

(2005 July 23)

*The continental United States is currently in the midst of a 38-year period that has not seen a single total eclipse of the Sun. The last total solar eclipse for this region occurred in 1979 and the next will not happen until 2017*

**Most people have never observed a total eclipse of the Sun.** This is especially true for the continental USA where none has occurred in the last 26 years. Although some individuals “think” they may have seen this awesome phenomenon, anyone who has to “think about it,” probably has not. Indeed, Isabel M. Lewis of the Nautical Almanac Office of the U. S. Naval Observatory wrote in her book, *A Handbook of Solar Eclipses* (1924):

“To witness a total eclipse of the Sun is a privilege that comes to but few people. Once seen, however, it is a phenomenon never to be forgotten.”

Someone, in fact, who “thinks” they have seen a total solar eclipse may have only seen a *partial* solar eclipse, or confuse lunar eclipses with solar eclipses. The difference between these eclipses and a total eclipse of the Sun is nearly impossible to explain. Sadly, people who are only several miles from the track of a total solar eclipse often decide not to travel into the path assuming that a partial eclipse with 99 percent of the Sun hidden is good enough. Many who have observed total eclipses of the Sun have tried desperately to explain the difference between seeing a partial from a total solar eclipse. The astronomer Jay M. Pasachoff tried to illustrate this difference in a often quoted statement (1983) that I have paraphrased:

“Some people see a partial eclipse (of the Sun) and wonder why others talk so much about a total eclipse. Seeing a partial eclipse and saying that you have seen an eclipse is like standing outside a football stadium and saying that you have seen the football game; in both cases, you have missed the main event.”<sup>1</sup>

Unfortunately, no picture or movie has ever adequately conveyed the complete and overwhelming appearance, feelings, excitement, mystery and even sounds associated with this extraordinary spectacle. Although the Sun is typically hidden but for a few minutes, the emotional impact of totality exceeds anything one can imagine.<sup>2</sup>

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<sup>1</sup>Pasachoff used an “opera house” in his original statement!

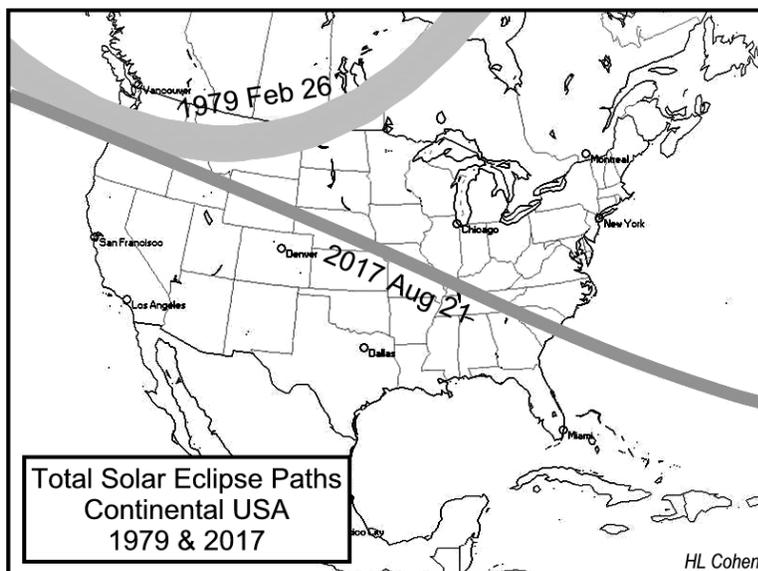
<sup>2</sup>The maximum duration of totality is 7m31s (Meeus 2004) but most last only a few minutes. The last eclipse with a central duration exceeding seven minutes occurred 1973 June 30 (Africa). No seven minute eclipse occurs in the 21<sup>st</sup> century. In fact, an eclipse approaching maximum duration will not happen until 2186 July 16 (7m29s), a duration longer than any other total eclipse from 3000 B.C.E. to 5000 C.E. (Littmann et al. 1999)! Note: The word “duration” in this article refers to the maximum length of totality possible for a given total eclipse. This occurs on the central line of the eclipse path typically about mid-way down the path of totality over the Earth’s surface.

A friend, who had never seen a total solar eclipse, once remarked, “I can imagine what it must be like.” Then she brazenly added, “If you have seen one, you have seen them all.” *Absurd*, especially from one who has never experienced totality!

Many people who have not seen total eclipses of the Sun think it is because this type of eclipse is very rare. Actually, this phenomenon is moderately frequent—one occurs somewhere on Earth approximately every year and a half. However, a given location will only *average* one total eclipse roughly every 375 years (Meeus 1997).<sup>3</sup> Although paths of totality are often thousands of miles long, they are also very narrow, typically less than 150 miles wide. In addition, since most of Earth’s surface is water, total solar eclipse paths often pass over large stretches of ocean, or even uninhabited and often inaccessible land areas. So, unless one is willing to travel into the path of totality, it is unlikely they will ever encounter this incredible and shocking spectacle.

This may seem inconsequential for those who have not witnessed a total eclipse of the Sun and foolishly do not care to do so. Most such people cannot understand why they should, even must, witness this great wonder of nature one or more times during their life. Truly, chasing the lunar shadow often becomes a passion after seeing one’s first total solar eclipse. Some even say a person has not lived a full life if they have not stood in the path of the Moon’s umbral shadow!

The purpose of this article, however, is not to convince readers to witness this natural wonder, an almost impossible task. Instead, if convinced this is an event one must experience, the following provides information on prospects of seeing a total eclipse of the



**Figure 1.** Map showing the total eclipse paths of the last and next total solar eclipse for the continental USA. (Paths plotted with aid of software by Marriott 2003.)

Sun over the next dozen years—a daunting task if one is unwilling or unable to travel.

Few opportunities have arisen in the last quarter century for stay-at-home Americans. The last total solar eclipse in the “lower 48 states” occurred more than 26 years ago on 1979 February 26. Totality could only be seen in the extreme Northwest and Canada (Fig. 1). Likewise, a total solar eclipse passed through our remote state of Hawaii 14 years ago (1991 July 11) before continuing on through Baja California Sur and Costa Rica. So, few Americans also witnessed this eclipse.

<sup>3</sup>This value for the frequency of eclipses is a *mean* or *average* for a given place. Actual intervals can be very irregular. For example, Tallahassee, Florida will experience two total solar eclipses within seven years, 2045 August 12 and 2052 March 30! But, the total eclipse of 2142 May 25 will be the first for Antwerp, Belgium in about seven centuries. Then Antwerp has another nine years later, 2151 June 14 (Meeus 1997).

The following 12 years suffer the same fate. The next total solar eclipse visible from the USA is not until 2017 August 21 (Fig. 1). This eclipse shadow will traverse the full width of our continent with a maximum duration for totality of 2m40s southeast of St. Louis. The long shadow path from coast to coast will, therefore, potentially allow millions of Americans to see their first total solar eclipse. Unfortunately, much of the USA suffers cloudy weather in late summer. Regions in the Northwest may offer the best prospects for clear skies since their marine west coast climate typically brings more rain in winter rather than summer. (More information about weather prospects is given later.)

In contrast to the lack of any total solar eclipses in the *continental* USA from 1979 to 2017, the same period before 1979 had five: 1945 July 9, 1954 June 30, 1959 October 2, 1963 July 20, and 1970 March 7. (The path of totality of the latter eclipse passed through north Florida including Perry, 80 miles northwest of Gainesville, but overcast skies spoiled the view!) A sixth total eclipse prior to the 1979 eclipse (1972 July 10) just missed the USA passing about 75 miles from Maine as the shadow moved southeast through Nova Scotia.

### What to Do?

For those who want to observe a total eclipse of the Sun in the next dozen years, the following information may help. Table 1 shows all upcoming total eclipses of the Sun up through the 2017 American eclipse. Nine occur but few are easily accessible for most people. (Notes following the table are my own views. Readers may differ on their accessibility.) All require traveling beyond the borders of the USA except the 2017 eclipse. Nevertheless, even the 2017 eclipse may require east coast residents to travel a few thousand miles westward to have clear skies. (See below.) Over the next 12 years only two out of the nine total eclipses are “easily reached” for most people (2006 and 2017):

**Table 1.** The Next Nine Total Solar Eclipses Up Through the USA 2017 Eclipse<sup>4</sup>

Date	Type	Duration	Geographic Region for Total Eclipse
2006 Mar 29	T	4m07s	c Africa, Turkey, Russia
2008 Aug 01	T	2m27s	n Canada, Greenland, Siberia, Mongolia, China
2009 July 22	T	6m39s	India, Nepal, China, c Pacific
2010 July 11	T	5m20s	s Pacific, Easter Is., Chile, Argentina
2012 Nov 13	T	4m02s	n Australia, s Pacific
2013 Nov 03	H	1m40s	Atlantic, c Africa
2015 Mar 20	T	2m47s	n Atlantic, Faeroe Is, Svalbard
2016 Mar 09	T	4m09s	Sumatra, Borneo, Sulawesi, Pacific
2017 Aug 21	T	2m40s	n Pacific, USA, s Atlantic

<sup>4</sup>Eclipse data adapted from Espenak (1987, 2005). Type is total (T) or hybrid (H), a combined annular-total solar eclipse. Geographic abbreviations used: n = north, s = south, e = east, w = west, c = central. Duration is the central duration for maximum total eclipse.

## Brief Eclipse Notes for Table 1

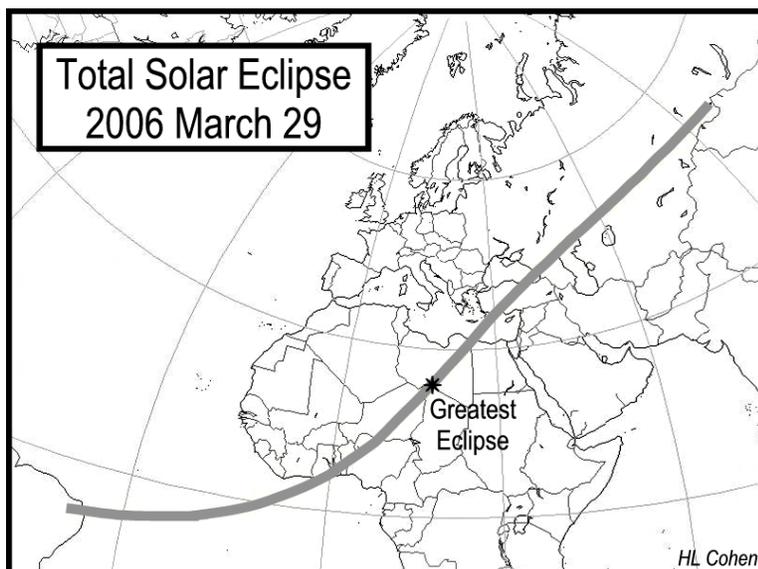
<b>2006 Mar 29</b>	Most readily accessible total solar eclipse for USA until 2017 eclipse
<b>2008 Aug 01</b>	Very difficult — not readily accessible due to its extreme northern path
<b>2009 July 22</b>	Accessible <i>if have means</i> to travel to SE Asia or ocean south of Japan
<b>2010 July 11</b>	Faraway — S. Pacific, Fr. Polynesia, Easter Is.; ends on S. tip of S. Amer
<b>2012 Nov 13</b>	Faraway — begins over N. Australia then crosses S. Pacific O.
<b>2013 Nov 03</b>	Difficult for most — path crosses mid-Atlantic Ocean & central Africa
<b>2015 Mar 20</b>	Very inaccessible due to extreme North latitude of path
<b>2016 Mar 09</b>	Difficult — crosses E. Indies & S. Pacific; ends abt. 800 mi. n. of Hawaii
<b>2017 Aug 21</b>	Next USA total eclipse but may require traveling for good weather!

## Additional Comments on the 2006, 2009, 2010 and 2017 Total Eclipses of the Sun

Two of the above nine eclipses are easily accessible to USA residents, the 2006 passing through the Mediterranean region and the 2017 USA eclipse. Two others are faraway but intriguing if one can afford the time and expense of the trip, the 2009 Asia eclipse and the 2010 South Pacific eclipse—both long eclipses in exotic and appealing faraway places.

**The upcoming 2006 eclipse** has become the most popular in many years (Fig. 2). The path of totality is easily accessible for people living in both Europe and the United States. Totality is also longer than average (maximum 4m20s in the Sahara Desert) in contrast to the last few total eclipses that had durations of only a few minutes or less. In fact, totality remains long throughout reachable North African and Mediterranean locations. In addition, the path passes through wonderfully exciting and ancient landscapes (e.g., Libya, Egypt and Turkey) giving travelers many options for this next wonderful eclipse.

Travel organizations have planned a large number of tours to these exotic lands in March and April 2006 for this eclipse. Travelers can choose from many eclipse tours going to Egypt, the Nile, the Mediterranean Sea, Turkey and even Libya, which is now encouraging



**Figure 2.** Path of the next total eclipse of the Sun. (Path plotted with the aid of software by Marriott 2003.)

tourism. Libya is currently trying to rebuild relations with Europe and the USA, which has now lifted restrictions on the use of U.S. passports for travel to Libya. (However, the U.S. Department of State still warns U.S. citizens traveling to Libya to exercise caution.) Still, several tours to Libya to see this eclipse are booking well. In fact, maximum duration of totality occurs in the Sahara Desert of southern Libya, which may have the clearest skies in the world with a mean cloud cover less than 10 percent (Esenak & Anderson 2004).

Other options include viewing the eclipse from Al Sallum on the

northwest Mediterranean coast of Egypt near the Libyan border. Most of these tours include visits to other interesting sites such as Cairo, Alexandria, the El Alamein battlefields and Nile wonders as part of a Nile cruise. Mean cloud cover on the North African coast is still low (less than 40%) although sand storms could pose problems for some North African locations (Espenak & Anderson 2004, Anderson 2005).

Several cruise ships also plan to sail into the Moon's shadow as it crosses the eastern Mediterranean Sea and many tours will take travelers to Turkey. However, weather prospects for the eclipse deteriorate as one moves north off the coast of Africa across the Mediterranean Sea and into Turkey where mean cloud cover can exceed 70 per cent in some locations (Anderson 2005).

*Most of the 2006 eclipse tours are now selling very well with many already fully booked since no other total solar eclipse will be so easily reachable for many years to come.*

**The 2009 July 22 eclipse** has the longest duration of totality of the current century (over 6-1/2 minutes)! This eclipse belongs to the same *Saros* cycle<sup>5</sup> that produced many long eclipses of the twentieth century including the last, the 1991 July 11 eclipse (6m53s maximum duration east of Baja California Sur over the southern Gulf of California). This fact alone will make the 2009 eclipse a must-see for many. However, the eclipse path is far from the USA passing through China and the sea south and east of Japan.

The path of totality actually passes through Shanghai with a duration of nearly six minutes about 60 miles south of this city. Maximum duration (abt. 6m39s) occurs more than 700 miles south southeast of Tokyo in the Philippine Sea near Iwo Jima. But, it is still four years away and *traveling to southeast Asia or cruising the seas east of China and south of Japan may exclude many wanting to see this event.*

Unfortunately, poor July weather prospects in this part of the globe may also hinder seeing totality. In addition, typhoon activity is very high in the northwest Pacific in July. Consequently, most cruise ships do not sail here during this time of the year. Still this eclipse will attract dedicated eclipse chasers, especially many Japanese, who have the means to witness this very long duration eclipse almost in their backyard.

**The 2010 July 11 eclipse**, like the previous total eclipse, is far from the USA and crosses remote areas of the South Pacific Ocean before ending on the southern tip of South America. However, several factors may entice some eclipse chasers who can travel into this eclipse path. The umbral shadow moves through exotic French Polynesia passing just south of Tahiti (partially reminiscent of the 2005 April 8 hybrid eclipse in the Pacific Ocean). The duration of the 2010 eclipse is also a very long (5m20s) although this occurs 1,800 miles east of Tahiti.

The lure of this eclipse, nevertheless, is because the eclipse's umbral shadow then passes through *Easter Island* where totality still lasts nearly five minutes! The attraction of viewing

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<sup>5</sup>The Saros cycle is a period of about 6,585.3 days (18 years 11 days 8 hours). Two eclipses separated by one Saros cycle have similar geometry (similar duration, same time of year, etc.). The 2009 total eclipse belongs to Saros cycle 136 (Espenak 1987).

a total eclipse of the Sun from *Easter Island* will obviously draw those who can afford to chase the Moon's shadow to this very remote, mysterious island!

**The 2017 August 21 eclipse** requires a wait of a dozen years for a total eclipse of the Sun to take place in the United States. (Note that North Central Florida will only have a partial eclipse although the Moon will hide 89% of the solar disk when the Sun is 65 degrees above the horizon.) On the East Coast, the only state that will see the total eclipse is South Carolina where the duration of totality is slightly over 2-1/2 minutes. But maximum precipitation for South Carolina cities as Charleston occurs in August! (Charleston lies about 3/4 of the way out from the eclipse center line.)

Farther west, even St. Louis, which lies on the edge of the path of totality, has higher levels of precipitation from March through August. Maximum eclipse is, in fact, about 180 miles southwest of St. Louis. Here, approximately 11 miles southwest of the small town of Crofton, Kentucky, totality will last 2m40s. Although Crofton has very slightly drier weather in summer than other times, precipitation still averages about 3-1/2 inches in August.

Contrast eastern locations with west locations as Oregon, which will have a shorter eclipse but will still have nearly two minutes of totality. Here August precipitation is often near the low for the year although eclipse travelers to the Northwest will need to avoid regions with summer orographic clouds and rain. Some locations in Oregon, nevertheless, are shielded from rain and have semiarid climates such as Vale in eastern Oregon, which averages only 0.4 inches of rain in summer. (Vale, however, is near the edge of the eclipse path with only about one minute of totality.) Therefore eclipse chasers will need to plan carefully to find semiarid western locations near the center line with prospects of clear skies. Other places farther east of Oregon in Idaho or Wyoming may have good weather. A good example is Casper, which averages only 0.73 inches of rain in August and is almost on the center line with nearly 2-1/2 minutes of totality.

Consequently, although the 2017 August eclipse is total in the USA, east coast residents must still plan to travel if they want much better assurance of seeing this eclipse. It may be tempting to go to South Carolina for totality but remember middle west and east locations have much higher probabilities of cloudy weather than points still farther west. So, the eclipse rule for 2017 is "go west eclipse chaser, go west."

**If still not convinced that seeing a total eclipse of the Sun is one of life's treasures,** be warned that even annular<sup>6</sup> or partial eclipses of the Sun for USA observers are sparse in coming years. Until the 2017 USA total eclipse, eight partial and eleven annular solar eclipses occur for our planet. However, few are visible from the USA (Espenak 1987).

On May 20, 2012, an annular eclipse will move across the North Pacific Ocean, sweeping through northern California before ending in the Texas panhandle, far from Florida. This eclipse is partial for most of Canada and the United States *except the East Coast including Florida!* Technically, the extreme western part of the Florida panhandle will have a partial

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<sup>6</sup>In annular solar eclipse, the Moon's umbral shadow fails to reach the Earth's surface resulting in an annulus (ring) of sunlight around the Moon. These eclipse, although striking in appearance, still pale in comparison to a total eclipse of the Sun.

eclipse but the eclipse begins just before sunset with the Sun only about one degree above the horizon!

Another partial eclipse occurs again for most of the USA, on 2014 October 23, but, as before, eastern locations lose. East of the Ohio Valley the Sun will set before maximum eclipse. In North Central Florida the Sun will be only seven degrees above the horizon at the *beginning of the eclipse* and will set soon after.

*Therefore, from a "practical point of view," the Southeast and especially Florida, will not see any eclipse of the Sun until 2017!*

**So, why wait until 2017?** Since cloudy skies can ruin any eclipse, make the most of any upcoming total eclipse of the Sun. Remember, the famous weather adage, "climate is what you expect, weather is what you get." The 2006 March 29 is almost with us and tour space is already limited. So, if one wants to stir their soul with the excitement, awe, mystery and wonder of the total solar eclipse, wait no longer and travel a bit.

For details about future eclipses, see the NASA Eclipse site by Fred Espenak:

<http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html>

For travel info about eclipse tours, contact Marian (our AAC Secretary) at **Continental Capers Travel and Cruises**:

**Address:** 4061 NW 43 Street, Suite 20  
Gainesville, FL 32606  
**Telephone:** 352-240-1004 (Toll Free 1-800-446-0705)  
**E-Mail:** [marian@flycapers.com](mailto:marian@flycapers.com), **Web Address:** <http://www.flycapers.com>

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