Curriculum Vitae

HASOK CHANG

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1. BIOGRAPHICAL INFORMATION

Date of Birth: 26 March 1967
Place of Birth: Seoul, South Korea
Nationality: United States of America

2. ACADEMIC APPOINTMENTS

01/1995–present **University College London**
Department of Science and Technology Studies
Professor of Philosophy of Science from 10/2008
Reader in Philosophy of Science 10/2005–09/2008
Senior Lecturer in Philosophy of Science 10/2002–09/2005
Lecturer in Philosophy of Science 01/1995–09/2002

07/1993–12/1994 **Harvard University**
Research Associate, Department of Physics

3. EDUCATION

09/1989–08/1993 **Stanford University**
Ph.D. in Philosophy
Dissertation: Measurement and the Disunity of Quantum Physics

09/1992–01/1993 **Harvard University**
Visiting graduate student, Department of the History of Science

09/1985–06/1989 **California Institute of Technology**
B.S. with Honors in Independent Studies Program,
with an emphasis on theoretical physics and philosophy

09/1987–06/1988 **Hampshire College**
Visiting student

09/1983–06/1985 **Northfield Mount Hermon School**, Northfield, Massachusetts

4. PUBLICATIONS (in reverse chronological order in each category)

Books

Hasok Chang, Is Water H_2O? Evidence, Pluralism and Realism, forthcoming in Boston Studies in the Philosophy of Science. Dordrecht: Springer.

Hasok Chang, Inventing Temperature: Measurement and Scientific Progress. Oxford Studies in the Philosophy of Science. New York: Oxford University Press, 2004.

Edited books

Hasok Chang and Catherine Jackson, eds., An Element of Controversy: the Life of Chlorine in Science, Medicine, Technology and War, BSHS Monographs, No. 13. British Society for the History of Science, 2007. A collection of studies by undergraduate students at University College London.

Seung-Joon Ahn, From State to Community: Rethinking South Korean Modernization, ed. by Hasok Chang and Eric Jacobson. Littleton, Colorado: Aigis Publications, 1994.

Articles: major research papers (peer-reviewed, unless otherwise indicated)

Hasok Chang, "Phlogiston Revisited: How Philosophical Failure Can Generate Historiographical Refinement", in Seymour Mauskopf and Tad Schmaltz, eds., Integrating History and Philosophy of Science: Problems and Prospects (Durham, N.C.: Duke University Press, forthcoming).

Hasok Chang and Grant Fisher, "What the Ravens Really Teach Us: The Intrinsic Contextuality of Evidence", in Philip Dawid, ed., Evidence, Inference and Enquiry (London: British Academy, forthcoming).

Hasok Chang, "We Have Never Been Whiggish (About Phlogiston)", Centaurus 51 (2009), 239–264.

Hasok Chang, "Ontological Principles and the Intelligibility of Epistemic Activities", in Henk de Regt, Sabina Leonelli, and Kai Eigner, eds., Scientific Understanding: Philosophical Perspectives (Pittsburgh: University of Pittsburgh Press, 2009), 64–82.

Hasok Chang, "Operationalism", Stanford Encyclopedia of Philosophy (online, published in July 2009). http://plato.stanford.edu/entries/operationalism

Hasok Chang, "Contingent Transcendental Arguments for Metaphysical Principles", in Michela Massimi, ed., Kant and Philosophy of Science Today, Royal Institute of Philosophy Supplement 63 (Cambridge: Cambridge University Press, 2008), 113–133.

Hasok Chang, "Scientific Progress: Beyond Foundationalism and Coherentism", in Anthony O'Hear, ed., Philosophy of Science, Royal Institute of Philosophy Supplement 61 (Cambridge: Cambridge University Press, 2007), 1–20.

Hasok Chang, "The Myth of the Boiling Point" (online hypertext paper with video links), http://www.ucl.ac.uk/sts/chang/boiling, first posted on 18 October 2007. Not peer-reviewed.

Hasok Chang, "A Case for Old-Fashioned Observability, and a Reconstructed Constructive Empiricism", Philosophy of Science 72 (2005), 876–887.

Hasok Chang and Sabina Leonelli, "Infrared Metaphysics: The Elusive Ontology of Radiation (Part 1)"; "Infrared Metaphysics: Radiation and Theory-Choice (Part 2)", Studies in History and Philosophy of Science 36 (2005), 477–508, 686–705.

Hasok Chang and Sang Wook Yi, "The Absolute and Its Measurement: William Thomson on Temperature", Annals of Science 62 (2005), 281–308.

Hasok Chang, "Preservative Realism and Its Discontents: Revisiting Caloric", Philosophy of Science 70 (2003), 902–912.

Hasok Chang, "Rumford and the Reflection of Radiant Cold: Historical Reflections and Metaphysical Reflexes", Physics in Perspective 4 (2002), 127–169.

Hasok Chang, "Spirit, Air and Quicksilver: the Search for the 'Real' Scale of Temperature", Historical Studies in the Physical and Biological Sciences 31:2 (2001), 249–284.

Hasok Chang, "How to Take Realism Beyond Foot-stamping", Philosophy 76 (2001), 5–30.

Hasok Chang, "History and Philosophy of Science as a Continuation of Science by Other Means", Science and Education 8 (1999), 413–425.

Hasok Chang, "Can Planck's Constant be Measured with Classical Mechanics?", International Studies in the Philosophy of Science 11 (1997), 223–243.

Hasok Chang, "On the Applicability of the Quantum Measurement Formalism", Erkenntnis 46 (1997), 143–163.

Jordi Cat, Nancy Cartwright and Hasok Chang, "Otto Neurath: Politics and the Unity of Science", in Peter Galison and David Stump, eds., The Disunity of Science (Stanford: Stanford University Press, 1996), 347–369.

Gerald Holton, Hasok Chang and Edward Jurkowitz, "How a Scientific Discovery is Made: A Case History", American Scientist 84 (1996), 364–375.

Hasok Chang, "Circularity and Reliability in Measurement", Perspectives on Science 3 (1995), 153–172.

Hasok Chang, "The Quantum Counter-Revolution: Internal Conflicts in Scientific Change", Studies in History and Philosophy of Modern Physics 26 (1995), 121–136.

Hasok Chang, "A Misunderstood Rebellion: the Twin-Paradox Controversy and Herbert Dingle's Vision of Science", Studies in History and Philosophy of Science 24 (1993), 741–790.

Hasok Chang and Nancy Cartwright, "Causality and Realism in the EPR Experiment", Erkenntnis 38 (1993), 169–190.

Jordi Cat, Hasok Chang and Nancy Cartwright, "Otto Neurath: Unification as the Way to Socialism," in Jürgen Mittelstraß, ed., Einheit der Wissenschaften (Berlin and New York: Walter de Gruyter, 1991), 91–110.

Other articles

Hasok Chang, "Practicing Eighteenth-Century Science Today", in Mario Biagioli and Jessica Riskin, eds., Worldly Knowledge: Science in Law, Practices, & Institutions, a volume in honor of John Heilbron, forthcoming in Palgrave Studies in Cultural and Intellectual History. Originally given as the inaugural lecture at UCL on 13 May 2009; video podcast available on www.ucl.ac.uk/sts/chang.

Hasok Chang, "Joseph Priestley", in Andrea Woody and Robin Hendry, eds., Handbook of the Philosophy of Chemistry and Pharmacology (Amsterdam: Elsevier, forthcoming).

Hasok Chang, foreword to Matthew D. Lund, N. R. Hanson: Observation, Discovery, and Scientific Change (Amherst, N.Y.: Prometheus Books, 2010), in press.

Hasok Chang, "Chlorine: Undergraduate Research on an Element of Controversy", Journal of Chemical Education 86 (2009), 418–420.

Hasok Chang, "The Myth of the Boiling Point", Science Progress 91 (2008), 219–240.

Hasok Chang and Nancy Cartwright, "Measurement", in Martin Curd and Stathis Psillos, eds., Routledge Companion to the Philosophy of Science (Abingdon and New York: Routledge, 2008), 367–375.

Hasok Chang, "Complementary Science", The Philosopher's Magazine, issue 40 (2008, first quarter), 17–24.

Hasok Chang, "The Historian of Science: Painter, Guide, or Connoisseur?", Centaurus 50 (2008), 37–42.

Hasok Chang, "When Water Does Not Boil at the Boiling Point", Endeavour 31 (2007), 7–11.

Hasok Chang, "Turning an Undergraduate Class into a Professional Research Community", Teaching in Higher Education 10 (2005), 387–394.

Hasok Chang, "La fisica dei fenomeni termici", in Storia della scienza, editor-in-chief Sandro Petruccioli, 10 vols. (Rome: Istituto della Enciclopedia Italiana, 2001-04), vol. 7 (2003), 451–470.

Nancy Cartwright, Stathis Psillos and Hasok Chang, "Theories of Scientific Method", in The Cambridge History of Science, vol. 5, Modern Physical and Mathematical Sciences, ed. by Mary Jo Nye (Cambridge: Cambridge University Press, 2003), 21–35.

Book reviews

- Bernadette Bensaude-Vincent and Jonathan Simon, Chemistry: The Impure Science, for Metascience (forthcoming).
- Ursula Klein and Wolfgang Lefèvre, Materials in Eighteenth-Century Science, for 1650–1850: Ideas, Aesthetics, and Inquiries in the Early Modern Era (forthcoming).
- Katharine Anderson, Predicting the Weather: Victorians and the Science of Meteorology, for Public Understanding of Science 16 (2007), 507–508.
- Peter Galison, Einstein's Clocks, Poincaré's Maps: Empires of Time, for The American Scientist 91 (2003), 552–554.
- Peter T. Landsberg, Seeking Ultimates: An Intuitive Guide to Physics, for Studies in History and Philosophy of Modern Physics 33 (2002), 368–371.
- Xiang Chen, Instrumental Traditions and Theories of Light: The Uses of Instruments in the Optical Revolution, for Annals of Science 59 (2002), 436–439.
- Imre Lakatos and Paul Feyerabend, For and Against Method, ed. by Matteo Motterlini, for Annals of Science 57 (2000), 456–457.
- Crosbie Smith, The Science of Energy, for Ambix 47 (2000), 50–51.
- Robert Locqueneux, Préhistoire & Histoire de la Thermodynamique Classique (Une histoire de la chaleur), for Ambix 45 (1998), 37.
- Deborah Mayo, Error and the Growth of Experimental Knowledge, for British Journal for the Philosophy of Science 48 (1997), 455–459.
- Alan Megill, ed., Rethinking Objectivity, for International Studies in the Philosophy of Science 10 (1996), 82–84.
- David Cassidy, Einstein and Our World, for Isis 87 (1996), 383–384.

5. MASS MEDIA

Series Consultant for The Genius of Britain, produced by IWC Media for Channel 4, 2009.

Appearances on In Our Time, BBC Radio 4

- Heat, 4 December 2008
- Oxygen, 15 November 2007

Appearance on Absolute Zero, BBC4/Nova documentary produced by Windfall Films, 2007.

"Turning an undergraduate class into a professional research community", Times Higher Education Supplement, 30 November 2007, p. 21.

6. SELECTED PRESENTATIONS (in reverse chronological order; full list available on request)

General note:
By the end of 2009 I will have given academic presentations in 12 countries, at a variety of settings including 17 UK universities and 9 US universities. Since 2006 I have given an average of 15 presentations per year. The following is a selection designed to give a sense of the range of topics and venues, and to include the most significant occasions.

"We Have Never Been Whiggish (About Phlogiston)", for the CHSTM seminar series, University of Manchester, 13 October 2009; for the Berkeley/UCSF Colloquium in History of STM, at UC Berkeley, 14 April 2008.

"A Case for Scientific Pluralism", for the conference "Science as it could have been: perspectives on the contingent/inevitable aspects of scientific practices", 2 September 2009, at the Fondation des Treilles, Tourtour, France.

"Practicing 18th-Century Science Today", inaugural lecture at UCL, 13 May 2009.

"Bringing History, Philosophy and Science Together in the Lab", at the 2nd Biennial Conference for Integrated History and Philosophy of Science, University of Notre Dame, South Bend, Indiana, 12 March 2009.

"Water: the Long Road from Aristotelian Element to H_2O", for the Royal Society Lunchtime Lectures, 5 December 2008.

"Phlogiston Revisited: An Argument for Scientific Pluralism" (various titles), at the Dept. of HPS, University of Cambridge, 20 November 2008; at the University of Minnesota, 12 September 2008; at the Program in History & Phil. of Science and Technology, Stanford Univ., 17 April 2008.

"The Myth of the Boiling Point" / "When Water Does Not Boil at the Boiling Point" (various titles), for Salisbury Café Scientifique, at the Salisbury Arts Centre, 14 October 2008; at the Royal Academy of Engineering ("Engineering and Metaphysics"), 3 September 2007; for the UCL Chemical and Physical Society, 9 January 2007; at Kingston Grammar School, Surrey, 10 October 2006; etc.

(with Ruth Ashbee, Rosemary Coates, Emma Goddard, and David Nader) "How Chlorine Helped Research and Teaching to Come Together", at the British Society for the History of Science annual conference (joint meeting with the Canadian and U.S. societies), at Keble College, University of Oxford, 5 July 2008.

"Inventing Temperature"/"The Philosophical Thermometer" (various titles), for the Portsmouth and District Physical Society, at the Univ. of Portsmouth, 16 Jan. 2008; for the Institute of Physics, South Central Branch, at the University of Sussex, 27 Nov. 2007; for BURPS (Balliol Undergraduate and Research Physics Society), Oxford, 9 May 2006; at the Deutsches Museum, Munich, 25 October 2004; etc.

"The Philosophical Grammar of Scientific Practice", keynote address at the first biennial conference of the Society for Philosophy of Science in Practice, at the University of Twente, 23 August 2007.

"Conditional Transcendental Arguments for Ontological Principles", at the conference "Kant and the Philosophy of Science Today" at UCL, 2 July 2007.

"Inventing Temperature", Lakatos Award Lecture, at the London School of Economics, 18 April 2007.

"HPS as Complementary Science" (various titles), at the workshop "Does History of Science and Philosophy of Science Have a Future Together?", at UCL (the first UK annual Integrated HPS workshop), 16 June 2006; at the conference "*What Is This Thing Called Science?* — 20 Years On", Univ. of Sydney, 21 June 1997; etc.

"Scientific Progress: Beyond Foundationalism and Coherentism", at the Royal Institute of Philosophy, London, 28 October 2005.

"Ontological Principles and the Intelligibility of Epistemic Activities", keynote lecture at the conference "Philosophical Perspectives on Scientific Understanding", Vrije Universiteit Amsterdam, 26 August 2005.

"Preservative Realism and Its Discontents: Revisiting Caloric", at the Philosophy of Science Association biennial conference, Milwaukee, 7 November 2002.

"Spirit, Air and Quicksilver: the Search for the 'Real' Scale of Temperature" (various titles), at the Centre National de Recherche Scientifique, Paris, 16 October 2001; at the Program in History and Philosophy of Science, Seoul National Univ., 10 April 1999; at the Royal Institution (Centre for the History of Science and Technology), 27 Jan. 1998; at the History of Science Society annual meeting,

San Diego, 7 November 1997; for the British Society for the Philosophy of Science (Monthly Seminars), 13 May 1996; etc.

"Rumford and the Reflection of Radiant Cold: Historical Reflections and Metaphysical Reflexes", at Oxford University, Philosophy of Physics seminars, 8 February 2001; at the Program in STS, Massachusetts Institute of Technology, 1 May 2000; etc.

"On the Applicability of the Quantum Measurement Formalism", for the Philosophy of Physics Seminar, University of Oxford, 23 February 1998; etc.

"The Quantum Counter-Revolution", at the Department of History & Philosophy of Science, Univ. of Cambridge, 29 April 1997; etc.

7. AWARDS, GRANTS, AND PROFESSIONAL SERVICE

Awards

For Inventing Temperature:

- Lakatos Award, 2006 (joint winner)
- Ivan Slade Prize of the British Society for the History of Science, 2005 (for excerpted article).
- Finalist for Times Higher Education Supplement (THES) Young Academic Author of the Year, 2005.

Distinguished Teacher Award for 1998–99, Faculty of Mathematical and Physical Sciences, University College London.

Grants

Research Project Grant, "Analysis and Synthesis in 19th-Century Chemistry: Toward a New Philosophical History of Scientific Practice", Leverhulme Trust, 2005–08, £153,905, awarded on 4 July 2005. Funded on this grant, working under my supervision: Georgette Taylor, postdoctoral research fellow; Catherine Jackson, PhD student; Rosemary Coates, administrative assistant (part-time).

"Evidence in the Natural Sciences", part of the multidisciplinary "Evidence, Inference and Inquiry" Research Programme Grant, Leverhulme Trust and the ESRC, 2004–08 (total funding under my management £119,383). Co-director of another part of the programme, "Towards an Integrated Concept of Evidence"; member of the Management Committee for the overall programme (PI: Prof. Philip Dawid). Funded on this grant, working under my supervision: Grant Fisher, postdoctoral research fellow.

Research Fellowship, Leverhulme Trust, 1 October 2000–31 December 2001, £15,800.

Grants from UCL for pedagogical innovations:

- "Electronic access to primary sources in the history of science", £3,000, secondment grant from the Educational and Professional Development (EPD) section, on 27 June 2002.
- "Producing original research through an undergraduate course: a pilot project on the history of chlorine", £5,646, secondment grant from the Centre for Advancement of Learning and Teaching (CALT), on 30 March 2004.
- Follow-up grant on the above, £3,000, granted by the Executive Sub-Committee in Teaching, Learning and Assessment (ESCILTA) on 8 July 2005

Finalist in the category of History and Philosophy of Science, McDonnell Centennial Fellowships, 1999.

Professional service

British Society for the History of Science, Council, July 2007–present.

British Society for the Philosophy of Science, Committee, October 1998–June 2003; in that capacity, representative to the UK Forum for the History of Science, Technology and Medicine.

Centre for Philosophy of Natural and Social Science, London School of Economics:

- Chair of the Management Committee, 2006–09
- Permanent Research Fellow
- Co-director of the research project on "Measurement in Economics and Physics", 1999–2002
- Co-director of the research project on "Dissent in Science", 2002–04

Co-founder, and member of the Organizing Committee, Society for Philosophy of Science in Practice (http://www.gw.utwente.nl/spsp/), 2006–present.

Founding member, Committee for Integrated History and Philosophy of Science (http://www.nd.edu/~andhps), 2006–present.

Philosophy of Science Association:

- Program Committee, biennial conference 2008
- Selection Panel for the editor of Philosophy of Science, 2008

Executive Committee, History of Science Section (Q), British Association for the Advancement of Science, 2002–05.

Editorial board, Historical Studies in the Natural Sciences (formerly Historical Studies in the Physical and Biological Sciences), 2007–10.

Associate editor, British Journal for the History of Science, 2009–present.

Minor editorial-board duties: Teaching in Higher Education, 2006–08; Oxford Dictionary of Scientific Quotations (Oxford: Oxford University Press, 2005), 2000–05; Journal of the Korean History of Science Society; European Journal for the Philosophy of Science (to be launched in 2011); New Directions in Philosophy of Science (monograph series for Routledge).

Referee for manuscripts and proposals for various other journals, and publishers and funding bodies, including: British Journal for the Philosophy of Science, British Journal for the History of Science, Historical Studies in the Physical and Biological Sciences, HYLE: International Journal for Philosophy of Chemistry, International Studies in the Philosophy of Science, Science and Education, South African Journal of Philosophy, Studies in History and Philosophy of Modern Physics, Studies in History and Philosophy of Science; Blackwells, Elsevier, Gordon and Breach, Oxford University Press, University of Queensland Press; Arts and Humanities Research Board.

Referee for tenure and promotion cases at: Harvard University, Indiana University, Duke University.

Ph.D. examiner for: Mauricio Suárez (LSE, 1997), Tchafu Mwamba (LSE, 1997), Towfic Shomar (LSE, 1998), Cynthia Ma (LSE, 2001), Antigoni Nounou (LSE, 2002), John Heard (Imperial College, 2004), Sandy Sakorrafou (Leeds, 2005), George Zouros (LSE, 2006), Samuel Schindler, (Leeds, 2007), Maria Elena Di Bucchianico (LSE, 2009), Daniel Mitchell (Oxford, 2009); M.Phil. examiner for Darrell Rowbottom (Durham, 2002).

External examiner for BA Natural Sciences (Part 1B), University of Cambridge, 2001–04.

Member of departmental review panel for the Department of Philosophy, Durham University, 2009.

8. ADMINISTRATIVE EXPERIENCE AND SERVICE (AT UNIVERSITY COLLEGE LONDON)

Acting Head of Department, Department of Science and Technology Studies, 2008–09;
Deputy Head of Department, 2003–08.

Departmental Graduate Tutor (including admissions), Department of Science and Technology Studies, 1995–2007.

Faculty Graduate Tutor, Faculty of Mathematical and Physical Sciences, 1995–98.

London Centre for the History of Science, Medicine and Technology (collaboration between the Dept. of STS at UCL, the Wellcome Trust Centre for History of Science at UCL, and the Centre for History of Science, Technology and Medicine at Imperial College London, responsible for delivering the MSc in History of Science, Medicine and Technology, and now also the MSc in Science, Technology, Medicine and Society):

- Convenor, 1997–99; 2007–09
- MSc Admissions Tutor, 1995–2004
- MSc Programme Tutor, 1999–2004
- Secretary, 1996–97, 2004–07
- Teaching Monitor, 1995–96

Stream Coordinator (History, Philosophy and Social Studies of Science) for the **Natural Sciences** BSc/MSci programme, 2007–09.

Miscellaneous duties for the Department of Science and Technology Studies:

- Undergraduate Admissions Tutor, 1996–98
- Seminar Coordinator, 1995–96, 2000, 2002–04
- Library Coordinator, 1995–96
- Facilitator/Deputy Chair, Undergraduate Board of Examiners, 1999–2000, 2003–08

Miscellaneous service for UCL:

- College Discipline Committee, 2005–present
- ESCILTA (Executive Sub-Committee on Innovations in Learning, Teaching and Assessment), 2007–present
- Service on a redundancy appeal panel, 2009

9. TEACHING AND SUPERVISION

(Course syllabi and summaries of student evaluations and can be supplied on request.)

Postdoctoral research fellows

- Grant Fisher, 2005–08, on the project "Evidence in the Natural Sciences"
- Georgette Taylor, 2006–08, on the project "Analysis and Synthesis in 19th-century Chemistry"
- Gianluca Baio, 2006–08, on the project "Towards an Integrated Concept of Evidence" (co-supervised with Philip Dawid)
- Josipa Petrunic, 2009–10, ESRC postdoctoral research fellow

PhD students (in the order of starting date; "P" indicates students for whom I have been the principal supervisor; "S" indicates subsidiary supervisor)

- Sarah Star (P), Revisiting the Question of Ontology in Philosophy of Science, 1999–2009 (with a break); pending examination.
- Paolo Palmieri (S, with Andrew Gregory), Galileo's Mathematical Natural Philosophy, 1999–2002; funded by the AHRB. Dr Palmieri is now a tenured associate professor at the University of Pittsburgh.
- Georgette Taylor (P), Variations on a Theme: Patterns of Congruence and Divergence among 18th Century Chemical Affinity Theories, 2001–06; funded by the AHRB. Dr Taylor was subsequently a research fellow at University College London.
- Danny Leung (S, with Chris Lawrence), Biological and Physiological Thinking in English Medicine, with reference to Clifford Allbutt, 2001–05; funded by the Wellcome Trust (primary registration at the Wellcome Trust Centre for the History of Medicine at UCL). Dr Leung went on to teach at the University of Hong Kong.
- Irena McCabe (P), Second Best as a Researcher, Second to None as a Populariser? The Atmospheric Science of John Tyndall, 2002–present (part-time); writing up.
- Hauke Riesch (P, with Brian Balmer), Scientists' View of the Philosophy of Science, 2003–08; funded by the ESRC. Dr Riesch is now a research fellow at the University of Cambridge.

- Catherine Jackson (P), The Transforming Role of Synthesis in 19th Century Chemistry, 2004–08; funded by the Leverhulme Trust. Dr Jackson is currently a teaching fellow at University College London.
- Iain Watts (P), Galvanists and Galvanism in Britain 1790–1820, Jan.–Aug. 2009 (part-time); transferred to Princeton University.
- Andreas Sommer (P, with Sonu Shamdasani), Crossing the Boundaries of Mind and Science: Carl du Prel (1839–1899), Psychical Research, and the Demarcation Problem, 2009–present; funded by the Wellcome Trust.

Research–teaching integration

From 2000 to 2005, I directed a research project in which a community of undergraduate students produced a history of the chemical element chlorine, from its first isolation in the 1770s to the late 20th century. Our chief innovation was the mechanism of *inheritance*: each year students received a body of work produced by the previous cohort and made improvements and additions to it, critiquing and building on their predecessors' works in the same way researchers use "real" secondary literature. The final results were published as a collection entitled *An Element of Controversy: The Life of Chlorine in Science, Medicine, Technology and War* (British Society for the History of Science, 2007). Our work was supported by grants from UCL, which allowed the collaboration of Catherine Jackson (co-editor of the volume), Stephen Rowland and Jason Davies. A new phase of this project started in 2008, on the theme of "Electricity: Innovation and Discovery" (www.ucl.ac.uk/chang/electricity), with the collaboration of Chiara Ambrosio. I have also made attempts to apply the inheritance model on a smaller scale in ordinary courses.

Other teaching innovations and good practice

- An exercise in which students simulate an 18th-century scientific periodical, designed to enhance the understanding of primary sources through immersion (introduced in 2001); developed into the online "Virtual Nicholson's Journal", which is still continuing (www.ucl.ac.uk/sts/chang/nicholson_v6/nicholson6_1.htm, etc.).
- Component-based essay for the introductory philosophy of science course, each component designed to drill the students on each of the stated marking criteria (1998).
- Short-answer examinations, based on a larger number of highly focused questions, designed to test for breadth and precision of knowledge, to complement assessment by essays (1997).
- Essay-marking and feedback: overall mark on each essay computed as a weighted average of marks given on several clearly articulated criteria; a separate page of typed comments on each assessed essay, as well as detailed mark-up of the text itself (1995).
- Re-writing: intensified teaching of writing skills through a follow-up mechanism in which students can rewrite essays in response to criticism for higher marks (1995); this practice was later adopted as departmental policy for first-year modules.

Undergraduate courses at UCL

- HPSCB111/1003 **Philosophy of Science**, 1995/6–1999/0, 2002/3–2003/4, and 2006/7.
- HPSCB106/210 **Topics in Philosophy of Science**, 1994/5–1999/0, and 2002/3.
- HPSCB218/2007 **History and Philosophy of the Physical Sciences**, from 2006/7 **History and Philosophy of Chemistry**, 2001/2–2002/3, 2004/5–2005/6, and 2006/7–2008/9.
- HPSCB211/C311 **History of the Philosophy of Science**, 1994/5, 1997/8, and 1999/0.
- HPSCC313 **Topics in the History of the Physical Sciences** (as an ordinary course before I transformed it as a vehicle for the undergraduate research project mentioned above), 1995/6, 1996/7, and 1998/9.
- Supervision of **BSc dissertations** nearly every year (total of 38 by 2010); full list available upon request.

MSc in History of Science, Medicine and Technology

- **Philosophy of Science**, 1994/5–2008/9, except 2000/1 and 2005/6.
- **Sciences in the Age of Industry** (some lectures), 1998/9–2003/4.
- **Core Course** (some lectures, and tutees), 1995/6–2008/9
- Supervision of **MSc dissertations** nearly every year (total of 21 by 2009); full list available upon request.

MSc in Crime Science, Jill Dando Institute, UCL

- **Thinking Scientifically**, 2003/4 and 2004/5. I designed and taught this required course in the first two years of the new Crime Science MSc programme.

PhD-level seminars

- **Philosophy of Science Workshops**, UCL Graduate School, 5 three-hour sessions yearly, designed especially for PhD students in science and engineering departments, 2006/7–present.
- **All-London History and Philosophy of Science Seminars**: a collaboration between UCL, LSE and Imperial College; primarily intended for PhD students and teaching and research staff in our institutions; 5–6 seminars each year, since the late 1990s; I have been the main UCL-side organiser and contributor for these annual seminars.

Minor or incidental contributions

- HPSCB116/1007 (Research Methods in Science and Technology Studies), occasional sessions in 2001/2–2003/4, and one quarter of the course in 2005/6–2006/7, and 2008/9.
- Undergraduate Preparatory Certificate in Science and Engineering (UPCSE), one lecture on the scientific method yearly, 2002/3–2008/9.
- Key Concepts in Science and Technology Studies: I created this series of masterclass seminars initially for PhD students in our own department; it is now organised by Michela Massimi, and since 2008 given through the Graduate School, open to all UCL PhD students.
- PhD induction, Life Sciences and Clinical Sciences Faculties, lecture on the philosophy of science, yearly, 2006/7–present.
- Session on the history and philosophy of modelling, for the MRes programme in CoMPLEx, 2008/9.

Courses taught at Stanford University, as a graduate teaching assistant:

- The History and Philosophy of 20th-Century Physics
- The Scientific Revolution
- Medical Ethics
- God, Self and World (introduction to philosophy)
- Mind, Matter and Meaning (intermediate epistemology and metaphysics)