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BOOK IV

On Determining Distances and Sizes of Bodies,
in Six Chapters

CHAPTER ONE

On Determining the Measure of the Earth's Sphere and Its Explication

[1] Since it has become well known that the Earth is spherical, its center is the center of the World, its outer surface is parallel to the surface of the zodiacal orb and the distances in any direction are the same, [and] since any celestial equator is divided into 360, with each division called a degree, [then] an equator can also be imagined on the Earth such that its divisions are according to the divisions of the orb. Therefore, anyone moving beneath the meridian circle, such that the altitude of the pole or the maximum altitude of the Sun or any other planet increases or decreases one degree, that person will have traversed the amount of one degree on the Earth. If this amount is multiplied by 360, the size of the Earth's equator will be known. [Now,] from [the size of] the equator, which is well known to the practitioners of the science of surveying, the sphere's diameter, the area of its outer surface, and size can be determined. [This is] because the product of

the radius multiplied by half [the circumference of] the equator gives the area of the plane of the equator, and this amount is a quarter of the area of the surface of the sphere. The practitioners of the discipline [of surveying] have proven these statements and clarified them.

[2] [Concerning this matter,] Ptolemy, who is the master of this science, undertook testing and observation and found the amount of one degree of [the circumference of] the Earth to be $66+\frac{2}{3}$ miles, each mile [being] 3,000 cubits, each cubit 32 digits, [and] each digit 6 barleycorns laid edge to edge. Therefore, the circumference of the Earth is 24,000 miles. [Then] the diameter of the Earth is 7,636 miles, since the ratio of the circumference to the diameter is as the ratio of 22 to 7, approximately, as Archimedes has proven. The surface area of the Earth is 183,264,000 [square] miles, and one quarter of this amount is the area of the inhabited quarter. If we determine the miles [of the length] of the complement of the obliquity and multiply it by the diameter, the area of the settled portion will be 33,812,208 [square miles], which is approximately $\frac{1}{6}+(\frac{1}{6}\times\frac{1}{10})$ of the Earth['s surface area].

[3] During the reign of the Caliph Maʾmūn, a group of the learned reassessed this matter at his order and found the one-degree portion [of the circumference of the Earth] to be $56+\frac{2}{3}$ miles, each mile [being] 4,000 cubits, each cubit 24 digits, [and] each digit being 6 barleycorns laid edge to edge. This amount is close to the amount of Ptolemy's [unit for a] mile, since the difference that arises from the number of cubits [of each mile] is eliminated due to [the difference in] the number of digits [of each cubit], whereas there is a difference in the number of the miles. Thus, the circumference of the Earth is 20,400 [miles], its diameter 6,491 [miles], [its] surface area 132,416,400 [square miles], the width of the settled [portion] 3,763 [miles], [and] the surface area of the settled [portion] 24,425,633 [square miles], each mile being $\frac{1}{3}$ of a parasang.