How can we explain the durability of the concept of an unmoving earth at the center of the cosmos? Aristarchus had proposed a heliocentric system and Heraclides suggested that the earth rotated on its axis; yet their ideas were convincingly refuted by Aristotle and Ptolemy, who created a comprehensive geocentric model that persisted for centuries. To understand the longevity of the geocentric perspective we must consider its cultural context. Greeks believed that earth was composed of four elements; this sublunar realm was subject to “generation and destruction” and characterized by rectilinear motion.[[1]](#footnote-1) The heavens, however, were composed “of a different substance”; its motion was circular and eternal.[[2]](#footnote-2) Geminus explains, "For the **hypothesis underlying the whole of astronomy** is that the sun, the moon and the planets move at uniform speeds in circles . . . For they could not brook the idea of such disorder in things divine and eternal . . .” Disorder could not be tolerated in the Greek cosmos. The job of astronomers was to “save the appearances”—to explain apparently erratic planetary movement in terms of perfect circular motion.

Ptolemy attacked the problem with a clear sense of method. In his preface he declared “that only mathematics can provide sure and unshakeable knowledge to its devotees, provided one approaches it rigorously. For its kind of proof proceeds by indisputable methods, namely arithmetic and geometry.” [[3]](#footnote-3) His geocentric system, although mathematically complex, was based on everyday physical experience and common sense. It also accorded with ancient authority and religion: human beings, then as now, believe they live in a central place. As observed from earth, the heavens move like a sphere[[4]](#footnote-4), “the most perfect and the most like itself of all figures.”[[5]](#footnote-5) The earth “taken as a whole, is sensibly spherical.”[[6]](#footnote-6) Ptolemy states, “it is manifest to any observer that the earth occupies the middle place in the cosmos, and that all weights move toward it.”[[7]](#footnote-7) Since this is the case, “the earth cannot make any movement whatever,” because if it did, “the animals and all separate weights would have been left behind floating in air.” Since earthly substances are naturally at rest and subject to motion only by external force,[[8]](#footnote-8) the idea of a revolving earth is “ridiculous.” Ptolemy declares “that the revolving motion of the earth must be the most violent of all motions associated with it, seeing that it makes one revolution in such a short time.”[[9]](#footnote-9) If the earth were to rotate with such forced motion, “all objects not actually standing on the earth would appear to have the same motion, opposite to that of the earth: neither clouds nor other flying or thrown objects would ever be seen moving towards the east.”[[10]](#footnote-10) He notes that birds are not “fused to the air,” as one might imagine if the air were to move with the earth’s rotation

Ptolemy had “saved the appearances” by using eccentrics, epicycles, and equants to predict anomalous planetary motion accurately enough for ancient observers. He had preserved Aristotelian notions about the nature and movement of heavenly bodies. For Christians, Aristotle’s crystalline spheres left room for God as Prime Mover.[[11]](#footnote-11) The Bible confirmed the earth’s immobility: “The world is firmly established, it cannot be moved.”[[12]](#footnote-12)

1. “In absolutely all parts of the earth, . . . the direction and path of the motion (I mean the proper, [natural] motion) of all bodies possessing weight is always and everywhere at right angles to the rigid plane drawn tangent to the point of impact.” Ptolemy’s *Almagest* I,7; G.J. Toomer, trans. (Springer-Verlag, 1984). [↑](#footnote-ref-1)
2. “. . . there are two different primary motions in the heavens. One of them is that which carries everything from east to west: it rotates them with an unchanging and uniform motion along circles parallel to each other. . .” *Almagest* I,8. See also Aristotle, *On the Heavens* I.3.270b: “For in the whole range of time past . . . no change appears to have taken place either in the whole scheme of the outermost heaven or in ay of its proper parts.” J.L. Stocks, trans. [↑](#footnote-ref-2)
3. *Almagest* I,1. [↑](#footnote-ref-3)
4. *Almagest* I,3: “What chiefly led them to the concept of a sphere was the revolution of the ever-visible stars, which was observed to be circular . . .” [↑](#footnote-ref-4)
5. Plato, *Timaeus* 33 b; B. Jowett, trans. [↑](#footnote-ref-5)
6. *Almagest* I,4. [↑](#footnote-ref-6)
7. *Almagest* I,7. [↑](#footnote-ref-7)
8. “The final cause, then, produces motion as being loved, but all other things move by being moved.” Aristotle, *Metaphysics* XII,7, 1072. “Everything that is in motion must be moved by something.” Aristotle, *Physics* VII,1; R.P. Hardie and R.K. Gaye, trans. [↑](#footnote-ref-8)
9. *Almagest* I,7. [↑](#footnote-ref-9)
10. *Almagest* I,7. [↑](#footnote-ref-10)
11. Ptolemy says that “the first cause of the first motion of the universe . . . can be thought of as an invisible and motionless deity.” *Almagest* I,1. [↑](#footnote-ref-11)
12. Psalm 96:10, New International Version, 1984. [↑](#footnote-ref-12)