Preface

The original meaning of έκλειψη (the Greek word for "eclipse") is a forsaking, quitting, or disappearance. Hence the covering over of one object by another or the immersion of something into something else represents precisely the facts of an eclipse.

Earth and the Moon are solid bodies in space. Each casts a shadow as a result of the Sun's illumination. To understand eclipses, all we need to know is what results from the existence of these shadows. Total eclipses, be they of the Sun or the Moon, are examples of sublime celestial geometry. Each one is an exact lineup of the Sun, the Moon, and Earth for a total solar eclipse, or the Sun, Earth, and the Moon for a total lunar eclipse.

Our solar system is a group of a huge number of bodies, a few large and many small. The main one is the Sun. Its Latin name, *sol*, indicates why we call the collection a solar system. Now imagine a line between the Sun and any other body at a given time. Because everything in the solar system is in motion, that line will point in a different direction as time passes. Such a line shows the direction of the object's shadow, precisely opposite the Sun's position in space.

Every so often, an additional body comes into alignment with the other two. If the two non-solar bodies are close enough, the shadow from the closest one to the Sun may fall on the other. It may completely cover the second body or only partially cover it. Likewise, the first body may completely block out the Sun's disk or it may only partially obscure it. It is during these times that eclipses occur.

The larger a body is, the farther into space it will cast its shadow. At Earth's average distance from the Sun, any object casts an umbral shadow 108 times its diameter. This makes Earth's umbral shadow an average length of 855,000 miles and the Moon's umbral shadow approximately 255,000 miles long. Of course, these numbers vary because the distances of these bodies from the Sun change. Still, with them in mind it's easy to see why total lunar eclipses last much longer than total

solar eclipses. The disk of Earth's shadow is much larger than the corresponding disk of the Moon's shadow at the average Earth-Moon distance of about 238,900 miles.

Most readers of this book will never have experienced a total solar eclipse and may therefore think that solar eclipses are rare. Actually, at least two and as many as five occur every year. During the period from 2000 B.C. to 3000 A.D., a total of 11,898 solar eclipses occurred. Of that number 3,173 (26.7 percent) were total. Within that span of five millennia, Earth experienced five solar eclipses in one calendar year only 25 times (0.5 percent). The most recent was in 1935, and the next time will not be until 2206.

Indeed the numbers surrounding eclipses, the scientific reasons they happen, and the way astronomers can predict—to a fraction of a second—where, when, and for how long a given eclipse will occur make these events fascinating. But all of this pales in comparison to actually witnessing totality at your location.

94.5 percent of the continental United States will experience a partial eclipse on August 21, 2017. Do you know the difference between a partial eclipse and a total one? It's the difference between a lightning bug and lightning. Between testing negative and positive with a pregnancy test. Between a paper cut and stepping on a land mine. In other words, there's no comparison.

Thankfully, comets and eclipses no longer generate the anxiety and alarm among uneducated populations that they did even as recently as a century ago. This means the upcoming total solar eclipse on August 21, 2017, will not only attract a good deal of attention from many millions of people, it may even induce a respectable number to think about the science and history of eclipses. And that's a good thing. Every now and then when something this remarkable happens—a great thunderstorm, an earthquake, a volcanic eruption, a bright comet, or an eclipse—it allows people who normally don't think of astronomy a chance to stop and appreciate the wonderful universe we live in.

Because this book is about a scientific event, it contains lots of facts. But it's also meant to appeal to astronomy newbies, people who certainly will be interested in this event, but who may not be well versed in science.

That said, my advice regarding how you use this book is to concentrate on the section or sections that mean the most to you when you're ready to deal with them. Your first order of business probably will be either to familiarize yourself with what's actually going to happen or to identify the ideal location you'd like to be at on eclipse day. Later, you may be interested in reading about eye safety. At some point, you'll want to cross-reference your ideal location with the discussion of weather prospects you'll read about here. And if you wish to enhance your viewing, the equipment chapters will speak to you as the event approaches.

However you choose to approach it, I cannot stress enough that you really should observe the eclipse. This is a must-see event. I think of it as "awesome" in the truest sense of that word: able to inspire or generate awe. Especially in the United States, people throw that word around like it's nothing "Your shoes are awesome!" "This crème brûlée is awesome!" "Little Julie's new crayon drawing is

awesome!" Really? Do these things actually generate *awe*? On second thought, probably not.

But the eclipse on August 21, 2017, will be nothing short of awe-inspiring. I guarantee that if you stand under the Moon's shadow in the daytime you'll never forget it. Furthermore, it will stand out as one of the greatest—if not the greatest—sights you ever have or ever will behold. I'm smiling as I write this because I know some of you are thinking, "Wow, this guy should have worked for P. T. Barnum!"

Remember, however, that I've traveled to observe 13 total solar eclipses, and for 11 of those, I had groups accompanying me. I made passionate presentations to thousands of people before those events. And afterward, how many people thought I'd gone overboard? That I'd over-hyped the eclipse? That I'd set their expectations so high they could never reach them?

Zero.

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