Millions travel to view 2017 total solar eclipse

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Today marks the first time in 38 years that the continental United States will experience perhaps the most spectacular astronomical event, a total solar eclipse. The Moon will pass directly between Earth and the Sun, casting a shadow that will, for a 70-mile wide corridor across 14 states, briefly turn day into night.

On a global scale, total solar eclipses are hardly rare: one takes place approximately every 18 months, with a regularity so well-studied and explained by science that tables of future eclipses, their locations and exact times and duration, are available covering the next one thousand years. But the totality, complete blotting out of sun for several minutes, is highly localized, extending in a band about 70 miles wide and 3,000 miles long.

Today's eclipse will race at 1600 miles per hour diagonally across the United States, beginning at 10:15 a.m. at Depoe Bay, Oregon, and departing an hour and a half later from McClellanville, South Carolina. For those wholly within the Moon's shadow, the sky will suddenly dim as bands of shadow play upon the ground, a last bead of light will flare out where the Sun stood, birds will roost, and up to two and a half minutes of darkness will begin. The Sun will remain only in the form of its faint pearly outer atmosphere, the corona, surrounding the inky void of the Moon's silhouette.

A partial solar eclipse, where the Moon only blocks out part of the Sun, will be visible across virtually the entire North American continent, though special solar viewing glasses will be needed to safely observe this.

Nearly a century has passed since a similar eclipse path cut across the heart of the United States on June 8, 1918, while World War I still raged and the Bolshevik Revolution in Russia faced its first challenges from civil war and imperialist intervention. The following year, another solar eclipse would be used to provide the first experimental evidence for Einstein's general theory of relativity.

Accordingly, the event has generated a great deal of public interest in the United States. Hundreds of thousands, possibly millions of people from around the world are traveling to towns, campgrounds and highway roadsides that fall within the eclipse's path of totality, where the Moon fully blots out the Sun. Millions of solar viewing glasses and thousands of hotel rooms are sold out. The eclipse will be live streamed by government, news and social media outlets throughout the day.

At the same time, cities and municipalities in the eclipse's path are rightly worried about the mass influx of people to areas along the eclipse path. While only 12 million people live directly under the path of totality, 200 million people live within a day's drive. Hundreds of thousands have flocked to Idaho and Oregon alone, where it is the height of wildfire season and no coordinated plans exist should mass evacuations prove necessary. Nor do plans exist nationwide to deal with the expected traffic or potential shortages of gasoline, food and water.

Eclipses are among the oldest recorded astronomical phenomena, having been studied by civilizations across the globe for more than four millennia. Their interruptions to the ordinary rhythms of the sky remain just as vivid now as when the earliest lunar eclipse (when the Moon is shadowed by the Earth, rather than the Earth by the Moon) was recorded in Sumeria in 2094 BCE, or the first solar eclipse recorded in what is now modern Syria in 1375 BCE.

Until the 20th century, total solar eclipses provided the only views of the faint atmosphere of the Sun by covering the brilliant solar "photosphere." The pink glowing clouds of hydrogen gas called prominences would be described by Fermicus Maternus during a solar eclipse of 334CE, and the faint solar corona would enter the literature with the solar eclipse of 968CE. These and subsequent observations provided a

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glimpse into the inner workings of the Sun.

Approximate recurring patterns in the motion of the Earth and Moon relative to the Sun enabled the Babylonians to make rough estimates of when lunar eclipses might be seen in the 6th century BCE. Fragmentary evidence even suggests the Neolithic culture of Stonehenge may have noted some of the principal periods in which eclipses repeat. In Greece, Hipparchus observed the 189 BCE eclipse of the Sun and estimated for the first time the distance between Earth and the Moon, the first "astronomical" calculation, giving the first hint of vast scales of distance to come.

The intense study of the cycles of sky motion, both of eclipses and the planets, reached a high point with the work of Claudius Ptolemy in the second century CE, drawing on centuries of Greek records. With Ptolemy's work, "rough" predictions of solar eclipses became possible for the first time. The solar eclipse of 1560 became the first to be predicted with some specificity, creating a sensation in Europe and inspiring the 13-year-old Tycho Brahe to dedicate his life to astronomy.

Isaac Newton, who published his theory of gravity in 1687, further refined eclipse predictions by basing the motion of the Moon and Sun (and all the planets) on concrete physical principles which explained the recurrences of nature at a deeper level. His predictions were improved upon after the British government offered a £20,000 prize (about $5 million in modern value) in 1714 for methods by which the position of a ship at sea (vital for both the navy and seaborne trade) could be determined: one such method required accurate positions of the Moon. Between 1748 and 1751, a series of papers by Alexis Clairaut, and more practical work inspired by him published by Leonhard Euler, solved this problem theoretically. High-precision tables of the Moon's celestial movements emerged; ships at sea could get their position and solar eclipses could be predicted precisely.

In the 20th century, scientists combined historical records of eclipses over three millennia with high-precision computer calculations on the motions of the Earth-Moon system. Because of the narrowness of the path of a total eclipse, even tiny variations in the rotation of the Earth or the revolution of the Moon about it would change the locations where an eclipse was reported. Historical records, made only with the naked eye, have pinned the average rotation rate of the Earth over these millennia to a few parts per billion.

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