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VOLUME 2

Medieval Science

This volume in the highly respected Cambridge History of Science series is devoted to the history of science in the Middle Ages from the North Atlantic to the Indus Valley. Medieval science was once universally dismissed as nonexistent – and sometimes it still is. This volume reveals the diversity of goals, contexts, and accomplishments in the study of nature during the Middle Ages. Organized by topic and culture, its essays by distinguished scholars offer the most comprehensive and up-to-date history of medieval science currently available. Intended to provide a balanced and inclusive treatment of the medieval world, contributors consider scientific learning and advancement in the cultures associated with the Arabic, Greek, Latin, and Hebrew languages. Scientists, historians, and other curious readers will all gain a new appreciation for the study of nature during an era that is often misunderstood.

David C. Lindberg is Hilledale Professor Emeritus of the History of Science and past director of the Institute for Research in the Humanities at the University of Wisconsin–Madison. He has written or edited a dozen books on topics in the history of medieval and early-modern science, including *The Beginnings of Western Science* (1992). He and Ronald L. Numbers have previously coedited *God and Nature: Historical Essays on the Encounter between Christianity and Science* (1986) and *When Science and Christianity Meet* (2003). A Fellow of the American Academy of Arts and Sciences, he has been a recipient of the Sarton Medal of the History of Science Society, of which he is also past president (1994–5).

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A. GEORGE MOLLAND (1941–2002) pursued the mathematics tripos at Corpus Christi College, Cambridge, receiving the PhD degree in 1967. He then spent his subsequent academic career at the University of Aberdeen, advancing from Lecturer to Senior Lecturer in History and Philosophy of Science.

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Molland's major scholarly contributions were in medieval mathematics and mathematical science (especially the science of motion) and the relationship of medieval mathematical sciences to those of Galileo and the seventeenth century. Toward the end of his career, he returned to studying the Middle Ages, especially Roger Bacon. An edition of a Latin text, with English translation, of Bacon's *Opus Tertium* remains incomplete, owing to Molland's untimely death.

ROBERT G. MORRISON is Associate Professor of Religion at Bowdoin College. His recent book *Islam and Science: The Intellectual Career of Nizam al-Din al-Nisaburi* (2007) won Iran's 2009 World Book Prize for Islamic studies. His research has been funded by NEH and a Graves Award in the Humanities. He is currently studying a Judeo-Arabic text on astronomy and its relation to currents in Islamic science.

WILLIAM R. NEWMAN is Ruth N. Hall Professor and Distinguished Professor in the History and Philosophy of Science at Indiana University. Most of his recent scholarly work has focused on "chymistry" in the early-modern period and on the experimental tradition more broadly. His recent books include *Atoms and Alchemy: Chymistry and the Experimental Origins of the Scientific Revolution* (2006); *Promethean Ambitions: Alchemy and the Quest to Perfect Nature* (2004); and *Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of Helmontian Chymistry* (with Lawrence M. Principe) (2002).

JOHN NORTH (1934–2008) was Professor Emeritus of History of Philosophy and the Exact Sciences at the University of Groningen. A universal scholar, he received his higher education at Merton College, Oxford, where he read mathematics, philosophy, politics, and economics, followed by an external degree in astronomy from the University of London. After earning his doctorate at Oxford, he served as a curator in the Oxford Museum of the History of Science before taking the chair at Groningen. North's many interests included, preeminently, medieval astronomy and astronomical instruments. He was a prolific author, whose major publications included *Chaucer's Universe* (1988); *Richard of Wallingford*, 3 vols. (1976); *Horoscopes and History* (1986); *The Ambassadors' Secret: Holbein and the World of the Renaissance* (2002); and, most recently, *Cosmos* (2008).

VIVIAN NUTTON is Professor of the History of Medicine at the Wellcome Trust Centre for the History of Medicine, University College, London. He has written extensively on the history of medicine from Classical Antiquity to the Renaissance. His books include *Galen, On My Own Opinions* (1999); *Ancient Medicine* (2004); and *Girolamo Mercuriale, De arte gymnastica* (2008). His edition of a forgotten work by Galen, *On Problematical Movements*, will be published by Cambridge University Press. He is a Fellow of the British Academy and of the Deutsche Akademie der Wissenschaften.

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GEORGE OVITT received his PhD from the University of Massachusetts. He has taught history at Dean College, Drexel University, and Sidwell Friends School, and is currently at Albuquerque Academy. His scholarly interests include the history of technology and labor and, in particular, the ways in which the material aspects of human life are affected by cultural concerns. He is author of *The Restoration of Perfection: Labor and Technology in Medieval Culture*.

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KAREN MEIER REEDS, of the Princeton Research Forum and Visiting Scholar at Columbia University and the University of Pennsylvania, is an independent historian of science and medicine whose research focuses on the history of botany from antiquity through Linnaeus. She is the author of *Botany in Medieval and Renaissance Universities* (1991) and *A State of Health: New Jersey's Medical Heritage* (2001); coeditor, with Jean Givens and Alain Touwaide, of *Visualizing Medieval Medicine and Natural History, 1200–1550* (2006); and guest curator of “Come into a New World: Linnaeus & America” (2007). She is also a Fellow of the Linnaean Society of London.

EMILIE SAVAGE-SMITH is Professor of the History of Islamic Science at the Oriental Institute, University of Oxford. She has published studies on a variety of medical and divinatory practices in the Islamic world, as well as on celestial globes and mapping. Her most recent book (with Peter E. Pormann) is *Medieval Islamic Medicine* (2007).

MICHAEL H. SHANK (coeditor of this volume) teaches at the University of Wisconsin–Madison, where he is Professor of the History of Science (and Herbert and Evelyn Howe Bascom Professor of Integrated Liberal Studies, 2008–10). A former associate editor of *Isis*, he is the author of *“Unless You Believe, You Shall Not Understand”: Logic, University, Society in Late Medieval Vienna* (1988); the editor of *The Scientific Enterprise in Antiquity and the*

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Middle Ages (2000); and a coeditor, with Peter Harrison and Ronald L. Numbers, of *Wrestling with Nature: From Omens to Science* (2011) and of Johannes Regiomontanus's *Defensio Theonis contra Georgium Trapezuntium* (Web publication in progress, in association with Richard Kremer).

KATHERINE H. TACHAU earned her PhD from the University of Wisconsin–Madison in 1981. After teaching at Montana State University and Pomona College, she joined the History Department at the University of Iowa in 1985, where she has served as Faculty Senate President. A Guggenheim Fellowship recipient, she studies thirteenth- and fourteenth-century philosophy, science, and art of Paris, Oxford, and other European universities, in publications ranging from *Vision and Certitude in the Age of Ockham: Optics, Epistemology, and the Foundations of Semantics, 1250–1345* (1988) to “God’s Compass and *Vana Curiositas*: Scientific Study in the Old French *Bible moralisée*,” *Art Bulletin*, 80 (1998).

ANNE TIHON is Doctor in Classical Philology (Université Catholique de Louvain) and also Professor at the Université Catholique de Louvain (Louvain-la-Neuve). Her teaching concerns the history of science in Antiquity and the Middle Ages, Byzantine history and civilization, Greek paleography, Byzantine texts, and methodology of textual editions. She has provided critical editions of the commentaries of Theon of Alexandria on Ptolemy’s *Handy Tables (Small Commentary and Great Commentary)* (*Studi e Testi* 282, 315, 340, 390) and several editions of Byzantine astronomical texts. She is the director of the *Corpus des Astronomes Byzantins* (ten volumes published).

DAVID WOODWARD (1942–2004) was Arthur H. Robinson Professor Emeritus of Geography at the University of Wisconsin–Madison. A wide-ranging scholar of the history and the art of cartography, he was founding coeditor (with J. B. Harley) of the award-winning multivolume *History of Cartography*. His essay on “Medieval *Mappaemundi*” for volume one (1987) revitalized the study of cosmographical representations.

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GENERAL EDITORS' PREFACE

The idea for *The Cambridge History of Science* originated with Alex Holzman, former editor for the history of science at Cambridge University Press. In 1993, he invited us to submit a proposal for a multivolume history of science that would join the distinguished series of Cambridge histories, launched nearly a century ago with the publication of Lord Acton's fourteen-volume *Cambridge Modern History* (1902–12). Convinced of the need for a comprehensive history of science and believing that the time was auspicious, we accepted the invitation.

Although reflections on the development of what we call "science" date back to antiquity, the history of science did not emerge as a distinctive field of scholarship until well into the twentieth century. In 1912, the Belgian scientist-historian George Sarton (1884–1956), who contributed more than any other single person to the institutionalization of the history of science, began publishing *Isis*, an international review devoted to the history of science and its cultural influences. Twelve years later, he helped to create the History of Science Society, which by the end of the century had attracted some 4,000 individual and institutional members. In 1941, the University of Wisconsin established a department of the history of science, the first of dozens of such programs to appear worldwide.

Since the days of Sarton, historians of science have produced a small library of monographs and essays, but they have generally shied away from writing and editing broad surveys. Sarton himself, inspired in part by the Cambridge histories, planned to produce an eight-volume *History of Science*, but he completed only the first two installments (1952, 1959), which ended with the birth of Christianity. His mammoth three-volume *Introduction to the History of Science* (1927–48), more a reference work than a narrative history, never got beyond the Middle Ages. The closest predecessor to *The Cambridge History of Science* is the three-volume (four-book) *Histoire Générale des Sciences* (1957–64), edited by René Taton, which appeared in an English translation under the title *General History of the Sciences* (1963–4). Edited just before the late-century boom in the history of science, the Taton set quickly became dated.

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General Editors' Preface

During the 1990s, Roy Porter began editing the very useful Fontana History of Science (published in the United States as the Norton History of Science), with volumes devoted to a single discipline and written by a single author.

The Cambridge History of Science comprises eight volumes, the first four arranged chronologically from antiquity through the eighteenth century and the latter four organized thematically and covering the nineteenth and twentieth centuries. Eminent scholars from Europe and North America, who together form the editorial board for the series, edit the respective volumes:

Volume 1: *Ancient Science*, edited by Alexander Jones, University of Toronto, and Liba Chaia Taub, University of Cambridge

Volume 2: *Medieval Science*, edited by David C. Lindberg and Michael H. Shank, University of Wisconsin–Madison

Volume 3: *Early Modern Science*, edited by Katharine Park, Harvard University, and Lorraine Daston, Max Planck Institute for the History of Science, Berlin

Volume 4: *Eighteenth-Century Science*, edited by Roy Porter, late of Wellcome Trust Centre for the History of Medicine at University College London

Volume 5: *The Modern Physical and Mathematical Sciences*, edited by Mary Jo Nye, Oregon State University

Volume 6: *The Modern Biological and Earth Sciences*, edited by Peter J. Bowler, Queen's University of Belfast, and John V. Pickstone, University of Manchester

Volume 7: *The Modern Social Sciences*, edited by Theodore M. Porter, University of California, Los Angeles, and Dorothy Ross, Johns Hopkins University

Volume 8: *Modern Science in National and International Context*, edited by David N. Livingstone, Queen's University of Belfast, and Ronald L. Numbers, University of Wisconsin–Madison

Our collective goal is to provide an authoritative, up-to-date account of science – from the earliest literate societies in Mesopotamia and Egypt to the end of the twentieth century – that even nonspecialist readers will find engaging. Written by leading experts from every inhabited continent, the essays in *The Cambridge History of Science* explore the systematic investigation of nature and society, whatever it was called. (The term “science” did not acquire its present meaning until early in the nineteenth century.) Reflecting the ever-expanding range of approaches and topics in the history of science, the contributing authors explore non-Western as well as Western science, applied as well as pure science, popular as well as elite science, scientific practice as well as scientific theory, cultural context as well as intellectual content, and the dissemination and reception as well as the production of scientific knowledge. George Sarton would scarcely recognize this collaborative effort as the history of science, but we hope we have realized his vision.

David C. Lindberg
Ronald L. Numbers