

including an autobiography of Harald von Klüber, are reprinted in full in the appendix (pp. 227–261). Nevertheless, the first part is much more selective in just picking a few interesting episodes, thus omitting many other figures altogether.

For readers interested in episodes relating to Potsdam and its famous array of research institutions (aside from the AOP also the Einstein-Tower, the Miethe reflector (pp. 50ff.), transferred to Potsdam's Telegraph Hill from Berlin downtown), the geomagnetic observatory, the Babelsberg Observatory etc., this book will be of interest as a quarry full of gems, accessible via a reliable name and institution index as well as a clear and finely structured book. Furthermore, many of the author's sentiments and regrets are shared by the reviewer. However, history of science is more than mere compilation of interesting events and remarkable anecdotes.

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***The Globe: How the Earth Became Round*, by James Hannam. (London, Reaktion, 2023). Pp. 376. ISBN 978-1-78914-758-2 (hardback), 140 × 220 mm, US\$27.**

***Eratosthenes and the Measurement of the Earth's Circumference*, by Christopher A. Matthew. (Oxford, Oxford University Press, 2023). Pp. xxiii + 324. ISBN 978-0-19-887429-4 (hardback), 160 × 240 mm, US\$130.**

The size and shape of the Earth is the subject of the two books under review here. The first is by Dr. James Hannam, who obtained a PhD in the history and philosophy of science at the University of Cambridge after a lengthy career as an accountant.

Little ink need be spilt on this book, which drowns in irrelevant details such as the number of oarsmen on a Greek galley, and the development of hybrid strains of rice in China. A tighter narrative would have improved the book tremendously. More significant, he ignores relevant sources.

One wonders how Hannam could write such a text without referencing the book by Nicholas Nicastro (2008) that deals directly with measuring the globe. Hannam's discussion of Pythagoras does not mention the important book by Dr. Alberto Martinez (2013).

Those seeking recent research on Pythagoras specifically as it relates to the Earth's shape must consult Kočandrlje (2023), and for a more nuanced exploration of the Chinese understanding of the sphericity of the Earth than Hannam offers, the recent paper by Huiyi Wu (2024) is essential. On the subject of sources, Hannam gives the quote from Carl Sagan about Earth being a "... pale blue dot ..." as seen from space (page 117), without correcting the record that the phrase was taken by him from the writing of the Soviet astronomer Gavriil Tikhov (Campos, 2021).

That said, I did find Hannam's description of "... history's most notorious defense of the flat earth ..." to be quite interesting (page 173). While its author is best known today under his acquired nom de plume of Cosmas Indicopleustes, he was actually a mere merchant from Antioch named Constantine (fl. c. 520–550). An illustration of the world picture promoted by Cosmas is given on page 174. Even though his text *Christian Topography* from the 540s is notorious now, Cosmas "... was also the first person to explicitly deny Aristotle's view that heavy objects fall faster than light ones ..." (page 175), a fact that took another thousand years to be proven by Galileo. The book by Cosmas was not translated into Latin until the eighteenth century, but

.... it was far from forgotten in the Byzantine Empire. The three complete surviving manuscripts are sumptuously illustrated with reproductions of the pictures that Cosmas himself had originally commissioned. (page 176).

Now to *Eratosthenes and the Measurement of the Earth's Circumference* by Christopher Matthew. Matthew is a Lecturer in Ancient History at the Australian Catholic University in Sydney. He has a PhD in ancient history from Macquarie University (in Sydney), and a second PhD in astronomy/astrophysics from Western Sydney University. His book is a prime example of a fully academic book that reaches the highest standard of excellence by solving a problem that has been outstanding for more than 2,000 years.

As an aside, I find it curious that extremely few references published within the last decade are cited in either book. Many references date to the early twentieth century and earlier; can it really be the case that no

scholarship of relevance has been published recently?

Matthew goes into far greater detail than Hannam on Greek astronomical thought before Eratosthenes (died 194 BCE), with 45 pages devoted to this early work. One point where he needed to be more assertive is in a discussion of Aristarchus, who proposed a heliocentric model. Was he charged with impiety for doing so? Matthew cites the work of Lucio Russo, who claims it was not Cleanthes who filed charges against Aristarchus, but quite the reverse:

However, it is this notion of a prosecution of Aristarchus that still holds today, and the altered text [of Plutarch] is found in almost all modern translations. (page 59).

Setting out the details of the case is all well and good, but Matthew never states which of the two alternatives of this critically important event he accepts.

Going much further back, to Eudoxus (390–337 BCE), Matthew develops a fascinating discussion that mixes money and eclipses. According to Seneca, Eudoxus' knowledge of planetary motion was obtained during his sojourn in Egypt. Matthew does reference the book by Nicastro, who claims Eudoxus ushered in the "... beginning of scientific astronomy." (page 51). His model of the Solar System made allowance for both retrograde motion and "... the inclination of some of the heavenly bodies into one comprehensive system." (page 51). Here he cites an early *JAHH* paper by N.S. [Hetherington](#) (1999: 100), who

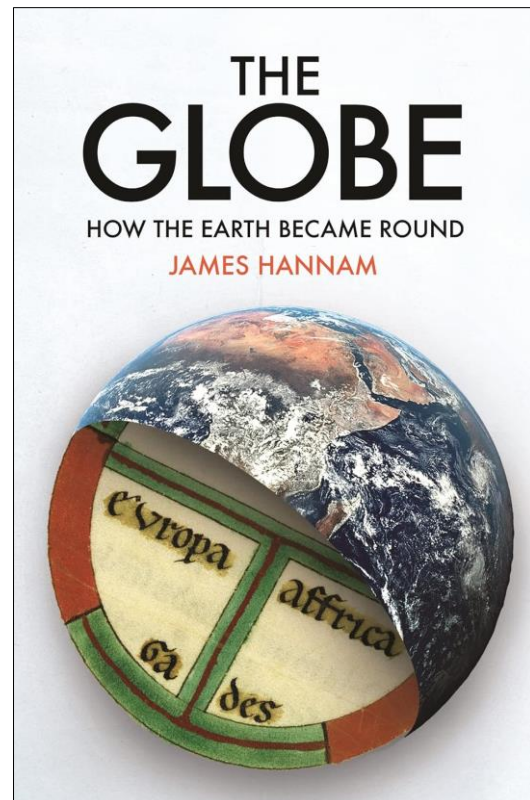
... points out that the four homocentric circles of the Eudoxan model cannot account for the length of planetary retrograde motion, nor changes in latitude, with any accuracy.

Nonetheless, it was the best model available and had a long life. A pupil of Eudoxus

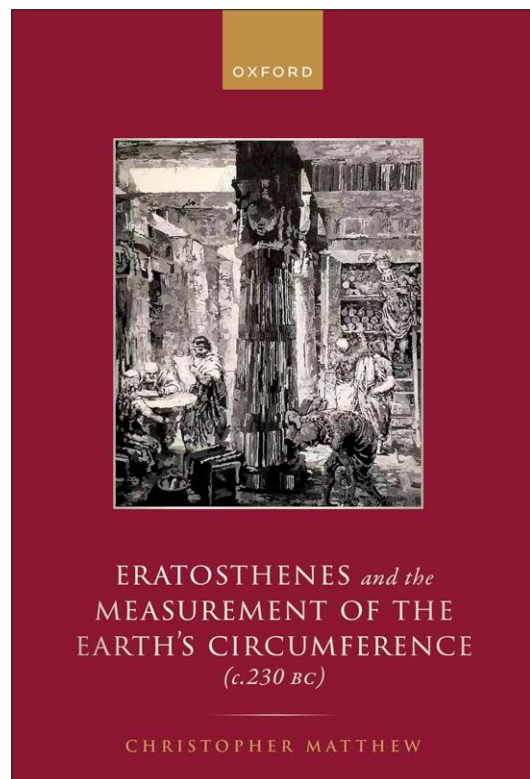
... was awarded 60kg of silver by the tyrant of Syracuse, Dionysius II, for correctly predicting the time of a solar eclipse using the Eudoxan model. (pages 51–52).

Yes, there was a time when astronomers were properly compensated for their hard work!

It is only in Chapter 2, pages 74–128, that Matthew describes Eratosthenes' experiment to calculate the Earth's circumference.



He goes into meticulous detail on ancient Greek and Egyptian sundials, and describes the type of sundial that Eratosthenes possessed. Photos are shown with computer modelling of the sundial, leading to a complete 3D build of it. Pages of mathematical



calculations fully explore this replica and how it was used. In Chapter 3, Matthew enumerates and investigates every possible potential source of error with the sundial, concluding that

... their combined impact is so small as to not contribute to any significant variance to the outcome of Eratosthenes' calculations in Alexandria.

The most startling conclusion Matthew draws is that

... the methodology that Eratosthenes would have employed did not require any direct observations to be made in either Alexandria or Syene at midday on the Summer Solstice, and the measurement from the sundial in Alexandria could have been done at any time of day and on any day of the year ... Indeed, Eratosthenes' methodology was so adaptable in its concept that the experiment and calculations could have been done with any two sundials, for any two locations, regardless of where on the planet the cities they were calibrated for were located. (pages 141–142).

Matthew then offers an in-depth study of all previous attempts to understand what Eratosthenes did, accusing many of "... mathematical expediency." (page 264). This took the form of changing numbers to fit preconceived theories: scholars worked "... backwards from a point that includes the incorrect value for his result." (page 281). The key is determining the length of the *stade* used by Eratosthenes. Remarkably, every previous scholar has used whatever length seemed suitable to fit their ideas, without actually reading two ancient texts that directly state the length of the *stade* used was that of the Pan-Hellenic standard of 180 m.

This is a value for the size of the *stade* that has never been applied to an examination of Eratosthenes' calculation of the circumference of the Earth by any prior scholar,

and has far-reaching implications for understanding the accuracy of his results. (page 232).

With the correct value of the *stade*, Matthew delivers the *coup de grâce* that makes this, in my opinion, one of the most important books on the history of astronomy published in 2023.

Converting the 224,100 *stade* value using the 180 m *stade* identified in this research gives a result for Eratosthenes' calculations of 40,338 km, which differs from the polar circumference of the Earth (40,007 km) by only 0.8 per cent. (page 286).

Matthew's book deserves an award, and contains few typos: "of a life" should read "on a life" (page 44); "that that" should be "that" (page 51); "form Egypt" should be "from Egypt" (page 71); and "that that" should read "that the" (page 87). The book is complete with 80 figures, 17 tables, 18 pages of References, and an Index.

References

- Campos, L., 2021. Mutant strains, mutant rays, and mutant states. *Akademie Schloss Solitude*, 3, June issue.
- Hetherington, N.S., 1999. Plato's place in the history of Greek astronomy: restoring both history and science in the history of science. *Journal of Astronomical History and Heritage*, 2, 87–110.
- Kočandrle, R., 2023. Origins of the spherical Earth in ancient Greek cosmology. *Ancient Philosophy*, 43, 315–335.
- Martinez, A., 2013. *The Cult of Pythagoras: Math and Myths*. Pittsburgh, University of Pittsburgh Press.
- Nicastro, N., 2008. *Circumference: Eratosthenes and the Ancient Quest to Measure the Globe*. New York, St. Martin's Press.
- Wu, H., 2024. An encounter of incommensurables: European cosmological knowledge in the Fenye chapters of Chinese local gazetteers. *Journal of History of Science and Technology*, 18(1), 31–60.

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