

Eratosthenes of Cyrene (c.276c.196 BC)

A Greek scholar who was the first person to determine the circumference of the Earth. He compared the midsummer's noon shadow in deep wells in Cyrene (now Aswan on the Nile in Egypt) and Alexandria. Then, correctly assuming that the Sun's rays are virtually parallel (since the Sun is so far away) and knowing the distance between the two locations, he worked out the Earth's circumference to be 250,000 stadia. The exact length of a stadium is not known, so his accuracy is uncertain, but he wasn't far off the mark. Among his many other accomplishments, he accurately measured the tilt of Earth's axis and the distance to the Sun and Moon, and devised a method for finding all the prime numbers up to a given number (the Sieve of Eratosthenes).

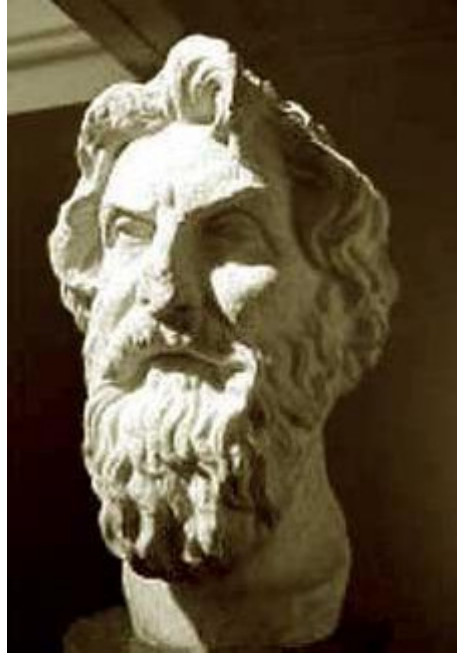


Eratosthenes

Aristarchus of Samos (c.310c.230 BC)

A Greek mathematician and astronomer who was the first to propose a heliocentric theory, with Earth revolving around the Sun. To explain the lack of observed stellar parallax, he argued that the stars must lie very far away. However, his new scheme for the Solar System found little support at a time when Aristotle's geocentric model was in favor and the idea of a moving Earth was frowned upon.

Aristarchus also applied modern geometric methods to measuring the size of celestial bodies. From a lunar eclipse, he concluded that the Moon's radius is half that of Earth (actually it is 0.28 times as big). He measured the Moon's angular diameter to be 2° (actually 0.5°) and calculated the Earth-Moon distance to be 114.6 Earth radii (actually 60.4). By noticing that the Sun and Moon have equal angular diameters during a solar eclipse, he estimated that the Sun's distance was 19.1 times the Moon's (actually 390 times).



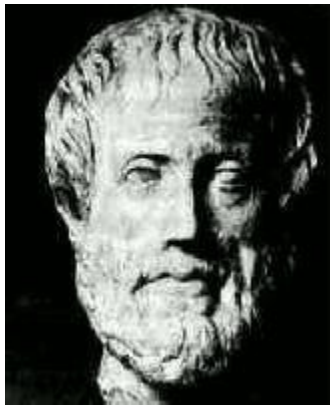
Aristarchus

Aristotle of Stagira (384-322 BC)

Major Greek philosopher, student of Plato, and founder of the Lyceum in Athens, who argued vehemently against the pluralistic teachings of atomism. "The world must be unique," he wrote. "There cannot be several worlds." He justified this stance on a number of grounds. For example, in his *Metaphysics*, he explains the motion of the planets and stars (around the Earth) as due to the "Prime Mover" acting at the periphery. If there were other Earths, there would have to be a plurality of Prime Movers, an idea he rejected as philosophically and religiously unacceptable. In Aristotle's cosmology, the Earth was located at the center of a nested system of crystalline spheres to which were attached the Moon, Sun, planets, and stars. According to his doctrine of "natural motion and place", the four basic elements of earth, air, fire, and water tended to move to their rightful positions with respect to the Earth. Fire moved naturally outward, earth moved naturally inward to the center, while air and water assumed intermediate stations. This fundamental tenet underlay Aristotle's belief in a single *kosmos*, or world system, with the Earth at its focus. If there were more than one world, the elements of fire and earth would have no unique natural place to which to move – for him, a physical and logical contradiction. Aristotle also maintained that there was a clear distinction between the terrestrial and celestial regions. The latter knew neither life nor death and the bodies within it were composed not of Earthly matter but of a fifth element, or "quintessence". It was the innermost sphere, carrying the Moon, he believed, that marked the boundary between the impermanent "sublunary" realm of the Earth and the unchanging superlunary" domain of the heavens. See also ancient philosophy,

related to the possibility of extraterrestrial life.

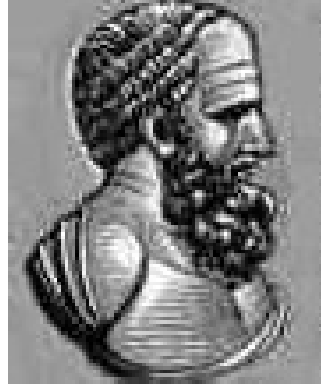
Following its transmission to the West in the 12th century, Aristotle's doctrine of a one-world, geocentric cosmos was appropriated by the Church and largely upheld as being in keeping with the Christian belief in a special relationship between God and Man. However, it did not go unquestioned by medieval theologians, particularly as its insistence that there could be only one world appeared to put constraints on God's power. Between the thirteenth and fourteenth centuries, university scholars, including Jean Buridan, William of Ockham, and Nicole Oresme, gradually reformulated the Aristotelian dictum of natural place so that an omnipotent God would at least have had the logical option to create other worlds. Having said this, almost all medieval Scholastics held to the view that God had in reality created only one world. Extraterrestrials were restricted to spiritual beings like demons, ethereal in their make-up, which, it was supposed, lived in the "middle region", between heaven and Earth. Only following the Copernican Revolution and the overthrow of Aristotle's geocentric cosmology, could the idea of other worlds and other life made of ordinary matter finally take hold



Aristotle

Hipparchus of Nicaea (190-125 BC)

Greek astronomer and mathematician, considered the true founder of his science, who compiled an extensive star catalogue in which he gave the positions of some 850 stars and also classified them according to their magnitude (on a scale of 1 to 6, brightest to faintest). Ptolemy later incorporated this information into his *Almagest*. Hipparchus also found the distance to the Moon using the parallax method (for which he had to produce a table of chords – an early example of trigonometric tables), and, independently of Kidinnu of Babylon, discovered the precession of the equinoxes by comparing his observations with those of Timocharis 150 years earlier. He extended Apollonius of Perga's work on epicycles and eccentrics by offsetting Earth from the center of the planets' orbits in order to explain the different lengths of the seasons.



Hipparchus

Ptolemy (c. 100-168)

An Egyptian astronomer, mathematician, and geographer, also known as Claudius Ptolemaeus, who worked at the great library in Alexandria and based his astronomy on the belief that all heavenly bodies revolve around Earth (see Ptolemaic system). He authored a 13-volume work called *Mathematical Syntaxis*, better known by its later Arabic name, the *Almagest*, which is a compendium of the astronomical works of Hipparchus, Aristotle, and others, and represents the most complete description of the Universe as it was then understood. The *Almagest* includes a star catalogue containing 48 constellations, using the names we still use today. Although no longer in serious use, the catalogue lists 1,022 stars visible from Alexandria and was used as a standard in the Western and Arab worlds for over a thousand years. An even earlier star catalogue was that of Timocharis of Alexandria, written in about 300 B.C. and later used by Hipparchus. Ptolemy's work promulgated a sophisticated version of the Aristotelian, geocentric theory which held sway in the west until the Copernican Revolution.



Ptolemy