

Preface to the Second Printing

This work was first printed in 1996 by Garland Publishing as No. 4 in the series *Sources and Studies in the History and Philosophy of Classical Science* (Alan C. Bowen and Francesca Rochberg, eds.). The printed copies sold out and the work has been out of print for well over five years. Since there seemed to be a steady interest in obtaining copies of the work, the authors approached the American Mathematical Society and were pleased to learn that they, with the London Mathematical Society, were interested in republishing it in the AMS/LMS *History of Mathematics* series. Both authors take this opportunity to thank both societies and AMS Acquisitions Editor Edward Dunne for their cooperation in making this work available again.

Euclid's *Phaenomena* belongs to a branch of ancient mathematical sciences that the Greeks called spherics (*ta sphairika*), whose purpose was to explain the geometry of the celestial sphere and its circles as well as the consequences of that geometry for observers on a spherical earth located at the center of the celestial sphere. Ancient writers whose works were part of this genre included, in addition to Euclid, Autolycos, Aristarchos, and Theodosios.

Some recent works relevant to this area, not cited in the previous printing of the *Phaenomena*, are:

Czinczenheim, Claire. *Edition, traduction et commentaire des "Sphériques" de Théodose*. Thesis, Université de Paris IV (2000).

Berggren, J. L., and R. S. D. Thomas. "Mathematical Astronomy in the Fourth Century B. C. as Found in Euclid's *Phaenomena*." *Physis*. (N.S.) Vol. XXIX (1992), pp. 7–33.

Evans, J. C., and J. L. Berggren. *Geminos: Introduction to the Phenomena*. Princeton University Press (to appear 2006).

Evans, J. C. *The History and Practice of Ancient Astronomy* (especially Chapters 2 & 3). New York : Oxford University Press (1998).

Thomas, R. S. D. "Euclid's Non-euclidean Geometry" in *Daimonopylai* (R. B. Egan and M. A. Joyal, eds.). Winnipeg: University of Manitoba Centre for Hellenic Civilization (2004), pp. 469–478.

Lorch, R. "The Transmission of Theodosius' *Sphaerica*", in: *Mathematische Probleme im Mittelalter: Der lateinische und arabische Sprachbereich* (Menso Folkerts, ed.). Wiesbaden: Harrassowitz Verlag (1996), pp. 159–183.

The following errors/misprints in the previous printing should be noted:

p. 15, f.n. 22: C. Czinczenheim informs us in a letter that the citation referred to occurs in Theodosios's *On Habitations*, rather than in his *Sphaerica*.

p. 28: Delete the comma following 'earth' in line 9.

p. 118 (s.v. "Similar arcs"): Change "equal angels" to "equal angles."

p. 122: Change "Bruin, E." to "Bruin, F."

PREFACE

It has often been remarked how completely the masterpieces of Hellenistic exact sciences—for example, Euclid's *Elements*, Apollonius' *Conics*, and Ptolemy's *Almagest*—superseded their predecessors, so that we know almost nothing of, say, Hippocrates of Chios' *Elements*, Euclid's *Conics*, and Apollonius' astronomical writings. As a work of the fourth century BC, Euclid's *Phaenomena* is, therefore, a rare testimony to some of the problems and methods of Greek astronomy before Apollonius, to say nothing of Hipparchus and Ptolemy. Its very survival indicates that its many copyists—from Hellenistic antiquity through the Islamic and Latin Middle Ages and up to the Renaissance—thought that, despite the great advances in astronomy since Euclid's time, the text retained its value as an introduction to the geometry of circular arcs on the sphere and to the problem of rising times of ecliptic arcs.

Yet, in spite of the light the *Phaenomena* sheds on early Greek mathematical astronomy and its record of continuous study—in the East and the West—from the time of Euclid to that of Copernicus, the work has been underrated. Heath does not even summarize it, however briefly, in his *History of Greek Mathematics*; and the lack of a modern translation is surely symptomatic of present views of the work. We feel that much of the modern attitude towards the work reflects a rejection of those parts of Greek science that do not, or cannot be made to, come up to modern expectations of what science should be.

Our hope is that by making the *Phaenomena* available in English we will encourage its study not only by historians of science who have no Greek, but its inclusion in courses in the history of science from which it has up to now been excluded. How it happened that we decided to make Euclid's *Phaenomena* available is a story which is quickly told.

In 1986, one of us was the local organizer for the annual meeting of the Canadian Society for History and Philosophy of Mathematics / Société canadienne d'histoire et de philosophie des mathématiques in Winnipeg.

At that meeting the other of us presented a paper on the period of Greek astronomy into which *Phaenomena* falls and discussed the contents both of that treatise and those by Autolycus. In answer to a question from the audience at the end of the talk, he said that, unlike Autolycus' treatises, the text of Euclid's work was not available in English or French. Thinking that this was remarkable, regrettable and remediable, the other of us wrote to suggest that publication of an English translation with commentary would be a worthwhile joint project. We agreed and then began nearly a year later, having checked with the editor of this series, Alan Bowen, that no one else was working on such a translation. The translation was completed in a year or two; and the subsequent time has been spent preparing the other parts of this volume including the figures, the writing and revision of a paper¹ based on it, and final revisions of the translation, as well as preparing electronic files.

We thank Karl Berggren for preparing an initial version of the diagrams based on those in Menge's text. We also thank the following individuals who have, by their comments and criticisms, aided in improving both our translation and our commentary in content and style: Alan Bowen, Bernard Goldstein, Alexander Jones, and Wilbur Knorr. We alone, of course, are responsible for any errors that remain.

J.L.B. thanks both Harvard University's Department of the History of Science (where he was Visiting Scholar) and Quincy House (where he and his wife were Resident Affiliates) for their generous hospitality extended during a sabbatical leave in 1990–91 and a research term in the Fall of 1992. R.S.D.T. thanks the Department of Mathematics and Statistics at Simon Fraser University for its hospitality during a sabbatical leave in 1988–89. We also thank the Hill Monastic Manuscript Library for making available to us a microfilm of cod. Vind. gr. 31.13, and the Vatican Library for a microfilm of cod. Vat. gr. 204.

Finally, our greatest debt is to our wives, whose love and encouragement has been both support and stimulus in this endeavor, as in so many others. We dedicate this book to them as a token of our gratitude.

¹ J. L. Berggren and R. S. D. Thomas. 1992. 'Mathematical Astronomy in the Fourth Century BC as Found in Euclid's *Phaenomena*' *Physis: Riv. Internaz. Storia Sci.* (N.S.) 29:7–33.