COUNTDOWN TO

Let's do this all over again in seven years — with two more minutes of totality! by Michael E. Bakich

hat just happened? It's August 22, 2017. Citizens of and visitors to the United States are abuzz about yesterday's celestial event. Videos, photos, and social media reports abound, and traffic still isn't back to normal. But you missed it.

Why doesn't matter. Whether you were serving on a submarine at the bottom of the Pacific Ocean, just awoke in a hospital after a zombie apocalypse, or were hampered by the thickest (and darkest!) clouds anyone ever saw, you failed to experience the awesome wonder of the 2017 total solar eclipse.

Now what? Well, you can check various sources to see when Earth will again experience totality. Perhaps you'll want to plan a trip to South America or Antarctica. I urge you, however, to look carefully at April 8, 2024. That's when the next total solar eclipse will cross the United States. And although six years and seven months (plus 19 days) sounds like a long time from August 21, 2017, it's much shorter than the average time between eclipses in a specific

location (330 years in the Northern Hemisphere and 550 years for locations south of the equator).

A few details

The length of totality varies from one eclipse to the next. The reason stems from the fact that Earth is not always at the same distance from the Sun, and the Moon is not always the same distance from Earth. The Earth-Sun distance varies by 3 percent and the Moon-Earth distance by 12 percent. The result is that the maximum duration of totality from 2000 B.C. to A.D. 3000 is 7 minutes, 29 seconds. (That eclipse will occur July 16, 2186, so don't get too excited for it.)

While the maximum length of totality during the April 8, 2024, eclipse won't be that long, it's still a worthy chunk of time: 4 minutes, 28 seconds. And as with the 2017 total eclipse, everyone in the contiguous U.S. will see at least a partial eclipse. In fact, as long as you have clear skies on eclipse day, the Moon will cover at least 16.15 percent of the Sun's brilliant surface — that minimum comes at Tatoosh Island, a tiny speck of land west of Neah Bay,

Washington. Although our satellite covering any part of the Sun's disk sounds cool, you need to aim higher.

Likening a partial eclipse to a total eclipse is like comparing almost dying to dying. If you are outside during a solar eclipse with 16 percent coverage, you won't even notice it getting dark. And it doesn't matter whether the partial eclipse above your location is 16, 56, or 96 percent. Only totality reveals the true celestial spectacles: the two diamond rings, the Sun's glorious corona, 360° of sunset colors, and stars in the daytime.

To see any of this, you must be in the path of totality. That said, your next goal is to be as close to the center line as possible. The fact that the Moon's shadow is round means that the longest eclipse occurs at its center line because that's where you'll experience the lunar shadow's full width.

The big day

The Moon's shadow first touches Earth just north of Penrhyn Island, one of the Cook Islands in the South Pacific. That location will experience a 98-percent partial eclipse.

Seventy-three minutes later, totality first strikes land at Socorro Island, a possession of Mexico. If, for some reason, you choose that location to view the eclipse, be sure to position yourself at the island's far southeastern tip — you'll enjoy an extra 34 seconds of totality there. (The span is 3 minutes, 36 seconds.)

The shadow's path covers a few more tiny islands before it encounters North America just southeast of Mazatlán, Mexico. Hey! That city was my base of operations for the 1991 total solar eclipse. Viewers from that location will enjoy 4 minutes, 27 seconds of totality. And if you wish to stay in Mazatlán, you'll lose only 10 seconds off that span.

The greatest duration of totality — 4 minutes, 28.1 seconds — occurs when the shadow reaches San Martín, north of Torreón and roughly half the distance from the coast to the Mexican border with Texas. In fact, the duration of totality along the center line is never more than 1 second less than this maximum during the shadow's more than 550-mile (885 kilometers) voyage through Mexico.

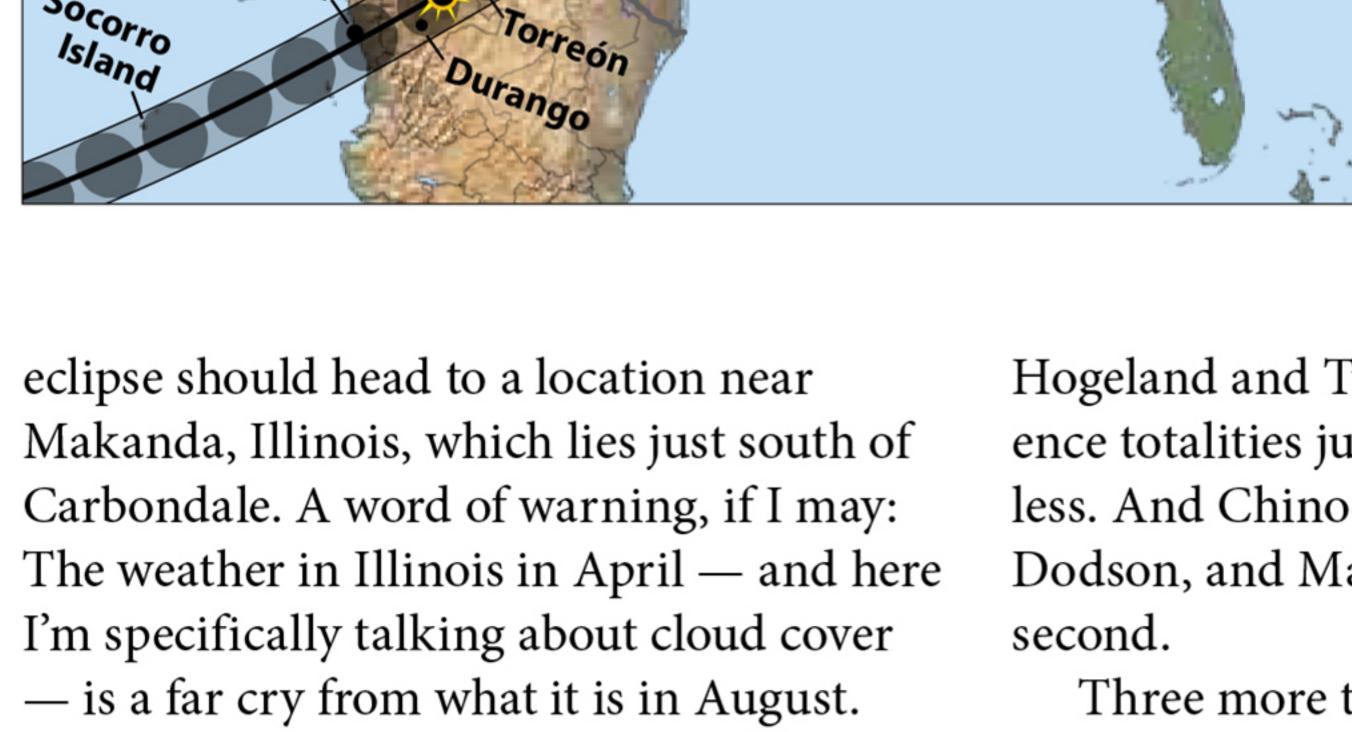
Border crossing

Totality first occurs in the United States as the shadow crosses the Rio Grande River at the wonderfully named Radar Base, Texas, which lies in Maverick

County. There, totality lasts 4 minutes, 27 seconds. As the eclipse progresses through the Lone Star State, a huge number of people won't have to travel anywhere to see it. That said, just a few miles' journey to the center line can increase their duration of totality.

28 seconds — San Antonio, Austin, Waco (Baylor University will enjoy percent longer 4 minutes, 10 seconds of darkness), Dallas, and Fort August 21, 2017, Worth all lie under the shadow, although none is on the center line. Still, that's more than 11 million people who can experience the eclipse with little to no effort. And we're not even out of Texas yet.

The center line then passes through Oklahoma, Arkansas, Missouri, Illinois, Indiana, Ohio, New York, Vermont, and Maine. Those wishing to observe the eclipse from the same location the center line crossed during the August 21, 2017,



Path of totalit

pick up an extra 15 seconds of totality from center line locations near San Antonio.

Your chances of actually seeing the 2024

the southwest. Not to mention that you'll

The maximum

length of

totality during

the April 8,

2024, eclipse

will be

4 minutes,

nearly 70

than for the

eclipse.

eclipse increase dramatically as you head to

Other cities in the path include Little Rock, Arkansas; Indianapolis; Dayton and Cleveland, Ohio (with northwestern parts of Cincinnati and Columbus under the shadow); Buffalo, Rochester, and Syracuse, New York; and about half of Montréal, Québec, Canada.

Beyond 2024

For those wanting to view a total solar eclipse in the contiguous United States after the 2024 event, it's a 20-year

wait until August 23, 2044, for the next one. That eclipse is visible only in northeastern Montana and a tiny segment of North Dakota. Its greatest duration of totality, 2 minutes, 4 seconds, happens over Canada's Northwest Territories.

At the intersection of the center line and the United States-Canada border, totality is 20 seconds shorter: 1 minute, 44 seconds. The small towns near that point, namely

Hogeland and Turner, Montana, experience totalities just a few tenths of a second less. And Chinook, Zurich, Harlem, Dodson, and Malta lose only another

Longest duration

Greatest eclipse

Three more total solar eclipses track through the contiguous United States in the 21st century. And if 2044's eclipse disappoints you, you'll be thrilled by the one that happens less than one year later. The event August 12, 2045, is a truly spectacular cross-country eclipse with totalities lasting 4 minutes, 23 seconds on the Northern California coast to an amazing maximum of 6 minutes, 6 seconds at Port St. Lucie, Florida.

The center line of the total solar eclipse on March 30, 2052, lands only on Florida and Georgia, but totality in that small path lasts between 3 minutes, 30 seconds in Savannah, Georgia, and 3 minutes, 44 seconds near Laguna Beach, Florida.

The final total solar eclipse whose path intersects the contiguous United States this century occurs May 11, 2078. Like the one in 2052, it also tracks through the southeastern United States. Totality lasts 5 minutes, 17 seconds for those in Nags Head, North Carolina.

For those of you who stand beneath the Moon's umbra this month, no convincing will be necessary to get you to darkness in 2024. It's a sight you'll never rate as anything other than awesome. Just be sure to check the weather first.

Michael E. Bakich is a senior editor of Astronomy.

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