Moon Tilt Illusion

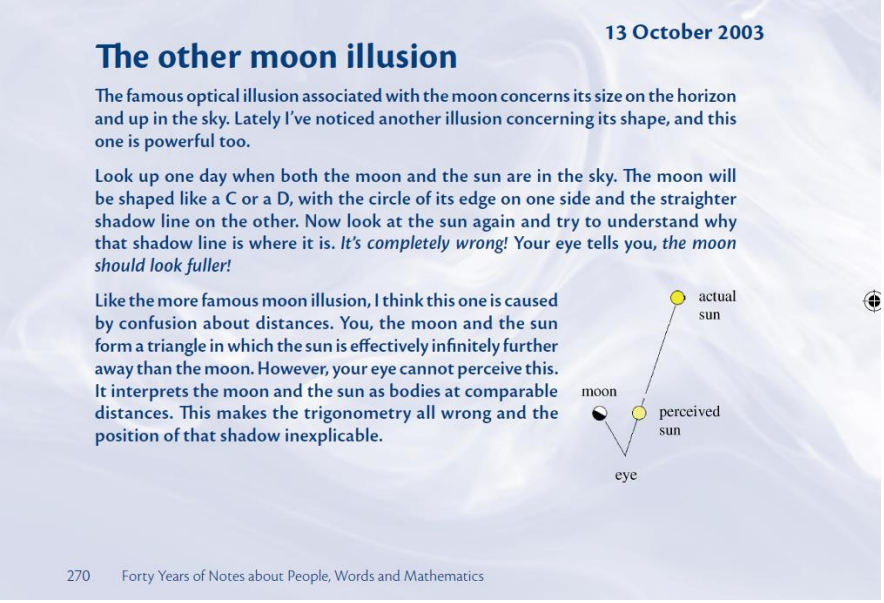
Nick Trefethen, 21 January 2018

For some years I've been interested in an illusion involving the moon but have not found any literature on it. Finally, via an essay by Marc Frantz, I learned last month that people speak of a "moon tilt," "moon terminator," "lunar terminator," "new moon," or "squint moon" illusion (this last is from Michael Berry).

Here are my two past notes on the subject, which seem to differ in (1) focus and (2) brevity from other treatments.

My version has been that "the moon should look fuller!" and my explanation that the illusion results from our failure to perceive that the sun is much further away than the moon. What I find by others emphasizes the surprising *angle* rather than *size* of the illuminated portion of the moon, with more complicated explanations. For example, the Wikipedia article on the lunar terminator illusion writes "The cause of the illusion is simply the observer is not taking into account that the observed slope of a light ray will change across the sky because of the lack of visual clues to establish 3D perspective." I think it boils down to the same, but I need to learn more.

And is it an issue of angle, or size? I think it's both. It would seem that I've focused on one, and others have focused on the other; and that both effects result from misperception of relative distances of sun and moon in 3D geometry. But I don't pretend to have studied this carefully.



13 October 2003

The other moon illusion

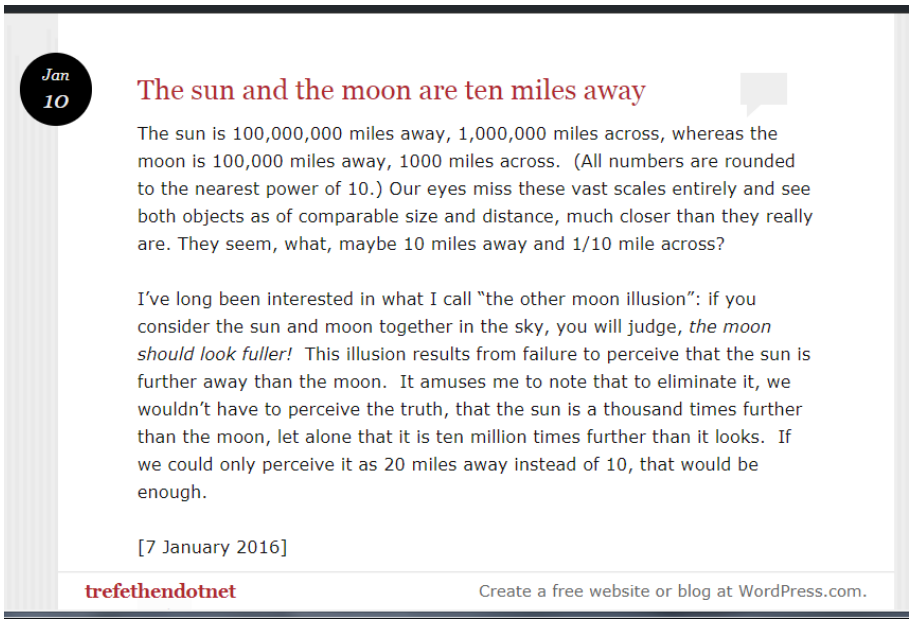
The famous optical illusion associated with the moon concerns its size on the horizon and up in the sky. Lately I've noticed another illusion concerning its shape, and this one is powerful too.

Look up one day when both the moon and the sun are in the sky. The moon will be shaped like a C or a D, with the circle of its edge on one side and the straighter shadow line on the other. Now look at the sun again and try to understand why that shadow line is where it is. *It's completely wrong!* Your eye tells you, *the moon should look fuller!*

Like the more famous moon illusion, I think this one is caused by confusion about distances. You, the moon and the sun form a triangle in which the sun is effectively infinitely further away than the moon. However, your eye cannot perceive this. It interprets the moon and the sun as bodies at comparable distances. This makes the trigonometry all wrong and the position of that shadow inexplicable.

270 Forty Years of Notes about People, Words and Mathematics

From *Trefethen's Index Cards*



Jan 10

The sun and the moon are ten miles away

The sun is 100,000,000 miles away, 1,000,000 miles across, whereas the moon is 100,000 miles away, 1000 miles across. (All numbers are rounded to the nearest power of 10.) Our eyes miss these vast scales entirely and see both objects as of comparable size and distance, much closer than they really are. They seem, what, maybe 10 miles away and 1/10 mile across?

I've long been interested in what I call "the other moon illusion": if you consider the sun and moon together in the sky, you will judge, *the moon should look fuller!* This illusion results from failure to perceive that the sun is further away than the moon. It amuses me to note that to eliminate it, we wouldn't have to perceive the truth, that the sun is a thousand times further than the moon, let alone that it is ten million times further than it looks. If we could only perceive it as 20 miles away instead of 10, that would be enough.

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From trefethen.net