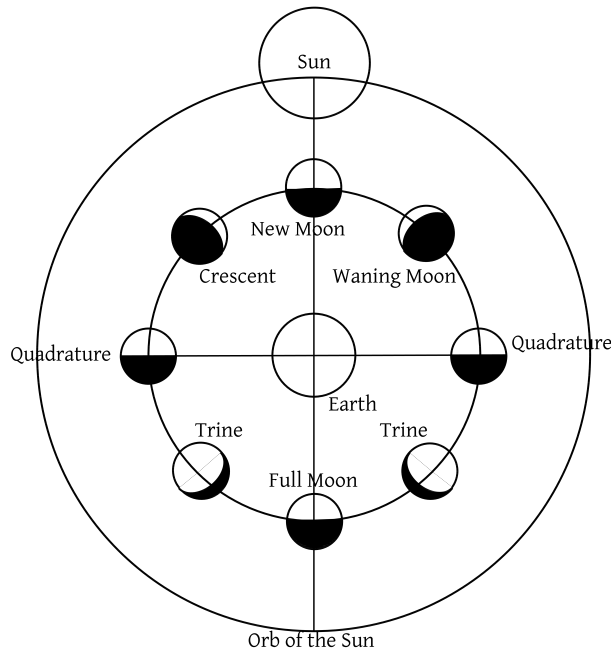


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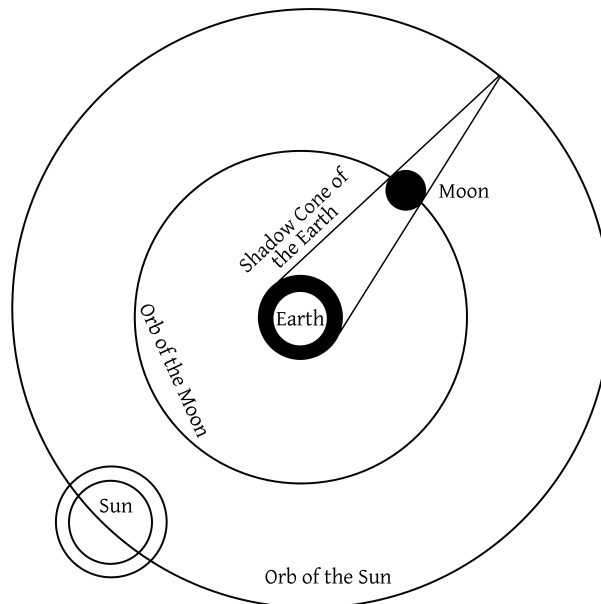
[Figure 1]

CHAPTER THIRTEEN

On the Reason for Lunar and Solar Eclipses, and the Interval Between Two Lunar or Two Solar Eclipses

[1] **Lunar Eclipse.** Since the light of the Moon is from the Sun, whenever the Earth interposes between the Moon and the Sun, it blocks the Sun's light from the [Moon], so that it appears in its actual color. This situation is called a lunar eclipse. It is of course conditional in this case that the Sun, Moon, and Earth, all three, be aligned with one another. Since the Sun is always on the zodiacal equator and the Earth is at the place of the equator's center, inasmuch as the Earth's center is the center of the zodiacal equator, then whenever the Moon is in opposition and does not have much latitude, it will fall into alignment with the Sun and the Earth, and then the lunar eclipse will occur. But if [the

Moon] has a [notable] latitude, it will diverge from this alignment, and there will not be a lunar eclipse. When Sun[light] falls on the Earth, the Earth casts a shadow in the direction opposite its alignment with the Sun. If the Moon's latitude equals the radius of the shadow circle, which [can] touch the Moon, plus the radius of the Moon, the Moon will touch the shadow but no eclipse will occur. If it is greater, the Moon will not even touch [the shadow circle]. If it is less, but greater than the excess of the shadow's radius over the radius of the Moon, part of the Moon will be eclipsed. If it is equal to that excess, the Moon will be fully eclipsed, but there will be no duration. If it is less, there will be a duration. If opposition does not occur at night, the eclipse is imperceptible. Parallax has no effect on a lunar eclipse, because as the Moon falls into darkness, its visibility is the same for all localities. Since it is the Moon that reaches the shadow by its own motion and then passes away from it, a lunar eclipse always begins from the eastern side, and reappearance also begins from that direction—God is all-knowing. And this is the figure of a lunar eclipse:



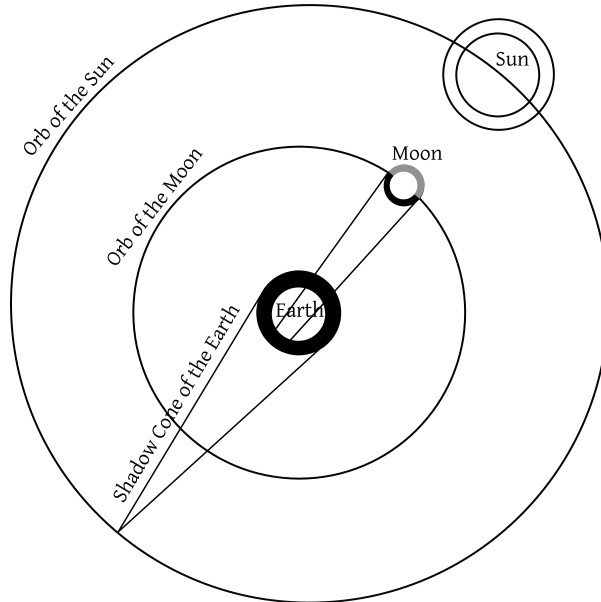
[Figure 1]

[2] **Solar eclipse.** When there is a conjunction such that the body of the Moon interposes between the eyes of individuals and the body of the Sun, the [body of the Moon] blocks the sunlight from them. The side of the Moon's body that is toward them appears black and of its actual color, so it appears that the Sun is blackened; this state of affairs is a solar eclipse.

[3] Since the Sun is on the [zodiacal] equator, for a solar eclipse to occur, the Moon must also be near the [zodiacal] equator; this occurs when its latitude is small. In this instance, parallax has a great effect, inasmuch as sometimes there may be a true conjunction and the Moon has no latitude but still no solar eclipse occurs because the Moon [apparently] has deviated [from conjunction]. When there is an apparent conjunction, a solar eclipse certainly occurs. For the reason we have stated in [the section on] parallax, true conjunction is always closer to the meridian than apparent conjunction. It may also happen that a solar eclipse will occur in one place but not in another.

[4] The apparent latitude is that which is adjusted by parallax. Thus, when there is no apparent latitude, the center of the Moon will be aligned with the center of the Sun [and] the entire body of the Sun will be eclipsed. However, there will be no duration to the solar eclipse, since the circle of the Moon's surface is not larger than the circle of the Sun's surface. When the apparent latitude is less than [the sum of] the radii of both bodies, part of the Sun is eclipsed. If it is equal to that [sum], the Moon appears to be tangent to the Sun, and no eclipse will occur. If conjunction occurs at night, the eclipse will not be visible. And since it is the body of the Moon that passes across the Sun, the beginning of the solar eclipse and its reappearance are always from the western side. Because a northerly latitude appears less in northern localities due to parallax, and a southerly latitude appears greater, there [may] be a solar eclipse with a greater northerly latitude but not with a southerly [latitude, with the same amount]; and the opposite [is the

case] in southern localities. This is an illustration of the solar eclipse:



[Figure 2]

[5] It should be known that usually between any two [consecutive] lunar or two [consecutive] solar eclipses, there will be a period of six lunar months, because when the Moon and Sun come together at one node [in conjunction or when they are at the two nodes]¹ in opposition, a solar or lunar eclipse occurs. Thereafter an eclipse will not re-occur until the Sun reaches the other node. The node condition is due to the fact that the Moon does not have much latitude [at the nodes]. Sometimes a solar eclipse may occur, for example, at a distance from the head, whereby the Sun has passed beyond the head several degrees, and again several degrees before the Sun reaches the tail another solar eclipse may occur, and five months elapse between the two [consecutive solar eclipses]. In lunar eclipses too this is possible. In solar eclipses, however, if the first time it has passed the tail and the

1. The additional bracketed phrase is found in MSS M and F.

second time it has not reached the head, no solar eclipse will occur within five months, because in both [cases] the latitude was southerly. For southerly latitudes not many solar eclipses are possible. [However] this is possible in the [case of the] Moon, because southerly and northerly [latitudes] do not affect lunar eclipses. Sometimes seven months may elapse between two solar eclipses, such that at the first eclipse the Sun has not yet reached the tail and the Moon's latitude is northerly, and at the second eclipse [the Sun] has passed the head, so long as the [Moon's] latitude is still northerly. In lunar eclipses this is not possible, because in lunar eclipses the distance from the node must be less than it is in northerly solar eclipses.

[6] These rules apply to the northern habitations. In the southern ones, the opposite must be conceived. It is even possible for two solar eclipses to occur within the span of one month: one in northern habitations at a very northerly latitude, and the second in southern habitations at a very southerly latitude; but it is not possible in the same habitations. It often happens that solar and lunar eclipses occur within half a month [of each other]. This is all to be said in this chapter—God is all-knowing.

CHAPTER FOURTEEN

On Conjunctions and on Visibility and Invisibility of the Planets

[1] Since the position of a planet on the zodiacal orb is the endpoint of a line extending from the center of the World through the center of the body of the planet to the surface of the zodiacal orb; and since their true positions on the [zodiacal] equator in terms of degrees are where the latitude circle at the endpoint of the [above-mentioned] line intersects the zodiacal equator (if the planet has latitude, otherwise, at the endpoint of the line on the zodiacal equator), therefore, any two plan-