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Obituary

David Charles Gooding (21 November 1947–13 December 2009)

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Following his brave fight against cancer that extended over several years, David Gooding died on 13 December 2009, aged sixty-two. The history-of-science community has lost a creative and knowledgeable member of the profession, a popular and distinctive teacher who made substantial and important contributions to the subject from his own unique perspective.

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David was born on 21 November 1947 at Iserlohn, Germany, where his father, Charles Gooding, a captain in the Royal Electrical and Mechanical Engineers, was stationed in the British Military Zone after the Second World War. In 1952 the family moved to Kuala Lumpur, where Charles served as an intelligence officer working with the Malayan secret police during the Malayan Emergency and David's mother, Marjorie, was an assistant controller of economics at the Malay Treasury. Two years later, when David was seven, his parents decided to remove their family from the dangers of the Malayan Emergency and they settled in British Columbia – first in the Comox Valley on Vancouver Island and later in Gibsons on the mainland – where he attended local schools. He had an enquiring mind and early in his life manifested a keen interest in science and the construction of machines.

After attending the University of British Columbia he transferred to Dalhousie University, where he majored in philosophy, gaining his BA in 1970. In the following academic year he proceeded to a master's degree in philosophy at Dalhousie under the encouragement of Ravi Ravindra, who became his friend and mentor. Ravindra, a professor both of physics and of comparative religion at Dalhousie, has written on Christianity from a Hindu perspective, for example in *The Yoga of the Christ in the Gospel According to St John* (1990), and also on science and religion. He exerted a strong influence on David's subsequent life and work. In his personal life David was committed to a liberal and tolerant evangelical Christianity – indeed for a short period served as a churchwarden in Bath.

With a doctoral fellowship from the Canada Council, David entered Linacre College, Oxford, in 1971. Although his D.Phil. was officially supervised by John North (then an Assistant Curator at the Museum of the History of Science), Rom Harré influenced him most while in Oxford. David had originally intended to study Einstein, but, in a bad case of historians' regression, found that to understand Einstein he needed to read Maxwell and in turn that led him to Faraday, where fortunately he stopped. His doctorate was awarded in 1975 for a thesis entitled 'Faraday and the powers of matter: the role of principles, hypotheses, and the interpretation of experiment in the development of Faraday's field theory, as presented in his *Experimental Researches in Electricity*, 1830–1855'. In this thesis (for which he obtained permission for its length to exceed the prescribed limit by fifteen thousand words), he made a close study of Faraday's laboratory notebook, published papers and other primary sources in order to analyse the conceptual and practical resources that Faraday brought to his electrical studies. Although David would later move away from strictly historical studies of Faraday, this early engagement with Faraday's electrical and magnetic researches formed the bedrock of his understanding of the processes of scientific investigation.

Following the award of his doctorate, David was appointed to a lectureship in the Science Studies Centre at the University of Bath, then directed by Harry Collins. Drawing on his doctoral research David subsequently published several important papers in history-of-science periodicals on the development of Faraday's philosophy of nature. These show that Faraday's science, including his experimental work, was informed by a range of intellectual commitments which themselves developed in response to his experiences. Most importantly, David addressed such key conceptual issues as the

conservation and conversion of force, Faraday's notion of space and the geometry of space, the development of field theory and his innovative conception of lines of force, and his rejection of action at a distance. In other papers featuring Faraday, David addressed the question of how scientists working on related topics but using different conceptual systems reach consensus. Taken together these papers provide a penetrating understanding of Faraday's science and are a major contribution to the history of science. They enable us to understand better the processes of science, especially the role of innovative thinking and of visualization. Furthermore, he stressed the role of human agency in the construction of scientific knowledge and that experiment was not just subservient to scientific theory, but could produce knowledge on its own account. It is perhaps difficult now to appreciate just how radical and liberating these ideas were when David first published them.

David not only made substantial contributions to Faraday scholarship through his research papers but also co-organized, with Frank James, a conference in 1984 held at the Royal Institution to reassess Faraday and his work from a number of different perspectives. In accordance with David's insistence that the participants should not ignore scientific practice, the conference included demonstrations of Faraday's experiments (including a splendid one from the cognitive psychologist Ryan Tweney who demonstrated Faraday 'thinking' before providing a cognitive analysis). Papers from this conference were published in *Faraday Rediscovered* (1985), which David co-edited with Frank James. David also co-authored, with Geoffrey Cantor and Frank James, a popular introductory text entitled *Faraday* (1991; subsequently reissued in 1996 as *Michael Faraday*) for the Faraday bicentenary. With Tweney, he edited Faraday's 1822 manuscript notebook of scientific ideas, also published in 1991. In addition to making this important text readily available, the edition was notable for the addition of a very useful glossary of scientific words which were defined in terms of their contemporary meanings.

By the mid-1980s the cuts to university budgets commenced by Shirley Williams and continued by the Conservative government, which came to power in 1979 under Margaret Thatcher, were impacting especially severely on small academic subjects. This entailed various defensive measures which, for David, meant devoting much of his time to attracting American students (who paid significantly higher fees than European students) to come and study at Bath University, a task which involved him in significant travelling. Later, in 1997, the Science Studies Centre was incorporated into the Department of Psychology and David became director when Harry Collins moved to Southampton University. To a considerable extent David had to reinvent himself as a psychologist so that he could be included within his new department's returns for the Research Assessment Exercises. Hence he taught courses on advanced statistics, helped establish the natural-sciences undergraduate degree and the innovative MSc in Science, Culture and Communication which had a strong practical element – the support of the University for this course varied over time.

It is, however, his principal monograph, *Experiment and the Making of Meaning: Human Agency in Scientific Observation and Experiment* (1990; paperback 1994), for which he is best known. It contains a sustained criticism of the then current

philosophies of science for focusing exclusively on the writings of scientists – most often papers published in scientific journals – and ignoring the practice of science, especially the ways in which scientists engage nature in the laboratory. Philosophers were also criticized for making science a cerebral exercise rather than an exploration in which both hand and head were intimately, and reciprocally, involved. David therefore proposed that science should be understood in terms of the interaction of thought, action and actors (i.e. scientists), including the beliefs and skills that the scientist brings to the laboratory. He also recognized that the scientist is a social being who is subject to many influences from the scientific community and from the wider society. David's own experiences as both a philosophy student and a person of practical orientation are reflected in this book.

Although *Experiment and the Making of Meaning* was directed at philosophers of science and also at the emerging discipline of sociology of science, David keenly utilized historical sources and offered a model of how historians can describe experimental procedures. The book is itself a creative dialogue between theories about the nature of science and primary sources dealing with electricity and magnetism in the nineteenth century. A key source was Faraday's detailed laboratory notebook, which he maintained throughout his career, and which allowed David to appreciate in remarkable detail the development of Faraday's research and to chart the interaction between Faraday's thought and his manipulation of wires, magnets, compass needles and so on in the basement laboratory at the Royal Institution. Faraday's published papers were scrutinized by David, but the laboratory notebook enabled him to see just how science was made. For this David developed a remarkably complex and detailed system of mapping various scientific operations which was, in effect, modelling scientific creativity.

In 1989 David met Tom Addis at a conference in Dubrovnik (just before the siege that destroyed much of the old city). Addis, a computer scientist then at the University of Reading, soon moved to Portsmouth. However, their meeting and walks around the old walls were the start of a collaboration that was to last for the remainder of David's life. Addis wanted to develop a visual language for programming and he saw in David's modelling of Faraday's procedures a potential way to achieve this. With significant grants from a joint research council programme and later from the ESRC and the Leverhulme Trust, they and their collaborators worked on producing this visual programming language. This was perhaps the most rarefied of David's work, but he was already moving in this direction; yet his writings and lectures remained rooted in his empirical studies of Faraday, so that even his most ferociously statistical papers included discussion of Faraday's experiments.

David further extended his ideas about the cognitive development of science in his contribution to a conference held at the University of Virginia in March 2001 which led to the publication of *Scientific and Technological Thinking* (2005), which he co-edited with Michael Gorman, Ryan Tweney and Alexandra Kincannon. He had earlier co-edited, with Trevor Pinch and Simon Schaffer, *The Uses of Experiment: Studies in the Natural Sciences* (1989), based on papers from a conference he organized at the University of Bath.

The stress that David was placed under was reflected in a number of ways. For instance, he was unable to speak even for twenty minutes at the International Congress for the History of Science held in Berkeley in 1985 and his paper had to be read for him. Although David was not diagnosed with leukaemia until 2002, it is clear that his illness had begun during the 1990s. Following the diagnosis, David underwent four courses of ever more severe treatment at the Royal United Hospital, Bath, and latterly at the Royal Marsden Hospital.

Tom and Jan Addis's book *Drawing Programs*, dedicated to David in the present tense, was published only a few weeks after his death. They had been planning to write another book together, but David lacked the energy to complete his contribution. However, it appears that sufficient of the text exists to make it publishable in the near future. We therefore look forward to reading David's last academic contributions. He was also intending to write a full-scale study of Faraday's experimental and visual practice – which tragically we will now never see. We will continue to remember David as a wonderfully supportive friend and colleague with a wry sense of humour.

David Gooding: bibliography

'Faraday and the powers of matter: the role of principles, hypotheses, and the interpretation of experiment in the development of Faraday's field theory, as presented in his *Experimental Researches in Electricity*, 1830–1855', University of Oxford D.Phil. thesis, Trinity Term 1975.

Review of Berkson, *Fields of Force*, *British Journal for the History of Science* (1975) 8, pp. 89–91.

'Conceptual and experimental bases of Faraday's denial of action at a distance', *Studies in the History and Philosophy of Science* (1978) 9, pp. 117–149.

'Metaphysics versus measurement: the conversion and conservation of force in Faraday's physics', *Annals of Science* (1980) 37, pp. 1–29.

'Faraday, Thomson, and the concept of the magnetic field', *British Journal for the History of Science* (1980) 13, pp. 91–120.

'Final steps to the field theory: Faraday's study of magnetic phenomena, 1845–1850', *Historical Studies in the Physical Sciences* (1981) 11, pp. 231–275.

Review of Barnes and Shapin, *Natural Order*, *British Journal for the History of Science* (1981) 14, pp. 84–86.

Review of Steffans, *Joule*, *British Journal for the History of Science* (1981) 14, pp. 217–219.

'Faraday, Michael 1791–1867', in Justin Wintle (ed.), *Makers of Nineteenth Century Culture 1800–1915*, London: Routledge and Kegan Paul, 1982, pp. 204–205.

'Empiricism in practice: teleology, economy, and observation in Faraday's physics', *Isis* (1982) 73, pp. 46–67.

'A convergence of opinion on the divergence of lines: Faraday and Thomson's discussion of diamagnetism', *Notes and Records of the Royal Society of London* (1982) 36, pp. 243–259.

Review of Swenson, *Genesis of Relativity*, *British Journal for the History of Science* (1982) 15, pp. 199–200.
Review of Harré, *Great Scientific Experiments*, *British Journal for the History of Science* (1983) 16, pp. 313–314.
Review of Goldman, *Maxwell*, *Isis* (1985) 76, p. 281.
Review of Reingold, *Joseph Henry Papers*, vols. 3 and 4, *British Journal for the History of Science* (1985) 18, pp. 113–114.
(ed., with Frank James), *Faraday Rediscovered: Essays on the Life and Work of Michael Faraday, 1791–1867*, London: Macmillan, 1985.
(with Frank James), 'Introduction', in *Faraday Rediscovered*, pp. 1–13.
'"In nature's school": Faraday as an experimentalist', in *Faraday Rediscovered*, pp. 105–135.
'Experiment and concept formation in electro-magnetic science and technology', *History and Technology* (1985) 2, pp. 151–176.
'"He who proves, discovers": John Herschel, William Pepys and the Faraday Effect', *Notes and Records of the Royal Society of London* (1985) 39, pp. 229–244.
Review of Bernhard, Crawford and Sörbom (eds.), *Science, Technology and Society*, *British Journal for the History of Science* (1985) 18, pp. 239–240.
'How scientists reach agreement about new observations', *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, vol. 1: *Contributed Papers* (1986), pp. 236–244.
Review of Nersessian, *Faraday to Einstein*, *Isis* (1986) 77, pp. 521–523.
'How do scientists reach agreement about novel observations?', *Studies in History and Philosophy of Science* (1986) 17, pp. 205–230.
Review of Nersessian, *The Process of Science*, *British Journal for the History of Science* (1988) 21, pp. 254–255.
(ed., with Trevor J. Pinch and Simon Schaffer), *The Uses of Experiment: Studies in the Physical Sciences*, Cambridge: Cambridge University Press, 1989.
(with Trevor J. Pinch and Simon Schaffer), 'Introduction', in *The Uses of Experiment*, pp. 1–27.
'"Magnetic curves" and the magnetic field: experimentation and representation in the history of a theory', in *The Uses of Experiment*, pp. 183–223.
'History in the laboratory: can we tell what really went on?', in Frank James (ed.), *The Development of the Laboratory*, London: Macmillan, 1989, pp. 63–82.
'Thought in action: making sense of uncertainty in the laboratory', in Michael Shortland and Andrew Warwick (eds.), *Teaching the History of Science*, Oxford: Blackwell, 1989, pp. 126–141.
'How to be a good empiricist', essay review, *British Journal for the History of Science* (1989) 22, pp. 419–427.
'Mapping experiment as a learning process: how the first electromagnetic motor was invented', *Science, Technology and Human Values* (1990) 15, pp. 165–201.
Experiment and the Making of Meaning: Human Agency in Scientific Observation and Experiment, Dordrecht: Kluwer Academic Publishing, 1990; paperback 1994.

'Theory and observation: the experimental nexus', *International Studies in the Philosophy of Science* (1990) 4, pp. 131–182.
(with Tom Addis), 'Towards a dynamical representation of Faraday's experimental procedures', in *Bath 3: Proceedings of the Workshop on Rediscovering Skills in Science, Technology and Medicine*, Bath, 1990, pp. 61–68.
'First lord of British science', review of Smith and Wise, *Energy and Empire*, *Nature* (1990) 344, p. 900.
(with Geoffrey Cantor and Frank James), *Faraday*, London: Macmillan, 1991. Republished as *Michael Faraday*, Atlantic Highlands: Humanities Press, 1996; and translated into Spanish as *Faraday*, Madrid: Alianza Universidad, 1994.
(with Ryan Tweney), *Michael Faraday's 'Chemical Notes, Hints, Suggestions and Objects of Pursuit' of 1822*, London: Peter Peregrinus, 1991.
'Faraday was a hands-on scientist', *Physics Education* (1991) 26, pp. 307–312.
'Faraday's contribution to field physics', *Physics World* (September 1991), pp. 37–39.
(with Tom Addis and Jan Townsend), 'Modelling Faraday's discovery of the electric motor: an investigation of the application of a functional database language', *Proceedings of the Fifth European Knowledge Acquisition for Knowledge-Based Systems Workshop*, 1991.
'From the Royal Institution to the Bank of England', *Physics World*, December 1991, pp. 52–53.
Review of Thomas, *Michael Faraday*, *Endeavour* (1991) 15, p. 192.
'Michael Faraday's apprenticeship: science as a spiritual path', in Ravi Ravindra (ed.), *Science and Spirit*, New York: Paragon House, 1991, pp. 389–405.
'What is experimental about thought experiments?', *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, vol. 2: *Symposia and Invited Papers* (1992), pp. 280–290.
'The procedural turn, or, why do thought experiments work?', in Ronald N. Giere (ed.), *Cognitive Models of Science*, Minneapolis: University of Minnesota Press, 1992, pp. 45–76.
'Putting agency back into experiment', in Andrew Pickering (ed.), *Science as Practice and Culture*, Chicago: University of Chicago Press, 1992, pp. 65–112.
'Mathematics and method in Faraday's experiments', *Physis* (1992) 29, pp. 121–147.
(with Tom Addis and Jan Townsend), 'A principle-based engineering environment', *IEE Colloquium Digest*, No. 1992/191, pp. 2/1–2/10.
(with Tom Addis and Jan Townsend), 'Knowledge acquisition with visual functional programming', in *Knowledge Acquisition for Knowledge-Based Systems*, Lecture Notes in Computer Science, vol. 723, Berlin, 1993, pp. 379–406.
'Imaginary science', review article, *British Journal for the Philosophy of Science* (1994) 45, pp. 1029–1045.
'Re-presenting Faraday', essay review, *British Journal for the History of Science* (1994) 27, pp. 361–364.
'Discovery as creative exploration: Faraday's experiments', *Creativity Research Journal* (1996) 9, pp. 189–205.

'Creative rationality: towards an abductive model of scientific change', *Philosophica* (1996) 58, pp. 73–102.
'Picturing experimental practice', in Michael Heidelberger and Friedrich Steinle (eds.), *Experimental Essays – Versuch zum Experiment*, Baden-Baden: Nomos, 1998, pp. 298–323.
'What can particle physicists count on?', review article, *Metascience* (1999) 8, pp. 361–367.
(with Tom Addis), 'A simulation of model-based reasoning about disparate phenomena', in Lorenzo Magnani, Nancy J. Nersessian and Paul Thagard (eds.), *Model-Based Reasoning in Scientific Discovery*, New York: Kluwer, 1999, pp. 103–123.
(with Tom Addis), 'Learning as collective belief-revision: simulating reasoning about disparate phenomena', *Proceedings of AISB Symposium*, Edinburgh, 1999, pp. 19–28.
'Cognitive history of science: the roles of diagrammatic representations in discovery and modelling discovery', abstract only, in Michael Anderson, Peter Cheng and Volker Haarslev (eds.), *Theory and Application of Diagrams*, New York: Springer, 2000, p. 4.
'Experiment', in W.H. Newton-Smith (ed.), *A Companion to the Philosophy of Science*, Oxford: Blackwell, 2000, pp. 117–126.
'Experiment as an instrument of innovation: experience and embodied thought', in Meurig Benyon, Chrystopher Nehaniv and Kerstin Dautenhahn (eds.), *Cognitive Technology: Instruments of Mind*, Heidelberg: Springer, 2001, pp. 130–140.
'Varying the cognitive span: experimentation, visualization and computation', in Hans Radder (ed.), *The Philosophy of Scientific Experimentation*, Pittsburgh: University of Pittsburgh Press, 2003, pp. 255–283.
'Envisioning explanations – the art in science', *Interdisciplinary Science Reviews* (2004) 29, pp. 278–294.
'Cognition, construction and culture: visual theories in the sciences', *Journal of Cognition and* Culture (2004) 4, pp. 551–593.
'Visualization, inference and explanation in the sciences', in Grant Malcolm (ed.), *Multidisciplinary Approaches to Visual Representations and Interpretations*, Amsterdam: Elsevier, 2004, pp. 1–26.
(ed., with Michael E. Gorman, Ryan Tweney and Alexandra Kincannon), *Scientific and Technological Thinking*, Mahwah, NJ: Erlbaum, 2005.
'Seeing the forest for the trees: visualization, cognition and scientific inference', in *Scientific and Technological Thinking*, pp. 173–217.
(with Michael E. Gorman, Ryan Tweney and Alexandra Kincannon), 'The future of cognitive studies of science and technology', in *Scientific and Technological Thinking*, pp. 345–352.
'Visualisation, inference and explanation in the sciences', *Studies in Multidisciplinarity* (2005) 2, pp. 1–25.
'From phenomenology to field theory: Faraday's visual reasoning', *Perspectives on Science* (2006) 14, pp. 40–65.

'Visual cognition: where cognition and culture meet', *Philosophy of Science* (2006) 73, pp. 688–698.
Review of Baird, *Thing Knowledge*, *British Journal for the History of Science* (2006) 39, pp. 598–599.
'Some historical encouragement for TTC: alchemy, the calculus and electromagnetism', CCT, Warwick, 2–3 November 2007.
(with Tom Addis, Jan Townsend Addis, Dave Billinge and Bart-Floris Visscher), 'The abductive loop: tracking irrational sets', *Foundations of Science* (2008) 13, pp. 5–16.
(with Tom Addis), 'Modelling experiments as mediating models', *Foundations of Science* (2008) 13, pp. 17–36.
(with Tom Addis), 'Simulation methods for an abductive system in science', *Foundations of Science* (2008) 13, pp. 37–52.
Review of Andersen, Barker and Chen, *The Cognitive Structure of Scientific Revolutions*, *Isis* (2008) 99, pp. 661–662.
'Visualizing scientific inference', *Topics in Cognitive Science* (2009) 2, pp. 15–35.