou, National Technical University, Athens, Greece/ St. Hugh's College, Oxford, UK
Sir Geoffrey Lloyd, University of Cambridge, UK
Henry R. Mendell, California State University, USA
David N. Sedley, University of Cambridge, UK
Leonid Zhmud, Institute for the History of Science and Technology, St. Petersburg

István Bárány

Assistant Professor at at Eötvös University, Budapest. He is currently a Mellon Research Fellow at the Warburg Institute of London. His main area of research is Platonic philosophy and ancient epistemology. He published a Hungarian translation and commentary of Plato's *Theaetetus* and is preparing a translation and commentary of the *Protagoras*.

Gábor Betegh

Assistant Professor at the Philosophy Department of Central European University. He earned his PhD at the École des Hautes Études en Sciences Sociales, Paris and at the Eötvös University, Budapest. He conducted research at Christ's College, Cambridge and was a Junior Fellow at the Center for Hellenic Studies of Harvard University. He has published on various aspects of ancient cosmology, and his book *The Derveni Papyrus: Cosmology, Theology and Interpretation* is forthcoming at C.U.P.

István Bodnár

Associate Professor at Eötvös University and a Recurrent Visiting Professor at Central European University. He was a Visiting Assistant Professor at the Department of Philosophy of the State University of New York at Buffalo, and held various fellowships: Alexander von Humboldt Research Fellow at the Seminar für Griechische Philologie, Freie Universität Berlin and the Max Planck Institute for the History of Science, Berlin, and most recently Lindzey Fellow at the Center for Advanced Study in the Behavioral Sciences, Stanford. He has published numerous papers on ancient logic, Presocratic philosophy and Peripatetic natural philosophy. He edited (with W. Fortenbaugh) a volume on Eudemus of Rhodes.

Katerina Ierodiakonou

Tutorial Fellow in Philosophy at St. Hugh's College, Oxford and an Assistant Professor in Philosophy at the National Technical University, Athens. She has published numerous papers on ancient logic, Byzantine philosophy, medicine Her current work focuses on theories of vision and theories of colour. She published (with J. Barnes) *Alexander of Aphrodisias on Aristotle: Prior Analytics 1.1-7* (London, 1991) and is the editor of *Topics in Stoic Philosophy* (O.U.P. 1999) and of *Byzantine Philosophy and its Ancient Sources* O.U.P. 2002.

Henry Mendell

Professor at the Department of Philosophy of California State University. He has worked on different aspects of ancient Greek philosophy and logic (especially Aristotle), ancient Greek mathematics, ancient astronomy (especially Eudoxus). He has created various graphic and animated illustrations of ancient astronomy, mathematics and philosophy of mathematics, including the Internet based 'Vignettes of Ancient Mathematics'. His recent publications include the edition (with Pat Suppes and Julius Moravcsik) of *Ancient and Medieval Traditions in the Exact Sciences: Essays in Memory of Wilbur Knorr*.

David N. Sedley

Laurence Professor of Ancient Philosophy at the University of Cambridge. He is best known for his work on Hellenistic philosophy. As well as many articles in the field, he has published, with A.A. Long, the standard work on the subject, *The Hellenistic Philosophers*. He is an expert on Epicureanism, and his latest book is *Lucretius and the Transformation of Greek Wisdom* (C.U.P. 1998). His book on Plato's *Cratylus* is coming out at C.U.P, and he is preparing now a book on Plato's *Theaetetus*. He has also worked extensively on the editing of philosophical papyri. One recent publication is an edition of the anonymous commentary on Plato's *Theaetetus*, in *Corpus dei papiri filosofici greci e latini III* (Florence 1995). He is currently editor of *Oxford Studies in Ancient Philosophy*.

Leonid Zhmud

Leonid Zhmud is Professor at the Institute for the History of Science and Technology in St. Petersburg. He has published on ancient science and medicine and on early Greek philosophy and religion, especially Pythagoreism. He worked at numerous research institutes, including the Institute for Advanced Study at Princeton. He is currently Fellow at the Wissenschaftskolleg in Berlin. His books include *Wissenschaft, Philosophie und Religion im frühen Pythagoreismus* (Berlin, 1997) and *The Development of Technological Ideas in Antiquity, Middle Ages, and the Renaissance* (St. Petersburg 1995, in Russian).

Course objectives

The course will explore the relationship of philosophy and science in the Greco-Roman world, from the Presocratics through the Hellenistic age up to the close of classical antiquity. We will first look at their interrelation in a general way, then try to refine this picture through a number of case studies. Having first discussed the problem of differentiation and emancipation, we will examine the particular influence that mathematics, the natural sciences, astronomy, and medicine exerted on philosophy. On the other hand we will study how philosophy and its methods and techniques framed the content and techniques of scientific thinking and of the individual sciences. Our intention is to show how questions asked and methods used either in science or in philosophy fertilized other areas of intellectual activity, to point out the intimate interaction of science and philosophy. The focus would be on questions concerning the structure of knowledge, methodology, second order theories, argumentation, demonstrational techniques, and polemics.

Course level, target audience

The course is primarily intended for advanced graduate students and young faculty members teaching ancient philosophy, but prospective participants could be those teaching and doing research in the history of sciences, and more generally in classics and philosophy. Preference will be given to those applicants who do have some previous knowledge of the ancient world and classical philosophy, but in-depth knowledge of topics discussed will not be required. The language of the course is English, but as some texts will be analyzed in the original, a working knowledge of Greek and Latin will be strongly recommended.

Course content

As a first approach to the topic we will set the scene by raising some general problems. Some modern versions of how scientific knowledge and philosophy could be characterized independently and in relation to each other will be discussed. In this preliminary discussion, we will raise some of the questions the course intends to refine, enlarge and perhaps tentatively answer, viz. the similarity and difference of ancient and modern scientific knowledge, the nature and standards of ancient science and ancient philosophy. The overall question of the relationship of science and philosophy in the Greco-Roman world will be formulated. We will also ask here how this relationship was conceived by the

ancients. As a historiographical introduction, the ways of writing the history of early Greek philosophy and science will be discussed.

The individual courses held by the different resource persons will then explore various facets of this many-sided relationship both from a chronological and a thematic perspective. The major thematic topics to be discussed are cosmology, the mathematical sciences – including optics and astronomy – and medicine.

The Presocratic period stands apart not only chronologically, but in more essential ways as well. It is questionable whether we should speak about the relationship between philosophy and the sciences in the so-called Presocratic period as two distinct intellectual areas, or instead we should speak about science and philosophy *in statu nascendi* before differentiation. The criteria according to which Plato and Aristotle are considered philosophers and those they set up for philosophy and science will also be discussed as the background against which Presocratic science and philosophy can be interpreted.

We will look closely at the Presocratics recurrently, as a number of the prevalent topics, problems, and questions were formulated or adumbrated in this period. The relationship of medicine and philosophy, as well as the science of cosmology, the paradigm for any philosophical enterprise will be examined. A complete module will be devoted to the Pythagorean school, concentrating on the development of the exact (i.e. geometry, arithmetic, astronomy, harmonics) and the natural (physiology, botany, anatomy) sciences in the Pythagorean school of the 6th-4th centuries, and their relationship to the philosophical theories of the Pythagoreans will be assessed.

Cosmology remained one of the foci of interest throughout the history of Greek philosophy. It is also here where the interaction of scientific and philosophical considerations is most conspicuous in the different theories. One particularly notable aspect of this is the debate between teleology and its opponents which became explicit in the 4th century BC. It will be asked how far such concerns had already informed Presocratic thinking, in addition to examining the character of the debate as it is found in Plato, Aristotle, and the Hellenistic philosophers.

Besides cosmology, another science deserving particular attention is mathematics. One module will examine mathematical proof as a major form of Greek cultural practice. Greek mathematical proof will be contrasted with (1) mathematical practice in the Ancient Near East, (2) non-demonstrative mathematical practice in the Greek world. Then the main features of Greek mathematical proofs will be discussed, focusing on the role of the diagram in Greek mathematics. The survey leads on to a brief glance at the relevance of mathematical proof to ancient philosophy of science.

Another example for the strong interplay of mathematics – geometry – and philosophical thinking is provided by a basic characteristic of Classical and Hellenistic science, that of explaining phenomena with geometrical models. How did scientists and philosophers conceive this relation? We shall examine several puzzling stories about the relation between the phenomena to be explained in a theory and the models constituting the theory. There are two fundamental historical questions we shall raise. First, to understand a description of an astronomical model, it is important to grasp what phenomena the model captures. As a case study, we shall examine the development of the astronomical models of Eudoxus (4th century) from the evidence in Plato, Aristotle, and Epicurus. The relation between phenomena and models in Greek science poses a second, deeper puzzle for us. Commonly, the construction of geometrical models employs assumptions known to be either false or unobservable. Yet these models cannot merely be thought experiments, as is the case with Archimedes' *Sand Reckoner*, since the conclusions are believed. This is particularly problematic when we consider Aristotle's argument on the rainbow, given his views that the premises of demonstration must be necessary. Thus, how are we to understand such modeling?

Another instance of the interaction between philosophy and sciences is to be found in the different theories of vision. Research on ancient theories of vision has mainly dealt with Plato and Aristotle. Besides these, we will also examine later theories of vision, namely (1) those of the Stoics and the Epicureans in Hellenistic times, and (2) those of Galen and the Aristotelian commentators in Late Antiquity. In particular, the focus will be on colour perception, that is on what exactly happens on these views when we see colours. These theories will be considered both on their own and against the background of Plato's *Timaus* and Aristotle's *De anima* and *De sensu*. This topic has also important

bearings on the philosophy of mind, and is discussed frequently in this context by historians of philosophy and modern philosophers alike.

Tentative course syllabus:

TOPICS	RESOURCE PERSON	NO. OF HOURS	TEACHING MODE	DISCUSSION POINTS
Introduction	Course directors	2	Lecture and panel discussion	
Proofs and mathematical practices	t.b.a.	2	Lecture	Comparison of mathematical practice in the Ancient Near East with Greek demonstrative and non-demonstrative procedures
Proofs and mathematical practices	t.b.a.	2	Participant presentation and discussion of core texts	see above
Diagrams and proofs	t.b.a.	2	Lecture	The main features of Greek mathematical proof are presented, focusing on the role of the diagram in Greek mathematics. The class leads on to a brief glance at the relevance of mathematical proof to Ancient Philosophy of science.
Diagrams and proofs	t.b.a.	2	Participant presentation and discussion of core texts	see above
The exact sciences and philosophy in the early Pythagorean school	Leonid Zhmud	2	Lecture	The development of the exact (geometry, arithmetic, astronomy, harmonics) sciences in the Pythagorean school of the 6th-4th centuries (from Pythagoras to Archytas and his students) and their relationship with the philosophical theories of the Pythagoreans.
The exact sciences and philosophy in the early Pythagorean school	Leonid Zhmud	2	Participant presentation and discussion	see above
Natural sciences, mathematics, and philosophy in the early Pythagorean school	Leonid Zhmud	2	Lecture	Pythagorean study of nature: physiology, botany, anatomy, and its interrelationship with mathematical research and philosophical presuppositions in the school
Natural sciences, mathematics, and philosophy in the	Leonid Zhmud	2	Participant presentation and	see above

early Pythagorean school			discussion	
Applied mathematical sciences in the 5th-1st cent. BCE.	Henry Mendel	2	Introductory lecture	Philosophical issues of using geometrical models as explanatory devices of the phenomena. We shall chart several puzzling stories about the relation between the phenomena to be explained in a theory and the models constituting the theory.
Applied mathematical sciences in the 5th-1st cent. BCE.	Henry Mendel	2	Seminar, analysis of key texts and discussions	A case study: the development of the astronomical models of Eudoxus (4 th c. BC) from the evidence in Plato, Aristotle, and Epicurus.
Thought experiments and explanations from false starts	Henry Mendel	2	Participant presentation and seminar	Commonly, the geometrical models employ assumptions which were known to be either false or at least unobservable. Yet these models cannot merely be thought experiments, since the conclusions are believed. This is particularly problematic in Aristotle's case, given his views that the premises of demonstrations must be necessary.
Mid-course discussion	Course directors	2	Participant presentation and discussion	
Design and accident in Greek cosmology	David Sedley	3	lecture	The debate between teleology and physicalism -how far such concerns had already informed Presocratic thinking -examining the character of the debate as it is found in Plato, Aristotle - the polemics between the Hellenistic schools
Design and accident in Greek cosmology	David Sedley	3	Participant presentation and seminar	see above
Before differentiation 1	t.b.a.	2	Lecture and discussion	Ways of writing the history of early Greek philosophy and sciences
Before differentiation 2	t.b.a.	2	Lecture and discussion	Criteria for philosophicity in Plato and Aristotle
The cosmological paradigm as a philosophical enterprise	t.b.a.	2	Participant presentation and discussion	The Presocratics and the <i>Timaeus</i>
Medicine and philosophy in the Presocratic period	t.b.a.	2	Participant presentation and discussion	Discussion of mutual influences: method, content, and argumentative strategies
Ancient theories of vision.	Katerina Ierodiakonou	3	Lecture	Theories of vision - of the Stoics and the Epicureans - of Galen and the Aristotelian commentators in Late Antiquity,

				with special focus on colour vision, both on their own and against the background of Plato's <i>Timaeus</i> and Aristotle's <i>De anima</i> and <i>De sensu</i> .
Ancient theories of vision.	Katerina Ierodiakonou	3	Seminar: analysis of key texts, discussion	see above
End of course discussion	Course directors	2	Participant presentation and discussion	

Teaching methods and assessment

Teaching will be centred on the discussion of source texts. Each resource person chooses manageable sized ancient source texts (with optional secondary literature) which he/she considers as characteristic, outstandingly influential, or in other ways significant for the topic. These texts will be distributed and studied by the participants in advance. The resource person first gives a lecture in which he/she can give his/her reasons for choosing these particular texts or passages, delineates the historical context, and provides an interpretative framework. For selected topics, the participants will be asked to prepare presentations in advance. Lectures and presentations will be followed by a discussion in a seminar format. Visual presentations will be especially important for the mathematical and astronomical topics.

The assessment will be based on the level of mastery of the assigned readings, on the contribution in discussions, and on the quality of the presentations.

For more detailed biographies, updated course description, syllabus, reading lists please check <http://www.ceu.hu/sun/index.html>

Non-discrimination policy statement

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