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are equal in size when the distance of one of them from a pole is equal to the distance of the other circuit from the other pole. When any great circle passes through the two poles of another great circle, their surfaces intersect one another at right angles. [Great circles] that do not pass through each other's two poles intersect at acute and obtuse angles. In any case, any two great circles assumed on a sphere intersect one another at two points. These two points are called the two points of intersection. The maximum distance between those two circles should be equal to the maximum distance between the two poles.

[9] An **orb** is a body bounded by two circular surfaces, one inside and the other outside, the center of both surfaces being the same point. [The orb (*falak*)] has been likened to the whorl (*falaka*) of a spindle. Of the two surfaces, one is called the convex and the other the concave. By borrowing [the term], circles are also called orbs.

[10] A **circular cylinder** is a body whose base and top are two equal and parallel circles and which is bounded by a circular surface. A line serving as the axis stands at right angles to the two circles, and that line is called its **sagitta** (*sahm*).

[11] A **circular cone** is a body whose base is a circle and whose top is a point. The line from that point to the center, i.e., the sagitta of the cone, is perpendicular to the plane of the circle. It is also called a **pine-shaped cone**. This is all that is necessary to present in this chapter.

CHAPTER TWO

On the Introductory Propositions Pertaining to the Science of Natural Philosophy

[1] The introductory propositions that have been demonstrated in the science of natural philosophy, and that are used in this science by way of [accepted] principles without being demonstrated, are as follows:

[2] (a) A body is either simple or composite. A simple is that which is not made up of bodies of different natures or forms. A composite is the opposite of this. Necessarily composites are composed of simples. Simples are of two types: celestial and elemental. The celestials are all the orbs and stars. The elementals are those fourfold substances that are the bases of the world of generation and corruption, i.e., fire, air, water, and earth. The composites are of four types: (1) that whose composition is not complete, such as clouds, wind, shooting stars, and the like. These are called upper phenomena; (2) that whose composition is complete, i.e., it can remain for a period of time and have the capacity to retain its form, but it is not subject to growth. This is called mineral; (3) that whose composition is complete but nonetheless has the capacity for growth. This is called vegetal; (4) that which has in addition to the capacity for growth, the capacity for perception and voluntary movement. This is called animal. The latter three types are called the three engendered [kingdoms]: the fourfold elements are the mothers of these engendered, and the celestial bodies are the fathers. The elements and composites are called lower bodies, and the orbs and stars are called the upper bodies.

[3] (b) Motions are also of two types: one simple, the other composite. Simple motions are of three types: (1) that from the circumference toward the center, and what has this motion is called heavy; (2) that from the center toward the circumference, and what has this motion is called light. Each of these two motions is rectilinear; and (3) that around the center. This motion is circular. In the science of natural philosophy, it has been demonstrated that circular motions are by essence prior to rectilinear motions, i.e., if there is no circular motion there will be no rectilinear motion. The upper bodies can have circular motion but cannot have rectilinear motion, for which reason the philosophers say that the orbs and stars are neither light nor heavy and that rectilinear motion is proper to what is in the world of gen-

eration and corruption. Two of the elements, fire and air, are light; and two, water and earth, are heavy. The heaviness and lightness of composites are according to [their] composition, i.e., that in which the heavy parts are greater is heavy, and that in which the light parts are greater is light.

[4] (c) Every motion must have a principle, which is called the mover of the moving body. If the mover of a body is not outside of the body itself, the motion is attributed to that body. If it is outside, the body is said to be moved by another body. It is not possible for one simple body to be the principle of two different motions. Therefore, for every motion a mover must be established. Those bodies that are set in motion externally terminate at those bodies that are not set in motion externally.

[5] (d) No simple body in which there is a principle of circular motion, such as the celestials, may receive rectilinear motion. This being so, it is not allowable for the celestials to tear and mend. Therefore, the motion of the stars in the orbs cannot be like the motion of a fish in water; rather, for every star an orb must be established by whose motion it is moved. If a star has a particular motion of its own, [this motion] will also be circular about itself.

[6] (e) In circular motions, stopping, turning, reversing direction, and intensifying and its opposite are not permissible, but rather they are always monofromly continuous in the direction toward which the inclination (*mayl*) is directed. These are the introductory propositions that are the principles of this science, the verification of which pertains to the science of natural philosophy and metaphysics—God is all-knowing.