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astronomy.

Cleomedes wrote an elementary two-part handbook of astronomy entitled *Κυκλική θεωρία μετεώρων* (“Circular Theory of the Heavens”). Nothing is known of his personal circumstances, and even his dates are uncertain. Since the latest authority he quotes is Posidonius (*ca.* 135–50 b.c.) and since he nowhere mentions Ptolemy (fl. a.d. 127–141), Cleomedes must have lived not earlier than the first century b.c. and not later than the early second century a.d. Attempts have been made to determine his dates astronomically from his statement (I, xi, 59) that at diametrically opposite places on the horizon Aldebaran could be observed setting as Antares rose, each at 15° of its sign (Taurus and Scorpio, respectively); Ptolemy in his star catalog (*ca.* a.d. 138) puts these stars at $12\frac{2}{3}^\circ$ of their signs (*Almagest*, VII, 5, 88, Heiberg, ed; VIII, I, 110). Therefore, it is suggested, the differences of $2\frac{1}{3}^\circ$ must correspond to the difference in date between Cleomedes and Ptolemy because, by the phenomenon known as the [precession of the equinoxes](#), stellar longitudes increase with time by an amount that Ptolemy estimated as 1° in 100 years; hence, $2\frac{1}{3}^\circ$ corresponds to 233 years, giving a date for Cleomedes of *ca.* a.d. 371 (or a.d. 306 by the true figure for precession, 1° in seventy-two years).

Unfortunately, the phenomena described could not possibly have been observed. Since the two stars have different latitudes, they can never be seen at the same time at diametrically opposite points of the horizon; and in any case refraction effects, which near the horizon cause celestial objects to appear over $1/2^\circ$ higher than their true positions, would preclude their being 180° apart in longitude. Aside from this, it is highly improbable that Cleomedes’ “fifteenth degree” of the signs means other than simply the “middle” of them, a loose designation that may include anything from 12° to 18° . He was not writing a scientific treatise but a popular handbook; he almost certainly made no observations himself; and other numerical data he gave are often far from accurate—for example, he described (I. Viii, 42–43) the head of Draco (γ) as being in the zenith” at Lysimachia (lat. 41° N.), whereas its true declination in the period a.d. 1–500 was between $+52.8^\circ$ and $+52.3^\circ$, an error of over 20 percent; similarly, he stated that from Lysimachia to Syene (now Aswan) (lat. 24° N.), assumed to be on the same meridian, is $1/15$ the whole circumference, an error of over 25 percent.

Thus, to base conclusions concerning his date on an apparent discrepancy of $21/3^\circ$ (or 17 percent) is unrealistic. Other internal evidence—the extent and virulence of his diatribes against the Epicureans (in the longest chapter of his work he compared them unfavorably with rats, reptiles, and worms and poured scorn on their scientific naïveté [II, i, 86 ff., 91 f.] and his omission of any reference to Ptolemy (hardly conceivable for a Greek writer on astronomy after the second century)—argues strongly against a date as late as the fourth century but is consistent with one in the first century.

Cleomedes’ work belongs to the class of handbook written to popularize the main ideas in the purely technical treatises of the scientists (particularly astronomers); such books were common in Alexandrian and later Greek literature and exerted considerable influence on Roman and medieval writers (*cf.* W. H. Stahl, *Roman Science* [Madison, Wis., 1962], p.32f.) The treatment of much of the material (usually derived not from the scientific works at first hand but through intermediary sources; e.g. Cleomedes evidently knew Hipparchus’ work only at second hand [II, i, 83] became standardized, and there are many correspondences in both style and subject matter between extant examples of the handbook tradition, as in

the astronomical works of Geminus (first century b.c.), Cleomedes, Theon of Smyrna (early second century a.d.), and Achilles (third century a.d.).

Cleomedes' chief authority is Posidonius, and it is unlikely that he himself added anything original (two sentences affixed to the end of the manuscripts expressly state this), but he also used other sources that sometimes disagreed with Posidonius' views (see I, vi, 32–33). His own astronomical knowledge was that of the well-educated Stoic writer of his time, and its limitations are sometimes apparent—in I, vi, 28, after giving a highly inaccurate arithmetical scheme for calculating the length of the day, he asserted that the zodiac intersects the equator “nearly at right angles”; in II, iv, 105 he rejected altogether the possibility of annular solar eclipses; and in II, vi, 123 that of the “paradoxical” case, when the eclipsed moon rises while the sun appears to be still above the horizon. Where he understood his sources, however, he gave a clear and useful account of basic astronomical phenomena.

In Book I, Cleomedes described the Stoic view of the spherical cosmos permeated by “pneuma” and surrounded by the limitless void (for which he argues, against Aristotle), with the spherical earth stationary at the center; he explained the main circles of the [celestial sphere](#) (equator, tropics, “arctic” and “antarctic” circles, the latter being the limits of the stars always visible or always invisible at a particular latitude), the corresponding zones of the terrestrial globe, their different climates, and changes in the length of day and night and in the positions of the circles relative to the horizon at different latitudes. He gave approximately correct values for the astronomical seasons and knew that the sun's orbit is eccentric to the earth, that the sidereal day is shorter than the solar day (first discovered by Hipparchus), and that the sun rises four hours earlier for the Persians than for the Spaniards (I, vi, 29, 30, I, viii, 41). He (or rather his source) showed understanding of the effects of refraction at the horizon (II, i, 66 f.; see II, vi, 124, which he might have used to account for the “paradoxical” lunar eclipse), explained the moon's phases correctly, intelligently criticized current notions about lunar phenomena, and understood the mechanism of eclipses (I, IV, V, VI). Planetary phenomena were only briefly touched on; there is no mention of epicycles, but lunar and planetary deviations in latitude were recognized (II, vii); approximately correct figures for the zodiacal periods (except for Mars) were given (I, iii—known to the Greek astronomers since the end of the fifth century b.c.); and remarkably accurate values for the synodic periods (Mercury, 116 days; Venus, 584; Mars, 780; Jupiter, 398; Saturn, 378—II, vii) are presented. Finally, Cleomedes was the only Greek writer whose extant work gives details of the methods used by Eratosthenes and Posidonius for estimating the circumference of the earth (I, x).

BIBLIOGRAPHY

The text of the handbook, with Latin trans. and commentary by J. Bake, was ed. by R. Balfour (Lyons, 1820); and, with Latin trans., was ed. by H. Ziegler (Leipzig, 1891).

See also A. Rehm, “Kleomedes,” in Pauly-Wissowa, XI (1922), cols. 679–694.

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