Feature Story: ALPO Eclipse Section

The 21 August 2017 Total Solar Eclipse – The Great American Eclipse

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Part 1: The Eclipse Itself

A series on the 2017 total solar eclipse, site selection, weather prospects, observing the eclipse, and specific observing projects will be a focus over the next several issues of the JALPO leading up to the eclipse. This first article provides the reader with an overview of the eclipse itself, as well as some initial recommendations.

Discussion

On 21 August 2017 the United States will experience its first total solar eclipse since February 26, 1979. All of the Continental United States will experience at least a significant partial solar eclipse; the eclipse is being referred to as *The Great American Eclipse*. For those fortunate enough to live along the narrow track of totality, or travel to the path of totality, up to 2 minutes and 40 seconds under the shadow awaits observers. The partial phase of an eclipse never compares to totality; *one should plan now to get to the total line!*

The Moon's shadow first comes ashore in the northern Pacific, moving west to east. Totality first crosses the west coast of the United States at Oregon, then to Idaho, Montana, Wyoming, Nebraska, Kansas, Missouri, Illinois, Kentucky, Tennessee, North Carolina, Georgia, and South Carolina before going out to sea. Note that totality is only visible from within the Continental United States. There are a number of cities and smaller communities near or on the path of totality, with several directly on the center line. Interstate highways and state roads should make accessibility to the center line relatively easy before eclipse day. *(See Figure 1.)*

Figure 1. Path of totality across the continental United States. Viewers will have an opportunity to observe the 21 August 2017 total solar eclipse from coast to coast. *Credit: Michael Zeiler with Xavier Jubier, additional data and programming support from Bill Kramer, Jean Meeus and Fred Espenak.*

This eclipse will attract a great deal of attention, both internationally and within the United States, from amateur and professional astronomers, the general public and media. It is best to make plans for the eclipse early; there are already hotels completely booked. Things to consider in advance include where you are going to go to observe the eclipse, how you are planning on observing the eclipse, local eclipse circumstances, weather contingency, travel and accommodations, etc. *(See Figure 2.)*

The Earth finds itself in a marvelous Solar System location, with a large moon. These dynamics allow for a possible lunar eclipse at full moon and a possible solar eclipse at new moon. Eclipses do not always occur due to the orbital planes of the Sun-Earth and Earth-Moon; usually the Moon's shadow (solar eclipses) or Earth's shadow (lunar eclipses) passes above or below the Sun or Moon.

When a solar eclipse occurs, at least one event ensues, depending on Earth-Moon

distance or if the Moon's pass in front of the Sun is not central. If the Moon is at or near apogee (furthest point), it will appear smaller and an annular eclipse or a hybrid (annular along part of the path and total at the path's center) will occur.

Partial eclipses are seen by those outside totality or a non-central eclipse.

21 August 2017 eclipse chasers will have a long path from which to observe the eclipse. *(See Table 1.)* Most will probably select the closest point to their home. Excellent highways and roads should allow for fairly easy transportation. There are numerous large and small airports the eclipse chaser may choose to fly into, and then drive to the eclipse center line. If flying, just remember to consider what equipment you might want to take to the eclipse versus airline luggage constraints. And know that a lot of people will travel to see the eclipse, including from outside the United States.

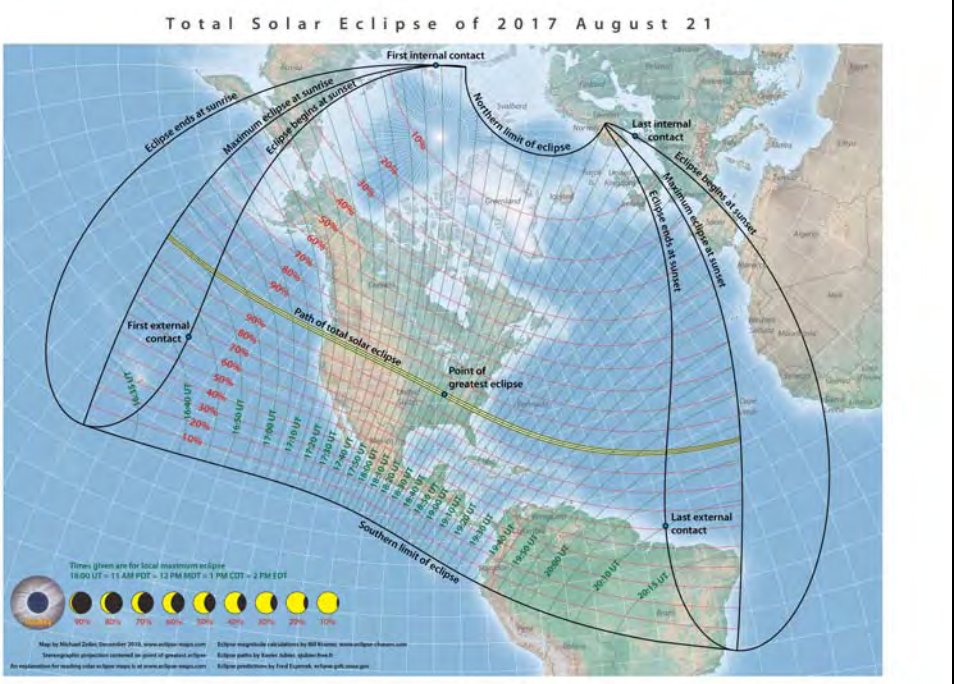

Figure 2. Stereographic projection, magnitude and time of greatest eclipse. The graphic also shows partial eclipse percentages, as well as the entire eclipse shadow projected on Earth. *Credit: Michael Zeiler with Xavier Jubier, additional data and programming support from Bill Kramer, Jean Meeus and Fred Espenak.*

Table 1. Mechanics of *The Great American Eclipse*

Calendar Date	2017 August 21
Terrestrial Dynamical Time at Greatest Eclipse	18:26:40
Eclipse type Partial, Annular, Total, or Hybrid	Total Solar Eclipse
Saros Series	145
Eclipse magnitude Fraction of the Sun's diameter obscured by the Moon	1.031
Central Duration Duration of totality at greatest eclipse	2 minutes 40 seconds
Geographic Region of Eclipse Visibility	N. America, n S. America Totality (west to east): Pacific Ocean, Oregon, Idaho, Montana, Wyoming, Nebraska, Kansas, Missouri, Illinois, Kentucky, Tennessee, North Carolina, Georgia, South Carolina, Atlantic Ocean

You will want to get as close to the center line as possible to enjoy the maximum totality duration unless you want to observe a grazing eclipse by setting up along either the northern or southern limit to see extended Bailey's beads and diamond ring. Many uninformed individuals will think you can be close to the northern or southern limit to see totality. This is one thing we can all do within our communities, especially those close to the eclipse path, is to inform people they need to be within the totality eclipse path to see totality. Otherwise they will see a deep partial solar eclipse and truly miss the beauty of totality. Then you will be asked why the eclipse was supposed to be so spectacular.

Experienced eclipse chasers – unless on a ship or planning to 'fly' the eclipse path – choose a preferred location based on several variables, such as site access and weather prospects. They also look for weather alternatives and routes that can get them to clear(er) skies. Excellent maps and online resources are available; see References at the end of this article.

Weather Prospects

Successful eclipse chasers will tell you that one of the most-important aspects of eclipse expedition planning are the weather scenarios. A lot of reliable historical weather pattern data, from rainfall to cloud cover, is available. You want to maximize your chance of observing the eclipse! There are

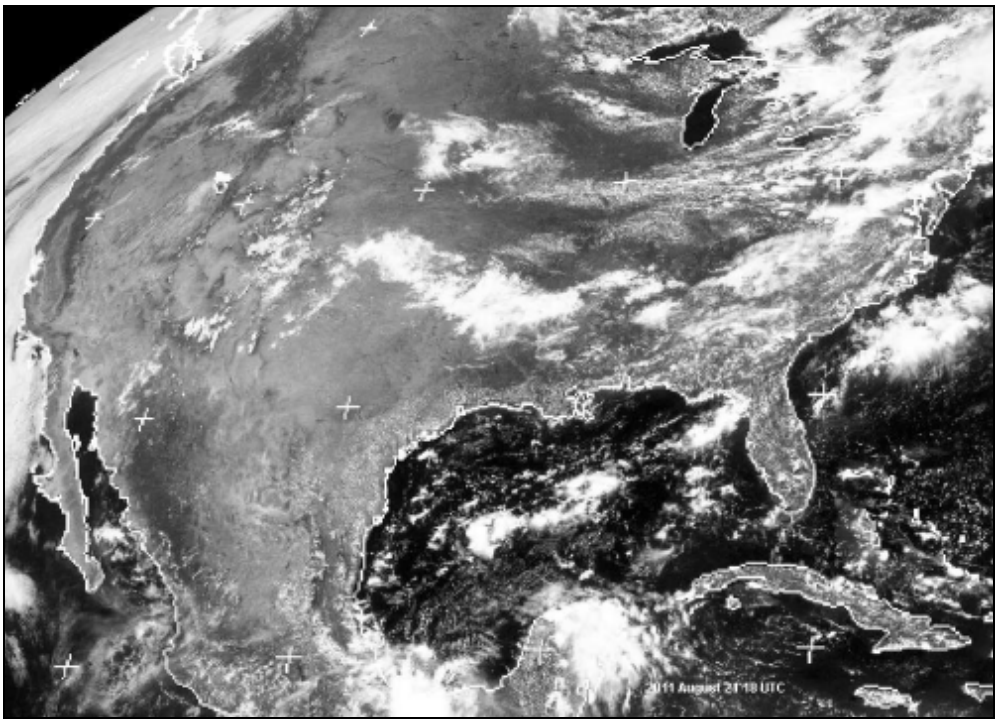

Figure 3. Image by the Geostationary Operational Environmental Satellite - East (GOES - East) taken on 21 August 21, 2011 at 18:00 UTC. *Credit: National Aeronautics and Space Administration and National Oceanic and Atmospheric Administration.*

Figure 4. The 20 May 2012 annular eclipse, visible with a projection-type set-up (Sunspotter^{TM}) from Page, Arizona. *Credit: Dr. Mike Reynolds*.

numerous ways to research location-specific meteorological data and weather patterns around the date of the eclipse. And the advantage is that several people have already done much of that research.

Some of the best pre-eclipse forecasts and summaries since 1979 have been produced by Canadian meteorologist Jay Anderson, an avid total solar eclipse chaser with twenty total solar eclipses. Other meteorologists will produce reliable weather forecasts based on up-to-the-minute satellite imagery and U.S. ground stations. *(See Figure 3.)* The best advice is to be tuned to forecasts prior to the eclipse and have alternate sites planned.

Observing the Eclipse

How do you plan on observing the eclipse? Is this your first eclipse? Will you be with a group of people that will want you to detail what is going on? Do you have photography or video plans? Or will you be doing some sort of public outreach for the eclipse; which is a great way to bring astronomy to people!

Viewing Safety

As a friendly reminder that is more for us to share with other is to not forget SAFETY! You have several options to observe the partial phase of the eclipse, from a telescope with a solar filter to a telescope or binoculars which project the image onto a surface. *(See figures 4 and 5.)* Totality itself will not harm your eyes; the unaided Sun, whether partially eclipsed or not, will do the damage. Order both eclipse glasses and camera/telescope filters well in advance; prior to the eclipse there will be a big demand. And entrepreneurs will look for ways to make money from the event; high-priced "got to have" eclipse glasses will be one of those ways.

Binoculars and Telescopes

Nearly any binocular or telescope you own would provide satisfactory views of the total eclipse. Some observers prefer binoculars because it gives them the ease of observing other eclipse phenomena and then easily go back to totality. Others like the view through the telescope. Do not use too high a magnification if this is your first eclipse; remember that the solar corona can extend several solar diameters. A mount that tracks will take away one potentially-distracting factor: continuing to center the Sun during the eclipse. Regardless of what equipment you use, be prepared to quickly put back on the proper solar filters at the third contact diamond ring.

Eclipse Imaging

If you decide to photograph the eclipse, check out your equipment well in advance, from your system's focus to exposure. Focus is one of the most-critical factor to assure you take excellent images. Understand your system's field of view; you do not want to miss out coronal features unless you are planning high-magnification imaging. Video will also provide a way to image the eclipse. Time lapse images of people – which also show changes in sunlight as the

Figure 5. A front-mounted glass solar filter for imaging the partial solar eclipse phases. *Credit: Dr. Mike Reynolds.*

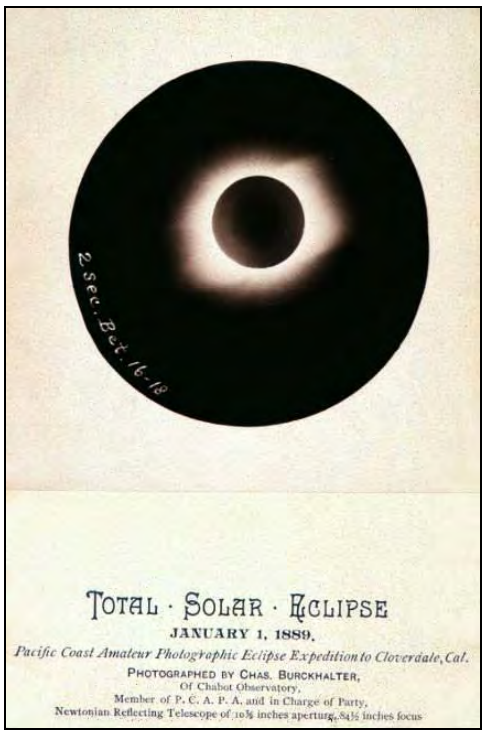

Figure 6. The 1 January 1889 Total Solar Eclipse, imaged by Charles Burckhalter, Chabot Observatory. *Image courtesy of the Chabot Space and Science Center, the Eastbay Astronomical Society, and personal files.*

Moon's shadow sweeps across Earth – can be fascinating. *(See Figure 6.)*

Many first time imagers will set their cameras to auto focus (if using the camera's lens instead of a telescope-camera system) and auto exposure. The camera will 'look' for focus and have difficulties finding the focus. This is not something you want to be dealing with during totality. You should pre-set the camera at manual focus and infinity; just make certain the lens infinity setting is in fact infinity. *(See figures 7 and 8.)*

Seasoned eclipse imagers make certain they have fully-charged and reliable batteries and plenty of space on recording medium. Have extra batteries and recording medium available; you do not want to shoot so many partial phase photos that you discharge your battery or use all available card space. Many prefer to image in the highest quality possible; usually 'raw.'

Looking UP! Finally make certain you look at the eclipse! Search for planets and stars right before and during totality. Notice the shadow as it approaches you; look for the sunset-sunrise effect: the colors around the horizon. Look at Bailey's beads and the diamond ring, the signal that second contact – and totality – have arrived.

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Online

Bill Kramer's Eclipse Chasers' Map: *http://www.eclipse-chasers.com/tseCalculator.php?TSE=tse2017d*

Detailed JPG Maps on NASA's Eclipse Page: *http://eclipse.gsfc.nasa.gov/SEmono/TSE2017/TSE2017.html*

NASA's Animated Map: *http://eclipse.gsfc.nasa.gov/SEanimate/SEanimate2001/SE2017Aug21T.GIF*

NASA Eclipse Path Table: *http://eclipse.gsfc.nasa.gov/SEpath/SEpath2001/SE2017Aug21Tpath.html*

NASA Interactive Google Map: *http://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2017Aug21Tgoogle.html*

Xavier Jubier's Interactive Map: *http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2017_GoogleMapFull*

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Figure 7. 11 July 2010 Total Solar Eclipse 2nd Contact; Canon EOS 5D Mark II and Explore 80mm APO, 1/2,000 second. *Credit: Dr. Mike Reynolds.*

Figure 8. 29 March 2006 Total Solar Eclipse; 5 stacked images; Canon EOS 10D and a Meade 80mm apochromat refractor. *Credit: Dr. Mike Reynolds.*

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