

ANATOLIA "THE LAND WHERE SCIENCE WAS BORN AND FLOURISHED"



LIFE

Hipparchus was a Greek astronomer and mathematician. Hipparchus carried out his observations in Bithynia, at Rhodes, where he spent much time, and also, it seems, at Alexandria. He is known for discovering the change in the orientation of the Earth's axis and the axis of other planets with respect to the center of the Sun. He was also the inventor of trigonometry. He had immense in geography and was one of the most famous astronomers in ancient times. He made the first models of the motion taken by the Sun and the Moon which are considered very accurate even in modern times. It is believed that he had used the mathematical formulas derived by the Mesopotamians and the Babylonians over the centuries to arrive at his conclusions. He was the founder of trigonometric tables and was the first one to solve many of the problems related to the trigonometry of spheres. He was possibly the first astronomer to predict the occurrence of solar eclipses with the help of trigonometry and his theories on the movement of the Sun and the Moon. His other great discovery was the accurate calculation of the equinox precession, creation of the first star catalog in the western world, development of the 'astrolabe' and the 'armillary sphere'. His discoveries and creations could only be superseded after three centuries by Claudius Ptolemaeus. Very few documents are available on his life and works.

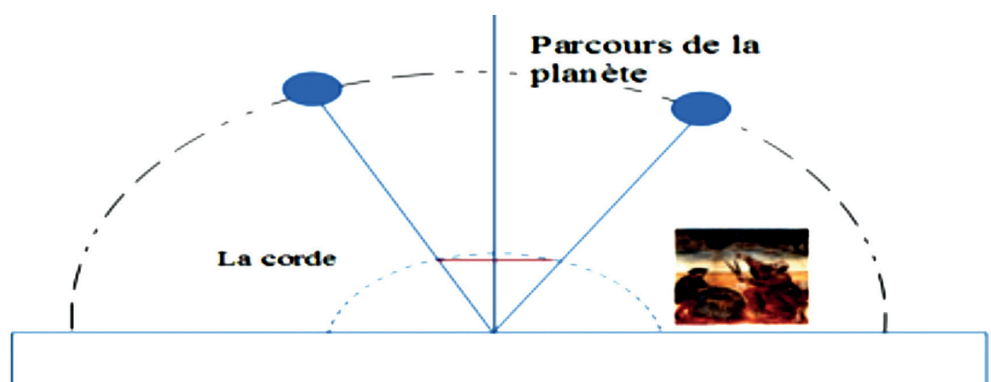
1. Major Works

Out of the numerous works written by Hipparchus the only surviving one available today is a commentary on a poem written by Aratus from the 3rd century titled 'Commentary on the Phenomena of Eudoxus and Aratus'.

1.1. Planetary, Solar, and Lunar Studies

In planetary theory Hipparchus was undoubtedly familiar with the work done by earlier astronomers, and he combined many of his observations with his own but was unsuccessful in formulating a planetary theory. However, he did explain that there are two inequalities for each planet, that the retrogradations of each are variable in extent, and that these phenomena can be represented by combining earlier hypotheses of eccentric circles and epicycles on concentric circles.

With respect to the moon and sun, Hipparchus was indebted to the Babylonians, but he improved upon earlier estimates of the size and distance of the two bodies. Though he himself observed lunar eclipses, he also employed the data on two sets of three eclipses of 383-382 and 201-200. On the basis of his examination of one of these two sets, Hipparchus determined the radius of the lunar epicycle, and on the basis of his examination of the other set, he determined the eccentricity of the lunar orbit. That these factors were equal was a fact about which Hipparchus was well aware. Evidently Hipparchus tried to account only for the inequality in lunar motion, which is due to the elliptical form of the moon's orbit. In discussing lunar latitude, he used data from the eclipse of 502, derived from cuneiform sources; he determined the inclination of the lunar orbit to the ecliptic to be 5°.



In devising a model to account for the inequity of solar motion, Hipparchus was more successful than with the planets and the moon. Brilliantly, by means only of estimates of the time between the vernal equinox and the summer solstice and of that between the summer solstice and the autumnal equinox, he proved that the apogee of the sun lies at Gemini 5:30° (5° 30') and that the eccentricity of the solar orbit is 1/24 of the radius of the eccentric circle. His final work was the determination of the angular diameters and distances, in earth radii, of the sun and moon from the center of the earth. Though Ptolemy was able to improve on these parameters, the gross underestimation of the size of the solar system in antiquity could not be corrected before the 17th century.

HIPPARCHUS

Born & Died: C. 190 - C. 120 BC

Main Interest: Geography, Mathematics, Astronomy

School: Pythagoreanism

Notable Ideas: The father of Trigonometry

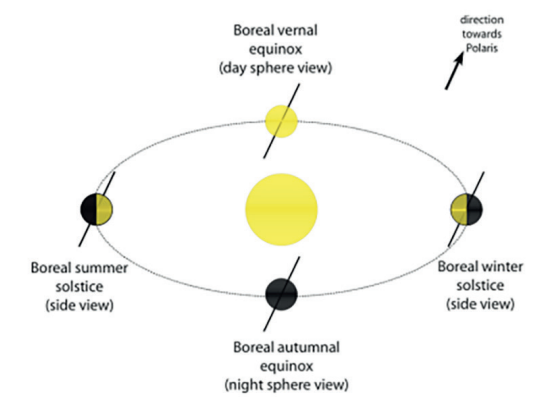
His main contribution was to apply rigorous mathematical principles to the determination of places on the Earth's surface, and he was the first to do so by specifying their longitude and latitude--the method used today

Hipparchus' catalog, completed in 129 BC, listed about 850 stars. For its time, the catalog was a monumental achievement.

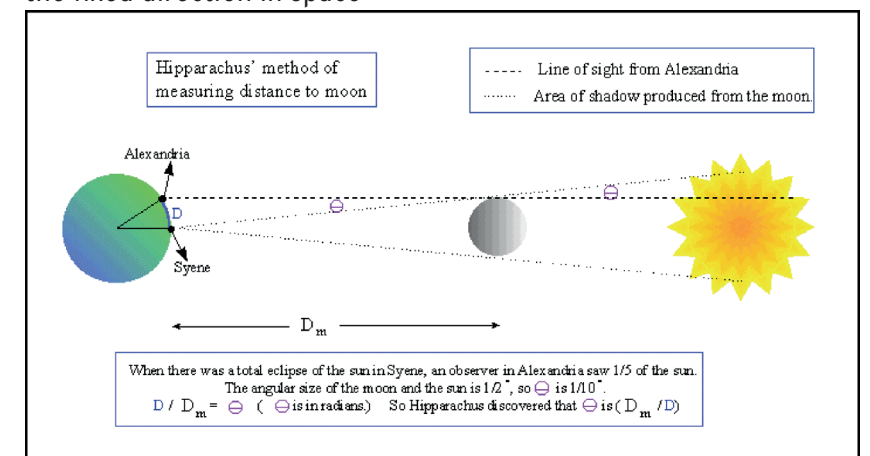
He discovered the precession of the equinoxes, calculated the length of the year to within 6 1/2 minutes, compiled the first known star catalog, and made an early formulation of trigonometry.

1.1. Geographical Work

Hipparchus's work on geography was a criticism, in three books, of Eratosthenes. In his discussion of Eratosthenes's geography he is concerned with mathematical errors in determining the latitudes of, and distances between, places. He evidently desired to establish a coordinate system of parallels of longitude and latitude for determining geographical positions, such as he employed for fixing the positions of the fixed stars. The data at his disposal, however, especially those concerning terrestrial longitude, were not sufficient to carry out his scheme. Fundamental to this effort was his estimate, based on Eratosthenes's value for the circumference of the earth (252,000 stades), that 1° of either longitude or latitude on the earth's surface is equal to a distance of 700 stades.



Schematic presentation of a seasonal cycle. Note the importance of the fixed direction in space



Hipparchus compared observations of a solar eclipse in Syene and in Alexandria

1. Influence of Hipparchus

Hipparchus was a careful and cautious scientist who prepared the way for those who followed him by establishing a high standard of observational astronomy, by devising trigonometrical methods of solving problems in mathematical astronomy, and by collecting and criticizing the observational material of his predecessors, both Babylonian and Greek. Like many another, his greatest achievement was to make it possible for his successors to eclipse him and relegate his works to oblivion.

KORKMAZ YIGIT ANATOLIAN HIGH SCHOOL
Physics Teacher: **HATICE KIRMACI**

