

The Great American Solar Eclipse

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A few years ago, I had the opportunity to present an open meeting Athenaeum paper and chose to do it on the Kentucky Derby, "the most exciting two minutes in sports." For those of you not present at the time, I would direct you to our website---just click on the foot.

Louisville, Kentucky has a transformation for the Derby as the city prepares for an onslaught of visitors from around the world. Homes become rental property or bed-and-breakfasts, lawns become parking lots and hotel rates soar as the locals take advantage of the opportunity that the Derby provides.

This year, our fair city and county will have its own Derby-esque experience as people flock here to witness "the most exciting two minutes and 41.2 seconds in astronomy," or the point of maximal totality of The Great American Solar Eclipse. A total solar eclipse last darkened the U.S. mainland on February 25, 1979. But August 21, 2017 will mark the first time in 99 years that such an event is available for viewing to people from coast to coast.

As the late Jim Love so often emphasized, most events of any importance have a Hopkinsville connection, and such is certainly true in the case of this eclipse. The point of maximal totality, or the spot from which the Moon's disc will totally cover the Sun for the longest period of time for viewing just happens to be in Christian County, just off Highway 91, near Cerulean. To eclipse chasers, this makes Hoptown the place to be, and our local officials have been preparing for quite some time for the invasion of 25-50,000 visitors to our area.

So tonight I will endeavor to enlighten you a bit about about solar eclipses, so that you will be a bit better informed when this epic day arrives.

The first fact to understand about solar eclipses is that they occur because of a remarkable cosmic coincidence. The Sun is just about the same *apparent* size in our sky as the

Moon. While the Sun is actually about 400 times bigger than the Moon, the Moon is almost 400 times closer to the Earth than the Sun. Therefore, the Sun and the Moon *appear* to be about the same size in our sky.

This fact explains why we see total solar eclipses: the Moon has an apparent size that just barely covers the Sun completely, yet it is not so large that the Sun's atmosphere, or its corona is eclipsed as well. We on Earth occupy the celestial "sweet spot" to witness this sight.

This was not always so. When the Moon first formed over 4 billion years ago, it was much closer to Earth and appeared much larger in the sky. So early total solar eclipses blocked not only the Sun, but most of the corona. Over the years, the Moon is gradually receding from the Earth due to frictions from the tides. At present, the distance from the Earth to the Moon increases by about an inch per year. So in some future epoch, the Moon's disc will become smaller, and no more total solar eclipses will be visible from Earth.

Solar eclipses have been a very valuable resource for historians, in that they have allowed a few historical events to be dated precisely, from which other historical events may be subsequently deduced. A solar eclipse of June 15, 763 B.C. mentioned in an Assyrian text is important for *The Chronology of the Ancient Orient*. In the ancient Chinese classic *Shujing* (or *Book of Documents*), is the record of how two court astronomers, Hsi and Ho, apparently got drunk and failed to predict an eclipse 4000 years ago. In the aftermath, King Zhong Kang, fourth emperor of the Xia dynasty, had both beheaded.

Eclipses have been interpreted as omens or portents. The ancient Greek historian Herodotus wrote that Thales of Miletus predicted an eclipse that occurred during a battle between the Medes and the Lydians. Both sides put down their weapons and declared peace

as a result of the eclipse. The exact eclipse involved remains uncertain, although the issue has been studied by hundreds of ancient and modern authorities. One likely candidate took place on May 28, 588 B. C., probably near the Halys River in Asia Minor. An eclipse recorded by Herodotus before Xerxes departed for his expedition against Greece, which traditionally dated to 480 B.C., was matched by John Russell Hind to an annular eclipse of the Sun at Sardis on February 17, 478 B.C.

Attempts have been made to establish the exact date of Good Friday by assuming that the darkness described at Jesus' crucifixion was a solar eclipse. This research has not yielded conclusive results. Good Friday is recorded as being at Passover, which is held at the time of a full Moon. However, the darkness lasted from the sixth hour to the ninth hour, or three hours, which is much, much longer than the eight-minute upper limit for any solar eclipse's totality.

In the book of Amos, chapter 8, verse 9, are the words, "I will cause the Sun to go down at noon and I will darken the Earth in the clear day." Biblical scholars believe this is a reference to a celebrated eclipse observed at Nineveh in ancient Assyria on June 15, 763 B. C. An Assyrian tablet also attests to the event.

The first known telescopic observation of a total solar eclipse was made in France in 1706. By the mid-nineteenth century, scientific understanding of the Sun was improving through observations of the Sun's corona during solar eclipses. The corona was identified as part of the Sun's atmosphere in 1842, and the first photograph (actually a daguerreotype) of a total eclipse was taken of the solar eclipse of July 28, 1851.

Giving new meaning to the term "scared to death," the timid emperor, Louis of Bavaria, the son of Charlemagne, witnessed an unusually long total eclipse on May 5, 840 A.D. which

lasted for five minutes. As soon the Sun began to emerge back into view, Louis was so overwhelmed by what he had just seen that he died of fright.

There are four types of solar eclipses: total, annular, partial, and hybrid. On average, a total solar eclipse occurs somewhere on Earth about every eighteen months. This happens when the dark silhouette of the Moon completely obscures the intensely bright light of the Sun, allowing the much fainter solar corona to be visible. There are actually two types of shadows: the umbra is that part of the shadow where all sunlight is blocked out, and takes the shape of a dark, slender cone. It is surrounded by the penumbra, a lighter, funnel-shaped shadow from which sunlight is only partially obscured.

During a total solar eclipse, the Moon casts its umbra upon the Earth's surface, that shadow can sweep a third of the way around the planet in just a few hours. When the shrinking visible part of the photosphere becomes very small, Baily's Beads will occur. These are caused by the sunlight still being able to reach the Earth through lunar valleys. Totality then begins with the diamond ring effect, the last bright flash of sunlight. During the brief period of totality, the beautiful corona, the tenacious outer atmosphere of the Sun is revealed. Totality may last as long as 7 minutes, 31 seconds, although most total eclipses are usually much shorter. We will be at the point of maximum totality here in Christian County, and that time period is projected to be 2 minutes, 41.2 seconds.

An annular eclipse occurs then the Sun and the Moon are exactly in line with the Earth, but the apparent size of the Moon is smaller than the Sun. Hence, the Sun appears as a bright ring.

A hybrid eclipse shifts between a total and an annular eclipse. At certain points of the Earth's surface, it appears as a total eclipse, whereas at other points it appears annular. These are comparatively rare.

A partial eclipse occurs when the Sun and Moon are not exactly in alignment with the Earth, and the Moon only partially obscures the Sun. Partial eclipses are virtually unnoticeable in terms of the Sun's brightness, as it takes over 90% coverage to notice any darkening at all. Even at 99%, it will be no darker than twilight.

On August 21, 2017, for the first time in 99 years, this rare event is readily available for viewing by people from coast to coast. The path of totality goes from the Oregon coast through Idaho, Wyoming, Nebraska, Kansas, Missouri, Illinois, Kentucky, Tennessee, Georgia, North Carolina, and South Carolina.

Totality begins at 10:19 a.m. PDT in Oregon and sweeps from west to east, with the moment of totality in Hopkinsville to occur at 1:24 p.m. CDT. Twelve million people live within the narrow band of totality and 220 million people live within a day's drive. Though the rest of the U.S. will have at least a 55% partial eclipse, it won't get dark there, and eye protection filters would have to be used at all times even to know the eclipse is happening.

If you are in the path of totality, you are seeing the main event, but if you are off to the side---even when the Sun is 99% covered---it's like going to the ticket window of the football stadium, but not going inside. This will be the most viewed eclipse ever, and the only large city in the path of totality is Nashville, Tennessee.

Our city has been getting ready for years now. We have our own Solar Eclipse Marketing and Events Consultant, Brooke Jung, whose office is in the Recreation Department. She was

kind enough to provide some of the information available to you. Our website is [www.eclipseville.com](http://www.eclipseville.com). Nine hundred campsites are available at DeBow Park, Ruff Park, and Pardue Lane. Twelve RV parking spots are available at Trail of Tears Park. Many events have been planned for our guests at MB Rowland Distillery, Casey Jones Distillery, Christian Way Farms, Copper Canyon Ranch, Kelly Little Green Men Days, and others.

You have to be ready, too. After all, to watch an eclipse, you don't just put on your Ray-Bans, go outside, and look up to the west. There are safety issues involved, and if you are not careful, as my esteemed co-presenter will attest, you can cause yourself some serious eye trouble. So, how do you safely view an eclipse?

The Sun can safely be viewed directly with the naked eye only during the brief minutes of totality. The remaining photospheric crescent is intensely bright and cannot be viewed directly without eye protection.

Generally, the same equipment, techniques, and precautions used to observe the Sun outside of an eclipse are required for the partial phases of total eclipses. The safest and most inexpensive of these methods is by projection, in which a pinhole or small opening is used to cast the image of the Sun onto a screen placed a half-meter or more beyond the opening.

The Sun may be viewed directly only when using filters specifically designed for this purpose. Such filters have a thin layer of aluminum, chromium, or silver deposited on their surfaces that attenuates ultraviolet, visible, or infrared energy. One of the most popular and available filters for safe solar viewing is a Number 14 welder's glass. More recently, aluminized Mylar has become a popular, inexpensive alternative. Mylar can be cut with scissors and adapted to any any kind of box or viewing device.

Unsafe filters include color film, some non-silver black-and-white film, medical x-ray films with images on them, smoked glass, and polarizing filters. Ray-Bans are definitely inadequate, but there are glasses that you can wear to safely see the eclipse. The key is when to put them on and take them off.

True eclipse chasers are, in a word, mobile. They plan for all contingencies, the foremost one being the weather, and will move to where they have the best viewing. After all, if it's cloudy, you'll miss it.

You cannot prepare yourself for the sight of a total solar eclipse. When totality arrives, you will experience primal emotions and wonderment at the unspeakable beauty of the corona and the panoply of colors and light as you've never seen before. You will involuntarily scream, gasp, or perhaps cry at this astounding vision.

You will be looking straight down a billiard shot of the Earth, Moon, and Sun lined up perfectly. By celestial coincidence, the Sun and Moon's apparent disks in the sky are nearly the same. This serendipitous fact allows the Sun to be completely covered during the eclipse, yet allows us to see the Sun's atmosphere, its corona. The corona is hidden from us all our lives except for the very special moments during the solar eclipse.

When you look at the eclipse, you will perceive the blackest black imaginable surrounded by the Sun's ever-changing atmosphere, the corona. The quality of light is stupendous, with an amazing light show of iridescence, scintillation, and delicate colors.

Another realization that may hit you during totality is that you are watching the solar system in motion. In real time, you can perceive the relative motions of the Moon around Earth and Earth around Sun.



Even for those of you who have seen it before, a total solar eclipse is an intensely emotional experience. You will feel ecstasy, wonder, and regret when it's over. You will immediately discuss plans to see the next one: April 8, 2024.

A piece of wisdom that all experienced eclipse observers tell those new to totality is: Do not attempt photography during those precious two minutes. What you see will be seared in your mind's eye for the rest of your life. No camera can capture the full range of light, darkness, and colors of the corona and the sky. Besides, you will be so mesmerized by the spectacle that you may not be able to operate your camera.

Experienced astrophotographers will make photographs available on the web soon after the event. You will appreciate these photos, but will know that these image, no matter how good, are a pale reflection of what you see with your own eyes.

In closing, I would like to leave you with a quote from Fred Espenak, a noted eclipse chaser, as quoted in the book *Total Addiction* by Kate Russo:

"Glorious totality.

"There are precious few events in life that leave such an indelible impression that the simple act of recollection can quicken the pulse and increase respiration as vivid memories flood one's mind. The total eclipse of the Sun is just such an event.

"The simple act of standing within the shadow of the Moon affords the rare and unprecedented opportunity to gaze directly at the halo of million-degree plasma surrounding one star. Twisted, tortured, and constrained by the Sun's enormous magnetic fields, the solar corona is revealed to the naked eye only during the brief seconds when the Moon completely blocks the brilliant disk of the Sun.

“The corona’s gossamer crown of pearly light displays an ethereal beauty that transcends both science and nature. It hypnotizes the viewer into an altered state where time seems to stand still. Nevertheless, the diamond ring of third contact, signaling the end of totality, appears much too quickly. Hungry eyes search in vain for one last glimpse of the corona hidden by the expanding glare.

“Totality is over. The memory of this fleeting event will be replayed many times in the years to come. But for some people, it will not be enough. They will travel to the far corners of the globe at the appointed time and place to witness the grand spectacle again. And again. And again. They are the eclipse chasers.”

And Guys, they are headed to Hoptown in just 227 days! Hope to hell it doesn’t rain!