Zhang Heng (CE 78-139) was a Chinese polymath who lived in the Han dynasty. He accomplished remarkable achievements as an astronomer, mathematician, engineer, and artist.

Zhang Heng was born to a prestigious family in Nanyang. He left home and studied at the imperial capitals of Chang’an and Luoyang. He gained a reputation for his rhapsodic essays depicting gorgeous landscapes in the empire. He also befriended the best minds of the time, including many literary scholars, calligraphers, and philosophers. At the age of 23, he was appointed as the official in charge of the documents and archives under the local governor of Nanyang. He studied astronomy and mathematics and published works on these subjects.
Career at the Court

In 112, Zhang Heng was summoned to the imperial court with honor thanks to his reputation as a mathematician. There he attained an audience with the emperor, and was appointed Chief Astronomer, a subordinate of the Minster of Ceremonies. His jobs included recording heavenly observations, drafting the calendar, reporting omens related to celestial movements, and educating clerks in the imperial Secretariat.

In 132, Zhang invented a seismoscope and introduced it to the court. It is reported that he was able to detect the direction of distant earthquakes with this device, while no tremor was perceived in the capital. Ancient Chinese believed in the mystical relationship between natural phenomena and political activities. Zhang Heng was no exception—he interpreted earthquakes and celestial movements as heavenly responses to human behavior. Using his astronomical knowledge, he criticized court policies and sought to influence the emperor.
When slandered by his political rivals, the eunuchs surrounding the emperor, Zhang Heng wrote a poem entitled “Four Sorrows” to lament his failure to woo a beautiful woman due to the barriers of mountains, snow, and rivers. It is believed that the poem was an innuendo for his inability to keep in contact with the emperor.

Achievements in Science

Before Zhang Heng, the Chinese approximated pi as 3. Zhang Heng compared the celestial circle to the diameter of the earth, proportioning the former as 736 and the latter as 232. He thus calculated pi as 3.1724. Later, in his book on science entitled Lingxian (the Spiritual Constitution of the Universe), he further calculated pi as 3.1466.

Zhang Heng speculated that the universe was shaped like an egg, “as round as a crossbow pellet”, with the stars on the shell and the Earth as the yolk in the center. Previously, in the Warring States period, early Chinese had compiled the first star catalogue. Based on this, Zhang Heng catalogued 2,500 stars and recognized 124 constellations. Zhang’s star catalogue documented more stars than that of the Greek astronomer Hipparchus.
To explain solar and lunar eclipses, Zhang Heng put forward a “radiating influence” theory. He argued that: “The Sun is like fire and the Moon like water. The fire gives out light and the water reflects it. Thus the moon’s brightness is produced from the radiance of the Sun, and the Moon’s darkness is due to [the light of] the sun being obstructed. The side which faces the Sun is fully lit, and the side which is away from it is dark.” This was one of the first Chinese theories to scientifically interpret such natural phenomena.

Zhang Heng was also the first to apply hydraulics to power an armillary sphere, an astronomical instrument representing the celestial sphere. He is also credited with inventing the first odometer in China, a device installed on a horse-chariot to document the distance it covered: once one mile was traversed, a mechanically driven wooden figure struck a drum once. Zhang Heng’s technological inventions and scientific achievements greatly inspired later Chinese. In 2018, China launched a research satellite named Zhangheng-1 (ZH-1) to commemorate the legacy left by this great man.