

Introduction

Jay M. Pasachoff

Total solar eclipses have inspired many, including students, artists, scientists and members of the public—and many viewers of this exhibition and readers of this booklet will be inspired if they travel to the path of totality. Tycho Brahe was so inspired by the eclipse of August 21, 1560, and the fact that it was predicted (even though the prediction was a day off), that he set up the best observing pre-telescopic instruments in the world to obtain better data. Johannes Kepler, who used Brahe's data to discover his three laws of planetary orbits, described in his *Optics* the eclipse he saw in 1600 and predicted the eclipse of 1605, which he then observed in detail.

Only within totality does one see all the exciting, rapidly changing eclipse phenomena—especially the darkening by a factor of 10,000 within seconds as the Baily's beads (ordinary sunlight shining through valleys aligned at the edge of the Moon) and the diamond-ring effect (the last bead shining thousands of times more brightly than anything else in the sky for a few seconds as totality begins or ends)—and the glorious corona surrounding the lunar silhouette.

The phenomena at the onset of totality are so dramatic that the art historian Roberta J. M. Olson (of the New-York Historical Society) and I have made a case that the 18th-century artist and architect Cosmas Damian Assam, in Bavaria, must have seen an eclipse with his own eyes since one of his oil paintings of St. Benedict watching an eclipse was the first painting in history to capture the actual drama. We have identified eclipses of 1706, 1724, and 1733 as possibilities.

Edmond Halley, of comet fame, was the first to show the elliptical shadow of the Moon projected on a map of Earth for the eclipse of 1715 as it was to pass over England. His map appeared on a broadside that included an appeal to the public to send him observations. He wrote, “The Curious are desired to Observe it, and especially the duration of Total Darkness, with all the care they can; for thereby [sic] the Situation and dimensions of the Shadow will be nicely determined; and by means thereof [sic] we may be enabled to Predict the like Appearances for ye future, to a greater degree of certainty than can be pretended to at present, for want of such Observations.” With those observations, he improved the track of the 1715 eclipse by some tens of miles and predicted the path of the 1724 eclipse from England to the Continent.

Many superstitions about eclipses (“These late eclipses in the sun and moon portend no good to us” from *King Lear*, Act 1, Scene 2) persist. If it is a dragon eating the Sun that causes the eclipse, then the belief that beating a drum and banging a gong chases the dragon off can be confirmed. But how do we explain the science of eclipses in our modern age? Too many people believe that special rays come out of the Sun during an eclipse, when really it is merely the blocking of many ordinary rays of everyday sunlight. Too many students are prevented from seeing the eclipse by well-meaning school boards out of fear that students will injure their eyes. To the contrary, I think such attempts are counterproductive, since the students will soon find out that they missed something wonderful and may therefore not believe official warnings of more mundane and even more important matters, such as the need to be vaccinated and practice only safe sex. If after viewing an eclipse people who do not regularly have eye exams make appointments

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to see ophthalmologists and optometrists when they notice a problem with their vision, the net effect of the eclipse may actually improve the vision of the populace.

Pasadena is an excellent place for an exhibition about eclipses, since the beautiful streamers we see in the corona are held in place by the solar magnetic field, which was discovered by George Ellery Hale with a device he invented and used on a telescope on nearby Mt. Wilson a little more than 100 years ago, in 1908. And this year marks the 100th anniversary of the 100-inch reflector on Mt. Wilson, not usable for observing eclipses of our own Sun but used in the past by Olin Wilson (and briefly also by me) to study chromospheres—the reddish layer of the Sun just below the corona—in other stars. On August 21, 2017, I will be in Salem, Oregon, in the midst of totality, hoping for clear weather to observe the solar chromosphere and corona at the eclipse, joined by colleagues, students, family, alumni and others.

The circumstances of lunar months, as seen both from above and from the moving Earth, match pretty precisely every 18 years 11¹/₃ days, a period known (using a term from Halley that can be traced back to the Babylonian) as the saros. So whenever there is an eclipse, an eclipse of the same approximate length will recur 18 years, 11 days later with the Earth rotating a third of the way around, and its path—100 or so miles wide and thousands of miles long—occurring a bit north or south of the previous saros member's paths. Three such saros bring the eclipse path to the same longitude region of Earth, an exeligmos. So this August 21, 2017, the totality centered in the United States was preceded by the eclipse of August 10, 1999, centered in Europe. That totality was preceded by the eclipse of July 31, 1981, centered on the Asia/Pacific border. And that totality was preceded by the eclipse of July 20, 1963, centered in Canada. All of which I have observed among the 65 solar eclipses of my personal history. This will be my second exeligmos.

The current exhibition contains both art and artifacts. The scientific eclipse expeditions carried out by the Lick Observatory and the Mt. Wilson Observatory provided photographic images that we can still study. It is a pleasure to have artifacts from Lick's expeditions as part of our exhibition, specially selected by artist and Lick curator Tony Misch.

From art to artifacts, from superstition to science, from fear to inspiration, from ignorance to knowledge: eclipses of the Sun provide us with wonderful opportunities to gaze at and to explore the most dramatic phenomenon visible on Earth. It is a pleasure to associate this indoor exhibition with the outdoor phenomenon of this year's August 21 Great American Eclipse.

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