A total eclipse of the Sun, by the Moon, seen from the Earth

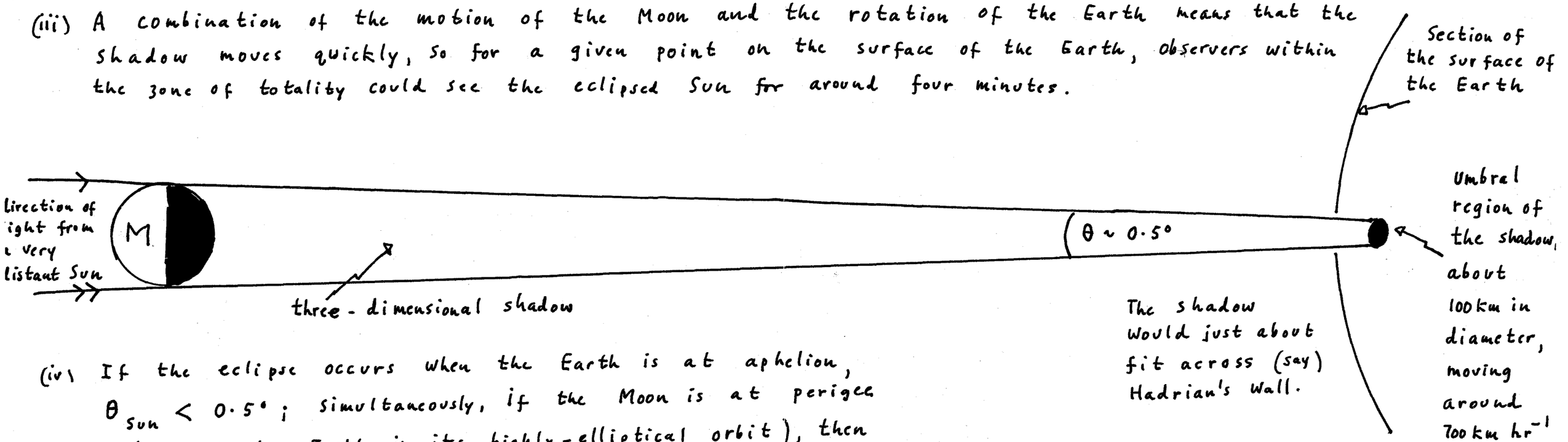
The are the important features of a <u>total</u> Solar eclipse.

(i) The Sun and the Moon subtend the <u>same</u> angle at the surface of the Earth.

(ii) <u>Only</u> those observers who are within the umbral region of the shadow will witness the eclipse. So, if the shadow moves across a thinly-populated area, for example, the oceans, there will be relatively few observers.

[Compare this with a total Lunar eclipse : everyone in the night-time hemisphere, provided observing conditions are favourable, would see the eclipse, <u>lasting (up to) three hours</u>. In theory, nearly half the population of the Earth could be witnesses.]

(iii) A combination of the motion of the Moon and the rotation of the Earth means that the shadow moves quickly, so for a given point on the surface of the Earth, observers within the zone of totality could see the eclipsed Sun for around four minutes.



(iv) If the eclipse occurs when the Earth is at aphelion,

$\theta_{Sun} < 0.5°$; simultaneously, if the Moon is at perigee (closest to the Earth in its highly-elliptical orbit), then

$\theta_{Moon} > 0.5°$, the eclipse will be prolonged to about five minutes, or so.

(v) The area of the umbral (central) region of the shadow is of the order of $\pi \times (50\ km)^2$

$= \underline{7500\ km^2}$

(vi) <u>Note</u> : On this scale, the distance of the Sun would be 120 m (0·12 km) to the left. I decided to confine my diagram to only the Moon and the Earth. The textbooks continue to include ridiculous diagrams.

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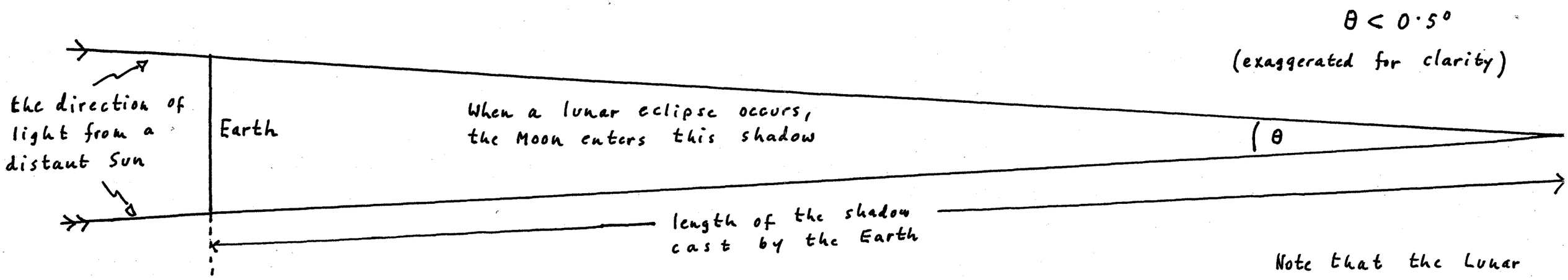
2015, January 27

Calculating the length of the shadow cast by the Earth

Remember that the Astronomical Unit (the mean Earth-Sun distance) is about 115 Solar diameters, and that the diameter of the Sun is roughly 100 times the diameter of the Earth. Also, the angles involved are extremely small ($\sim 0.5^\circ$), so that the scales of these diagrams are incorrect — and possibly misleading. Our calcuation will show that the shadow has a length equal (roughly) to one <u>Solar</u> diameter.



Note that the Lunar diameter is approximately one-quarter of that of the Earth. The Moon takes around 2→3 hours to cross the inner shadow

A total eclipse of the Moon