Lunar Standstills and Chimney Rock

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To understand the motion of something, we require a reference. For a car, it's the road. For the hands of a clock, it's the numbered dial behind them. In the case of the Moon seen in the sky, nature provides a terrific reference: It's the background of stars. The stars are so distant that their motions through space are imperceptible to the naked eye over human history. Thus we speak of the "fixed stars."

Imagine that the spherical Earth is surrounded by a shell of fixed stars. It isn't really, of course. (The stars are at varying distances from the Earth, they aren't physically attached to anything, *etc.*) Still, that's what it looks like! During the course of the night, this shell appears to partly rotate around us, due to the Earth—the thing that's really rotating—turning completely once each twenty-four-hour day. You can even infer the place in the sky about which the shell seems to be spinning. It's a point, directly north, about one third of the way from the horizon at Chimney Rock to the point overhead. Look for the star of modest brightness (the "North Star") that nearly marks its exact location. This North Celestial Pole [NCP] is just the extension of the Earth's North Pole (one of two poles defining the axis about which the Earth rotates), infinitely into the sky. (The South Celestial Pole [SCP] is forever below the southern horizon at Chimney Rock.)

We can do better than just imagining! A few hours spent stargazing under the real sky will convince you that this is true. Stars will seem to set behind the western horizon and rise above the eastern horizon, just like the Sun does daily and for exactly the same reason.

(Some stars, close to the NCP, won't rise and set; they are continually above the horizon, tightly circling the NCP. Nevertheless, as seen from Chimney Rock, most stars rise and set.)

The important thing to notice is that some stars, closer to the NCP than the SCP, rise north of *due* east and some stars, closer to the SCP than the NCP, rise south of *due* east. The closer to a Celestial Pole they happen to be, the farther north or south they'll rise (or, for that matter, set). Always. A star always rises and sets at the same places on a particular horizon. Only a star that just happens to be equidistant between our NCP and SCP (a star on the so-called Celestial Equator [CE]) will rise *due* east (and set *due* south).

What does all this have to do with the Moon? The Moon appears to rise and set every twenty-four hours just like the stars. However, the much closer Moon is *not* "fixed." The Moon travels around (orbits) the Earth in a near circle once each month. (Notice the similarity between "Moon" and "month" in English.) As it does, its position against the starry background constantly changes. Watch it: It only takes a few hours' time to see that the Moon is closer to some stars and farther from others than it was when you first began to observe it that night.

The Moon's circular apparent path against the shell of stars is tilted such that half of it is closer to the NCP and half is closer to the SCP. (Think of a ring encircling a ball.) On those days (half of the month) when the Moon is on that part of its path closer to the NCP, it will rise in the Chimney Rock sky from the northeast. On those days (the other half of the month) when the Moon is on that part of its path closer to the SCP, it will rise in the Chimney Rock sky from the southeast.

When the Moon is as far north as it will travel during the month, we say that it is at its northernmost standstill. When the Moon is as far south as it will travel during the month, we say that it is at its southernmost standstill. Because "luna" is the Latin word for the Moon, we refer to this phenomenon as the *lunar* standstill.

The word "standstill" deserves some explaining. After all, the Moon never just stops! Picture a basketball shot at the hoop. As it arcs over toward the net, there is a moment when it is no longer getting closer to the ceiling. A moment later it is getting closer to the floor. We might call this instant "hang time" even though the ball is in continuous motion.

This is what we mean by a lunar standstill: The Moon appears to change directions. Night after night it rises more and more southerly. Then it reaches its standstill. It will thereafter rise more and more northerly. It will do this until it reaches a second standstill, at which time it will begin to rise more and more southerly again. Think of the direction of moonrise as a swinging pendulum. The cycle repeats every month, with the two standstills (northern and southern) happening about two weeks apart. Note that everything I've said about moonrise also applies to moonset, but at Chimney Rock it's the moonrise in which we're interested!

We might mention that the sunrise and sunset directions also "swing" back and forth across segments of the eastern and western horizons. The Earth revolves about the Sun rather than the other way around; just the same, the Sun has an apparent path in the sky (tilted with respect to the Celestial Equator) from our point of view. The standstills for the Sun go by the name of "solstices."

'Back to the Moon: Here's where it gets intriguing. The entire orbit of the Moon twists around the Earth in a big circle every 18.61 years. So sometimes the apparent path of the Moon in the sky is closer to the Celestial Equator than at other times. When it is closest to the CE, the southernmost and northernmost lunar standstills won't differ very much. They will "huddle" close to the CE, and the Moon will rise pretty close to east all month. When the position on the horizon of moonrise varies the least, at a time such as this, we call the two standstills (now closer to the CE than they will be at any other time during the 18.61-year cycle) the Minimum Southern Standstill and the Minimum Northern Standstill. When the apparent path of the Moon in the sky is farthest from the CE, though, the southernmost and northernmost lunar standstills differ greatly from one another. The Moon will rise far to the southeast one night and, half a month later, it will rise far to the northeast. When the position on the horizon of moonrise varies the most, at times such as this, we call the two standstills (now farther from the CE than they will be at any other time during the 18.61-year cycle) the Maximum Southern Standstill and the Maximum Northern Standstill.

Every 9.3 (18.6/2) years, there will be a month in which the Moon arrives at either a Minimum or Maximum Lunar Standstill. *But only at Maximum Northern Standstill will the Moon be far enough north to rise between the two chimneys at Chimney Rock!* More specifically, the apparent gap between the chimneys is wider than the apparent size of the Moon. So the lunar standstill will get far enough northward about fifteen months before the Maximum such that the Moon will just fit within the chimneys at moonrise (on one or more days during that month). And it will remain far enough northward about fifteen months after the Maximum to just fit within the chimneys at moonrise (on one or more days during that month). (That the bottom of the space between the chimneys is not exactly at the horizon has a small effect.) The alignment duration benefits from the slowing of the Moon's pendulum-like "swing" at either standstill. Even so, that's only thirty northernmost standstills per cycle during which we can see this phenomenon. But wait! Half of those moonrises will occur in the daytime. Odds are that some will occur during cloudy weather. Regardless, the scene won't repeat until the same window of opportunity opens 18.61 years later.