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978-1-108-06233-6 - Aristarchus of Samos, the Ancient Copernicus: A History of Greek Astronomy to Aristarchus, Together with Aristarchus's Treatise on the Sizes and Distances of the Sun and Moon

T. L. Heath

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Aristarchus of Samos, the Ancient Copernicus

The Greek astronomer Aristarchus of Samos was active in the third century BCE, more than a thousand years before Copernicus presented his model of a heliocentric solar system. It was Aristarchus, however, who first suggested – in a work that is now lost – that the planets revolve around the sun. Edited by Sir Thomas Little Heath (1861–1940), this 1913 publication contains the ancient astronomer's only surviving treatise, which does not propound the heliocentric hypothesis. The Greek text is based principally on the tenth-century manuscript Vaticanus Graecus 204. Heath also provides a facing-page English translation and explanatory notes. The treatise is prefaced by a substantial history of ancient Greek astronomy, ranging from Homer's first mention of constellations to work by Heraclides of Pontus in the fourth century BCE relating to the Earth's rotation. Heath's collection of translated ancient texts, *Greek Astronomy* (1932), is also reissued in this series.

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ARISTARCHUS OF SAMOS

THE ANCIENT COPERNICUS

A HISTORY OF GREEK ASTRONOMY TO ARISTARCHUS

TOGETHER WITH ARISTARCHUS'S TREATISE

ON THE SIZES AND DISTANCES

OF THE SUN AND MOON

A NEW GREEK TEXT WITH TRANSLATION

AND NOTES

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PREFACE

THIS work owes its inception to a desire expressed to me by my old schoolfellow Professor H. H. Turner for a translation of Aristarchus's extant work *On the sizes and distances of the Sun and Moon*. Incidentally Professor Turner asked whether any light could be thrown on the grossly excessive estimate of 2° for the angular diameter of the sun and moon which is one of the fundamental assumptions at the beginning of the book. I remembered that Archimedes distinctly says in his *Psammites* or *Sand-reckoner* that Aristarchus was the first to discover that the apparent diameter of the sun is about $\frac{1}{720}$ th part of the complete circle described by it in the daily rotation, or, in other words, that the angular diameter is about $\frac{1}{2}^\circ$, which is very near the truth. The difference suggested that the treatise of Aristarchus which we possess was an early work; but it was still necessary to search the history of Greek astronomy for any estimates by older astronomers that might be on record, with a view to tracing, if possible, the origin of the figure of 2° .

Again, our treatise does not contain any suggestion of any but the geocentric view of the universe, whereas Archimedes tells us that Aristarchus wrote a book of hypotheses, one of which was that the sun and the fixed stars remain unmoved and that the earth revolves round the sun in the circumference of a circle. Now Archimedes was a younger contemporary of Aristarchus; he must have seen the book of hypotheses in question, and we could have no better evidence for attributing to Aristarchus the first enunciation of the Copernican hypothesis. The matter might have rested there but for the fact that in recent years (1898) Schiaparelli, an authority always to be mentioned with profound respect, has maintained that it was not after all Aristarchus, but Heraclides of Pontus, who first put forward the heliocentric

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hypothesis. Schiaparelli, whose two papers *Le sfere omocentriche di Eudosso, di Callippo e di Aristotele* and *I precursori di Copernico nell' antichità* are classics, showed in the latter paper that Heraclides discovered that the planets Venus and Mercury revolve round the sun, like satellites, as well as that the earth rotates about its own axis in about twenty-four hours. In his later paper of 1898 (*Origine del sistema planetario eliocentrico presso i Greci*) Schiaparelli went further and suggested that Heraclides must have arrived at the same conclusion about the superior planets as about Venus and Mercury, and would therefore hold that all alike revolved round the sun, while the sun with the planets moving in their orbits about it revolved bodily round the earth as centre in a year; in other words, according to Schiaparelli, Heraclides was probably the inventor of the system known as that of Tycho Brahe, or was acquainted with it and adopted it if it was invented by some contemporary and not by himself. So far it may be admitted that Schiaparelli has made out a plausible case; but when, in the same paper, he goes further and credits Heraclides with having originated the Copernican hypothesis also, he takes up much more doubtful ground. At the same time it was clear that his arguments were entitled to the most careful consideration, and this again necessitated research in the earlier history of Greek astronomy with the view of tracing every step in the progress towards the true Copernican theory. The first to substitute another centre for the earth in the celestial system were the Pythagoreans, who made the earth, like the sun, moon, and planets, revolve round the central fire; and, when once my study of the subject had been carried back so far, it seemed to me that the most fitting introduction to Aristarchus would be a sketch of the whole history of Greek astronomy up to his time. As regards the newest claim made by Schiaparelli on behalf of Heraclides of Pontus, I hope I have shown that the case is not made out, and that there is still no reason to doubt the unanimous testimony of antiquity that Aristarchus was the real originator of the Copernican hypothesis.

In the century following Copernicus no doubt was felt as to

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identifying Aristarchus with the latter hypothesis. Libert Fromond, Professor of Theology at the University of Louvain, who tried to refute it, called his work *Anti-Aristarchus* (Antwerp, 1631). In 1644 Roberval took up the cudgels for Copernicus in a book the full title of which is *Aristarchi Samii de mundi systemate partibus et motibus eiusdem libellus. Adiectae sunt Æ. P. de Roberval, Mathem. Scient. in Collegio Regio Francia Professoris, notae in eundem libellum*. It does not appear that experts were ever deceived by this title, although Baillet (*Fugemens des Savans*) complained of such disguises and would have had Roberval call his work *Aristarchus Gallus*, 'the French Aristarchus,' after the manner of Vieta's *Apollonius Gallus* and Snellius's *Eratosthenes Batavus*. But there was every excuse for Roberval. The times were dangerous. Only eleven years before seven Cardinals had forced Galilei to abjure his 'errors and heresies'; what wonder then that Roberval should take the precaution of publishing his views under another name?

Voltaire, as is well known, went sadly wrong over Aristarchus (*Dictionnaire Philosophique*, s.v. 'Système'). He said that Aristarchus 'is so obscure that Wallis was obliged to annotate him from one end to the other, in the effort to make him intelligible', and further that it was very doubtful whether the book attributed to Aristarchus was really by him. Voltaire (misled, it is true, by a wrong reading in a passage of Plutarch, *De facie in orbe lunae*, c. 6) goes on to question whether Aristarchus had ever propounded the heliocentric hypothesis; and it is clear that the treatise which he regarded as suspect was Roberval's book, and that he confused this with the genuine work edited by Wallis. Nor could he have looked at the latter treatise in any but a very superficial way, or he would have seen that it is not in the least obscure, and that the commentary of Wallis is no more elaborate than would ordinarily be expected of an editor bringing out for the first time, with the aid of MSS. not of the best, a Greek text and translation of a mathematical treatise in which a number of geometrical propositions are assumed without proof and therefore require some elucidation.

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There is no doubt whatever of the genuineness of the work. Pappus makes substantial extracts from the beginning of it and quotes the main results. Apart from its astronomical content, it is of the greatest interest for its geometry. Thoroughly classical in form and language, as befits the period between Euclid and Archimedes, it is the first extant specimen of pure geometry used with a *trigonometrical* object, and in this respect is a sort of forerunner of Archimedes' *Measurement of a Circle*. I need therefore make no apology for offering to the public a new Greek text with translation and the necessary notes.

In conclusion I desire to express my best acknowledgements to the authorities of the Vatican Library for their kindness in allowing me to have a photograph of the best MS. of Aristarchus which forms part of the magnificent Codex Vaticanus Graecus 204 of the tenth century, and to Father Hagen of the Vatican Observatory for his assistance in the matter.

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CORRIGENDUM

P. 179, lines 26 and 31. It appears that *προχωρήσεις*, not *προσχωρήσεις*, is the correct reading in *Timaeus* 40 c. The meaning of *προχωρήσεις* is of course 'forward movements', but the change to this reading does not make it any the more necessary to take *ἐπανακκλήσεις* in the sense of retrogradations; on the contrary, a 'forward movement' and a 'returning of the circle upon itself' are quite natural expressions for the different stages of one simple circular motion. Cf. also *Republic* 617 B, where *ἐπανακυκλούμενον* is used of the 'counter-revolution' of the planet Mars; what is meant is a simple circular revolution in a sense contrary to that of the fixed stars, and there is no suggestion of retrogradations.