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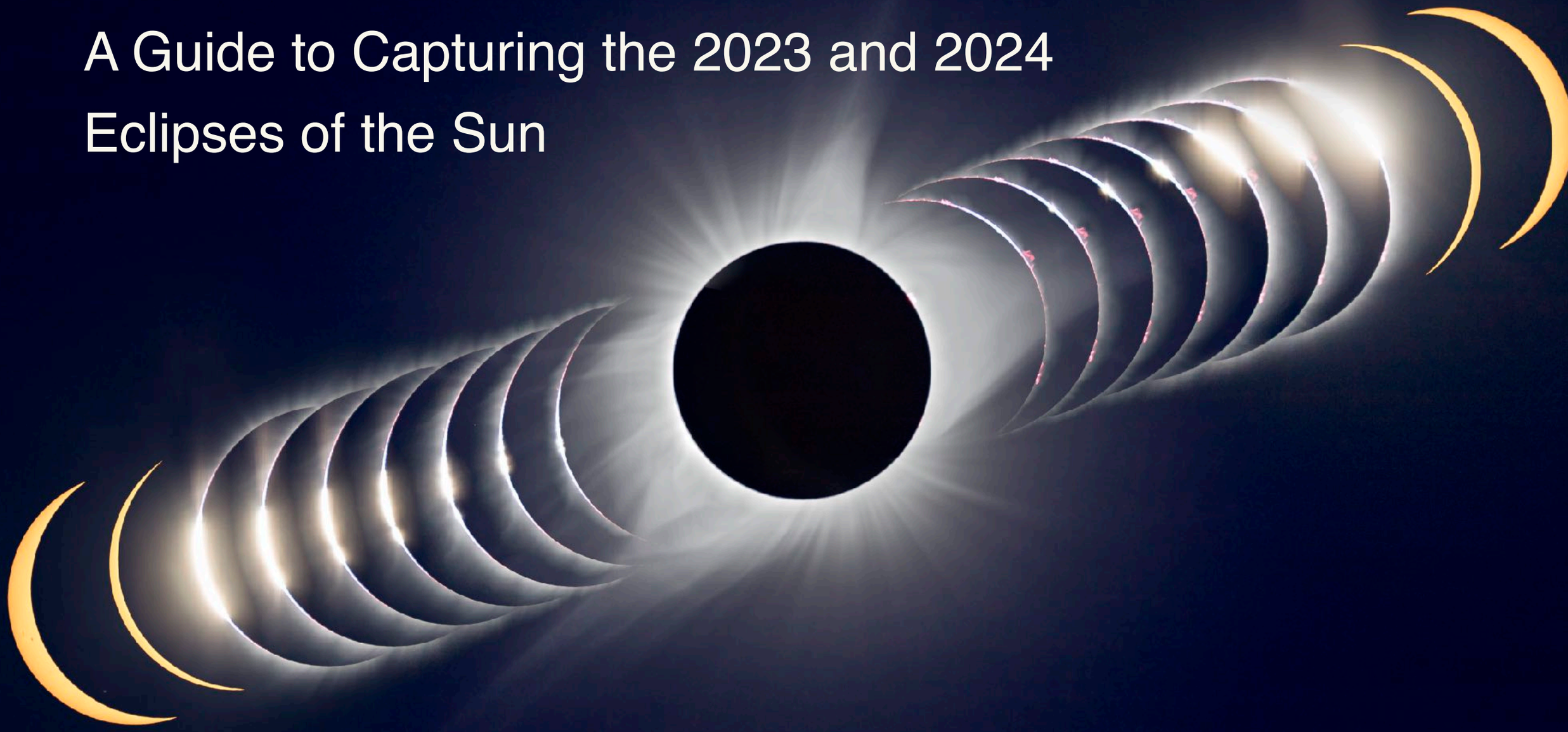
HOW TO PHOTOGRAPH THE SOLAR ECLIPSES

A Guide to Capturing the 2023 and 2024 Eclipses of the Sun



BY ALAN DYER
AMAZING SKY PHOTOGRAPHY AND PUBLISHING

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CHAPTER 1

1

INTRODUCTION

To start I provide a summary of what my ebook covers and what it does not. I introduce you to two eclipses: the October 2023 annular and April 2024 total. I list all the photo techniques I describe and where to find the details in the ebook.

October 14, 2023 annular eclipse seen from space by NASA's DSCOVR satellite

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Revised October 2023
ISBN 978-0-9939589-4-6

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THE COMING ECLIPSE OF THE SUN

The celestial experience – and photo opportunity – of a lifetime is coming to North America in 2024. But we got a sneak preview in 2023.

A total solar eclipse is the most spectacular and breathtaking event nature has to offer – on the Earth or in the sky. Period.

While most of the sky changes but slowly, in a procession of events that take eons to play out, an eclipse of the Sun descends upon you, plunges you into fearful, primal darkness, then returns you to light in moments. It is over far too soon, leaving you wondering if you really did see what just happened.

The sight of the Sun disappearing and turning into a black hole in the sky is so beyond everyday experience, you are left awestruck and tearful. Over the course of a few minutes you experience a range of emotions, from fear to joy, as no other event in the sky can evoke.

But … six months earlier we saw another type of solar eclipse that had its own unique attraction.

August 21, 2017, Idaho

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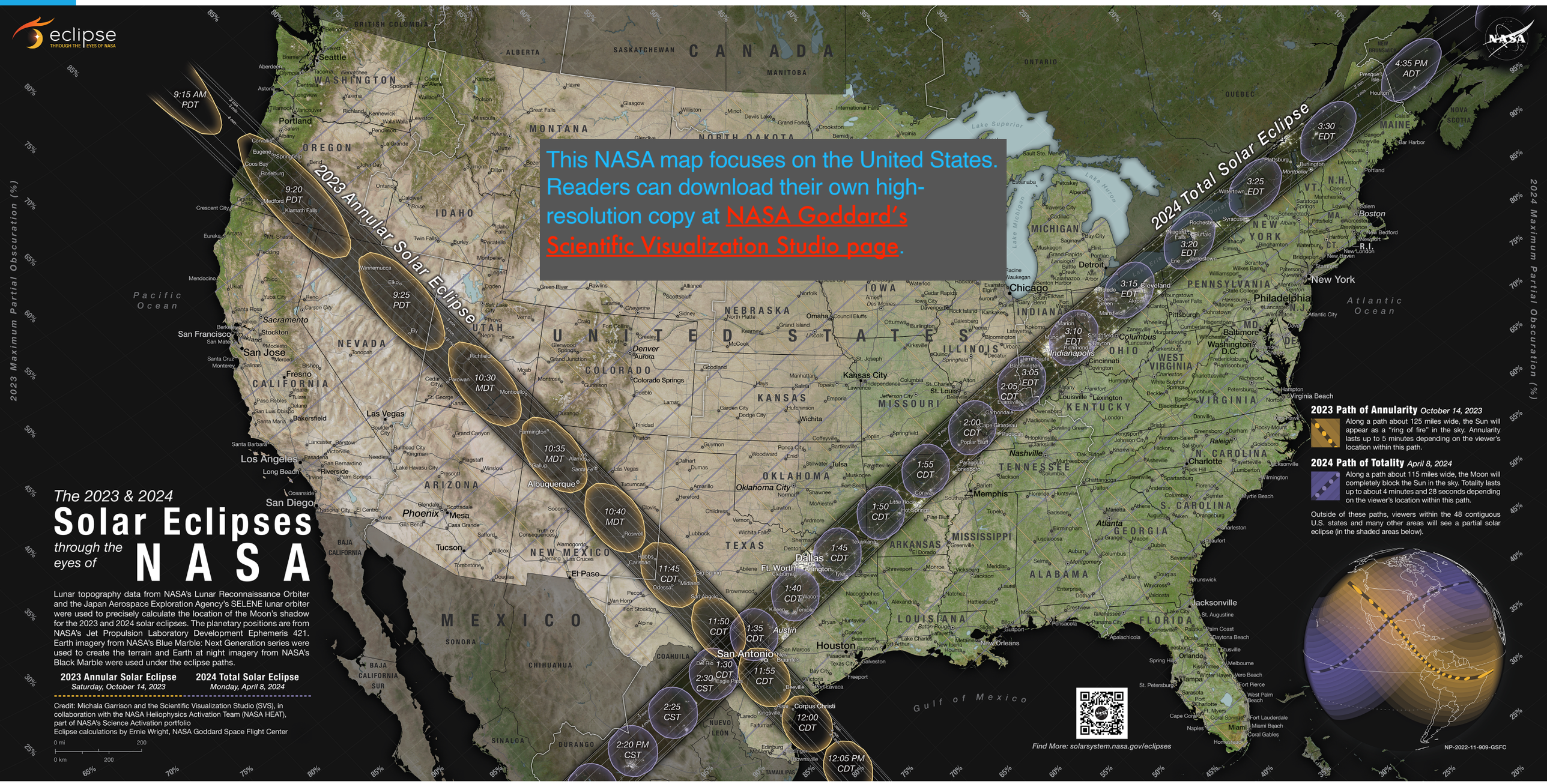
THE 2023 AND 2024 ECLIPSES OF THE SUN



Two solar eclipses cross North America from west to east: the October 14, 2023 *annular* eclipse (left path) traveled from Oregon down to Texas, while the April 8, 2024 *total* eclipse (right path) comes up from Mexico, crosses the U.S. from Texas to Maine, but also covers parts of six Canadian provinces. The bands mark the Moon's shadow paths. In those paths is where you needed to be to see the annular eclipse in 2023, or the total eclipse in 2024. Anyone outside those shadow paths will see a partial eclipse of the Sun. Remarkably, sites in southern Texas around San Antonio see both eclipses.

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THE 2023 ANNULAR ECLIPSE OF THE SUN

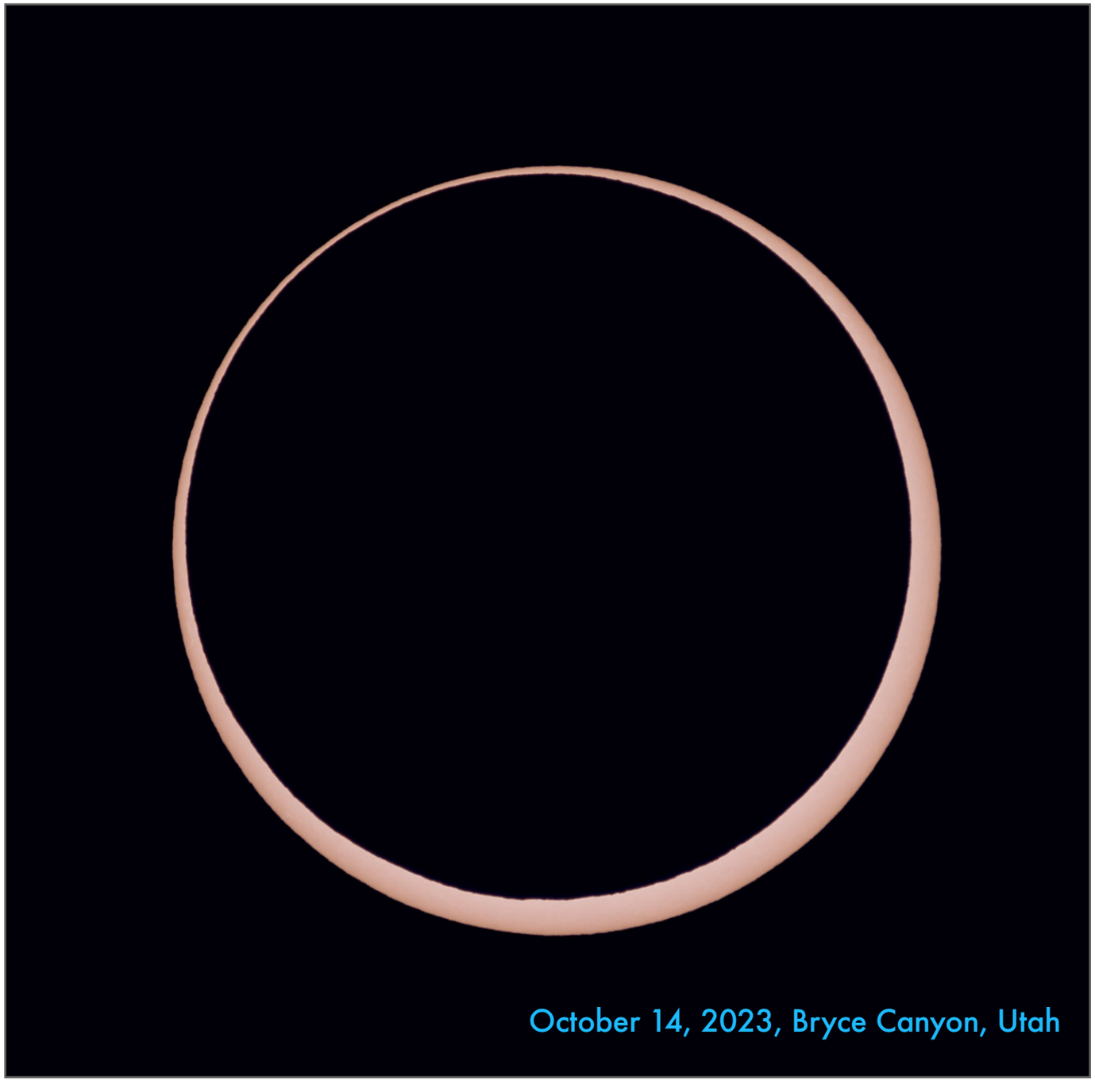
In a welcome dress rehearsal, we were treated to an annular eclipse of the Sun across the western United States, on October 14, 2023.

The October 14, 2023 eclipse served as a practice run. It lacked most of the visual effects of a total eclipse. But an annular eclipse, where the dark disk of the Moon isn't big enough to completely cover the disk of the Sun, is still exciting. And rare for any location.

Like a total eclipse, the best part lasts only a few minutes, or indeed seconds. You had to work fast to see and capture the eclipse at its best, with the Moon completely surrounded by a ring – or *annulus* – of sunlight.

The 2023 annular eclipse provided a great chance to test out gear and techniques, fine-tuning them for the big event on April 8, 2024.

I've revised Chapter 4 about the annular eclipse to cover lessons learned at the eclipse, while retaining advice that also applies to the total eclipse in 2024. I've revised Chapter 11 to include processing tutorials for the annular.



October 14, 2023, Bryce Canyon, Utah

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THE 2024 TOTAL ECLIPSE OF THE SUN

Then six months later, on April 8, 2024, we get the big show, perhaps for many a once in a lifetime experience – a total eclipse of the Sun.

When worlds align just right, we get a total eclipse, where the disk of the Moon – the dark silhouette here – is large enough because the Moon is close enough to cover the bright disk of the Sun.

That's what will happen across North America on April 8, 2024. It is the first total eclipse of the Sun on our continent since August 21, 2017 and the last until March 30, 2033 (in Alaska!).

Only during the rare and brief minutes of totality do we see the hallmark feature of a total solar eclipse – the silvery-white corona, the outer atmosphere of the Sun. Only with the disk of the Sun covered do we see the fiery pink prominences leaping into space from behind the edge of the Moon. And only during a total eclipse does day quickly turn to deep twilight.

It is an experience not to be missed.

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HAVE YOU SEEN PREVIOUS ECLIPSES?

If you missed the 2017 total solar eclipse, the 2024 event might be your first total solar eclipse – at least as best as you can remember!

This image is one of my photos of my first total solar eclipse – on February 26, 1979, from southern Manitoba. I shot this on Kodachrome 64 film through a Questar 3.5-inch telescope.

If you've lived in North America since then, and are old enough, and passionate enough about eclipses, then perhaps you saw that event. If your dedication to eclipses hasn't been enough to inspire travel, then the total eclipse of August 21, 2017 might have been your second eclipse. Did you miss it? Here's another chance.

However, for many readers, the April 8, 2024 eclipse will be their first eclipse. The usual advice to eclipse newbies – umbral virgins! – is to forget about taking any photos at all. Just look.

But clearly, you've bought this ebook because you want to capture the event. I'll show you how.

February 26, 1979, southern Manitoba

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WHAT THE BOOK IS ABOUT

NOTE: In October 2023 I revised my ebook for a post-annular eclipse edition, replacing planning information for the October 14 annular eclipse with "lessons learned."

I'm going to provide you with all the answers to the question "How do I shoot the total eclipse?" I offer many options, from easy to complex.

Everyone who sees an eclipse wants to take home a souvenir – their souvenir – of the experience. You'd like to have a photo you took, perhaps even a family portrait with the eclipse in the background. Wouldn't that be a keeper for the generations!

Shooting a solar eclipse souvenir can be very easy. Or it can invite complexity and anxiety.

I'll try to provide my best advice, garnered from 38 years of experience shooting 16 total solar eclipses (TSEs in the lingo), on how to get great images with single or multiple cameras.

I'll provide many options, from wide-angle scenes and selfies, to detailed close-ups and composites, plus time-lapses and videos. I'll cover what can go wrong and how to avoid common mistakes. I assume some familiarity with cameras, but none with shooting a TSE.

November 3, 2013, mid-Atlantic Ocean

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WHAT THE BOOK IS NOT ABOUT

My ebook is about photographing the eclipse. It isn't a travel guide, science book, or history survey.

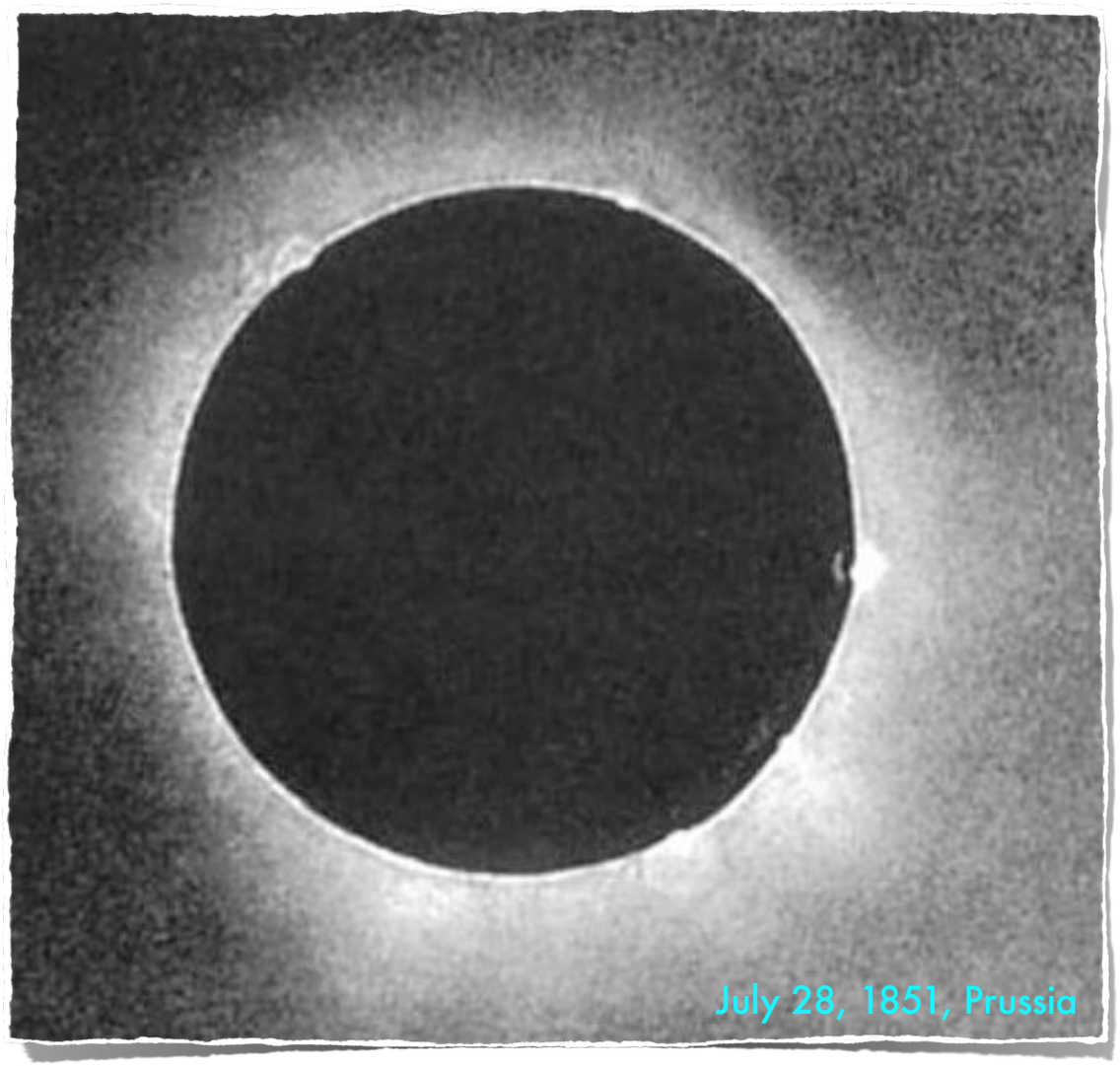
Eclipses are rich subjects, full of travelers' tales and paradigm-shifting events in the history of science.

The 2024 eclipse provides a wealth of options on where to go to see it. However, this is not a travel guide for where best to go or how to plan your eclipse expedition.

Other authors have covered the other aspects of eclipses. There are histories of eclipses, travel atlases, and science books that delve into the intricacies of lunar and solar motion.

Do read them. It will make the experience of seeing the eclipse all the better. I provide recommended reading at the end of my ebook.

But apart from some cursory looks on why and where, my book concentrates on one question: how to shoot the eclipse with a camera...or two.



This is the first good photograph ever acquired of a total solar eclipse, taken from Königsberg, Prussia (now Kaliningrad, in Russia) on July 28, 1851.

Photographer Johann Julius Friedrich Berkowski used a Daguerreotype plate camera attached to six-centimetre (2.5-inch) refracting telescope. It is an 84-second (!) exposure started shortly after totality began.

Now we can shoot real-time video and "webcast" it to the world, live.

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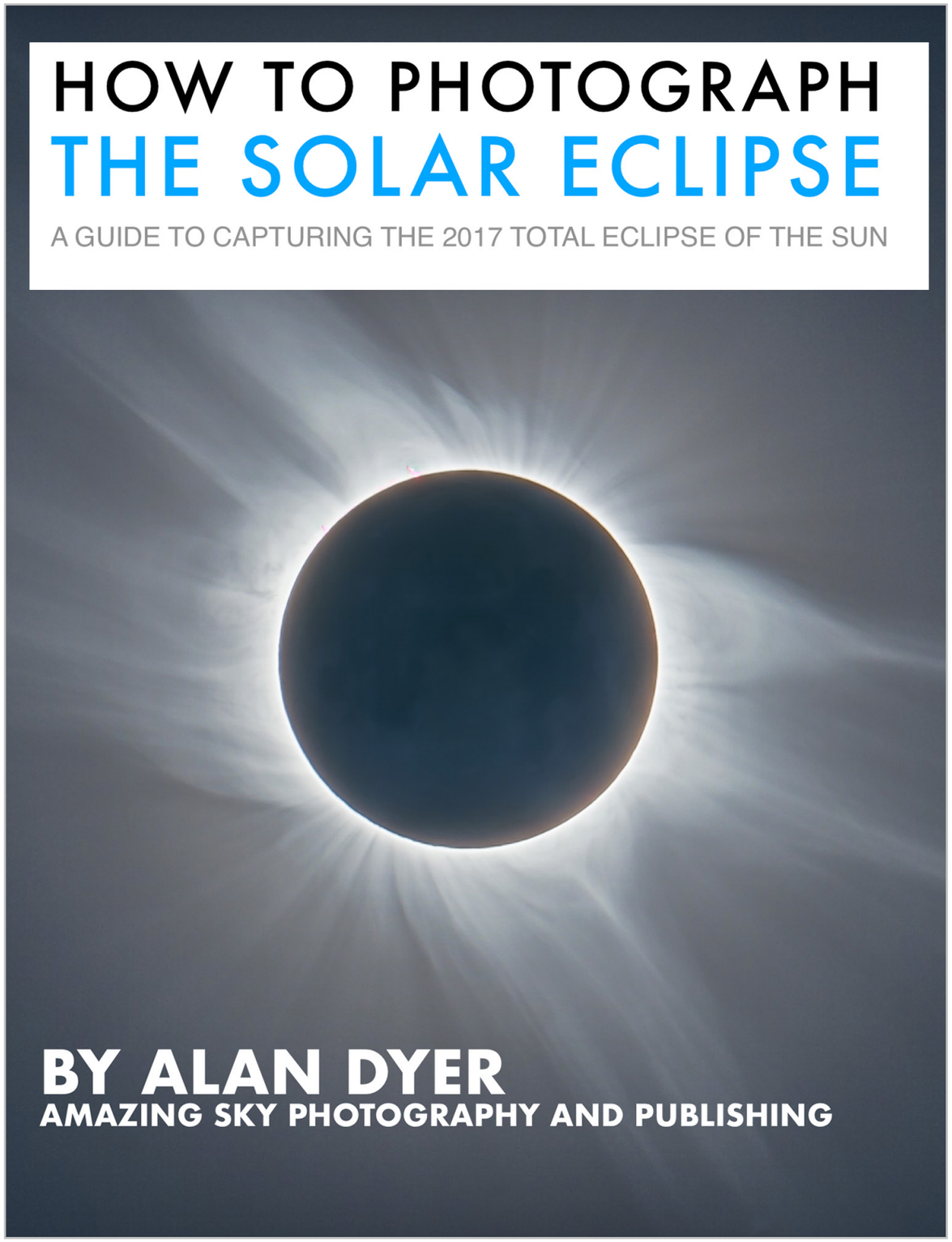
WHAT'S NEW IN THIS 2023 EDITION

This ebook is a revision of one I published in 2017 (shown at right) for the August 21 total solar eclipse that year across the United States. I have also revised this edition of the ebook following the October 14, 2023 annular eclipse.

If you purchased the previous 2017 edition of my eclipse ebook, then portions of this 2023/2024 edition will be familiar. Some sections needed only minor revisions to make them applicable to the 2024 solar eclipse.

However, most of the book's contents, while keeping a similar outline, have been greatly revised from 2017. I have made all the charts and planning diagrams applicable to the 2024 eclipse, for several locations along the paths.

Since 2017, camera technology has also advanced a lot! In 2017 shooting 4K video required a costly, high-end camera. Now your phone can do it, and some cameras can shoot 8K video. In 2017 DSLRs could shoot 5 or 6 frames a second. Mirrorless cameras can now shoot 20 to 30! So, I've expanded information about shooting video and rapid burst stills. I also completely revised Chapter 11 on processing.



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THE PHOTO TECHNIQUES DESCRIBED

The table summarizes the many techniques I describe in detail in the book, from simple to complex, for stills, time-lapses and video.

There are many ways to capture a total eclipse:

- ☑ Framing in close with a superzoom camera, a long telephoto lens, or a telescope is the obvious method that many will opt for.
- ☑ But compelling images can also be acquired by shooting wide-angles or panoramas.
- ☑ Time-lapses reveal the passage of the lunar shadow and the changing sky colors.
- ☑ Rapid-fire stills or a movie capture the iconic “diamond rings” as the Sun disappears, then reappears from behind the Moon.
- ☑ Composites blend all the stages of the eclipse onto one frame.
- ☑ Movies capture motion but also sound, a big part of the eclipse experience.

The “Demand on Your Time” is my gauge of how much time that method will leave for you to just look. Low = you’ll have lots of time free.

Technique	Gear Needed	Level of Difficulty	Demand on Your Time	Described in Chapter...
Grab Shot	Phone or Point-and-Shoot Camera	Easy	Low	**5**
Wide-Angle Video	Video Camera on Tripod	Easy	Low	**9**
Wide-Angle Stills	DSLR/DSLM Camera on Tripod	Moderate	Low	**5**
Wide-Angle Time-Lapse	DSLR/DSLM Camera on Tripod	Moderate	Low	**8**
Panorama Still	DSLR/DSLM Camera on Tripod	Moderate	Modest	**5**
Close-Up Video	Video Camera on Telescope	Moderate	Modest	**9**
Close-Up Stills	Superzoom, DSLR/DSLM w/ Telephoto or Scope	Harder	High	**6**
Close-up Composite	DSLR/DSLM with Telephoto or Scope	Harder	High	**7**
Tracked Images	DSLR/DSLM on Telescope and Tracking Mount	High	High	**6**
Wide-Angle Composite	DSLR/DSLM Camera on Tripod	High	High	**7**
Close-Up Time-Lapses	DSLR/DSLM on Telephoto or Scope	Highest	High	**8**

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As the last ray of sunlight vanishes, a scene of unexampled beauty, grandeur, and impressiveness breaks upon the view.

— Simon Newcomb, 1890

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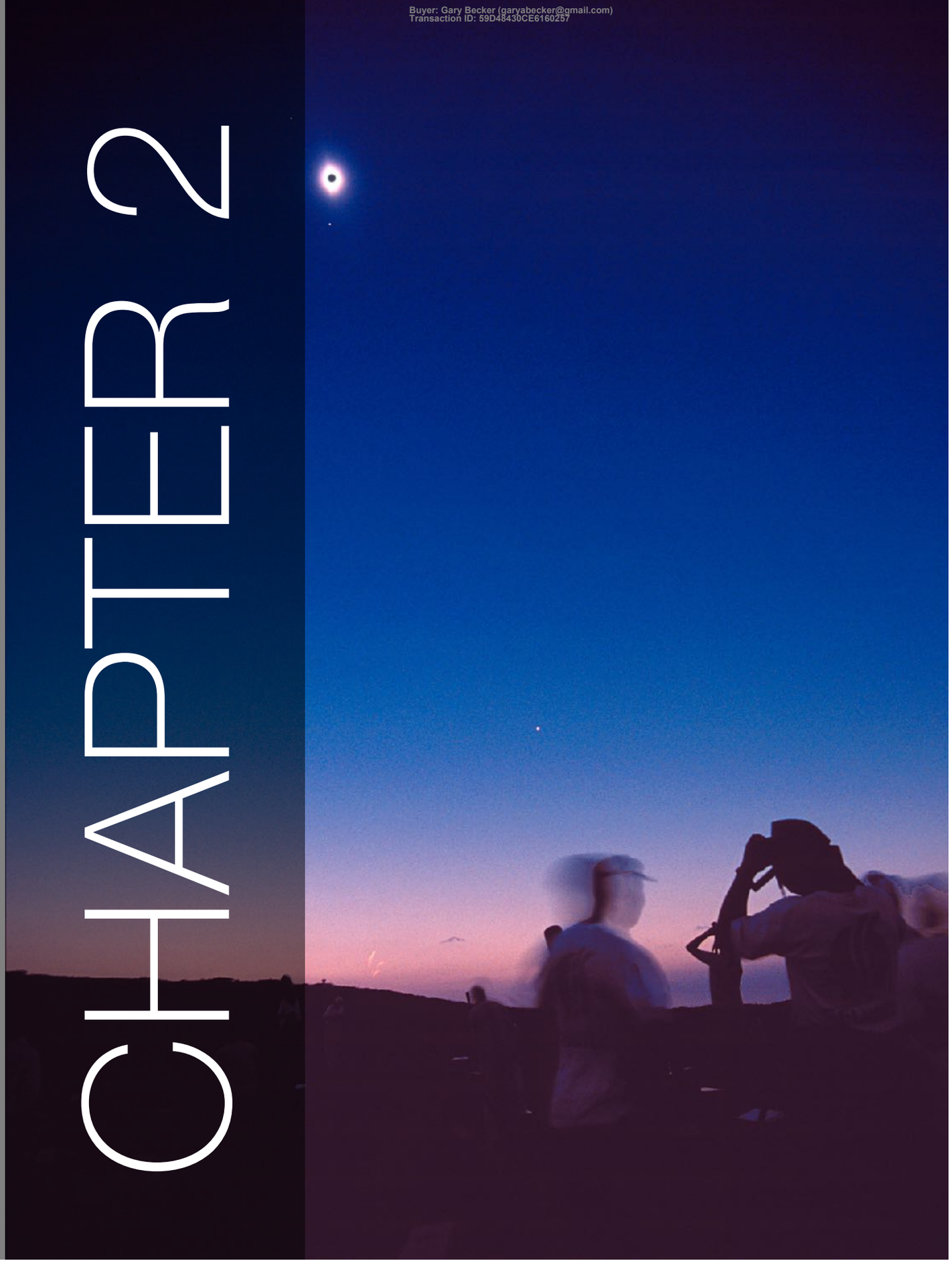

2

THE ECLIPSE EXPERIENCE

Forget f-stops and ISO speeds – for now. Successfully photographing the eclipse first requires a knowledge of what's going to happen. And a lot will happen in just a few minutes, more than your senses and cameras can possibly take in. But let's try!

February 26, 1998, Curaçao, Caribbean

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SECTION 1

ECLIPSE ESSENTIALS

I begin with the requisite introduction to celestial mechanics. Just why is the Sun going to disappear? It is because of a remarkable coincidence that happens no where else in the solar system. Perhaps in the universe!

NOTE: I should mention that all the eclipse images in my book, with a few notable – and noted – exceptions, are my own, taken with film and digital cameras at eclipses over the last 50 years.

February 26, 1998, Curaçao – Note Mercury and Jupiter near the Sun and Venus below

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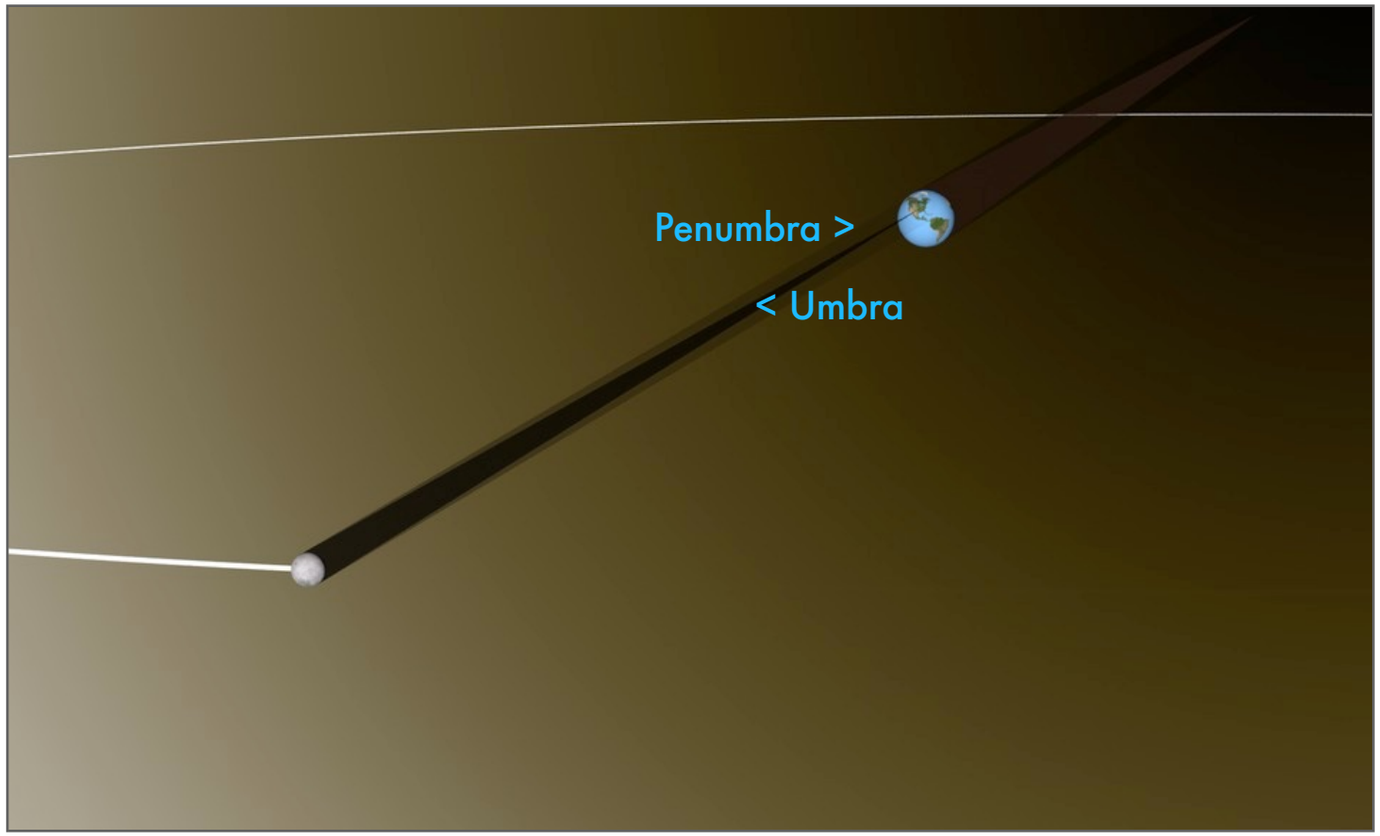
WHAT IS A SOLAR ECLIPSE?

While the Moon is 400 times smaller than the Sun, it is also 400 times closer, so the two appear nearly the same size, a remarkable coincidence.

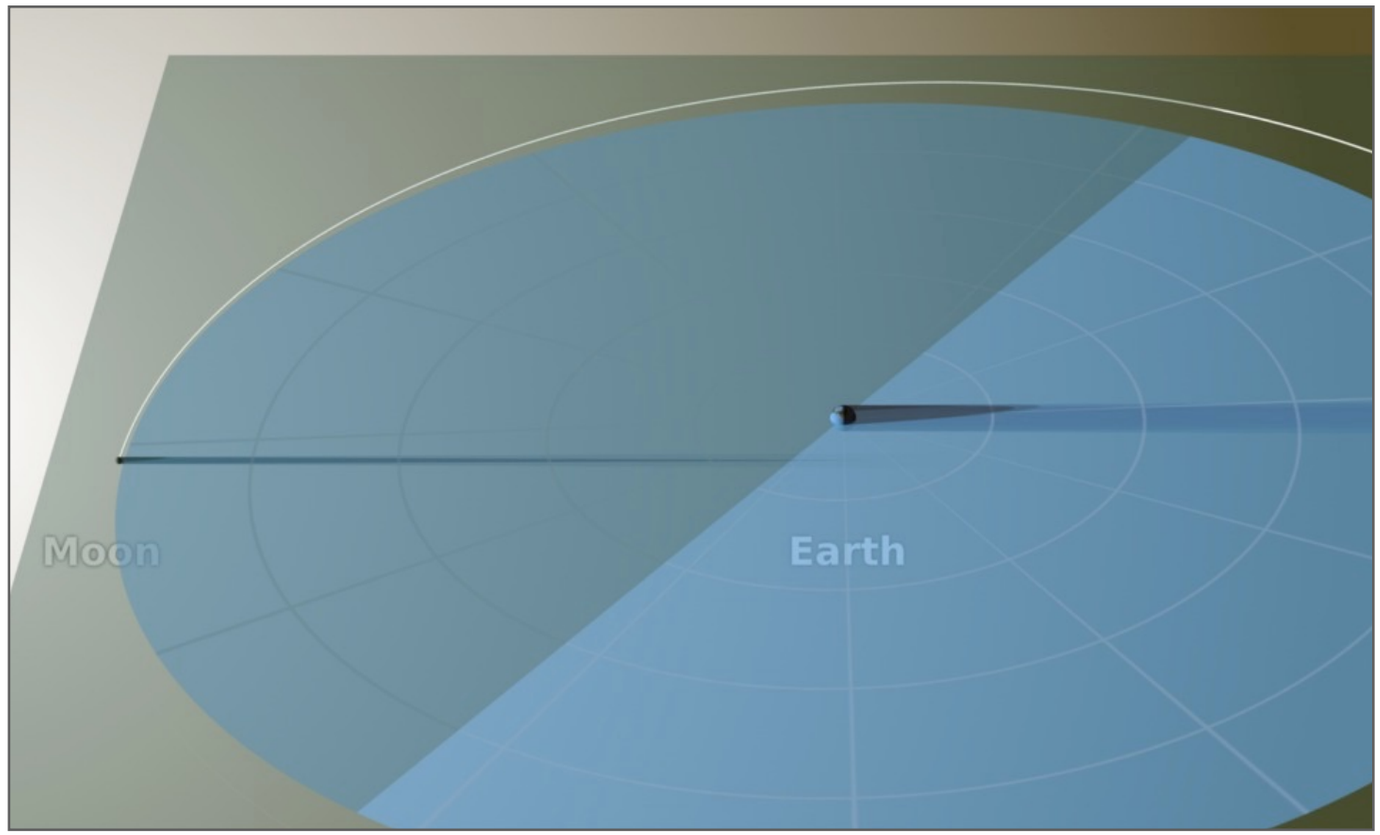
When the Moon casts its shadow onto the Earth. we see some type of solar eclipse from within that shadow. The wide, diverging penumbral shadow is where you see only a partial eclipse. The narrow, converging umbral shadow is where you need to be to see the total eclipse.

These NASA illustrations provide a fairly realistic depiction of the distance between the Earth and Moon and the great length of the narrow lunar shadow. That umbral shadow stretches across some 360,000 kilometres of space, and when it touches Earth can be no more than 273 kilometres wide. On April 8, 2024 the umbra will be no more than 203 kilometres wide.

Eclipses occur in “seasons” six months apart. Eclipses don’t occur every month due to the tilt of the Moon’s orbit relative to Earth’s orbit, causing the lunar shadow to usually pass above or below the Earth, as shown at right.



Tap on images to go to web pages with NASA/Goddard eclipse animations.



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THE VIEW FROM SPACE

The Moon is caught in the act of casting its shadow onto the distant Earth in a rare view from the Moon.

This remarkable and unique view was taken from lunar orbit on April 20, 2023 by the Japanese Hakuto-R probe from orbit 100 kilometres above the lunar surface.

It shows the dark shadow of the Moon cast onto the Earth during the 2023 hybrid solar eclipse that was visible from Western Australia, Timor-Leste, and Papua New Guinea. This was an unusual eclipse in that it started as an annular eclipse at sunrise in the Indian Ocean, became a short total eclipse for most of the path, then reverted to an annular eclipse at sunset at the end of the path in the Pacific Ocean.

The umbral shadow itself was never wider than 49 kilometres. The shadow captured here appears larger as it also includes the darkening from the wider penumbral shadow where only a partial eclipse would have been seen this day, one lunar year before the April 8, 2024 TSE.

Image courtesy iSpace-Inc.

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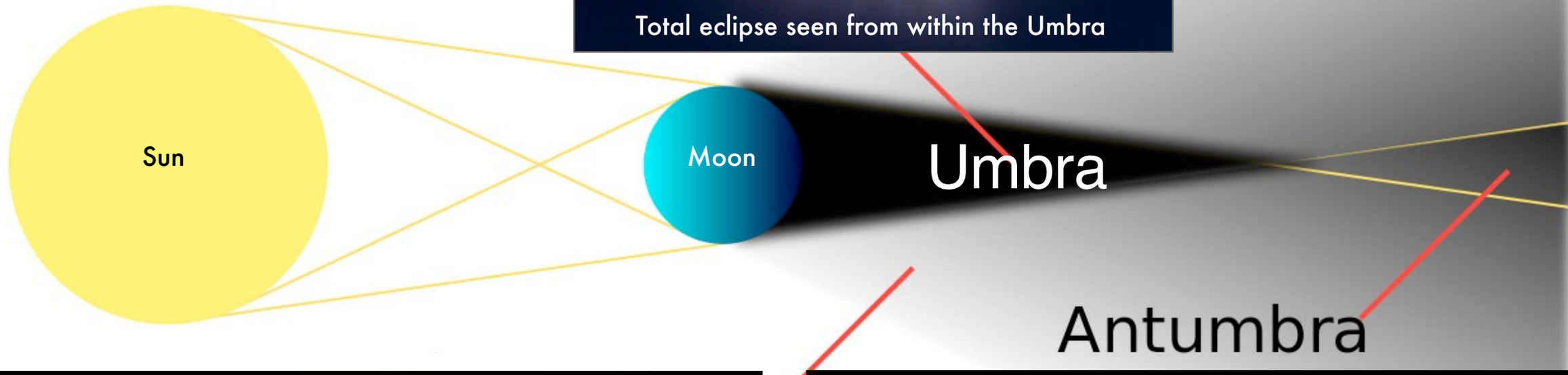
NOT ALL SOLAR ECLIPSES ARE TOTAL

To see a total eclipse you must stand, sail, or fly within the umbral shadow of the Moon.

Total eclipse seen from within the Umbra



Stand in the penumbra and you see only a partial eclipse. Some eclipses are only partial – the umbra passes over or under the poles and no one on Earth sees totality. It takes at least a 75% to 80% partial eclipse before you notice any darkening of the daylight. All those outside the paths of the 2023 and 2024 eclipses will see this.

At some eclipses the Moon is too far away for its umbra to reach Earth. Stand in the antumbra and you see a ring-like annular eclipse, with the Moon smaller than the Sun's disk. The sky grows dark but the Sun remains a brilliant source of light. Filters are always required. This is the type of eclipse that occurred on October 14, 2023.

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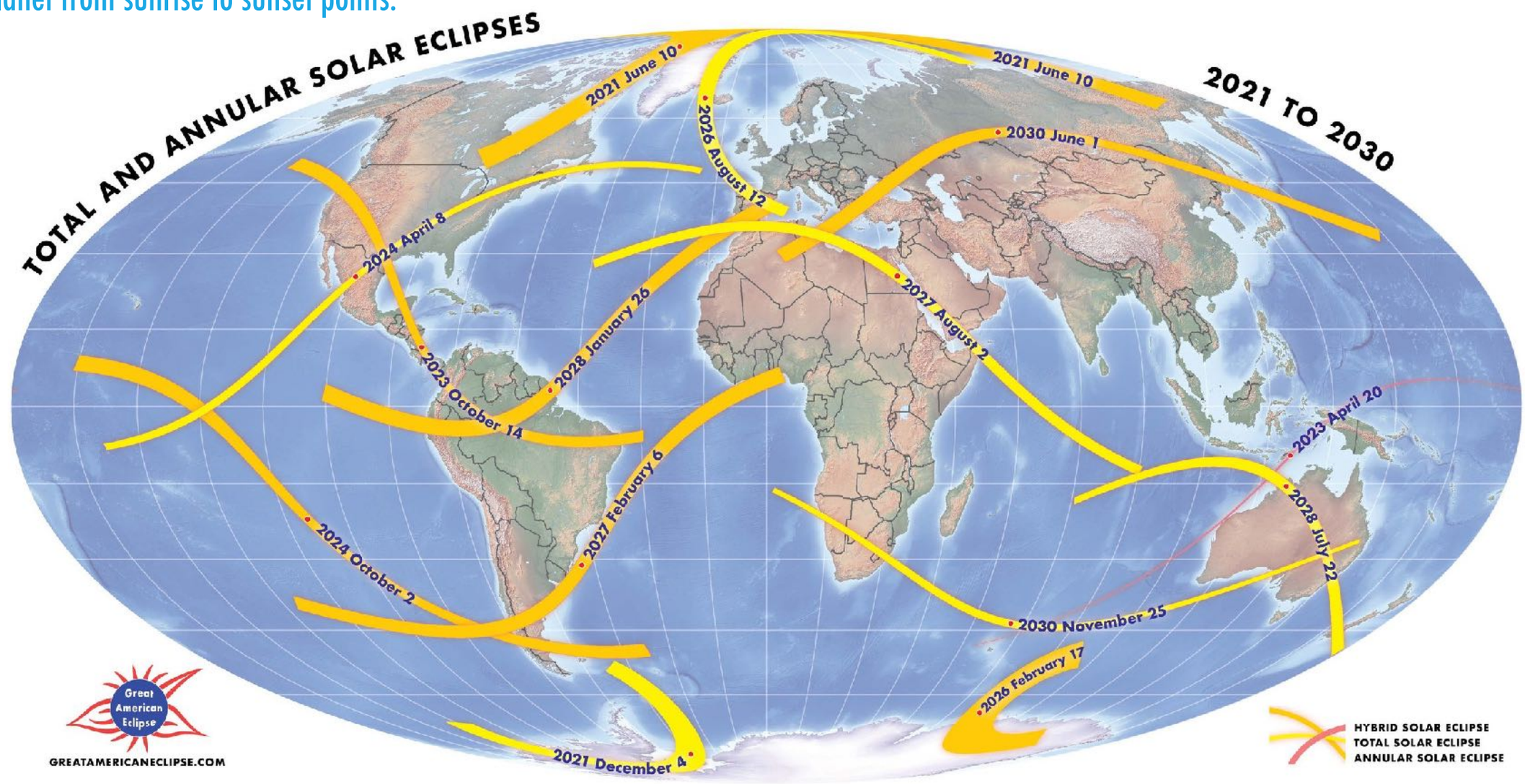
WHEN AND WHERE DO THEY OCCUR?

Solar eclipses can occur anywhere in the world, even at the poles. But all are visible as central eclipses only along narrow paths sweeping across the planet from sunrise to sunset points.

This plots the total (bright yellow), annular or ring-type eclipses (orange), and hybrid annular-totals (purple) for the current period, past and near future. As you can see, most eclipses occur over remote locations, inspiring dedicated eclipse chasers to travel far and wide to stand in the Moon's shadow.



Map courtesy Michael Zeiler/GreatAmericanEclipse.com

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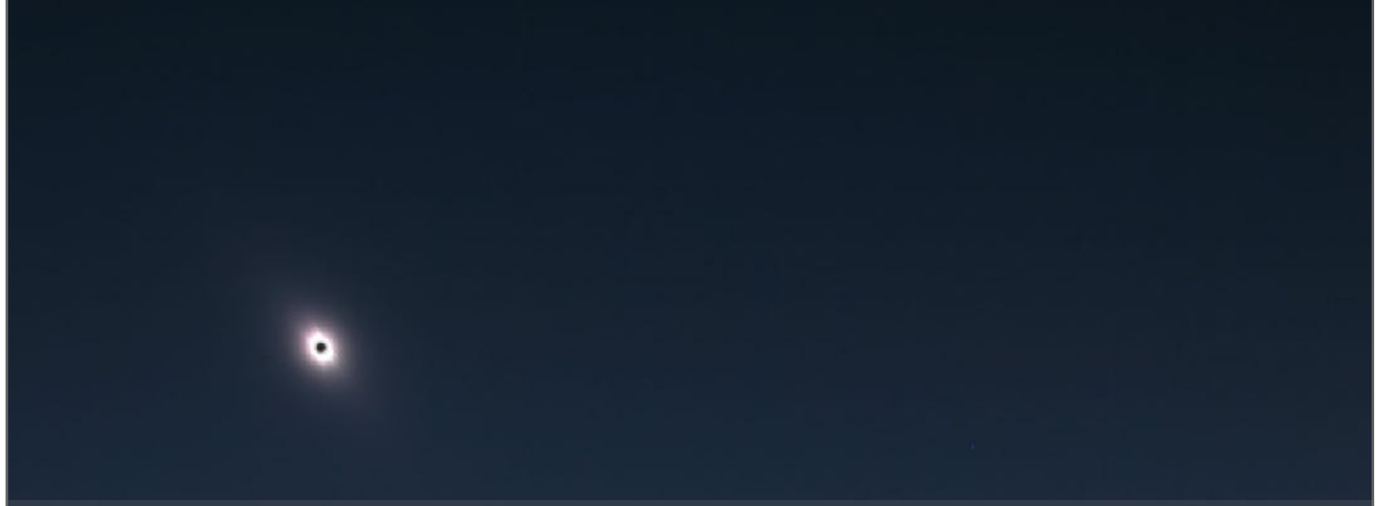
AMAZING ECLIPSE FACTS

I present a bevy of eclipse facts and trivia to amaze and amuse.

The maximum length of totality anyone can experience at the 2024 total eclipse is 4m28s, at a site near the town of Nazas, Mexico. The longest any total eclipse can last is 7m31s.

To maximize the length of totality, the eclipse has to meet each of these criteria:

- ☑ Occur near July 4, when Earth is farthest from the Sun so the Sun appears smallest.
- ☑ Occur near lunar perigee when the Moon is closest to Earth and has the largest disk.
- ☑ Occur with a path close to the equator, to slow the speed of the lunar shadow relative to the rotation of the Earth.
- ☑ Occur with the Sun overhead – eclipses always last longest at sites where the Sun appears near true solar noon.



- If the Moon were 273 kilometres smaller in diameter we would never see a total solar eclipse from the surface of the Earth.
- The longest total solar eclipse of the 21st century was July 22, 2009 with a totality of 6m39s.
- In 600 million years the Moon will be too far away to cause a total eclipse. Enjoy them while they last!
- Annular solar eclipses outnumber total eclipses by 5:4.
- The maximum number of solar eclipses that can occur in a calendar year is 5, but of those 4 must be partial-only eclipses.
- The shortest interval between total solar eclipses is 12 lunar months, about 355 days. Full total solar eclipses cannot occur 6 months apart.
- The next total eclipse over 7 minutes is June 25, 2150, with a duration of 7m14s in a path across the Pacific.
- The relative positions of the Sun, Moon and Earth repeat with a cycle of 18 years, 11 1/3 days – this is the Saros cycle over which similar eclipses repeat. See the Wikipedia page for details.
- The April 8, 2024 eclipse is similar to the March 29, 2006 eclipse across Africa and Asia. Both belong to Saros #139.

March 29, 2006, Libya

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I REMEMBER SEEING AN ECLIPSE IN ….

Every eclipse inspires us to look back at memorable eclipses of the past we might have seen as kids. Did the day go dark? Was it total?

To have seen a <u>total</u> solar eclipse in the last 50 years of the 20th century from North America, you would have had to have stood in one of the yellow shadow paths marked here (the orange paths are annular eclipses).

The candidates can only be 1991 (Mexico), 1979, 1972, 1970, 1963 and 1954. However, during the annular eclipses of 2012 (not marked here), 1994, 1984 (almost total!) and 1951 it would have become darker, but you would have not seen the corona, diamond rings, and any total eclipse phenomena. If you were near any of these paths, you would have seen a deep partial where the day got darker, but was not total.

If the Sun didn't turn into a black hole in the sky (something you would have remembered if it had been clear), then what you saw was <u>not</u> a total eclipse. If you always had to use the filter Dad made, it was a partial or annular eclipse.

Map courtesy Michael Zeiler/Eclipse-Maps.com

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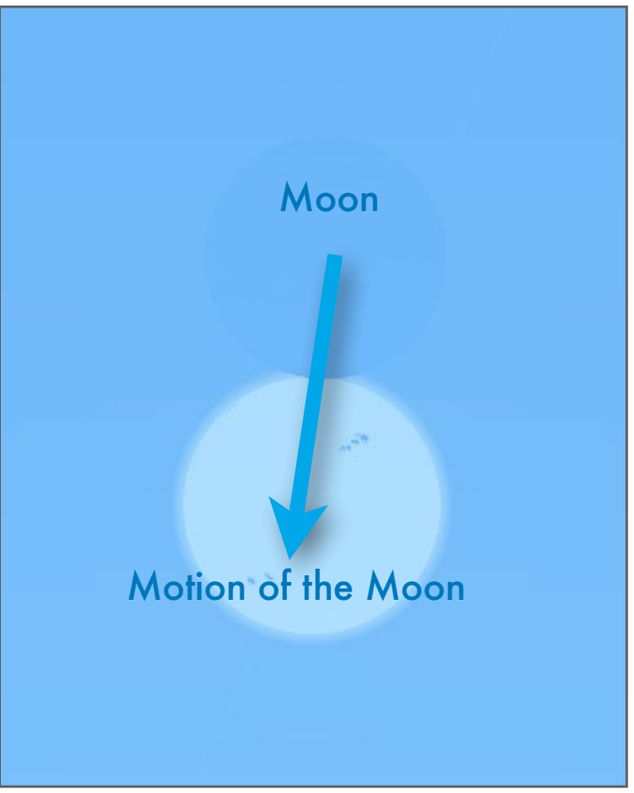
2023 ANNULAR ECLIPSE TERMINOLOGY

It's helpful to know the jargon that describes the key moments of any solar eclipse. These illustrate the major times of an annular eclipse.

Where on the limb of the Sun these contacts occur will depend on your location both along and across the eclipse path. The interactive maps linked to in the Conclusion chapter provide this information for your site. These sample diagrams are for Albuquerque, New Mexico, and have the zenith up, and horizon down.

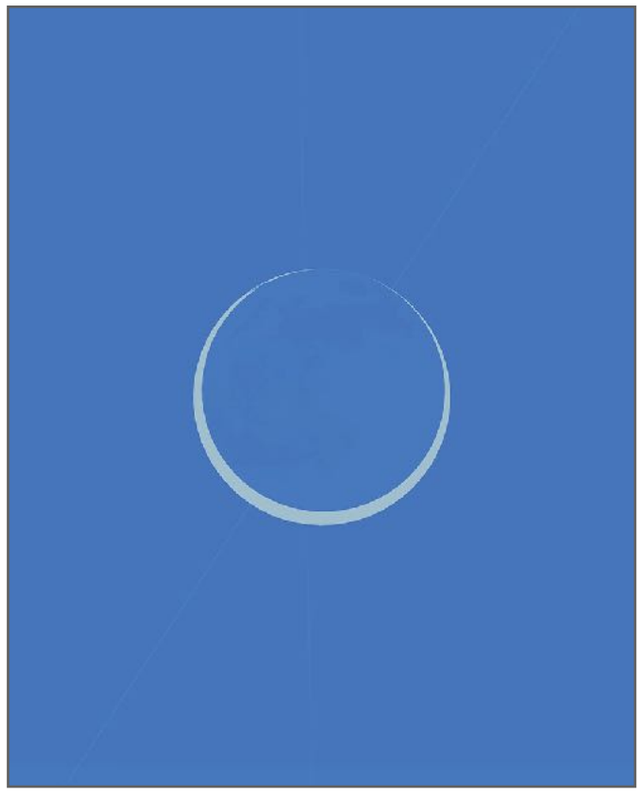
FIRST CONTACT – C1

The partial eclipse begins. You see a tiny but reassuring notch on the limb of the Sun.



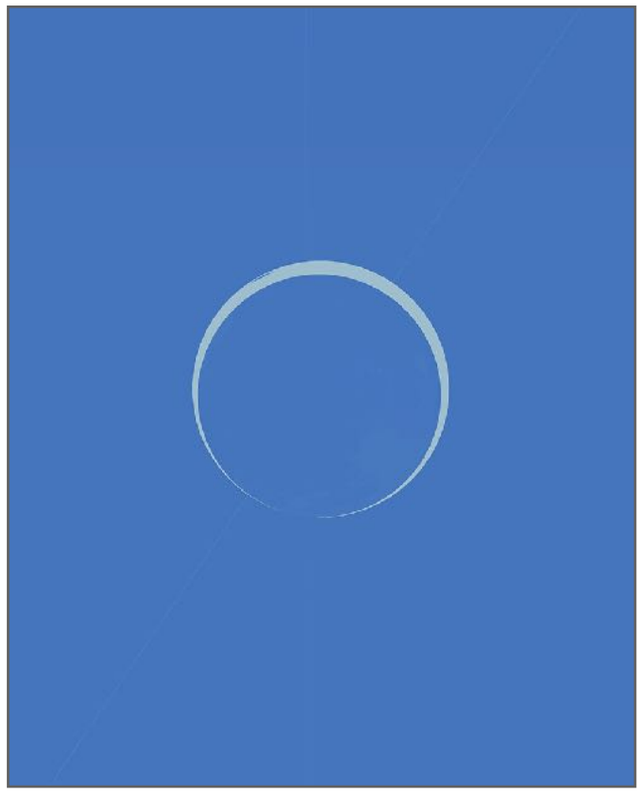
SECOND CONTACT – C2

The annular eclipse begins. The Moon is now tangent to the limb of the Sun as the central annular phase begins. Filters are still essential.



THIRD CONTACT – C3

The annular eclipse ends. The Moon has moved across the Sun over about 4.5 minutes and is now tangent to the Sun's opposite edge.



FOURTH CONTACT – C4

The partial eclipse ends. The Moon leaves the Sun in a final tiny notch opposite to where it entered about 3 hours earlier.

NOTE: You would not have seen the Moon in the sky beside the Sun, only the part of its disk in front of the Sun in silhouette.

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2024 TOTAL ECLIPSE TERMINOLOGY

Here are the same key moments for a total eclipse of the Sun, with totality occurring between Second and Third Contacts, C2 and C3.

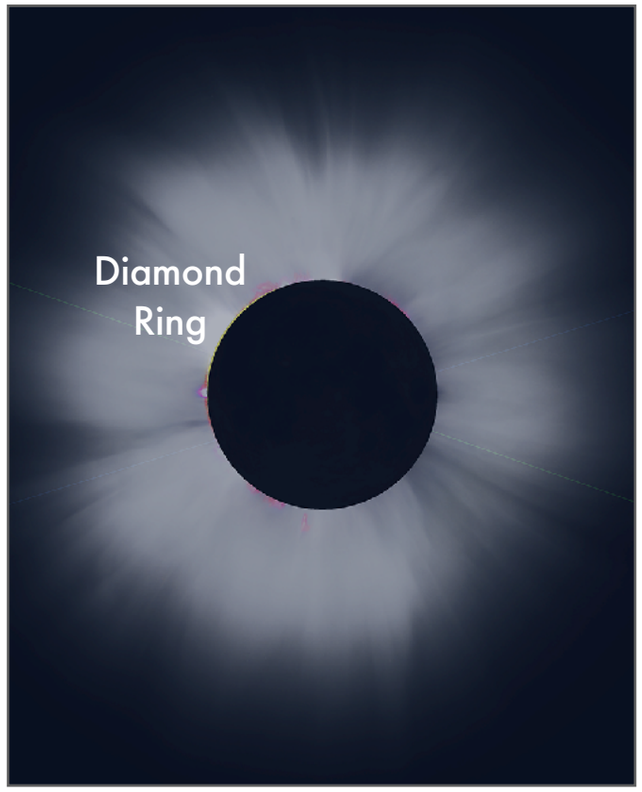
Again, where on the limb of the Sun these contacts occur depends on your location both along and across the eclipse path. The maps described and linked to in the Conclusion chapter provide this information for your site. These diagrams are for Kerrville, Texas, and have the zenith up, and horizon down.

FIRST CONTACT – C1

The partial eclipse begins. You see a tiny but reassuring notch on the limb of the Sun.

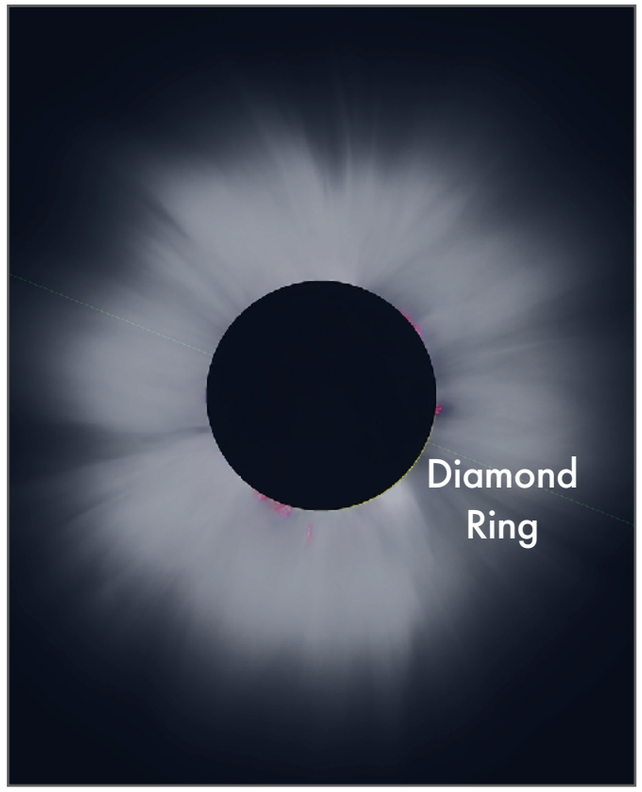
SECOND CONTACT – C2

The total eclipse begins. The Moon covers the last bit of the Sun's bright photosphere, at the end of a diamond ring effect. Filters OFF!



THIRD CONTACT – C3

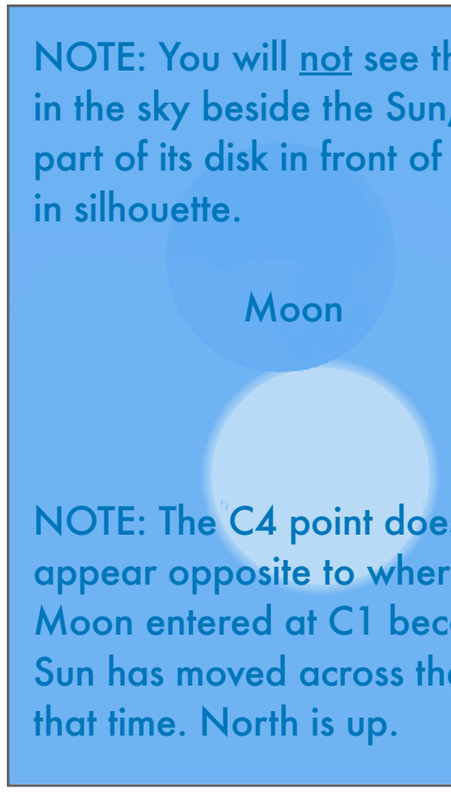
The total eclipse ends. Another diamond ring announces the end of the short 4 minutes of totality. Filters back ON!



FOURTH CONTACT – C4

The partial eclipse ends. Some 2.6 hours after the eclipse began, the Moon leaves the Sun in a final tiny notch.

NOTE: You will not see the Moon in the sky beside the Sun, only the part of its disk in front of the Sun in silhouette.



NOTE: The C4 point does not appear opposite to where the Moon entered at C1 because the Sun has moved across the sky in that time. North is up.

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SECTION 2

TOTAL ECLIPSE – THE NAKED-EYE VIEW

Before getting into the nitty-gritty of exposures and f-stops, let me first review what it is you are trying to capture. On April 8, 2024 a lot will happen at a quickening pace as totality approaches, overwhelming the senses and often playing havoc with your well-laid plans for meticulously shooting a sequence of images.

I outline in chronological order the phenomena to look for during the 2024 total eclipse, from T-45 minutes, leading up to T=0 and the start of totality.

February 26, 1998, Curaçao – Note Mercury and Jupiter near the Sun and Venus below

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THE 2024 TOTAL ECLIPSE EXPERIENCE

A total eclipse is so immersive and dramatic, no one can take it all in at a single eclipse. This montage produced prior to the 2017 TSE captures some of the effects.

Tap on the background image to go to my Vimeo site with the 5-minute eclipse video. Enjoy!

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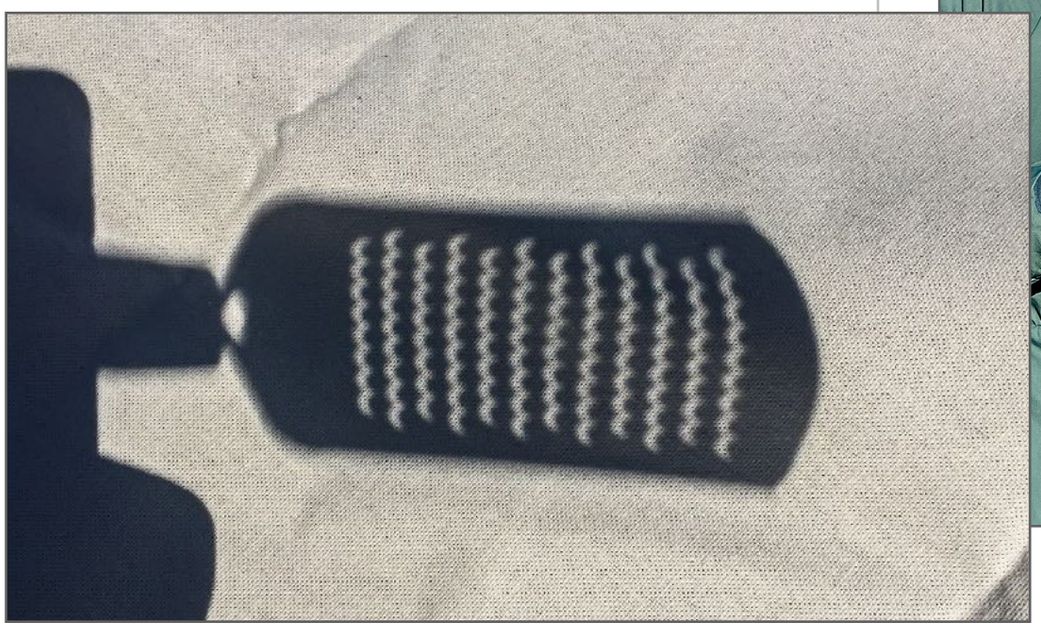
PROJECTED CRESCENTS — T-45 TO T-5 MINUTES

During the 70 to 80 minutes of the partial phase from C1 to C2 you spend time in anxious waiting. Only toward the end do things get interesting.

As the Moon eats into more and more of the Sun's disk, you might be able to amuse yourself by photographing the tiny crescent Suns projected by the natural pinholes created by leaves on trees. Anything with lots of holes in it will do the job. Like the cheese grater! Or, as at right, create eclipse signs by punching holes into cards, to project images of the eclipsed Sun spelling out your souvenir phrase.

This is a good project for kids to do and shoot.



The annular eclipse on the date indicated!

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SHARP SHADOWS – T-20 TO T-2 MINUTES BEFORE C2

As the Sun diminishes to a thin crescent, shadows become very sharp. Light is no longer coming from a wide disk but from a more point-like source.

The light takes on a very strange quality you will not have experienced before except at an eclipse. Shadows look unusually sharp, particularly in the direction parallel to the orientation of the crescent Sun. Here in the tropics, the thin crescent was horizontal, creating a narrow slit of light shortest in the vertical direction. Shadows on the horizontal fingers look sharper than on the vertical hand.

While you can capture this before totality, likely other events will preoccupy you! Instead, put this on your “to shoot” list in the minutes after totality. All you need is a white surface – we were using the structure of a ship here – and any simple camera.

This is another aspect of the eclipse you could assign to a family member to capture. It’s one of the post-eclipse phenomena that people often miss as they begin partying.

July 21, 2009, South Pacific

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EERIE LIGHT — T-15 TO T-1 MINUTE BEFORE C2

In the few minutes leading up to and following totality the light takes on a steely metallic quality that is unlike any normal twilight.

You might have seen some of this effect during annularity in 2023. It is not like any twilight you have seen and is difficult to capture on camera. It's as if the Earth is illuminated by a distant but brilliant star, which it is, as the Sun becomes reduced to a star-like point or sliver of light.

The level of lighting is bizarre. You see a brilliant Sun that is far too bright to look at, and yet the scene around you appears dim, with a deep blue sky, as if it were twilight. In 2024 Venus will appear as a bright star west of the Sun well before totality begins.

TIP: If you've been wearing sunglasses up to now, take them off. The dimming of the day is best appreciated with eyes unencumbered by any filters dimming the daylight. The eclipse will do that for you naturally. And remember, you have two chances to enjoy this light, both before and after totality.

With the Sun now so small, it will likely diffract and appear with star-like spikes when lenses are stopped down.

March 29, 2006, Libya

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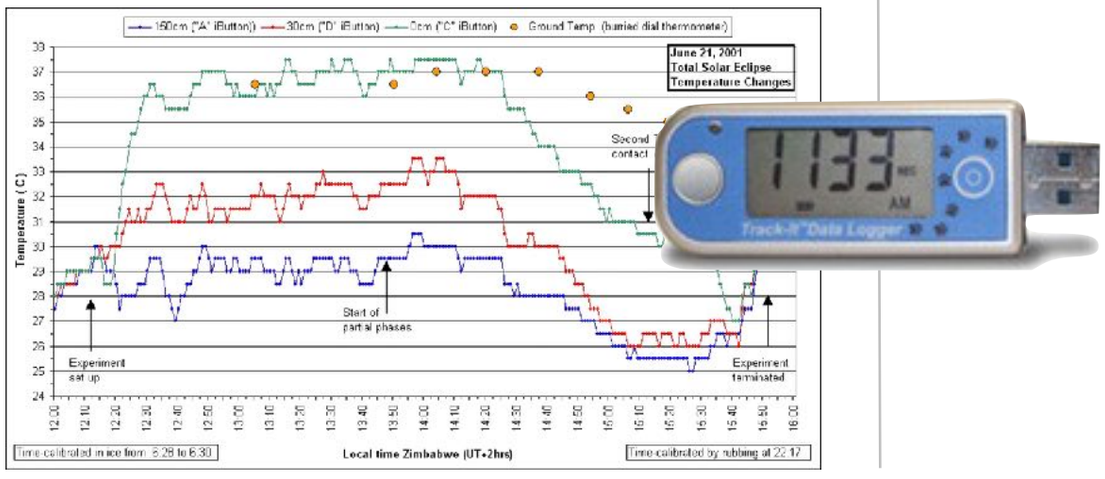
SENSING ECLIPSES – T-15 TO T-1 MINUTE

You not only see the eclipse, you hear it and you feel it. Birds make noises thinking it is time to roost. And the air cools as sunlight grows weaker.

If it is a hot day, the eclipse will likely cool the air noticeably. You or a family member might want to record the temperature change, either manually by noting time and temperature, or by using data loggers that record the temperature automatically for later transfer and charting.

If you are in a natural area, listen to the birds and insects. Sometimes their noise increases, though at some eclipses I've been to the environment has gone eerily quiet just before totality. Try to record the sounds as well.



Data loggers can automatically record the temperature.

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SHADOW BANDS – T-2 TO T-1 MINUTES BEFORE C2

TIP: You could make use of your phone camera for recording shadow bands. Mount it on a tripod aimed at a white sheet, and start it going in movie mode a few minutes before totality. Keep it going until after totality.

In the 1 to 2 minutes leading up to and just after totality you might see subtle rippling bands of light and shadow racing across white surfaces.

Shadow bands are diffraction effects caused by turbulence in our atmosphere being made visible by the now narrow slit-like source of light.

As David Makepeace and friends did here in 2012, people often place white sheets on the ground to at least see shadow bands. Even then you might miss them, if only because you forget to look. Perhaps assign someone the task of looking and calling out if bands become visible, both pre- and post-totality.

But capturing them on camera is very tough. It takes a movie camera dedicated to the task aimed at the sheet, then perhaps lots of contrast boost later in processing.

For a nice recording of shadow bands see this YouTube video shot in Australia in 2012. It demonstrates just how subtle they can be. They are more easily seen than photographed.

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ARRIVAL OF THE SHADOW – T-10 SECONDS

In the seconds before totality, you might see a wave of darkness sweep across the sky. At the 2024 eclipse, the shadow arrives from the southwest.

The umbral shadow is something you can see and record. It can be subtle if the sky is very clear, which you hope it will be. The shadow's passage is most dramatic when the sky has clouds. You first see them darken off in the distance, as at top. Clouds closer to you suddenly darken (as below, in a frame taken moments later) as the shadow sweeps in at thousands of kilometres an hour. Meanwhile the sky and clouds off in the distance outside the shadow remain bright.

Capturing the motion of the shadow is best with a very wide-angle lens, perhaps a fish-eye. The conical shape of the shadow is most prominent at eclipses near sunrise or sunset when the Sun is low and the shadow most elongated as it touches Earth. That won't be the case in 2024, so it's possible the shadow's arrival and departure might go unnoticed, lost amid the other phenomena surrounding totality.

April 8, 2005, South Pacific, looking opposite the Sun

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THE DESCENT INTO DARKNESS: T-0 SECONDS – C2!

The final descent into darkness and totality happens in seconds. It is the most dramatic event you'll experience in nature – and survive!

To the unaided eye you see what looks like a brilliant star suddenly diminish and turn into a black hole. The Sun's corona appears surrounding that black hole – the lunar disk.

What was dim, eerie daylight suddenly plunges into a deep twilight. It does not turn into night. That's a popular misconception. The sky looks as it does here, deep blue, with a bright planet or two in it, and perhaps one or two of the brightest stars visible.

If you are attending to a camera shooting though a telescope, you might miss the unaided eye sight. But you will certainly hear it! Everyone cheers and exclaims! It is great to capture the sounds of the eclipse as well as the sights.

IMPORTANT! Once the "black hole" appears, it is safe to look at the eclipse with any optical aid you wish. Filters OFF! Or you'll miss it all!

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360° TWILIGHT

Take your eyes off the eclipsed Sun and look around. You'll be surrounded by a 360° sunset twilight in every direction.

I don't have a 360° shot of the complete twilight. This wide image from 2009 will have to do. My attempt to shoot such a scene at the next eclipse in 2010 was thwarted by clouds.

In 2024, the twilight glow will be brightest to the north and south where the edges of the path are no more than 100 kilometres away, assuming you are on the centerline. If you are north of the centerline, the twilight will be brightest to the north and shadowed sky darker to the south. And vice versa.

TIP: Eclipse chasers prefer sites with clear and low horizons all the way around, or at least to the east, south and west, for views of the shadow and twilight.

The lunar shadow will darken the sky to the southwest at totality. But as the end of totality nears, the western sky will brighten rapidly as the trailing edge of the shadow approaches.

July 21, 2009, South Pacific, north of the Cook Islands

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BRIGHT PLANETS IN THE SKY

If you think of it, look around to see what planets and stars become visible. You'll see the most if your skies are crystal clear, as here.

Venus will be obvious to the right (west) of the Sun, as it was in 2023 and here in 2006. Barring clouds, everyone will see it. Jupiter will be less obvious far to the left (east) of the Sun.

The stars in the 2024 eclipse sky are mostly dim autumn constellations, the ones visible at night six months later in October. To the east the winter stars are rising, and are the brightest the sky has to offer. However, the winter stars in and around Orion, being low, will not be obvious to the eye, especially if the air is humid and hazy. You will likely miss them! Don't expect to see lots of stars to appear at midday.

I show the eclipse sky later, in diagrams that illustrate how to frame the eclipse to take in the two planets that will be visible: Venus and Jupiter. While Mercury also appears close to the Sun, it will be too faint to pick out by eye. However, long exposures might capture it.

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THE RETURN OF LIGHT – C3!

All too soon, totality ends with a burst of sunlight emerging from the righthand edge of the Moon. As quickly as it descended, darkness departs.

No matter how long the eclipse was supposed to have lasted at your site, you will swear it was only seconds long. Totality always ends sooner than you expected.

The phenomena that led up to totality now repeat in reverse order. Darkness suddenly lifts as if someone fades up a giant light in the sky, which is just what is happening. The sky brightens suddenly and whatever stars and planets you did see fade from view, except for Venus which will remain for several minutes yet.

If your sky is very clear, you can try covering the bright Sun with an outstretched finger to continue the eclipse – the corona can be sighted for seconds or even minutes after the official end of totality. But it takes a dry, clear sky.

Be sure to look for shadow bands now. They can appear for another couple of minutes.

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THE DEPARTURE OF THE LUNAR SHADOW

As the second diamond ring appears, the edge of the lunar shadow will depart the Sun and head off to the northeast.

Again, if there are clouds you'll more easily see the contrast between the still shadowed area of the sky (to the left, or northeast, of the Sun as totality ends) and the bright sky to the right, or southwest, where the shadow has departed.

You'll see a rapid change in the brightness of the sky and clouds as the shadow heads off northeast. Dark clouds nearby suddenly light up. But the sky far off to the northeast will continue to look dark as the shadow heads that way, bringing totality to people farther down the path.

The post-totality minutes are good times to:

- ☑ Put filters back on all optics! Or turn cameras away from the Sun.
- ☑ See and shoot sharp shadow effects.
- ☑ See and shoot projected crescent Suns again.

November 14, 2012, Queensland, Australia

Note, above, how as the edge of the lunar shadow touches the Sun the diamond ring appears.

In 2013 (right), a marvelous rainbow projected by a thin crescent Sun appeared.

November 3, 2013, mid-Atlantic

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SECTION 3

THE TELESCOPIC VIEW

The view everyone wants – and should see – is the close-up view of the eclipsed Sun, with details in the silvery corona and the contrasting flaming pink prominences.

Your eye can see much more than any single image can record. No matter how you plan to shoot the eclipse, do try to also see it close-up, through binoculars, if not a telescope. It is for this view during totality that you do not use filters.

March 29, 2006, Libya

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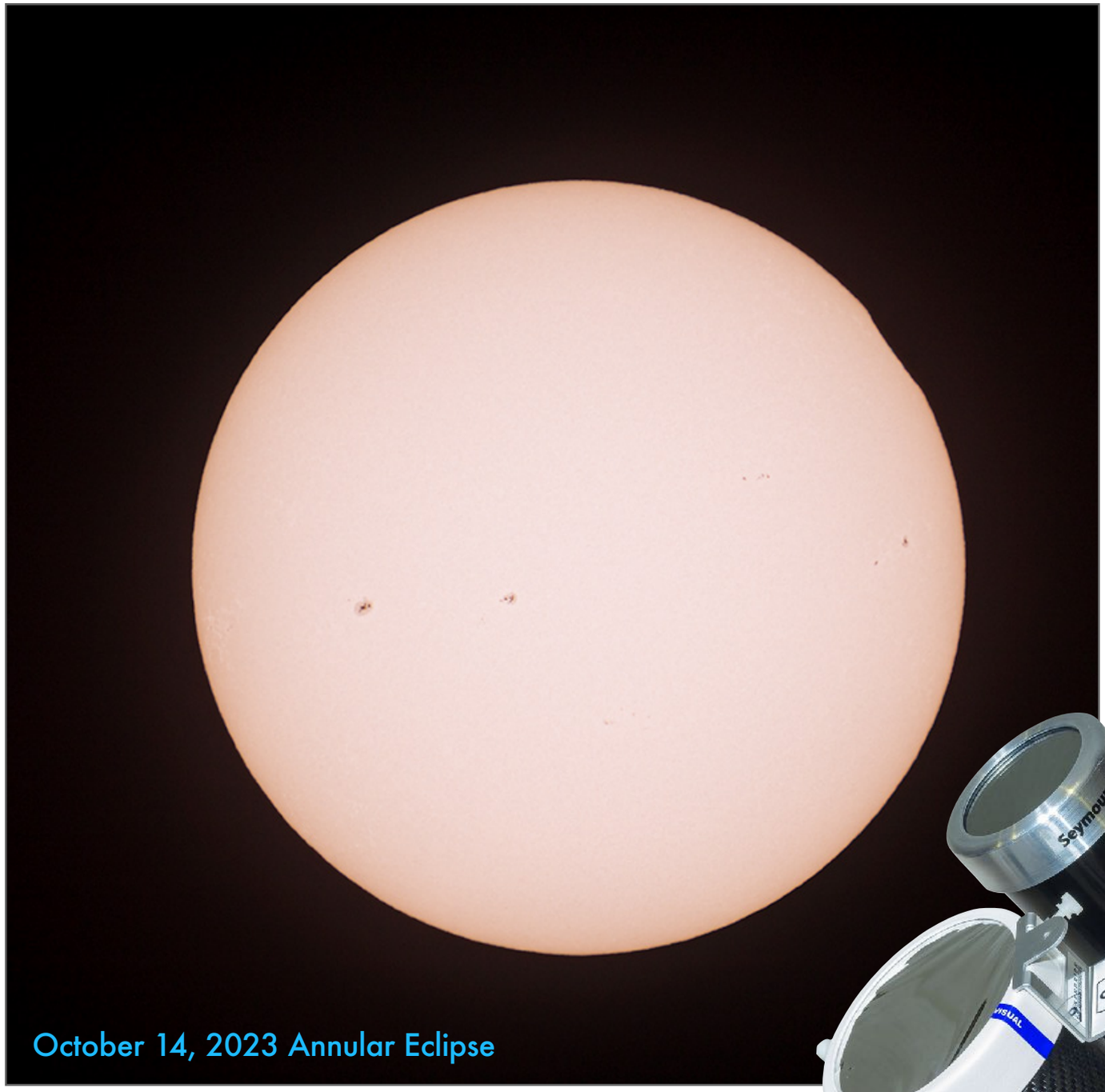
FIRST CONTACT – C1 – THE ECLIPSE BEGINS

The eclipse begins when the Moon takes its first tiny bite out of the edge of the Sun. It is a welcome sight but one you can see only through a telescope.

IMPORTANT! All parts of the partial eclipse leading up to and then following totality must be viewed through a safe solar filter, as shown, whether it be by unaided eye or through optics. Chapter 4 has the recommendations for what's safe to use, and what isn't.

As the Moon covers more of the Sun you might see its dark edge cover up *sunspots* – dark regions of magnetic storms on the *photosphere*, the bright disk of the Sun, such as at the annular eclipse. If so, shoot a time-lapse or movie.

Through a well-focused telescope you'll likely see that the Moon's edge (or *limb*) looks rough, with dips and peaks from craters and mountains. You'll also see the edges of the Sun and Moon rippling rapidly. That's heat and turbulence in our atmosphere distorting the image. When the Sun gets down to a thin crescent it's time to prepare for the annular or total eclipse phase.



October 14, 2023 Annular Eclipse

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ALMOST 2ND CONTACT – THE FIRST DIAMOND RING

At a total eclipse, second contact is technically when the last bit of the Sun disappears. But for our purposes it is the first diamond ring.

Just before the exact moment of C2, we see the last bit of sunlight shining through craters and valleys on the Moon's rough edge, creating the iconic *diamond ring* effect. Despite sunlight remaining, the inner corona is beginning to appear, yielding the ring effect.

It is a very difficult phenomenon to see with the eye. That last bit of the Sun is still dangerously bright, especially when viewed though any optics. The safest way to enjoy the diamond ring is with the unaided eye, when you can watch it without filters.

To capture it with a camera you also cannot use a filter, but you cannot look at it directly through your optics, only on your Live View camera screen. Diamond ring images are usually captured by firing away through your telephoto or telescope at the assumed correct exposure while you are looking up with your naked eye.

March 29, 2006, Libya

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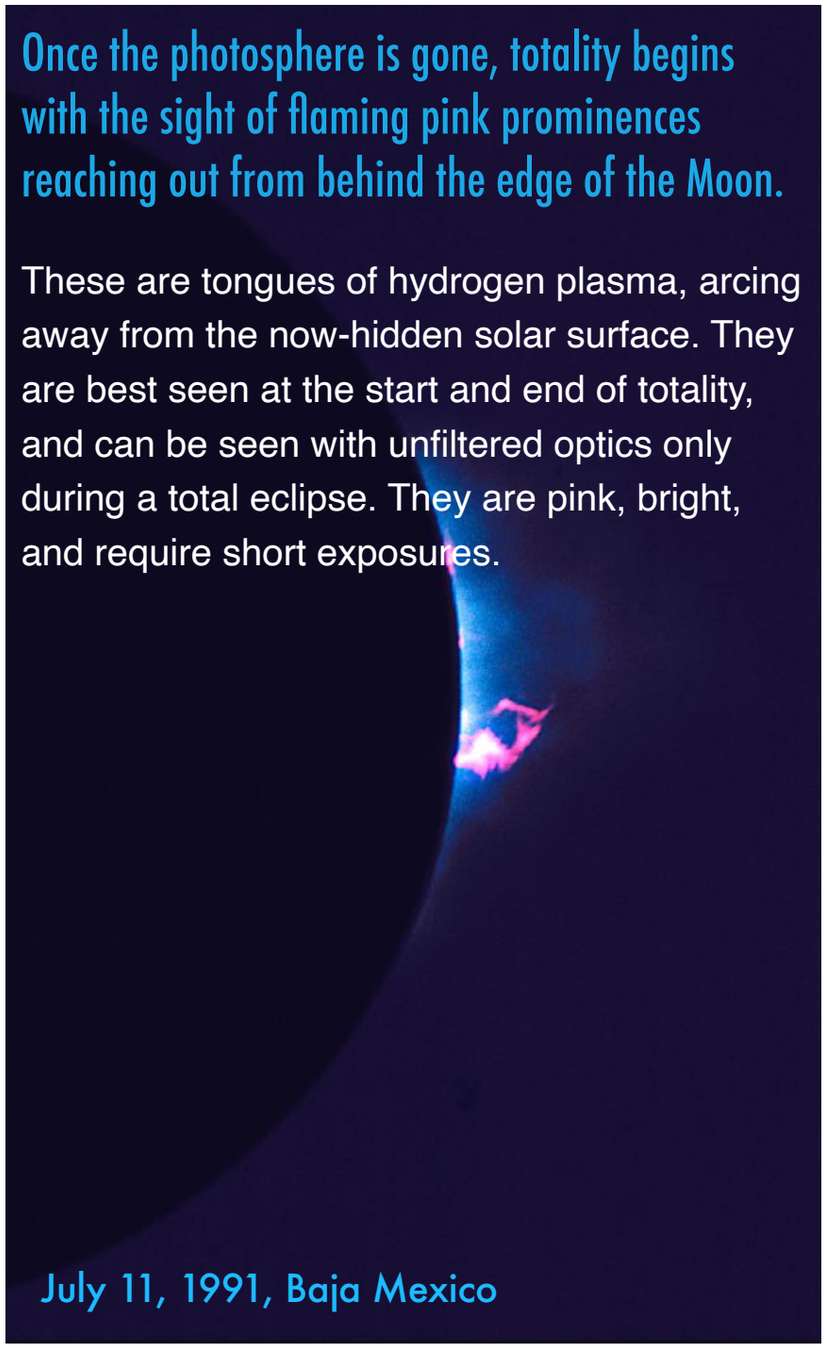
SECOND CONTACT – C2 – PROMINENCES

Once the photosphere is gone, totality begins with the sight of flaming pink prominences reaching out from behind the edge of the Moon.

These are tongues of hydrogen plasma, arcing away from the now-hidden solar surface. They are best seen at the start and end of totality, and can be seen with unfiltered optics only during a total eclipse. They are pink, bright, and require short exposures.



July 11, 1991, Baja Mexico

March 29, 2006, Libya

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TOTALITY: THE CORONA

This is what you came for – the sight of the Sun's pearly outer atmosphere reaching far off into space. Even satellites cannot get quite this view.

The *corona* is the atmosphere of the Sun – very rarified but intensely hot gases shaped and sculpted by magnetic fields. Close to the Sun the inner corona is brilliant – and is overexposed here. It fades away in intensity as it streams away from the Sun.

Your eyes can take in this great range of brightness very well, showing you holes and bubbles in the inner corona, as well as the streamers reaching out into the dark sky.

The camera cannot record the full extent of the corona in one exposure. You must take a range of exposures, to either show in sequence later in your slide shows, or to composite into one *high-dynamic range* stack. But don't get so obsessed with taking images you leave yourself no time to take in the view by eye, through binoculars or a small telescope. There is no celestial sight that can compare for its detail, yet subtle shading.

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TOTALITY: THE CHROMOSPHERE

In theory, you can see the chromosphere at the start of totality. But chances are the diamond ring is too glaring and you miss the chance.

Instead, in my experience, you won't see the chromosphere until just before third contact when its appearance as a brilliant red rim announces the end of totality. When you see it, get ready! *Baily's Beads* (explained next) and the second diamond ring are but moments away.

What you are seeing is the *chromosphere*, a layer of red hydrogen just above the bright visible surface of the Sun. Just before the Moon uncovers the photosphere it reveals the red chromosphere as a rim of pink all along the edge of the Moon. It appears for mere seconds.

Like prominences, which might also be seen along this edge, the chromosphere is very bright and requires short exposures. You might even see it naked eye as a red edge to the Sun. At this point you might want to be shooting a movie as a lot will happen within seconds as the Sun reappears and totality officially ends.

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THIRD CONTACT – C3 – BAILY'S BEADS

At C3 the Sun returns. Like the chromosphere, you can see Baily's Beads at the start of totality. But your best view probably will be at third contact.

The last bits of sunlight at second contact and the first bursts of sunlight at third contact often appear as broken beads of light along the edge of the Moon. That's because deep craters on the limb of the Moon are the last to cover and first to uncover the bright disk, or photosphere, of the Sun. These multiple beads of sunlight were explained by Francis Baily in 1836.

The effect is exceedingly brief, perhaps no more than 1 to 3 seconds. At third contact, shown here, the discrete beads of light will soon merge into an arc of continuous light, creating the second diamond ring.

As that happens you must look away from any optics, as the returning Sun is dangerously bright. However, your camera can keep shooting stills or a movie at this point. But not long afterwards you will need to filter the optics or turn them away from the Sun.

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THIRD CONTACT – C3 – SECOND DIAMOND RING

This is the diamond ring you will likely capture, as you are more prepared for it – you hope! – and you can see it coming.

To the naked eye, the Sun is now returning as a brilliant star in the sky. Through a telescope, telephoto lens, or binoculars the returning edge of the Sun is becoming much too dazzling to look at.

But if you keep the camera shooting you can capture the emerging Sun as it creates the beautiful effect of the diamond ring. The inner corona is bright enough to remain visible and photographable for many seconds, even a minute or more, after the official end of totality.

It is at this point that the landscape is also lighting up, the shadow edge is passing off the Sun and heading east, shadow bands are rippling on the ground, and people are cheering and crying in exultation and joy. It is this moment that is one of the most powerful events you can experience in nature. You can hope to capture only a portion of the sight, sound, and emotion.

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FOURTH CONTACT – C4: THE ECLIPSE ENDS

You might stay with your telescope to witness the very end of the eclipse, to capture the last moment when the Moon leaves the Sun. Or ...

August 11, 1999, Southeast Turkey, banks of the Tigris River

You party! Below is the only fourth contact image I've ever shot at a total eclipse, from 2017. Usually, by C4 I'm busy with post-eclipse celebrations, and really don't care about recording every last aspect of the eclipse.

Or we've been on the road back to our hotel and have seen the end of the eclipse through handheld eclipse glasses. In 2024, traffic congestion at some sites might dictate that you stay put for several hours. If so, keep shooting!

And have a bottle of champagne ready.

Near C4 on August 21, 2017

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PREVIEWS: H-ALPHA VIEWS OF PROMINENCES

No one can predict exactly where and to what extent we might see those pink prominences at totality. A special telescope can give you a preview.

These specialized solar telescopes not only dim the Sun to safe levels, they filter out all wavelengths of light except the deep red H-alpha emission line emitted by hydrogen plasma, the constituent of prominences. Use one of these to inspect the Sun the morning of the eclipse and during the partial phase to see where prominences might be. They change day by day, even hour by hour.

However, these H-alpha scopes are for use only during the partial phases. Do not use one during totality in 2024. You won't see anything but prominences! Certainly none of the other effects I've just described.

In the United States, manufacturers include:
Coronado Solar (Division of Meade Instruments)
Lunt Solar Systems
Daystar Filters

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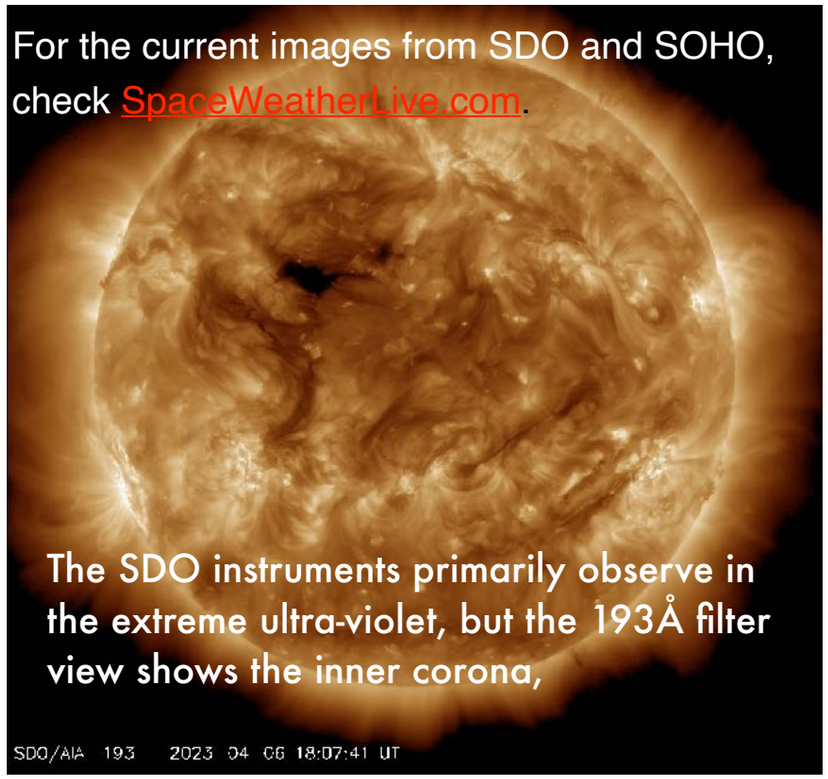
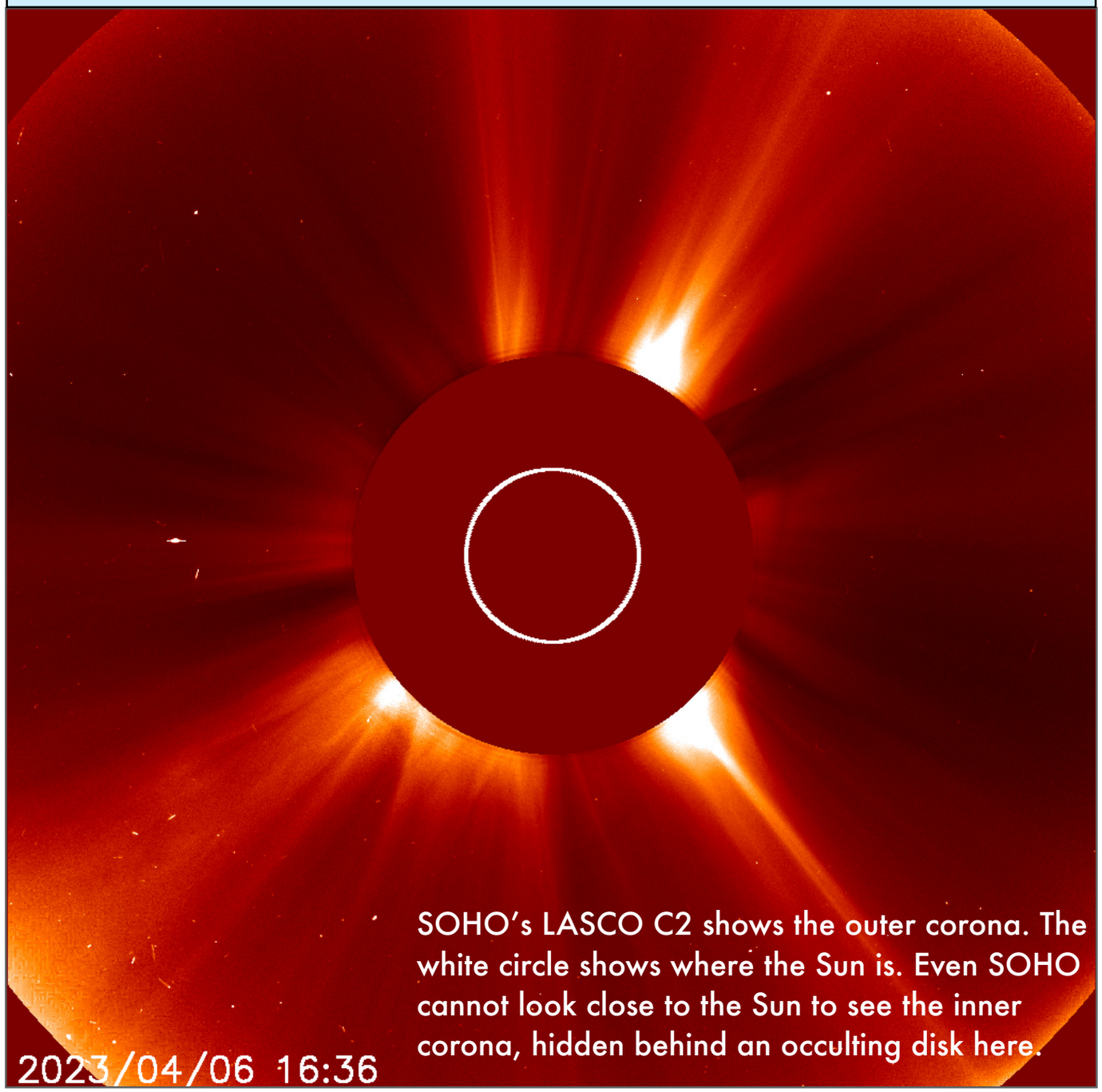
PREVIEWS: SATELLITE VIEWS OF THE CORONA

The attraction of a total eclipse is that only then can you see what otherwise requires a satellite in space to view. They can provide previews.

The Solar and Heliospheric Observatory (SOHO) satellite operated by NASA and ESA has two LASCO (Large Angle and Spectrometric Coronagraph) instruments that show the outer corona. NASA's Solar Dynamics Observatory (SDO) can show details in the inner corona.



TIP: In the days prior to the eclipse the private service Predictive Science Inc. will likely be posting their projections of how the solar corona will look.



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SECTION 4

ECLIPSE ETIQUETTE

This is a topic rarely discussed in eclipse guidebooks. But almost all eclipse tour leaders will provide this advice, so everyone can enjoy totality without interference from unwanted noise, flashes and distractions. Totality represents a few precious minutes you might never get to experience again in your lifetime, or that others around you might see only once. Don't spoil it for them, and you hope others don't for you.

February 26, 1998, Curaçao – Note Mercury and Jupiter near the Sun and Venus below

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ECLIPSE ETIQUETTE – AVOIDING BEHAVING BADLY!

You and your eclipse companions will be happier if you follow a few rules of eclipse etiquette. You hope others around you do the same!

- ☑ **Stay Put** – Don't wander at the last minute to a better location. You might spoil someone's composition, or worse, trip over a tripod. In a crowd, it's best not to move during totality.
- ☑ **No Music** – It might be a "new age" or "60's headspace" experience for you, but others won't appreciate Pink Floyd or Bonnie Tyler.
- ☑ **Don't Expect Help** – This is my rule when I've helped lead eclipse groups. You might get expert advice beforehand, but in the minutes before totality, don't expect help from others.
- ☑ **No Drones** – Who wants a camera drone helicopter buzzing overhead?
- ☑ **No Fireworks or Horns:** Goes without saying? You'd be surprised!
- ☑ **No Pets** – They can get very stressed. Leave them at home under care. A howling dog is not what others want to hear during totality.

Shots of the eclipse site with people and telescopes in the foreground can be some of the best ways to record the eclipse. But take care not to spoil the scene for others with flags, banners, umbrellas, fireworks, and other distracting elements protruding into the sky, and potentially blocking other peoples' views.

Also, as totality approaches and temperatures cool, "eclipse winds" can kick up, possibly blowing over tall items at the last minute, something you definitely want to avoid at all costs. As such, beware when setting up at dusty sites.

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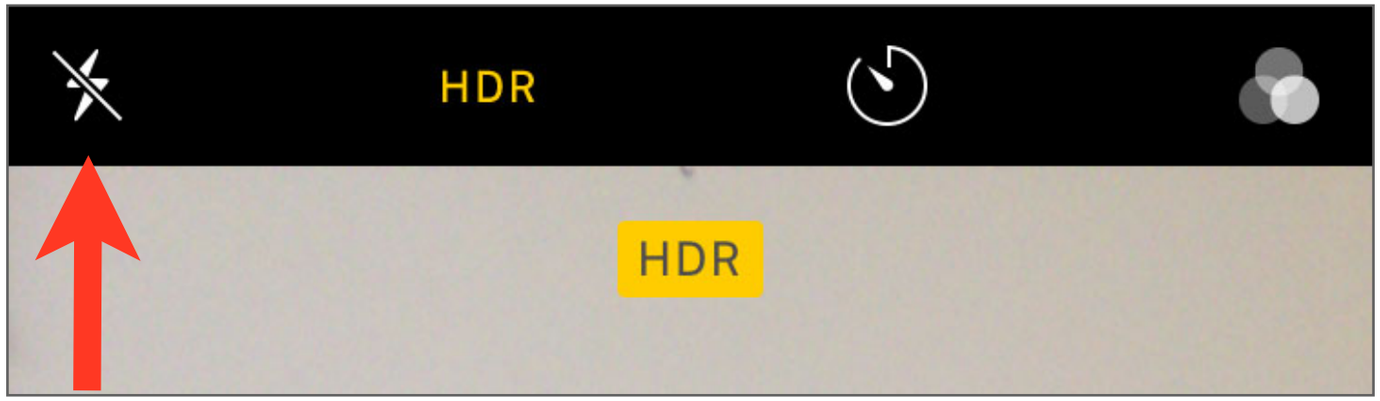
NO FLASH, PLEASE!



The Number One rule of eclipse etiquette is to turn **off** the flash. Or, if the flash is so automatic it has no off switch, cover it up with black tape.

Flashes are annoying. Use one by design or by accident during totality and someone nearby will yell at you, destroying the mood more than the flash itself. But don't invite the wrath. Please turn off any flash so it will not fire automatically once it gets dark during totality. The flash will do no good to improve your photo, and will almost certainly ruin someone else's. You are all there to enjoy the darkness. Don't spoil it.

On mobile devices, as above, you will have to purposely disable the flash. Then make sure it stays that way after the camera is powered off and on again. Ditto on point-and-shoot cameras.

If the flash cannot be turned off, then put black tape over it. Do the same for any warning lights that blink to aid auto focusing or when using a self-timer. Test your camera in the dark first to see if it is really "eclipse friendly." If it isn't, simply do not use it. Everyone will thank you!

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CELEBRATE …!
OR COMMISERATE

Post-totality is the time to party, make noise, and break out the bubbly. Or cry! This can be the most emotional time – either joy or heartbreak!

By about 5 to 10 minutes after totality most of the strange phenomena are over and the environment is returning to normal. But not the people! If you are shooting video, this is a great time to record reactions and comments from your fellow eclipse chasers. They make an excellent addition to your eclipse home movie.

Note how the sky is clear and blue for our 2010 group photo on Hikueru Atoll in French Polynesia. It wasn't an hour earlier for totality. Clouds can form during totality as the air cools. I've seen that happen only once, during the record-breaking 7-minute-long eclipse of July 11, 1991 in Baja California. It likely will not happen in 2024. But if the air is humid, you never know! If so, just accept it. Enjoy the play of the shadow on the clouds, the colors that the returning Sun might add to the clouds, and the change in lighting. Keep shooting! Chapter 10 has more on what to do if clouds intervene.

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CHAPTER 3

3

WHERE TO GO

Getting to the path of the total eclipse is easy. Getting to a site where skies will be clear may not be so easy. Out of 16 total solar eclipses I've been to, I've had to chase to clear skies (by land, sea, or air) for about half of the eclipses, often at the last hour.

July 21, 2009, South Pacific, north of Cook Islands

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SECTION 1

THE ECLIPSE PATH

Total solar eclipses demand that you be in the right place at the right time to intercept the shadow of the Moon as it sweeps across a small area of the world. Normally, that requires traveling to a remote location, making for quite an adventure in just getting to the path, let alone seeing the eclipse. By contrast, in 2024, the shadow path is accessible by tens of millions of people. But you must be in the path. Outside the path you will not see totality.

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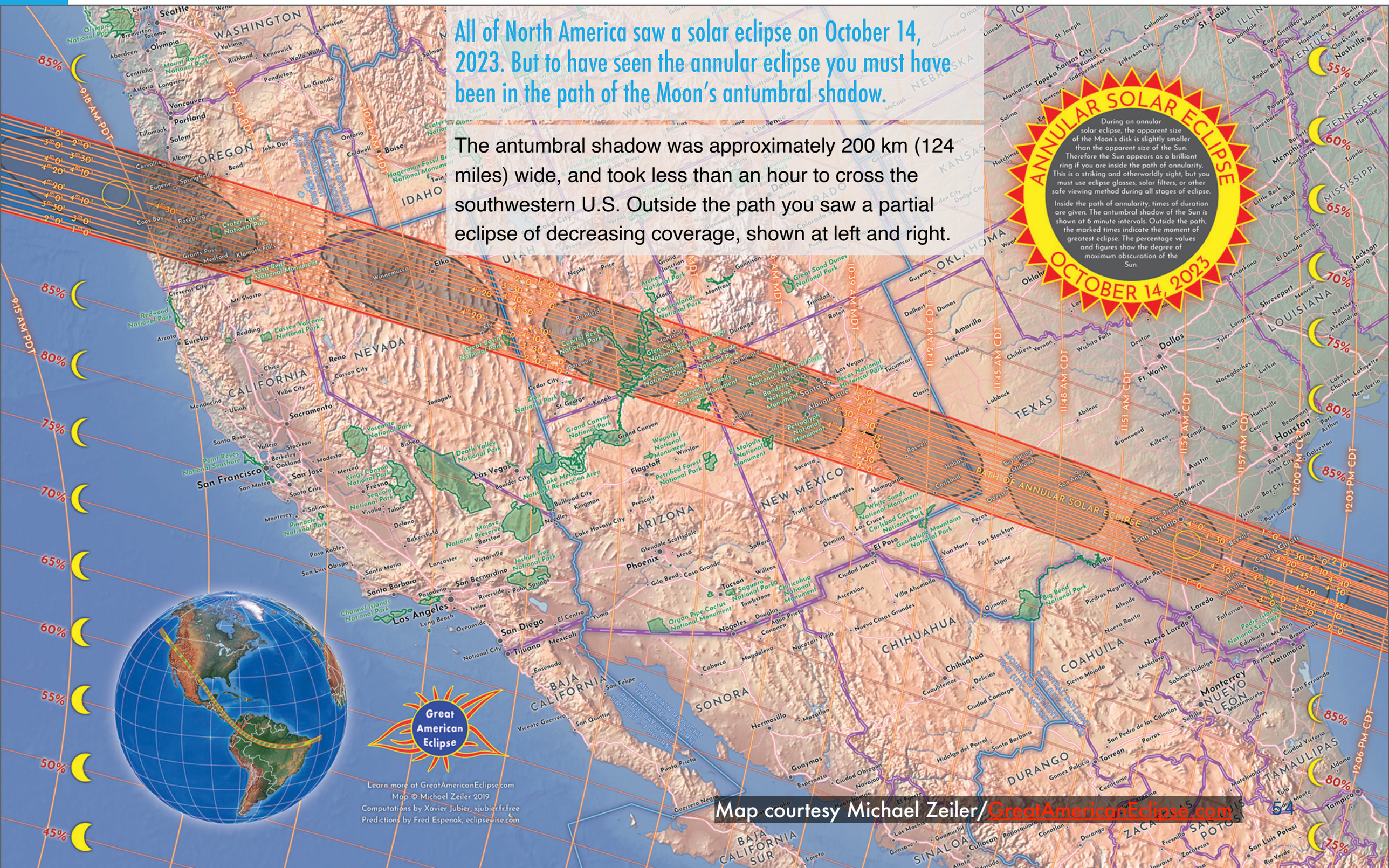
2023: WHERE DID ANNULARITY OCCUR?



Map courtesy Michael Zeiler/GreatAmericanEclipse.com

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2024: WHERE DOES TOTALITY OCCUR?

All of North America (except Alaska) sees a solar eclipse on April 8, 2024. But to see a total eclipse you must be in the path of the Moon's umbral shadow.

The umbral shadow is no more than 200 km (124 miles) wide, and takes less than two hours to cross the continent. Outside the path you see a partial eclipse of decreasing coverage the farther away you are from the path, as shown at left and right.

PATH OF TOTAL SOLAR ECLIPSE

Map courtesy Michael Zeiler/GreatAmericanEclipse.com

Total solar eclipse of April 8, 2024

After an interval of seven years since 2017, a total solar eclipse visits North America again. This is easily nature's most spectacular sight. To see the beauty of the Sun's corona in the suddenly darkened sky, you must travel to the path of total solar eclipse.

Durations of total solar eclipse are given inside the path of totality.

The gray oval shapes show the Moon's shadow at five minute intervals.

Times of greatest eclipse are shown in local time along the purple curves.

Degrees of partial eclipse (obscuration) are shown along the orange curves.

Great American Eclipse.com

Map by Michael Zeiler, GreatAmericanEclipse.com, Dec 2016
Eclipse computations by Xavier Jubier, xjubier.free.fr
Eclipse predictions by Fred Espenak, eclipsewise.com

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THE SHADOW'S MOTION

The motion of the Moon in its orbit around Earth carries the lunar shadow from west to east across the planet, from sunrise to sunset points.

The Moon's revolution in its orbit around us is what causes its shadow to travel across the surface of the Earth. The lunar shadow first touches Earth far to the west where the Sun (and Moon) are rising as seen from Earth. For both eclipses, viewers at the start of the path see the rising Sun eclipsed. The shadow travels at a speed relative to Earth of thousands of kilometres per hour to the east, eventually departing Earth at the sunset point. Viewers in the Atlantic will see the setting Sun eclipsed.

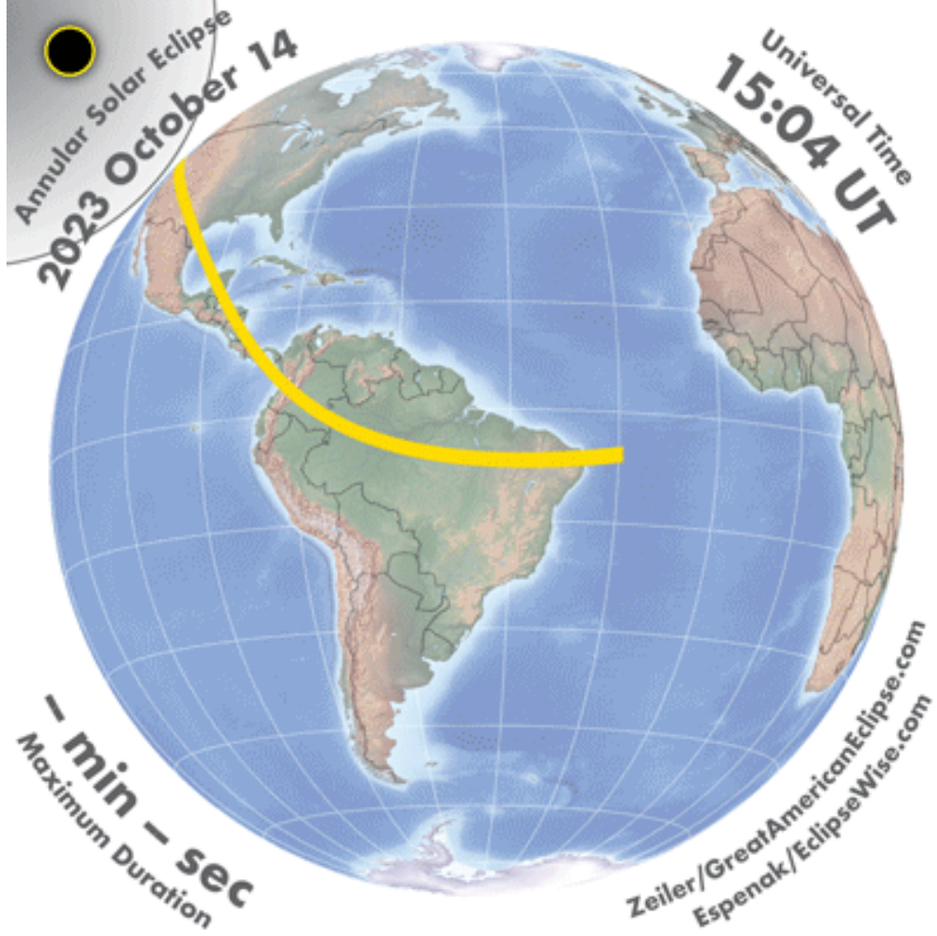
The speed of the umbral shadow relative to the turning Earth in part governs how long totality lasts. In 2024, totality is longest as the umbra crosses Mexico because that's where it is noon, the Sun is highest, Earth's curving surface is closest to the Moon, and Earth's rotation speed serves to lengthen totality. The shadow is then moving the slowest and is the largest, creating the maximum length of totality.

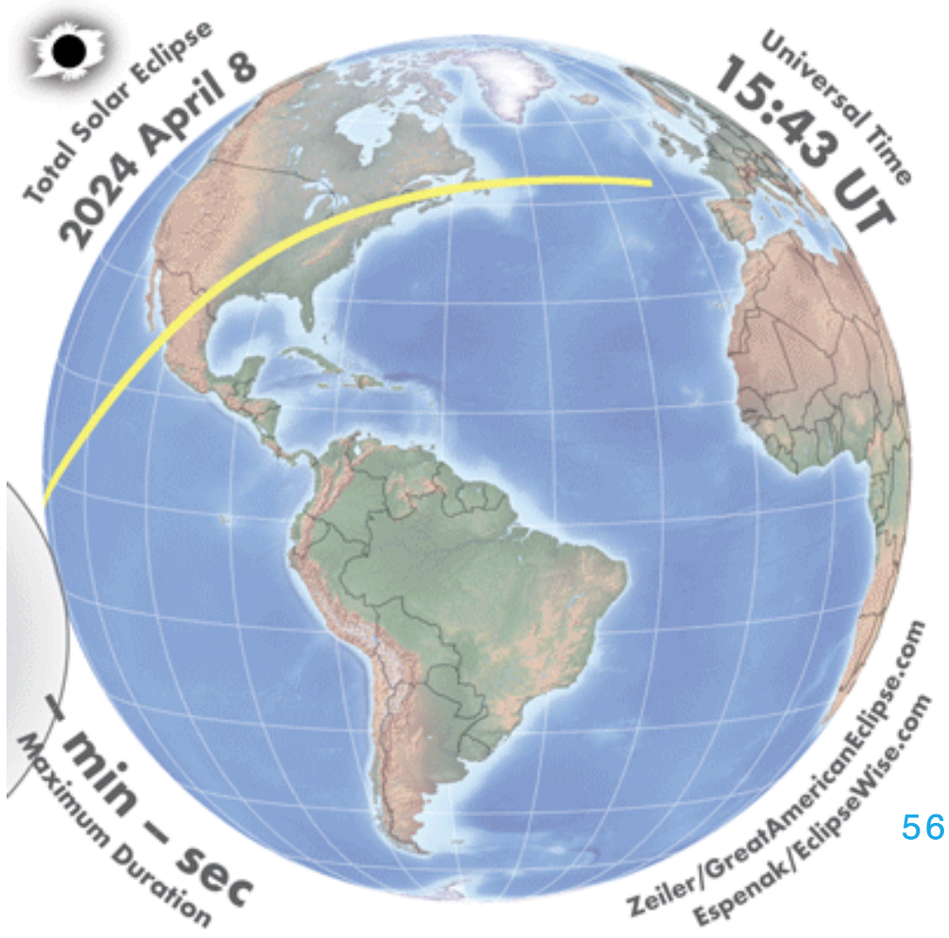
These two GIF animations depict the shadow's motion for the 2023 (top) and 2024 (bottom) eclipses.

The curving shape of the paths is due to the tilt of the Earth and its rotation west to east during the time the shadow crosses the Earth.

NOTE: In the Apple Books version these should autoplay.

For readers of the PDF version, the originals can be found here at EclipseWise.





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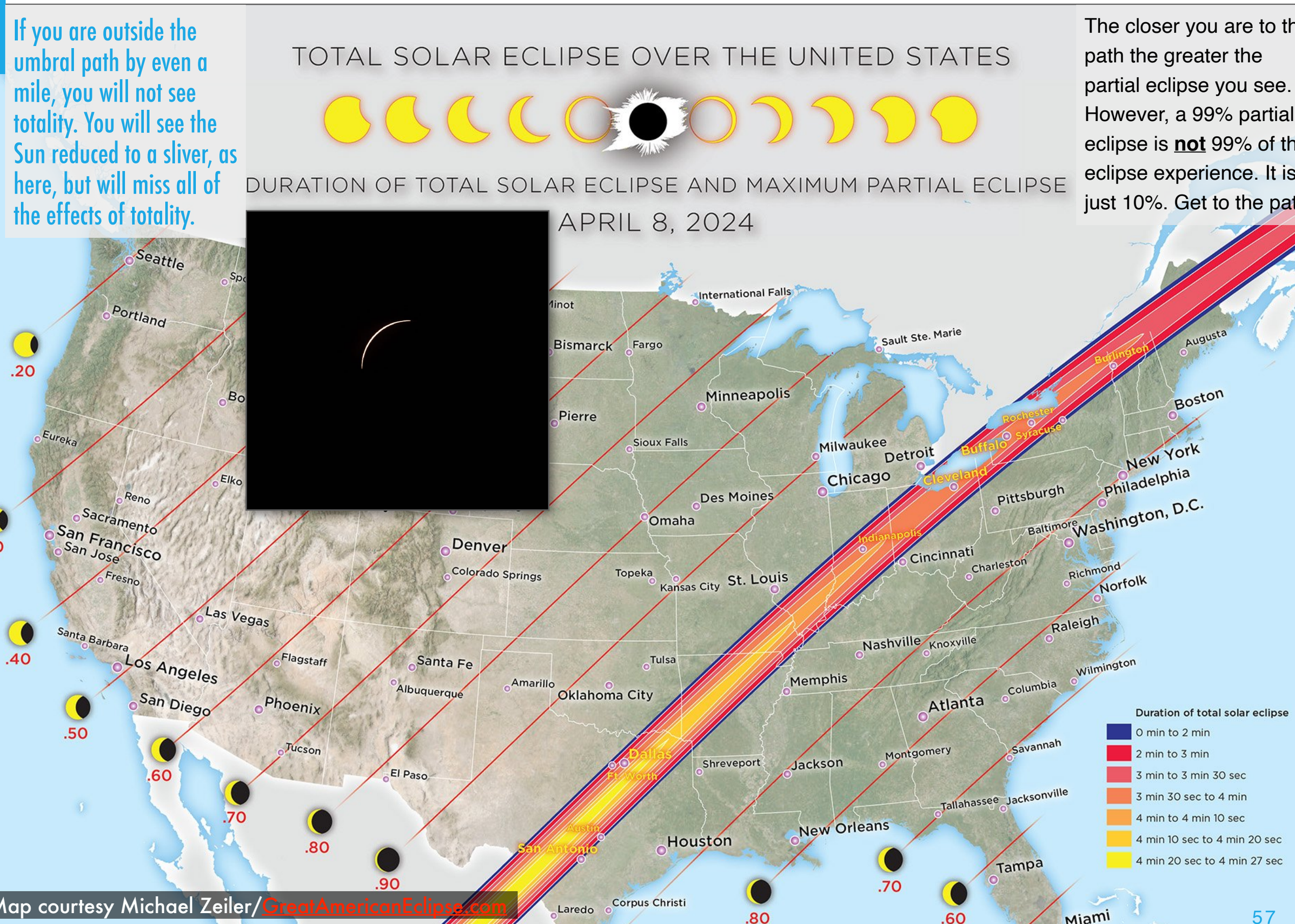
2024: YOU MUST BE IN THE UMBRAL SHADOW…

If you are outside the umbral path by even a mile, you will not see totality. You will see the Sun reduced to a sliver, as here, but will miss all of the effects of totality.

The closer you are to the path the greater the partial eclipse you see. However, a 99% partial eclipse is **not** 99% of the eclipse experience. It is just 10%. Get to the path!



Map courtesy Michael Zeiler/GreatAmericanEclipse.com

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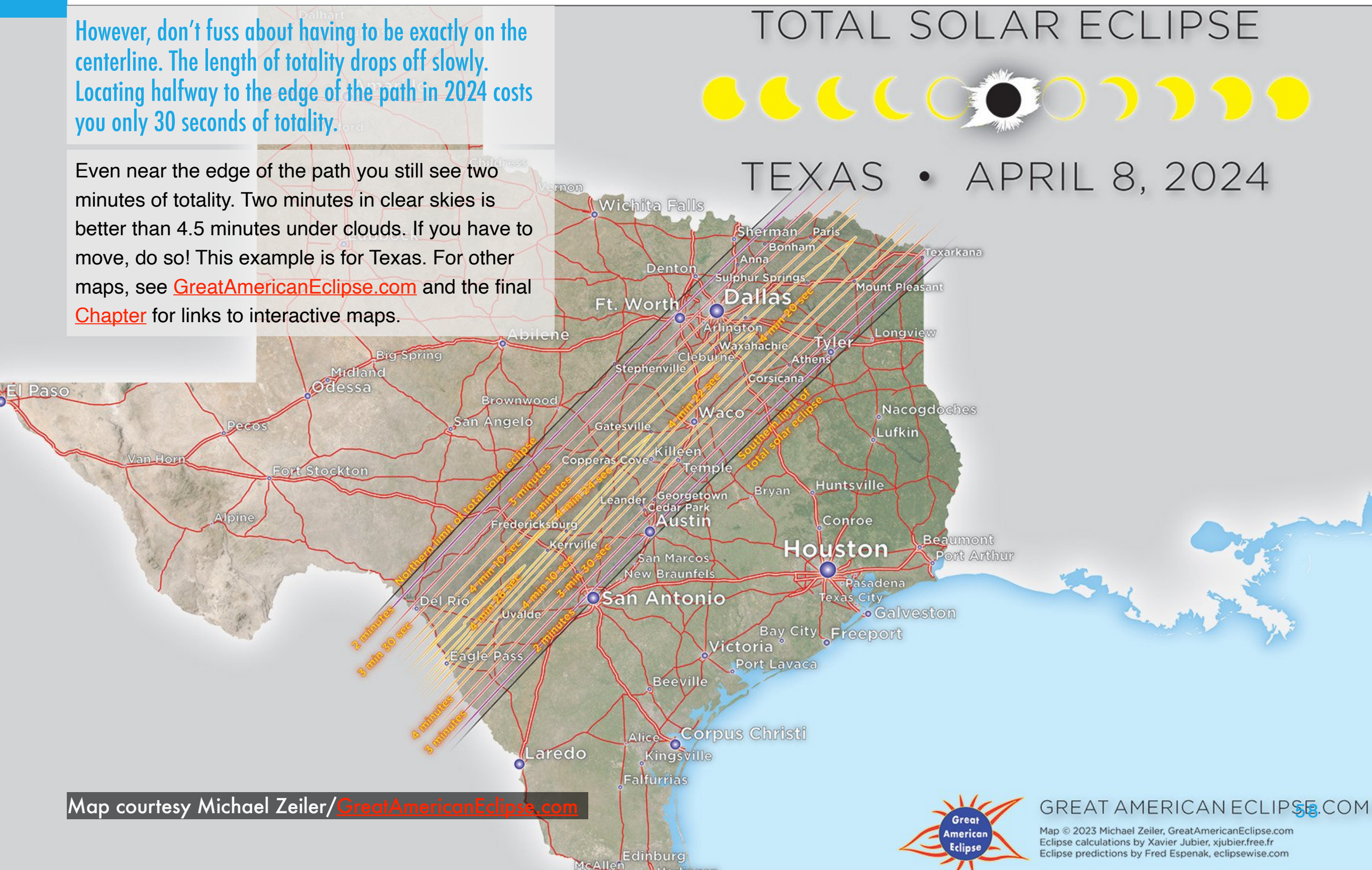
…BUT YOU DON'T NEED TO BE ON THE CENTERLINE

However, don't fuss about having to be exactly on the centerline. The length of totality drops off slowly. Locating halfway to the edge of the path in 2024 costs you only 30 seconds of totality.

Even near the edge of the path you still see two minutes of totality. Two minutes in clear skies is better than 4.5 minutes under clouds. If you have to move, do so! This example is for Texas. For other maps, see GreatAmericanEclipse.com and the final Chapter for links to interactive maps.



Map courtesy Michael Zeiler/GreatAmericanEclipse.com

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SECTION 2

TIMING AND ECLIPSE LENGTH

Over North America – the only land the shadow crosses for the 2024 eclipse – the eclipse happens in late morning and early afternoon in Mexico and the southwestern U.S., in mid-afternoon in the northeastern U.S., and later in the afternoon in eastern Canada. From southern locations the Sun is also high in the sky. The Sun appears highest and totality lasts the longest from locations in Mexico. The Sun is lowest and totality the shortest from sites in Atlantic Canada.

July 21, 2009, South Pacific, north of Cook Islands

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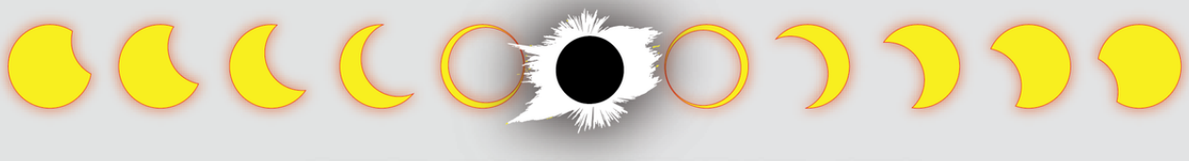
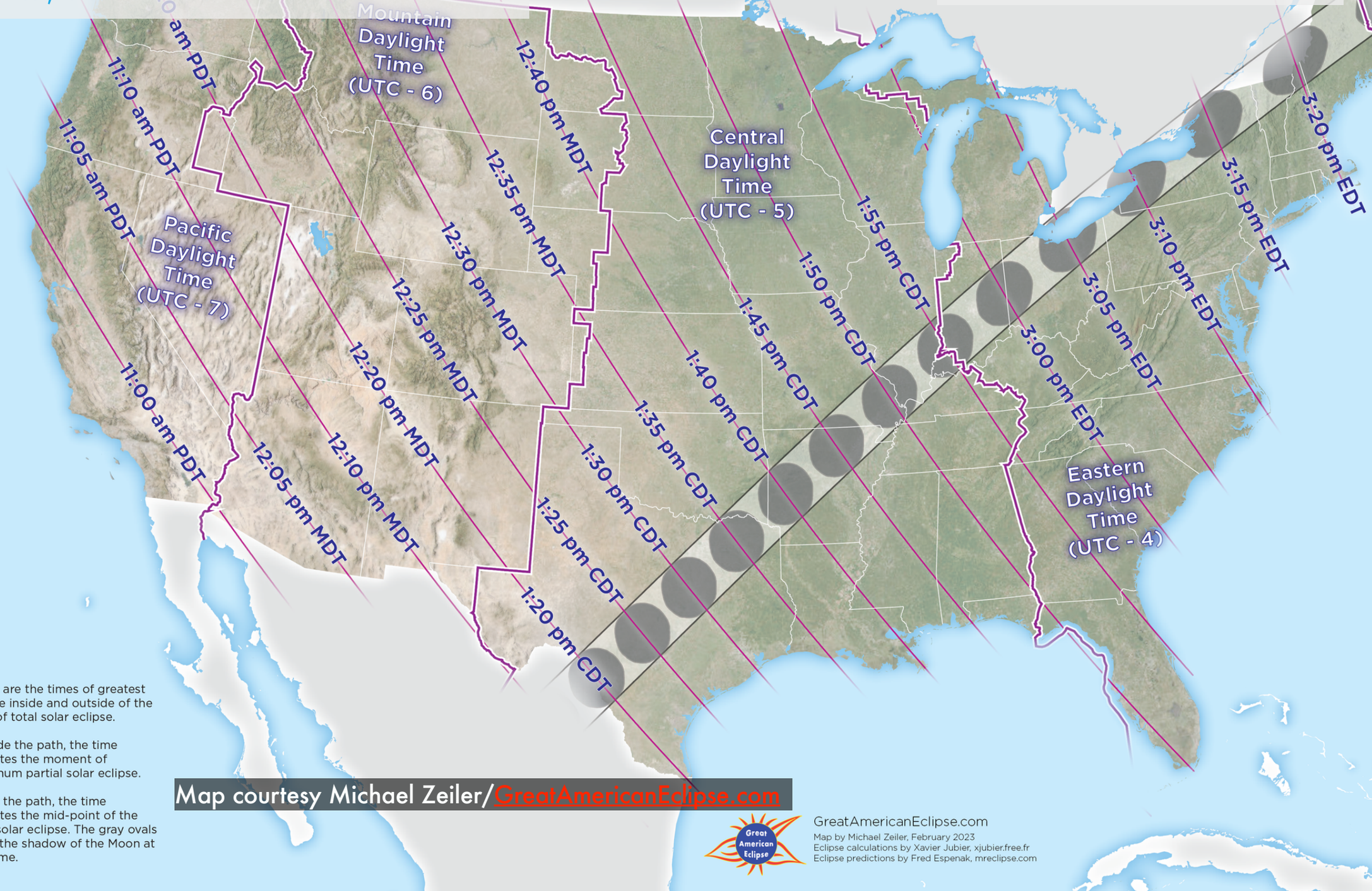
2024: WHEN DOES TOTALITY OCCUR?



This shows when totality happens in the U.S.: early afternoon in Texas and the South, mid-afternoon in the Midwest, later afternoon in the Northeast and Canada.

TIMES OF GREATEST ECLIPSE
APRIL 8, 2024

For precise times see the final Chapter for links to eclipse websites and interactive maps.



These are the times of greatest eclipse inside and outside of the path of total solar eclipse.

Outside the path, the time indicates the moment of maximum partial solar eclipse.

Inside the path, the time indicates the mid-point of the total solar eclipse. The gray ovals show the shadow of the Moon at this time.

Map courtesy Michael Zeiler/GreatAmericanEclipse.com

GreatAmericanEclipse.com
Map by Michael Zeiler, February 2023
Eclipse calculations by Xavier Jubier, xjubier.free.fr
Eclipse predictions by Fred Espenak, mreclipse.com

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2024: HOW LONG WILL TOTALITY LAST?

MAXIMUM DURATION OF TOTALITY ALONG THE ECLIPSE CENTERLINE

APRIL 8, 2024

This plots the length of totality – how long the Moon completely covers the disk of the Sun. It is 4m27s in Texas, decreasing to 3m15s in Atlantic Canada.

Map courtesy Michael Zeiler/GreatAmericanEclipse.com

The longest duration of totality will be found in the center of the path of total solar eclipse. This map shows the longest durations as the shadow of the Moon moves from Mexico to Canada.

GreatAmericanEclipse.com
Map by Michael Zeiler, February 2023
Eclipse calculations by Xavier Jubier, xjubier.free.fr
Eclipse predictions by Fred Espenak, mreclipse.com

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SECTION 3

PLAN B !

I cannot emphasize this more strongly. Plan your site carefully, to be sure. But be prepared to dump all those plans for a “Plan B” or “Plan C.” You might have to chase into clear skies the day before, or even (if you can move) the hour before the eclipse. Try not to be locked into a site. Research what traffic restrictions might be in effect and what local officials are advising for travel before and after the eclipse. You do not want to be stuck in traffic just outside the path!

July 21, 2009, South Pacific, north of Cook Islands

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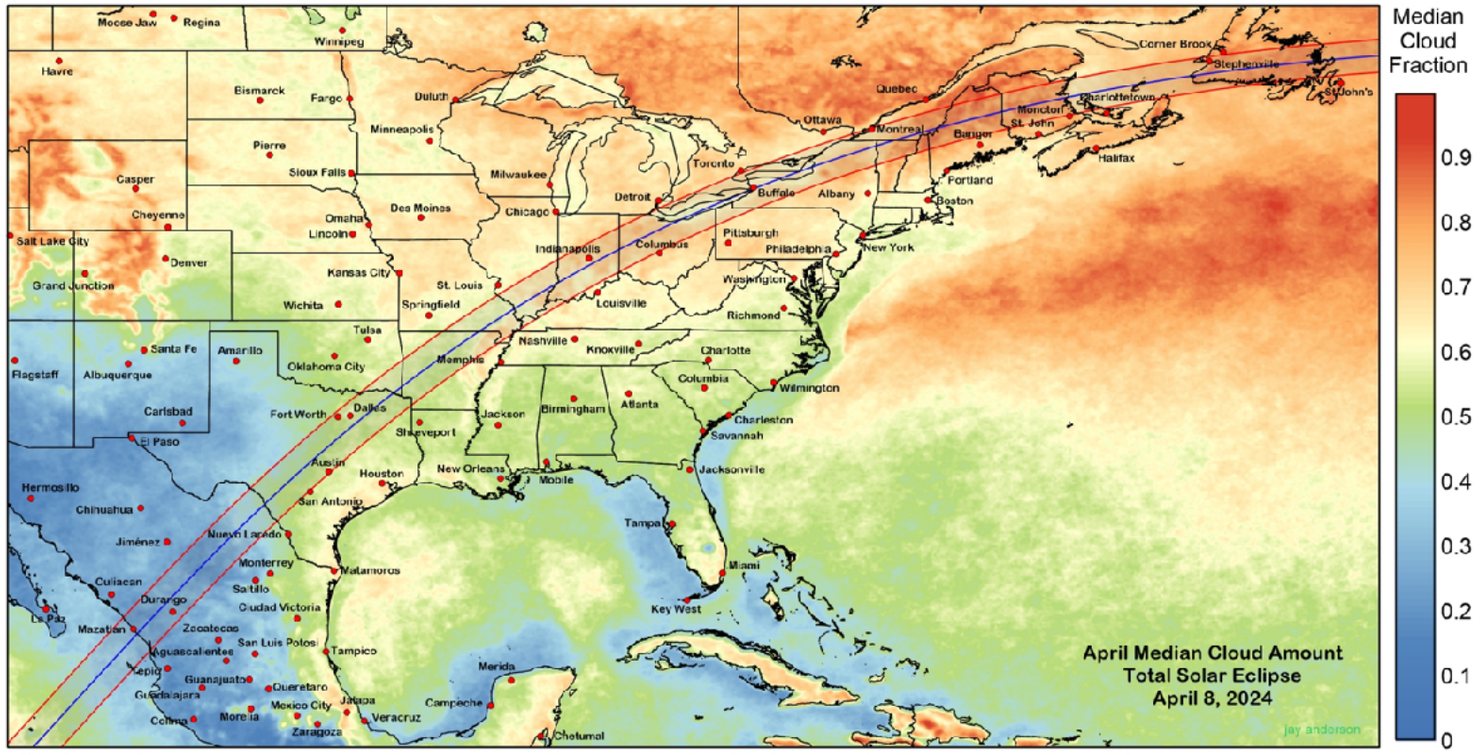
2024: WHAT WILL THE WEATHER BE LIKE?

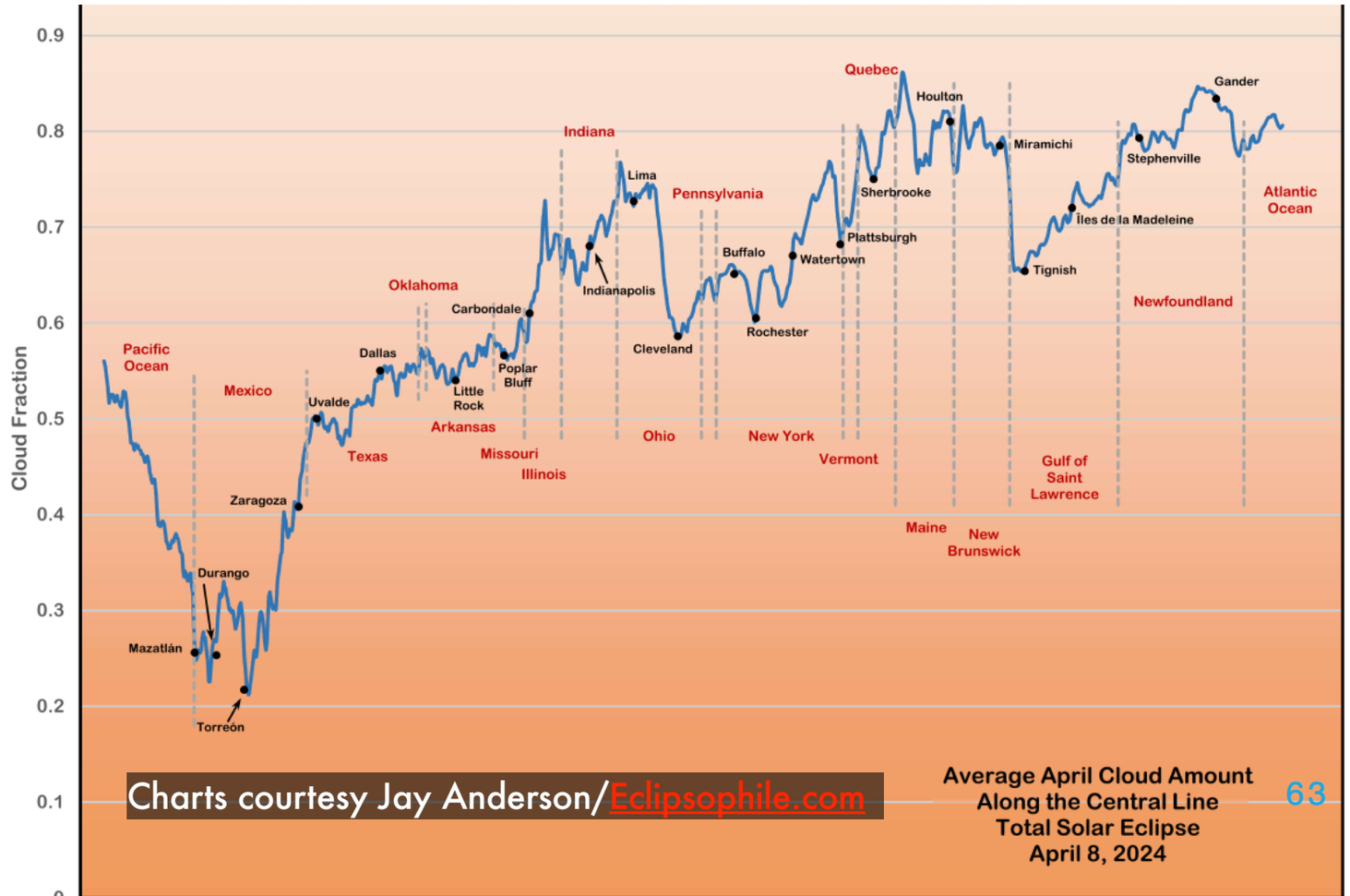
These maps show the climatological averages for April 8. The trend is clear – weather prospects worsen as the shadow moves northeast.

Mexico has the best weather prospects, with just 20% to 30% chances of cloud. For many chasers, Mazatlan, a popular destination for tourists at any time, will be the preferred location. Or on a ship offshore in the Pacific.

Cloud cover prospects worsen as the shadow moves northeast, with Texas hovering about 50% even in the southwest of the state. Those in the midwest and northeast who choose to stay closer to home will have to contend with cloud cover chances in the 60% to 70% range. Eastern Canada fares even worse, with cloud likely as high as 80% to 90%. But April 8, 2024 might bring clear skies to those willing to chase at the last minute to find a hole.

For a detailed eclipse weather summary for the 2024 TSE, see Jay Anderson's page at www.eclipsophile.com. He explains why some sites have unusually good prospects.





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WHERE TO CHECK THE WEATHER

The weather on April 8, 2023 was almost the reverse of what statistics suggested it should be. Almost everyone would have seen it, except Texas!

Everyone will be glued to the 1-week and 2-week long-range forecasts. The latter is best ignored. But as the day approaches forecasts will become more accurate. A 3-day forecast is something you will want to act on – if it is very bad, plan to move. However, don't take small-scale predictions too seriously – if forecasts show broken cloud with lots of holes, those holes may or may not be over your site. But they are a warning eclipse day could be iffy. For forecasts and maps see:

College of DuPage (Select GFS & Average Cloud Cover for long-range forecasts, or GEM/RDPS & Average Cloud Cover for 3-day forecasts)

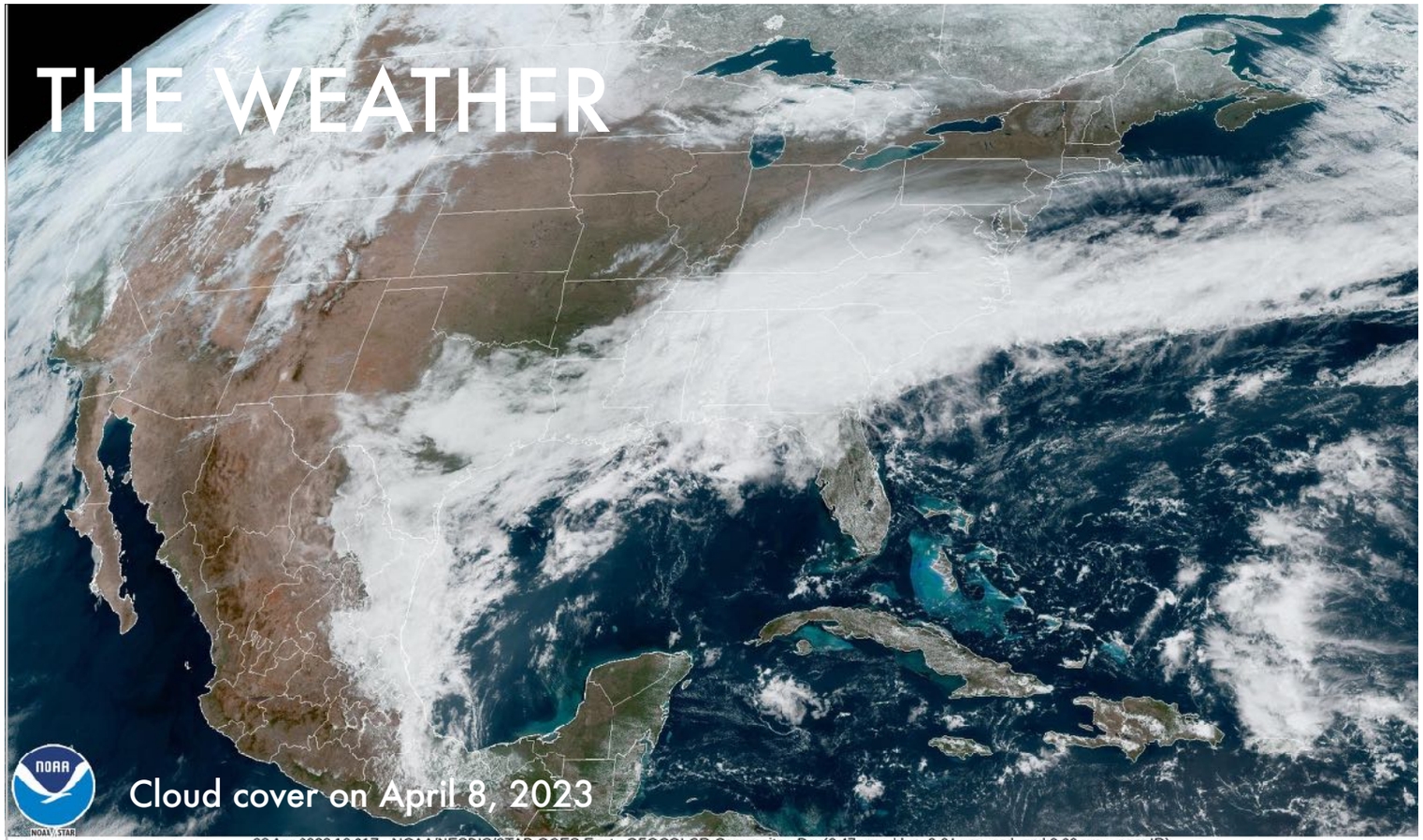
GOES Satellite Imagery (for current cloud cover)

National Weather Service

The Weather Network (U.S.)

Environment Canada

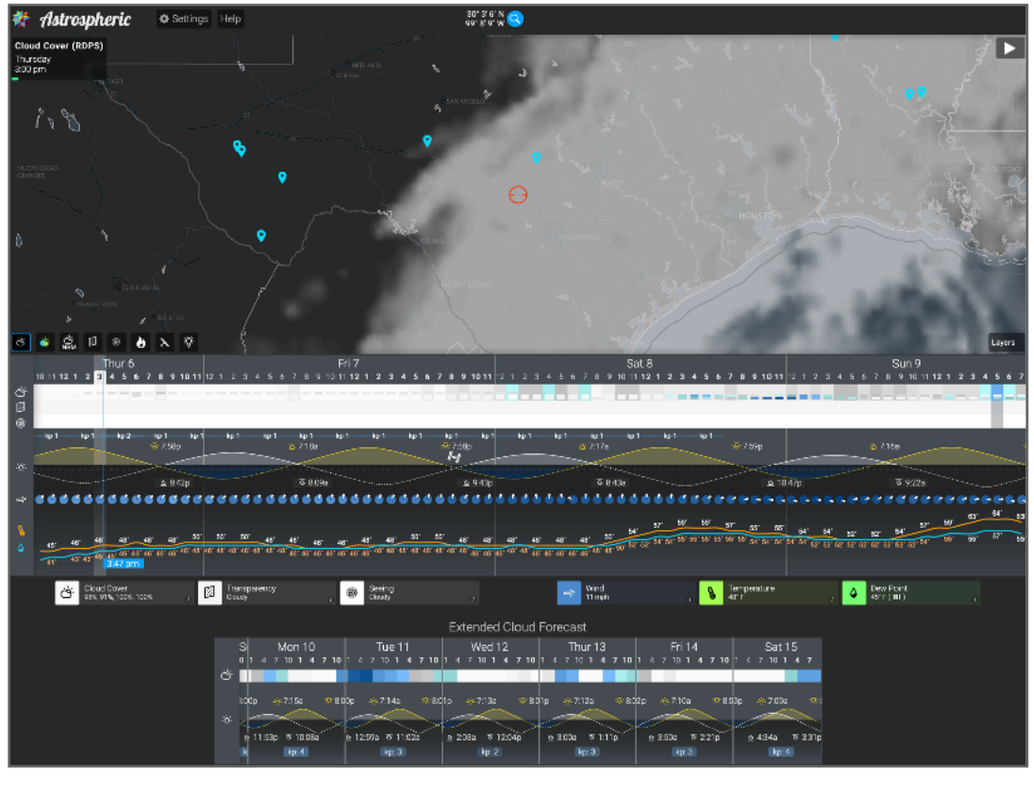
Windy



Cloud cover on April 8, 2023

08 Apr 2023 16:31Z - NOAA/NESDIS/STAR GOES-East - GEOCOLOR Composite - Day(0.47 um - blue, 0.64 um - red, and 0.86 um – near IR)

A favorite site and app for astronomers' forecasts is astrospheric.com, shown at right. It uses data from a selection of weather models, for 3-day and 10-day forecasts. This shows the poor conditions in Texas in early April 2023.



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STAYING MOBILE: PLAN B

Three days prior, forecasts should be fairly accurate. One day prior, you will definitely want to act – packing up and moving if forecasts are poor.

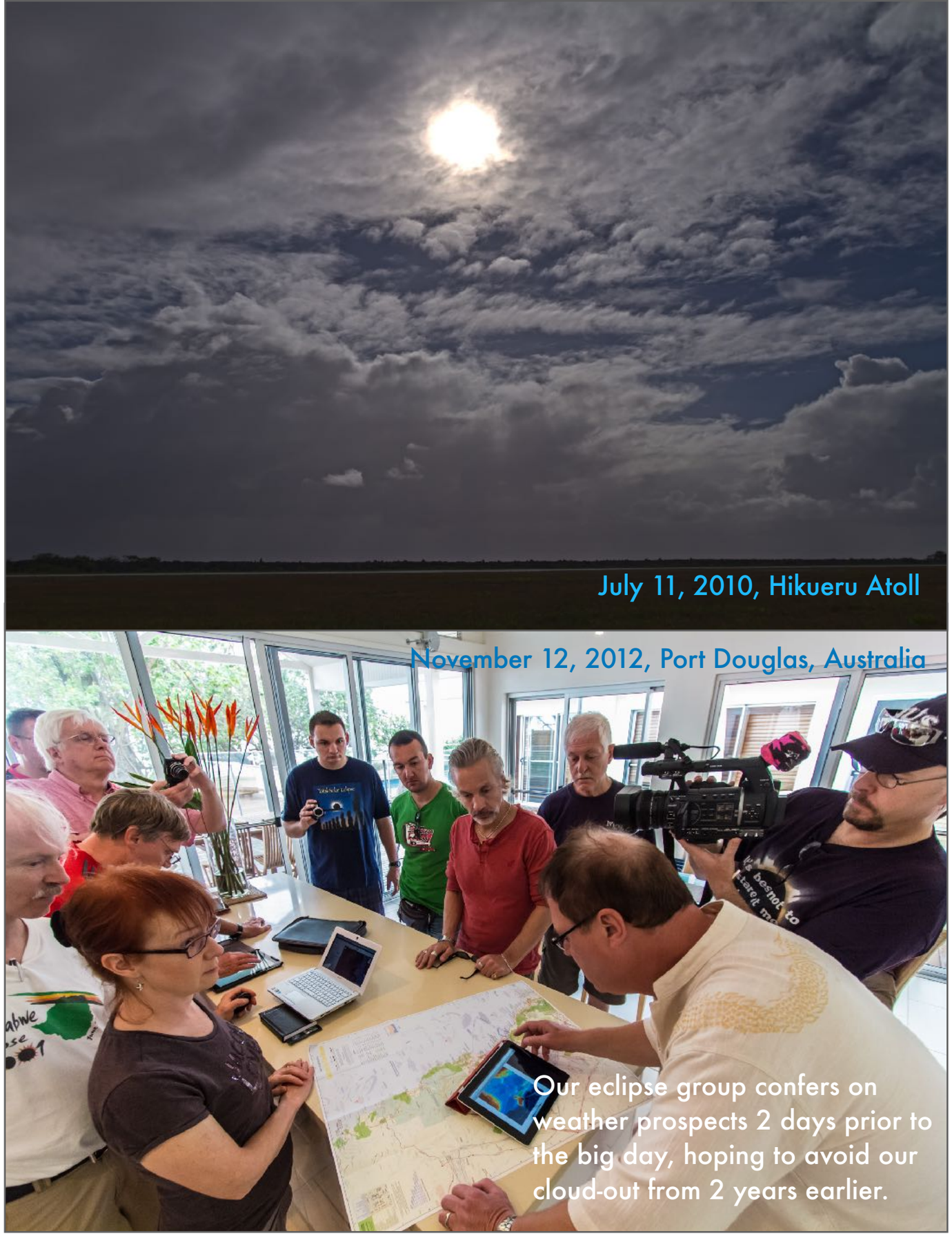
Always have a Plan B: Figure out what gear to take. If you have to set up in a hurry, what will be the priority for seeing and shooting the eclipse? Choose a simpler array of gear, and a simpler shooting plan as a contingency. See Chapter 10.

Check for any planned closures or highway checkpoints. Last minute moves may be hampered by traffic jams and police control.

Try not to drive out of the path in an escape to clear skies, as traffic might halt you and prevent you from driving back into the path.

Gas up well before the eclipse. Take food and sleeping bags – whatever you might need to sleep in your car if needed. Make sure all batteries are charged.

Leaving a site post-eclipse may be tougher than leaving a fireworks show or football game – exit routes could be jammed. Plan to stay a while.



July 11, 2010, Hikueru Atoll

November 12, 2012, Port Douglas, Australia

Our eclipse group confers on weather prospects 2 days prior to the big day, hoping to avoid our cloud-out from 2 years earlier.

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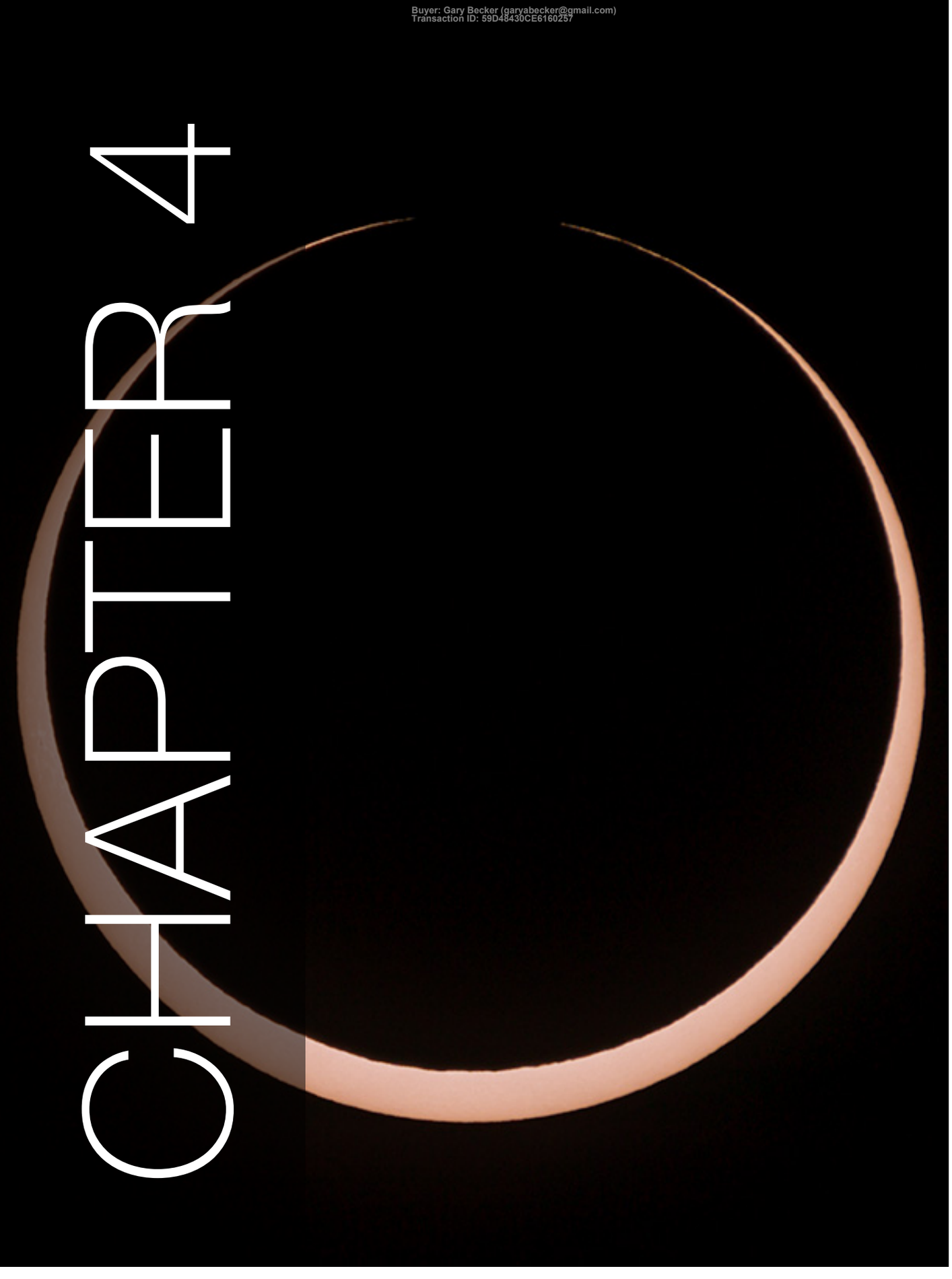
CHAPTER 4



4

2023: LESSONS LEARNED AT THE ANNULAR ECLIPSE

As the October 14, 2023 annular eclipse is now history, I have converted this chapter from planning to one listing lessons learned at the eclipse. There were many! However, my advice and tests of solar filters still apply to the partial phases of the 2024 total eclipse. So that's the first topic.

October 14, 2023 Annular Eclipse, Utah

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SECTION 1

FILTER FUNDAMENTALS

The number one question eclipse viewers ask is, “Don’t I need a filter?” Yes! And it has to be one made for the purpose. Do not risk damaging your eyesight and equipment by using some concocted makeshift filter or one not designed for looking at the Sun. It is NOT enough to simply dim the Sun; the filter must also block infrared and ultraviolet light as well which, though invisible, can also damage your eyes. Only filters made for solar viewing block visible, IR and UV.

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WHAT FILTERS TO USE

TIP: Important! Solar filters safe for viewing meet the ISO 12312-2 standard. Beware of cheap imposters that can appear from fly-by-night importers.

Filters made for solar viewing are made of a special aluminized Mylar®, or black polymer plastic, or metal-coated glass.

The “eclipse glasses” sold by astronomy dealers are good for naked eye views. A #13 or #14 welder’s filter will also work, but do not use anything lower than a #13. Photography is best with a filter of aluminized Mylar/polyethylene or metal-coated glass. The latter provides a yellow colored Sun, and with the lowest light scatter.

Solar filters in cells to clamp over a lens or telescope (below) are the best for looking at and shooting the partial phases. Unlike screw-on types (at left), they can be removed quickly at totality.

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THE COLOR OF THE SUN THROUGH FILTERS

The Sun is naturally white, not yellow. Mylar/ polyethylene filters present that true color, but other filters provide a more pleasing yellow tint.

The shiny aluminized Mylar filters (in glasses and for scopes, as at top right) provide a blue-white Sun, closer to the Sun's real color. But metal-coated glass filters (below at right) and hand-held black polymer filters (below) provide a more pleasing yellow Sun. Any will work fine, and colors can always be shifted in processing.

ALUMINIZED MYLAR®

I shot the 2023 annular eclipse image through a Kendrick/Baader solar filter. They are very sharp, despite their wrinkled surface, but tend to scatter light more. The image here shows the tint of the Sun from such a filter without any color correction.

METAL-ON-GLASS

I shot the partial phases of this 1998 eclipse through a Thousand Oaks metal-coated glass filter. Glass filters present a sharper image than black polymer filters, with the latter best reserved for naked eye views and wide-angle photography, not telescopes.

NOTE: Most solar filters have a density rating of ND5.0, meaning they block all but 1/100,000th of the light. See Wikipedia.

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TESTING FILTERS FOR LENSES

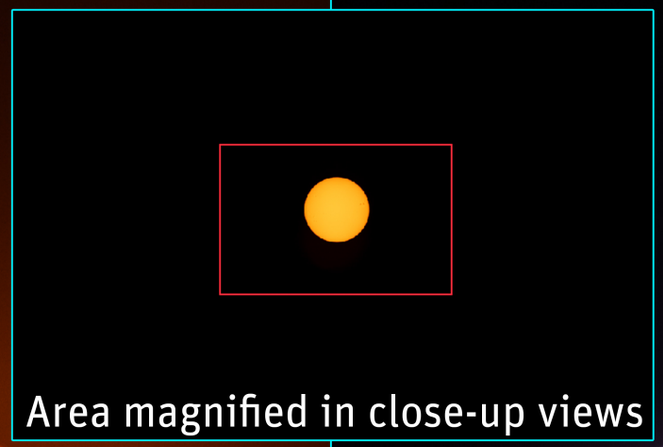
Here I show a comparison of three filters used on a 400mm telephoto: two threaded filters from Seymour Solar – a glass and a black polymer type – and a Mylar filter from Kendrick.

Seymour Solar – Glass Threaded

Unlike the Seymour glass filter shown on the next page, this thread-on glass filter produced fairly sharp images with the Sun set into a black sky with good contrast. It's my choice for wide-angle composites and shots through telephoto lenses, as here.

Seymour Solar – Black Polymer Threaded

This thread-on black polymer filter, as most do, proved slightly soft and produced a lot of light scatter around the Sun. Contrast is not as good as glass or even Mylar.



Kendrick/Baader – Mylar Clamp-On

This Mylar/polyethylene filter, as most do, provides excellent sharpness but yields a blue-white Sun, with some light scatter visible in longer exposures.

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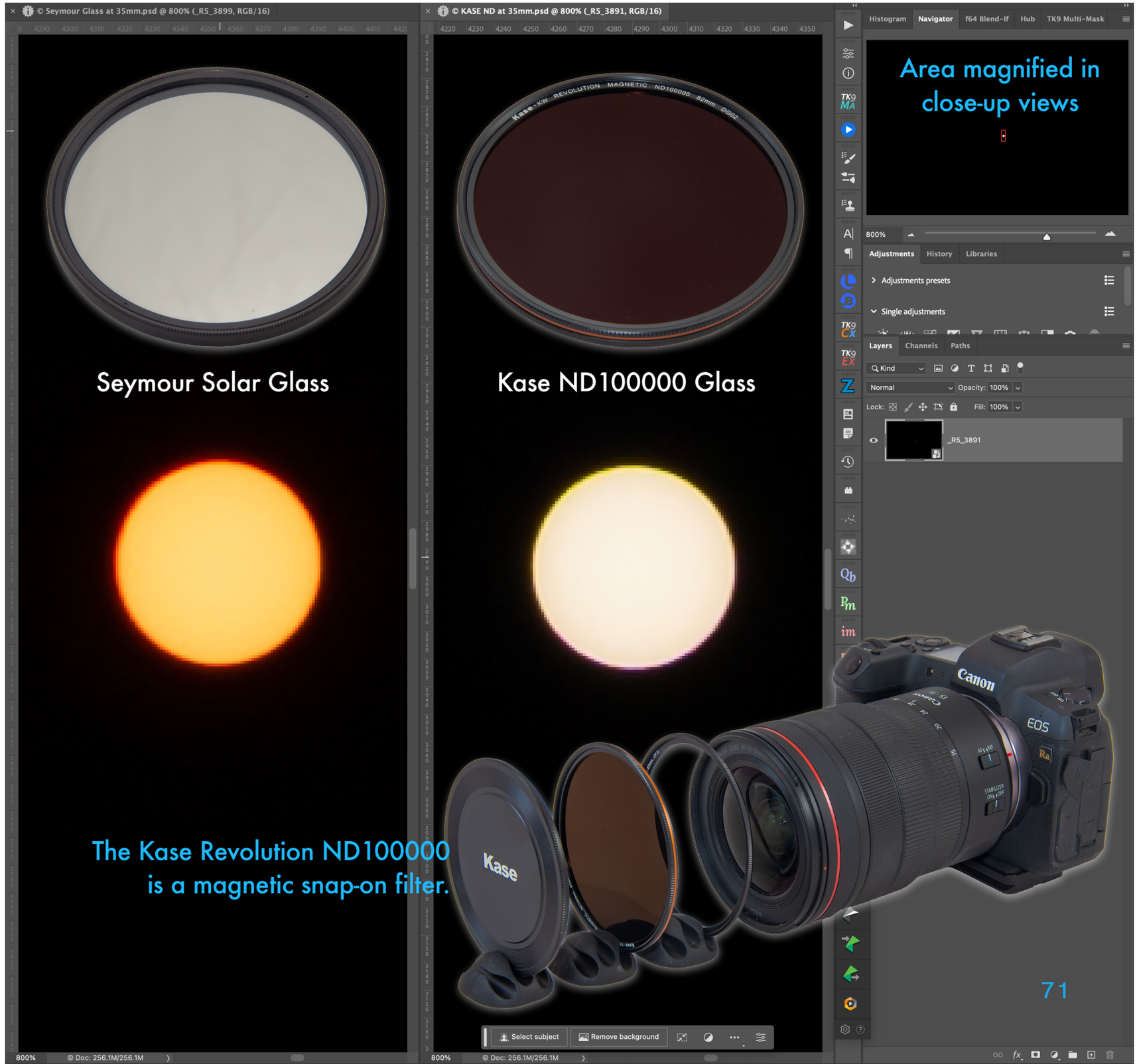
TESTING FILTERS FOR LENSES

Here I show a comparison of two screw-in filters for lenses: a Seymour Solar glass filter and a new solar filter from KaseUSA, their ND100000 Revolution filter.

In mid-2023 the UK-based filter company Kase introduced their ND100000 glass solar filter specifically for the Sun and eclipses. It is available from their U.S. outlet here, which is where I purchased mine. Oddly, it is not available from their UK outlet, nor from Kase Canada.

Available in sizes for 58mm to 95mm, the ND100000 is part of their Revolution series, which are magnetic filters that snap onto an included thin threaded ring, as I show in the image below right. The threaded ring can stay on the lens and is complemented by an optional magnetic lens cap. The filter itself can be snapped on or off easily, with no worries of threads binding at the critical moment of totality.

I compared it to the other screw-in glass filter I found works well, from Seymour Solar. The Kase filter provides a more neutral white image and proved perhaps a bit sharper in this test with a wide-angle lens with small Suns, as would be the case with composites. Over an afternoon there were no problems leaving the filtered lens and camera aimed at the Sun for hours. A test example is shown in the next section.



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TESTING FILTERS FOR TELESCOPES

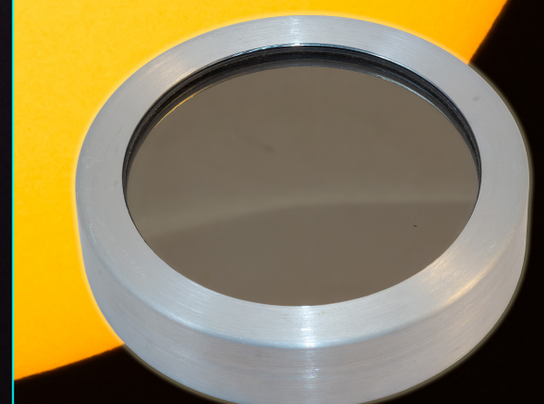
Here I show a comparison of four filters used on a telescope: a Mylar filter from Kendrick, two filters (old and new) from Thousand Oaks, and a glass filter from Seymour Solar.

Kendrick/Baader – Mylar

Mylar/polyethylene filters and ones made by Baader in particular are noted for their sharpness. This is a blow-up of an image taken with the filter on an 80mm Askar V scope at 600mm focal length.

Old Thousand Oaks – Glass

This is the glass filter I have had for decades and that I used for many images in the book. It is no longer made. This is on the Astro-Physics Traveler 105mm refractor at 600mm focal length.



Seymour Solar – Glass

This new glass filter, here also tested on the Traveler, proved a disappointment, as it is very soft both visually and photographically. It appears to not use optical-grade plane-parallel glass.

New Thousand Oaks – Solarlite

Thousand Oaks stopped making glass filters in 2018. They now offer their version of a polymer filter. It proved a bit soft, with a lot of light scatter. It is also very dark, almost too dark for visual use.

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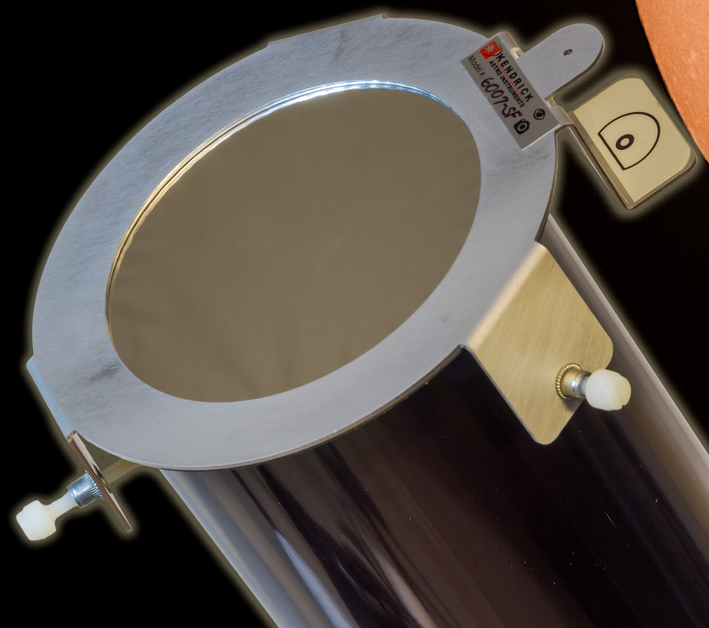
TESTING FILTERS FOR TELESCOPES

Here I show a comparison of two filters used on a telescope: a new Mylar/polyethylene filter from Kendrick compared to the old Thousand Oaks glass filter I had used for many decades.

Kendrick/Baader Mylar Filter

A new Mylar/polyethylene filter from Kendrick using the Baader Astro Solar Safety Film (ASSF) proved equal in performance to older Mylar filters I have from Kendrick. The Baader film is consistent in density and sharpness. The new “open cell” design Kendrick offers comes with the handy Sun Finder pinhole device for quickly aiming at the Sun, a nice added bonus.

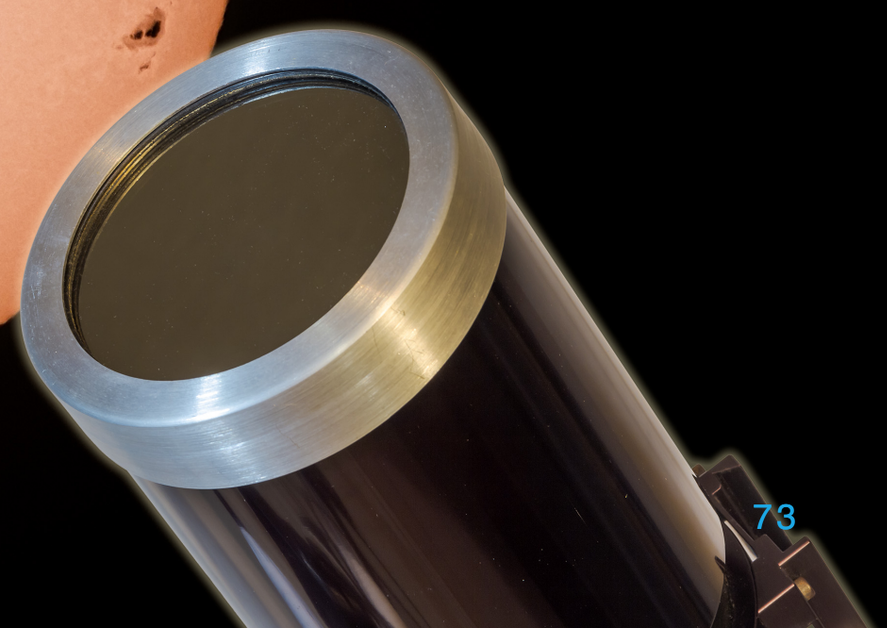
In tests, I found the new Kendrick filter a bit sharper than the old glass filter, in this pair of images taken moments apart with my Astro-Physics refractor.



Old Thousand Oaks Glass Filter

Also shown on the previous page, this is the glass filter I have used for decades with good success. However, in tests against the new Kendrick/Baader filter it proved not quite as sharp. In these images, I applied identical processing, except for color balance. I made the Mylar Sun more yellow and the glass-filtered Sun less yellow, to make them similar in tint.

In all, with the issue I saw with the 4-inch Seymour glass filter (though smaller glass filters from them were fine), and the poor performance of SolarLite and other black polymer filters, I would suggest that Baader Mylar filters are the best bet for consistently sharp images with good density – not too bright but not too dark.



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WHAT FILTERS NOT TO USE

Don't even think about doing a stupid thing like this: viewing with filters between your eyes and optics. Your eyes will fry!

Contrary to the dire warnings you'll read prior to any eclipse, it is safe to look at the Sun and eclipse, but NOT if you use homemade filters.

We don't care what filter your father might have concocted for you to use at that vaguely remembered eclipse of yesteryear. It was probably unsafe. Remember, back then people also used to smoke, never wore seat belts, and insulated their attics with asbestos. The following are all UNSAFE because, while they dim visible light, they do NOT block infrared and ultraviolet light that can damage your retina:

- ✖ **Do not use:** Photographic neutral density filters, even stacked, no matter how dense
- ✖ **Do not use:** Photographic polarizing filters
- ✖ **Do not use:** Sunglasses
- ✖ **Do not use:** Negative film (exposed or not)
- ✖ **Do not use:** Smoked glass
- ✖ **Do not use:** Space blankets and other forms of household Mylar, or silvery CD/DVD disks.

August 11, 1999, southeast Turkey

June 21, 2001, Zimbabwe

At eclipse sites chasers often hand out safe solar filters for everyone to use.

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WHERE TO GET FILTERS

Most telescope stores sell solar filters to fit a variety of lenses and telescopes. Order yours soon to ensure you have one in time for testing.

A few manufacturers (Kase, Kenko, K&F Concept, NiSi USA, Thousand Oaks and Seymour) offer screw-in filters to go on camera lenses. However, most filters (glass, polymer, and Mylar) are housed in cells that clamp over the front of lenses, binoculars, and telescopes. They MUST go on the front of any lenses. These are the easiest and fastest to remove at the critical moment of second contact. Most telescope companies sell solar filters for their telescopes. Or you can get filters here. **Tap** on the name to go to their website.

AstroZap
Baader Astro Solar (for Europe)
Kendrick Astro Instruments (Baader Solar Film)
Orion Telescopes
Seymour Solar Filters
Thousand Oaks Optical
Rainbow Symphony (eyeglass type only)
EclipseGlasses (eyeglass type only)
American Astronomical Society (links to suppliers)

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WHERE AND WHEN TO USE FILTERS

TIP: Cap any finder scope so it doesn't burn up when aimed at the Sun.

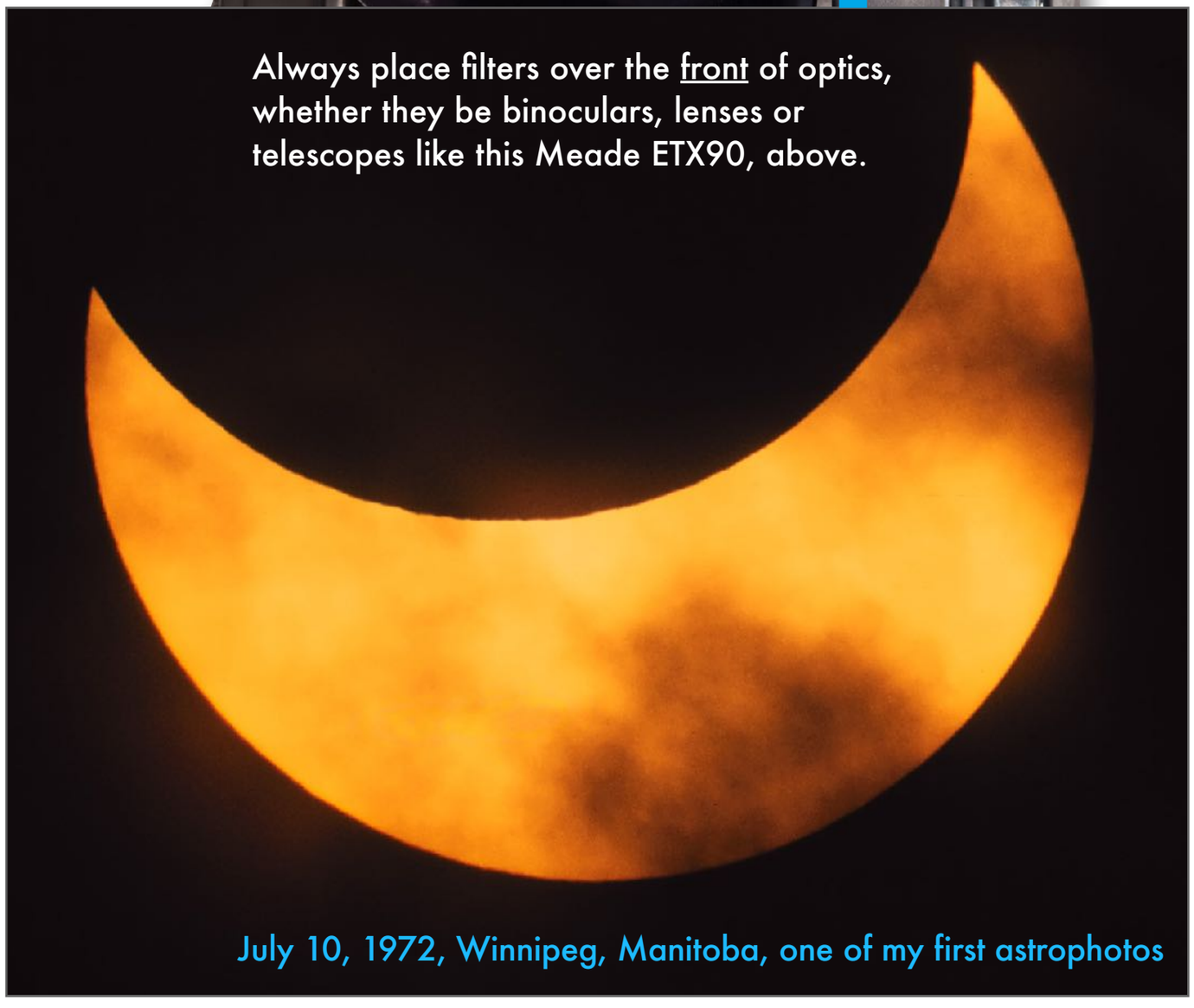
Whether it is for viewing or photography, you need the solar filter for the partial phases of the 2024 eclipse. A filter that worked in 2023 will be fine.

All filters must go on the front of lenses, to block light before it enters the optics. Do not place filters over the telescope eyepiece, screwed into an eyepiece, or near the focus of a telescope. Heat will burn those filters in an instant. Remember frying ants with a magnifying glass? That's what will happen to your filter – and eyes. Watch children carefully to ensure they do not misuse filters. But it is often adults who think they know better and do not have to follow instructions who are the worst offenders.

In 2024 you need filters only for the partial phases (one you used in 2023 will work). In 2024 you remove all filters for totality. Keep your eclipse glasses on and you'll miss it all! Fail to remove the filter from your lens, and the camera will record nothing but black during totality.

But, you must then replace the solar filter after totality ends and the Sun returns. Don't forget!!

Always place filters over the front of optics, whether they be binoculars, lenses or telescopes like this Meade ETX90, above.



July 10, 1972, Winnipeg, Manitoba, one of my first astrophotos

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FINDING THE SUN

This might seem like a dumb concern – how can you not find the brightest thing in the sky? You'd be surprised!

Finding the Sun with a filtered lens or telescope can be tough, as the view is utterly black except for the Sun. One trick is to move the optical tube until its circular shadow on the ground is as small as possible. A variation on this is used by clever little devices such as the Sun Finder from Kendrick Astro Instruments. It comes with some of Kendrick's filters or can be added to others. It projects a pinhole image of the Sun onto a bull's-eye target. It'll be very handy for rapidly aiming at the Sun when it reappears from behind clouds.

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SECTION 2

2023: LESSONS LEARNED AT THE ANNULAR ECLIPSE

I've revised this portion of the ebook to cover lessons learned at the October 14, 2023 annular eclipse in attempting to shoot it with three cameras: a wide-angle composite (at right), a telephoto time-lapse, and close-ups with a telescope. I got lots of great images, but not all went to plan, due to equipment issues, but mostly due to dumb mistakes on my part, often from not following my own advice! The 2023 annular was a dress rehearsal and it served that purpose very well.

October 14, 2023, Bryce Canyon, Utah

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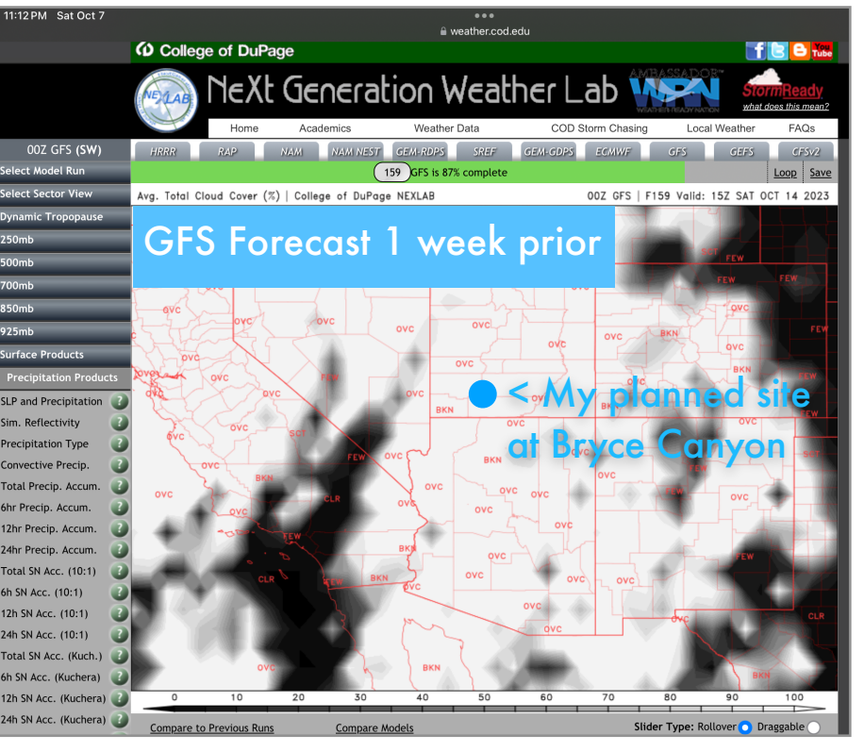
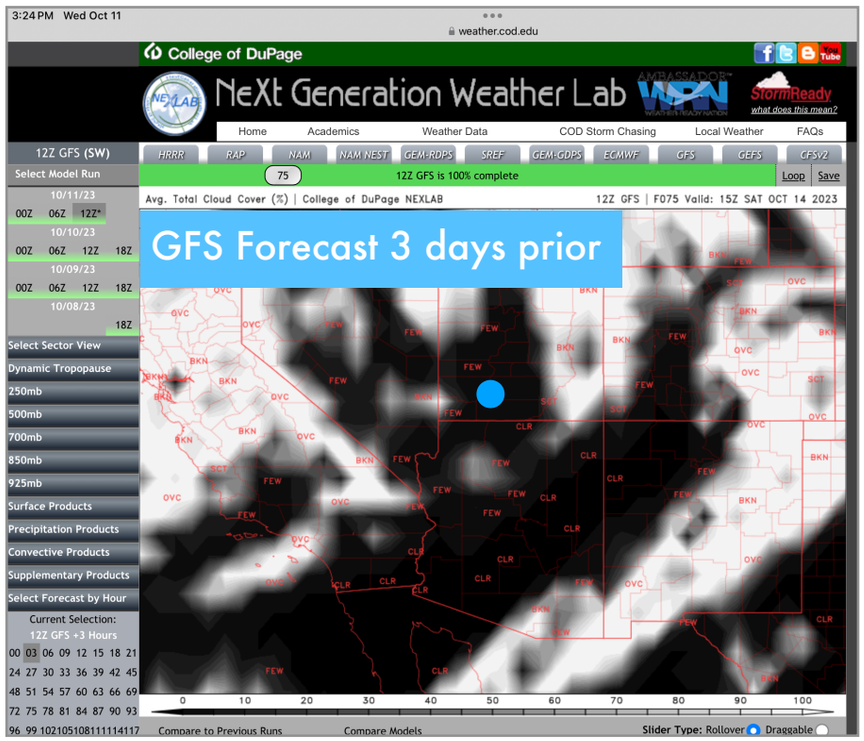
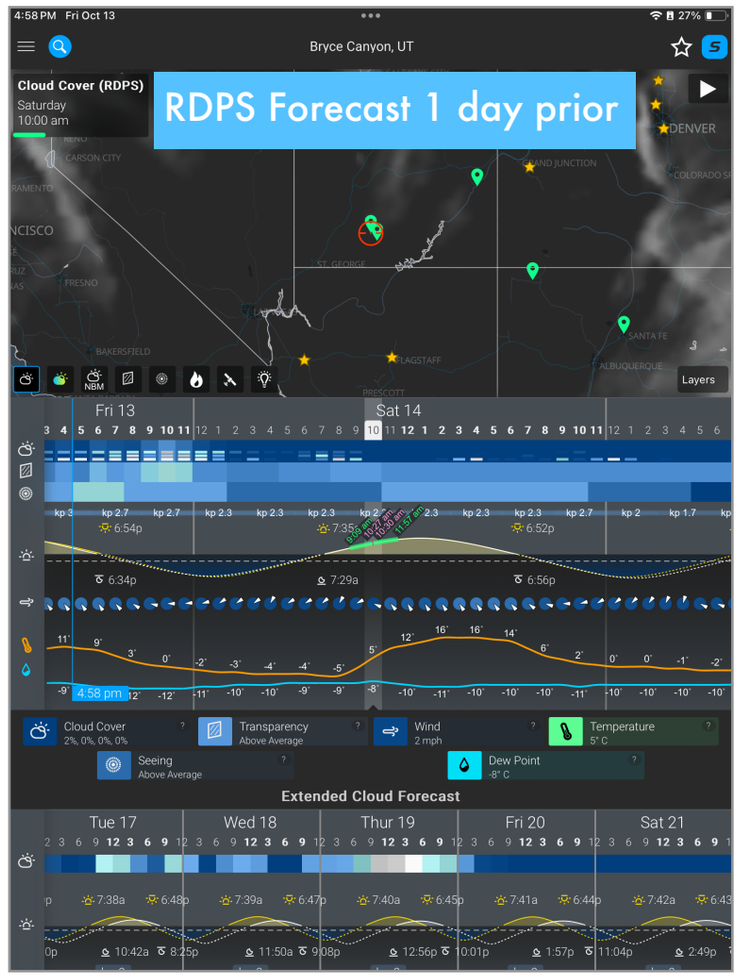
WATCHING THE WEATHER

The week leading up to the October 14, 2023 eclipse was fraught with anxiety about weather. The same might happen in early April 2024. Start thinking about a Plan B one week out, and act upon it three days out. Book accommodation if needed (and if possible!) at back-up sites.







Above are the GFS (Global Forecast System) forecasts from the College of DuPage site for cloud cover for the southwest U.S. prior to the October 14, 2023 eclipse. One week out the prospects looked poor for the entire region. A run down into SE New Mexico or West Texas seemed likely, and I looked at possible sites and accommodation. By October 11, with 3 days to go, the forecast improved a lot! I stuck to my original plan to go to Bryce Canyon. By eclipse eve (right), the Astrospheric app, which uses the RDPS (Regional Deterministic Prediction System) was showing clear skies over the entire region. However, it was good to have alternate sites. But to get to one would have taken another 1 to 2 days of driving.

☑ **Lesson Learned:** Don't panic until 3 days prior when, if the forecast still looks poor, act upon your Plan B while you still have time to move.

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CHECKING THE ROADS

In planning your travel in 2024, plan to arrive at or near your site well before the eclipse. Congested highways on eclipse morning could delay your travel to the site. Traffic jams could certainly delay your departure.

These were signs seen along the way in Utah prior to the October 14, 2023 annular, warning of possible eclipse traffic congestion. In reality, I found little to worry about. But my eclipse site was close to my accommodation. And annular eclipses have far less draw than total eclipses. As such, in 2024 eclipse traffic jams and road closures could hamper your travel and make it hard to arrive – or leave – when you want. Traffic congestion could also thwart plans for last minute moves to clear skies. Authorities tend to err on the side of caution expecting the worst. But it might be prudent to arrive at your eclipse site before dawn, or even the night before and sleep in your car. I've done that!

- ☑ **Lesson Learned (though I knew this one):** Arrive in your chosen area 1 to 3 days early to scout the site and roads, and learn of possible closures. Plan to stay at your eclipse site after the eclipse to allow traffic to clear.

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MY WIDE-ANGLE COMPOSITE

While this type of image takes planning, it can be easy to implement. Maybe!

This is my composite of unfiltered images of the landscape and sky taken at sunrise, blended with filtered images of the Sun taken at 3-minute intervals from sunrise, through the eclipse, until the Sun left the frame with the final partial phase in progress at top.

The lens was the Canon RF15-35mm at 24mm. The filter was the Kase ND100000 82mm tested in the previous section. It worked very well.

Taken at Ruby's Inn Overlook, just outside Bryce Canyon National Park, Utah

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PRACTICING FOR THE WIDE-ANGLE COMPOSITE

This shows two versions of a set of test images I shot to try out my lens and one filter I had, to check exposure times and intervals. I used a Canon RF15-35mm at 28mm.

Throughout I extoll the virtues of practicing. Here I tested my intended gear for shooting the composite of the 2023 annular (but the same findings apply to the 2024 total).

Using an intervalometer, I shot a bracketed set of images every 1 minute, knowing full well only a subset taken every 3 to 5 minutes would work for the final composite. But … shooting more frequently guards against the possibility of interruptions, such as having to swap batteries 2 hours into the shoot, spoiling the regular cadence. Using an outboard intervalometer (rather than the camera's built-in interval timer) maintains the cadence if you have to turn off the camera to change batteries.

At each interval I shot a set of 5 shots, from properly exposed at 1/640-second (the ones used here) to about 3 stops overexposed. Set the mid-exposure so the darkest image in a bracketed set is correctly exposed and the others overexposed. The bright images may be the best ones to select at that interval for the thin partials. Or, as here, if light clouds drift through.

Using a Seymour glass filter, with images taken at a 1-minute interval over 3 hours, and with all images stacked.

Battery change >

Cloud >

☑ **Lessons Learned in Practice** – Start with a full battery! Take bracketed exposures at each interval to give correct and over-exposed images, to compensate for thin clouds, and the dimming of the Sun in deep partial phases.

Subset of images stacked, from those taken 5 minutes apart

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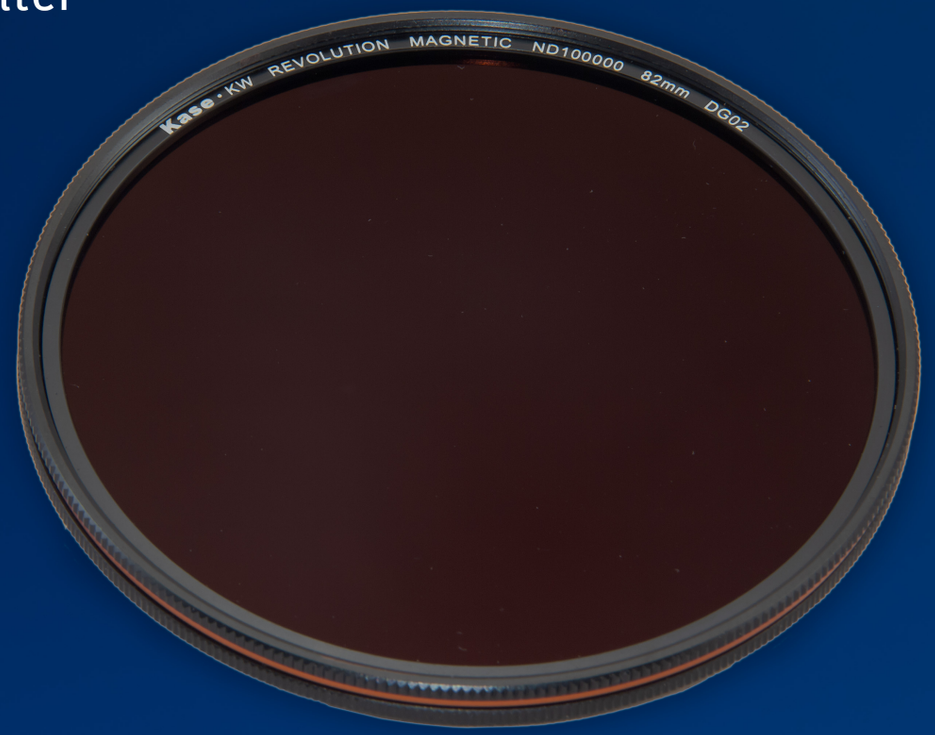
PRACTICING FOR THE WIDE-ANGLE COMPOSITE

In this example I tested shooting the composite using the Kase ND100000 filter I ended up using for the annular eclipse.

Annular Eclipse Composite Test with KASE ND100000 Filter

- Canon RF15-35mm lens at f/5.6 and 28mm (should have been ~30mm)
- Canon Ra camera at ISO 100 (30x magnification helpful for fine focusing)
- KASE Revolution ND100000 82mm glass filter (gives a neutral Sun)

- Images taken at one-minute intervals
- Bracketed set of 3 exposures (1/800 to 1/320 sec) taken at each interval
- Total of 560 images taken but ...
- Only images shot at 1/800 sec used
- Plus only every 5th image of that shutter speed used in final stack, for 39 Suns at 5-minute interval over 3 hours (~ length of the eclipse)
- One battery change & re-focus at mid-sequence, with external intervalometer always running to maintain the cadence (giving me <1 minute to make the swap)
- All layered in Photoshop with Lighten blend mode
- Sky background taken later with no filter; Suns layered onto sky



☑ **Lessons Learned in Practice** – The filter worked! Always good to know. The practice sessions helped determine the best exposure to use for the shortest shutter speed. And the interval to pick from for a final composite. But shoot more frequently.

KASE Revolution filter magnetically snaps onto threaded-on base ring
KASE accessory lens cap magnetically snaps onto filter

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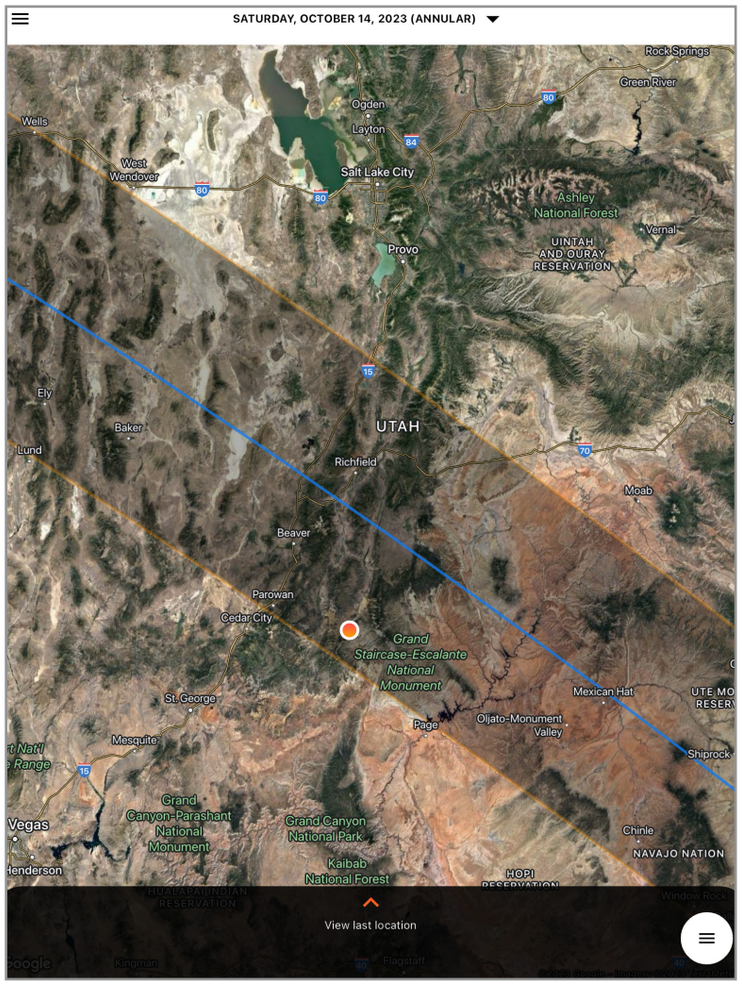
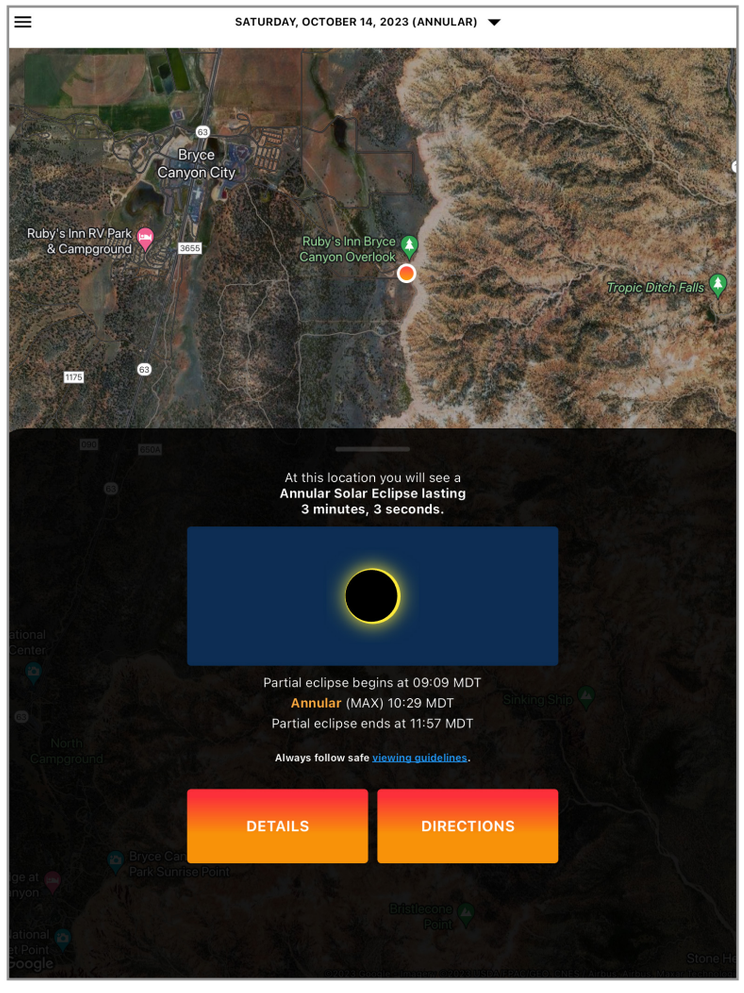
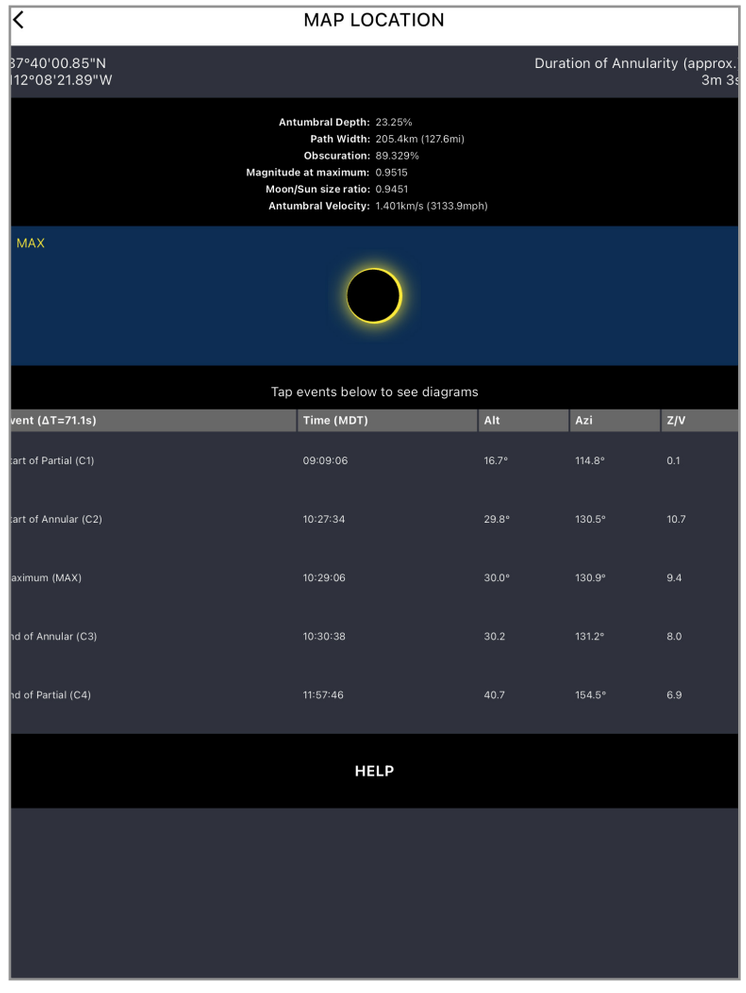
PICKING A SITE IN THE PATH

When on the road it is good to have either a printed atlas (such as Fred Espenak's book) and/or an app, such as Totality that I show here, to help decide where to go should you have to change plans and divert to another site.







This shows the path of the 2023 annular eclipse through southern Utah, and zooms into my chosen site at Bryce Canyon. It provides details on contact times, length of eclipse, maximum coverage, and previews what you'll see. It proved invaluable in planning alternative Plan B sites on the road when weather worries prevailed. You need such information to ensure you stay in the path in a last-minute run.

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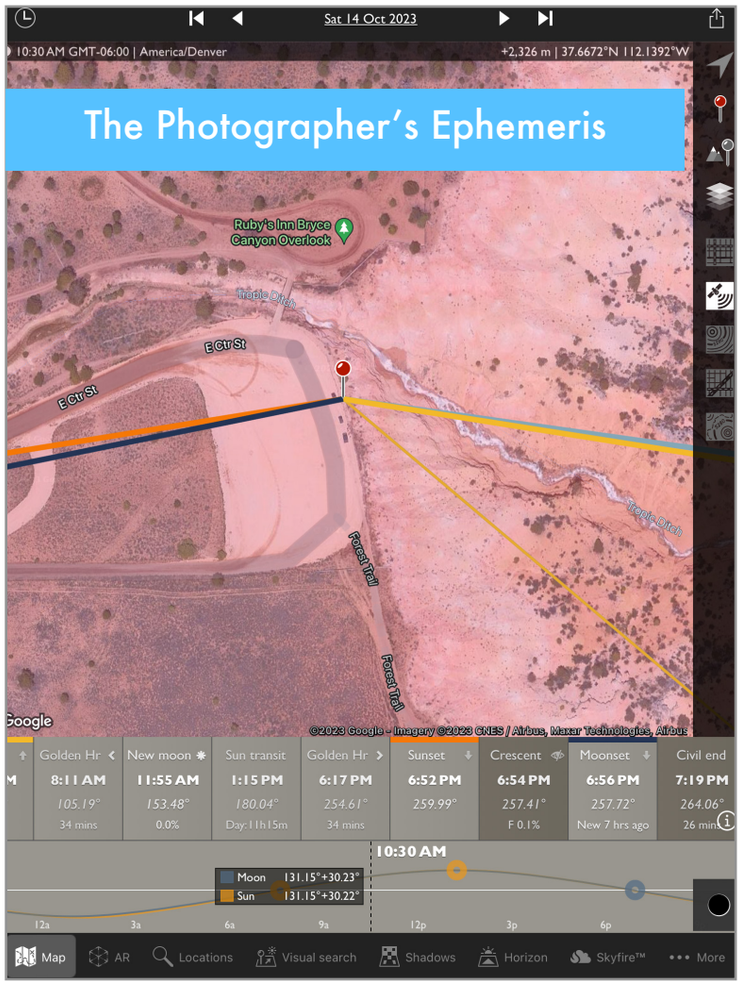
PICKING THE SITE FOR THE COMPOSITE

The wide-angle composite dictated my eclipse site. While Bryce Canyon was Plan A, I knew the popular viewpoints would have access limited on eclipse morning to only Park shuttle buses. I was looking for a site with a scenic foreground and where I could set up my telescope.



While I had Kodachrome Basin in my back pocket, a site I knew would be open early on eclipse day, Bryce was my preferred location. With the use of apps I found this site, just outside the Park in Bryce Canyon City. But would it be suitable and open on eclipse day?

☑ **Lesson Learned:** Have a site in mind but be sure to have an alternative should the main site prove unsuitable.

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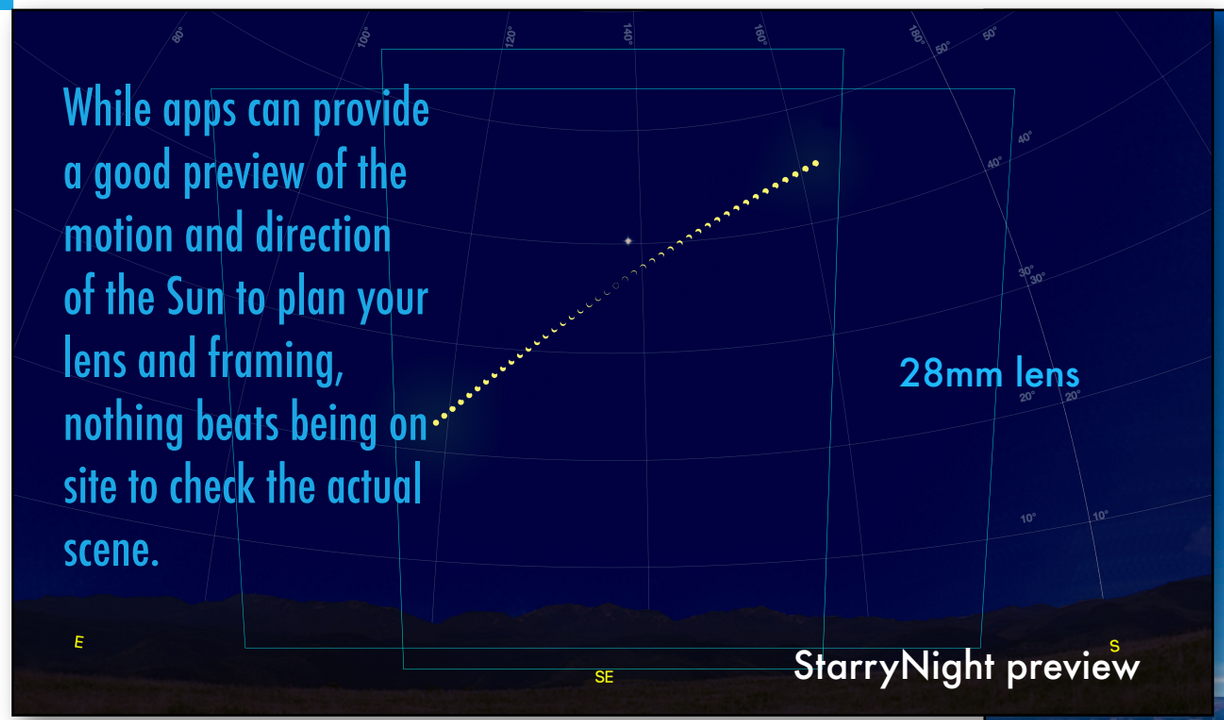
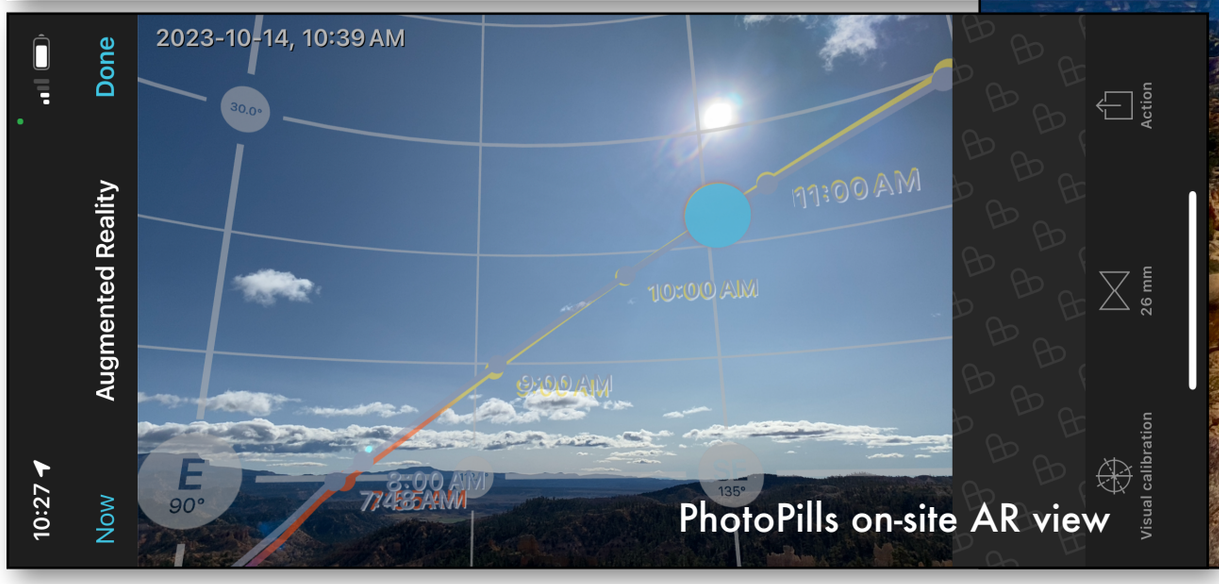
PLANNING THE SHOT: THEORY VS. REALITY





Two days before eclipse day I checked the site using PhotoPills' AR mode to superimpose the path of the Sun on eclipse day onto a real image of the scene, to check the framing and sunrise point.

At left is the framing chart I included in the pre-annular ebook edition, showing how a 28mm lens would frame the path of the Sun. But when I got on site, I saw all the great landscape formations below, such as the river, that would require not only a wider lens but also a vertical panorama of at least two segments, to take in all the photogenic foreground, as well as the sky. I used the lens at 24mm, and even then the Sun went off frame with the eclipse in progress, an acceptable compromise to include more foreground below.

To get the shot, the camera had to be at this exact spot by this very fencepost. I arrived early to make sure I got the spot!

☑ **Lesson Learned:** For wide-shots, scout your site and check that the lens and framing you intended to use will work as planned, or might need adjusting to suit the actual landscape.

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TAKING THE COMPOSITE

NOTE: Chapter 11 on processing contains new tutorials on assembling annular eclipse composites and processing individual still images.

The composite required taking the sky and foreground at sunrise, as during this eclipse the Sun had to be shot with a filter always on the lens.

The vertical extent of the foreground required shooting not one, but several images panning the camera up to create several segments to stitch later to form a panorama. These had to be shot quickly at the moment of sunrise. I shot frames both exposed for the sky, and for the ground to blend in Photoshop. They are labeled Green and with *** for the final ones used.

Then with the camera framed to include some foreground and enough sky to contain the path of the Sun, and not moved until the shoot finished 5 hours later, I placed the Kase ND100000 filter on the lens and started shooting bracketed sets of filtered shots every 1 minute. They are labeled Yellow. (The camera required one battery swap.)

While I knew that would be too short an interval, having more frames than needed allowed flexibility in picking the final set for stacking into a composite. I chose the best exposure from every third set, the ones marked *** and highlighted here in Adobe Bridge.

NOTE: For the 2024 total eclipse, the sky and foreground would come from an unfiltered shot (or shots) taken during totality. Unfiltered shots of the annular would have grossly overexposed the Sun if it was in the frame.

Lesson Learned – Once the sequence starts, check that the intervalometer is firing the camera at the cadence you desire. An error in setting the number of frames (to 1 or 99, for example) can mean the sequence fails to start or ends too soon.

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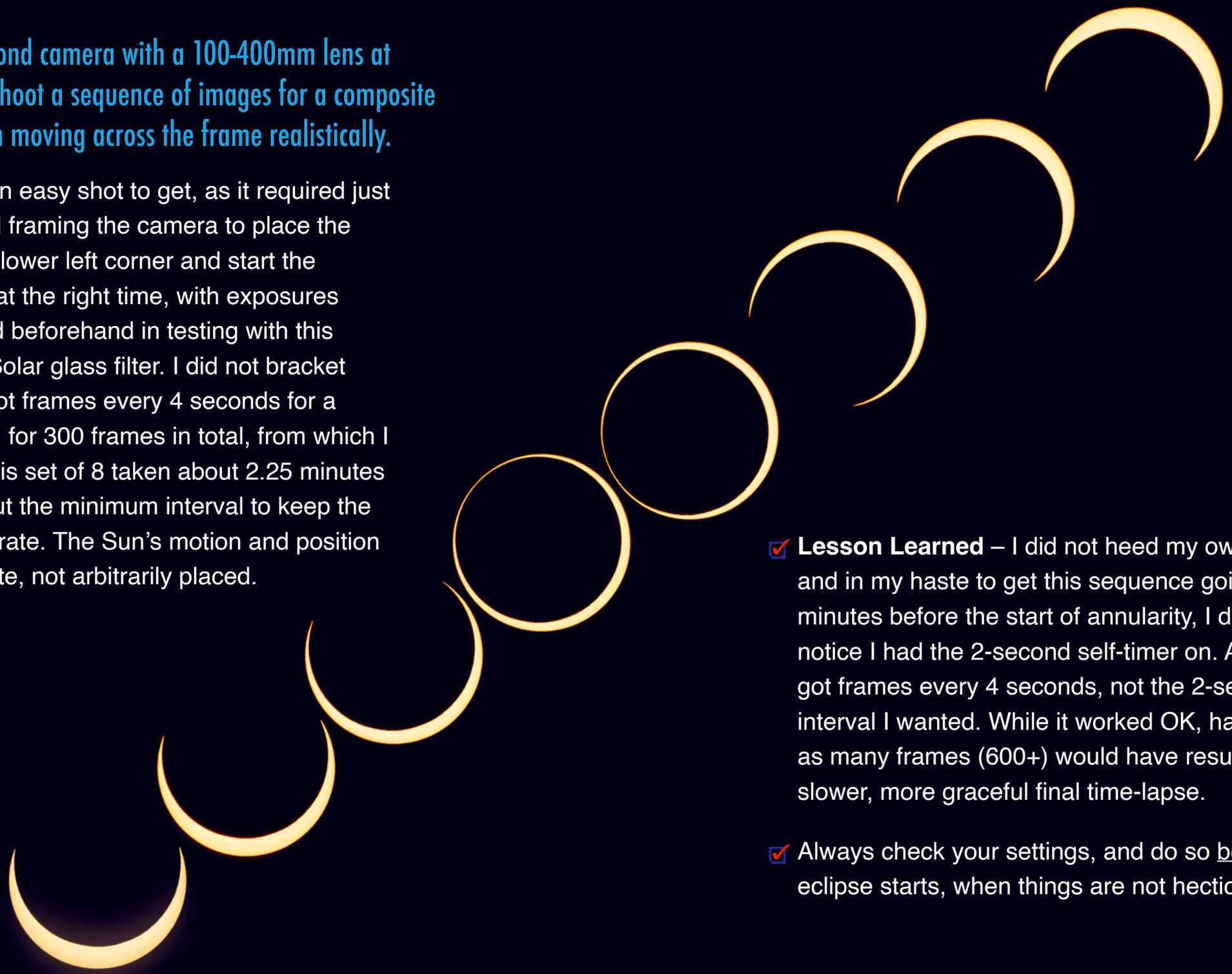
THE TELEPHOTO COMPOSITE

NOTE: You can see a time-lapse of the telephoto lens images here on my Flickr page. https://flic.kr/p/2p9Cyhf

I used a second camera with a 100-400mm lens at 400mm to shoot a sequence of images for a composite with the Sun moving across the frame realistically.

This was an easy shot to get, as it required just aiming and framing the camera to place the Sun at the lower left corner and start the sequence at the right time, with exposures determined beforehand in testing with this Seymour Solar glass filter. I did not bracket these. I shot frames every 4 seconds for a time-lapse, for 300 frames in total, from which I selected this set of 8 taken about 2.25 minutes apart, about the minimum interval to keep the disks separate. The Sun's motion and position are accurate, not arbitrarily placed.



- **Lesson Learned** – I did not heed my own advice and in my haste to get this sequence going about 7 minutes before the start of annularity, I did not notice I had the 2-second self-timer on. As a result I got frames every 4 seconds, not the 2-second interval I wanted. While it worked OK, having twice as many frames (600+) would have resulted in a slower, more graceful final time-lapse.
- Always check your settings, and do so before the eclipse starts, when things are not hectic.

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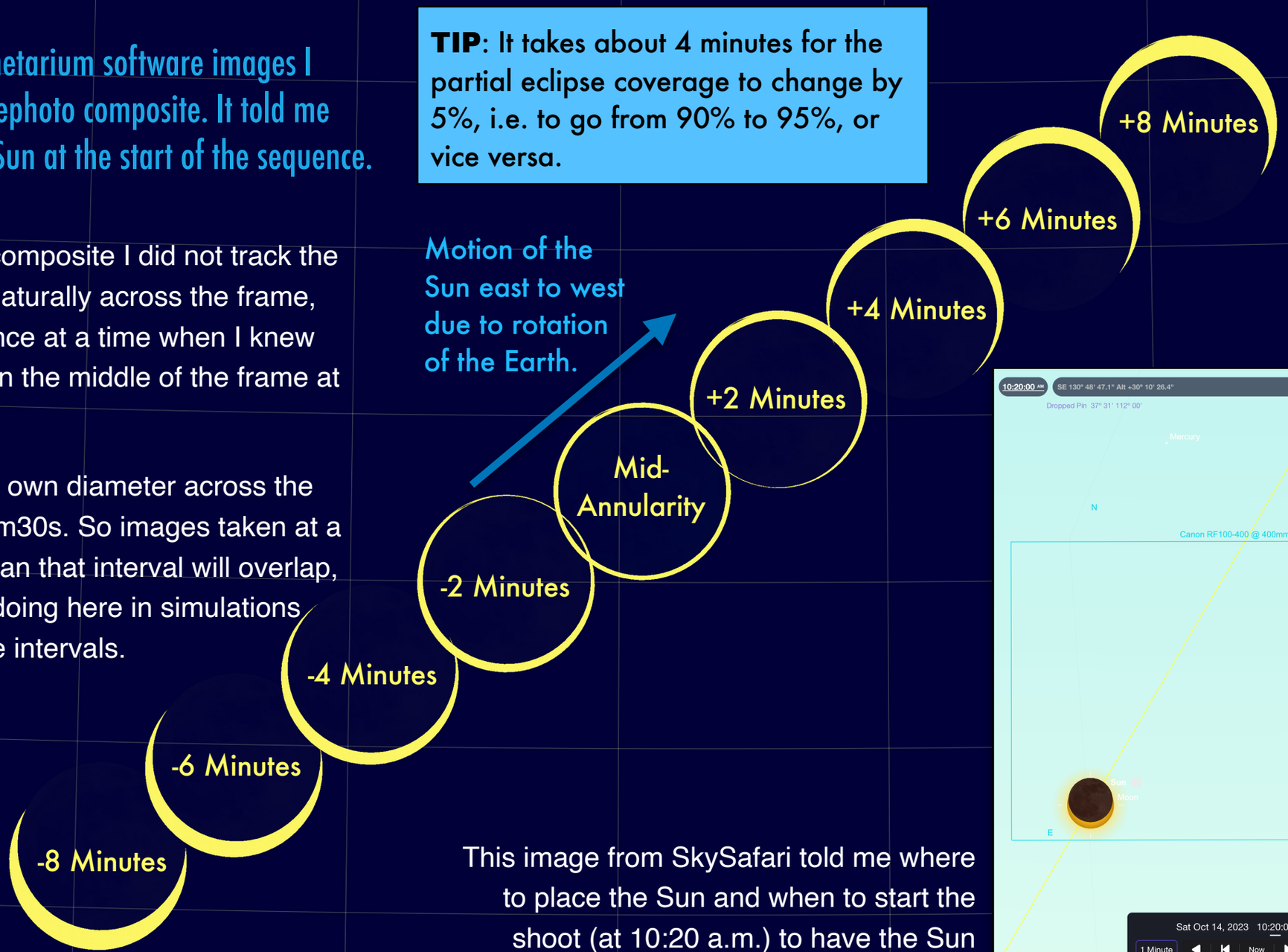
PLANNING THE TELEPHOTO COMPOSITE

These were the planetarium software images I used to plan the telephoto composite. It told me where to place the Sun at the start of the sequence.

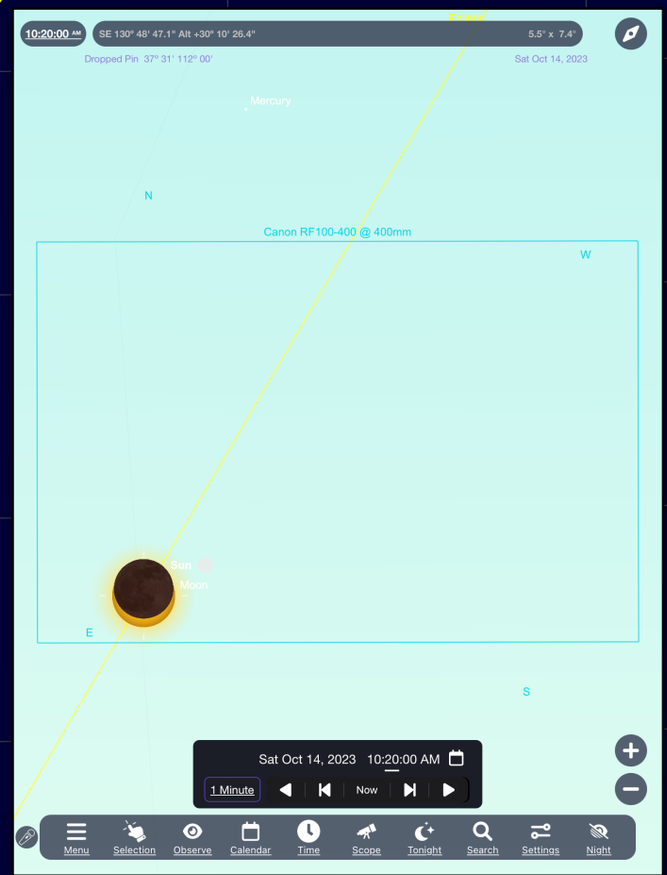
For the telephoto composite I did not track the Sun but let it drift naturally across the frame, starting the sequence at a time when I knew the Sun would be in the middle of the frame at mid-eclipse.

The Sun moves its own diameter across the sky in just under 2m30s. So images taken at a cadence shorter than that interval will overlap, partly as they are doing here in simulations spaced at 2-minute intervals.

TIP: It takes about 4 minutes for the partial eclipse coverage to change by 5%, i.e. to go from 90% to 95%, or vice versa.



This image from SkySafari told me where to place the Sun and when to start the shoot (at 10:20 a.m.) to have the Sun move up across the frame as desired.



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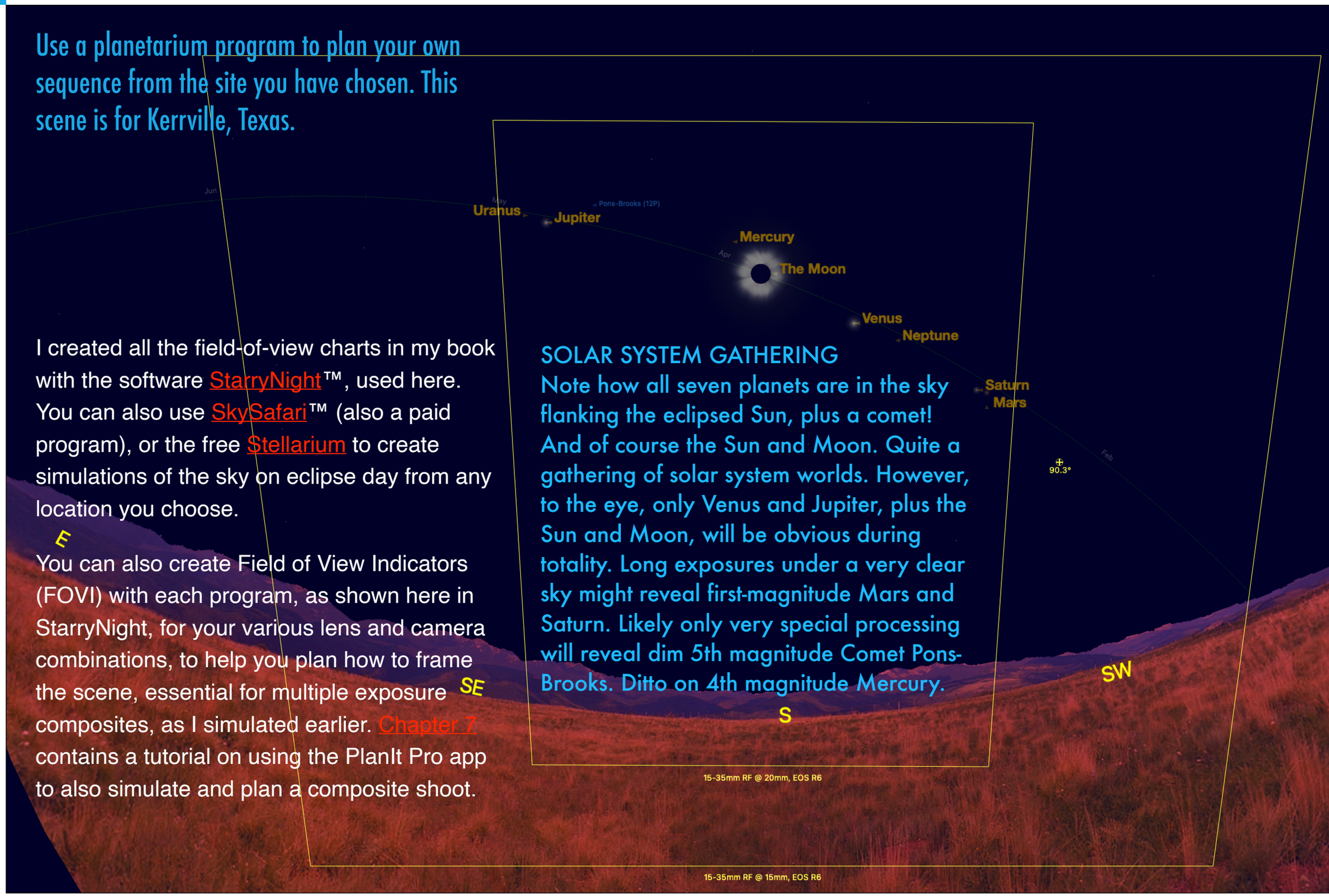
FOR 2024 – PLANNING FOR YOURSELF

Use a planetarium program to plan your own sequence from the site you have chosen. This scene is for Kerrville, Texas.

I created all the field-of-view charts in my book with the software StarryNight™, used here. You can also use SkySafari™ (also a paid program), or the free Stellarium to create simulations of the sky on eclipse day from any location you choose.

You can also create Field of View Indicators (FOVI) with each program, as shown here in StarryNight, for your various lens and camera combinations, to help you plan how to frame the scene, essential for multiple exposure composites, as I simulated earlier. Chapter 7 contains a tutorial on using the PlanIt Pro app to also simulate and plan a composite shoot.



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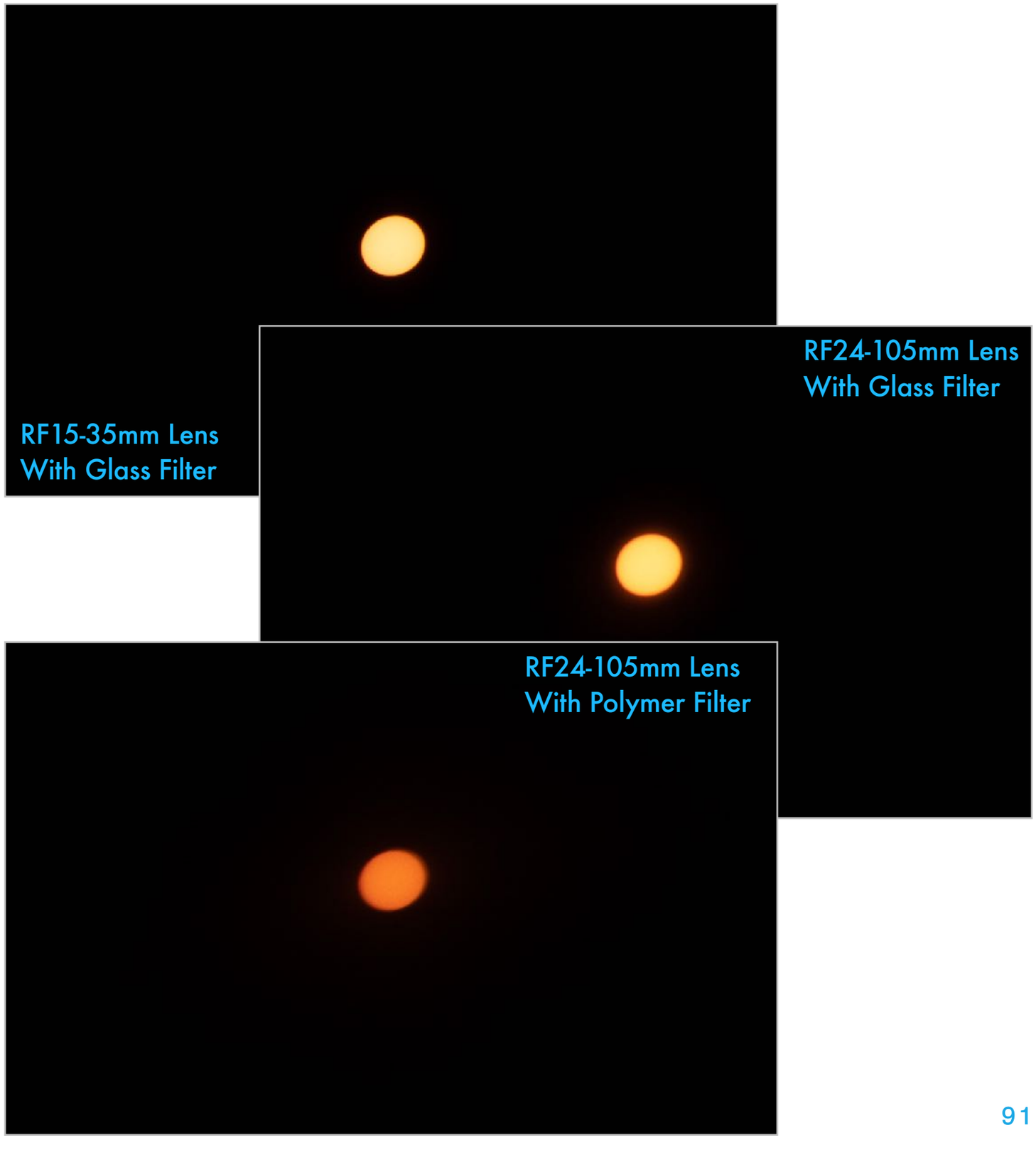
FOR 2024 – LENSES AND FILTERS FOR COMPOSITES

When planning a composite choose your lens and filter based on tests to see what combination produces the sharpest results.

At top is a 600% blow up of the Sun placed at the corner of the frame (as shown below) of a premium Canon RF15-35mm lens at 24mm, a suitable focal length for a composite sequence.

Below it is a similar blow-up of the frame corner using a lesser-grade Canon RF24-105mm lens also at 24mm, and also with a glass filter. The RF15-35mm image is sharper. For wide-angle composites use the best lens you can! Test its image quality on the Sun. Also notice the elongation of the Sun's disk due to distortions in wide-angle lenses.

At bottom is the same RF24-105mm lens at 24mm but with a black polymer filter. It is even softer. Glass *vs*. polymer is shown next.



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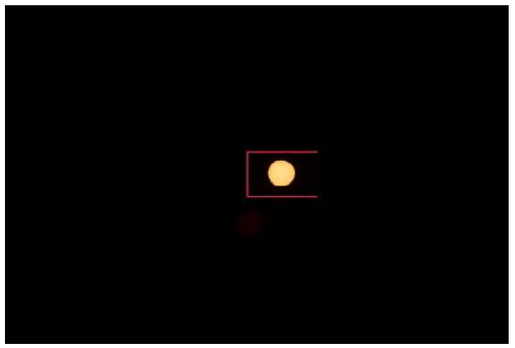
FOR 2024 – LENSES AND FILTERS FOR COMPOSITES

This comparison applies to any plan to shoot the Sun close-up with a telephoto lens or telescope. Here I used a Canon RF100-400mm at 400mm, what I used for the final image.

Both images are 400% blow ups of the Sun placed at the center of the frame (as shown below) of a good, though not top-class, Canon RF100-400mm lens at f/8 and at 400mm, a suitable focal length for a set of images for a composite, or just single images.



At top right is an exposure through a black polymer filter. At bottom right is the same lens but with a metal-on-glass filter. While both look quite sharp, the glass filter has less light scatter and better contrast with the surrounding dark sky. This trait will make it easier to blend images later in editing. While both types of filters provide a pleasing yellow Sun, glass filters produce better contrast.

However, as shown in the next section, glass filters can be prone to ghost reflections, especially if the filter is of the type that clamps over the lens, where it could be tilted slightly. The ghost image is usually very dim.

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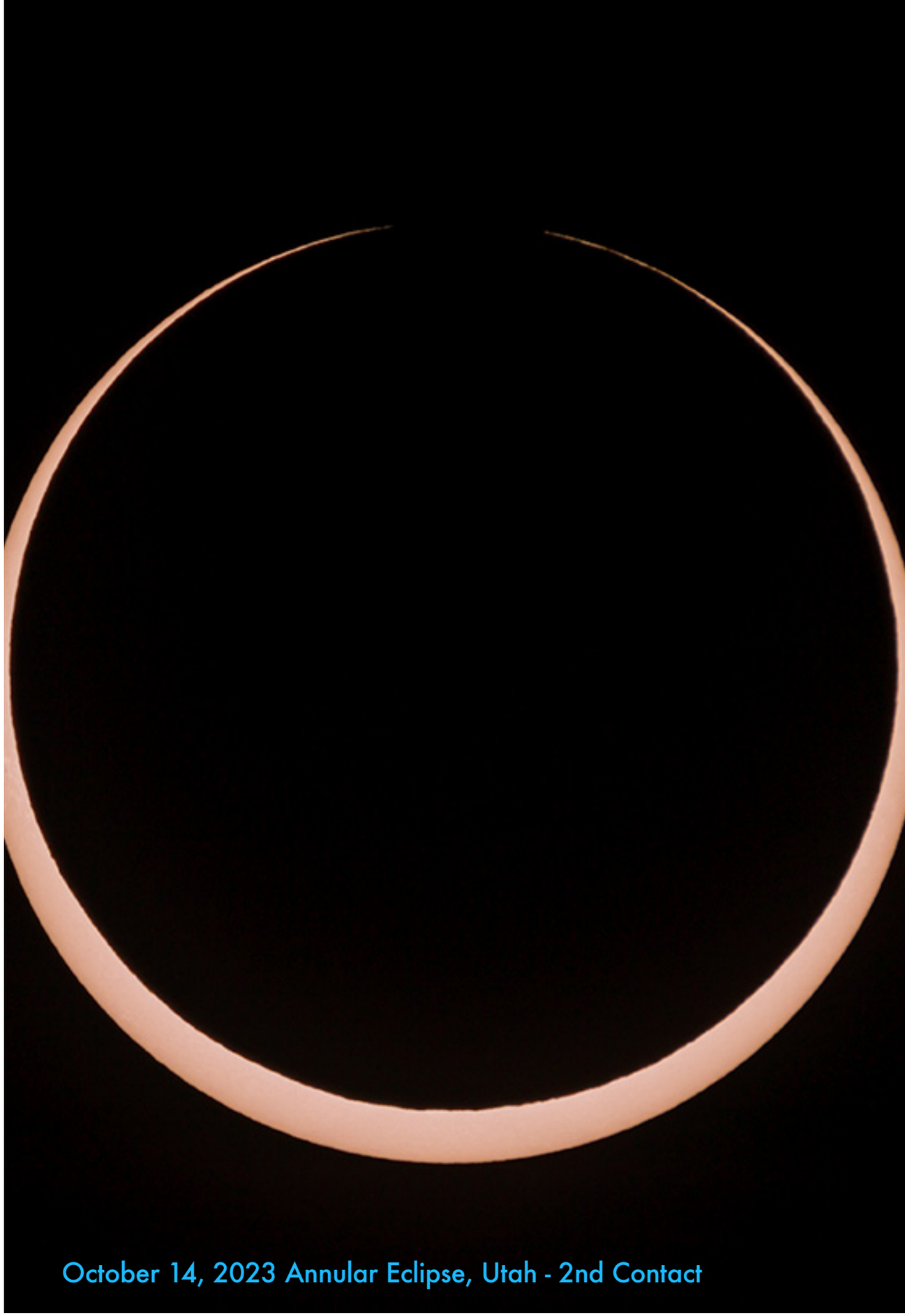
SECTION 3

2023: MORE LESSONS LEARNED – AT THE TELESCOPE

I had a third camera, one on my telescope, to shoot close-ups of the annular eclipse from start to finish, perhaps for a time-lapse, and for bursts of rapid-fire stills at the moments of second and third contacts.

Well, that didn't go as planned at all! A dumb user error and a camera error thwarted my plans. Here I outline what went wrong. But first, I present some more tips on filters and focal lengths for such a shoot of the partial phases in 2024.



October 14, 2023 Annular Eclipse, Utah - 2nd Contact

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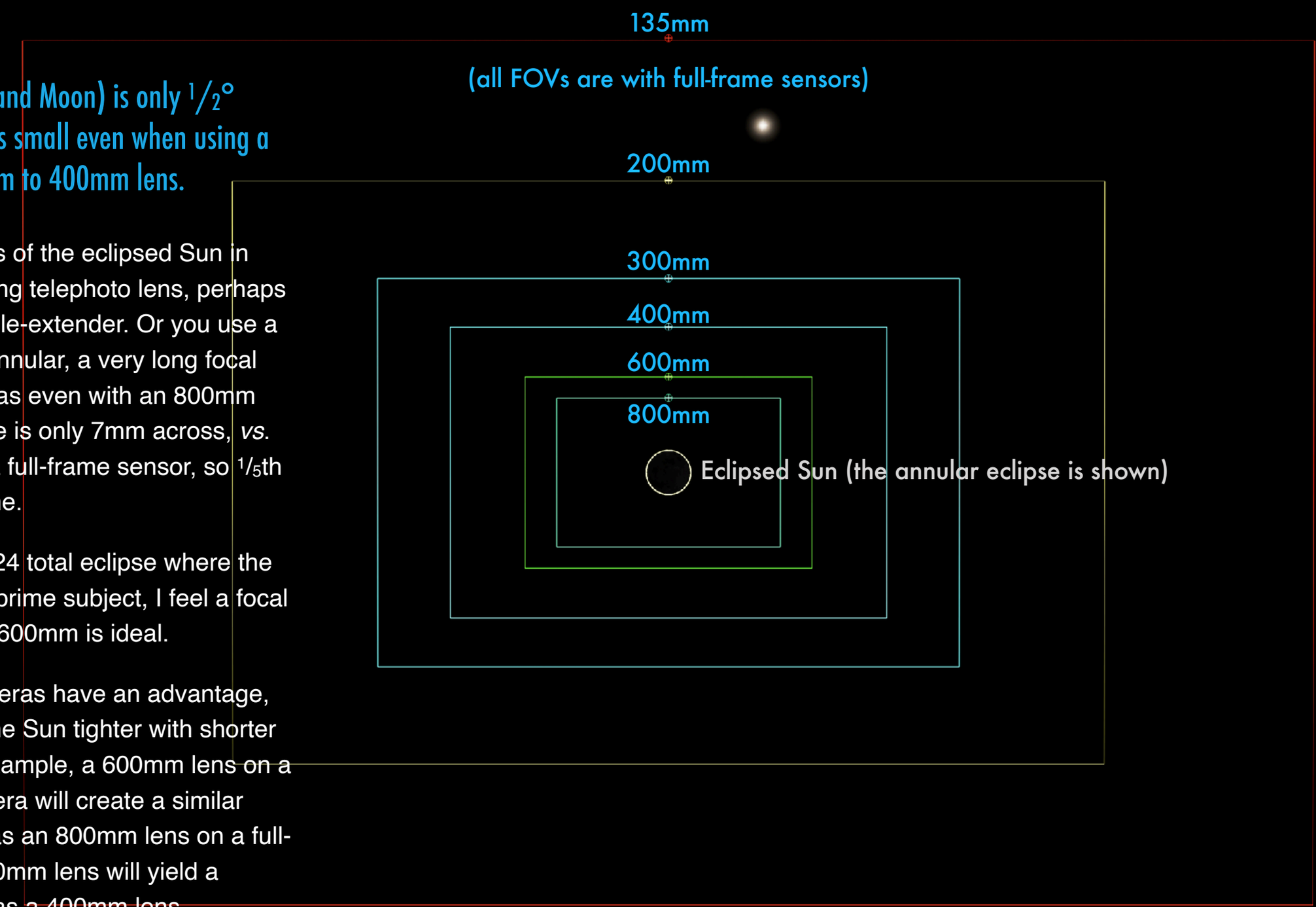
FOR 2024 – FOCAL LENGTHS NEEDED

The disk of the Sun (and Moon) is only ½° across and so appears small even when using a relatively long 300mm to 400mm lens.

To capture close-ups of the eclipsed Sun in 2024, you need a long telephoto lens, perhaps augmented with a tele-extender. Or you use a telescope. For the annular, a very long focal length proved best, as even with an 800mm lens the Sun's image is only 7mm across, *vs.* the 35mm width of a full-frame sensor, so 1/5th the width of the frame.

However, for the 2024 total eclipse where the Sun's corona is the prime subject, I feel a focal length of 400mm to 600mm is ideal.

Cropped-frame cameras have an advantage, as they can frame the Sun tighter with shorter focal lengths. For example, a 600mm lens on a cropped-frame camera will create a similar field of view (FOV) as an 800mm lens on a full-frame camera. A 300mm lens will yield a similar field of view as a 400mm lens.



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FOR 2024 – EXPOSURE TIMES WITH FILTERS

For the partial phases of the 2024 total eclipse you can determine the best exposures beforehand on the normal Sun.

Remember, you must shoot through a filter. Just stopping down, using your fastest shutter speed, and slowest ISO is not sufficient. The Sun will still be vastly overexposed. Nor can you use neutral density filters as they are not designed to block IR and UV light that can still damage equipment and eyes. Don't take chances. Buy the right filter. And buy it soon!

Then test it, as I did here, on a sunny day with the optics you intend to use on eclipse day. Run through a series of exposures, at ISO 100 – that will likely be the best ISO for the partials.

You want images that do not wash out the disk of the Sun, but are also not too dark. Note the setting(s) that produce the best images. But then on eclipse day, be prepared to improvise, because ….

Above is a series of images at increments of 1 stop or EV apart. The "correct" exposure was 1/200 sec with this filter. The 1-stop under = 1/400; 1-stop over = 1/100. Under or overexposing by one stop is fine but no more than that.

This pair of images (above and below) shows what you might see if the filter is tilted slightly. A ghost image appears from light bouncing off the reflective surface of the filter, particularly glass filters. The Sun is way overexposed above, but a ghost image shows up faintly even in a well-exposed image (below).

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FOR 2024 – SHOOTING THROUGH CLOUDS

It is possible that you might have to shoot all or part of the 2024 eclipse through clouds. That can still work for the partials.

October 23, 2014, Partial-only eclipse, Jasper, Alberta

On eclipse day, clouds might thwart your plans, requiring you to shoot much longer exposures or at higher ISOs than in a cloudless sky. For this image of the 2014 partial eclipse I still shot through an aluminized Mylar/polyethylene filter, but the exposure was 1/25 second, compared to 1/2000 needed in a clear sky. Part of the Sun's disk is overexposed but the clouds added nice colors, making a more interesting image than a crescent in a black sky.

If the clouds are too thick exposures can become long enough that the Sun will blur due to the motion of the sky. Using a tracking mount is a hedge against this possibility

It is possible that if the clouds are thick enough a photo might be possible without a filter in place. But that is risky, as a sudden clearing can flood your camera with damaging heat.

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FOR 2024 – FOCUSING

TIP: Your practice sessions will reveal how any vibration introduced by you touching the camera will make it difficult to focus. Get a better tripod!

Focusing for the sharpest image of the Sun is absolutely critical. You can partly fix bad exposure and framing later. But not poor focus.

Practice this on the normal Sun prior to the eclipse. Use Live View (or with a mirrorless camera, the normal rear LCD screen) with the display turned up to maximum brightness. If you are using a zoom lens set it to the focal length you expect to use on eclipse day.

If you are using an autofocus lens, it might focus on the edge of the Sun. Check that it provides whatever form of confirmation your camera supplies that it has done so.

But with most lenses, and certainly with telescopes, you will need to manually focus. Zoom up the display to its maximum of 10x or 15x, then shift focus gradually so the edge of the Sun is sharpest. Or so any sunspots appear sharp. On eclipse day it is best to recheck focus occasionally as temperature changes can shift the focus slightly.

Slightly Out of Focus

The image above is ever so slightly out of focus, but it is enough to make the edge of the Sun (and the limb of the Moon during an eclipse) appear soft. The sunspots barely show up. The image below is spot on focus! The edge of the Sun is sharp enough to show the rippling from heat waves in the atmosphere.

Right on Focus!

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FOR 2024 – TRACKING THE SUN

For the partial phases of the total eclipse, exposures are short enough that tracking the Sun and sky is not essential. But....

What a sky tracker can do, assuming it is at least roughly polar aligned (see Chapter 6), is keep the Sun centered automatically (or at least close) over the duration of the eclipse.

That has a few benefits:

- ☑ Not having to re-position the Sun is one less thing to fuss with during annularity.
- ☑ As mentioned, it allows for longer (perhaps ~1 second) exposures should you need to shoot through clouds with a filter on.
- ☑ It keeps the Sun oriented the same over the eclipse (likely with north up), making it much easier to assemble a time-lapse of the entire eclipse showing the Moon moving in a straight path across the Sun. Without tracking the Sun's disk will rotate during the eclipse. See Chapter 6 for more.

A small tracker like this Star Adventurer 2i might be all you need. But test beforehand on the Sun to be sure it will handle your lens or telescope. Heavy optics can stress the drive, and introduce bounce and vibration, especially if it is windy. Clutches or ball heads can slip, always at the last second, causing you to panic to re-center the Sun.

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SHOOTING THE ANNULARS 29 YEARS APART

I had to include this from my archives of scanned 35mm slides. This is my Mitsubishi Eclipse at the 1994 eclipse! And my RAV4 at the 2023 eclipse.

For both eclipses I had similar setups and the same telescope, the faithful Astro-Physics Traveler, a 105mm aperture refractor. At both eclipses I had a second refractor piggybacked on the main scope just for looking through. A second tripod was for a wide-angle camera (in 1994) and the telephoto composite (in 2023).

The telescope was on an equatorial mount, a Takahashi EM-10 in 1994 and the Astro-Physics Mach1 in 2023.

In 2023 I used a third camera for the wide-angle composite shown earlier. It's not in this photo as I used it after the eclipse to shoot this site image, long after everyone else had left and I was the only one there.

The Mach1 mount would have worked great – if only I had remembered to bring all the cables it needed!

For both eclipses I used the wonderful 105mm Traveler, a telescope designed by Astro-Physics for the 1991 eclipse. It has lived up to its name, now with five eclipses to its credit: two annulars and three totals.

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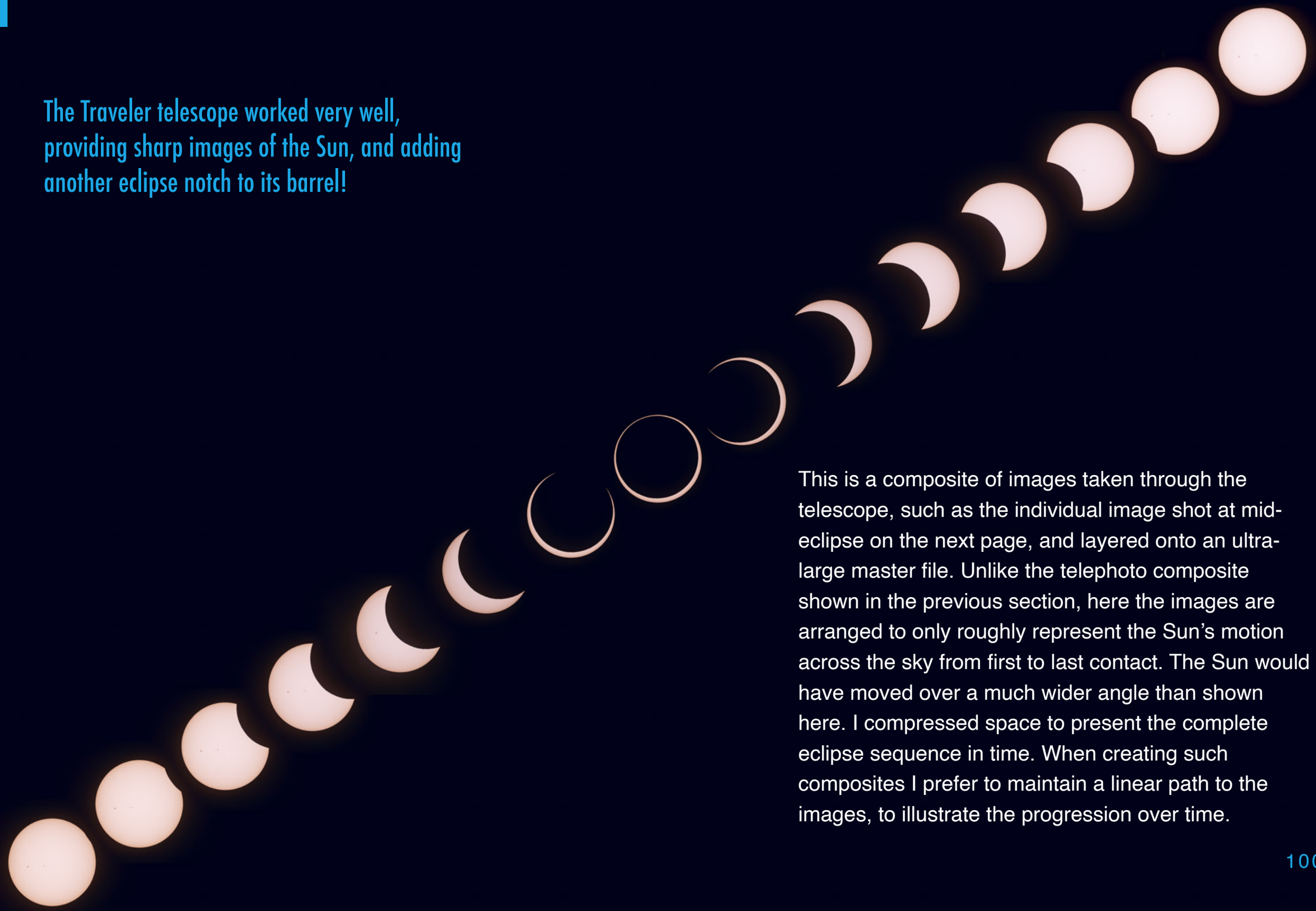
THE TELESCOPIC CLOSEUPS

NOTE: Chapter 11 on processing contains new tutorials on assembling annular eclipse composites and processing individual still images.

The Traveler telescope worked very well, providing sharp images of the Sun, and adding another eclipse notch to its barrel!



This is a composite of images taken through the telescope, such as the individual image shot at mid-eclipse on the next page, and layered onto an ultra-large master file. Unlike the telephoto composite shown in the previous section, here the images are arranged to only roughly represent the Sun's motion across the sky from first to last contact. The Sun would have moved over a much wider angle than shown here. I compressed space to present the complete eclipse sequence in time. When creating such composites I prefer to maintain a linear path to the images, to illustrate the progression over time.

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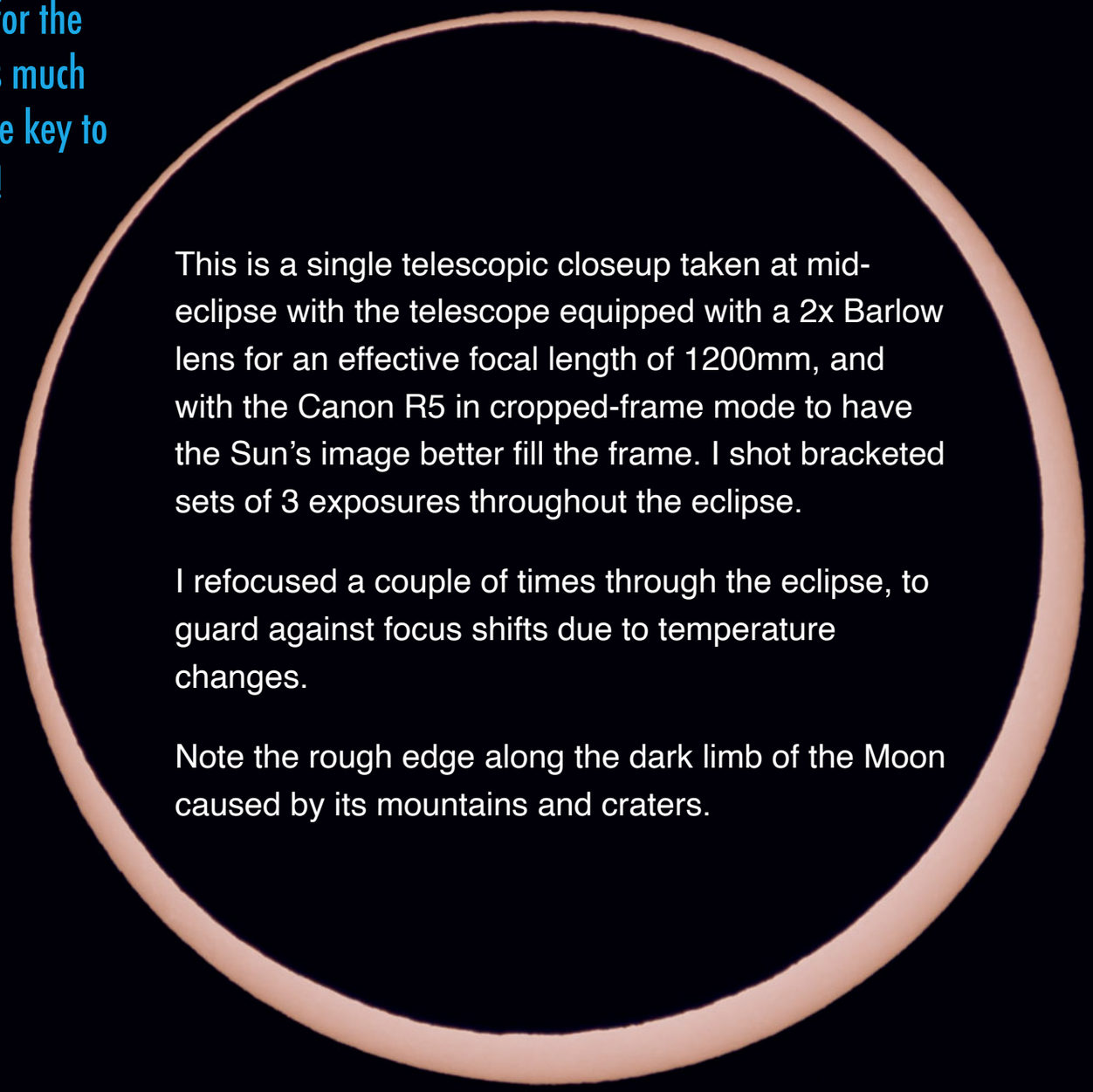
THE TELESCOPIC CLOSEUPS

Unlike the 2024 total eclipse, for the 2023 annular shooting with as much focal length as possible was the key to sharp images. And good focus!



This is a single telescopic closeup taken at mid-eclipse with the telescope equipped with a 2x Barlow lens for an effective focal length of 1200mm, and with the Canon R5 in cropped-frame mode to have the Sun's image better fill the frame. I shot bracketed sets of 3 exposures throughout the eclipse.

I refocused a couple of times through the eclipse, to guard against focus shifts due to temperature changes.

Note the rough edge along the dark limb of the Moon caused by its mountains and craters.

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THE TELESCOPIC CLOSEUPS – POLAR ALIGNMENT

While the site was great for all my shooting needs, it was not opened for entry until 7am on eclipse morning, too late for polar alignment.

For shooting with an equatorial mount (as described in Chapter 6) it is ideal if you can accurately polar align the mount when the sky is dark, either the night before or before dawn on the day of the eclipse. That was not possible here, so all I could do was note where due north was, to aim the mount's polar axis in that direction, and set the mount to the site's latitude.

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THE TELESCOPIC CLOSEUPS – WHAT WENT WRONG

I hauled my expensive telescope and equatorial mount to Utah only to find on eclipse morning I had forgotten a crucial cable to make it work!

The lack of accurate polar alignment was the least of my concerns. Upon setting up I discovered a crucial component was missing, the cable that runs from the mount's outboard control box to the two motors on the mount. Without it, the mount wasn't going to track.

That nixed any plans I had for taking a regular series of telescopic close-ups for a time-lapse. Instead, all I could do was loosen the axes's locks and manually push the mount, mostly in the east-west motion, to keep re-centering the Sun every couple of minutes. Hardly ideal, but it worked in a pinch. I only had myself to blame!

Of course, once I got home there was the cable, mixed in with the electronics from another mount, from testing both mounts prior to the eclipse.

- **Lesson Learned the Hard Way:** Don't just make a checklist, make it detailed, and then actually use it when packing to check off each mission-critical part as you pack it, noting where you put each part.
- Or better yet, pack everything. Then before departing, set it all up from the packed components to make sure you really do have everything and to practice where you put it all!

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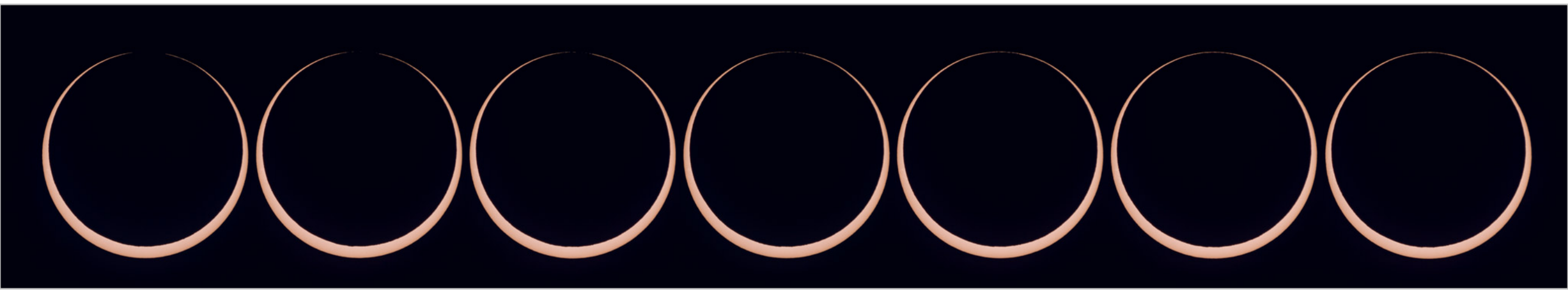
THE TELESCOPIC CLOSEUPS – THE CONTACTS

NOTE: You can see a time-lapse of the second contact images here on my Flickr page. https://flic.kr/p/2p9FCSA

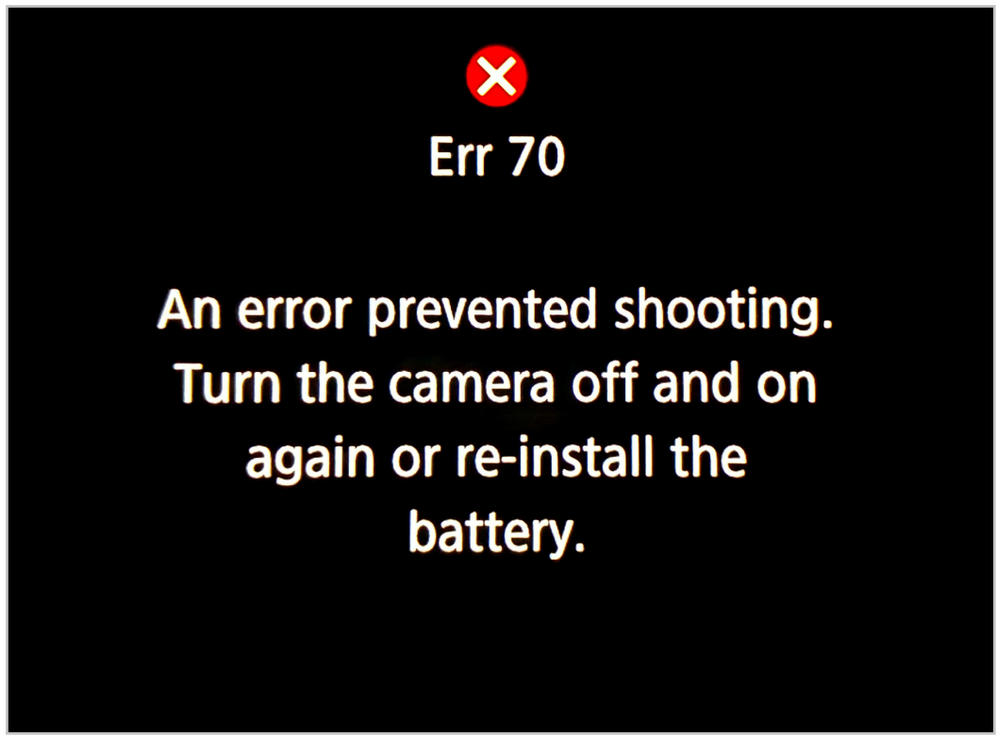
I planned to shoot the second and third contacts using a High Speed Continuous mode I programmed into one of the User presets. These were to record the fleeting "reverse Baily's Beads."

- **Lesson Learned:** If a camera misbehaves in testing, don't dismiss the warnings! Consider another plan, one that is likely to work more reliably, such as a slower frame rate.



My plan to shoot the internal contacts with the Canon R5's High Speed Continuous+ mode (which yields 20 raw frames per second) worked great at second contact (C2). The sequence above is of 7 images selected from 344 shot over 21 seconds, for an average of slightly less than 20 fps (the camera slowed down toward the end).

Just before third contact (C3), I started another High Speed set. It looked like it was working fine, until this dreaded Error70 appeared. It is a known bug in Canon firmware from a "Communication Error." None of the third contact images recorded. I did see this error once in testing pre-eclipse, and had a hard time reproducing it in post-eclipse testing. It is intermittent. But if something can go wrong …!



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DRESS REHEARSAL FOR 2024

While the 2023 annular lacked the spectacle of the 2024 total, it provided a great opportunity to test gear and techniques. And make mistakes I don't want to repeat!

The annular provided experience shooting an event where you needed to change camera settings quickly under the pressure of time and the excitement of a major sky event that will happen regardless of whether you are ready or not!

As it did for me in 2023, I can almost guarantee something won't go as planned. But it was better to make mistakes at the less-critical annular than during the very special total eclipse.

Whatever your successes or failures in 2023, look at them as learning experiences for 2024. For me, you can be sure I'll remember to pack that *@&*# cable!

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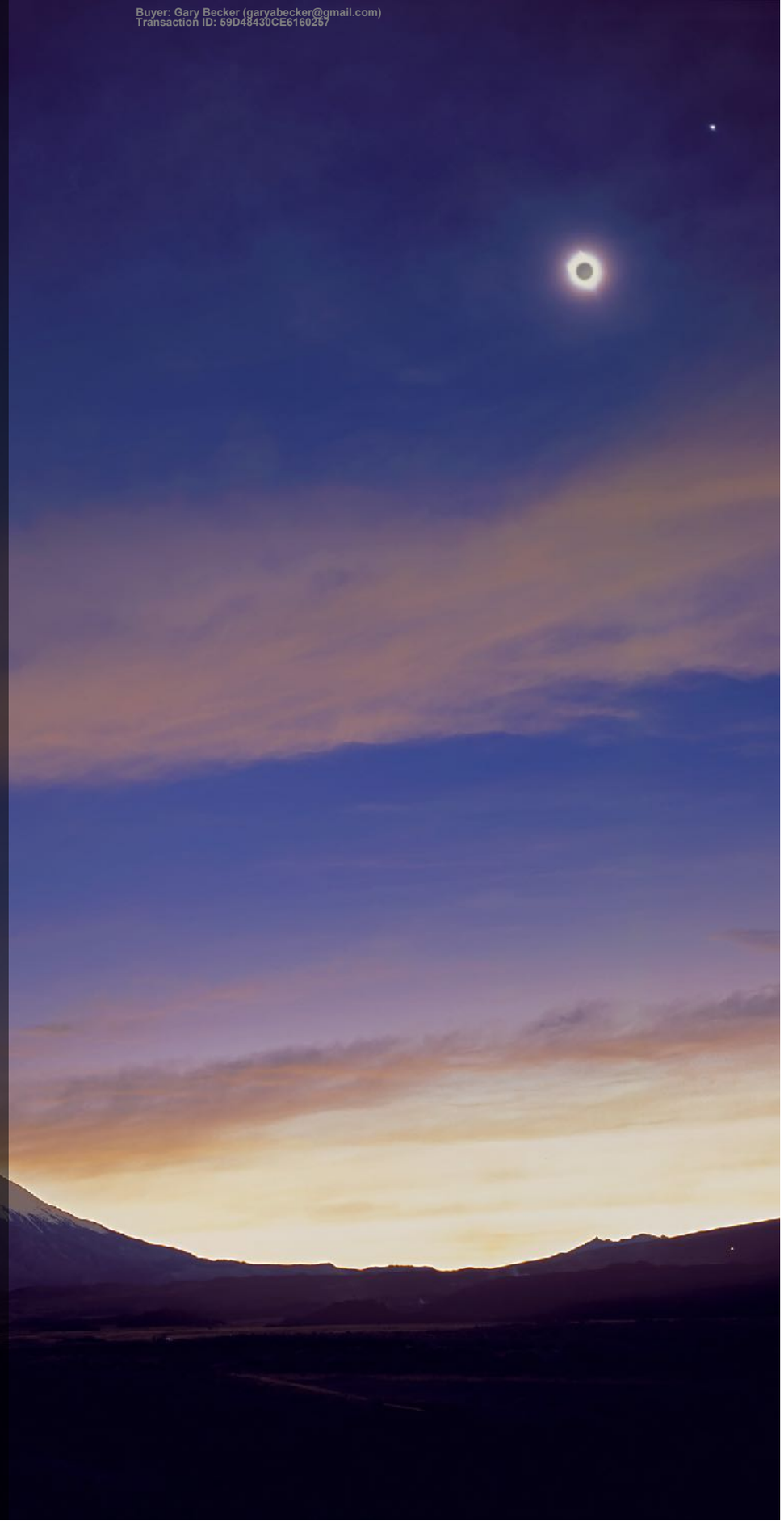
CHAPTER 5



5

2024: SHOOTING WIDE-ANGLE STILLS

Now we come to the total eclipse! The easiest way to capture the scene is with a wide-angle lens. Even so, there are several variations: still images, time-lapses, real-time videos, and multiple exposure composites. Or you can just grab shots with a hand-held phone!

November 3, 1994, Lauca National Park, Chile

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SECTION 1

SIMPLE AND EASY

While I am assuming readers of this book are primarily interested in taking images of the eclipse using serious photo gear, there's a place for the quick grab shot using a handheld phone camera. Family members might want to shoot the eclipse that way as their contribution to the family portfolio. Or, if a last-minute move is required, it might be your only choice for securing an image with moments to spare. Consider the phone camera a "Plan B" option.

November 3, 1994, Lauca National Park, Chile
on medium format film

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SHOOTING THE PARTIALS IN 2024 – WIDE-ANGLE

November 3, 2013, Mid-Atlantic

I'll mention this elsewhere, but I find that this type of partial eclipse image works well, putting the eclipsed Sun into context.

Shooting a wide-angle image of the eclipsed Sun through a filter covering the entire lens gets you only a tiny crescent amid a field of blackness. Not very impressive. Instead, this type of shot, using a single exposure, usually metered with the camera on Auto Exposure, usually works fine. Use a hand-held Mylar or black polymer eclipse filter of the rectangular type, not the eyeglass type. However, this is not a practical method for time-lapses or multiple exposure composites. I deal with those in later chapters.

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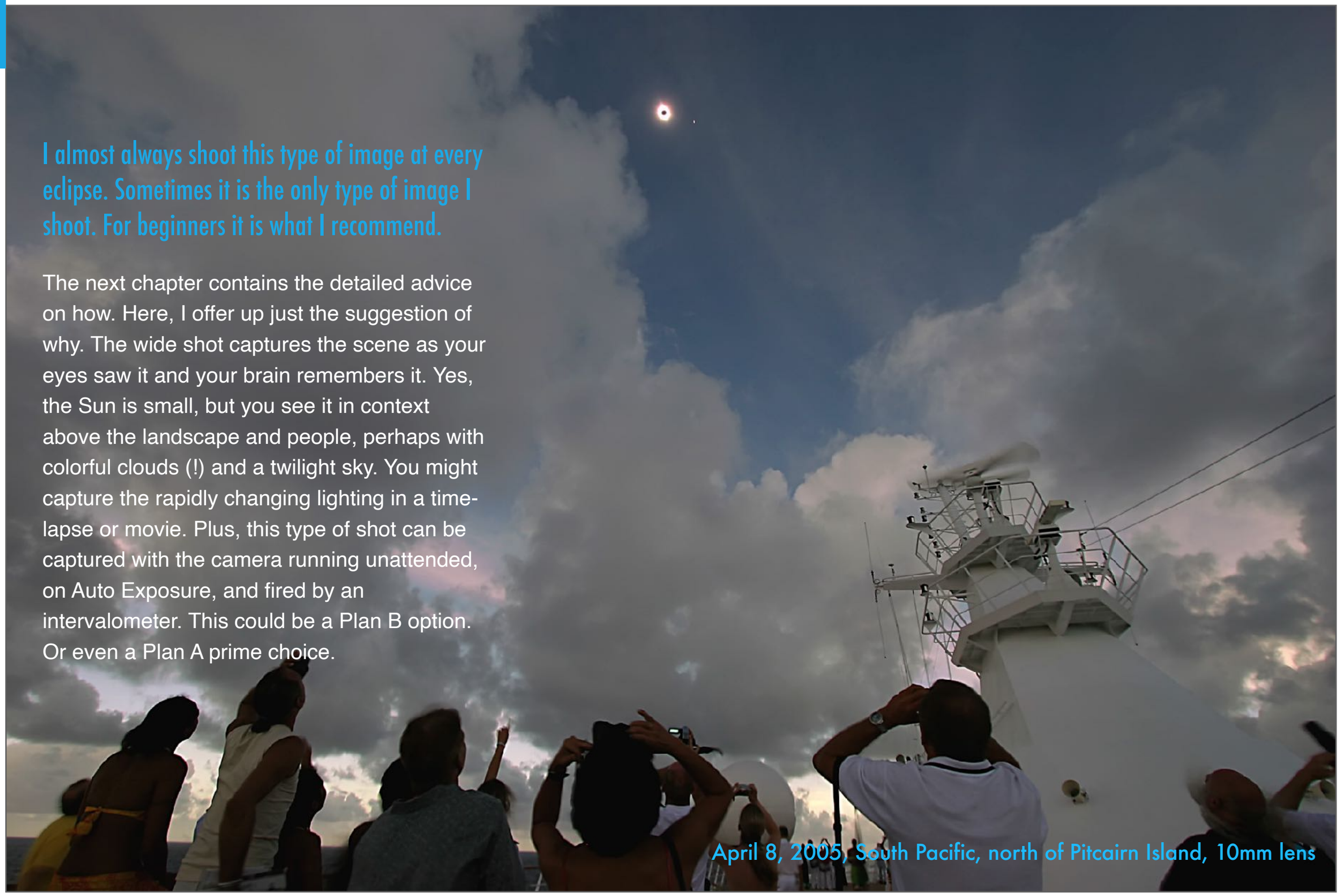
SHOOTING TOTALITY IN 2024 – WIDE-ANGLE



I almost always shoot this type of image at every eclipse. Sometimes it is the only type of image I shoot. For beginners it is what I recommend.

The next chapter contains the detailed advice on how. Here, I offer up just the suggestion of why. The wide shot captures the scene as your eyes saw it and your brain remembers it. Yes, the Sun is small, but you see it in context above the landscape and people, perhaps with colorful clouds (!) and a twilight sky. You might capture the rapidly changing lighting in a time-lapse or movie. Plus, this type of shot can be captured with the camera running unattended, on Auto Exposure, and fired by an intervalometer. This could be a Plan B option. Or even a Plan A prime choice.

April 8, 2005, South Pacific, north of Pitcairn Island, 10mm lens

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PHONES, 360° CAMERAS AND POINT-AND-SHOOTS

Handheld cameras can produce remarkably good images during totality, even on Auto Exposure. The factor to consider will be the height of the Sun.

With this class of simple camera you should be able to capture a quick “grab” shot of totality with everything on Automatic. The auto focusing might have some difficulty, taking precious seconds to hunt for focus before allowing you to fire a shot. Try your camera on the crescent Moon in twilight well before the eclipse to see how it behaves, and its image quality.

The height of the Sun might make it tough to include both it and the ground in the image at once. However, some phone cameras offer “super-zoom” options. Try it on the Moon to see if the image quality is worth the effort.

At the other extreme, people have achieved great results with 360° cameras intended to shoot virtual reality scenes. They will record the entire scene allowing viewers to pan around the image on Facebook. Again, test one in twilight to see what its image quality is like in low light.

I shot this image over Antarctica in 2003 using this Sony point-and-shoot with a princely 5 megapixels! And using Auto Exposure. Today, any phone camera can do much better. But it helps to solidly mount any camera, no matter how modest. Also, in processing you can clean up noise, improve color, and darken the lunar disk blown out by the corona.

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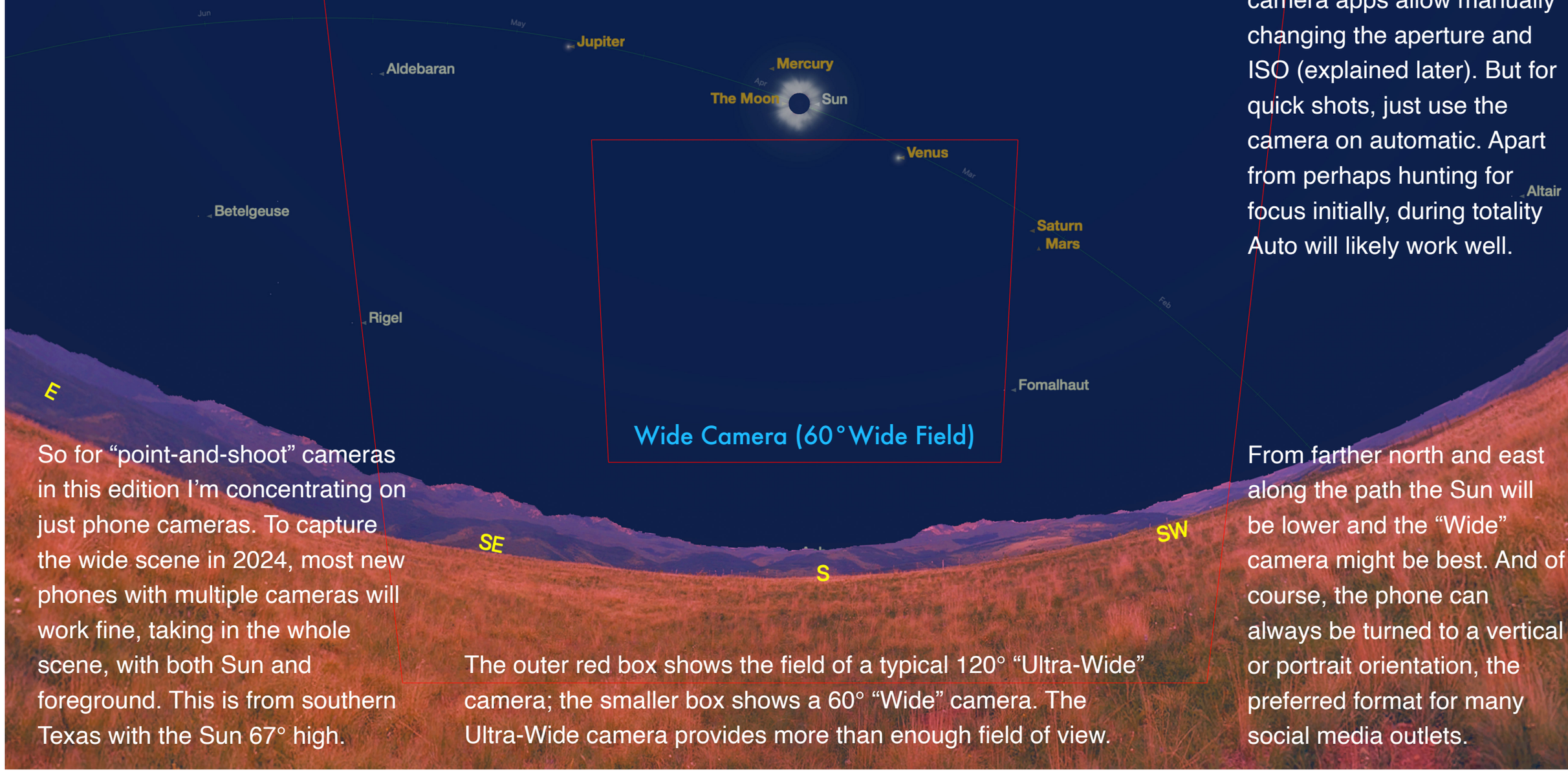
USING A PHONE CAMERA DURING TOTALITY

In the 2017 edition of this ebook I discussed compact point-and-shoot cameras. They've all but disappeared, replaced by phone cameras.



With phones, advanced camera apps allow manually changing the aperture and ISO (explained later). But for quick shots, just use the camera on automatic. Apart from perhaps hunting for focus initially, during totality Auto will likely work well.

So for "point-and-shoot" cameras in this edition I'm concentrating on just phone cameras. To capture the wide scene in 2024, most new phones with multiple cameras will work fine, taking in the whole scene, with both Sun and foreground. This is from southern Texas with the Sun 67° high.

The outer red box shows the field of a typical 120° "Ultra-Wide" camera; the smaller box shows a 60° "Wide" camera. The Ultra-Wide camera provides more than enough field of view.

From farther north and east along the path the Sun will be lower and the "Wide" camera might be best. And of course, the phone can always be turned to a vertical or portrait orientation, the preferred format for many social media outlets.

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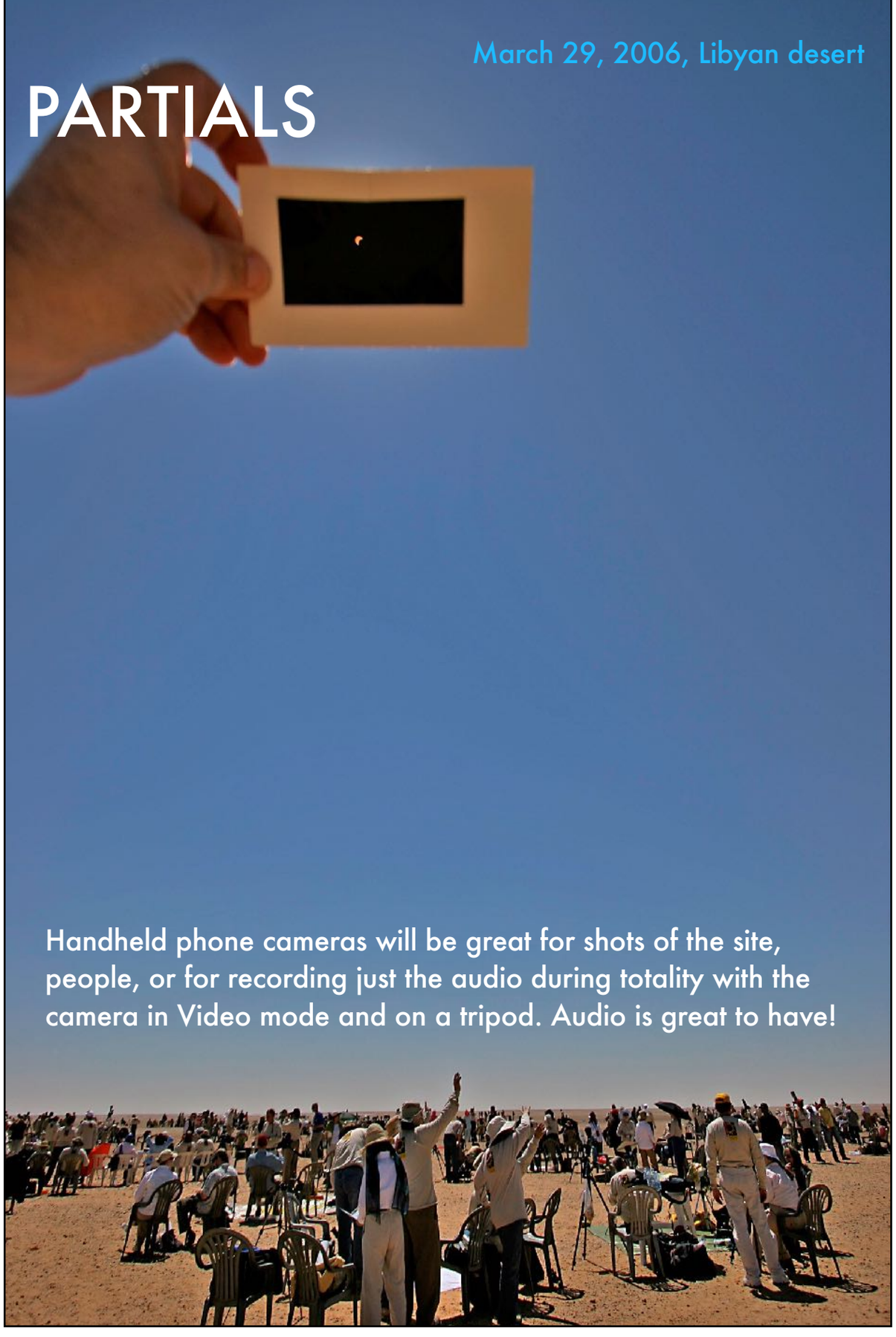
CAPTURING THE FILTERED PARTIALS

Shooting any images of the partially eclipsed Sun demands that you use a filter. However, it need not cover the whole lens, just the Sun.

Unless you have a long lens, or are shooting for a composite, I think there's little point in shooting the partial phases with a simple filtered camera, as the Sun's image will be too small and surrounded by a vast expanse of black sky.

Instead, I like to shoot these kinds of partial eclipse images with a filter hand-held to cover just the Sun, but the rest of the scene visible unfiltered. Exposures can be a bit tricky, but Auto Exposure and Auto Focus should work. Black polymer filters, as here, work best as they are not as shiny and reflective as Mylar types.

However, you will need a wide lens to record both the Sun and the landscape below. The Sun was at a high altitude here in Libya in 2006, as it will be in April 2024. Older phones and point-and-shoot cameras won't have lenses wide enough. But newer phones with wide-angle lenses should work fine.



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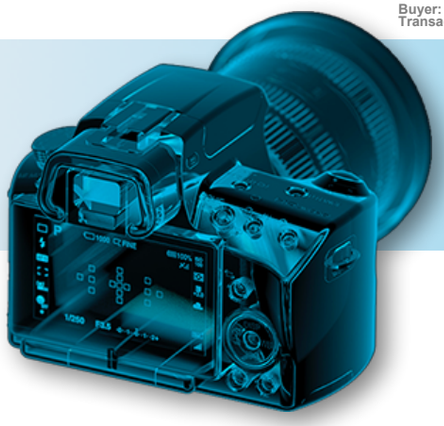


PHOTO 101 – EXPOSURE SETTINGS

While Auto Exposure settings can be used for some eclipse images, many require that you set the camera manually. There are three key settings.

Those new to photography and having used only highly automated phone cameras might not be familiar with what needs setting manually. There are three ways to control the exposure on any camera. Increase one, and you can decrease one of the other settings.

For example, if you use a higher or “faster” ISO speed of 400 instead of 100, you could use a shutter speed four times shorter than you could at ISO 100. This might be useful for minimizing blurring from the Sun and Moon moving during the exposure when using a long telephoto lens. But the image will appear grainier, or “noisier.”

Adding a 2x tele-extender to double the effective focal length of a lens also decreases its maximum aperture by 2 f-stops, making an f/4 lens into an f/8 lens. The smaller effective aperture might then require using longer shutter speeds or higher ISO settings, or both.

SHUTTER SPEED

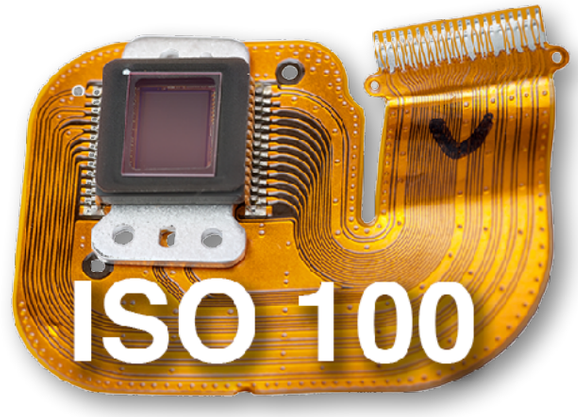
Increase how long the shutter is open and you increase the exposure. Lengthening the shutter speed by a factor of 2 – going from 1/250 second to 1/125 second for example – doubles the exposure time.

APERTURE

The iris diaphragm in lenses also controls the amount of light hitting the sensor. The unit of measure here is the f-stop or focal ratio, the ratio of lens focal length divided by the diameter of the iris. Each jump from f/1, to f/1.4, to f/2, f/2.8, f/4, f/5.6, f/8 cuts the amount of light hitting the sensor in half, i.e. by a factor of two.

ISO SPEED

Each doubling of the ISO speed from 100 to 200, to 400, 800, 1600, etc. doubles the “sensitivity” of the sensor, but also doubles the level of visual noise, or graininess, in the image.



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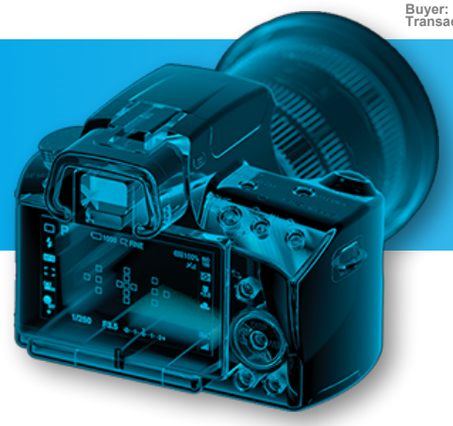


PHOTO 101 – AUTO SETTINGS

While the manual M settings allow control of all exposure settings, some eclipse images work fine using an Auto Exposure mode. But which one?

For those types of eclipse images and time-lapse movies where I suggest Auto Exposure can work well, you should use – and indeed may only be able to use – Aperture Priority. It provides the greatest range of exposures, to best accommodate the tremendous range in brightness from full daylight to twilight when shooting wide-angle scenes. I'd suggest keeping ISO to a fixed setting, which I'll specify later in exposure recommendations.

For movies taken on Auto Exposure, with many cameras the shutter speed might remain fixed at 1/30 second, with the aperture varying as needed (if you are shooting with a lens, not a telescope, that has a variable iris). However, chances are what the camera will vary is the ISO speed, going to a high ISO if needed, resulting in a noisy image when lighting gets dark. Best to test in twilight scenes to learn how your camera behaves on Auto as darkness falls.

APERTURE PRIORITY

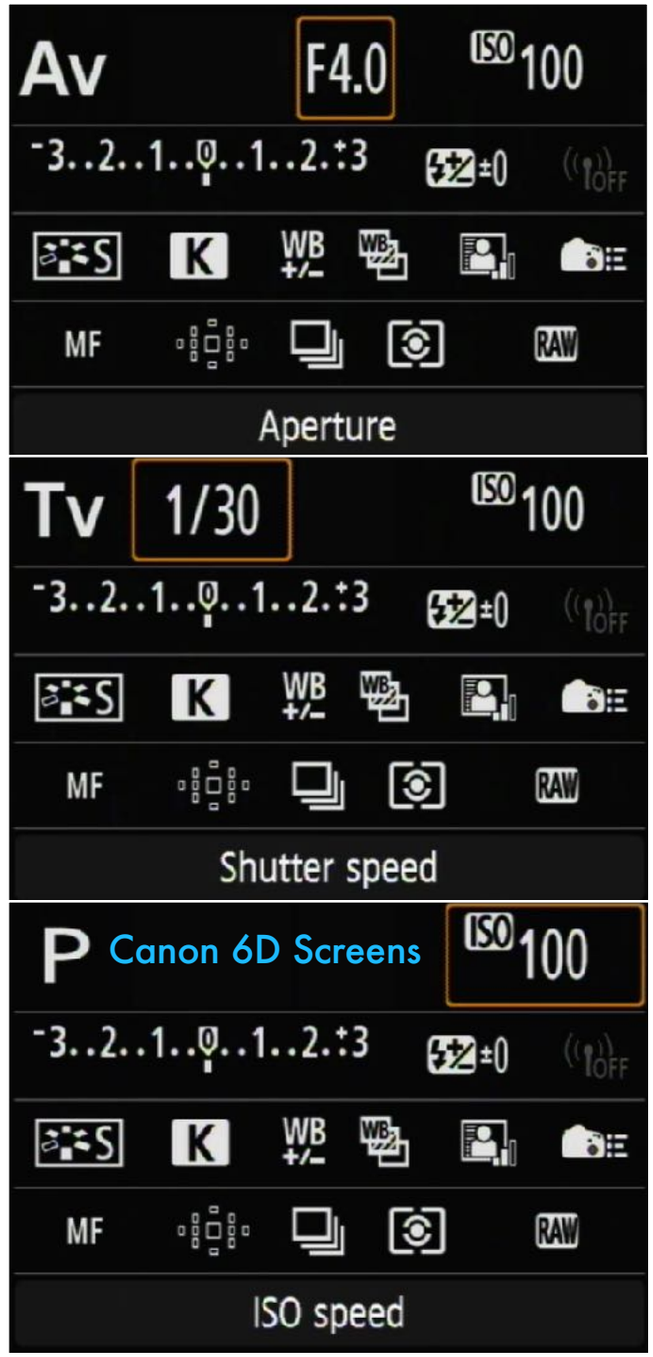
Usually marked as A or Av, in this setting you set the lens aperture, and the camera will then use its light meter to set the shutter speed, lengthening or shortening the shutter speed as needed. This is the mode I suggest.

SHUTTER PRIORITY

In this mode, often marked as S, T or Tv, you set the shutter speed, and the camera will vary the aperture of the lens as needed. This will work only on lenses with variable apertures. It will not work with a camera on a telescope.

PROGRAM MODE

In Program mode, usually marked P, the camera will vary both the shutter speed and aperture as it thinks best for the scene. It is also possible to set the ISO to an Auto or "A" setting so it also varies, increasing as the scene darkens. I'd suggest <u>not</u> to do this.



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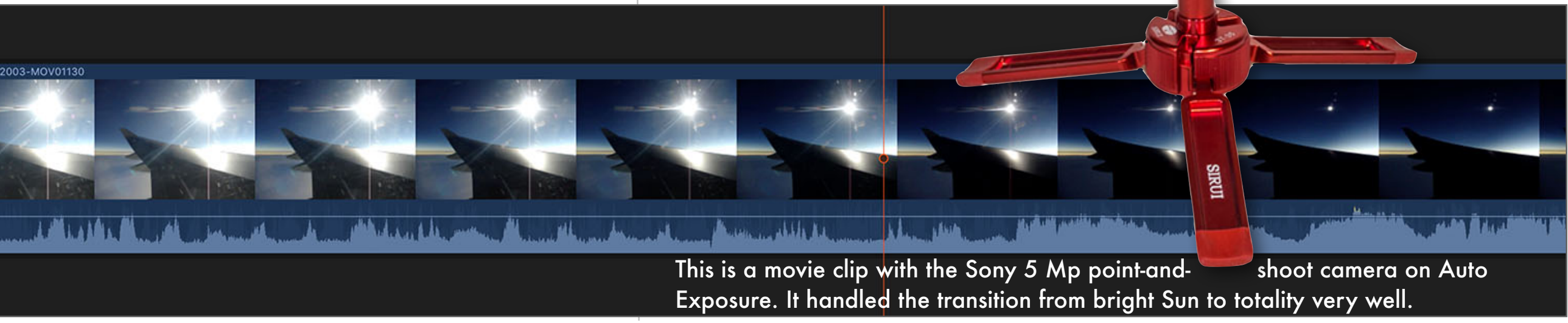
SHOOTING VIDEO

You can employ expensive video cameras. But the phone in your pocket can do a great job as well. For a memorable capture, just aim and shoot.

A phone camera in 4K movie mode can work well. Just put it into Auto Exposure (you might have little choice but to do so). As I showed earlier, the Ultra-Wide camera should frame the whole scene. But do put the camera on a tripod – your audience will not want to watch a dizzying handheld movie from an excited photographer. Be sure the camera has enough free storage to record several minutes of video, enough for the eclipse and other site videos.

With a phone or point-and-shoot camera mounted securely on even a mini or tabletop tripod using an accessory clamp, such as this SteadyPix unit from Orion Telescopes, you can start it before totality, then just let it run on its own. You'll get steadier images, and a much happier audience.

And if nothing else, the camera will at least record the sound.



This is a movie clip with the Sony 5 Mp point-and-shoot camera on Auto Exposure. It handled the transition from bright Sun to totality very well.

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USING SUPERZOOMS

Superzooms and "bridge" cameras offer lots of focal length to frame close-ups of the Sun. But these will need to be tripod-mounted.

This class of compact camera features a fixed, non-interchangeable lens, but with the ability to zoom in with equivalent focal lengths of 400mm to 2000mm! Those will frame the Sun very well.

Most offer an M mode for manually setting shutter speed and aperture, and perhaps ISO – check the instruction book. See later in this and the next chapter for exposure advice. The main concern is focusing – auto focus might not lock onto the eclipsed Sun at the critical moment. Check if you can manually focus and leave it there. But do so with the lens zoomed to where you intend to use it.

While auto exposure settings might work, exposures will be long enough that at extreme zoom settings you must put a superzoom like one of these on a tripod. Fire the shutter using the self-timer to reduce vibration. Just make sure warning lights don't flash, or tape them up.

Product photos are courtesy of the manufacturers.

Most brands offer a superzoom (all of these were for sale in 2023), with a lens featuring an equivalent range of 24mm to 1000mm or longer. While the lenses are long enough to frame the Sun, the small sensors in these cameras will produce noisier images than DSLRs or mirrorless cameras, especially at higher ISOs. But if that's the camera you have, then by all means put it to use.

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CAPTURING OTHER PHENOMENA

The simple camera may be your best tool for capturing all the ancillary phenomena, such as projected crescents and sharp shadows.

A good final eclipse story – a presentation to friends and family, or a movie for posting on YouTube – requires a lot of what videographers call “B roll.” This includes overall site shots, pictures and clips of people, close-ups of gear, shots of people with goofy filters on – shots that tell the story of the excitement of the day, building the tension and suspense, then delivering the payoff of the big event, both in images and sound.

These kinds of B roll shots, both stills and movies, might be best with a dedicated second or third camera, while the main camera(s) is tied up on telescopes or framed for wide scenes of the eclipse. That’s where the phone camera will work great. As I advised, be sure it has lots of free storage. People tend to fill up their phones with every photo they’ve ever taken in their life. Clear the storage for the eclipse! And be sure its battery is charged. Or it will die at totality.

In addition to shadows and projected crescents, be sure to capture images of the local eclipse wildlife gazing skyward!

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SECTION 2

GETTING SERIOUS

Yes, you can take some fine souvenir shots with simple cameras and automatic settings. That might be an option for a second camera, or for a camera assigned to a family member who is not a skilled photographer to look after.

However, the rest of my ebook assumes you are after more professional results with higher-quality cameras, usually, though not always, employing manually set exposures.

November 3, 1994, Lauca National Park, Chile
on medium format film

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DSLR AND DSLM CAMERAS

By far the best choice are cameras that offer interchangeable lenses: Digital Single Lens Reflex (DSLR) or Digital Single Lens Mirrorless (DSLM).

Either style of camera will work great. The key is that you can change the lenses, enabling you to either go very wide if needed, or to select a telephoto lens, or attach the lensless camera body to a telescope.

The other main advantage of these cameras over phone cameras, point-and-shoots, and superzooms is that DSLRs and DSLMs have larger sensors with larger pixels, yielding lower noise. This is particularly important when shooting dark night sky images. For eclipses it's less critical as the scene will never get very dark and even the eclipsed Sun and corona are still quite bright. However, low noise is always an advantage for the finest image quality.

Also, these cameras will provide lower noise and higher image quality when used in their video modes, with most new cameras offering 4K for better video quality than 1080 HD.

A Nikon DSLR (left) *vs.* a Nikon DSLM (right). The DSLM lacks a reflex mirror, so the sensor is much closer to the lens mount.

Cameras with articulated screens will be very useful for shooting the eclipse due to the Sun's high altitude. They make it easy to see and adjust settings, and preview images, with the camera aimed up.

Alternatively, top-mounted screens can be useful for adjusting settings, when the camera is on a telescope aimed up high at the Sun. Even some premium cameras lack these, like the Canon R6 above.

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FULL-FRAME *VS.* CROPPED FRAME

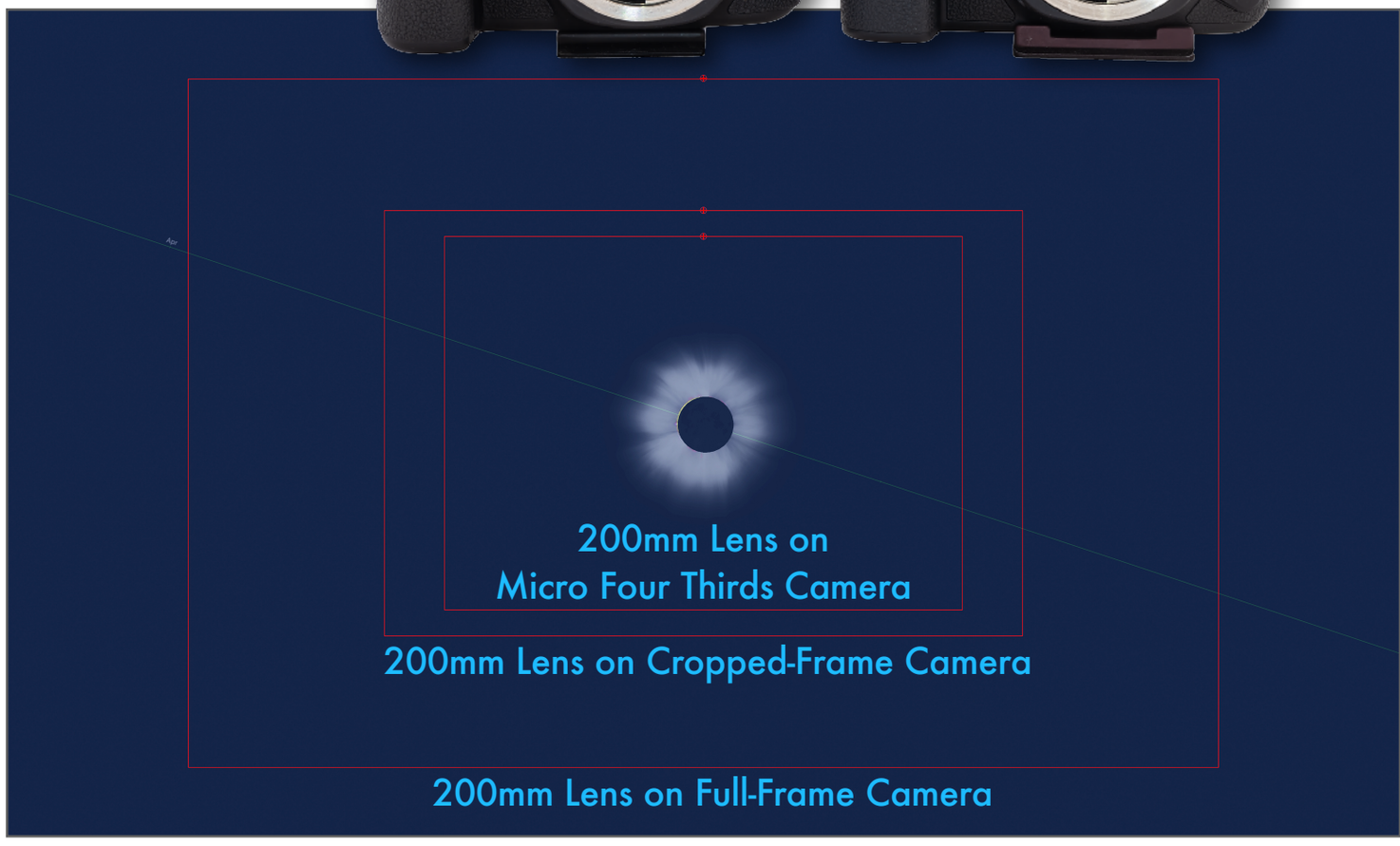
Cropped-frame (left) and full-frame (right) Canon DSLRs.

Among the DSLR and DSLM cameras, which is the best: Full-frame? Or cropped-frame? For eclipse photography, as with most uses, it depends ...

In the diagrams that follow in this chapter, for simplicity I usually show the field of just a full-frame (36 x 24mm) sensor (the size of a 35mm film frame). However, cameras with APS-C cropped-frame (23 x 15mm) sensors are also popular. APS sensors (named for Advanced Photo System film) have a crop factor of 1.5x or 1.6x – images are magnified 1.5x or 1.6x larger compared to a full-frame camera, with the same lens. That's an advantage for eclipse close-ups.

Conversely, you can use a lens with about 0.6x shorter focal length with a cropped-frame camera to yield the same field of view as with a full-frame camera. For example, a 300mm telephoto will yield the same field of view on a cropped-frame camera as a 480mm focal length lens or telescope will with a full-frame camera.

With a Micro Four Thirds (MFT) camera, you gain magnification by a 2x crop factor.



Full-frame cameras provide the widest field of view with any given lens. That's an advantage when shooting very wide shots. But cameras with smaller cropped-frame sensors have the advantage in close-ups by providing more highly magnified images with the same lens. For example, cameras with Micro Four Thirds sensors (such as Olympus and Panasonic) have sensors 18 x 13mm, half the size of a full-frame sensor, yielding a crop factor of 2x. So, in my later diagrams, wherever I show a lens field with a full-frame camera, users of Micro Four Thirds cameras know they'll get a similar field of view by using a lens with exactly half the focal length indicated for a full-frame camera.

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SHOOT RAW

There is no debate: Raw files will record much more detail and dynamic range than JPGs or the new HEIF format. If you are serious, shoot Raws.

Whether you are shooting individual still images or rapid fire time lapses, I suggest shooting all images using Raw image quality, and not just on JPG or the new High Efficiency Image Format (HEIF). Only the Raw files will record the most detail and dynamic range, critical for eclipses where the range in brightness is so great and the tonal gradients in the corona so subtle.

Even time-lapses are best shot with Raw files for the maximum flexibility and quality in processing later. If you need to buy a larger memory card to handle the several hundred or more Raw files you might shoot during an extended time-lapse, do so. They are now quite affordable.

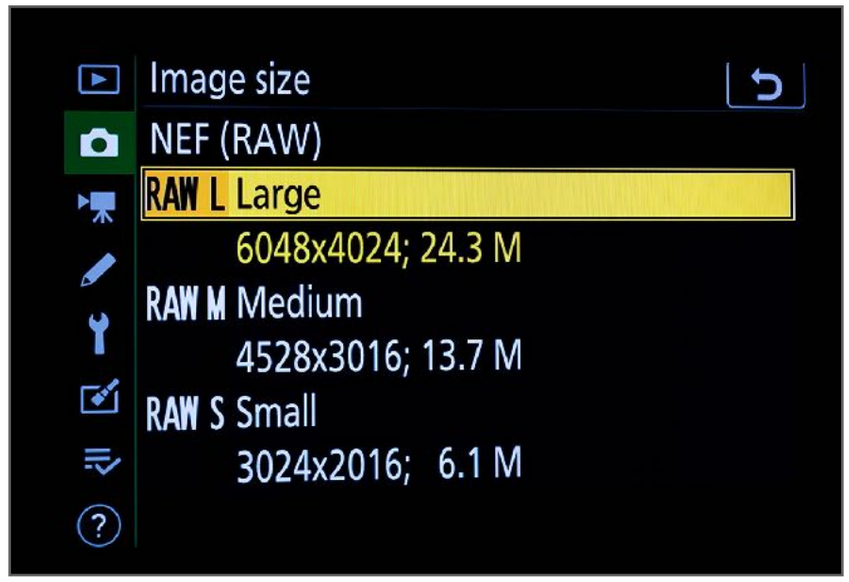
If your camera has two card slots, you might wish to allocate the second card to record a duplicate set of all the images, as a backup in case the main card becomes corrupt. The same can apply to movies with most cameras.

CANON

Choose RAW, not cRAW (Compressed Raw). Nikon and Sony also have options for shooting compressed Raws. Choose Uncompressed.

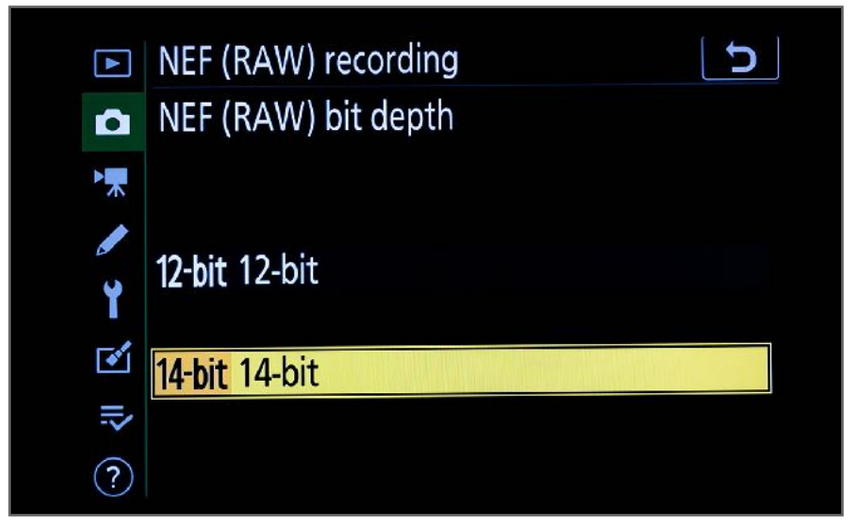
NIKON

Choose RAW Large, for the largest image size with the best resolution.



NIKON

Choose 14-bit for the widest dynamic range. Some Sonys have a similar choice.



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FOCUSING WIDE SHOTS

People fuss over "the best" exposure when, in fact, Auto Exposure modes can work quite well. It's the focusing that fails. Fuzzy eclipse pix are the norm!

No matter what camera system and lens focal length you use, take the time to focus carefully. Focus manually. Or, you might use Auto Focus to initially focus on a distant scene element. Fine. But then switch the camera or lens to Manual Focus for totality. Don't touch focus!

If you leave Auto Focus on, then during totality the camera might not be able to lock onto the Sun's image in the darkened sky. If the camera can't focus, it won't fire. And you'll panic.

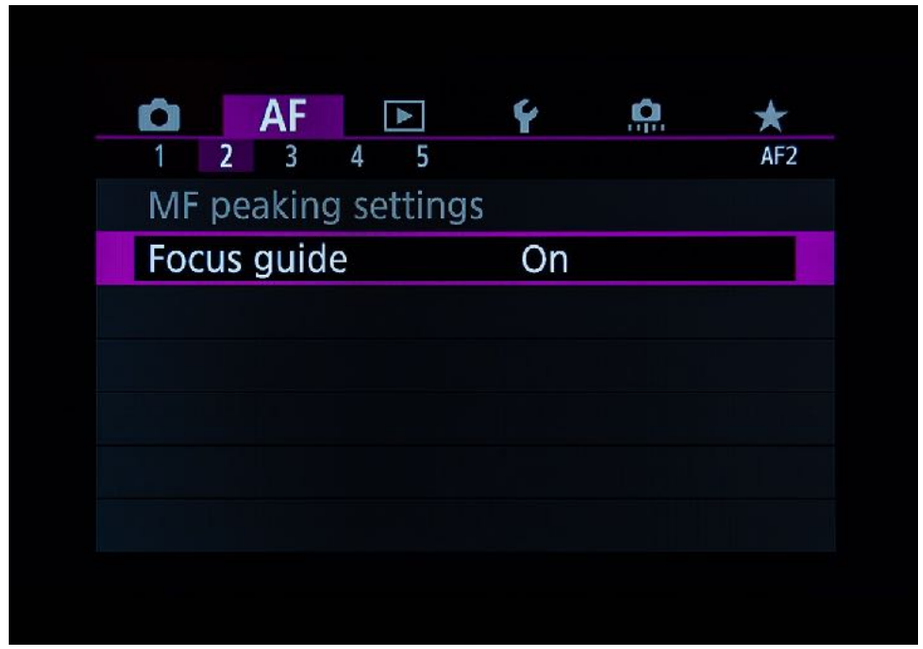
For wide shots, you might not need to manually focus. Auto Focus might be fine if you focus on the sunlit scene first. Focusing on distant landscape features will ensure the Sun and Moon are in focus in the sky. Stopping down the lens to f/4 or f/5.6 provides additional "depth of field" to accommodate any slight focus differences. However, for wide-angle time-lapses I suggest f/2.8 to keep shutter speeds short.

AUTO vs. MANUAL

For wide shots, you can use Auto Focus to achieve initial focus. Then switch off Auto Focus (putting the lens and/or camera on MF), so that the camera does not try to refocus every time it takes an image.

FOCUSING AIDS

Many DSLMs offer the option of some form of focus guides, visual indicators that the subject is in best focus. Turning these on might be useful, if only as an assurance the image is still in focus as the eclipse progresses.



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OTHER CAMERA SETTINGS – I

If you shoot Raw, none of the "Picture Styles" settings apply. Here are a few other menu options that do matter, illustrated with Canon screens.

If you are shooting with a very long lens on a lighter weight portable tripod, and using a DSLR camera, then vibration from mirror bounce might blur your images. You could use mirror lock-up but that takes time to first lock up the mirror then fire the shutter. Better to simply put the camera into Live View which also locks up the mirror. You then see the eclipse image full-time on the LCD screen, one way to watch the eclipse.

For white balance, Auto will work fine, or you could select Daylight or a fixed 5200 K setting for consistent white balance in time-lapses. But when developing Raw images you can alter white balance later to whatever you want.

High ISO Noise Reduction affects only JPGs. Leave it on Normal. Long Exposure Noise Reduction won't be needed for eclipse shots, and adds unwanted time between shots for any exposures longer than 1 second. Turn LENR off.

MIRROR LOCK UP (DSLRs)

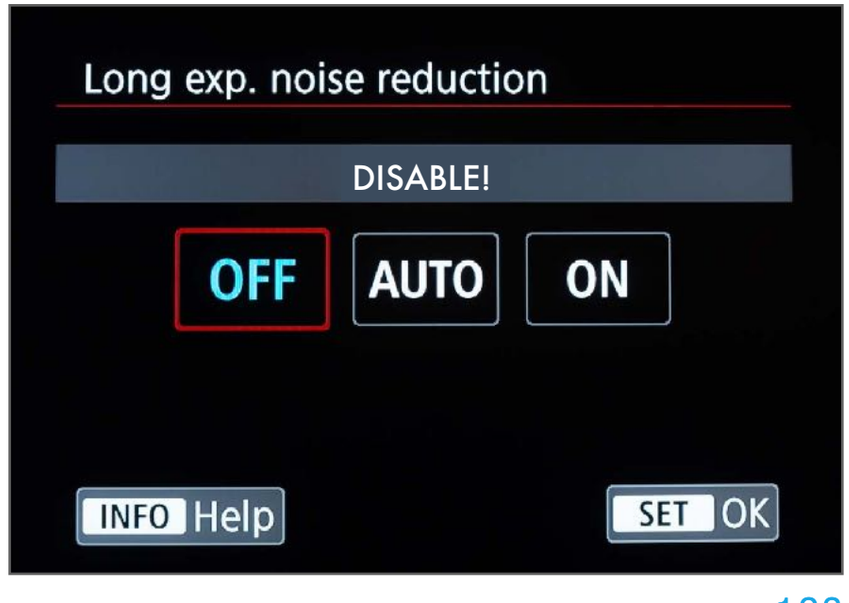
This can reduce vibration when shooting with long lenses. But for the fastest shooting Disable Mirror Lockup and shoot with Live View on.

WHITE BALANCE

Set this to Daylight or, as here, to a fixed 5200 K setting if you are taking time-lapses, for consistent color balance in all the images.

LONG EXPOSURE NOISE REDUCTION

Turn this off. While useful for long-exposure night sky images, LENR will only add unnecessary time between shots, compromising time-lapses during totality.



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OTHER CAMERA SETTINGS – II

While I've tried to be as detailed as possible, I can't provide advice on the best settings for your make and model of camera. Do check its manual!

The menus and choices offered in digital cameras can be overwhelming. And just when you get used to one model, the manufacturer decides to reorganize the menus entirely for the latest and greatest camera you just bought.

However, all cameras will offer these functions, somewhere! Not shown, but you might wish to turn up the LCD screen to full brightness for easier viewing on a sunny day. But that eats up more battery power. Turning on Airplane Mode helps prolong battery life.

Also not shown is setting exposure increments to $^1/_3$rd stop, the usual default. In Auto Exposure time-lapse sequences, this will lessen the brightness jumps as the camera adjusts the exposure pre- and post-totality. Using the self-timer on 2s delay can be useful for reducing vibration and might aid in automatically firing bursts of shots under Auto Exposure Bracketing.

BATTERY SAVING

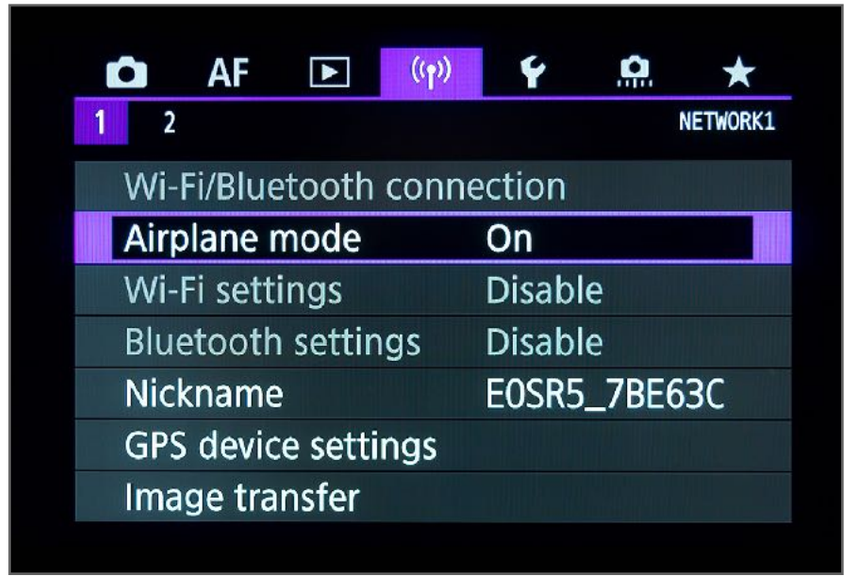
Turning on Airplane Mode turns off the WiFi and Bluetooth, saving battery power.

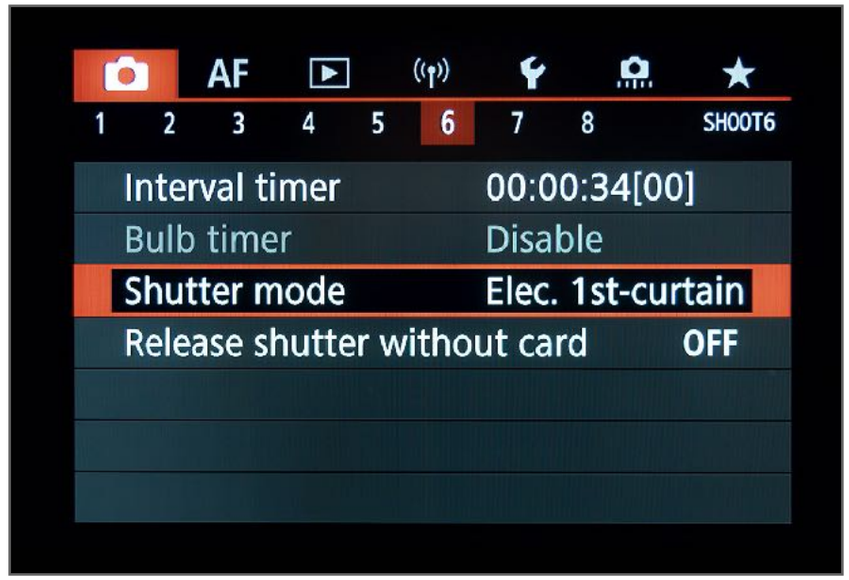
SHUTTER-MODE (DSLMs)

While shooting with purely electronic shutter reduces all vibration, with many cameras it also reduces the image bit depth to 12 bits. Shoot with either Mechanical shutter or Electronic First-Curtain.

TIME AND DATE

If your camera has GPS this might not be necessary, but ensuring all your cameras are set to the same date and time for your eclipse site will help in sorting images later. Not critical, but good to check.





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SECTION 3

CHOOSING YOUR LENS

In this section I review the best lens choices for framing the wide-angle scene. The next chapter deals with choosing long focal length telephotos and telescopes for close-ups.

What lens you select here depends on the size of your camera sensor, where you are along the path, and on how you wish to frame the scene. Being a high Sun, the 2024 eclipse demands a wide lens.

November 3, 1994, Lauca National Park, Chile
on medium format film

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GOING WIDE

TIP: Manual-focus wide-angle lenses (such as the Rokinon, Laowa, and TTArtisan brands) are economical but have good optics, and versions to fit most camera brands.

Don't discount the value – and ease – of shooting the eclipse with a wide-angle lens to capture the eclipsed Sun in context at your site.

The usual inclination at eclipses is to zoom in using the longest focal length you can muster for big close-ups. I'll be covering those kinds of images in the next chapter.

But let me lobby here for an alternative – the wide shot that includes a landscape and perhaps eclipse watchers below. It is a much easier type of eclipse image to take and records the scene as your eye saw it. Some of the best eclipse images ever taken are wide shots.

The challenge at the 2024 eclipse is that the Sun will be quite high in the sky, requiring a wide lens, resulting in a small Sun above a landscape with small and distant features.

However, the advantage is that it is a type of image you can have the camera shoot for you with automatic exposure settings. I always have a camera dedicated to doing just that.

Despite the fact you might have binoculars or a telescope to look through, in my experience it's the view of the eclipse with your unaided eyes, captured in wide-angle images like this, that will be your enduring memory of the eclipse. However, during totality the sky remains a bright twilight blue. Bright planets are easy to spot (Venus and Jupiter at the 2024 eclipse), but seeing bright stars during the eclipse can be a challenge. However, long exposures with a camera will certainly pick them up, as I've marked here.

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CHOOSING A LENS

In 2024, framing the Sun and landscape below will require a lens capable of delivering a field of view at least 70° high (in the west) to 50°(in the east).

One advantage of using a full-frame camera is that the larger sensor means you don't have to use as short a focal length to achieve a wide field as you would with a cropped-frame camera.

But no matter the camera, the eclipse doesn't demand a very fast lens, as the scene won't get as black as night. An f/3.5 to f/5.6 lens will work for wide shots, though a faster f/2.8 lens will keep exposures shorter, useful for time-lapses.

Both zoom and fixed-focal length prime lenses will work fine, with low-cost zooms more prone to lens flares from bright light sources off-centre, as the Sun will be during the diamond rings. I caution against using kit zooms that have flimsy manual focus rings with no distance markings. They are much too easy to turn by accident. In addition, remove any UV or Skylight filter to reduce the likelihood of flares and ghost images.

Lens FL	FOV: Full-Frame	FOV: APS Cropped-Frame	FOV: 4/3rds Camera
10mm	—	97° x 74°	82° x 66°
12mm	—	87° x 64°	73° x 52°
14mm	104° x 81°	78° x 57°	65° x 46°
16mm	97° x 74°	71° x 51°	58° x 40°
18mm	90° x 68°	64° x 45°	55° x 38°
20mm	84° x 62°	59° x 41°	48° x 33°
24mm	74° x 53°	51° x 35°	41° x 28°

The Table assumes a "rectilinear" lens, not a fish-eye, which can provide even wider fields at similar focal lengths, but present a curved horizon.

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360° FISH-EYE SCENES

At an eclipse every lens focal length has its use. A circular fish-eye lens aimed up will capture the entire scene.

A time-lapse taken with a circular fish-eye lens on a DSLR or DSLM (an 8mm lens for full-frames) on Auto Exposure would work well for recording the shadow sweeping in and out. If skies are cloudy (perish the thought!), as they were here in 2010, then it might be the only way to capture the effects of the eclipse, as the clouds darken then light up again.

Aiming the camera straight up can capture the entire sky. Or aim it lower to include the foreground below and your eclipse group. As per the tips in the next section, use an intervalometer to take images every 1 to 2 seconds, with the camera on Auto Exposure at an ISO of 400 to help reduce the exposure times during totality. Set the lens to its widest aperture, which might be f/4 or f/3.5.

July 11, 2010, Hikueru Atoll, French Polynesia
With a Sigma 8mm circular fish-eye lens

TTArtisan 7.5mm
circular fish-eye lens

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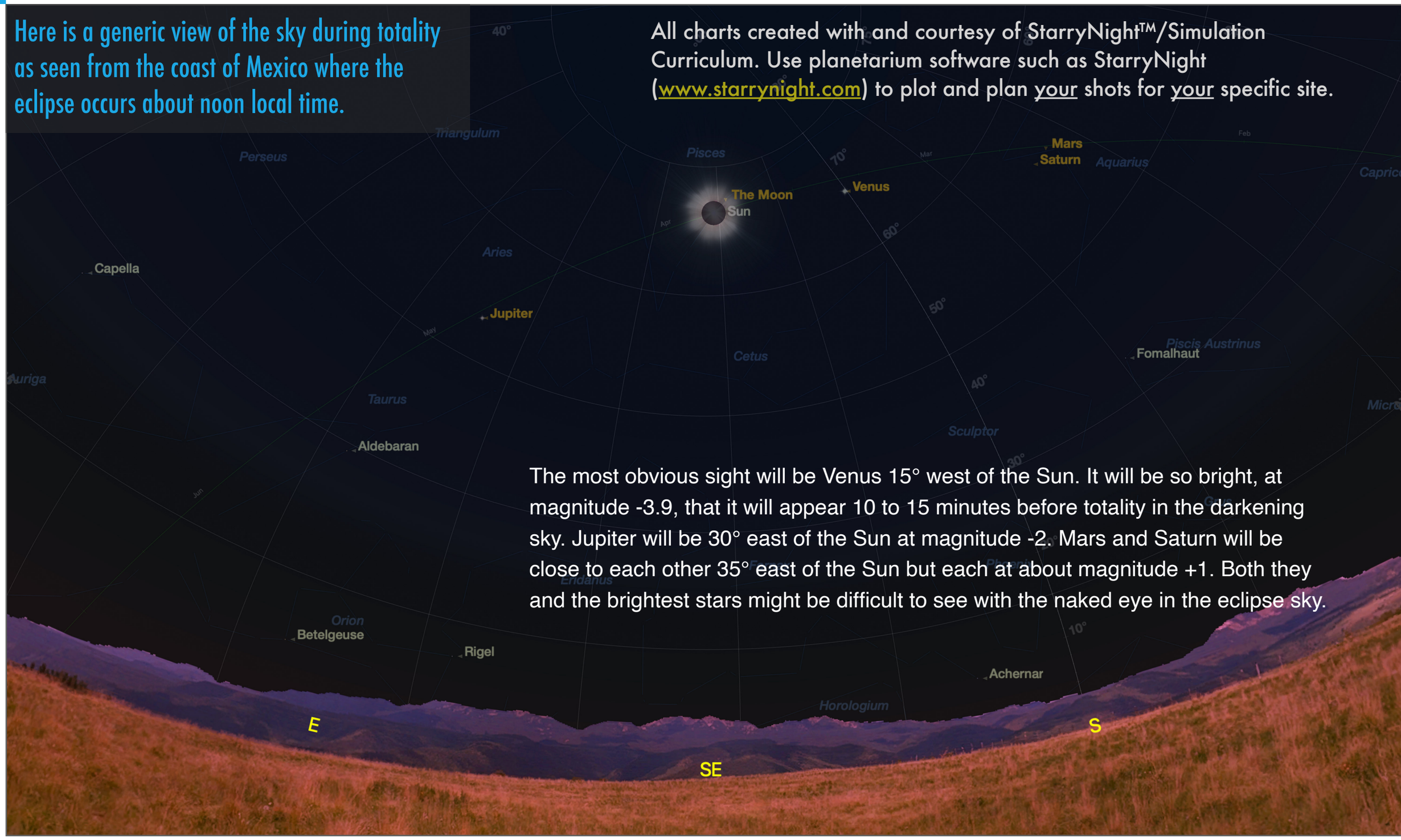
WHAT'S IN THE SKY? (MEXICO)

NOTE: For views in Mexico I am using Mazatlan as the site.

Here is a generic view of the sky during totality as seen from the coast of Mexico where the eclipse occurs about noon local time.

All charts created with and courtesy of StarryNight™/Simulation Curriculum. Use planetarium software such as StarryNight (www.starrynight.com) to plot and plan your shots for your specific site.



The most obvious sight will be Venus 15° west of the Sun. It will be so bright, at magnitude -3.9, that it will appear 10 to 15 minutes before totality in the darkening sky. Jupiter will be 30° east of the Sun at magnitude -2. Mars and Saturn will be close to each other 35° east of the Sun but each at about magnitude +1. Both they and the brightest stars might be difficult to see with the naked eye in the eclipse sky.

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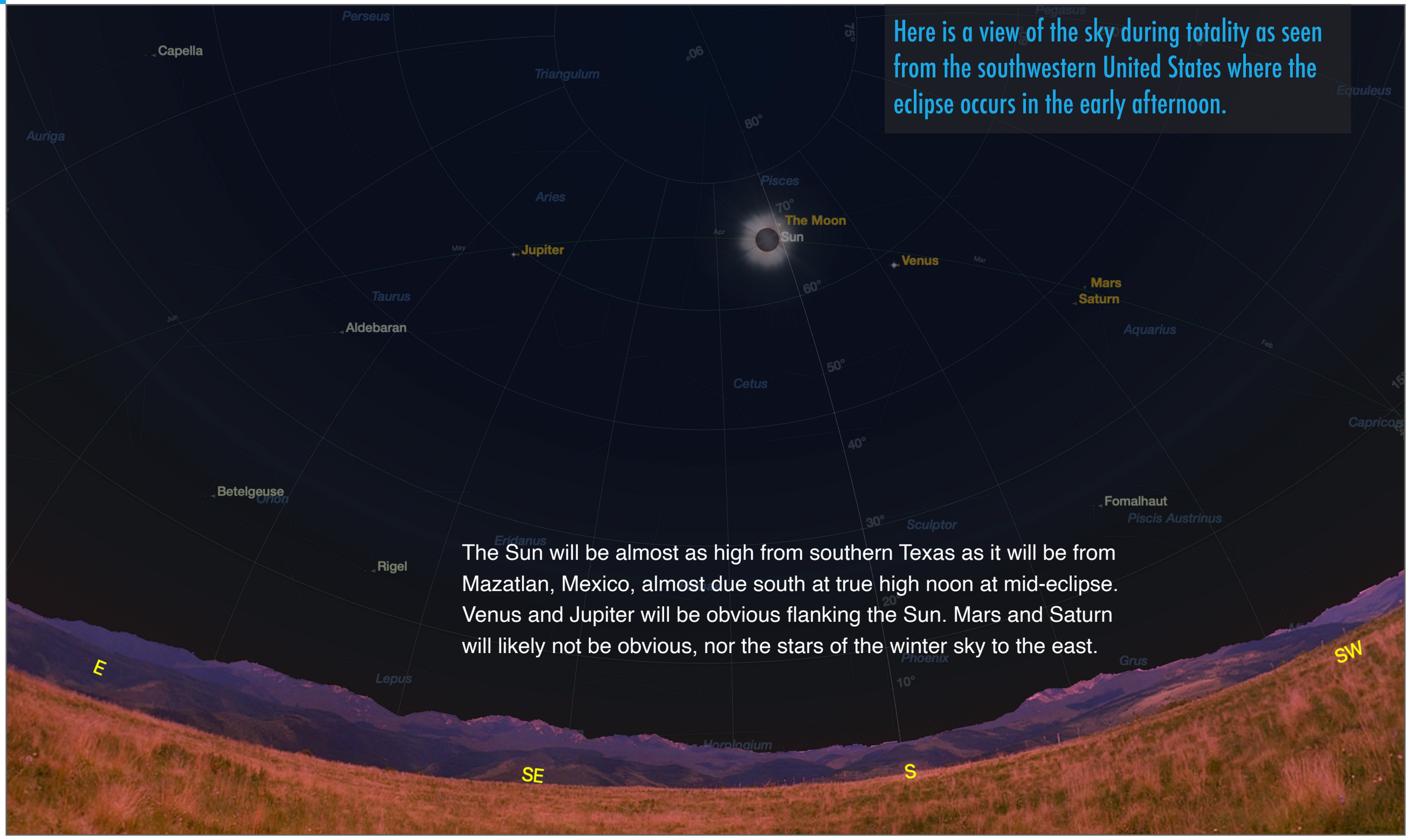
WHAT'S IN THE SKY? (WESTERN US)

NOTE: For views in the southwestern U.S., I am using Kerrville, Texas as the site.



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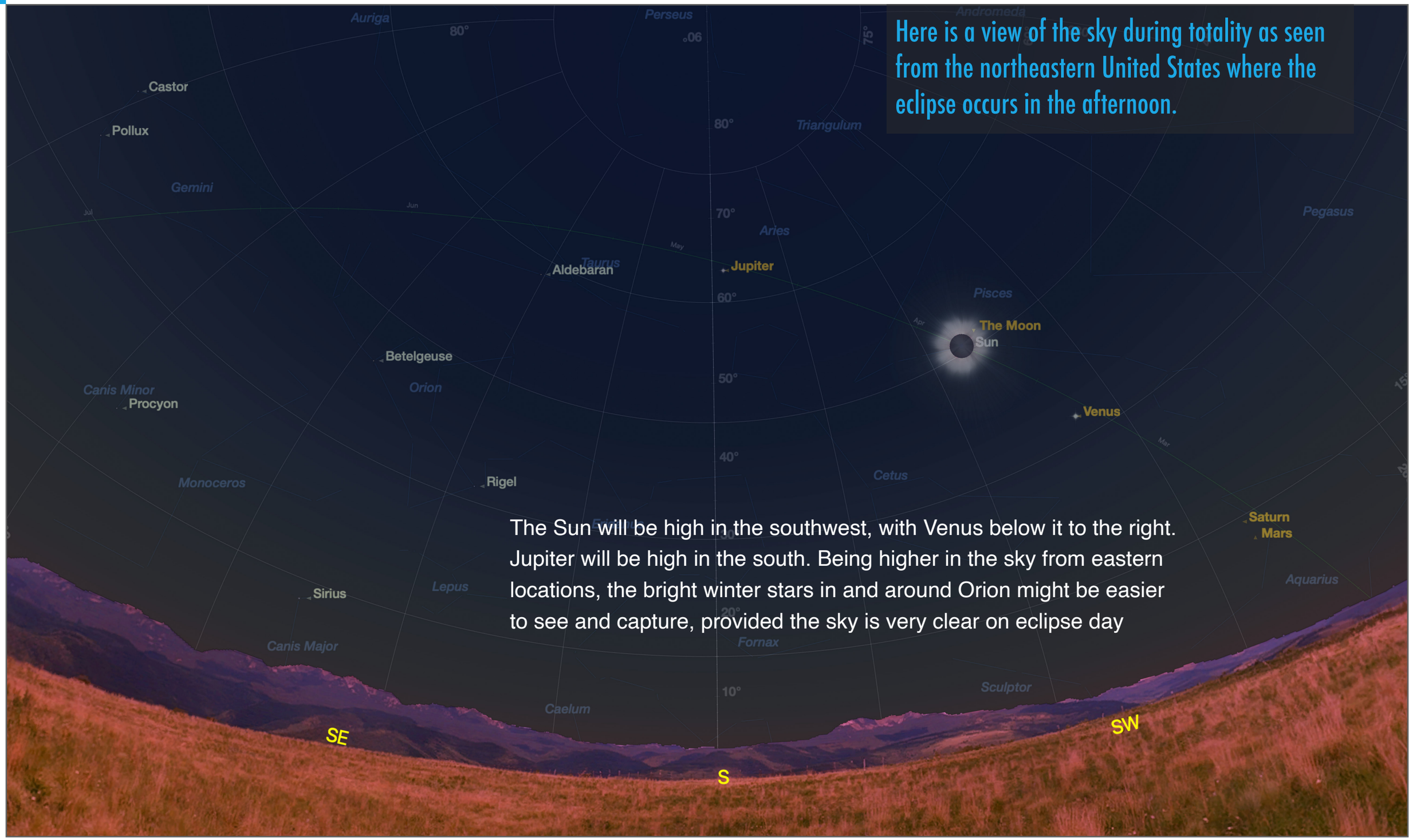
WHAT'S IN THE SKY? (EASTERN U.S.)

NOTE: For views in the northeastern U.S., I am using Buffalo, New York.



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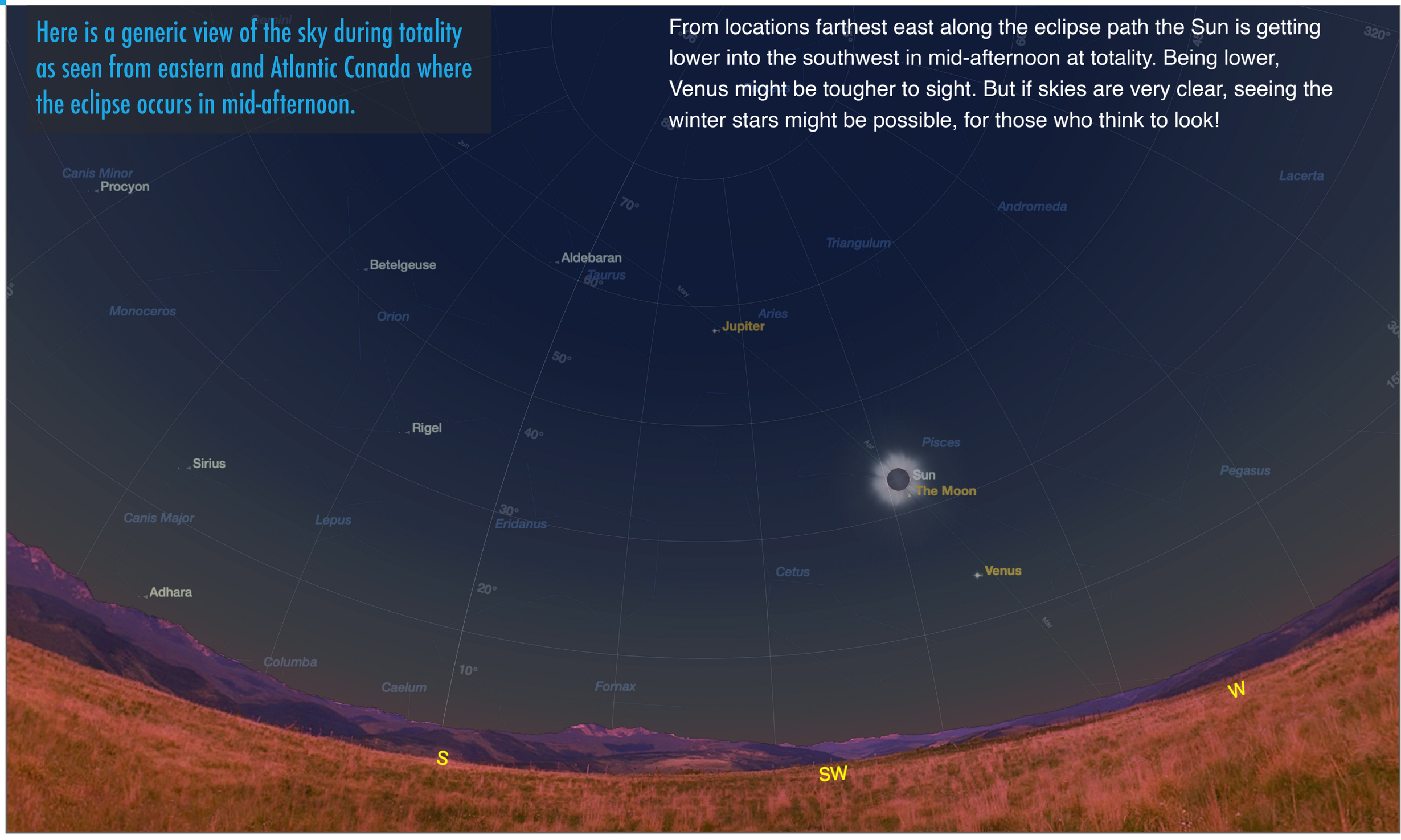
WHAT'S IN THE SKY? (CANADA)

NOTE: For views in eastern Canada I am using a site north of Fredericton, New Brunswick.

Here is a generic view of the sky during totality as seen from eastern and Atlantic Canada where the eclipse occurs in mid-afternoon.

From locations farthest east along the eclipse path the Sun is getting lower into the southwest in mid-afternoon at totality. Being lower, Venus might be tougher to sight. But if skies are very clear, seeing the winter stars might be possible, for those who think to look!



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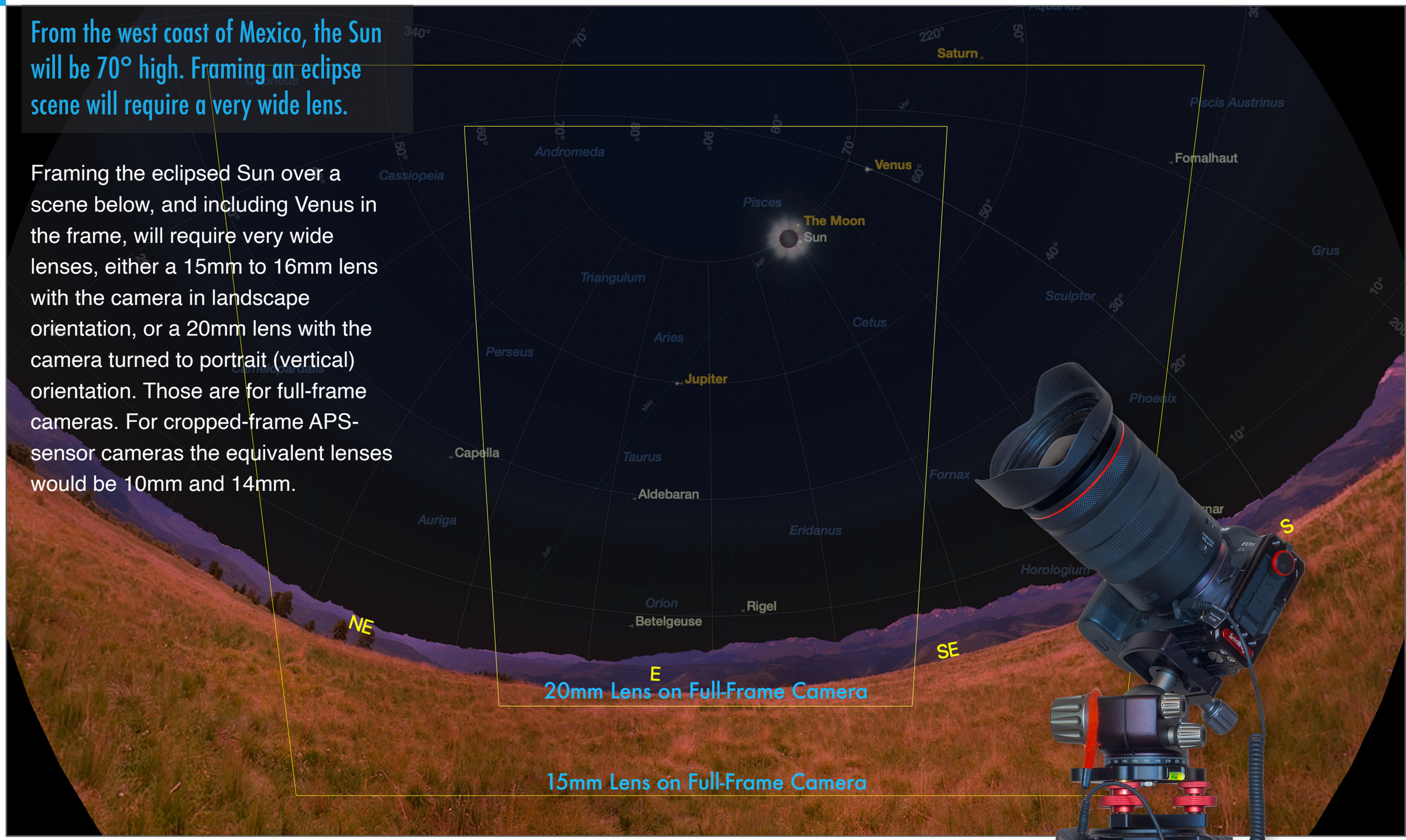
FRAMING THE SCENE (MEXICO)

NOTE: For views in Mexico I am using Mazatlan.

From the west coast of Mexico, the Sun will be 70° high. Framing an eclipse scene will require a very wide lens.

Framing the eclipsed Sun over a scene below, and including Venus in the frame, will require very wide lenses, either a 15mm to 16mm lens with the camera in landscape orientation, or a 20mm lens with the camera turned to portrait (vertical) orientation. Those are for full-frame cameras. For cropped-frame APS-sensor cameras the equivalent lenses would be 10mm and 14mm.



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FRAMING THE SCENE (WESTERN U.S.)

NOTE: For views in the southwestern U.S., I am using Kerrville, Texas.

From southern Texas the Sun is still quite high, up at 67° near high noon.

20 to 24mm Lens on Full-Frame Camera

15 to 20mm Lens on Full-Frame Camera

A 20mm lens in landscape orientation or a 24mm lens in portrait orientation just barely contains the scene, including Venus and Jupiter, but the framing is tight. Using a zoom lens to widen the field more than shown here will be best. Or use a wider lens.

A note about the illustrations: In these field-of-view charts the sizes of the Sun and Moon are exaggerated. They will appear much smaller in your real photos.

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FRAMING THE SCENE (EASTERN U.S.)

NOTE: For views in the northeastern U.S., I am using Buffalo, New York.

From sites in the northeastern U.S. the lower Sun, at 45° altitude from Buffalo, means a longer lens can frame the scene comfortably.

In the east, a 24mm lens will frame the scene in landscape orientation, or a 35mm lens with the camera turned portrait. Jupiter will be too far to the upper left to be worth trying to contain. Saturn and Mars might show up as faint dots on the image, but only if the sky is very clear.

The equivalent lenses for cropped-frame cameras would be 14mm and 21mm.

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FRAMING THE SCENE (CANADA)

NOTE: For views in eastern Canada I am using a site north of Fredericton, New Brunswick.

TIP: The Sun followed a similar path across the sky around September 2, 2023 as it will on April 8, 2024. That opportunity has come and gone; it was usable only if you were then at the same site as on April 8.

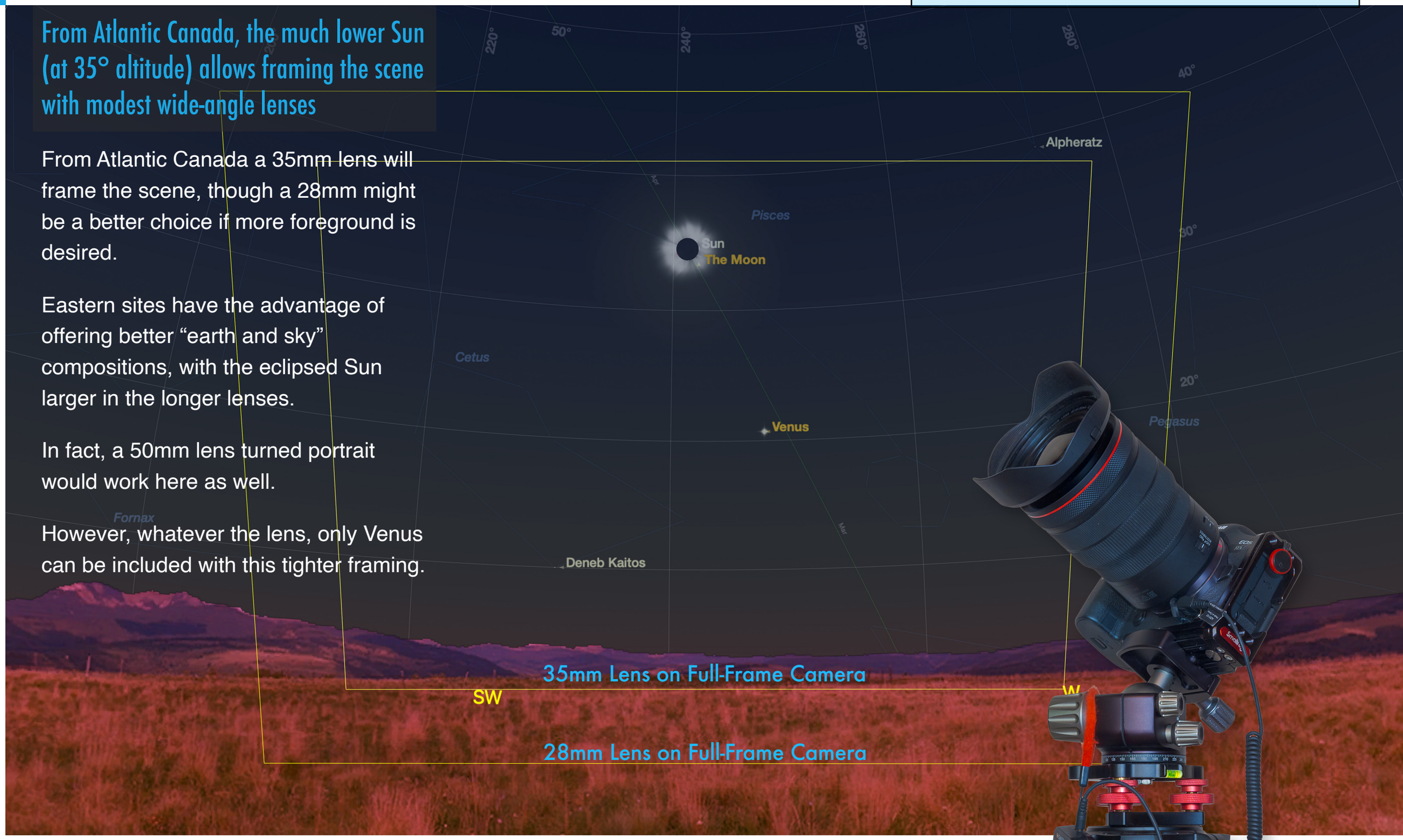
From Atlantic Canada, the much lower Sun (at 35° altitude) allows framing the scene with modest wide-angle lenses

From Atlantic Canada a 35mm lens will frame the scene, though a 28mm might be a better choice if more foreground is desired.

Eastern sites have the advantage of offering better “earth and sky” compositions, with the eclipsed Sun larger in the longer lenses.

In fact, a 50mm lens turned portrait would work here as well.

However, whatever the lens, only Venus can be included with this tighter framing.



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A WIDE-FIELD SHOT FROM 2017

This is an example of a camera with wide-angle lens on a tripod and just letting it run on Auto Exposure.

This is one frame from a 700-frame time-lapse I shot at the August 21, 2017 eclipse from near Driggs, Idaho. It was with a Canon 6D at ISO 100 and unfiltered 14mm Rokinon SP lens wide open at f/2.5 for an automatically set exposure of 1/5-second.

I started the camera shooting several minutes before totality, and just let it run. It's important not to forget to stop the sequence after totality. Don't leave the unfiltered camera aimed at the Sun!

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CHOOSING A FOREGROUND

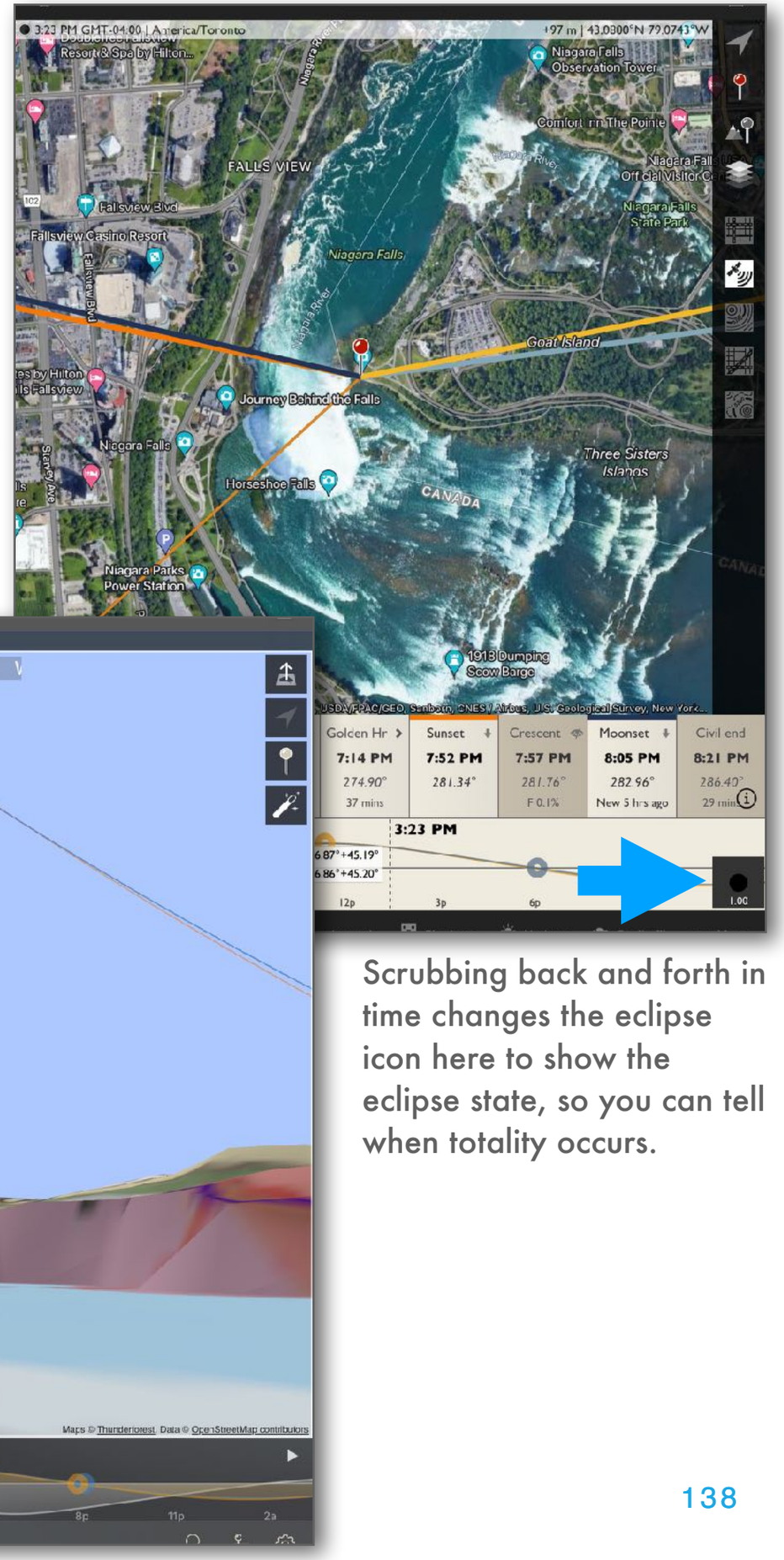
Striking images of the eclipsed Sun over a scenic landscape setting come from careful planning using mapping apps.

Photo planning apps for mobile devices such as The Photographer's Ephemeris (shown here with its companion app TPE 3D), PhotoPills or PlanIt Pro can help you plan where the Sun will be in relation to landscape features. (A more detailed tutorial for PlanIt Pro is in Chapter 7.) You might need to enter the time of totality for your site. The app will show you the azimuth (east-west direction) of the Sun and Moon at that time. TPE shows a little Sun in the bottom right corner indicating the eclipse.

I have set up TPE and TPE 3D here to preview the scene at the Goat Island Viewpoint at Niagara Falls, with the eclipse over Horseshoe Falls. What a shot! A simulation is in Chapter 7.

If you lack a great landscape like this, then frame a scene with fellow eclipse chasers, or photogenic trees or rustic rural buildings. Urban scenes with iconic city landmarks will also work. With their lower Suns, eastern sites will be best.

The Photographer's Ephemeris aka TPE (at right) and TPE 3D (below), previewing the eclipse photo everyone wants!



Scrubbing back and forth in time changes the eclipse icon here to show the eclipse state, so you can tell when totality occurs.

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SHOOTING A SELFIE

The best foreground could be you! Try a wide shot with you and your family or group watching the eclipse.

I've not taken selfie stills during any of the 16 eclipses I've been to, though I wish I had. You'll need a wide lens. Rather than taking time out to specifically shoot this image, I suggest setting up a camera to automatically take a series of time-lapse images (see Chapter 8), shooting every 1 to 2 seconds. Set the camera on Auto Exposure Aperture Priority, at f/2.8 to f/4, but for selfies, use an Exposure Compensation of +1 to +2 f-stops, to brighten the foreground. Don't use a flash! There should be enough light, as here, from the 360° twilight and sky to light you.

If you think of it, have everyone turn around to look toward the camera for 10 to 15 seconds. Hold still – each exposure is likely about 1 to 2 seconds. That should put you in a few of the images. But it means not looking at the eclipse for that time! Tough to do! Or, place the camera looking toward you and away from the Sun. You could also do this as a movie with sound.

March 29, 2006, Libyan desert south of Tobruk

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SHOOTING AN ECLIPSE PANORAMA

Can't fit the scenery and eclipsed Sun into one frame? Take several frames and stitch them into a panorama. It will capture the 360° twilight.

While I don't have an eclipse panorama to show as an illustration, the twilight panorama of Comet Neowise from July 2020 shows an example taken under similar lighting as at totality. Use the same exposure for all images and take shots in rapid succession from left to right with 30% to 50% overlap. With the high Sun you'll need to shoot with a 20mm to 24mm lens with the camera in portrait orientation.

Ensure the tripod head and camera are level. Use a panorama head with click stops you set for the desired overlap. It makes shooting a set much quicker. But don't be too hasty. Allow vibration from moving the camera to die down before firing the shutter again.

Lightroom, Adobe Camera Raw, and Photoshop can usually stitch the images seamlessly.

Panorama Head with click-stop settings >

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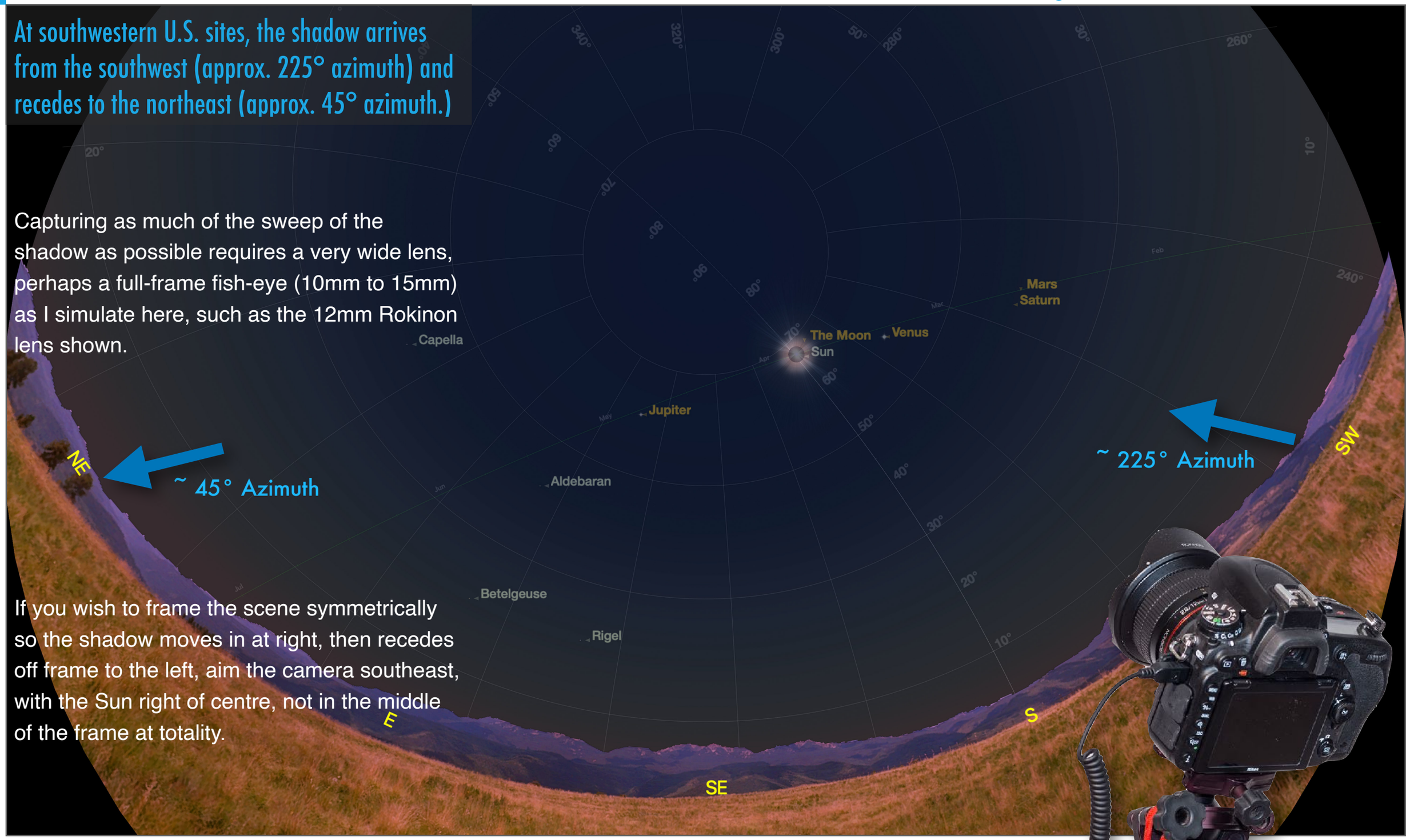
FRAMING THE SHADOW (SOUTHWESTERN U.S.)

NOTE: As with previous sky charts, for the view from the southwestern U.S. I am using Kerrville, Texas as the basis.

At southwestern U.S. sites, the shadow arrives from the southwest (approx. 225° azimuth) and recedes to the northeast (approx. 45° azimuth.)

Capturing as much of the sweep of the shadow as possible requires a very wide lens, perhaps a full-frame fish-eye (10mm to 15mm) as I simulate here, such as the 12mm Rokinon lens shown.

If you wish to frame the scene symmetrically so the shadow moves in at right, then recedes off frame to the left, aim the camera southeast, with the Sun right of centre, not in the middle of the frame at totality.



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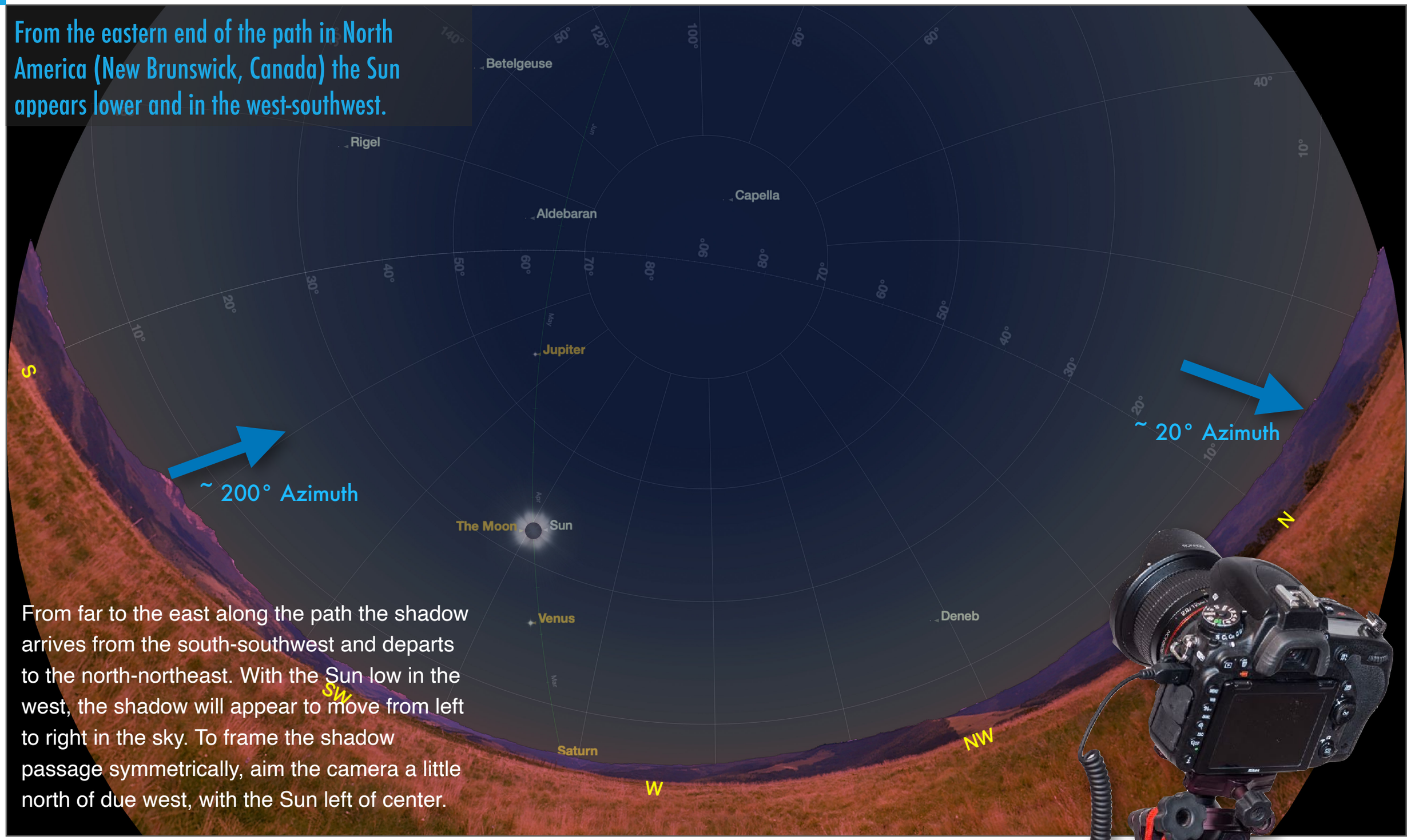
FRAMING THE SHADOW (CANADA)

NOTE: For views from Canada, I am using Fredericton, New Brunswick.

From the eastern end of the path in North America (New Brunswick, Canada) the Sun appears lower and in the west-southwest.



From far to the east along the path the shadow arrives from the south-southwest and departs to the north-northeast. With the Sun low in the west, the shadow will appear to move from left to right in the sky. To frame the shadow passage symmetrically, aim the camera a little north of due west, with the Sun left of center.

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A WIDE-FIELD SHADOW SHOT FROM 2017

This is an example of a camera with a fish-eye lens on a tripod and just letting it run on Auto Exposure.

This is one frame from a 660-frame time-lapse I shot at the August 21, 2017 eclipse from near Driggs, Idaho. It was with the Nikon D750 at ISO 100 and Rokinon 12mm full-frame fish-eye lens (shown here) at f/2.8 for an automatically set exposure of 1/13-second.

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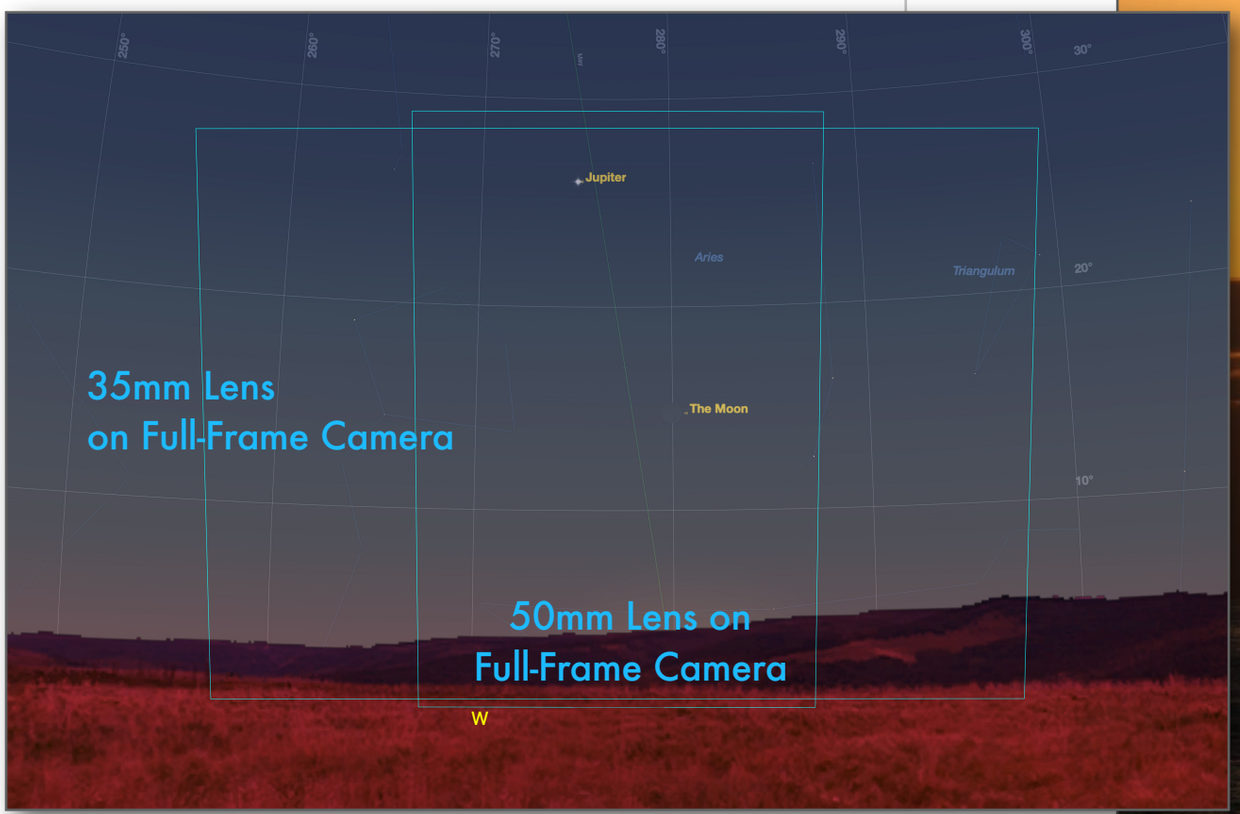
SIGHTING THE WAXING POST-ECLIPSE MOON

A tradition of eclipse chasers is to sight, and shoot, the first thin Moon that appears after the eclipse. Look Tuesday night, April 9, as shown below.

You won't see the Moon Monday night. But on post-eclipse Tuesday you should see the thin Moon low in the west after sunset. The morning for the pre-eclipse Moon is Sunday, April 7, low in the pre-dawn east and only 1.5° from Venus.



July 22, 2009, South Pacific

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SECTION 4

SETTING EXPOSURE

Wide shots are easy to take because this is one type of eclipse image where you can use Auto Exposure and expect to get great results. That was the case with this image from 2005 and others I use as examples. However, some photographers prefer to keep the camera at one fixed manual exposure and then let the scene get very dark to dramatically show the descent into darkness during totality. That's not my preference, but I offer it as an option.

April 8, 2005 Hybrid eclipse, north of Pitcairn Island

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WHAT'S THE BEST EXPOSURE?

During totality settings for a well-exposed image are similar to what's needed during twilight after sunset. The sky is deep blue, not dark as night.

Sky conditions and clarity will dictate the actual exposure, but typical exposures for wide shots during totality are likely to be about:

Shutter Speed:	1/4 to 1 second at either:		
Aperture:	f/2.8	f/4	f/5.6
ISO:	100	200	400

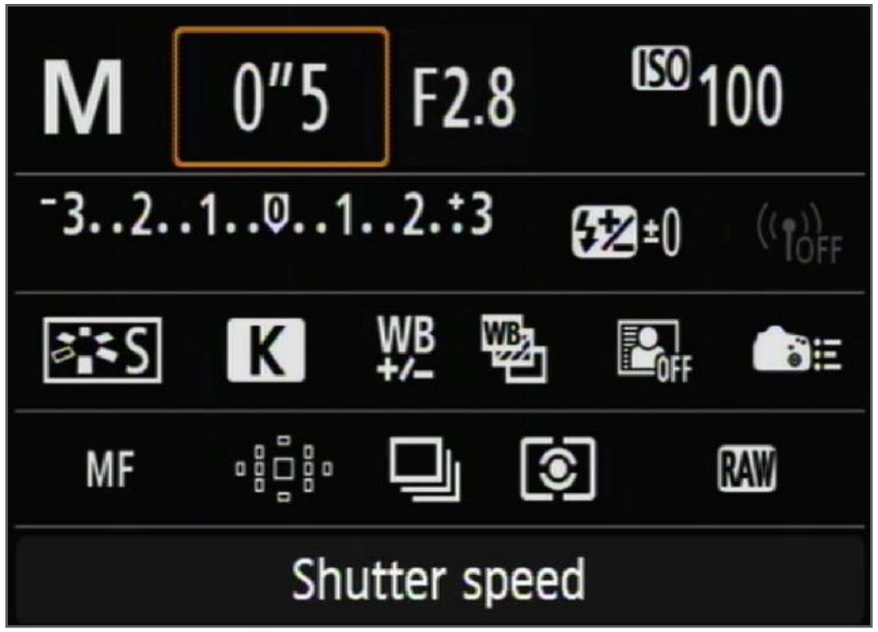
Use a higher ISO if you are using a "slow" lens such as an f/5.6 kit zoom. Use a slower, less noisy ISO speed if you are using a faster lens.

Choose an aperture and ISO speed to keep shutter speeds shorter than 1 second if you are shooting a time-lapse. That will maximize the number of shots you can acquire during totality, so the final time-lapse movie lasts long enough to be worthwhile. That might mean shooting at f/2.8 (if you can) and/or at ISO 400, especially when using a slower (> f/4) lens.

You could set the exposure based on what looks good during the partial phases for a normal sunlit scene, then leave the camera on Manual at those settings to let the scene go dark during totality. But it will go very dark and likely show little until the Sun returns.

Or you could use the ballpark settings I suggest at left to manually shoot better exposed images that record the foreground, the twilight colors, and eclipsed Sun in the deep blue sky, more as your eye saw it.

You can use a remote release to fire the shutter or set up an intervalometer like this to fire the shutter for you, with the camera on a fixed manual exposure or on Auto Exposure (next).



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AUTO EXPOSURE *VS.* MANUAL

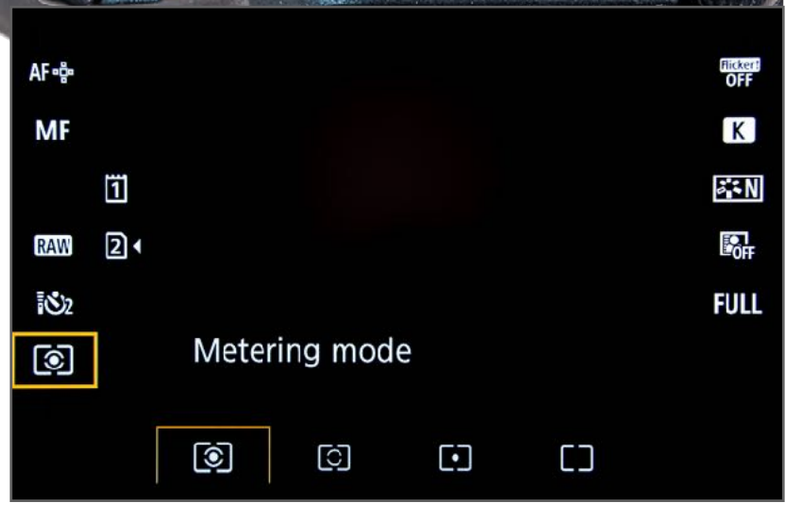
Dial "Av" for Aperture Priority

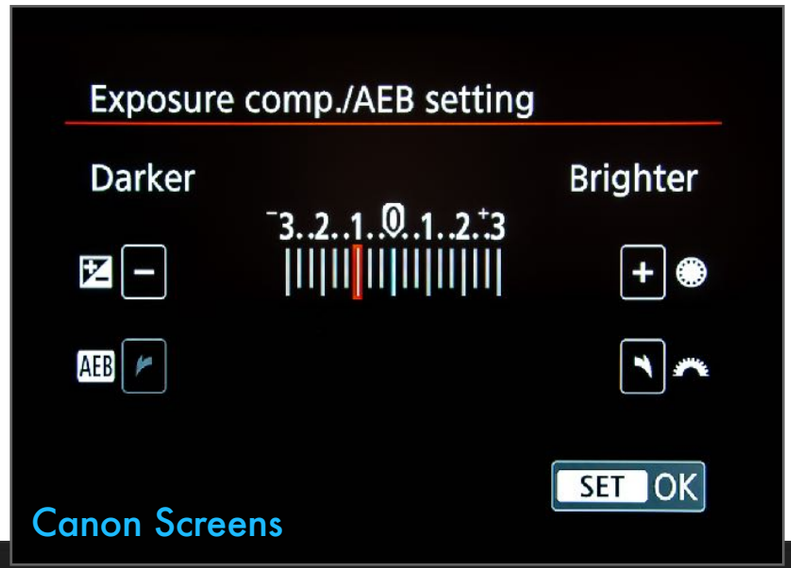
While you could fire shots and adjust exposures manually during totality, that's work and too much distraction from watching the eclipse.

I suggest that the best way to take a wide shot is to put the camera into Auto Exposure – Aperture Priority, and let the camera vary the shutter speed as an intervalometer fires the shutter. You'll end up with frames suitable for a time-lapse (see Chapter 8 for more). Use a wide aperture of f/2.8 to f/4 and an ISO of 100 to 200. In the scene below, with a -1 f-stop compensation, the shutter speed got no longer than 1/4-second at ISO 100 and f/2.8. If you have to use a slower lens, then choose a higher ISO speed, perhaps ISO 400 with an f/5.6 lens.

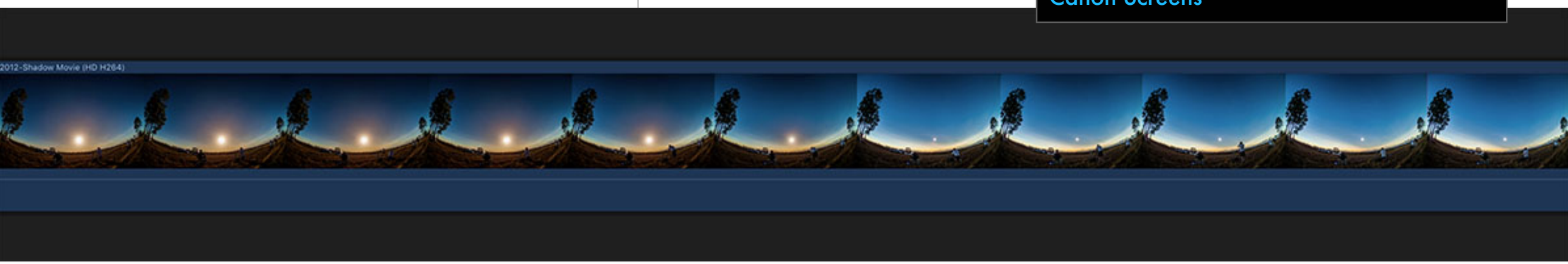
Setting the meter to read from an average of points (Evaluative here) across the frame and not a spot should provide the most accurate metering in the changing eclipse sky. Exposures may be longer if the sky is hazy.

If you wish to prevent the bright corona and distant twilight from getting too overexposed, set the +/– Exposure Compensation to underexpose each frame by an f-stop (check the manual). This will make the foreground dark but shadow detail can be recovered later in processing.





Canon Screens



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TIME-LAPSE CAMERA SETTINGS

Wide-angle techniques with the camera on Auto Exposure lend themselves to shooting time-lapses. Just start the camera and let it run.

The beauty of this technique is that you can start the sequence a few minutes before totality, using an intervalometer to automatically fire the shutter so the camera runs unattended.

Set it to take images every 1 or 2 seconds. The shorter 1s interval should work — if exposures do get longer than 1 second, the camera will simply miss every second shutter pulse, for fewer frames during the darkest time of totality. Using a higher ISO or faster lens should keep exposures under 1 second.

Shooting at a 1-second interval will produce hundreds of frames (~ 600 over 10 minutes), enough for an impressive time-lapse showing the descent into darkness and recovery, as well as the passage of the lunar shadow.

Chapter 8 provides more details on how to shoot a time-lapse sequence.

INTERNAL INTERVALOMETER

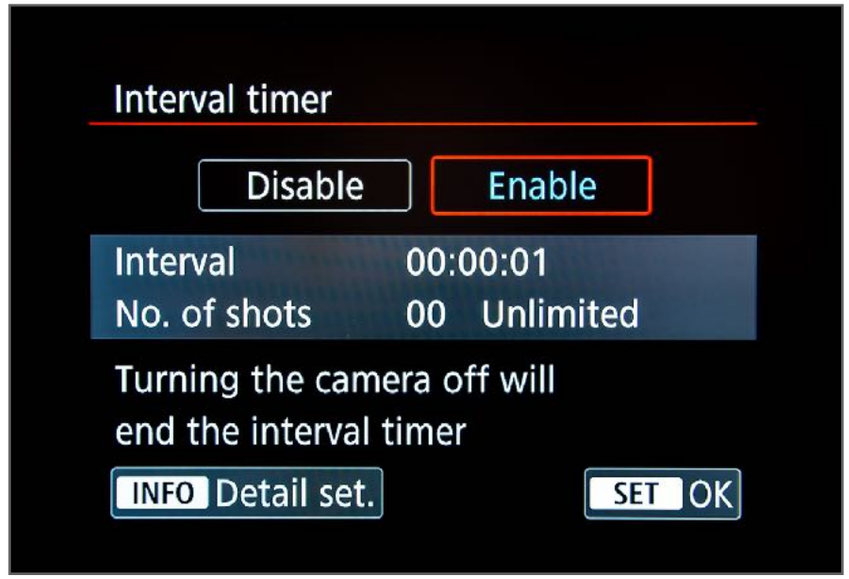
Many cameras have an "Interval Timer" built into their menu choices.

SETTING THE INTERVAL

Even during totality exposures are not likely to get longer than 1 second. An interval of 1 second should accommodate all exposures. You could use 2 seconds, but that will yield a shorter movie.

EXTERNAL INTERVALOMETER

The alternative is an external intervalometer, which is easier to start, stop and adjust. Settings would be similar. Have two at hand, as a back-up – they can fail!



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CHAPTER 6

6

2024: SHOOTING CLOSE-UP STILLS

Now we come to the core technique, the one most photographers will want to tackle, but that can be challenging. The reason is that unless you shoot wildlife or sports, you might not routinely use long lenses. And you are shooting a slowly moving target.

November 14, 2012, Queensland, Australia

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SECTION 1

SHOOTING WITH A TELEPHOTO

The majority of aspiring eclipse photographers will plan to use a telephoto lens, one made for their camera. The prime issue is that the Sun and Moon are surprisingly small and require much more focal length than you might typically use for landscapes and vacation shots. At eclipses, photographers often elect to use tele-extenders or a low-cost 600mm telephoto bought just for the eclipse. That's fine. But always test your eclipse gear on the Moon first.

November 14, 2012, Queensland, Australia with 105mm Traveler telescope (600mm focal length)

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WHEN TO REMOVE – AND REPLACE – FILTERS

TIP: To warn you when totality is imminent (it comes sooner than you expect!), set a "one-minute-to-go" alarm before the start of totality at your site. Use your phone on vibrate to prevent beeping from annoying others.

This is the BIG question eclipse newbies want to know: How will I know when to remove the filter? And when do I need to replace it?

For any views of the eclipse through optics (binoculars, telescopes), the rule is simple: You cannot look unfiltered until the last bit of the Sun, seen here in the diamond rings, is **gone**!

However, to capture the diamond rings in closeup photos like these the filter must be OFF. Your camera is safe for the few seconds or even a minute leading up to totality, and again afterwards for a short time.

But how do you know when that time is? Take the filter off your telescope or telephoto lens when the crescent is razor thin. Then don't look through any eyepiece! Instead, I look at the image on the camera's Live View LCD screen.

The end of totality is much easier to judge. You'll see the edge of the Moon getting brighter. Look away from any eyepiece, then put the filter back on your lens after the diamond ring ends.

These two consecutive exposures were taken one minute apart, with a filter (left) and without a filter (right). It is when the Sun gets down to a thin crescent, as here, that you want to remove filters for photography.

August 21, 2017, Idaho

If the sky is very clear the corona becomes visible before the onset of totality (below left) and appears along with the first diamond ring in short exposures. The corona remains visible for a minute or so after third contact (below right).

February 26, 1998, Curaçao (both on film with Traveler telescope)

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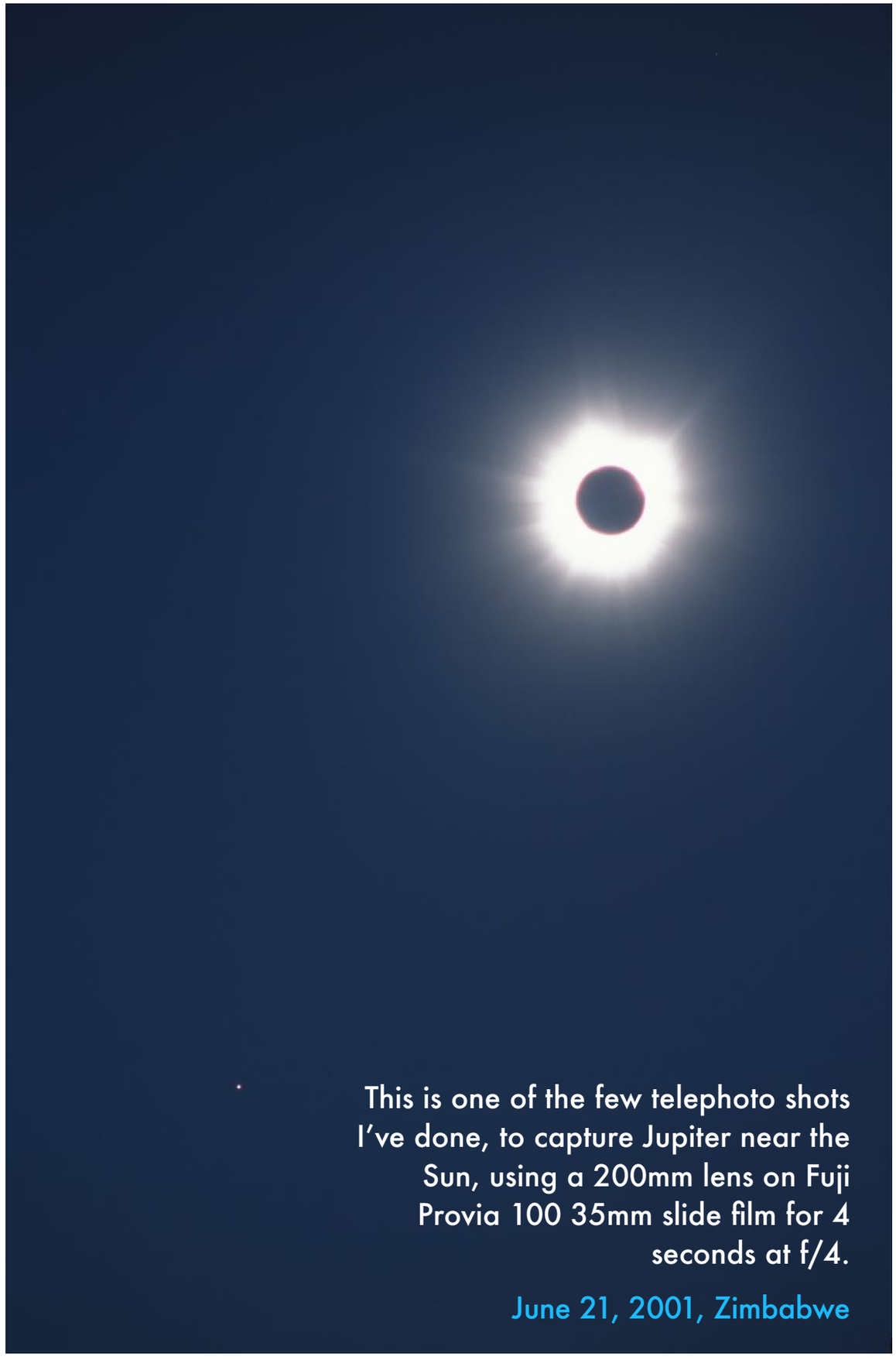
TELEPHOTO CLOSE-UPS

A telephoto lens, especially with a cropped-frame camera, can be a great way to get impressive shots easily.

The simplest way to get close-ups is with a tripod-mounted telephoto lens, using focal lengths up to 400mm to 600mm if you can. The challenges are: focusing the image and then following the moving Sun as Earth's rotation takes it from east to west across the sky.

At left, Murray sets up a well-travelled telephoto lens and tracking mount in French Polynesia for the 2010 eclipse. His image appears in Chapter 10.



This is one of the few telephoto shots I've done, to capture Jupiter near the Sun, using a 200mm lens on Fuji Provia 100 35mm slide film for 4 seconds at f/4.

June 21, 2001, Zimbabwe

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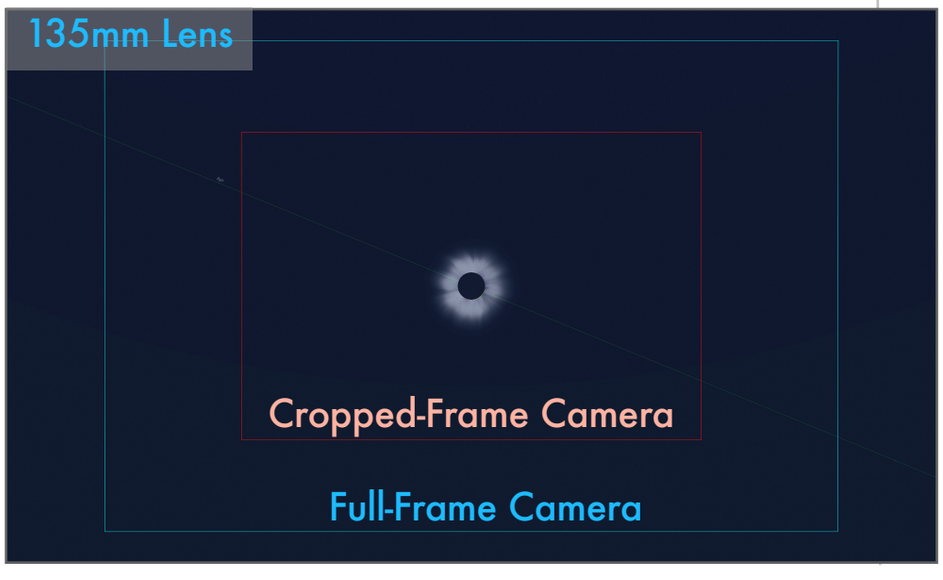
FOCAL LENGTH *VS.* IMAGE SIZE

As shown in Chapter 4, the Moon and Sun are small, a fact the camera mercilessly reveals. For an impressive eclipse close-up you need focal length.

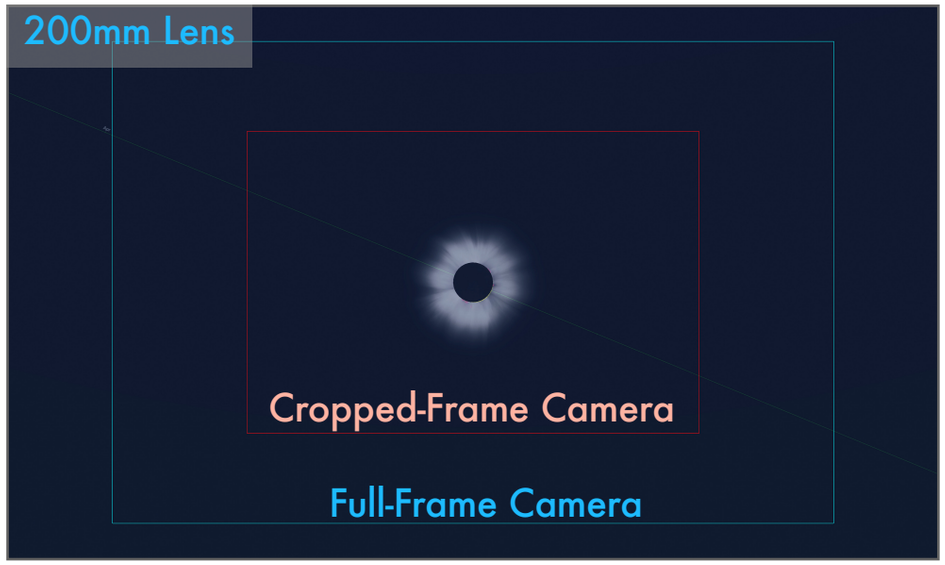
Cropped-frame cameras have the advantage in providing a larger solar image size with any given focal length of lens. Even so, as you can see, the image can still be quite small, even with a 200mm or 300mm lens that many photographers own. Using a 1.4x or 2x tele-extender can multiply the effective focal length by that amount, but with the loss of 1 stop or 2 stops in speed, respectively. Keep that in mind.

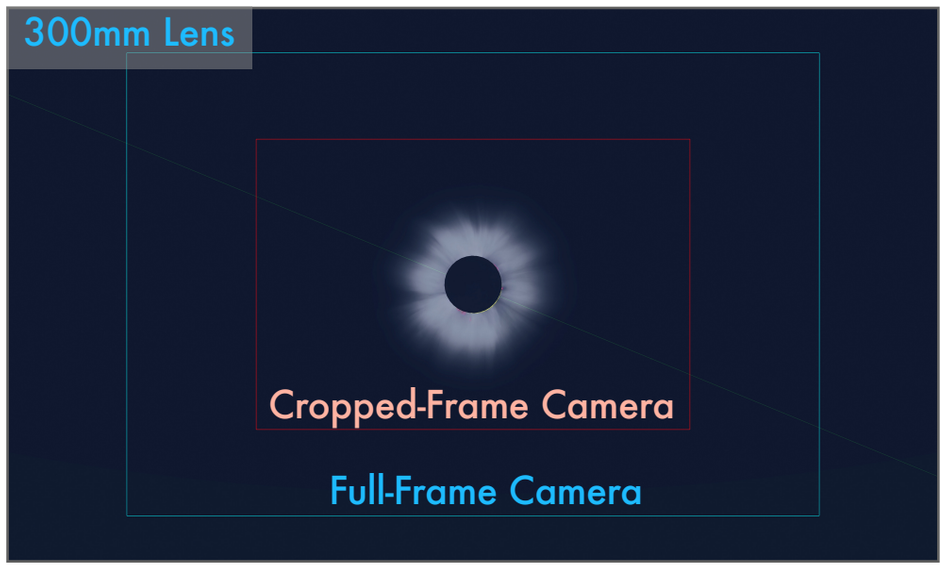


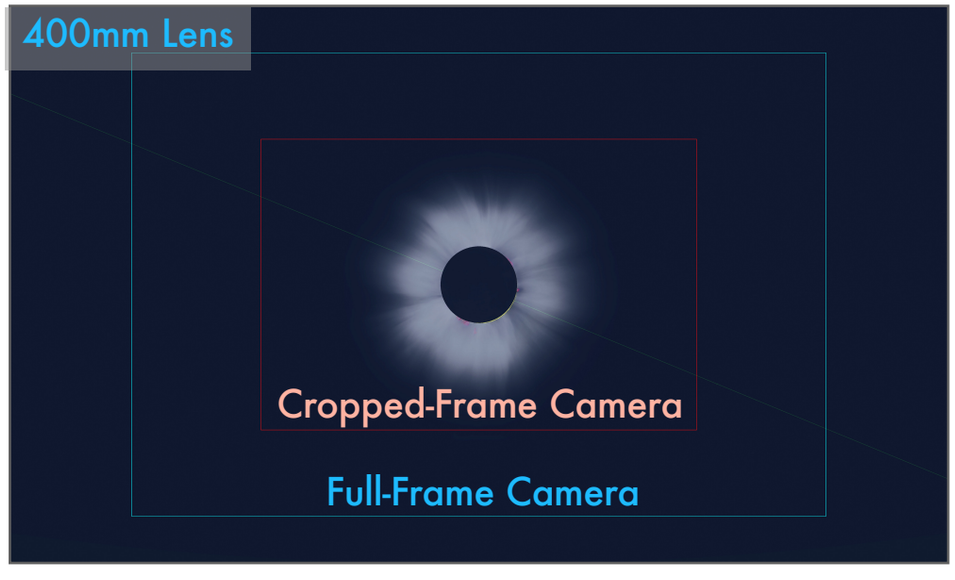
The more focal length you can muster the better. A modest 135mm telephoto (as below) won't really be enough, even with a cropped-frame camera. Go for at least 300mm to 400mm.

But the challenges are:

- Focusing.
- Keeping the camera steady.
- Yet also being able to move the camera to keep the Sun framed as you want it. The Sun can move enough even during totality to shift it out of frame or off-center, cutting off the corona.







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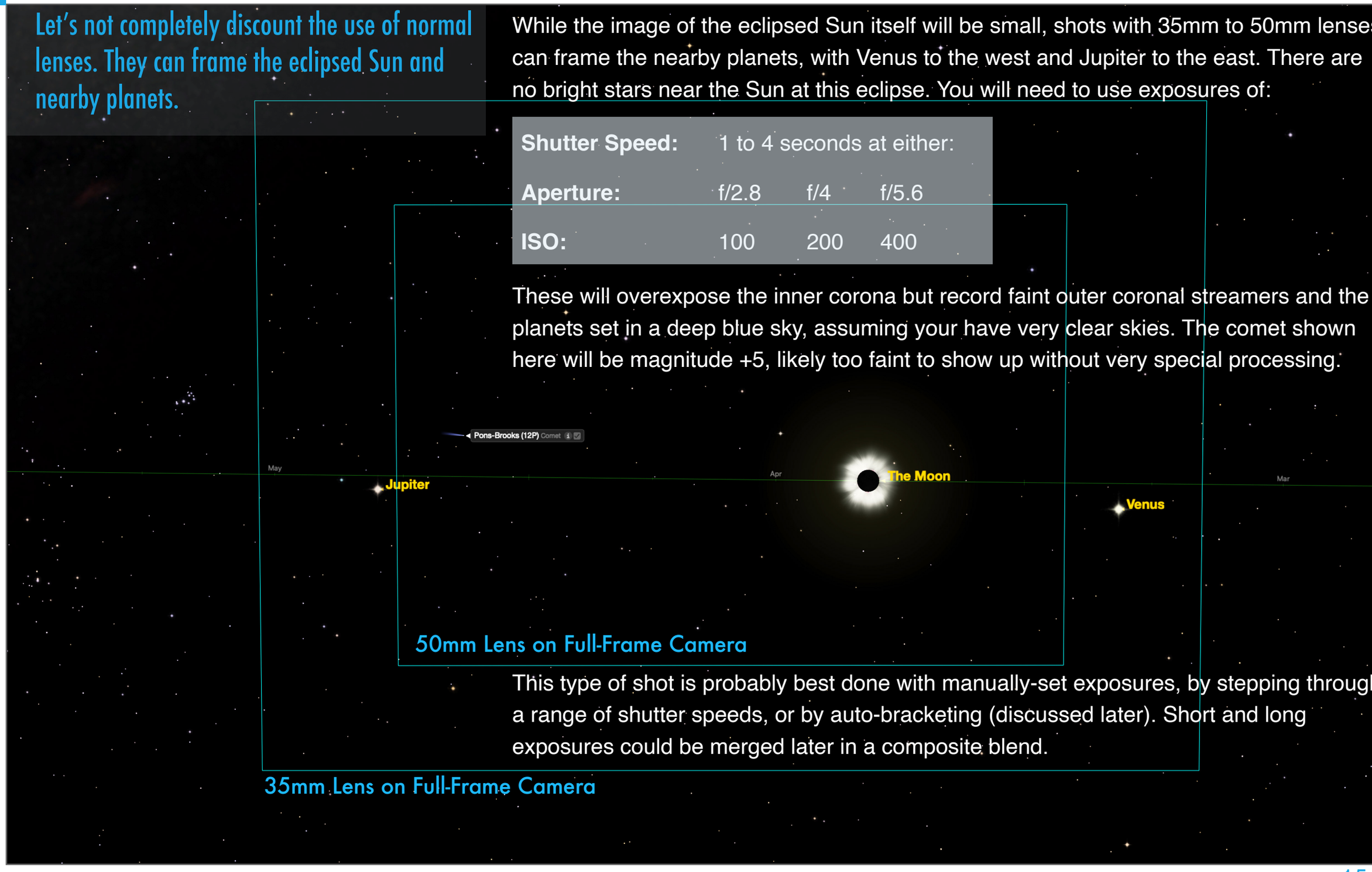
AN OPTION – USING A NORMAL LENS

Let's not completely discount the use of normal lenses. They can frame the eclipsed Sun and nearby planets.

While the image of the eclipsed Sun itself will be small, shots with 35mm to 50mm lenses can frame the nearby planets, with Venus to the west and Jupiter to the east. There are no bright stars near the Sun at this eclipse. You will need to use exposures of:

Shutter Speed:	1 to 4 seconds at either:		
Aperture:	f/2.8	f/4	f/5.6
ISO:	100	200	400

These will overexpose the inner corona but record faint outer coronal streamers and the planets set in a deep blue sky, assuming your have very clear skies. The comet shown here will be magnitude +5, likely too faint to show up without very special processing.



This type of shot is probably best done with manually-set exposures, by stepping through a range of shutter speeds, or by auto-bracketing (discussed later). Short and long exposures could be merged later in a composite blend.

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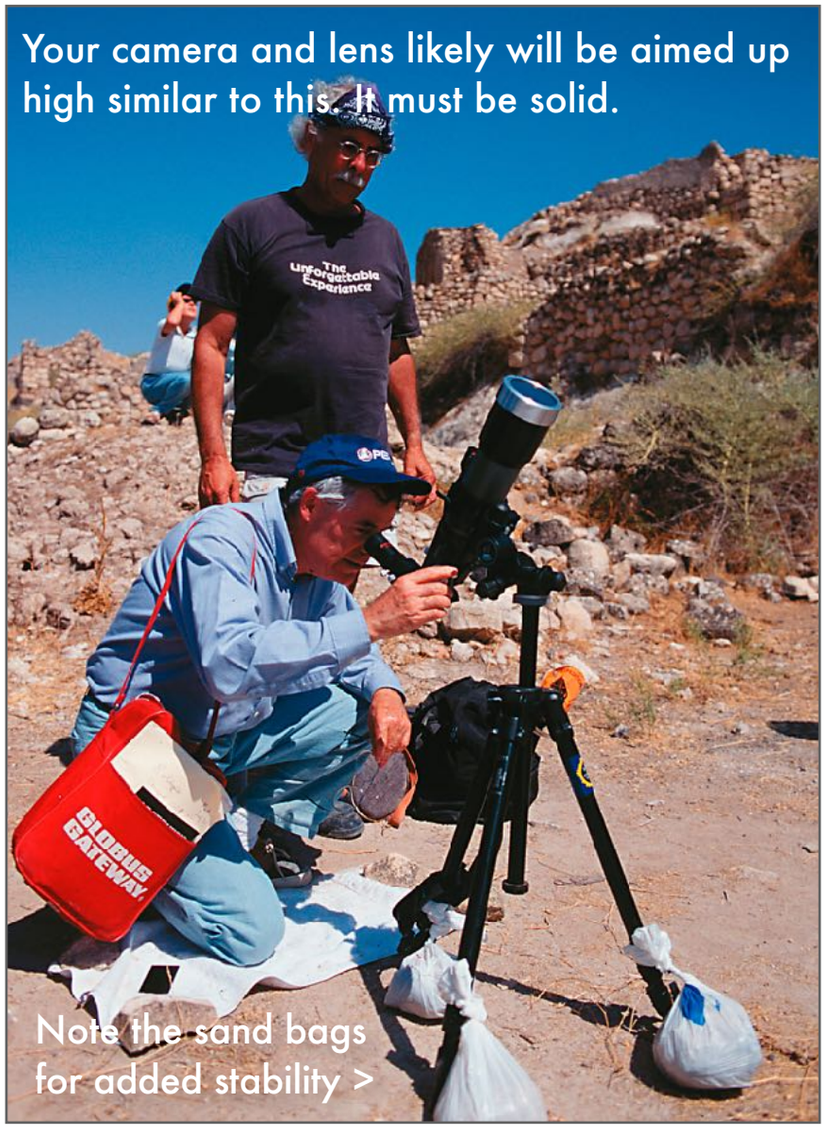
THE CRITICAL TRIPOD AND HEAD

People worry about the best camera and exposures, but neglect the tripod, using a flimsy travel tripod. It could be your undoing!



The longer the lens you have, the more critical it is to use a good tripod and head. They should:

- ☑ Be sturdy enough not to slip when holding a long lens aimed up high. Gimbal type mounts generally cannot aim up high enough.
- ☑ Be sturdy enough not to vibrate or bounce when you touch the camera, as you will need to do to adjust exposure settings, even if you are using a remote release to actually fire the shutter.
- ☑ And yet, be easily adjustable in order the recenter the Sun as it slowly drifts through the frame. If you have to loosen the head's locks to make any adjustment, the pointing could slip, making it tough to get the Sun framed back the way you want. You'll waste precious time framing, not shooting.
- ☑ Heads with geared adjustments in altitude (up-down) and azimuth (left-right), like this unit, are by far the best choice.
- ☑ As always, test!

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SECTION 2

SHOOTING WITH A TELESCOPE

Photographers are familiar with long telephoto lenses and often spend thousands of dollars on massive 600mm to 800mm monster lenses. If you make your money shooting sports and wildlife, those are great. But for the eclipse, if you want lots of focal length, an astronomical telescope will work just as well, if not better, at far less cost. They can be much lighter and easier to mount, have better optical resolution, and offer more precise focusing.

February 26, 1998, Curaçao, 600mm focal length Traveler, on film

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SHOOTING WITH A TELESCOPE

The eclipse close-ups I show in my ebook from 1979, 1998, 2006, 2012 (as here), and 2017 were all shot through a telescope, not a telephoto lens.

Telescopes offer focal lengths starting at 300mm to 600mm, and go up from there. For a total eclipse, the 600mm focal-length Traveler, as I'm using below, yielded this shot at right, taken with a cropped-frame Canon 60Da. It's as much image size as I would want for any eclipse.

Photo by Murray Paulson

November 14, 2012, Queensland, Australia

A small telescope is ideal for close-ups, but its great focal length introduces the issue of tracking the Sun. The bigger the image, the more it is going to move across the frame, even during the 4+ minutes of totality, not to mention over the entire eclipse.

Unless you are placing the telescope on a tracking mount (discussed later), you will absolutely need to place it on a head or mount that allows fine adjustments for centering the image, and sturdy enough not to bounce in the wind. Blurry images from vibration and poor focus are the most common flaws.

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FOCAL LENGTH *VS.* IMAGE SIZE

The longer the focal length the bigger the image, but the greater the chance for vibration and the motion of the Sun to blur the image.

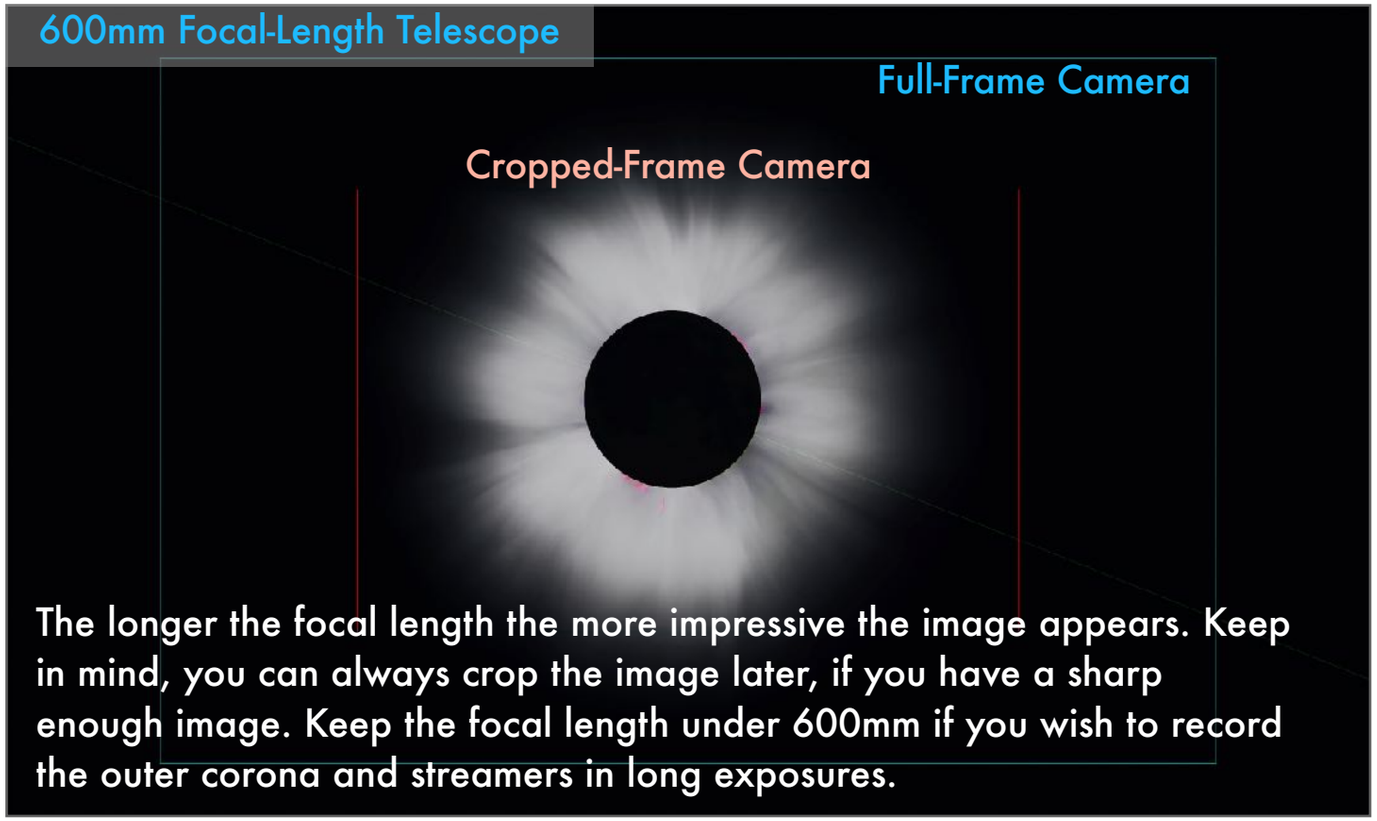
The size of the solar and lunar disk on your sensor is roughly:

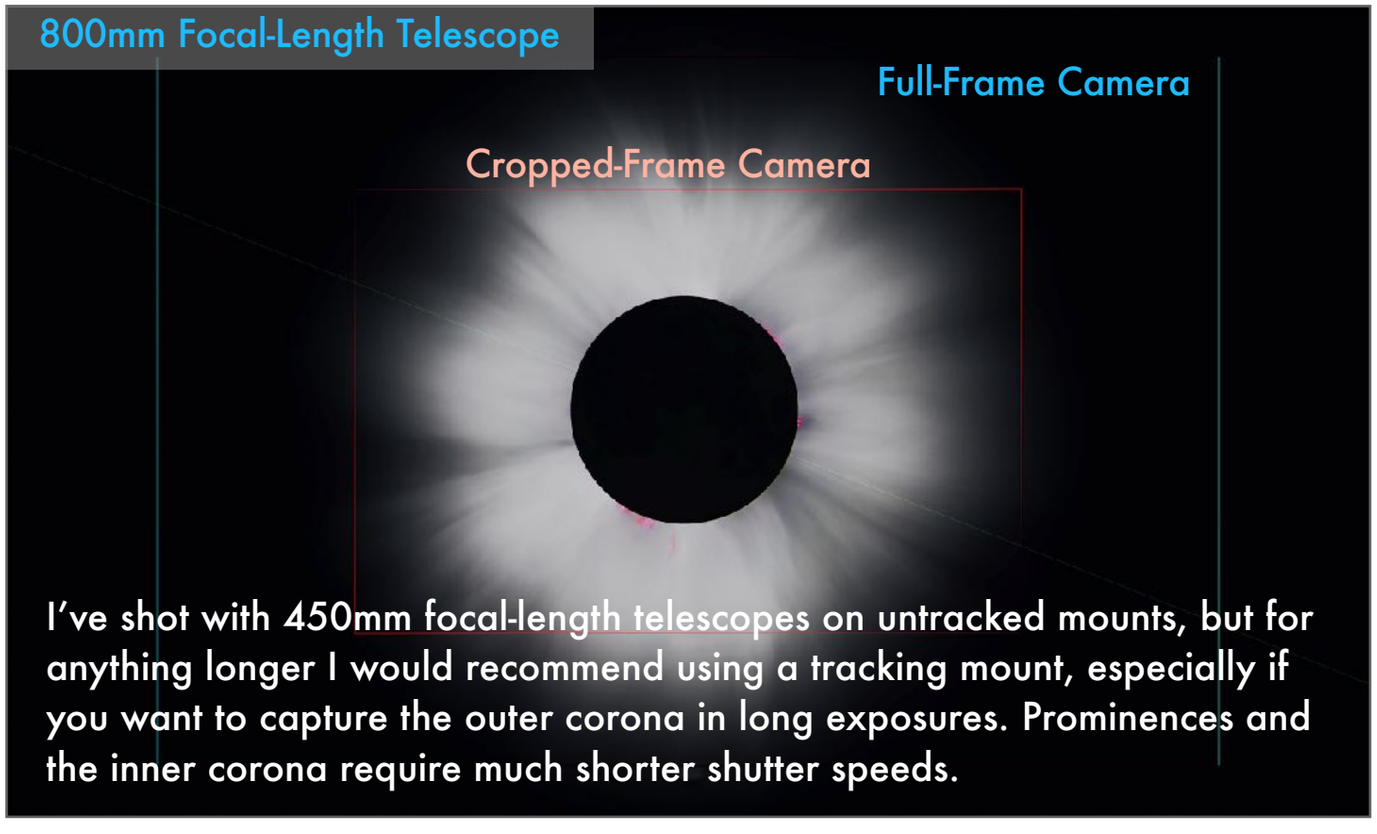
Focal length (mm) / 110

So with a 600mm lens or telescope, they will appear about 600/110 = 5.5mm across. An APS cropped-frame camera has a sensor 15mm tall, a full-frame camera 24mm tall. So you can see how much of the frame the solar/lunar disk will occupy. The corona extends 2 to 4 times farther.

But make the image big and you'll fight the motion of the sky if you are not tracking the sky. Below are roughly the longest exposures you can use before sky motion will blur the image.

Focal Length	Maximum Exposure
400mm	1 second
600mm	0.8 seconds
800mm	0.6 seconds
1200mm	0.4 seconds





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FOCAL LENGTH *VS.* EXPOSURE TIME

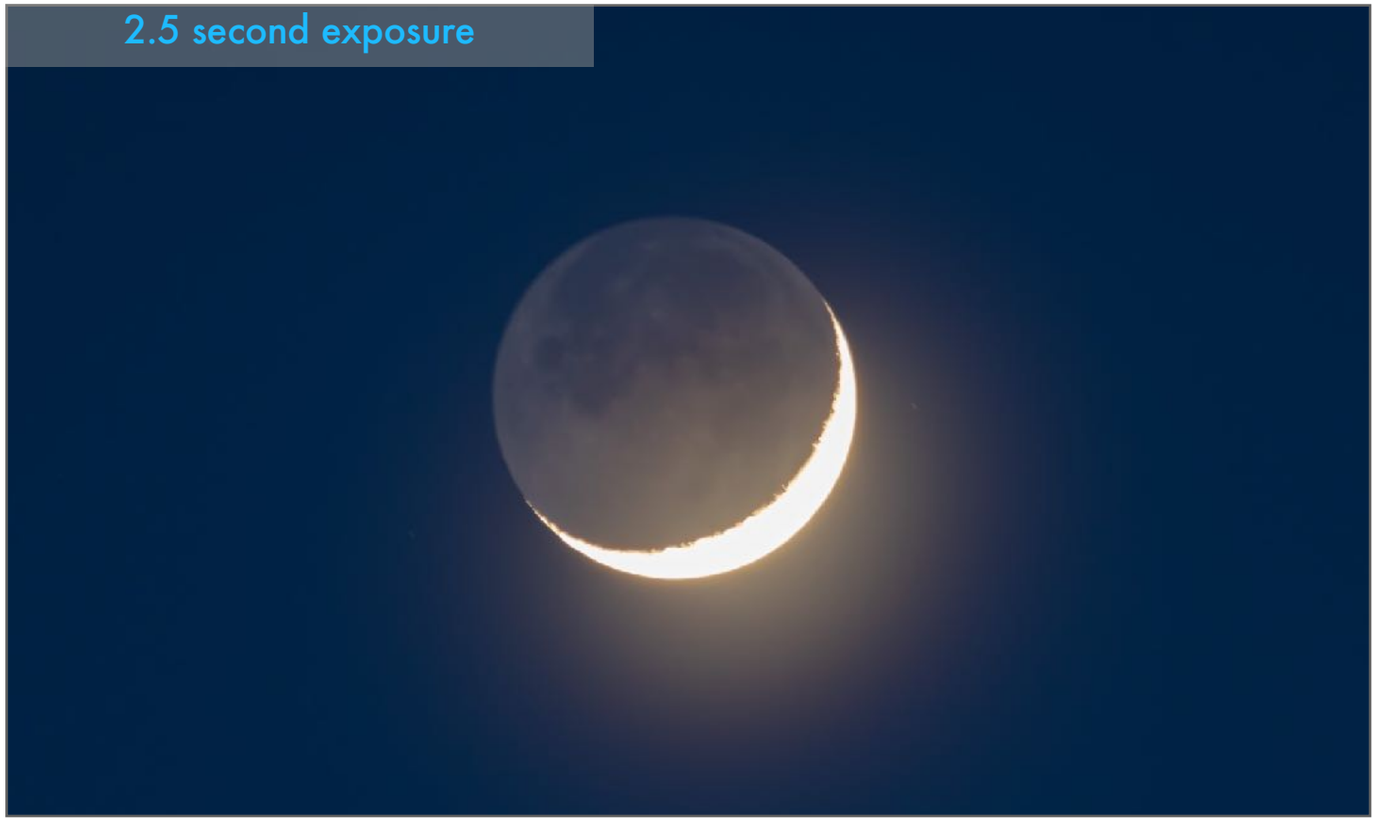
This page shows examples of blow-ups of the Moon taken with an untracked 400mm lens, illustrating the effect of sky motion vs. exposure time.

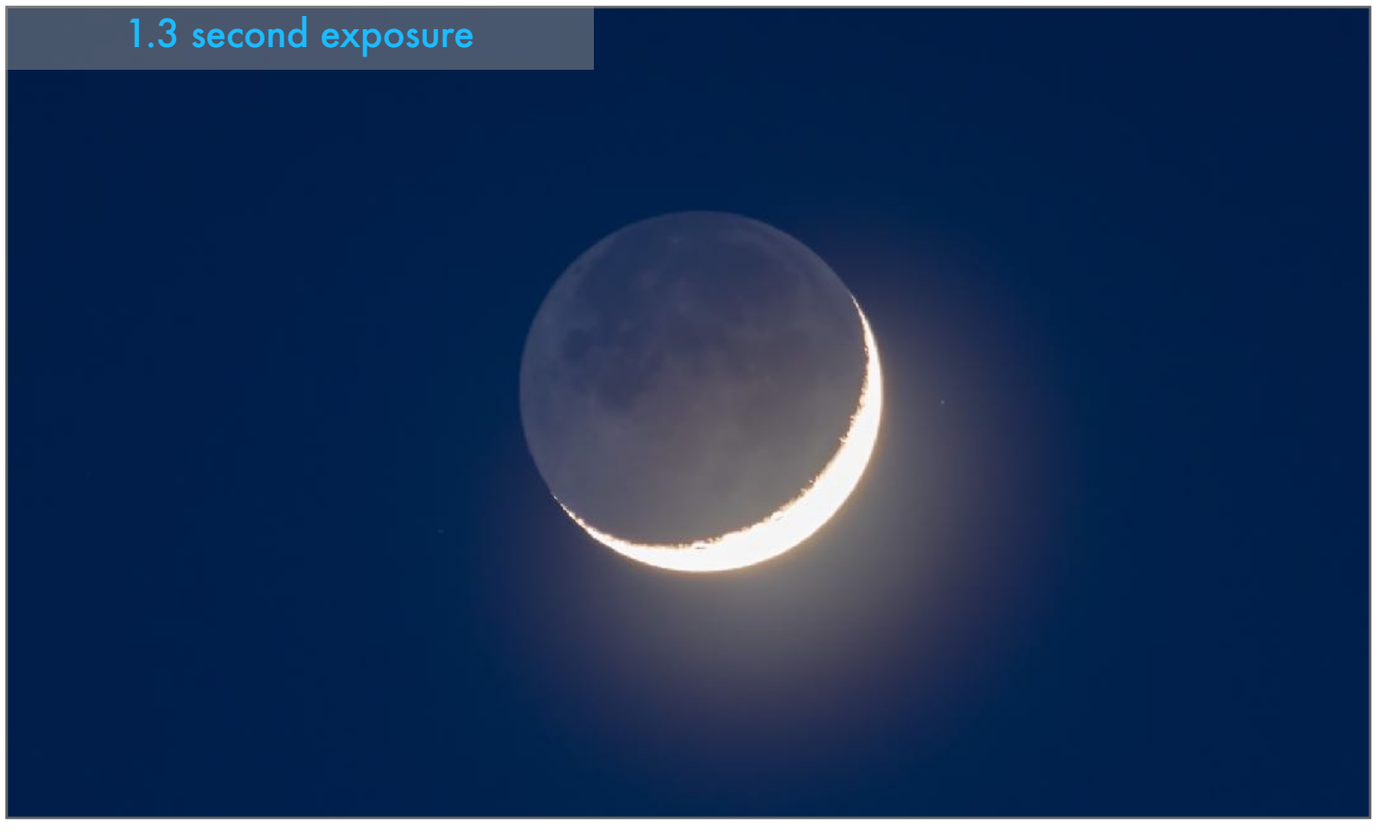
As per the table on the previous page, these examples show how much blurring is introduced when using an untracked telephoto lens or telescope, in this case a 100mm-400mm telephoto zoom set to 400mm. Being a slow f/8 lens at this focal length exposures had to be 1 second or longer at ISO 400 to pick up the Earthshine, which is similar to the outer corona.

But even the 1.3-second exposure shows noticeable blurring of the limb of the Moon. The corona around the eclipsed Sun will be more forgiving, but not the sharp edge of the Moon nor the red prominences.

The lesson here for long focal lengths is, either:

- ☑ Use a higher ISO, which means more noise.
- ☑ Use a faster lens, which is heavy and costly.
- ☑ Use a tracker to follow the sky.
- ☑ Or just ensure you also shoot short exposures for the prominences and bright inner corona.





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GOING FOR THE BIG ECLIPSE

If you really want to frame in tight for detailed images of the prominences and chromosphere a 1000mm+ focal length will do the job.

I shot the background image in 1979 on Kodachrome film using a 1400mm focal length Questar 3.5-inch telescope. It worked great!

A 2000mm focal-length scope, typical of popular 8-inch aperture Schmidt-Cassegrain telescopes, will frame the Sun – very tight!

I think the latter is far too much focal length, and even 1300mm to 1500mm is pushing it.

Go for it, if that's what you are after, such as detailed images of prominences.

But any telescope of this focal length class (much over 800mm) must be placed on a motorized mount capable of tracking the Sun and sky: either a traditional equatorial mount or a Go To alt-azimuth mount, both explained later.

February 26, 1979, southern Manitoba

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CHOOSING A TELESCOPE

TIP: When aiming at the Sun and viewing the eclipse, always filter, cap, or remove any finder scopes or finder aids so they, too, don't get fried!

My recommendation is to use a small apochromatic (apo) refractor. Lower-cost achromatic refractors can work well, as can compact reflectors.

For eclipses, I like 66mm- to 100mm-aperture apo refractors. They are deadly sharp, color-free, compact and sturdy for travel, and lightweight. With an f-ratio typically of f/5 to f/7, they offer focal lengths in the sweet spot of 400mm to 700mm. Lower-cost achromatic refractors, such as this 90mm Sky-Watcher, will work fine. But expect some blue "chromatic aberration" fringing on the edge of the Moon and on diamond rings.

66mm
apochromatic refractor

The 66mm aperture f/7 aperture William Optics refractor below is what I used to shoot the 2006 eclipse in Libya, images I use liberally throughout the book.

The 90mm aperture f/10 achromatic refractor shown is typical of popular beginner's telescopes. Especially if mounted on a motorized equatorial mount, as shown, it will work well, though has 900mm of focal length, fairly long.

The Meade 90mm ETX has the same aperture as the refractor but with 1250mm of focal length, at f/14. But it can track the sky and is very compact for travel. However, the Meade ETX models cannot aim up high enough with a camera attached when used in their alt-azimuth mode. They must be tipped over and aligned in an equatorial mode, as shown.

Low-cost Newtonian reflectors (not shown) might work, but often are not designed to reach focus with a camera attached. Test!

90mm achromatic refractor

90mm Maksutov-Cassegrain
reflector

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CAMERA ADAPTERS

TIP: Some refractors require accessory “field flatteners” and “focal reducers” intended for deep-sky photography. These shouldn’t be necessary for the 2024 eclipse, as there are no bright stars or planets near the Sun. The added lenses can contribute lens flares at the diamond rings.

No matter what your telescope, you will need an adapter to attach your camera body to the telescope, in place of the eyepiece.

The best way to attach a DSLR or DSLM camera body (with no lens on it) is to use a camera adapter tube that then screws onto or slides into the focuser of the telescope. The telescope becomes the lens. You are then shooting at whatever f-ratio the telescope offers, typically f/6 to f/10. But that’s fine.

What I do not recommend is what is called an “afocal” attachment, where you keep the lens on the camera and mount it so it is looking into a low-power eyepiece on the telescope. That introduces too many lenses into the light path, too many chances for flares and light leaks, and generally poor optical quality.

Users of mirrorless cameras might also need to use a lens adapter, to go from the standard T-rings shown here made for older DSLR lens mounts, to the newer lens mounts used on Canon R, Nikon Z and Sony Alpha DSLMs.

Adapters vary with the type of telescope. In most cases you will also need a T-ring for your brand of camera and its lens mount. Telescope dealers will stock the right adapter and T-ring for your telescope and camera. Get them well before the eclipse and take test shots of the Moon.

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CHOOSING A MOUNT

There are two kinds of telescope mounts: "alt-azimuth" that usually cannot track, and ones that do, usually "equatorial." Either type needs to be:

- ☑ Solid enough to hold your lens or scope. And it must be able to aim up high, to 60° or 70°. Mounts for sports and wildlife photography may not. Even some scope mounts fail here.
- ☑ Easy to move and aim, perhaps with slow-motion controls. That's especially important if you are not tracking the Sun and need to keep re-positioning it in the frame.

All of the mounts below will work quite well. The three on the left are non-motorized alt-azimuth mounts. They would require constant attention to re-center the Sun every few seconds. However, all are easy to adjust in both axes. The Voyager and AZ2 mounts have slow-motion controls for this.

With the little Stellarvue M1 you just nudge the mount with its handle. Its motions are smooth enough that it works well – I shot two eclipses with it.

The Celestron is also an alt-azimuth mount, but with a computer-controlled motor on each axis so it can follow the sky and keep the Sun centered. But to do so, the mount requires an initial alignment on the sky, discussed later.

The EQ3 is an example of a classic "German equatorial" mount. Its rotation axis needs to be aimed at the North Celestial Pole. Its single motor will then turn the scope around that one axis to keep targets centered.

Alt-Azimuth
Stellarvue M1

Alt-Az mounts move left-right and up-down. They cannot follow the sky with one motion.

Alt-Azimuth
Astro-Tech Voyager

The knobs & cables are slow-motion controls.

Alt-Azimuth
Sky-Watcher AZ2

Computerized "Go To" alt-az mounts can track the sky.

Alt-Azimuth Go To
Celestron NexStar 6SE

Equatorial mounts can track with a simple DC motor on one axis.

Motorized Equatorial
Sky-Watcher EQ3

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CHOOSING A RIG

If you are using a small and portable equatorial mount, don't weigh it down with too large and heavy a load.

☑ A 60mm to 90mm apo refractor is ideal for eclipses. But check that the mount you wish to use will handle its weight without vibration and moving off target unexpectedly.

☑ Test your combination with the mount set to the latitude you plan to be at, and with the telescope aimed to where the Sun will be during the eclipse. Make sure no parts collide and that the mount can track throughout the eclipse.

Askar V 60mm
On Sky-Watcher Star Adventurer GTi

SharpStar 94mm EDPH
On Sky-Watcher EQM-35

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USING A TRACKER ?

Many will be tempted to load one of these small tracker mounts designed for wide-angle Milky Way photography with a long telephoto lens. Maybe ...

In recent years several small equatorial mounts have been introduced specifically to be highly portable and ideal for shooting tracked images of the night sky. I use these units all the time, and good models are available from both iOptron and Sky-Watcher.

While they do work fine, I would caution against loading any small tracker with a lens longer and heavier than it is intended for, typically 200mm at best. While the short exposures needed for an eclipse are less demanding than long deep-sky images, the assembly can still be prone to vibration, from you touching the camera. Any vibration will negate the very detail you are after. In addition, if the mount slips off target you will be in a panic to recenter the Sun. Small trackers don't have full slow-motion adjustments, essential for shooting with telephotos and telescopes. But test one on the Moon. Are images sharp? Can you aim it well?

Polar Alignment by Day

All trackers need to be polar aligned for their tracking to be of value. One method is to use an app like Polar Scope Align Pro. Place the phone on the top surface of the tracker so (with this app) the top of the phone points up along the polar axis of the tracker. A graphic shows the location of the Celestial Pole. This will produce only a rough polar alignment.

Sky-Watcher Star Adventurer 2i with 135mm lens and counterweight kit

iOptron Sky-Guider Pro with 200mm lens and included counterweight

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USING A TRACKER? – CHECK!

True of any mount or tripod, but with small sky trackers it is imperative to check your camera can aim up high enough without parts colliding.

With sky trackers when they are polar aligned, the top plate where you attach a ball head is now tipped over at an angle. As a result, the ball head (or whatever type of head you use) might not allow the camera to aim up high enough to sight the Sun. This especially critical for sites in Mexico and Texas where the Sun will be 60° to 70° high and due south.

In the example here, the bolt for clamping the camera's dovetail plate is colliding with the base of the tracker. This is not something you want to find out on eclipse day.

Accessory V-plates are available that provide a level platform for the ball head to attach to. But in my experience they can slip and collapse. One will do so just before totality! Guaranteed.

This is a Canon telephoto lens on a ball head attached to a Sky-Watcher Star Adventurer GTi tracking mount.

Note the collision of the lock bolt with the mount's top plate.

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THE MOTION OF THE SKY AND SUN

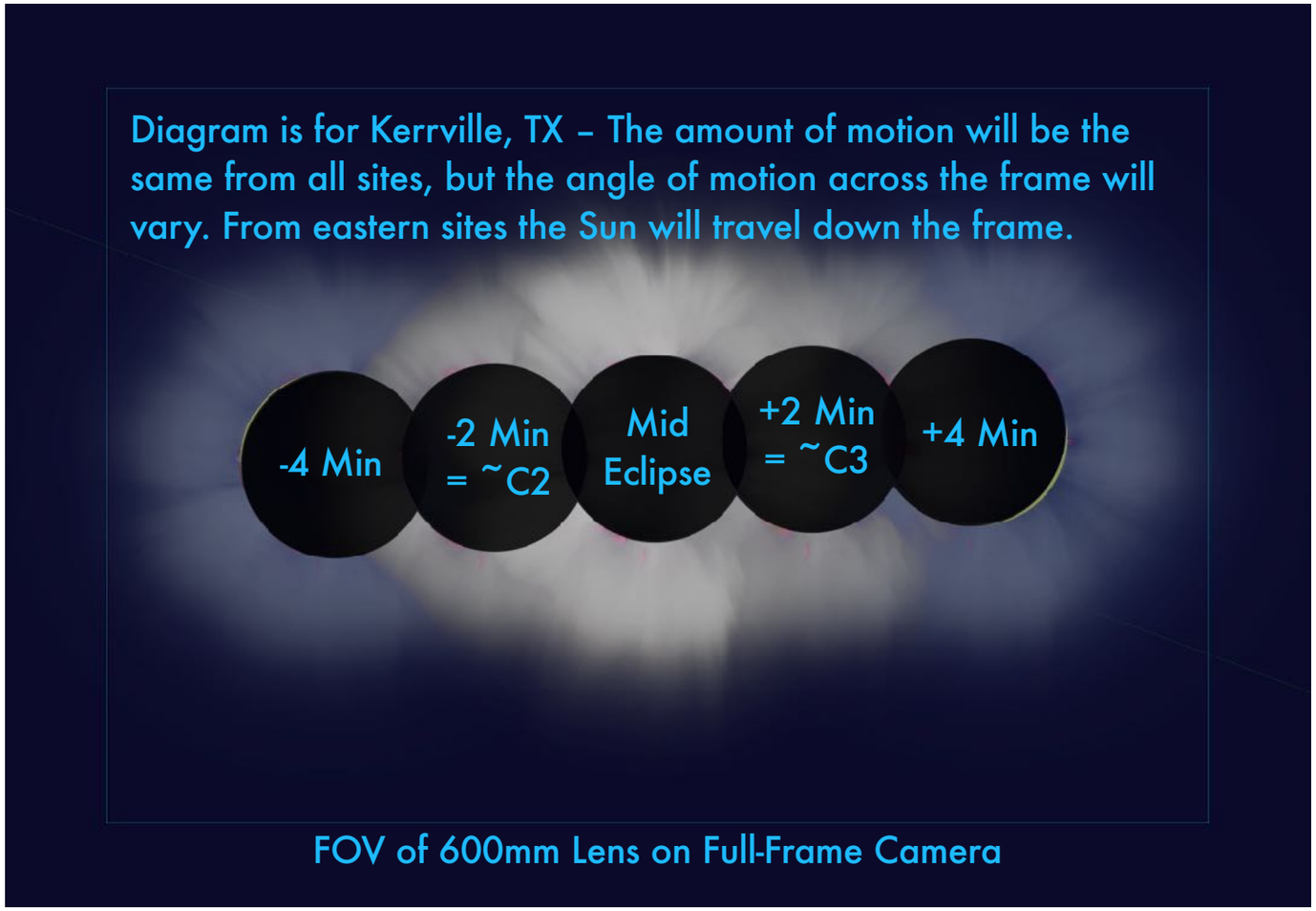
The longer the focal length you shoot with, the more you have to be aware how much the Sun will move during the 3 to 4.5 minutes of totality.

The east-to-west motion of the sky will carry the Sun (and Moon) its own diameter across the frame in about **2.5 minutes**. Keeping the Sun centered in a long lens will be constant work. Plus, with 300mm or longer lenses the Sun will move enough **during exposures 1-second or longer** to blur the Moon and corona detail. Fuzzy images are too often the norm.

If you are <u>not</u> tracking the sky, and want to capture the faint outer corona with a long lens, use higher ISO speeds (400 or more) to keep maximum exposures well under a second.

However, by employing a mount that can track the sky, you gain two advantages:

- ☑ The image remains centered = less work!
- ☑ And the image will be sharper from less motion. A tracking mount need not be an equatorial mount, as I show next.



This shows how much the motion of the sky will carry the Sun and Moon across your frame during 4 minutes on either side of totality, <u>if</u> you are using a mount that is <u>not</u> tracking the sky. With long focal lengths, especially with cropped-frame cameras, if you place the Sun at the center of the frame as totality starts, it could move out of frame by the end of totality. You will need to constantly re-adjust the positioning to keep the Sun centered and not crop the corona. Using a shorter focal length lens or scope makes the task easier.

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TRACKING THE SUN – A "GO TO" ALT-AZIMUTH

To track the sky you could use a "Go To" telescope like this, with an altitude-azimuth (alt-az) mount that follows the sky once it is aligned correctly.

These kinds of computerized "Go To" telescopes are very popular. They have computer-controlled motors to move the scope constantly left to right and up-down to keep images centered. They will work fine. However, as the telescope tracks the Sun over the eclipse, the image will rotate slowly in the frame. Note how the Moon enters at the 3 o'clock position (first frame) and leaves at the 11 o'clock position (last frame). This field rotation is a concern only if you are attempting to take a sequence of the complete eclipse from first to last contact and intend to make a time-lapse movie – in it the Moon will move in a curve!

Small alt-az Go To scopes, like the Celestron NexStar 6 Schmidt-Cassegrain, are portable. However, this model does have a very long 1500mm focal length at f/10. But its ability to track prevents blurring, despite the long focal length and longer exposures needed due to the slow f-ratio.

Also, any image rotation (as shown above) won't be an issue when shooting just during totality, only for ambitious C1 to C4 time-lapses.

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TRACKING THE SUN – AN EQUATORIAL MOUNT

Motorized equatorial mounts can track the sky without image rotation. They don't need to be "Go To" scopes, but they do need to be polar aligned.

A classic equatorial mount such as this can follow the sky automatically, without any fancy computers, provided it has a motor on the "right ascension" or "polar" axis. These are battery powered. With such a mount the image won't rotate and the Moon will appear to move, as it really does, in a straight path across the Sun, as shown here. However, the mount's rotation axis needs to be aimed up at the North Celestial Pole, near Polaris. Easy if you can set up the night before. But aligning a mount like this, or even a computerized Go To mount, is tricky in the daytime on eclipse day.

Small equatorial mounts will work well, but must be equipped with a motor on the "polar" axis to turn the mount at the same rate as the sky turns. If the image drifts, use the buttons to recenter it.

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ALIGNING AN ALT-AZ GOTO MOUNT IN THE DAY

To get an alt-az Go To scope tracking you must tell it where it is, when it is, and then aim at a known object to align the mount. That's the Sun!

You don't need to be able to find things precisely in the sky, you just want the telescope to track the Sun for a few minutes. So an accurate "Go To" alignment isn't necessary. But to start the tracking motors, you do need to align on something, ideally the Sun.

You also need ensure the controller is set to the correct time and location. Enter both manually if it does not have GPS built-in. Watch your time zone and Daylight Time correction: answer Yes.

You might then be able to perform a single-object or "Solar System Align" on the Sun. Some systems have a menu lockout you need to turn off to allow aiming at the Sun. Or they don't allow you to align on or aim at the Sun at all. In that case, choose the Moon. It's near the Sun!

While it might be possible to align on Venus, finding it in the day sky will not be easy.

Celestron mounts allow you to align on Solar System targets such as the Moon or Sun. Be sure to have Alt-Az Tracking turned ON. And tracking set at the Solar rate. Practice aligning on the Sun or New Moon prior to the eclipse.

If you can set up the night before, you can perform a full 2- or 3-star alignment. You put the scope into Park or Hibernate to wake it up on eclipse morning to resume tracking, already aligned.

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ALIGNING AN EQUATORIAL MOUNT IN THE DAY

Classic equatorial mounts like this one need to have their rotation axis aimed to the North Celestial Pole, near Polaris. At night that's easy!

As with Go To scopes, the job is much easier if you can polar align the night before. Most have small polar alignment scopes to allow this. If you can't align at night, then: **1) Set** the mount's altitude axis to your current latitude (as shown) **2) Level** the mount, and then **3) Aim** the polar axis true north (not magnetic north). An app on your phone can tell you where this is. Or use a polar alignment app with a Daytime routine, such as I showed earlier. While rough, it will be good enough to track the Sun during totality.

If all you can do is a rough alignment, then best not to plan to shoot a complete C1 to C4 time-lapse, or you will be faced with lots of tedious image alignment in processing. **NOTE**: If the mount is also a Go To, you needn't align the computer system so it can find things – tell the mount to skip alignment and simply track. Most have that option.

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SECTION 3

FOCUSING

As with wide-angle scenes, people worry about the absolute “best” exposure when shooting close-ups. In reality, a large range of exposures will work well, and if you shoot Raw you have even more latitude for correcting exposures in processing. Not so with focus. You must have a precisely focused original image coming out of the camera. Only then will you record sharp prominences, the sharp-edged limb of the Moon, and fine structures in the corona.

November 14, 2012, Queensland, Australia with 105mm Traveler telescope (600mm focal length)

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FOCUSING THE IMAGE

TIP: Auto-Focus lenses are often not in sharpest focus for the sky when set to Infinity (∞).

The best way to focus with DSLRs is to use Live View to focus on the edge of the Sun or Moon, or on a sunspot group during the partial phase.

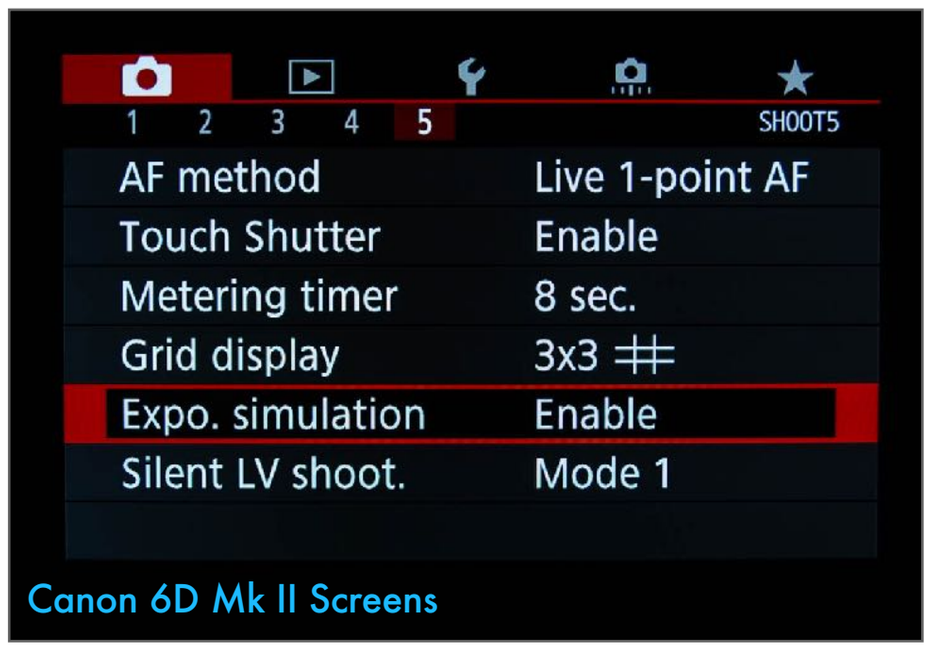
Telescopes must be manually focused. Even telephoto lenses cannot be simply dialed to the Infinity (∞) mark and be done. That might not be the point of sharpest focus. You must manually focus using Live View. (DSLM cameras are always in Live View on the rear LCD screen).

Trust me – the focus does **not** shift when you remove a front-aperture solar filter. You can focus on the filtered Sun and be assured the focus will work during totality without the filter. There is no need to refocus during totality.

The only caveat is that the focus might shift through the eclipse as the temperature changes (as the air gets hotter through the day, or colder with the decrease in sunlight). This can shift focus slightly with long telephotos and telescopes. For that reason, it is best to touch up focus in ample time before totality, using the sharp tip of the crescent Sun, or a sunspot.

When in Live View, zoom up using the 5x, 10x, or higher zoom mode of Live View to precisely focus on the limb of the Sun or Moon, or tip of the crescent. When using a zoom lens always focus with it zoomed to the setting you will use. This image is a simulation.

First, with DSLRs be sure to Enable Live View. The Exposure Simulation mode, when turned on, better simulates the view with long exposures. This might help make the image more visible in dark scenes, but won't make any difference for bright objects.



Canon 6D Mk II Screens

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CHOOSING A CAMERA

When shooting up at a high angle, as you will be for totality, a camera with a flip-out LCD screen will be a welcome luxury.

If your older camera does not have a flip-out or articulated LCD screen you'll have to work harder to look up at the screen to focus, and/or crank the tripod up that much higher, making it less stable. If you can't see the screen well, you might misjudge focus.

In lieu of articulated LCD screens, a right-angle finder helps when framing the Sun, but is not accurate enough for focusing.

When placed on a telescope aimed up high, an articulated LCD screen makes it easy to focus, and then to follow the eclipse in Live View, so you can check if the image is remaining centered. A top-mounted LCD settings screen, lacking on some cameras, is also handy. It allows you to check settings while looking down on the camera that is aimed up high.

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SHOOTING AND SEEING – SIDE-BY-SIDE SCOPES

While you can watch the eclipse on your Live View camera screen, another option is a tandem scope setup, one for photos and one for looking.

While having two telescopes side-by-side on the same mount demands a good mount, you do have the advantage of not only getting great images but also great views. An optical eyepiece will show much more than a camera's Live View screen.

Such an arrangement takes more time to set up, to be sure both telescopes are co-aligned. If they are, then the optical scope can serve as a gauge of whether the image is still centered OK in the photo scope. You can operate the camera at the same time as you are looking through the eyepiece. Very nice, but ...

... The risk is that if you don't pay proper attention to the photo scope, you could shoot away and not realize you've done something stupid like leave the solar filter on the photo scope. An alternative is to simply have a pair of binoculars handy for some quick views.

This Sky-Watcher AZ-EQ5 mount is an example of a telescope mount designed to accommodate dual telescopes, such as the 66mm (left) and 80mm (right) aperture apo refractors, two favorites in my collection. Either one could be fitted out as the photo scope and the other used as the visual scope. Adjustments at left allow the smaller scope to be aligned to the main scope, so their framing is identical.

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SHOOTING AND SEEING – STACKED SCOPES

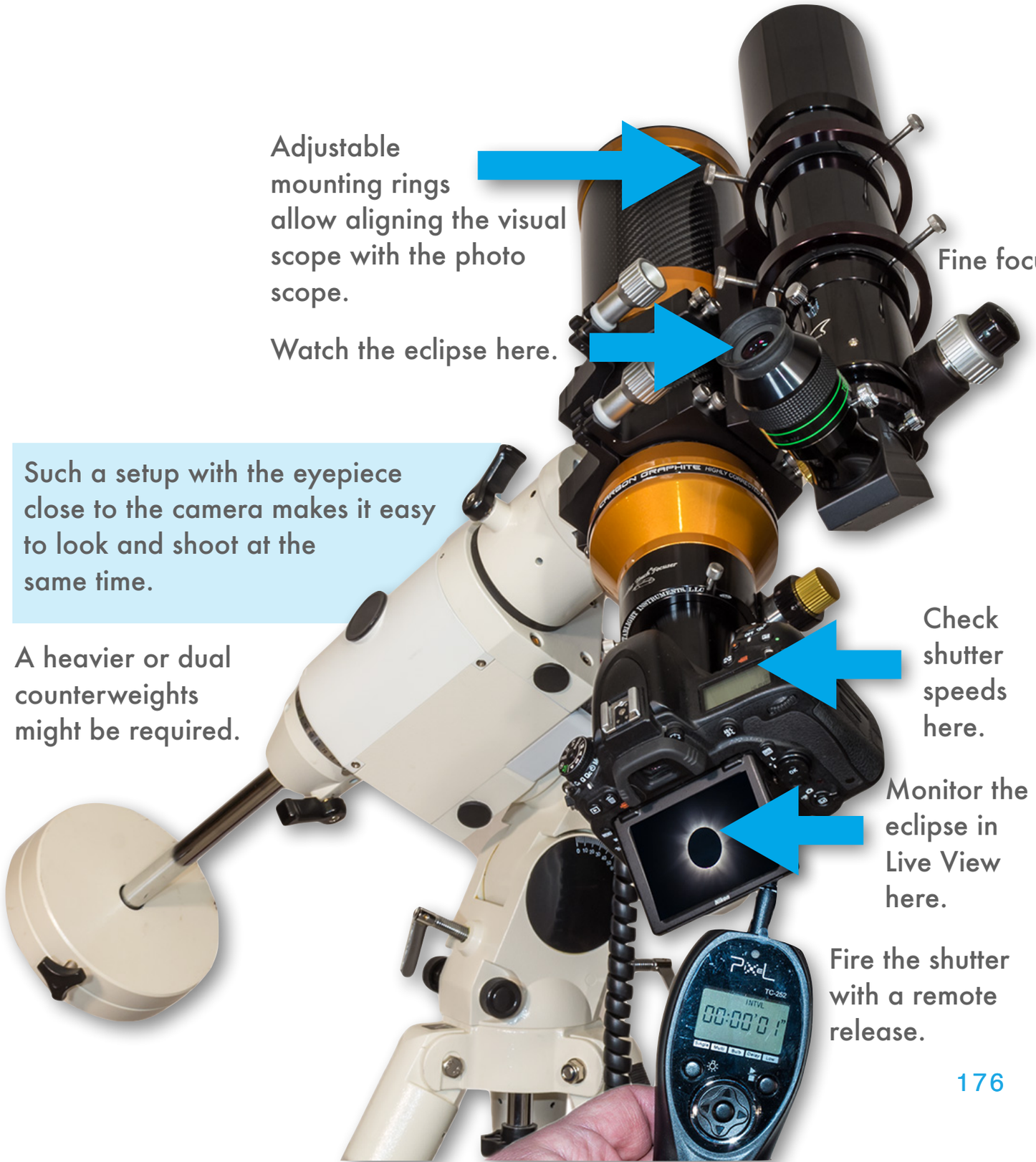
The previous arrangement requires a mount designed to handle tandem telescopes. This "stacked" arrangement will work on most mounts.

Here's a setup similar to one I used in 2017. The mount is a venerable Sky-Watcher HEQ5. There are many other fine mounts in this ~$1,000 price and size class, such as the Sky-Watcher EQM-35 and Celestron AVX. Larger telescopes will require larger (> $2,000) mounts, and there are many to choose from on the market.

The 80mm f/6 and 66mm f/7 apo refractors are the largest combo I'd use with this mount. I caution about saddling a portable mount with too much weight, as the mount can become bouncy and vibration prone. On test nights, check:

- ☑ That images are not blurry from vibration.
- ☑ That the drive is tracking OK with the weight.
- ☑ And that the added scope is secure.

Solid mounting hardware can be purchased from ADM, Losmandy and perhaps your telescope manufacturer and local or national dealers.



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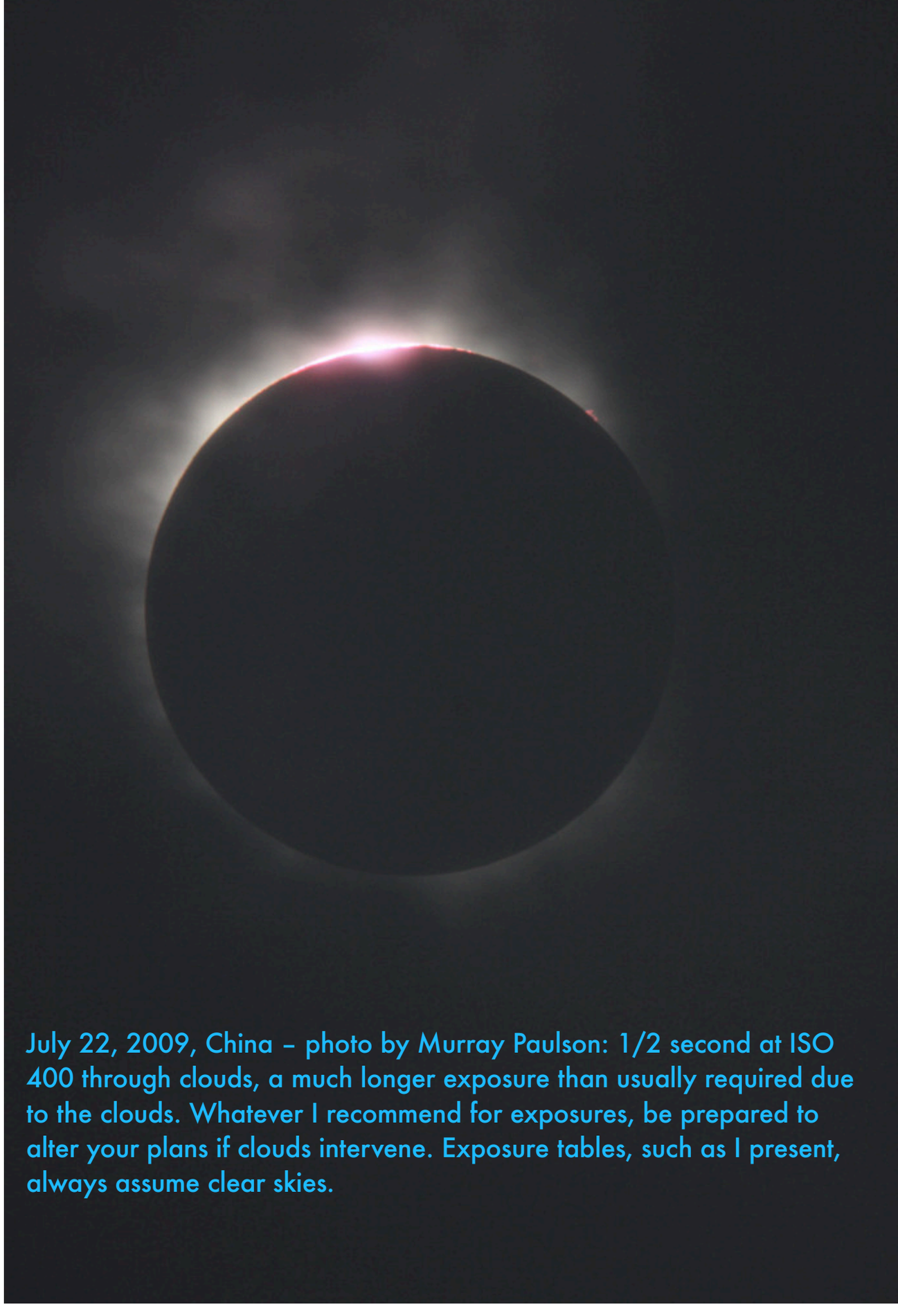
SECTION 4

SETTING EXPOSURES

Now, the big question everyone wants to know: What exposures do I use? While wide shots can be taken on Auto Exposure, close-ups are best shot using a wide range of manually-set exposures. Only then will you capture the wide range of eclipse phenomena, from the dazzling diamond ring to the faint wisps of the outer corona. No one exposure can do it all. Having a rehearsed “exposure plan” is essential to success. You have to know how to adjust your camera by feel.



July 22, 2009, China – photo by Murray Paulson: 1/2 second at ISO 400 through clouds, a much longer exposure than usually required due to the clouds. Whatever I recommend for exposures, be prepared to alter your plans if clouds intervene. Exposure tables, such as I present, always assume clear skies.

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WHAT'S THE BEST EXPOSURE?

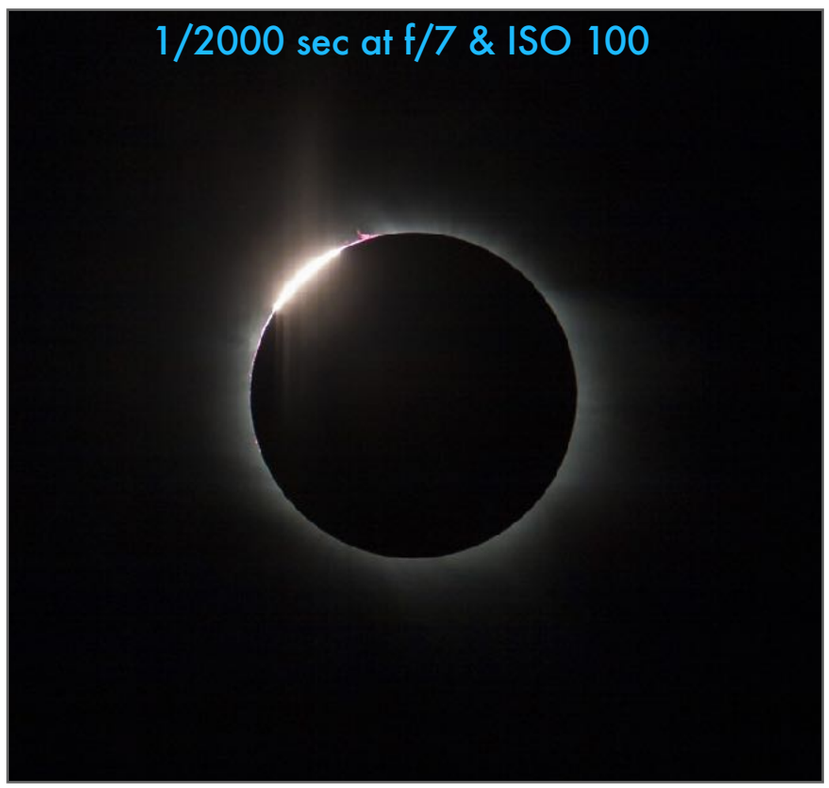
Dial "M" for Manual !

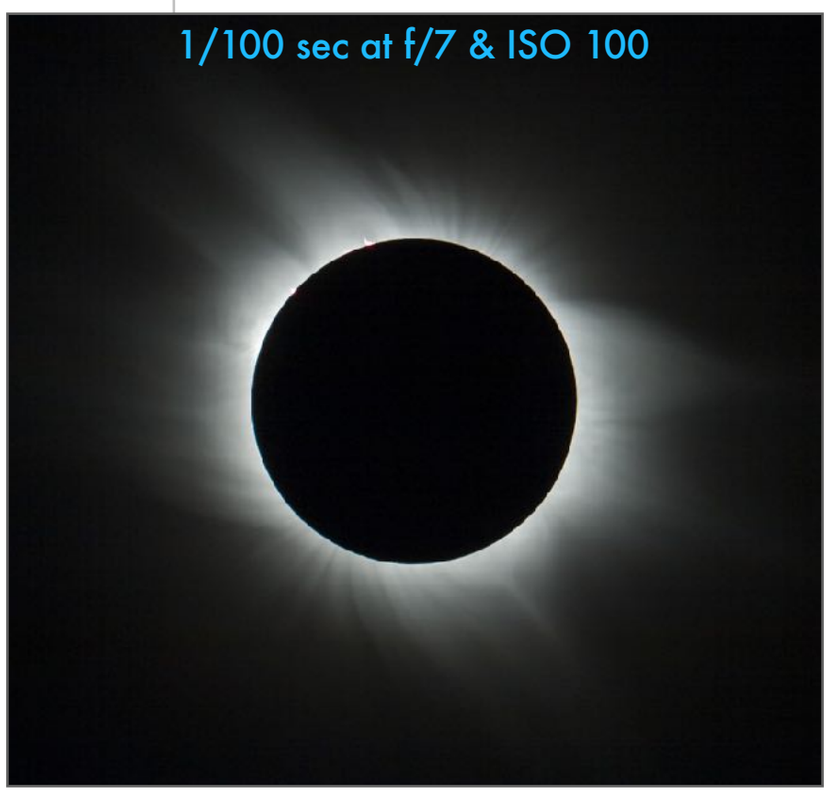
No one exposure is best for totality. Indeed, no one exposure can capture all that your eye can see during totality. Slow ISO speeds are all you need.

Short exposures capture the diamond rings and prominences. Longer exposures capture more of the corona. Use the table as a guide to the approximate exposures. **NOTE**: You do not need to use high ISOs unless you are shooting the outer corona with a slow f-ratio untracked scope.

ISO	Diamond Rings	Prominences	Inner Corona	Middle Corona	Outer Corona
100	1/4000	1/2000	1/125	1/8	1 sec
200	1/8000	1/4000	1/250	1/15	1/2 sec
400	–	1/8000	1/500	1/30	1/4 sec
800	–	–	1/1000	1/60	1/8 sec

The table assumes an f-ratio of f/5.6 to f/6, typical of long telephotos and small telescopes. Increase (lengthen) exposure times by factor of 2 for f/8, by factor of 4 for f/11; i.e. at f/11 the outer corona would require 4 seconds at ISO 100.





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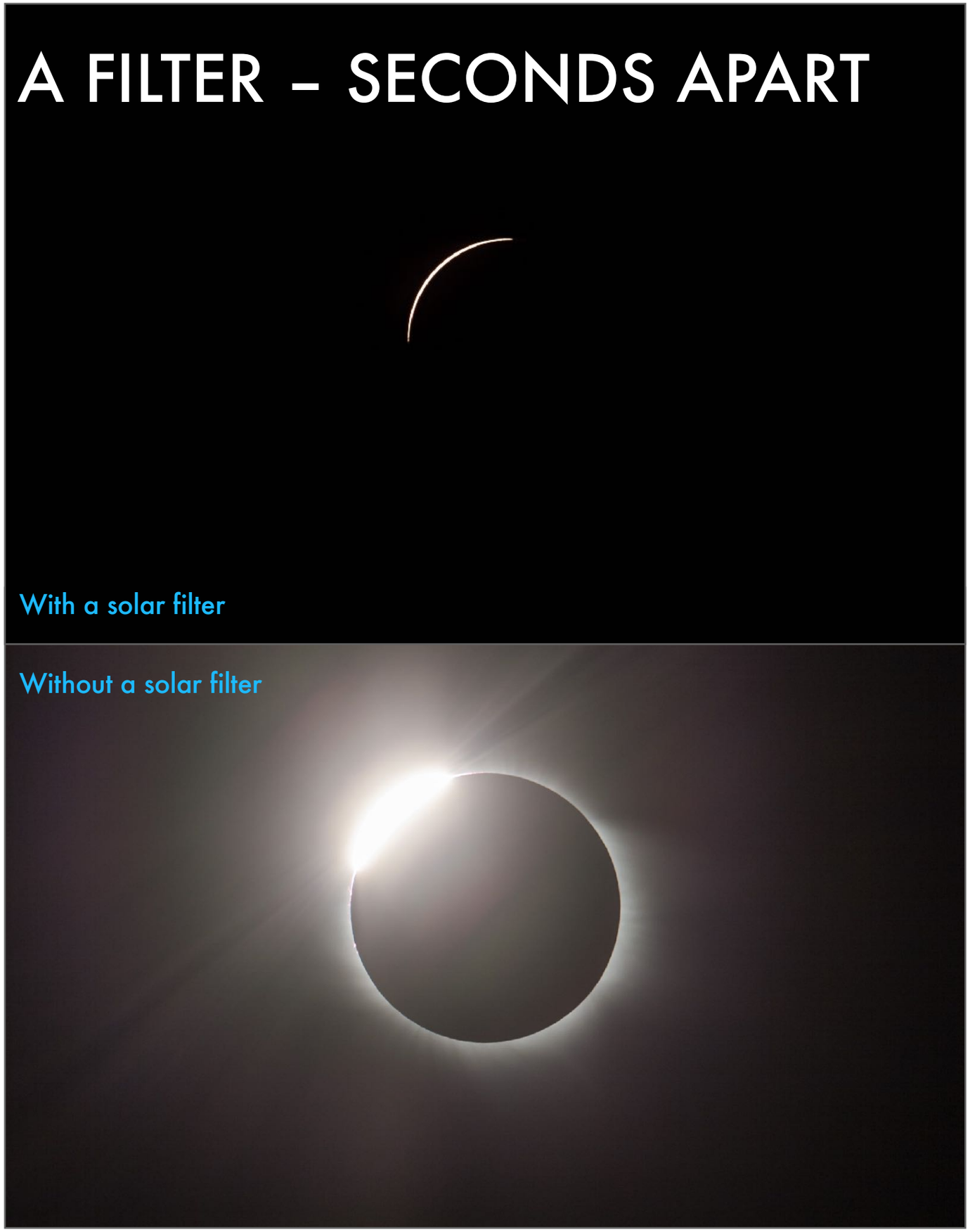
WITH AND WITHOUT A FILTER – SECONDS APART

Again, the all-important question: When to remove the filter? For catching the diamond ring, it's when the Sun gets as small as you see at top right.

These two images were taken moments apart at the 2006 eclipse in Libya – separated by just enough time to remove the filter.

However, no exposure adjustment was needed – both are at 1/640 second through an f/7 telescope at ISO 100. The short exposure worked for both the final filtered shots of the crescent Sun and the unfiltered shots of the diamond ring – very convenient!

However, as I stated earlier, while you can look at the unfiltered Sun like this on your camera's Live View LCD screen, do not look at the unfiltered Sun during the initial diamond ring through an optical eyepiece, such as with binoculars or a telescope, not until the diamond ring is over and the Sun's blinding photosphere is completely covered by the Moon. Then, you can gaze in wonder at the corona. If you remember to look! I almost didn't in 2017.



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LENS FLARES

TIP: If you are shooting with a lens (rather than a telescope) try to shoot with the lens aperture wide open if you can. Stopping down will introduce bright diffraction spikes – a "Sun-star" effect – on the Diamond rings. While you might like that effect, I think it can be distracting.

The diamond rings will be a severe test of optics. They will reveal lens flares and ghost images.

As with the previous pair, these two images were taken moments apart, but at the 2017 eclipse in Idaho – again, separated by just enough time to replace the filter at C3.

But without the filter, the full blast of the sunlight causes internal reflections in the optics. Remove any UV or Skylight filters on lenses. But in this case I think it was from the field flattener lens I had on the refractor telescope I used in 2017. It would have been better not to use it. However, that year the bright star Regulus was in the frame, and I wanted it to be sharp at the corners. In 2024, there are no bright stars near the Sun.

Try shooting with your telescope both with and without any accessory optics such as field flatteners, focal reducers, or tele-extenders. Shoot the bright crescent Moon and overexpose it as a stand-in for the eclipsed Sun. Place the bright crescent off-center.

Both are 1/2500-second exposures, seconds apart at third contact, but without a filter (top) and with a solar filter (bottom).

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BURST MODE / CONTINUOUS SHOOTING

For the brief seconds of the diamond rings you could have the camera in Continuous or Burst mode to fire off a rapid set of shots.

Today's cameras can shoot at up to 20 frames per second in Continuous or High-Speed mode when you hold down the remote shutter release button. It's one way to capture the diamond rings and Baily's Beads. The downside is that after X shots your camera will lock up as it writes images to the card. This will prevent you from taking more photos, just at a critical time.

To give you an idea how long you need your camera to work, the time from first photo (left) to last (right) is about 30 seconds, with 15 seconds often long enough to capture the fleeting diamond ring and Baily's Beads.

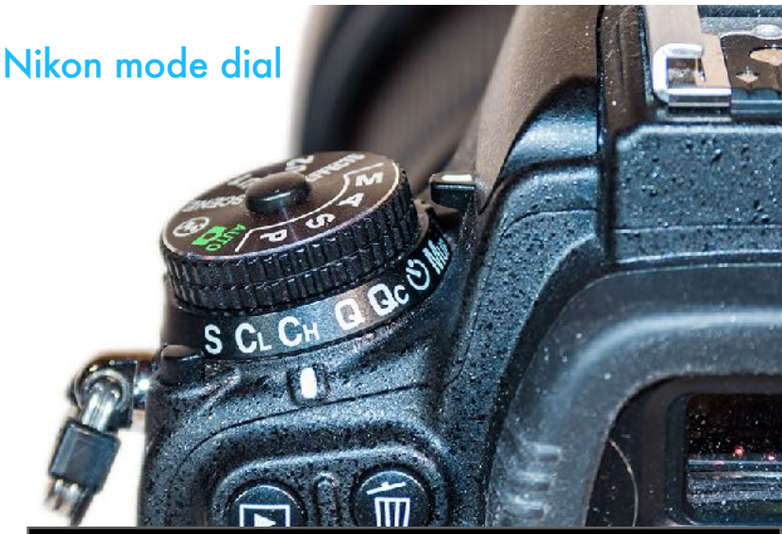
Cameras vary in how many Raw frames they can shoot in Continuous before the camera has to take time out to write them to the memory card. Test!

The other issue for DSLR cameras is that vibration from mirror slap can blur images. By using the camera in Live View you both lock up the mirror and see what's going on.

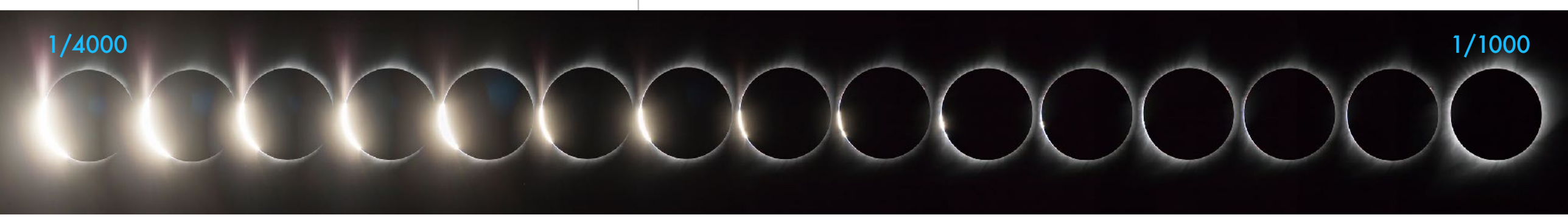
Even so, test your setup by shooting the Moon with and without a similar rapid-fire Continuous burst, to see if image sharpness is degraded.

And as I note in Chapter 4, at the 2023 annular the Canon R5 failed at C3 due to a firmware Error70!

Nikon mode dial



Canon R5 screen



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HIGH-SPEED CONTINUOUS OPTIONS

Cameras vary considerably in their high-speed shooting options and capabilities. Test by shooting the Moon to check for vibration.

While shooting the diamond rings at the highest speed possible might work, test your camera to see how it behaves. How long does it take to fill the buffer then write the images to the card and allow shooting again? Using a high-speed memory card will help a lot. Use Electronic First-Curtain Shutter (EFCS) on mirrorless cameras. While Electronic Shutter can provide faster burst rates, the dynamic range might be degraded to 12-bits, and the shutter speed limited to faster than 0.5 seconds. I would strongly advise staying with EFCS. Test your camera over a burst lasting 15 to 20 seconds. Check:

- ☑ How soon does the camera recover and allow shooting again?
- ☑ What happens if you want to press the shutter later for single shots? Do you get a burst?
- ☑ Does vibration blur the image? Shoot the Moon using the gear you intend to use.

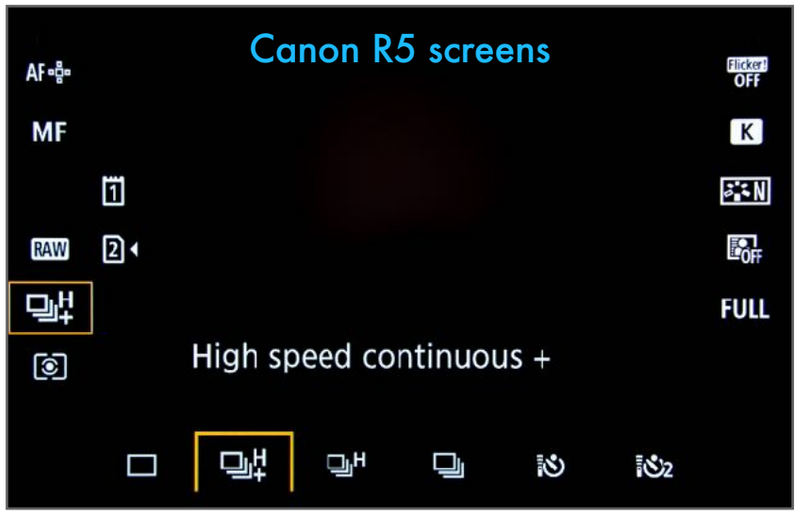
As an example, over 20 seconds my Canon R5 can shoot 180 full Raw frames at HighSpeed+, 120 frames at HighSpeed, and 60 at LowSpeed, all with Electronic First Curtain Shutter and with a shutter speed of 1/4000 second, typical for diamond rings.

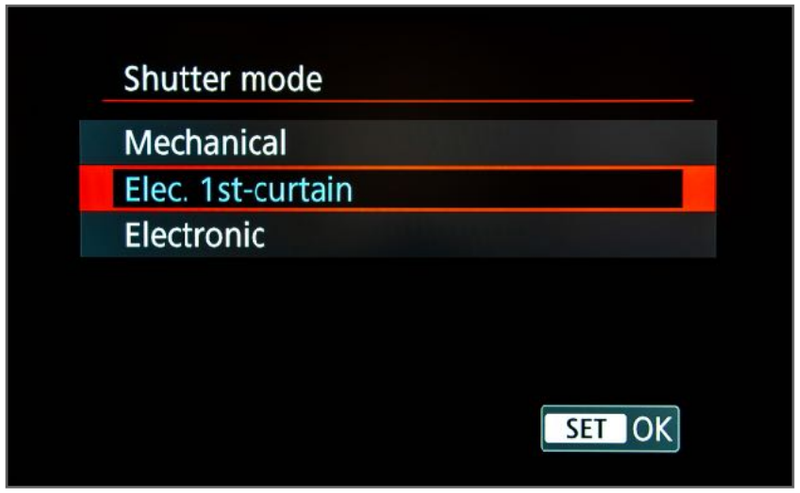
In Electronic Shutter it can shoot 250 frames at both HighSpeed+ and HighSpeed, though it slows down halfway through the burst.

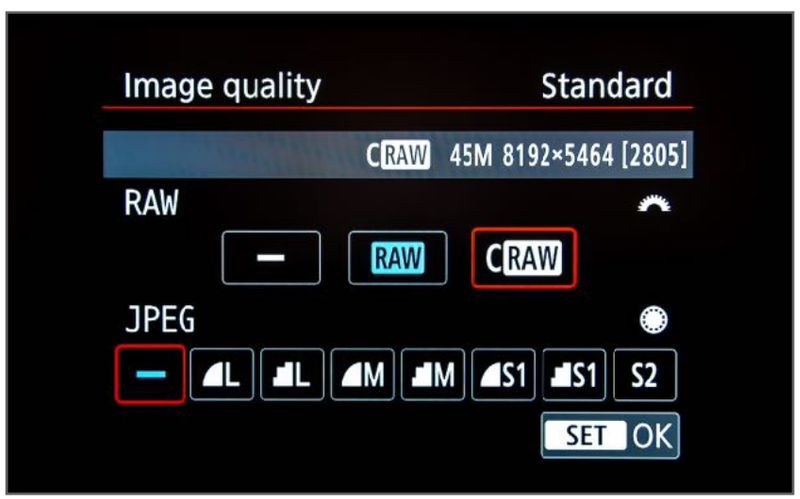
Even with 180 frames taken over 20 seconds, that's 9 frames per second. Assembled into a time-lapse at the usual 24 fps, the final movie would be sped up by 2.5x from a real-time movie.

Choosing cRAW format can increase the number of frames even more, and might be a good alternative to shooting video, providing higher resolution.

In theory! In 2023 it failed at C3.







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AN EXPOSURE SEQUENCE

TIP: If you operate the camera directly, be sure to allow 1 to 2 seconds between touching the dials and firing the shutter to allow vibration to die down. Don't bang off shots too fast!

The secret to success is a well-rehearsed sequence of exposures, from short to long and back to short again. These can be composited later in processing.

One option (discussed next) during totality is to use Auto Exposure Bracketing. The other plan is to shoot manual exposures, stepping through a wide range from 1/4000 to 1 second or so.

What you end up with is a set like this sample, ranging from 1/4000 second for the diamond ring to as long as perhaps 1 second for the outer corona. That's 12 jumps in increments of one f-stop each, i.e. each jump doubles the shutter speed. However, you could jump in $^1/_3$rd stop increments, for 36 steps to the longest exposure. But then you have to reverse the sequence to get back to your shortest exposures for the second diamond ring. Getting there in the time available can be a challenge. As I did here, once I have the longest exposures, I find it better to go right to the shortest one, to be ready for third contact well before the end of totality. It always comes sooner than you expect.

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AUTOMATING EXPOSURE SETS WITH BRACKETING

Should you set the camera to automatically step through a range of exposures using the Auto Exposure Bracketing function? Maybe, but ...

Most cameras offer Auto Exposure Bracketing (AEB) that steps through a series of shutter speeds each time the shutter is pressed.

However, for the diamond rings, AEB is <u>not</u> a good idea — you will end up with a lot of under- and over-exposed images, not a consistently exposed set to make a sequence or composite.

But during totality itself you <u>could</u> use AEB to step you through a range of exposures. Then turn it off for the final diamond ring. Easier said than done! So …

NOTE: To quickly switch from High-Speed Continuous to AEB and back to Continuous, you could program each mode into one of the Custom shooting modes (C1, C2, etc.) all cameras offer. <u>But practice switching modes</u>. On some cameras it takes just turning a mode dial. On others it's a more complex set of steps.

Cameras allow setting the number of frames shot and how much the shutter speed automatically increments between exposures during a Bracketing burst.

The Nikon D750 shown here can shoot a maximum of 9 frames, in as little as $^1/_3$rd stop increments, as shown.

However, even an AEB set of 9 frames taken one stop apart is <u>not</u> quite enough to record the full range of details, from inner to outer corona. The next page presents a routine for using AEB to aid capturing a full set of exposures.

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A SUGGESTED AEB SEQUENCE

NOTE: This recommendation partly contradicts my advice on the next page, to take exposures as quickly as possible. But we would like a wide range of exposures not too far apart in brightness.

Here's a possible routine for capturing a full range of exposures relatively easily using Auto Exposure Bracketing (AEB)

I show a screen from a Canon R5 which offers a maximum of 7 exposures in a single AEB set. Some cameras offer as many as 9 shots. Exposure increments can be as small as 1/3 of a stop, or as wide as 3 stops apart, much too wide for our purposes. If you shoot at an increment of 1 2/3 stop apart, starting with 1/30 second as a middle exposure, you get 7 images: 1/1000, 1/320, 1/100, 1/30, 1/10, 0.3, and 1 second. While they cover the range, those exposures might be too few and far apart to blend well.

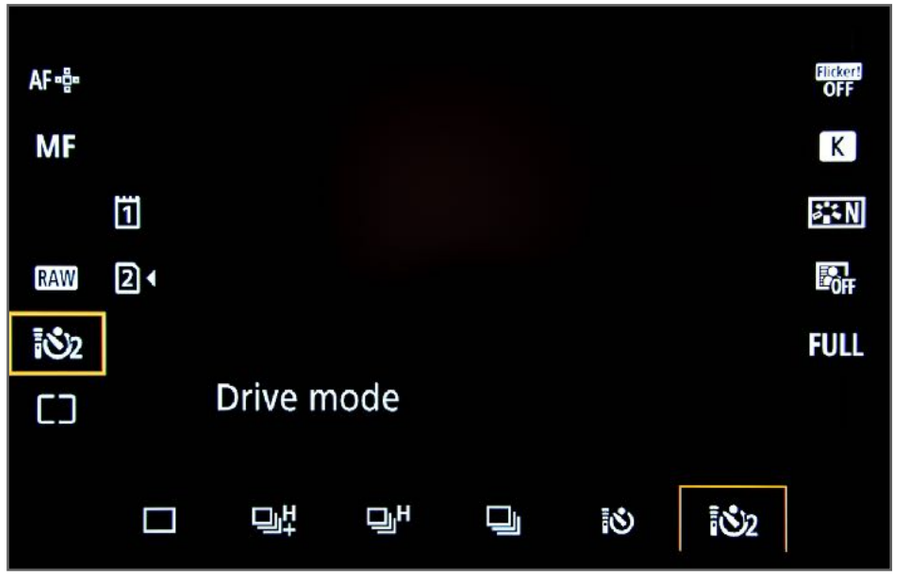
Here's an alternative: Set the increment to 2/3 of a stop and start at 1/250 second. Then after the first burst of 7, adjust the shutter speed down 2 stops to 1/60. Fire another 7 shots. Then step down to 1/15. Fire another 7. Step down to 1/4. Fire another 7. That set of four bursts of 7 shots yields 28 exposures, from 1/1000 to 1 second. Repeat the four 2-stop jumps in reverse to get back to 1/250 in another set of 28 frames.

With the Canon R5 I show it set to take its maximum of 7 shots in one AEB burst. The other choice is how much the shutter speed changes between each exposure. I show it set to increment by 2/3 of a stop.

Collecting a full set of exposures from 1/1000 second for the prominences, to 1 second for the outer corona, requires shifting the middle shutter speed four times, from 1/250 to 1/4 seconds, with each change requiring 6 clicks of the shutter speed dial.

NOTE: With Canon cameras if the Self-Timer is on with a 2 second delay, the camera will shoot all 7 frames in quick succession with one press of the remote release, very handy indeed.

While I show Canon screens, other brands offer similar settings. Practice with your camera.



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SHOOTING FOR AN EXPOSURE BLEND

To minimize alignment issues later in processing plan to shoot any set of images intended for blending as quickly as possible, within seconds.

I show this same image later in Chapter 11 on processing. It illustrates what you can be faced with at the computer when trying to blend exposures taken over even 30 seconds of time, as the set of 12 used here were. The motion of the Moon causes edge artifacts at the lunar limb. Why? The Moon is moving relative to the Sun and you want to align on the Sun to keep the prominences and corona details sharp. The workaround here was to layer in a single long exposure masked to show just the lunar disk, then enlarged by 2% to hide the offending limb artifacts.

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EARTHSHINE ON THE DARK SIDE OF THE MOON

Expose long enough and you can pick up light from the Sun reflected off Earth and illuminating the "dark side of the Moon."

Capturing this effect will require very clear skies and the longest exposures in any sequence. Through a telescope, exposures of 1 to 4 seconds at f/6 and ISO 100 to 200 should pick up details on the surface of the New Moon. See the lunar mare areas here?

These are being lit not by the corona – it's 150 million kilometres away on the other side of the Moon. While the lunar surface is being lit by sunlight, it is light that is reflecting off the brilliant full Earth in the lunar sky.

It is called Earthshine. Normally, it can be seen only on the crescent Moon in the dusk or dawn sky, such as in the image shown two pages on. During a total eclipse, your eye will not see Earthshine, but a long exposure with a camera can pick it up. It makes a useful addition to any multi-exposure composite.

August 21, 2017 – 1 second at ISO 100 with the faithful Traveler scope at f/4.5 and 480mm focal length, and tracked. Note the star Regulus above.

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PRACTICE ON THE MOON – I

This is critical. Don't assume gear will work. I've already suggested it several times – shoot the Moon to ensure you can get sharp images.

The challenge at any eclipse is that we often assemble combinations of gear just for the eclipse, often to create a portable package. It's not the gear we routinely use at home.

If so, it's all the more important to assemble your rig well before the eclipse and perform practice runs with it on the Moon. The Moon moves at close to the same rate across the night sky as the Sun will during the eclipse in the day sky.

If you can get sharply focused images of the Moon, showing detail on its surface, as here, then you're good to go! Be sure to practice assembling the gear, to ensure the camera is solidly mounted to the telescope, and the telescope solidly attached to the mount. Often the tiniest of setscrews on T-rings or focusers can be the downfall of an otherwise great setup. Practice changing camera settings quickly to see if you are introducing blurring vibration.

Use the Moon to see how large the image is, and if your planned setup will be steady enough to provide sharp images as you work the camera. If you are not tracking the sky, you can tell how much the Moon's motion will affect your image. And you get a chance to practice using Live View to focus on a real celestial target. Keep in mind how high the Sun will be however. The practice Moons of evening are likely to be much lower, and so easier to aim at than the eclipsed Sun will be. However, the Full Moons of autumn and winter are quite high and so serve as good stand-ins for the eclipsed Sun of early spring.

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PRACTICE ON THE MOON – II

A good stand-in for the eclipsed Sun is the crescent Moon (waxing or waning), due to its large range of brightness.

The waxing crescent Moon in the western evening sky after a New Moon, or the waning crescent Moon in the eastern sky before a New Moon are good practice targets.

To capture the faint glow of Earthshine on the dark side of the Moon you need to use exposures similar to what the outer corona will require. That gives you a test subject to check how much the motion of the sky and Moon will blur its image in longer exposures typical of what you might need to use. That's important for mounts that aren't tracking the sky. But even for a mount that can track the sky, test setting it up as you might have to do at the eclipse without any ability to precisely align the mount. Just roughly align it, then see how well it works for the few minutes you'll need it to keep the Sun centered during totality. Practice using the mount's controls to fine tune the positioning, and the camera's controls for adjusting exposure.

The crescent Moon (this is the waxing Moon of evening) has a bright sunlit side best shot with exposures of a fraction of a second, similar to the inner corona. The dark side, lit by Earthshine (sunlight reflected off the Earth), and any surrounding stars, requires exposures of more than a second, similar to the outer corona and nearby stars during totality. Plus the bright crescent when overexposed for the dark side serves as a good test for lens flares in your optics, useful for judging how well your scope will work for the diamond rings. This image is a blend of multiple exposures, as eclipse images also often are.

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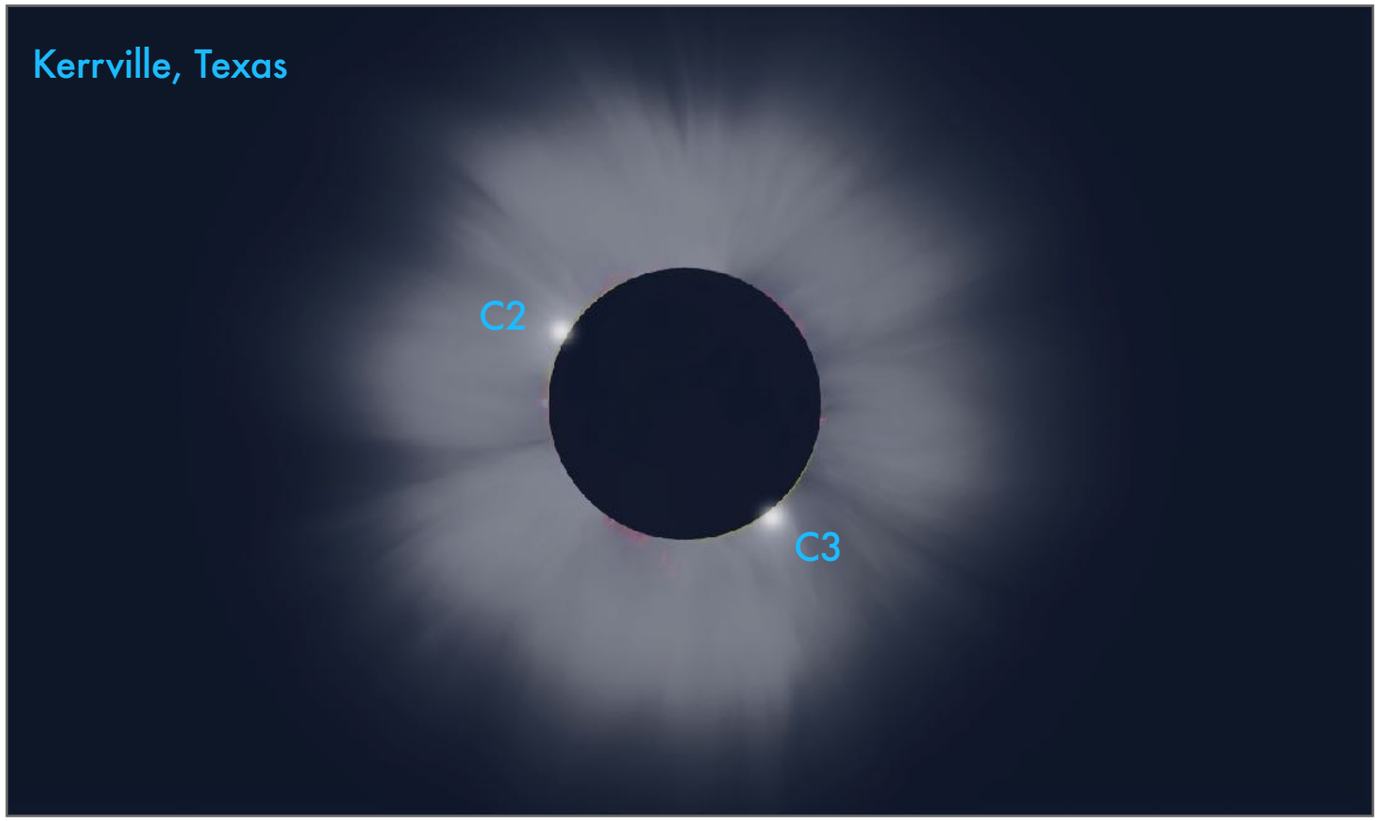
WHERE WILL THE DIAMOND RINGS APPEAR?

Totality begins with a diamond ring on the left (sky east) side of the disk and ends with a diamond ring on the right (sky west) side. In general!

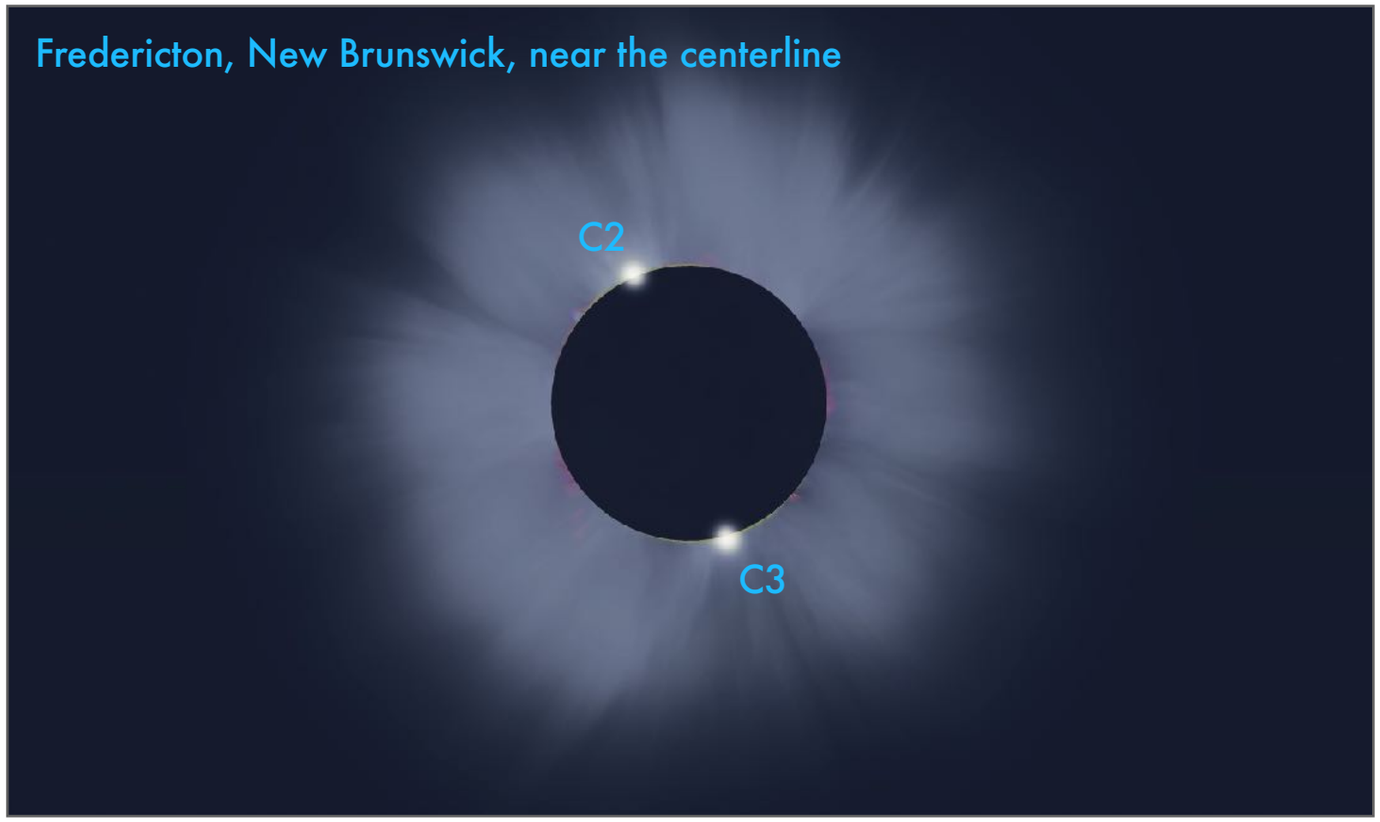
From Mexican and southwestern U.S. sites with the Sun high in the south, the diamond rings will be at upper left (at the start at C2) and lower right (at the end at C3). From eastern Canada with the Sun lower in the west, the diamond rings will be at the top (C2) and bottom (C3).

These simulations serve only as general indications. Precisely where the “diamonds” appear and how long they last depend on the shape of the lunar limb and the presence of craters and valleys.

However, moving north or south off the centerline makes the bigger difference. From sites north of the centerline the two diamonds will each appear in the upper half of the disk. From locations south of the centerline, they will both appear in the lower half of the disk. From the path edge you’d see a continuous diamond ring moving around the top or bottom of the disk.



These diagrams place the zenith up, with the horizon straight down, as you would likely frame a telephoto lens on a tripod, or an alt-azimuth telescope.



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WHAT WILL THE CORONA LOOK LIKE?

Because the 2024 eclipse occurs close to solar maximum, we can expect a corona extending all around the Sun, as it was in 2012 here.

The shape of the corona changes with solar activity. When the Sun is near the peak of its 11-year cycle of activity, we usually see a round, symmetrical corona, as it was in my image of the 2012 eclipse at top. It resembles a flower.

At times of low or minimum activity as it was in 2017, the corona has less extent north and south of the Sun. Instead, we see long streamers extending east and west along the ecliptic, the blue line passing through the Sun in many of the diagrams I show.

However, in 2024 and in a clear, dry sky, streamers might extend two to eight solar radii out from the Sun. To capture the full extent of the corona, use focal lengths no longer than 400mm to 500mm. Both images were taken with the same Astro-Physics Traveler refractor, but with a cropped-frame sensor at top, and a full-frame sensor and focal reducer at bottom.

2012 Near Solar Maximum

2017 Near Solar Minimum

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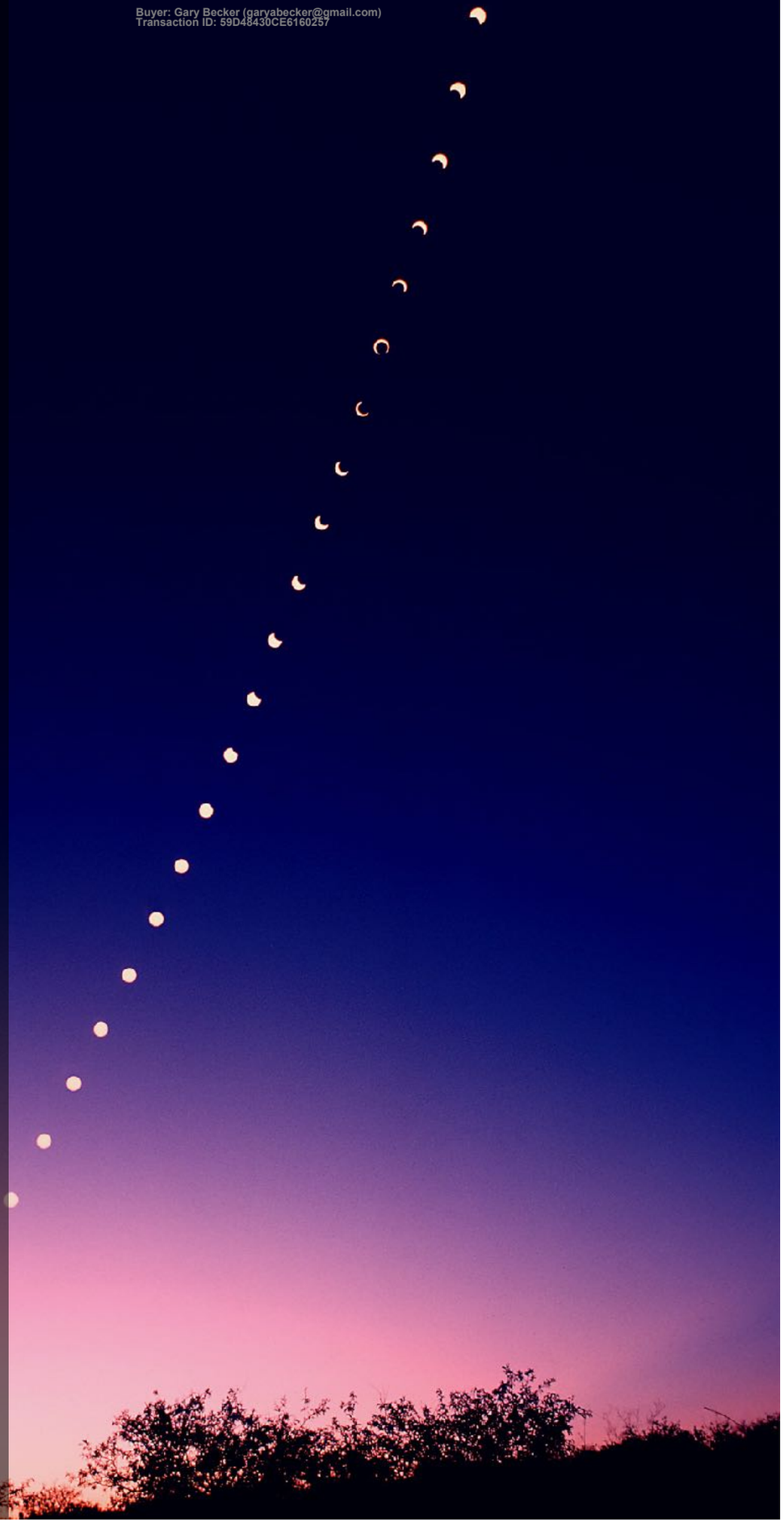
CHAPTER 7



7

2024: SHOOTING COMPOSITES

In this chapter I deal with what can be the most challenging eclipse image, the composite. I describe both wide-angle scenes and close-up views, with the latter being easier as the usual technique is to place Suns in the frame later in processing.

May 10, 1994 Annular Solar Eclipse, Arizona

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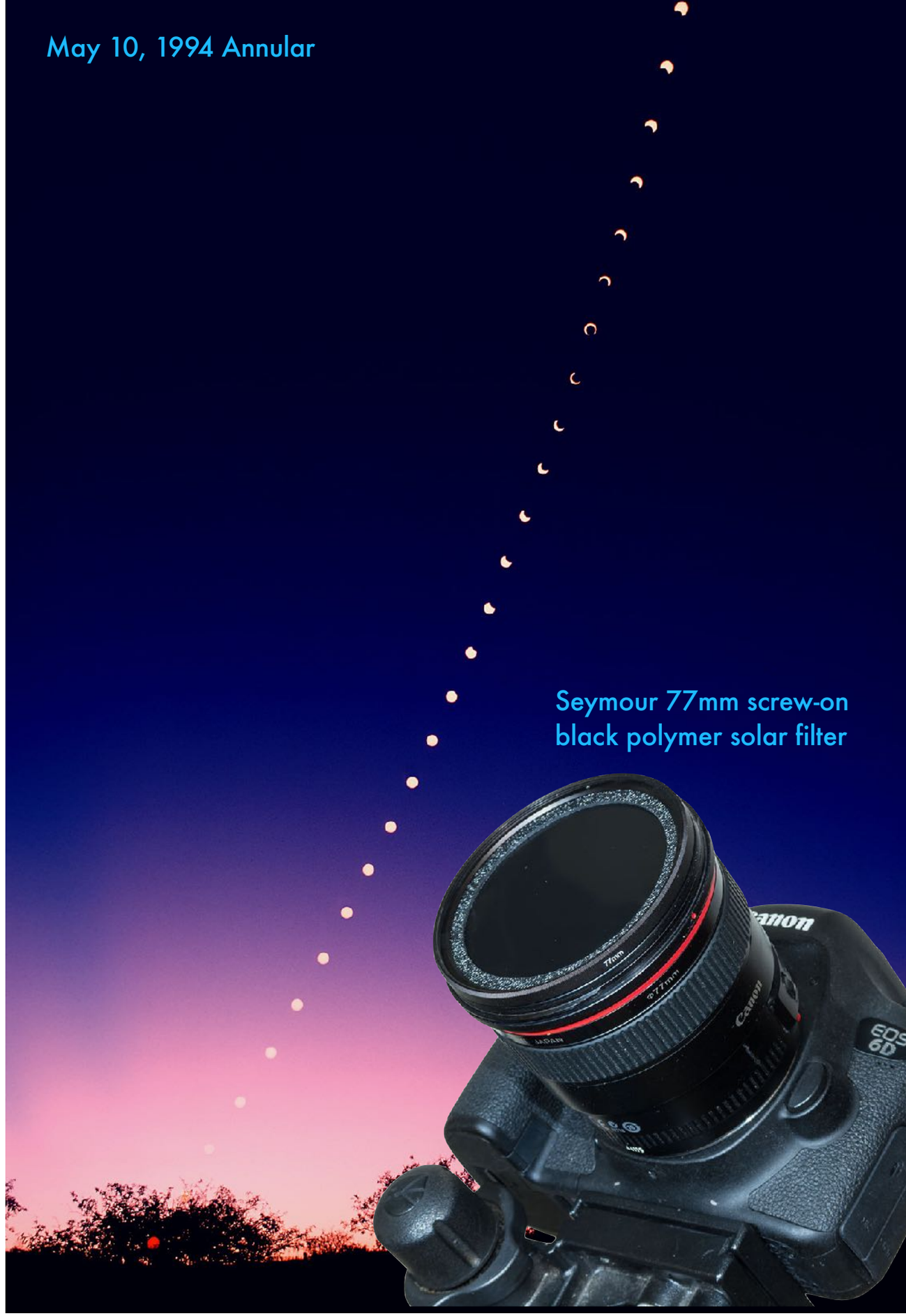
SECTION 1

PLANNING A WIDE-ANGLE COMPOSITE

In Chapter 4 I showed my result of this technique for 2023. Chapter 11 has a processing tutorial.

Here I deal with the planning of a sequence for 2024. In the old days, we did this “in camera,” by cocking the shutter without advancing the film, which is what I did here in 1994. In the digital age, assembly is much easier. But shooting a useful set of originals still requires a lot of planning before the eclipse and attention on eclipse day, especially at totality.



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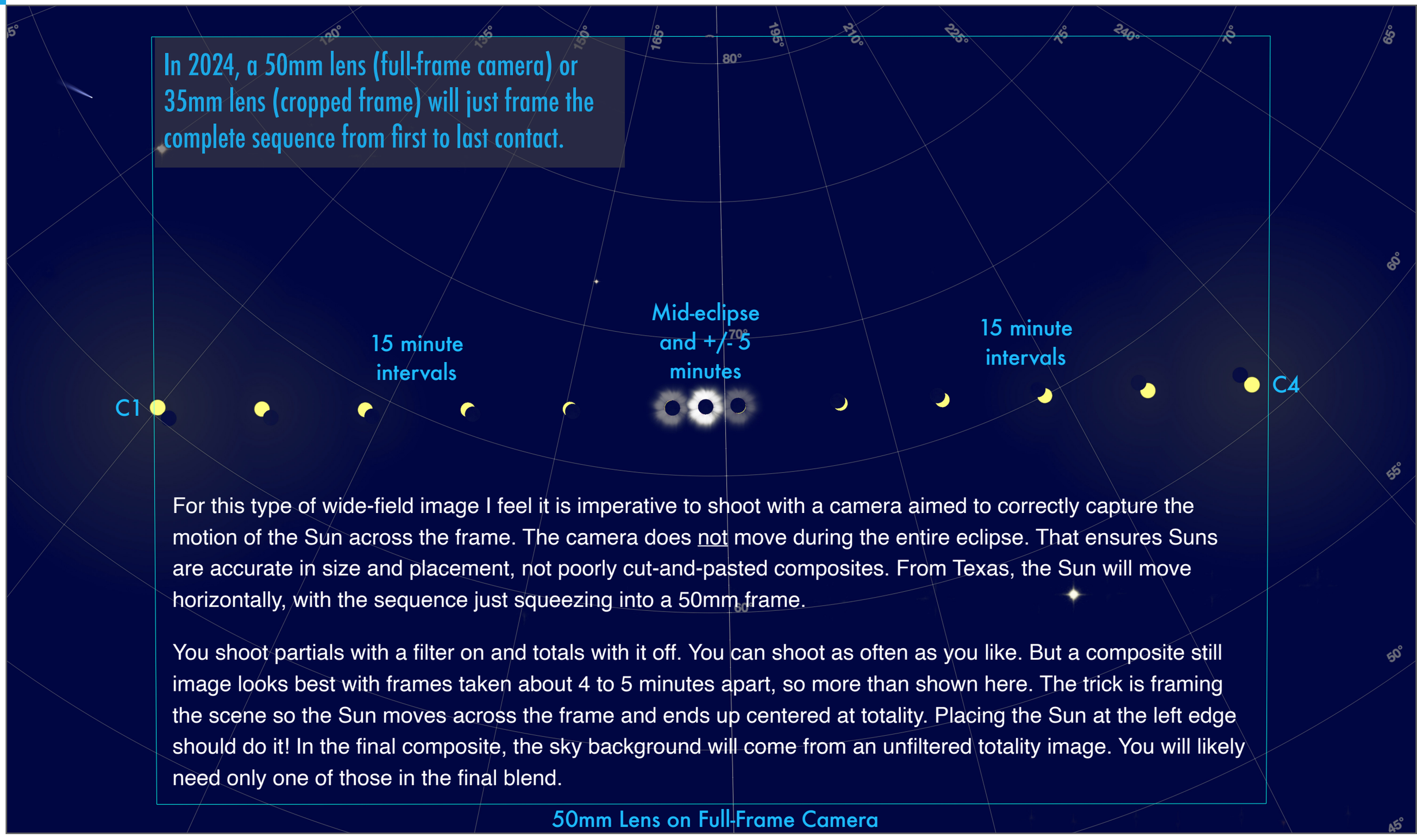
SHOOTING A WIDE-ANGLE COMPOSITE (WEST)

NOTE: As with previous sky charts, for the view from the southwestern U.S. I am using Kerrville, Texas as the basis.



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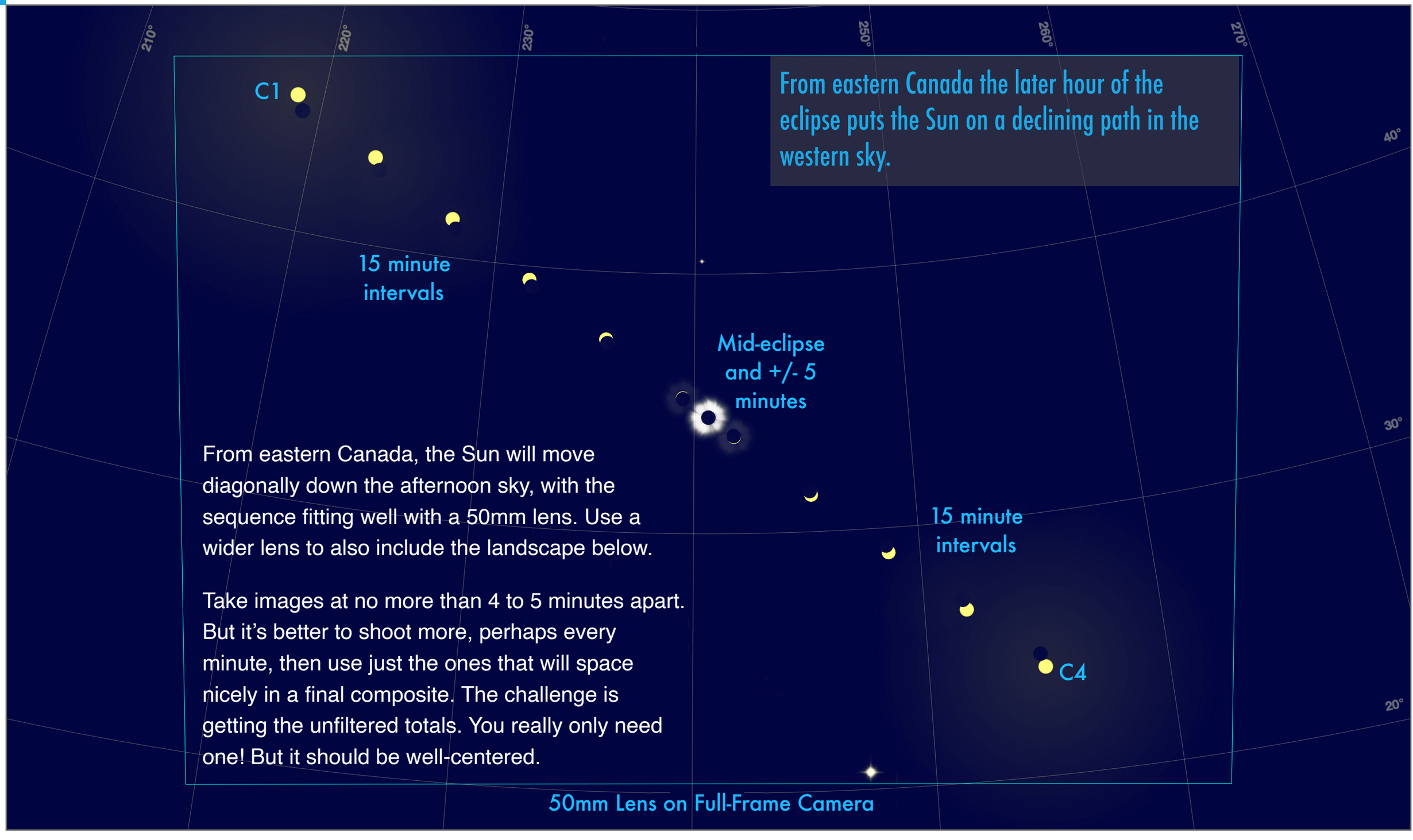
SHOOTING A WIDE-ANGLE COMPOSITE (CANADA)

NOTE: For views from Canada, I am using Fredericton, New Brunswick.



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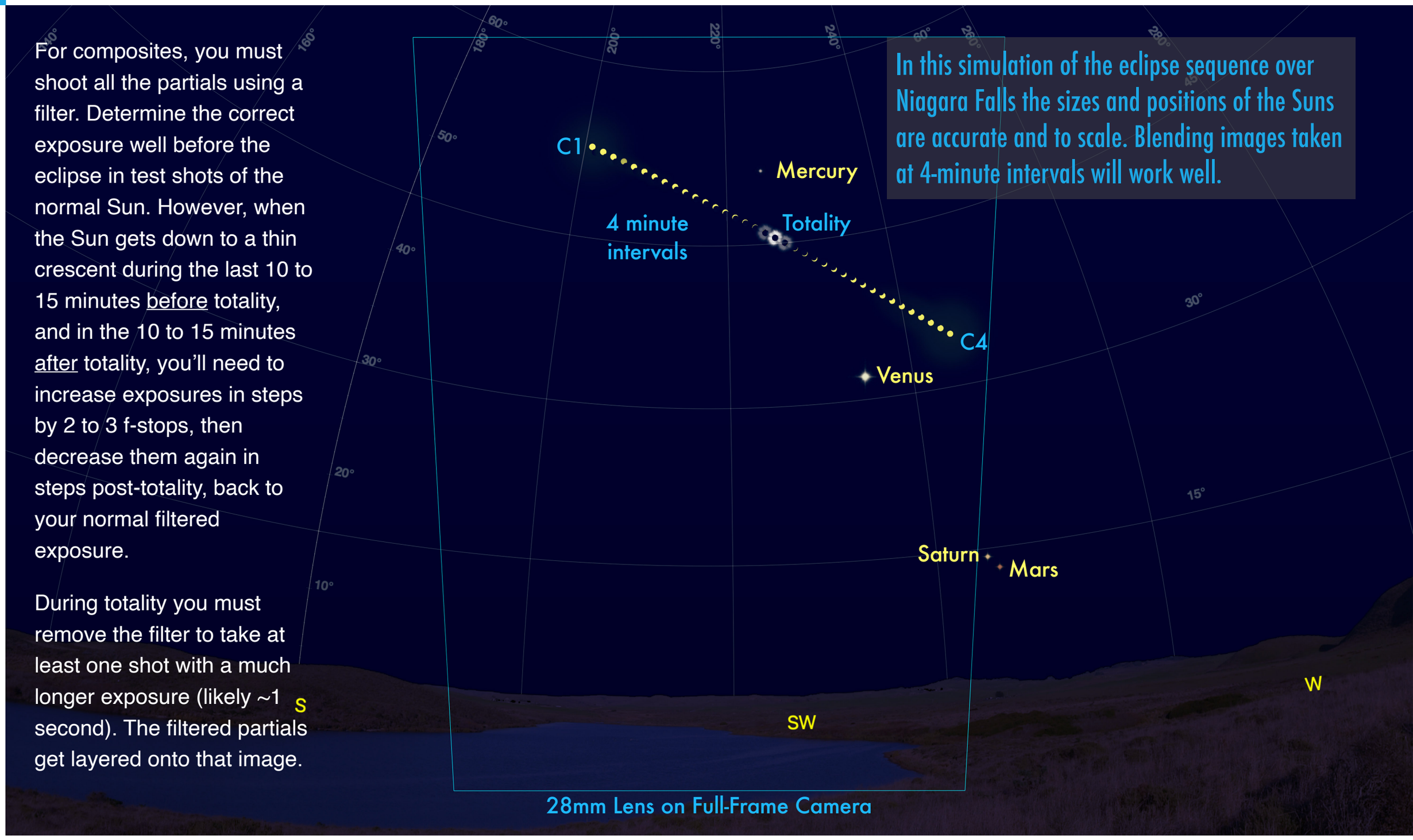
EXPOSURES AND INTERVALS

NOTE: For this example of a composite I show the scene simulated for Niagara Falls, from where at totality the Sun will be 45° high in the southwest.

For composites, you must shoot all the partials using a filter. Determine the correct exposure well before the eclipse in test shots of the normal Sun. However, when the Sun gets down to a thin crescent during the last 10 to 15 minutes <u>before</u> totality, and in the 10 to 15 minutes <u>after</u> totality, you'll need to increase exposures in steps by 2 to 3 f-stops, then decrease them again in steps post-totality, back to your normal filtered exposure.

During totality you must remove the filter to take at least one shot with a much longer exposure (likely ~1 second). The filtered partials get layered onto that image.



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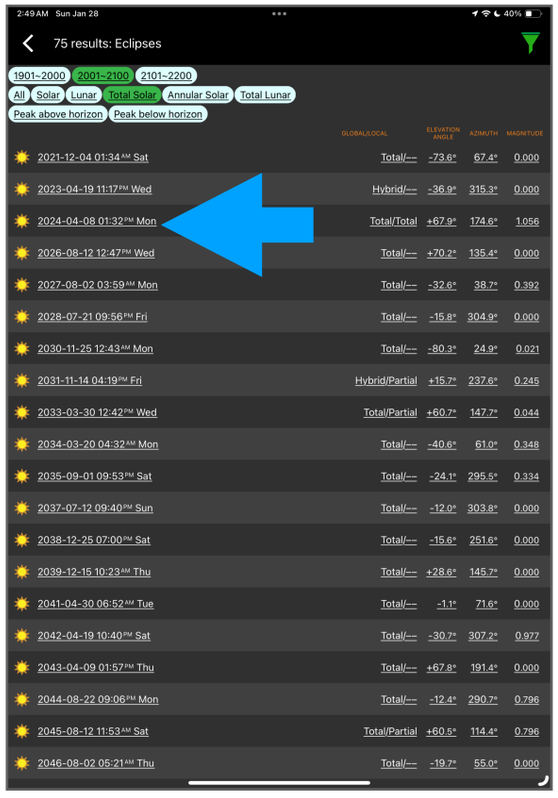
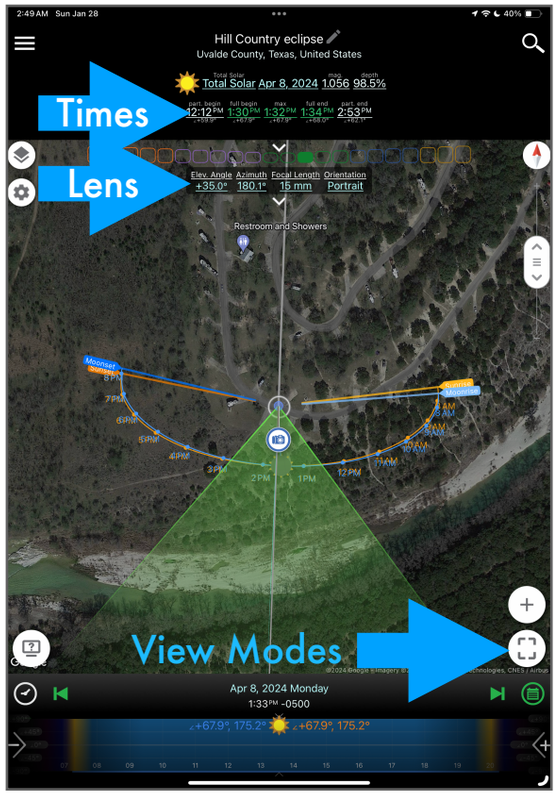
PLANNING A COMPOSITE WITH PLANIT PRO

This series of screen shots demonstrates how you can use the PlanIt Pro app to plan an eclipse composite sequence. It is a complex app to use with a busy user interface. But it is very powerful. For detailed tutorials on PlanIt Pro, see Mike Shaw's excellent website.

One of the many (!) modes of PlanIt Pro, which you select by swiping left and right on the top set of options, is Eclipses. Here I show it set for the April 8, 2024 total solar eclipse, with the camera location in the Hill Country of Texas. PlanIt Pro draws the eclipse path and indicates the key times of eclipse events for your site.



Tapping on the eclipse named in the screen at left brings up this screen that allows you to select which eclipse you want to simulate. The app has a vast database of solar and lunar eclipses, covering three centuries, past and future! Here I have filtered the list to just total solars in the 21st century, and picked April 8, 2024.



Use the Zoom slider indicated on the first screen to zoom into your chosen site. The field of view shown here is with a 15mm lens in portrait orientation, selected from the settings indicated. The time is set to mid-totality, which the app flags at top with the times marked in green. The Sun is almost due south at 175° azimuth.

Tapping on the icon at lower right brings up a further set of options for changing the view. The screens shown on the next page are with Viewfinder VR, to provide a 3D simulation of the sky and foreground, the latter based on terrain models. The app can even simulate city skylines, making it powerful for any nightscape image planning.

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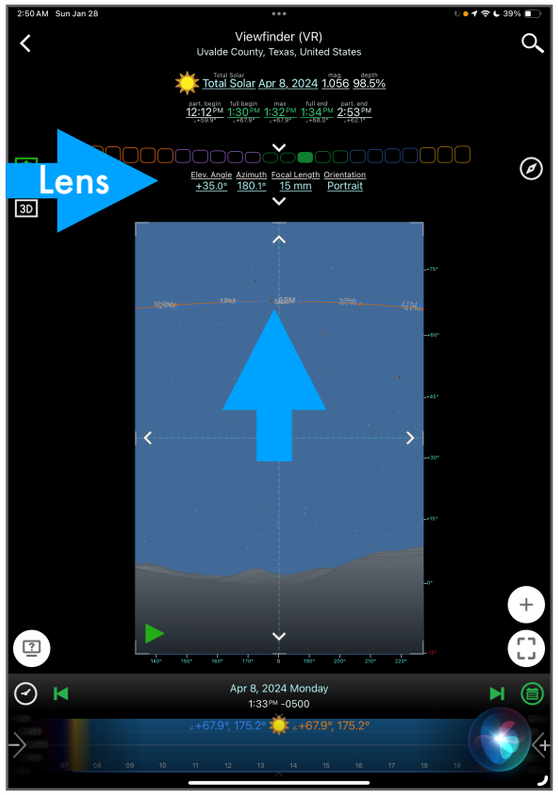
PLANNING A COMPOSITE WITH PLANIT PRO

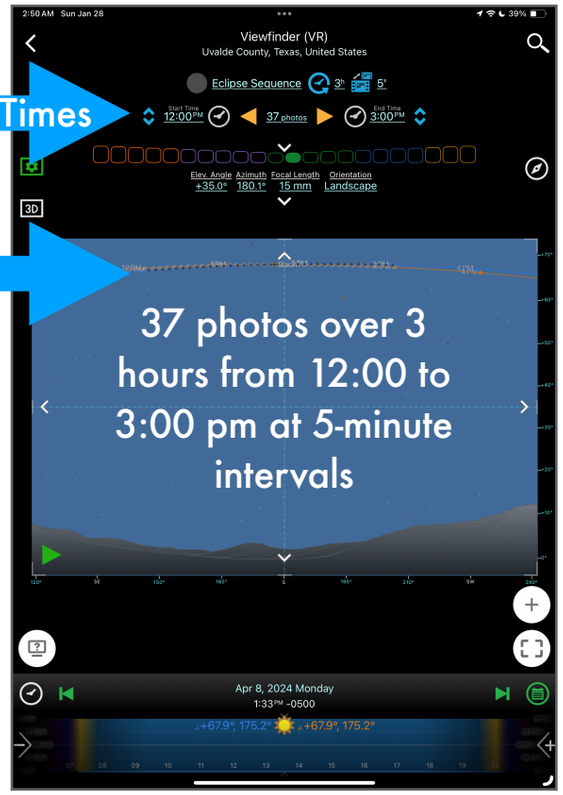
This further series of screen shots demonstrates how you can use PlanIt Pro to plan an eclipse composite sequence using its Viewfinder VR mode. However, activating these options requires paying for an annual subscription, an in-app purchase in addition to the cost of the app.



The Viewfinder VR mode now shows the sky and actual landscape at the site, framed with the lens chosen, to help you select a lens and plan how to compose the scene. The Sun and Moon, and their path across the sky, are drawn at top, with positions marked at hourly intervals. But the eclipsed Sun is the tiny black dot at top.

Here I switched from Portrait to Landscape orientation, to show how from Texas the Sun's high altitude requires using a very wide lens to frame the scene in a horizontal format. That will not be the case from sites farther north and east up the path where the eclipse occurs later in the afternoon with the Sun lower in the sky.

To simulate a sequence of images taken throughout the eclipse, swipe the options at top to reveal the Sequence set of options. It might read Sun Sequence by default. Tap on that name to reveal the menu of sequence choices to simulate. Choose Eclipse Sequence. Now you can select how many frames you want to display.



Adjusting the start and end times and the interval in the options bar draws a set of little Suns along its path in the sky, perhaps from start (C1) to end (C4) of the eclipse. But the times and intervals are up to you to choose. This simulation helps you plan the framing of a time-lapse or composite set, and when to start the series.

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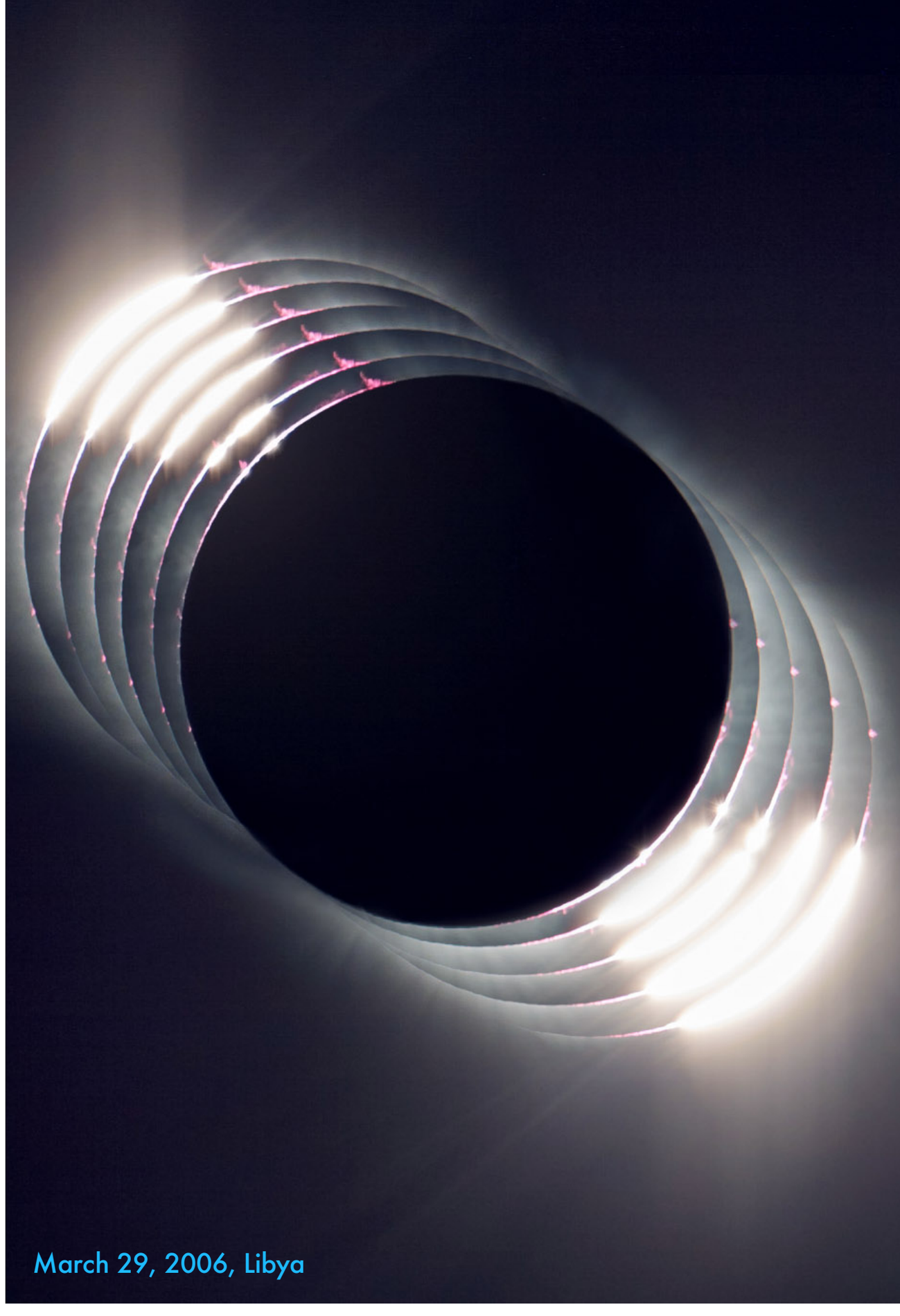
SECTION 2

PLANNING CLOSE-UP COMPOSITES

For this variation we usually don't need to be so fussy about shooting the original images with the Sun placed exactly where we want it in the final composite. We can keep the Sun centered, then place it where it should be on the frame later in processing. So the key here is to shoot the full range of partials and totals you'll need to make the composite. Shoot a uniform set of filtered partials at regular intervals in the minutes leading up to and following totality.



March 29, 2006, Libya

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SHOOTING FOR CLOSE-UP COMPOSITES

This type of composite is much easier, as you can just shoot close-ups as per Chapter 6, then place the Suns later in processing.

Here, we aren't so concerned about placing the Sun accurately in relation to the ground below, or reflecting its true motion across the sky. We are after a modestly realistic scene that encapsulates the sequence of events.

While you could compose the scene so the Sun moves through the frame, as per Chapter 8 on time-lapses, it isn't necessary for a single-image composite. But you do need a base image wide enough to accommodate the other Suns pre- and post-totality on either side of the central image of totality itself. Those flanking images can be of the diamond rings and of the partial crescents before and after totality.

The central image of totality can be a single image or, as here, it can be a stack of multiple exposures masked to reveal the outer corona without sacrificing too much of the inner corona. The key is getting a suite of great close-ups.

Such a composite is a "realistic fake." I show how to create it in Chapter 11. While the angle of the Sun roughly corresponds to how the Sun moved across the sky, in the time between the diamond rings, the Sun would not have moved as much as this in real life. A composite such as this has to distort reality to contain the events onto one frame without having Sun disks collide, which can be confusing to the viewer. Yes, the line between fakery and reality can be fuzzy indeed. But when people place giant telephoto Suns or Moons in the sky over a wide-angle landscape where they could never have appeared I think the line has been crossed.

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SHOOTING FOR A DIAMOND RING COMPOSITE

Images shot in rapid sequence at the diamond rings can be layered into a "time-lapse" composite of second and third contacts.

A more realistic spacing in time of layered images provides this type of eclipse photo, what I call the "diamond ring composite." As with other close-up composites, it is a creation using Photoshop. But to create it, you need a set of images taken perhaps no more than 1 second apart at the diamond rings.

In this example from 2006, I layered in images taken at both contacts. Interesting, but certainly confusing to the viewer. Which way are events happening? Which diamond ring is which? However, the decision on how to layer the images can come later, at the computer. The key is having the originals to begin with.

Missing the diamond rings is a common issue — they happen fast and before you are ready, with the camera not set to the correct short shutter speeds.

March 29, 2006, Libya

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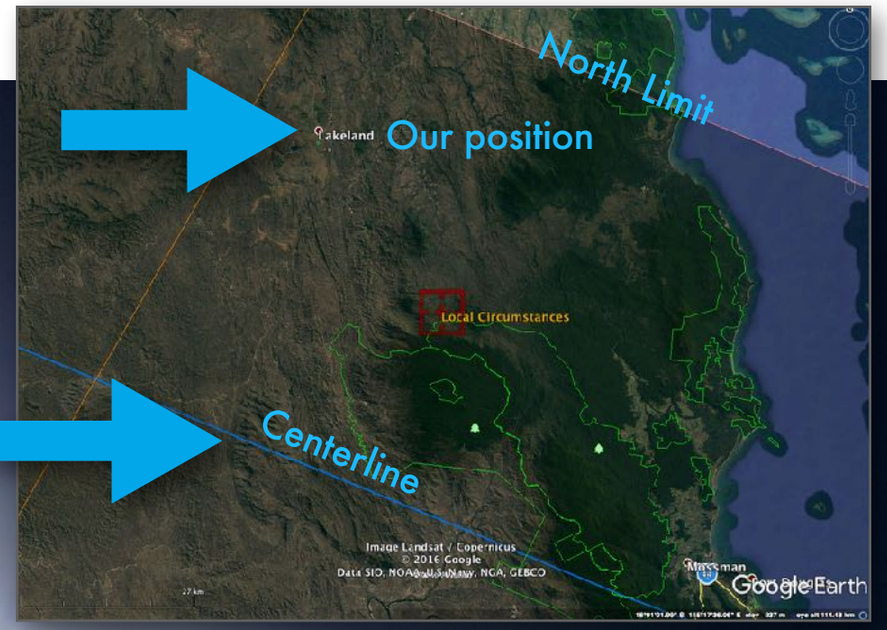
WHY ARE THE DIAMOND RINGS NOT SYMMETRICAL?

For the 2012 eclipse the diamond rings aren't 180° apart because we ended up <u>not</u> on the centerline, by choice, to avoid clouds and crowds.



In his case, the asymmetrical diamond rings are an effect of our position well off the centerline, toward the north limit of the shadow path. This was a last-minute "Plan C" move to avoid clouds present on eclipse morning at our preferred "Plan B site," which we picked over our preferred but often cloudy Plan A site at our luxury beach house near Port Douglas, Queensland, Australia.

If clouds move you to a site far off the centerline, then expect similarly asymmetric diamond rings.

November 14, 2012, Queensland, Australia

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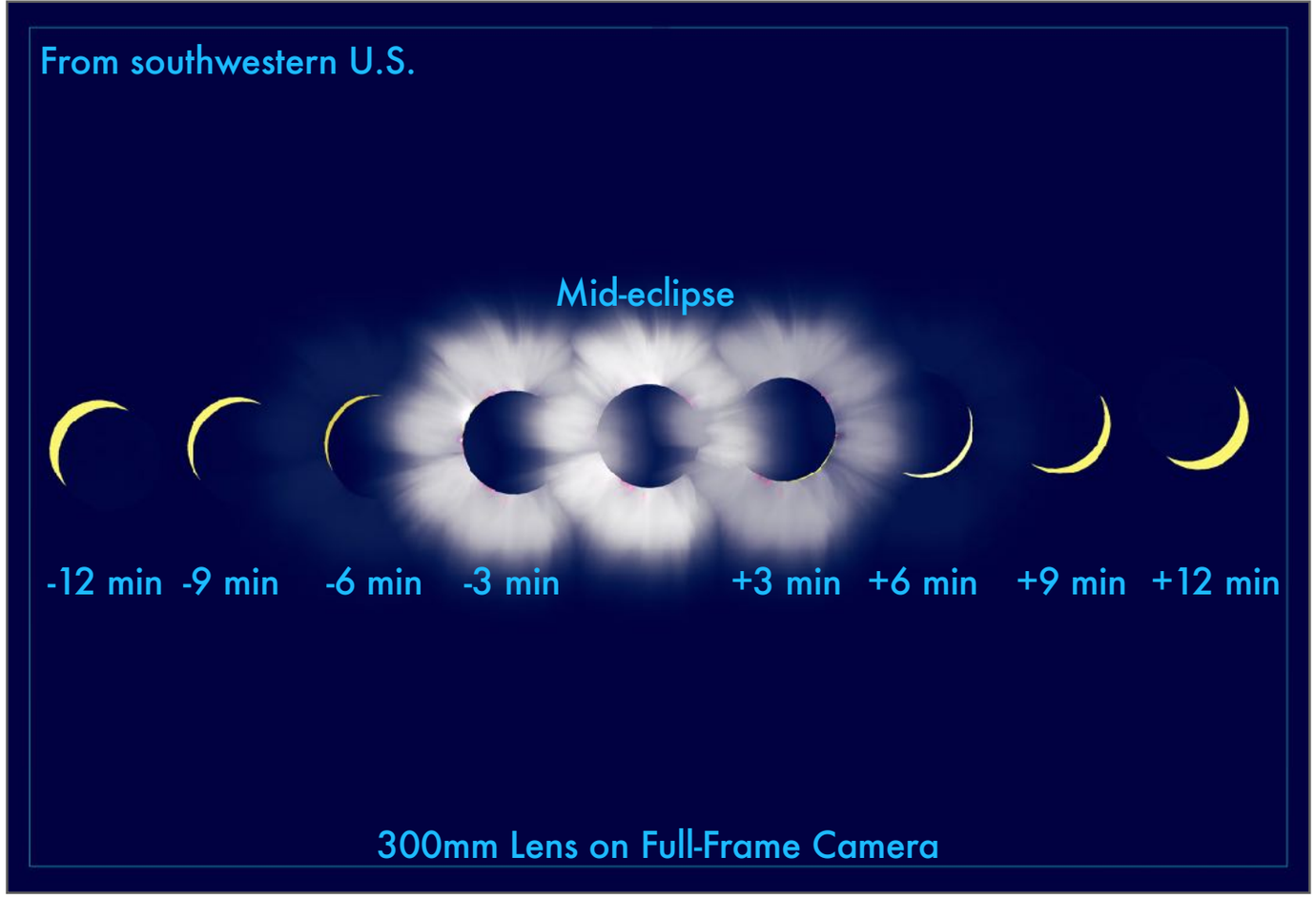
PLANNING A REALISTIC COMPOSITE

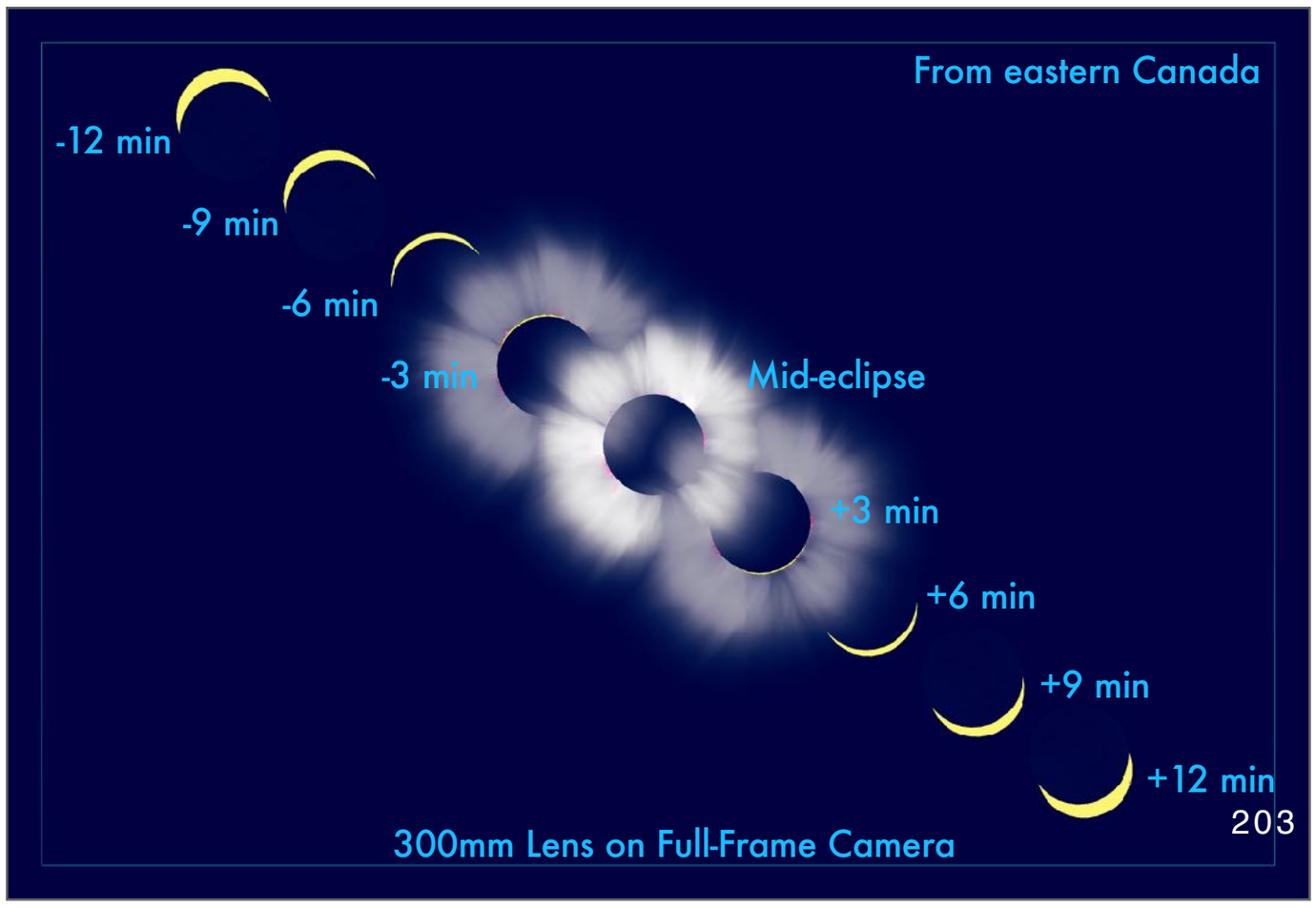
If you wish to create a composite in editing that closely resembles reality, then use these diagrams as your basis. Note the spacing in time.

These show how the Sun will actually move across a frame at 3-minute intervals during the minutes prior to and following totality. If you want to create a layered composite that looks like the real thing, this is how the Sun images should be placed on the frame.

Placing the solar disks to realistically space the images in time often requires superimposing and overlapping the images. From start to end of totality, the Sun will move about two solar diameters across the frame, a motion I illustrate in Chapter 6. With careful masking (shown in Chapter 11) it is possible to layer in the multiple images and create a good-looking yet accurate composite.

However, for such an image you'll need to shoot with a short enough lens (I show a 300mm lens here) to create a base image of totality wide enough to contain the layered crescents.





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CHAPTER 8

8

2024: SHOOTING TIME-LAPSES

The motions of the Moon and Sun lend themselves to shooting the eclipse with time-lapse techniques. However, be prepared to attend to the camera, perhaps from the start to the very end of the eclipse, often a tough task amid all the excitement.

August 21, 2017, Idaho

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SECTION 1

TIME-LAPSE OPTIONS

As with still images, you have two basic options for a time-lapse: either a wide-angle sequence of the entire eclipse, or a close-up of the Sun during the minutes surrounding totality.

Either option involves shooting lots of still frames at regular intervals, then assembling them later into a sped-up movie. At the camera, the main requirement is an intervalometer to automatically fire the shutter at an interval you set.

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WHAT ARE YOUR OPTIONS?

Here I cover the options for framing and capturing enough frames not just for a composite still image, but for assembly into a movie.

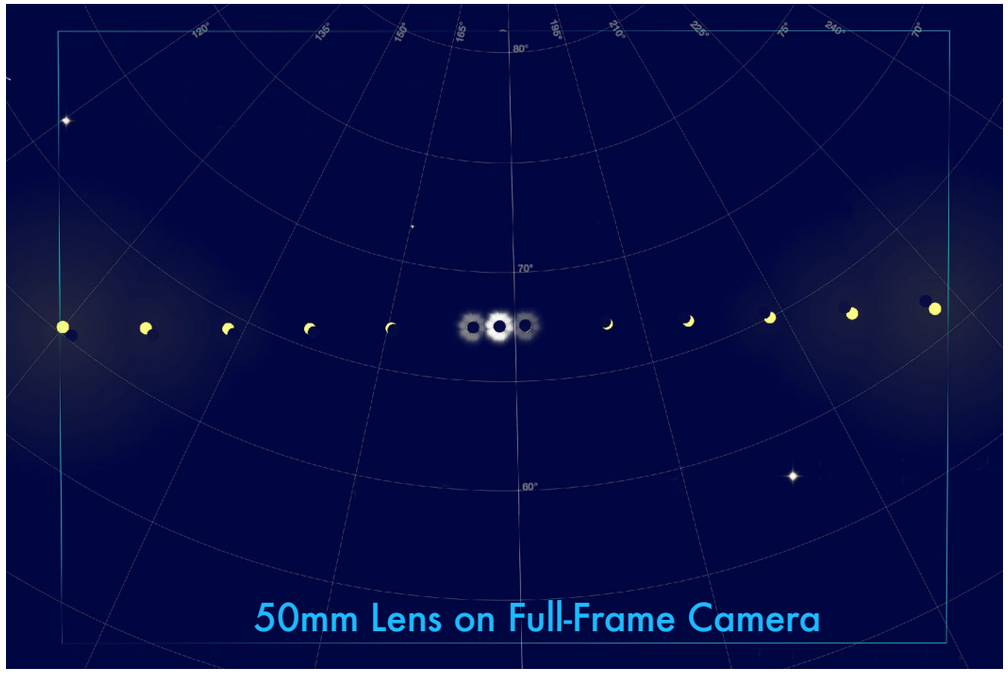
If you shoot lots of close-up still images of totality, as per the advice in Chapter 6, you can always assemble them into a movie or dissolving slide show. They will look best only if every image of the Sun is aligned. You don't want the Sun bouncing around the frame. However, this chapter deals with shooting frames specifically for time-lapses.

I think there are two main options: A wide-angle scene, or a moderate close-up. The wide-angle time-lapse is the easiest. Indeed, I've already covered the basics of how to shoot it in Chapter 5. And Chapter 7 covered more essentials.

As always, shoot Raw. Time-lapses require hundreds of frames. Don't shoot JPGs to save card space. Memory cards are not expensive. Even rapid-fire time-lapses will be fine with a moderate speed card. Expensive cards are needed only for continuous bursts and video.

WIDE-ANGLE

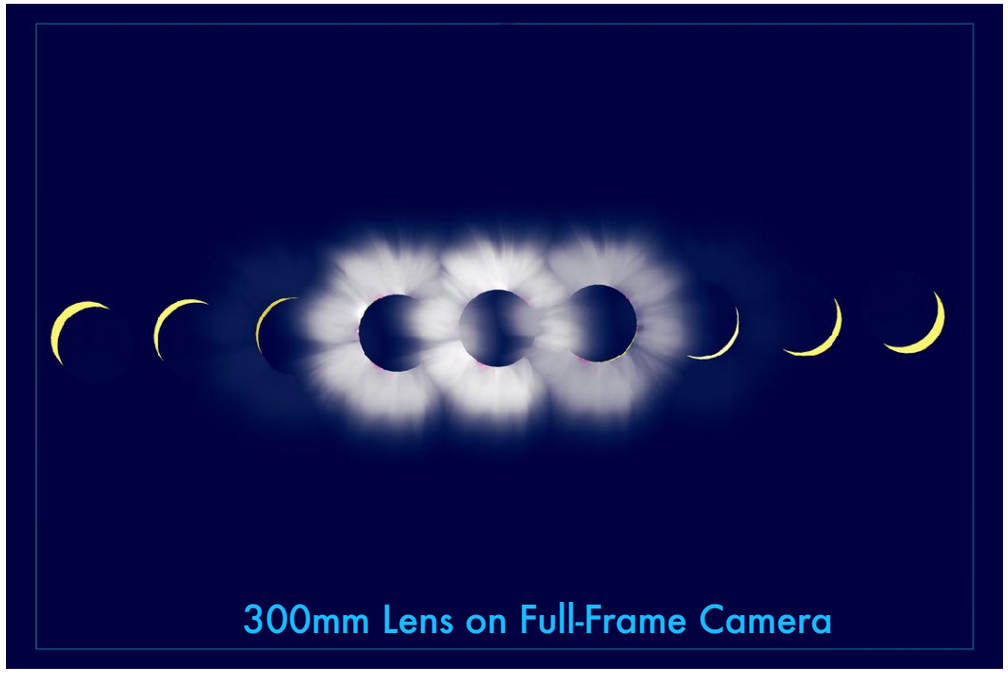
As described in the previous chapter, you could shoot with a wide or normal lens. But the final movie will show just tiny Suns moving across a black sky for the filtered partials. Better to shoot just around totality.



50mm Lens on Full-Frame Camera

CLOSE-UP

Use a modest telephoto composed so the Sun will drift through the frame from left to right. Partial eclipse frames must be shot with a filter, which you must remove just for totality.


300mm Lens on Full-Frame Camera

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INTERVALOMETERS

Shooting any time-lapse requires an intervalometer to fire the shutter automatically at an interval you set. Some can control exposure.

Most current models of DSLR and DSLM cameras have intervalometers built into their firmware. You set the number of shots and the interval. You also need to set the exposure, either to a fixed value or on Auto Exposure.

Outboard intervalometers offer the same option, though often with only 99 exposures as the maximum. Set the Number to 00 to have the intervalometer keep firing until you tell it to stop.

Advanced units are available programmed via apps that talk to a hardware controller via WiFi or Bluetooth LE. These offer sophisticated options, but none are suitable for eclipse shooting or for use with a camera set to Aperture Priority auto exposure. I'll discuss those again in Chapter 10. For most eclipse time-lapses, a simple $60 hardware unit is all that's needed for cameras that lack a built-in intervalometer. But have two at hand in case it or its cable fails.

Some cameras have intervalometers built into their firmware (right). Others require an outboard hardware intervalometer (below), available at most camera stores. Be sure to get one that fits the shutter release plug on your model of camera. I show the Canon TC-80N3.

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SECTION 2

SHOOTING WIDE-ANGLES

These are the easiest to shoot as you can largely leave the camera to run unattended on Auto Exposure, as I advised in Chapter 5. Indeed, I've essentially already outlined what to do here, as the best way to shoot wide-angle stills is to run the camera with an intervalometer. You'll end up with frames suitable for assembling into a time-lapse, even if that's not what you had intended to shoot. But you do want to shoot at rapid intervals to capture enough frames.

December 4, 2002, Ceduna, South Australia

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WHAT CAN YOU RECORD?

Wide-angle time-lapses are great for recording the rapid change in lighting and sky colors as the shadow moves in and out, plus the eclipse itself.

This is my favorite type of sequence that I try to take at every eclipse, at least since digital cameras made it feasible to automatically fire off hundreds of frames, something not easy to do with film.

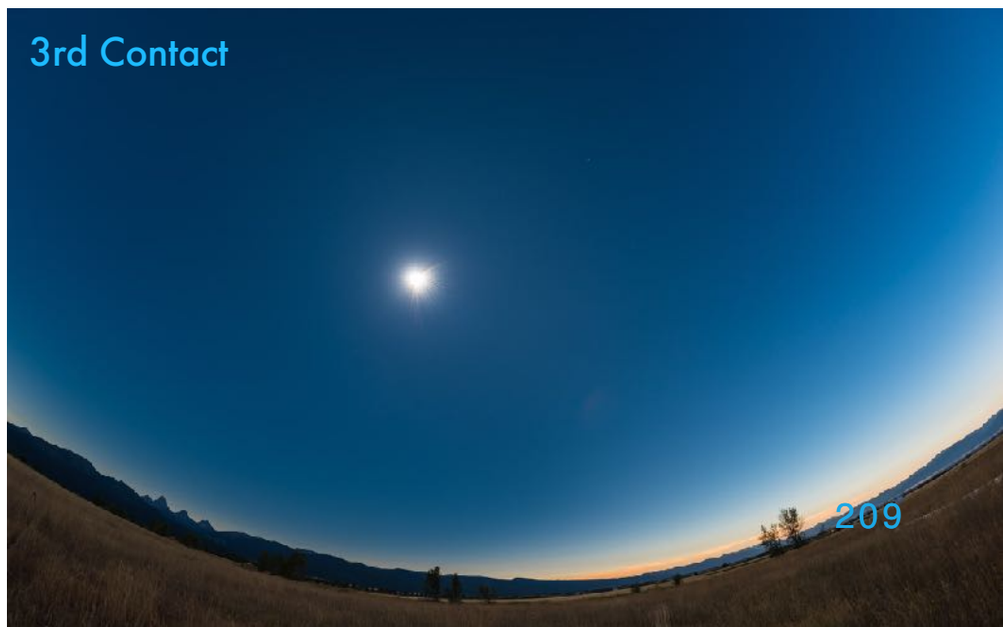
What you record is the Sun diminishing to a bright star then turning into a black hole. Settings suitable for showing the sky color will overexpose the corona to the extent that the dark disk of the Moon gets washed out, especially if the sky contains any haze or cloud. However, if there are clouds they will make the passage of the lunar shadow more obvious.

Your time-lapse will also show people moving around. What you'll miss are the sounds. Even if you don't shoot a movie, put whatever cell phone you have with you into movie or sound recording mode to pick up the sounds to edit in later on top of your time-lapse movie.

This was my view in 2017 using the Nikon DSLR and 12mm fish-eye lens shown four pages back. At top, the shadow of the Moon is coming in from the west at right, darkening the sky.

At mid-eclipse at center, the horizon is brightened with a 360° twilight, though most colorful here to the southwest, and less so to the east over the Grand Tetons.

At third contact, the sky brightens to the west, but is still dark to the east where the shadow is still present but heading rapidly up the path of totality.



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WHEN TO START AND END?

A wide-angle time-lapse is shot with no filter on the camera. You want to shoot only for the few minutes on either side of totality.

This type of time-lapse does not involve shooting the entire eclipse from first to fourth contact. I dealt with shooting complete eclipse composites in Chapter 7. For those images, you need to shoot the partials through a filter. You then layer those later in processing to make a single-image composite. While you could turn filtered shots into a time-lapse, the sight of a tiny Sun moving across a black sky isn't going to be too inspiring.

Instead, for a wide-angle time-lapse, shoot with an unfiltered lens. Start the sequence about 5 minutes before totality and end it as much after totality. Always remember, the same dramatic changes in lighting happen both before and after totality. For the 10 to 15 minutes that it will be aimed at the Sun, the camera will be safe. True, you wouldn't want to aim a telephoto or scope at the Sun unfiltered for that long, but a wide-angle lens will be fine. I've done it many times.

At the 2012 Queensland eclipse, Stephen gets ready to shoot totality with a telephoto lens. My wide-angle camera was metres away. I started it about 3 minutes before totality. Don't start it too soon as you don't want an unfiltered camera aimed at the Sun for longer than necessary. Similarly, be sure to remember to stop and cap the camera a few minutes after totality. Don't let it run unattended for another hour. Wherever you place your camera, be sure it will not be tripped over or that no one will walk into the frame to stand in front of your camera, blocking the view.

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HOW OFTEN TO SHOOT?

The big question with any time-lapse is, "How often do I shoot?" Here, the answer is simple: a frame every second.

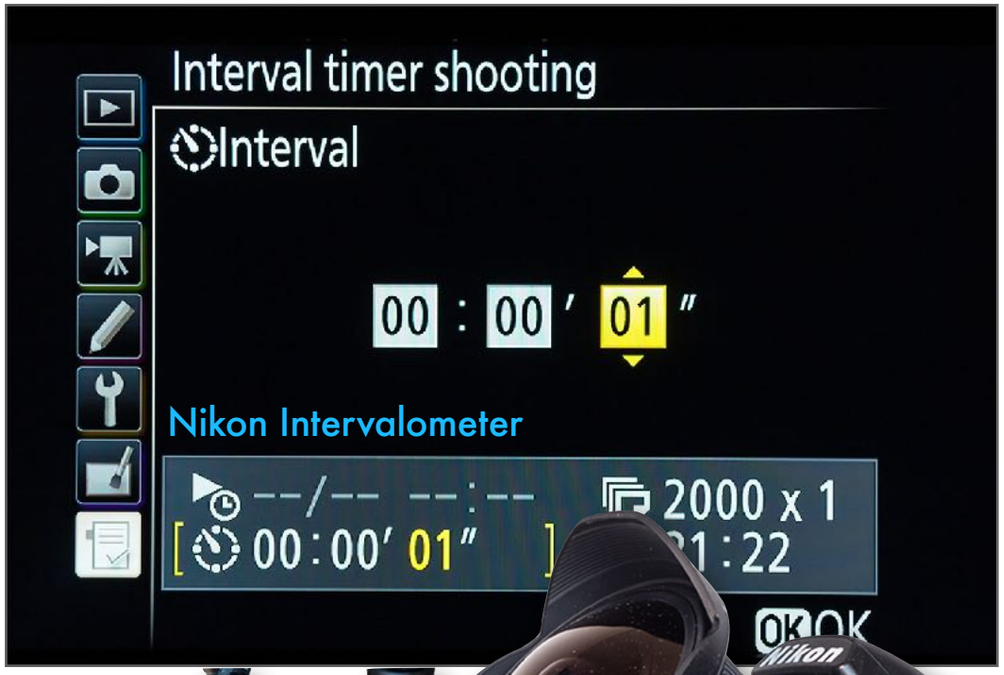
Even 10 minutes before totality the sky is still not changing too rapidly. However, the pace quickens as you approach totality. So I suggest shooting every second to record as much "time resolution" as possible.

The complication is that under Auto Exposure during totality exposures might grow longer than 1 second. If that happens, the intervalometer won't be able to fire the shutter and will skip frames. Just when you want as many frames as possible, your camera is missing frames, perhaps taking them only every 2 or 3 seconds. In the final movie playback, the cadence will appear to speed up, then slow down again.

To prevent this "frame collision," set your lens to f/2.8 if you can or, with a slower lens, use an ISO of 400. Either should keep exposures under 1 second during totality. A shot every second for 10 minutes = 600 frames = a 20 second video.

With either built-in (at right) or external add-on intervalometers (below), set the INT (Interval) to 1 second, as fast as a camera can shoot an extended time-lapse.

TIP: Make sure your memory card has enough space to store the hundreds of frames a time-lapse shoot will produce. Clear off your vacation shots before eclipse day.



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WHAT EXPOSURES TO USE?

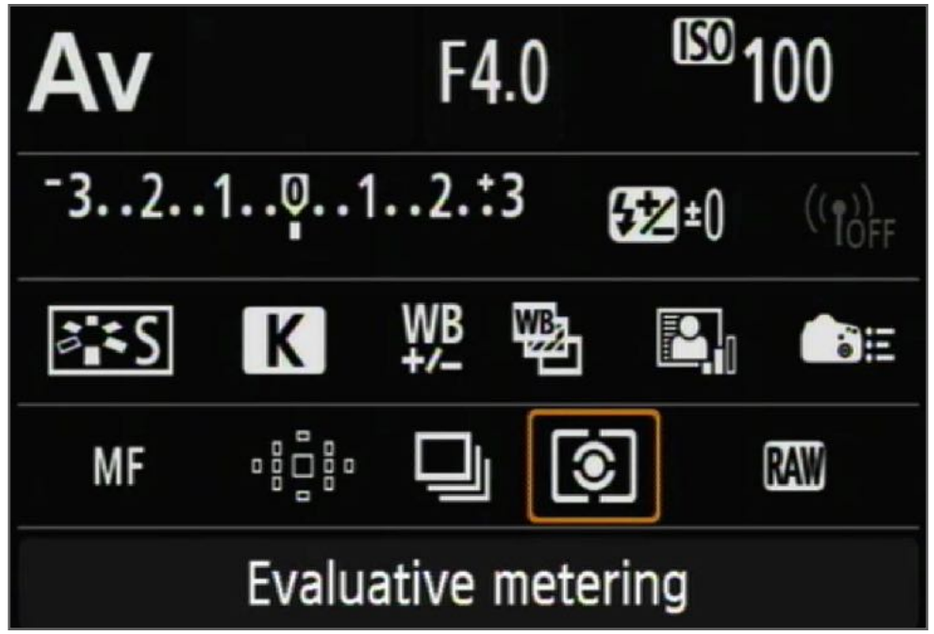
For all the wide eclipse time-lapses I've shot I've always used Auto Exposure - Aperture Priority. It works well and allows for unattended shooting.

One option I've seen people use is to set the exposure to be more or less correct for the bright daylit scene during the late partial phase, then leave the camera at that setting on Manual. They simply let the scene go dark. While that does dramatically show the descent into darkness, during totality the photos will be so underexposed you won't see anything. But your eyes certainly will, because they adapt to the dark. Plus the images will likely miss capturing the changing twilight colors and shadow motion, just what a time-lapse should record.

As I advised in Chapter 5, for what I feel is a more realistic sequence, I prefer to have the camera also adjust to the dark, by running it in Auto Exposure on Aperture Priority. If you want an overall darker scene, then set the Exposure Compensation to provide -1 to -2 stops of underexposure. Otherwise, the corona tends to overexpose, washing out the dark lunar disk.

METER MODE

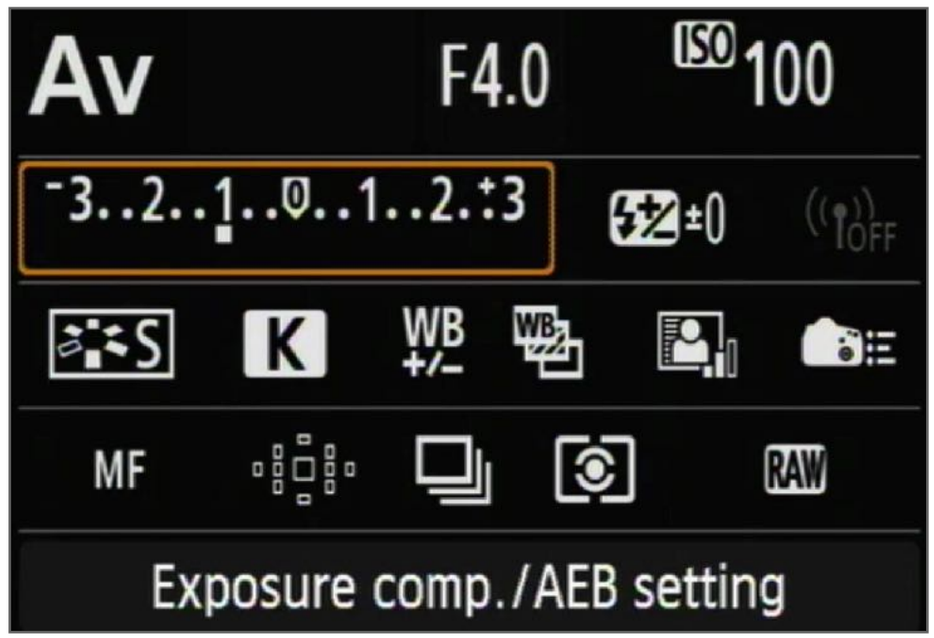
As with still images on Auto Exposure, to ensure the most accurate metering of the changing sky in a time-lapse, set the camera to an Average or Evaluative not Spot metering mode.



Canon 6D Screens

EXPOSURE COMPENSATION

Set the camera's Exposure Compensation to purposely underexpose each frame by 1 to 2 f-stops, to help retain the dark lunar disk and some detail in the corona, and in bright twilight sky areas.



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SECTION 3

SHOOTING CLOSE-UPS

Shooting a close-up time-lapse is a lot more difficult, requiring careful planning and framing, to ensure the Sun doesn't move out of frame and ideally ends up centered during totality. In addition, this type of image demands attending to the camera to adjust exposures and to remove and replace the solar filter. Attempt this type of image only if you are able to give it the attention it deserves, both in the planning, rehearsal, and in the execution.

November 14, 2012, Queensland, Australia

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SHOOTING AN UNTRACKED TIME-LAPSE

Here we let the motion of the sky work for us by letting it carry the Sun across the frame. With good planning the Sun will be centered at totality.

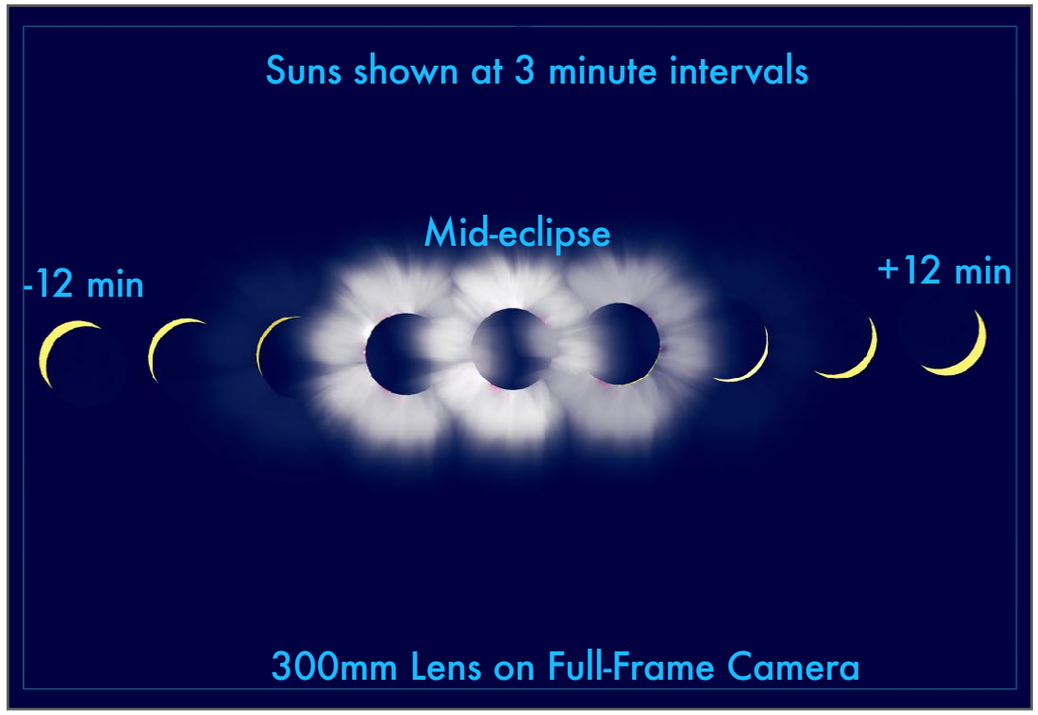
You might well ask, why not shoot this with real-time video? I'll cover that technique in the next chapter. Indeed, you could shoot video for many minutes, then speed it up in editing. But here I discuss shooting the key minutes surrounding totality using time-lapse techniques.

To do that, we make use of the east-to-west motion of the sky, by placing the Sun off-center on purpose, then letting it drift across the frame. The partials all must be shot with a filter in place, which you remove just before second contact for the diamond ring, then remember to replace (!) after third contact. That has to be done without bumping the camera, or else you will ruin the time-lapse motion. Use a very solid tripod!

Then during totality you can vary the exposure as per Chapter 6, to show progressively more of the corona. Shoot frames at intervals long enough to allow you time to make adjustments.

IN THE WEST

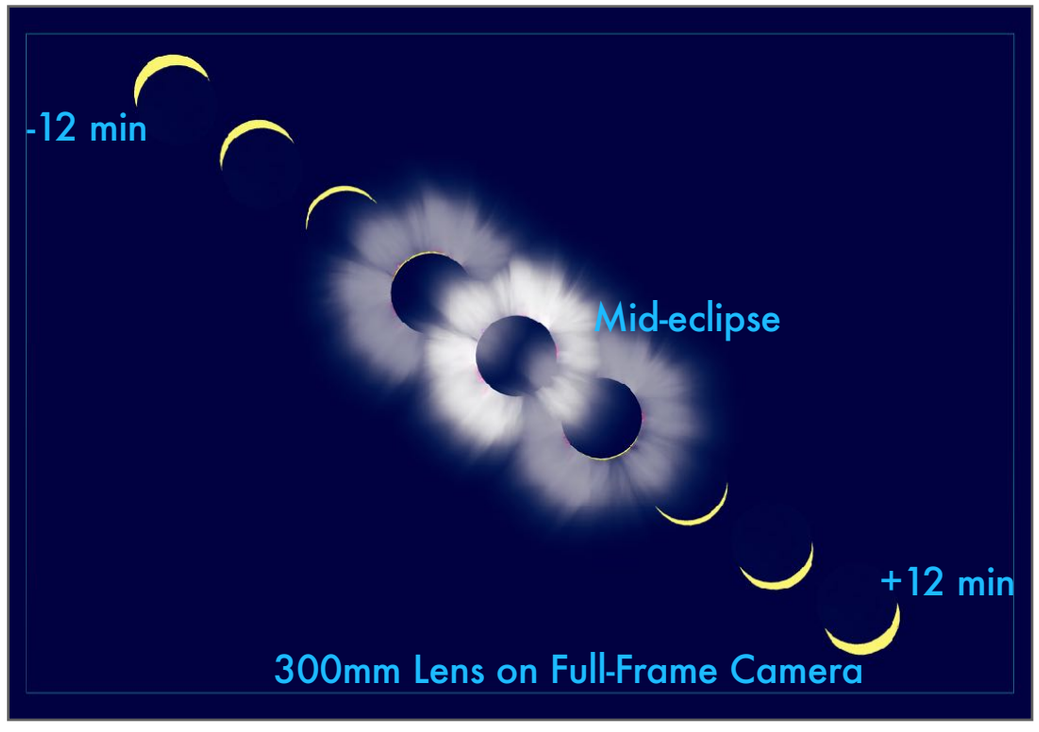
The motion of the sky will drift the Sun horizontally across the frame during the time before and after totality. Shooting every 3 seconds for 24 minutes = 480 frames.



IN THE EAST

The Sun will move diagonally down across the frame from eastern sites. The exact framing will depend on your site.

480 frames rendered at 24 fps = 20 seconds of video



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PRACTICE ON THE MOON – III

A close-up time-lapse requires practice. The best opportunity, once again, is on the Moon, with the crescent Moon offering a good range of brightness.

Pick a suitable night, and use planetarium software (such as Starry Night™ that I've used throughout the book for all the diagrams) to plan how the Moon will move over 20 minutes or so, Frame the scene to capture the Moon's path.

Set the intervalometer to shoot every 2 to 3 seconds and fire away at a suitable correct exposure. Then at mid-sequence, see if the Moon ends up centered as you had hoped.

During your "faux" totality, practice shifting the exposure by varying the shutter speed, either by physically adjusting the camera dials to change shutter speed, or by using a camera control app (discussed in Chapter 10) to change the settings via a wireless remote.

Do this several times! A successful time-lapse won't happen by accident or good luck. It will take skill and practice.

The waxing crescent Moon presents a similar wide range of brightness, from the sunlit crescent to the Earthlit dark side, as does the corona. It will move from east to west just as the Sun will during the eclipse, or as it does any day!

Close-up time-lapses make use of the motion of the sky to carry the Sun and Moon across the frame. The Moon's own motion along its orbit is what carries it across the Sun. Using a tracked telescope you could keep the Sun centered and shoot a time-lapse of the Moon moving across the Sun. That's next....

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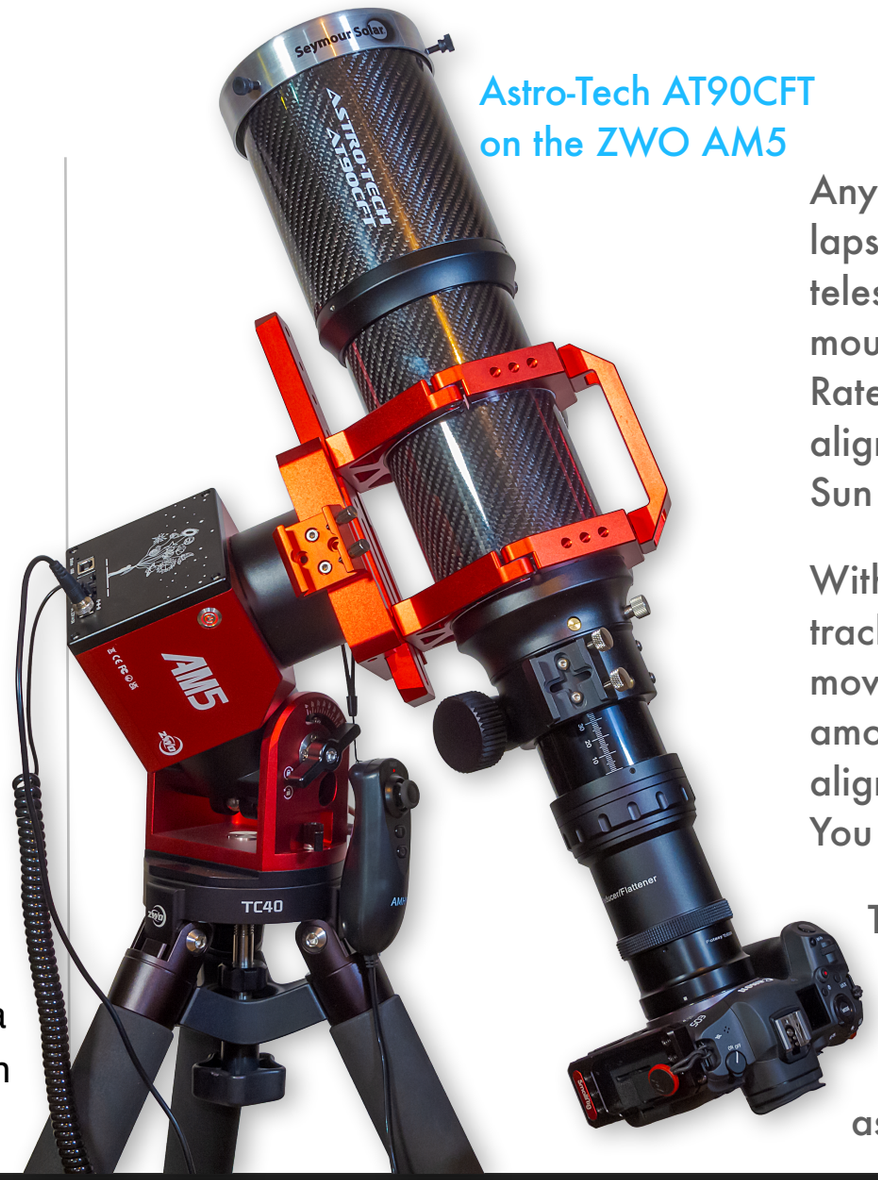
SHOOTING A TRACKED TIME-LAPSE

TIP: When shooting for any time-lapse be sure to shoot at frequent and regularly spaced intervals.

The other type of close-up time-lapse is to keep the Sun centered by using a tracking mount and telescope or telephoto. Shoot at regular intervals.

This involves less work because you don't have to plan how the Sun will move across the frame. Indeed, if you shoot lots of images – of the final partials, of totality, and then post-totality – you might end up with all the frames you need for a time-lapse, as I show below. But shoot at regular intervals, not haphazardly. You still need to remove and replace the filter, and then adjust the exposure during totality. Adjust exposures in 1/3-stop steps, from short, to long, and back to short again, to create a smooth transition from diamond ring to maximum corona and back to diamond ring. Much easier said than done!!

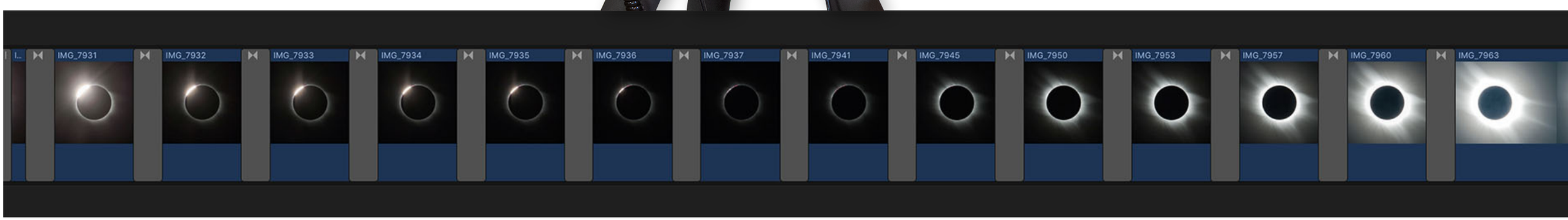


Astro-Tech AT90CFT on the ZWO AM5

Any attempt to shoot a full-length time-lapse from C1 to C4 contacts through a telescope will require an equatorial mount, such as this, running at Solar Rate and that is accurately polar-aligned the night before, to keep the Sun well centered during the shoot.

Without accurate polar alignment and tracking, assembling the time-lapse movie will first require an immense amount of hand work registering and aligning the Sun from frame to frame. You want to avoid that!

The telescope is an Astro-Tech 90mm CFT triplet apo refractor on a ZWO AM5 harmonic drive equatorial mount, a nice combination for any astrophotography, not just eclipses!



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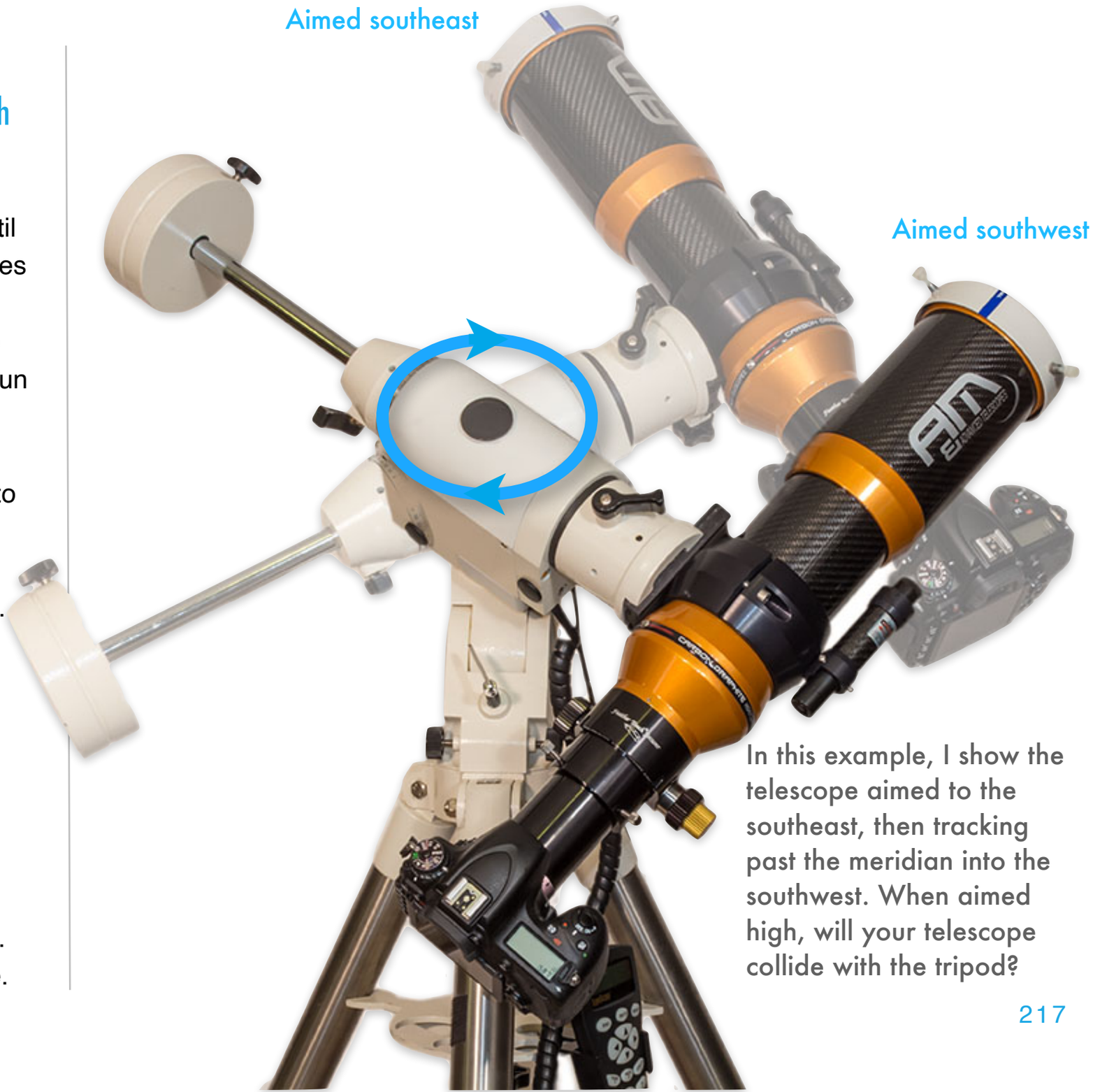
TRACKING THROUGH THE MERIDIAN – 1

Here's a factor to consider if you are planning a consistently-framed set of images for a full-length time-lapse through a telescope.

This is a possible glitch I hadn't considered until I was shooting the studio shots of the telescopes and mounts. A traditional German equatorial mount, such as this Sky-Watcher HEQ5, is the best to avoid field rotation when tracking the Sun over the length of the eclipse. But … what will happen as the telescope crosses the meridian due south, as it follows the Sun from morning to afternoon? Some mounts, like the ZWO AM5 shown on the previous and next pages, stop tracking at the meridian, forcing a meridian flip.

This is a concern for sites in Mexico and the U.S. southwest where the eclipse starts in the late morning but extends into the early afternoon. You don't want to find that the telescope, which might have started as shown here on the west side of the mount looking southeast, starts to collide with the mount as it follows the high Sun into the southwestern sky. This will ruin the last frames of your time-lapse.



In this example, I show the telescope aimed to the southeast, then tracking past the meridian into the southwest. When aimed high, will your telescope collide with the tripod?

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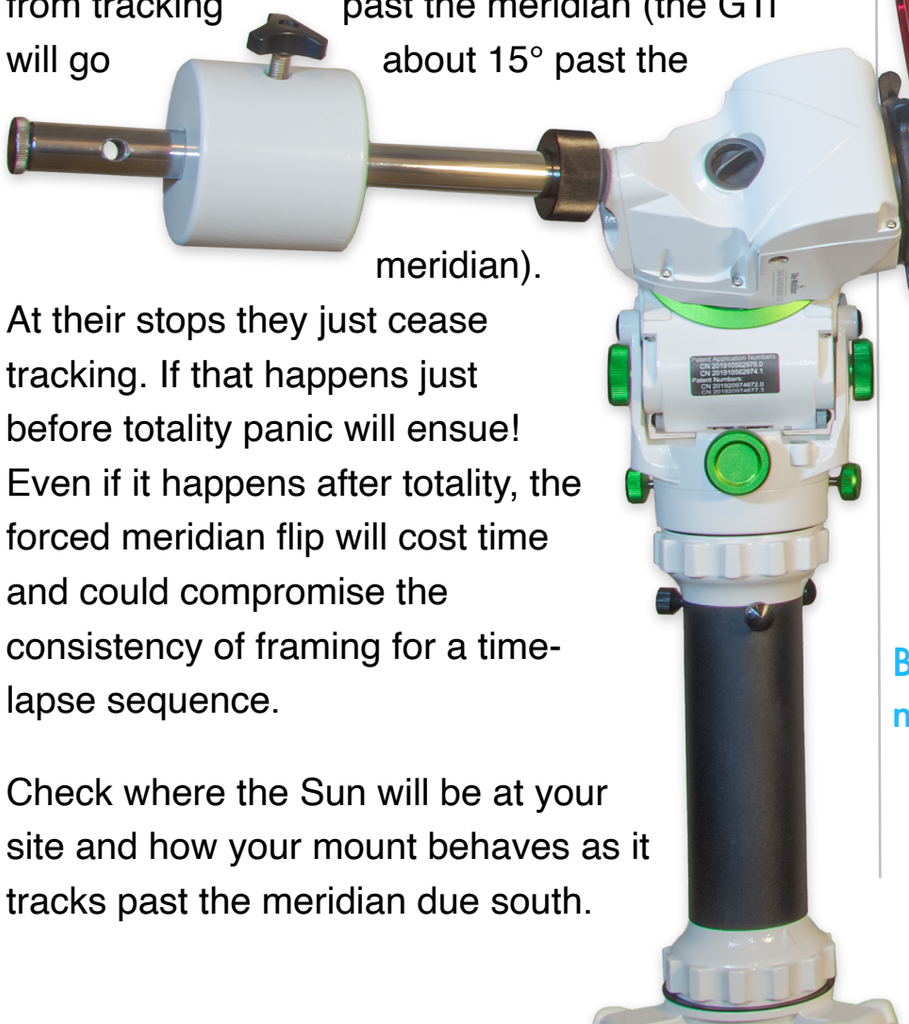
TRACKING THROUGH THE MERIDIAN – 2

Test your mount to be sure it will work when tracking a target – the Sun – as it crosses the meridian due south.

These two mounts, the Sky-Watcher Star Adventurer GTi and the ZWO AM5 (and presumably their newer AM3) each have hardware or software stops that prevent them from tracking past the meridian (the GTi will go about 15° past the meridian). At their stops they just cease tracking. If that happens just before totality panic will ensue! Even if it happens after totality, the forced meridian flip will cost time and could compromise the consistency of framing for a time-lapse sequence.

Check where the Sun will be at your site and how your mount behaves as it tracks past the meridian due south.



Sharpstar 61 EDPH on the Star Adventurer GTi

Astro-Tech AT90CFT on the ZWO AM5

Both shown aimed nearly due south

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USING A SMART SCOPE – THE DWARF II

In the last year this little telescope has become very popular as an entry-level astrophoto system. Its optional solar filters allow shooting the Sun.

Made by DwarfLabs, this compact $460 telescope offers a 25mm-diameter lens with a focal length of just 100mm. However, its small sensor (5.6mm by 3.1mm) yields a field of view of 3.3° by 1.8°, the equivalent of a 620mm lens on a full-frame camera. The device will track the Sun well enough to keep it centered for up to 30 minutes, with the pointing adjustable with a virtual joystick. The filters snap on magnetically and so will be easy to remove for totality. It can shoot either stills or 4K video, with auto exposure, or with user set manual shutter speeds. Image quality isn't up to what a good DSLR can achieve, but this might be a great choice to assign to a family member to shoot with. But practice!

The Dwarf II with solar filters in place on the main telephoto lens (at left) and wide-angle finder lens (at right). They screw into a holder which is held in place by magnets, making it easy to remove and replace.

The Dwarf can track the Sun (that option is turned on) or Track any target you select. The small inset screen is the view from the little finder lens.

The shooting screen (above) and final image. The Sun and Moon fill about 1/4 of the frame, ideal for framing the solar corona during totality. Images are 3840 x 2160 pixels in Photo mode.

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USING A SMART SCOPE – THE SEESTAR 50

The popular competitor to the Dwarf II is ZWO's Seestar S50, with its 50mm lens and 250mm focal length for a field of view of 0.7° by 1.3°.

The $500 Seestar from ZWO is another self-contained smart scope that provides easy operation with a minimum of user-selectable settings to confound the beginner. Its field of view is less than half the Dwarf's, about equal to that of a 1600mm focal length lens or telescope on a full-frame camera. Images are 1080 x 1920 pixels and in a fixed portrait (vertical) orientation. As such, the corona of the eclipsed Sun will be cut off. But the little Seestar could be excellent for closeups of prominences and Baily's Beads.

It can find and track the Sun, though if it misses, locating the Sun by scanning around with the virtual joystick can be tough with its small field. Resolution is good but the images are small and videos are only HD. But the portrait orientation suits social media apps and phone screens. Like the Dwarf II, the Seestar could be a great device to assign to a young family member, to shoot either stills or videos, or both. But again, practice on the Sun or, as here, on the Moon.

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CHAPTER 9

9

2024: SHOOTING VIDEO

If the purpose of your photography is to record images that capture not just the appearance of the eclipse but also the excitement of being there, then shooting a video is the priority. You capture the fast-changing motion – and the sounds.

August 21, 2017, Idaho

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SECTION 1

VIDEO OPTIONS

A total solar eclipse is one of the few celestial phenomena that is possible to record with a conventional video camera. Indeed, some aspects of the eclipse are best recorded with video.

With video capabilities now included with every camera, there is no longer any need to shoot with a specialized video camcorder. Now even the device in your pocket can shoot HD, if not 4K video. So why not?

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CHOOSING A CAMERA

All DSLRs and DSLMs made in the last decade can shoot HD or 4K video. Their interchangeable lenses provide the most options for framing.

Back in 2017 I talked about camcorders. Except for specialized vlogging or GoPro-style action cameras, camcorders as we once knew them are essentially gone. Now, for casual videography, we just use our mobile phones. Placed on a tripod they can record the rapid descent into, and emergence from darkness.

However, video works best for capturing close-up sequences of the diamond rings and Baily's Beads at second and third contacts. For those you will need the focal length of a superzoom camera, a long telephoto, or a telescope.

While a high-end cinema camera (such as from Sony's FX or Canon's Cinema EOS series) will work well, my experience is with DLSRs and DSLMs, using their movie modes. So those are the cameras I discuss here.

For long lenses, place them on a solid tripod and a head with fine adjustments for vertical and horizontal motions. Ball heads are not suitable here for untracked cameras.

For simple cameras even a mini tabletop or "Gorilla Pod" tripod is better than hand-holding, especially for video. Just aim them and press Record. The Auto Exposure will likely work well through totality.

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CHOOSING A LENS

Shooting video with a telephoto lens or telescope is the best way to capture the fast-moving transition from bright Sun to totality, and its return at C3.

For close-up videos use a DSLR or DSLM with a long telephoto or attached to a telescope as per Chapter 6. Use the camera in its video mode. I've found that Auto Exposure handles the rapid change from diamond ring to the corona well, though the camera will likely adjust exposure by changing the ISO, perhaps increasing the background noise as the scene dims.

Whatever the camera, the question is do you track or not track the Sun? See Chapter 6 and Chapter 7 for illustrations of how much and in which direction the Sun will drift through the frame during the few minutes on either side of totality if you are not tracking the Sun.

But if you are shooting with focal lengths longer than 500mm I would advise tracking the Sun, or it might drift out of frame before totality ends. Just be sure the tracker and head are solid. Wind can jostle the camera, ruining you video.

Superzoom cameras (mentioned in Chapter 5) can work well for video, if you can keep the Sun centered.

However, a DSLR or DSLM with a telephoto, perhaps augmented by a tele-convertor to increase the focal length still more, or a small telescope will be best for high-quality video. Place them on a tracker (as below) to follow the Sun for the few minutes around totality.

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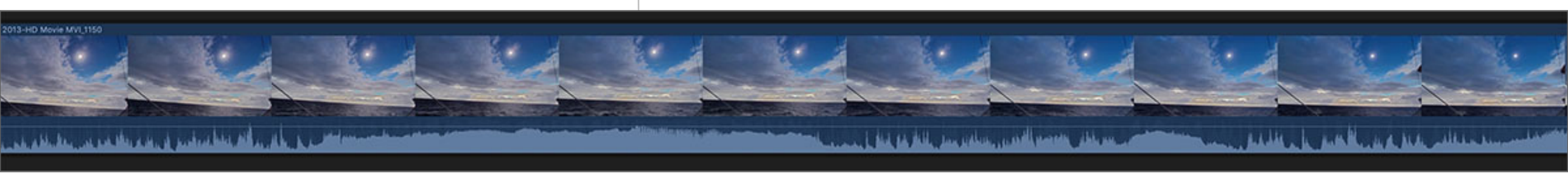
SHOOTING THE SCENE FOR B ROLL

While it is tempting to shoot just a close up video of totality, playing back all 4 minutes in real time will bore your audience. Cruel but true!

To tell the story, you also need wide shots of the scene, and of you and your fellow observers, to serve as “B roll” to cut to. A point-and-shoot, or even your phone, could provide these. Better cameras will provide cleaner, less “grainy” video during the darkness of totality. Be sure you have enough storage space free on the big day. You don’t want a “Card Full” or “No Memory” warning coming up at the worst moment.

Post-eclipse, use your B roll camera to interview people and get their reactions. Those are the uninhibited, honest moments you want to capture. That could be a great job for family members, to serve as second camera operators.

A video camera with a suitably wide lens will nicely record the darkening scene as the Sun goes into totality. Use Auto Exposure, as I did below at sea in 2013.



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SECTION 2

SETTING EXPOSURES

When shooting real-time video, shutter speeds are usually limited to being no longer than 1/30 second. They can be shorter, useful for the diamond rings. But recording the outer corona requires that you either open up the aperture of the lens (which will be impossible on a telescope), or increase the ISO speed of the sensor, increasing noise and decreasing dynamic range. How cameras allow you to adjust or override video exposure settings varies. Test!

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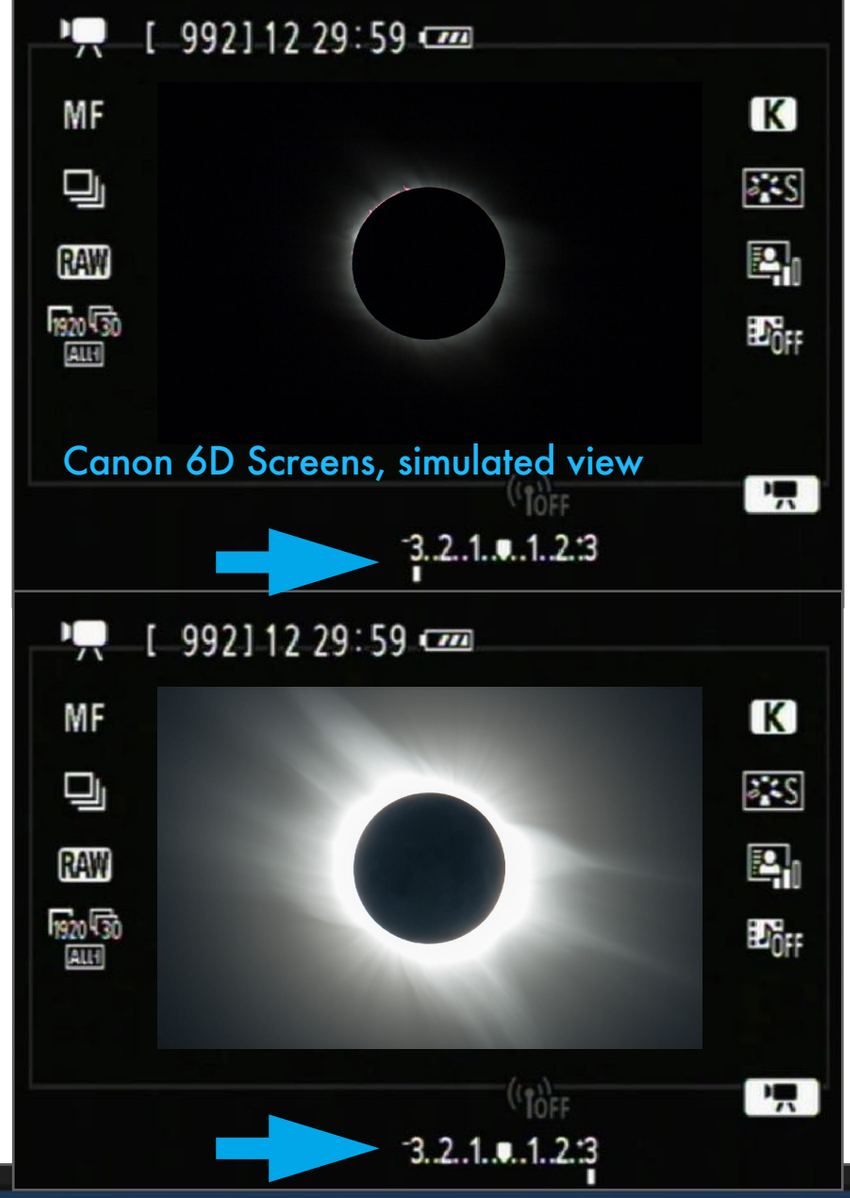
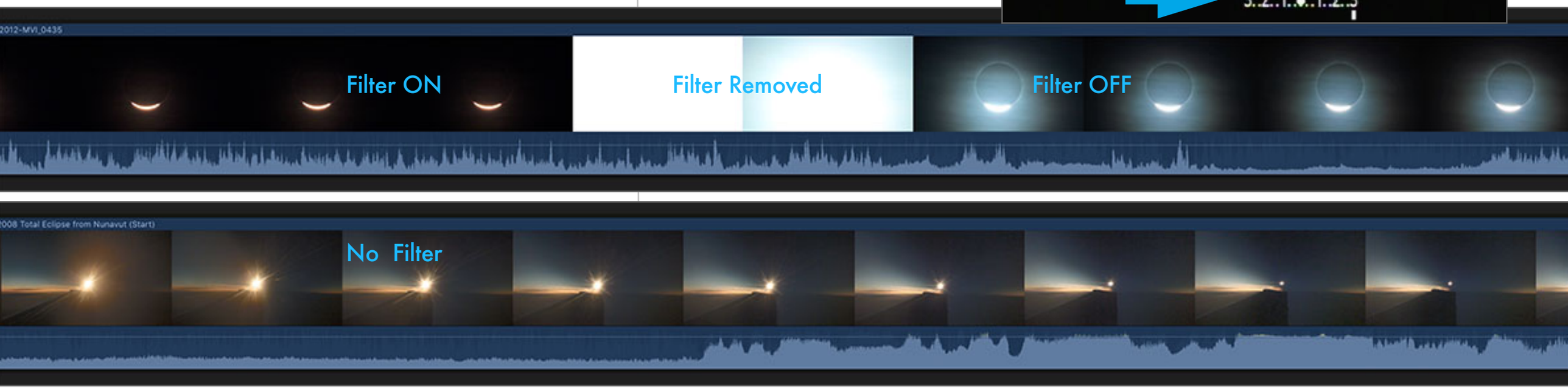
HOW TO SET EXPOSURES

One method of shooting close-up videos is to leave the camera on Auto Exposure, then vary the Exposure Compensation to show more corona.

When shooting video I've found leaving the camera on Auto Exposure works well. In the movie strip below I show what happened when I removed the filter from a telescope with a DSLR – a few frames were blown out until the camera adjusted and provided an excellent exposure. The bottom strip is with a video camera set wide, and with no filter at all. It worked great.

By varying the Exposure Compensation (+/–) during totality you can can record the bright prominences (–) or more of the outer corona (+) than what Auto Exposure might provide on its own. Do this only if you are shooting with enough focal length to see the corona well, or else you might get no more than an overexposed blob, with no "black hole" effect.





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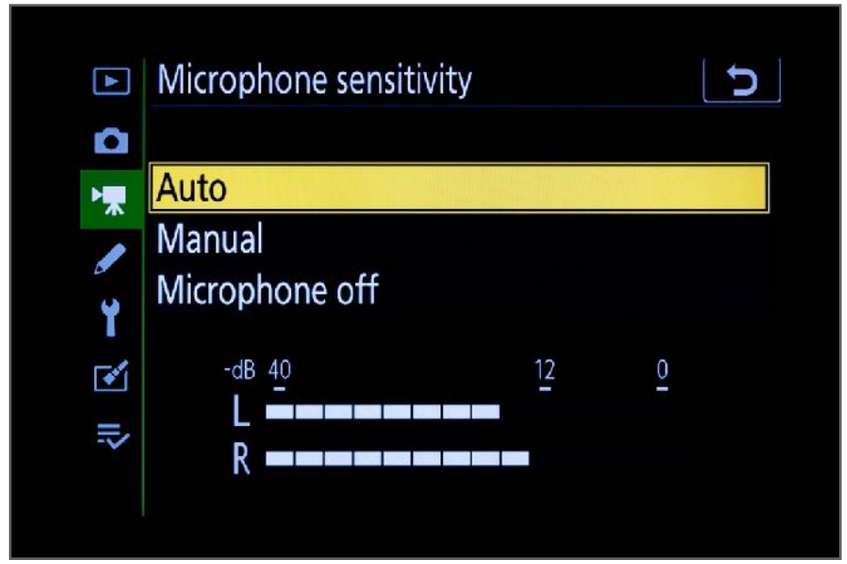
MOVIE AUDIO SETTINGS



One of the best aspects of shooting a movie is its ability to also record sound – of you and your group's excited reactions!

If you have a camera on a telescope or telephoto lens then its internal microphones will capture your commentary and exclamations. But it might also capture any sounds of you clicking camera settings.

A better option might be to dedicate a camera, perhaps one with a wide-angle lens and set off to one side, to shoot a wide-angle movie with sound. Test to see how well its microphones will pick up sound when set a few feet away. Or equip it with an external omnidirectional microphone.

Be sure to turn on the Audio recording. Audio levels can likely be left on Auto, as here on a Nikon Z6.

The built-in microphones might work well, but turn on any Wind Filter, as here on a Sony a7III.

Or for better audio use an external microphone with a wind sock on a camera dedicated to audio.

IMPORTANT!: In your excitement after the end of totality remember to replace the filter on any optics, or turn them away from the Sun. Forgetting your optics are still aimed at the Sun might melt your camera! Should you forget to remove the filter in the first place, your video camera will at least record the audio, which is often the best part of an eclipse movie.

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SECTION 3

MOVIE MODE OPTIONS

Today's "hybrid" cameras, ones that can shoot stills and video, offer a bewildering array of choices, not only for movie size (HD, 4K or 8K), but also video quality, format, compression rates, and the contrast curve applied to the recorded movie. These can make a big difference to the video quality. **NOTE**: I describe Canon settings. Other brands have similar options, but check your camera manual and test the various choices on the Moon to see what works best.

August 21, 2017, Idaho

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4K STANDARD *VS.* 4K HQ *VS.* 8K

Area blown up below

Canon R5
8K-D, All-I, 29.97 fps; Manual: 1/15 sec, ISO 1600, CLog3 ON

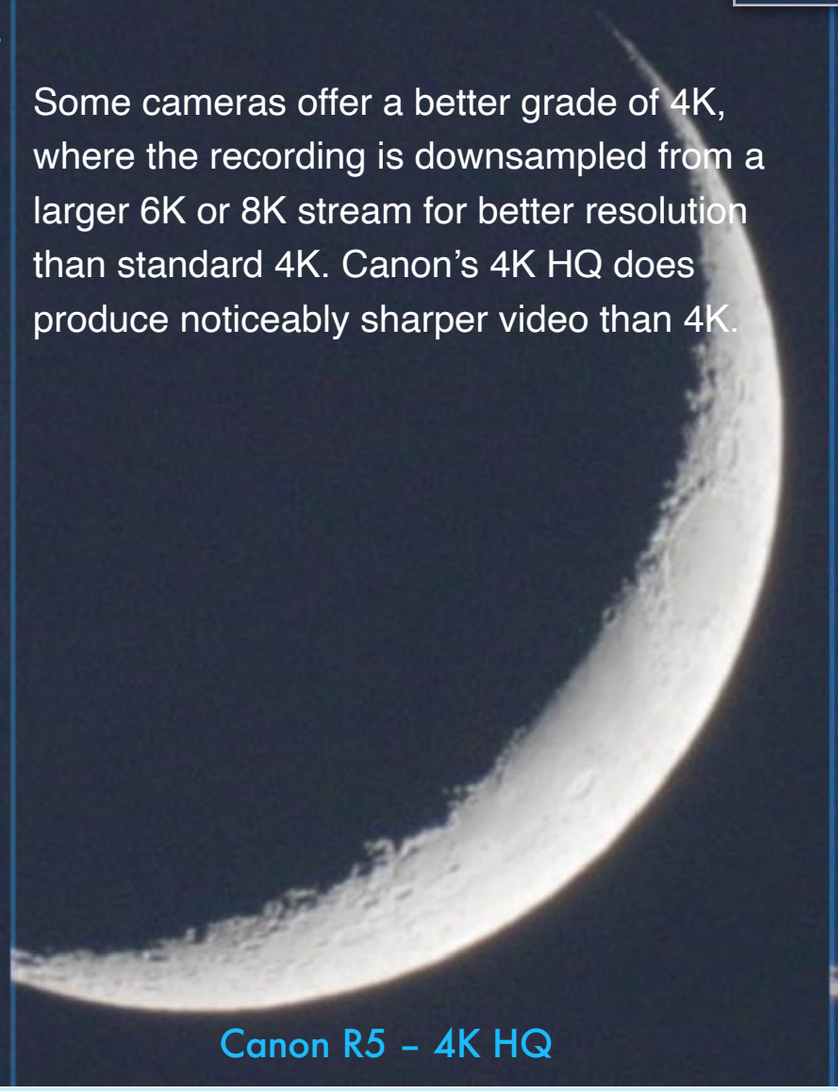
If your camera offers 4K video, use that format for the best quality. However, some cameras have a 4K HQ mode that's even better. Better yet is 8K.

This set compares frame grabs from three different video recordings of the Moon, blowing up a tiny portion of the frame as shown at right. Standard 4K is soft compared to 4K HQ and 8K. HD would be much worse.

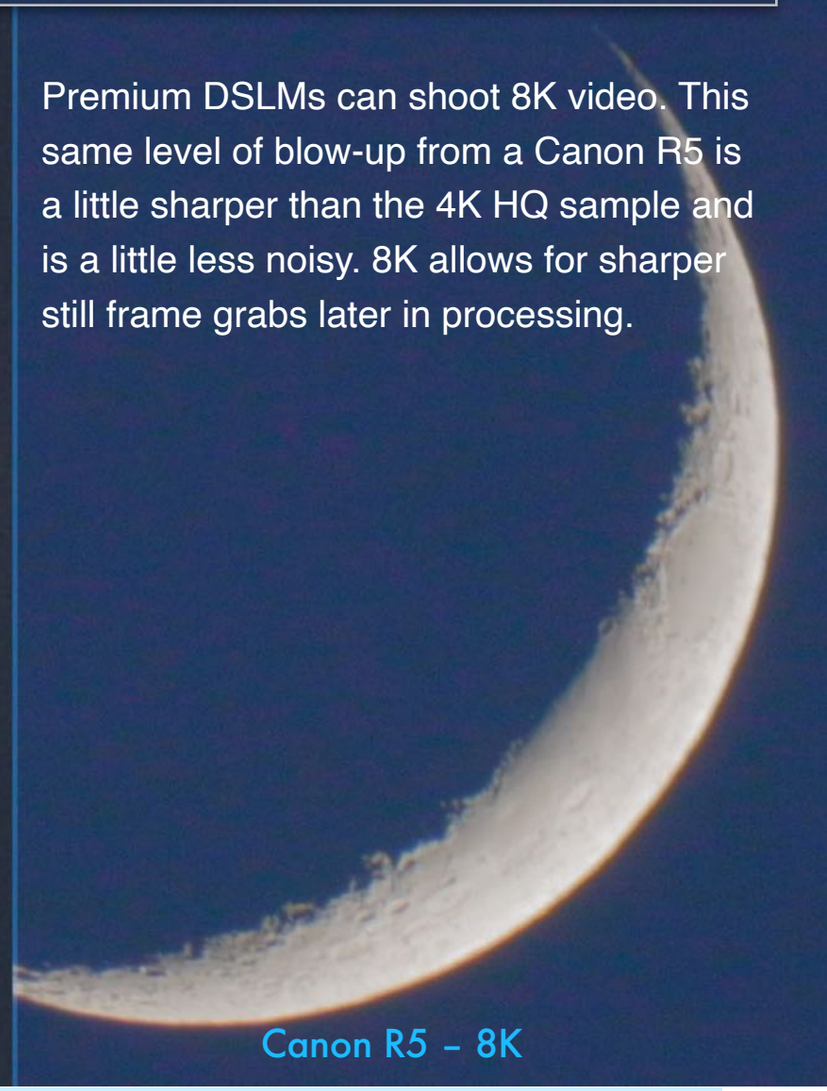
Some cameras offer a better grade of 4K, where the recording is downsampled from a larger 6K or 8K stream for better resolution than standard 4K. Canon's 4K HQ does produce noticeably sharper video than 4K.

Premium DSLMs can shoot 8K video. This same level of blow-up from a Canon R5 is a little sharper than the 4K HQ sample and is a little less noisy. 8K allows for sharper still frame grabs later in processing.

Canon R5 – Standard 4K



Canon R5 – 4K HQ



Canon R5 – 8K

VIDEO SIZES: I shot the 2009 eclipse in the South Pacific with the then new Canon 5D MkII, one of the first DSLRs able to shoot video, though only HD, which is 1920 x 1080 pixels. Now, most cameras can shoot 4K, aka "Ultra HD," usually 3840 x 2160, double the pixel dimensions of HD. 8K video, possible with cameras with 45 or higher megapixel sensors, is double that size again, to 7680 x 4320 pixels.

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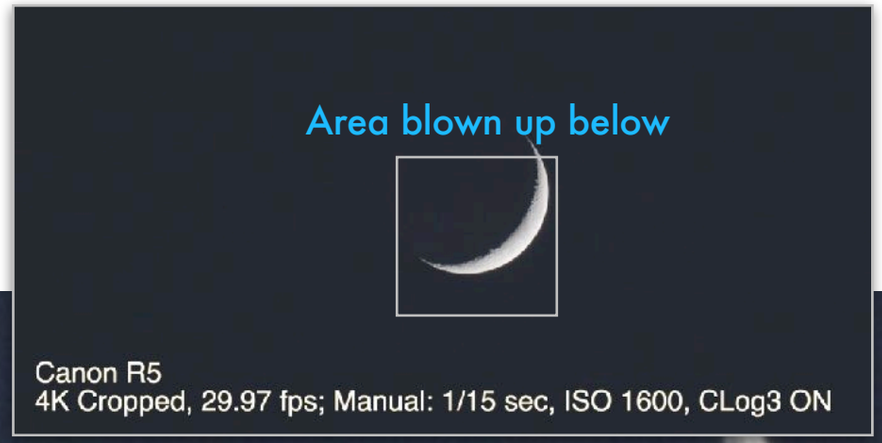
4K FULL-FRAME *VS.* CROPPED



Canon R5
4K Cropped, 29.97 fps; Manual: 1/15 sec, ISO 1600, CLog3 ON

Some full-frame cameras allow shooting in a "Movie Crop" mode, where a 4K video is sampled from the central 3840 x 2160 pixels of the sensor.

This pair compares frame grabs from two 4K videos: on the left from one shot with Movie Cropping ON, to produce an image as shown in the inset above, from which this blow-up is taken. The Moon's image is larger on the frame, just as if a longer lens was used.

This shows a frame grab from the same 4K HQ video shown on the previous page, one that was from the full frame area of the sensor. The grab from the Movie Cropping video shows similar details and sharpness but has a smaller field of view.

Canon R5 – 4K Cropped

Canon R5 – 4K HQ

If your camera offers a Movie Crop mode, it might produce sharper images than a 4K Full-Frame movie. It equalled the 4K HQ movie here in this test. The Moon and Sun will occupy a larger portion of the frame, which might be a good thing, depending on your lens. Just remember that the corona will extend out by two times the diameter of the Moon's disk, or more.

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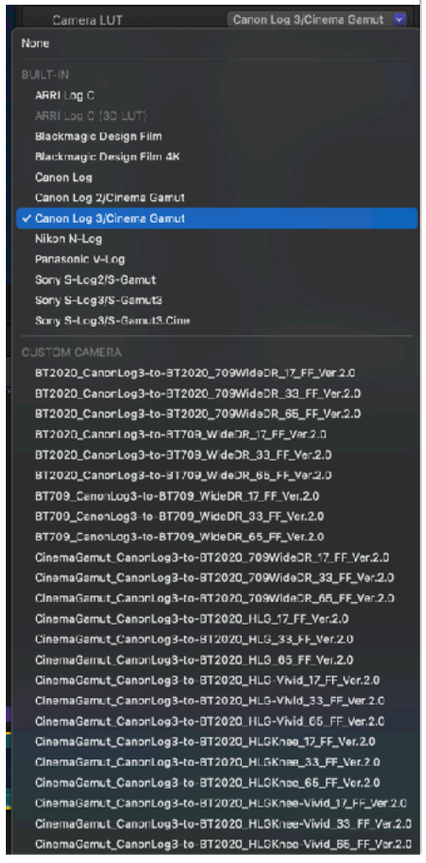
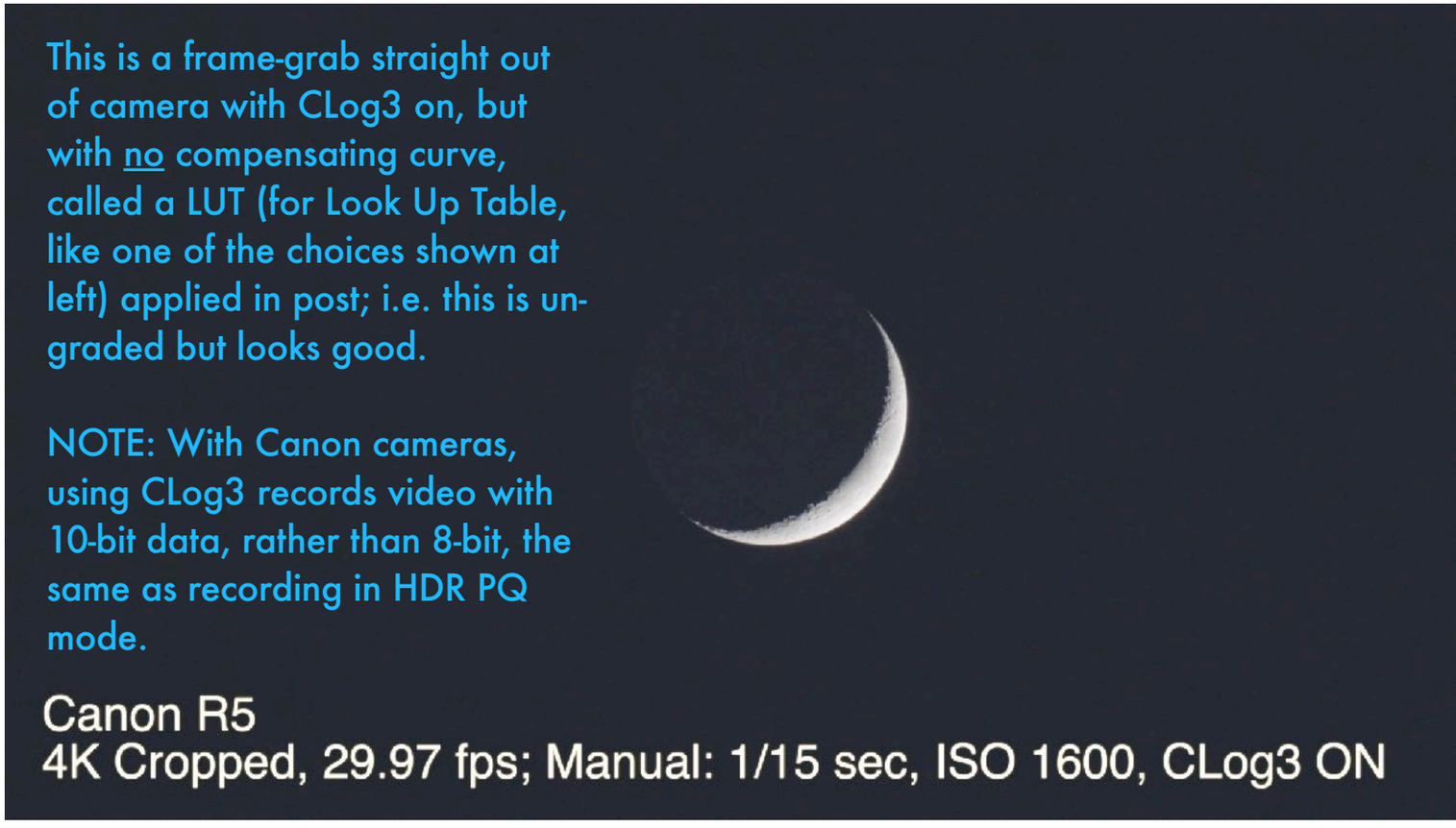
CONTRAST CURVES

Almost all modern DSLMs offer the choice of shooting with a Log Curve to flatten the contrast. This can help record a wider dynamic range.

Here I show frame grabs from two 4K Cropped videos: one with Canon's CLog3 turned off and one with it turned on. Fuji, Nikon, Panasonic, and Sony have their own Log curves. Shooting with CLog3 on in this case captured much more detail on the bright crescent of the Moon. The lower contrast of a Log profile was an advantage here. However, using Log curves can introduce shadow noise, and require the camera be set to a higher base ISO, such as ISO 800 for Canon cameras. Test on the Moon. This is a setting you want to get right; lost detail can't be recovered.





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AUTO *VS.* MANUAL EXPOSURE

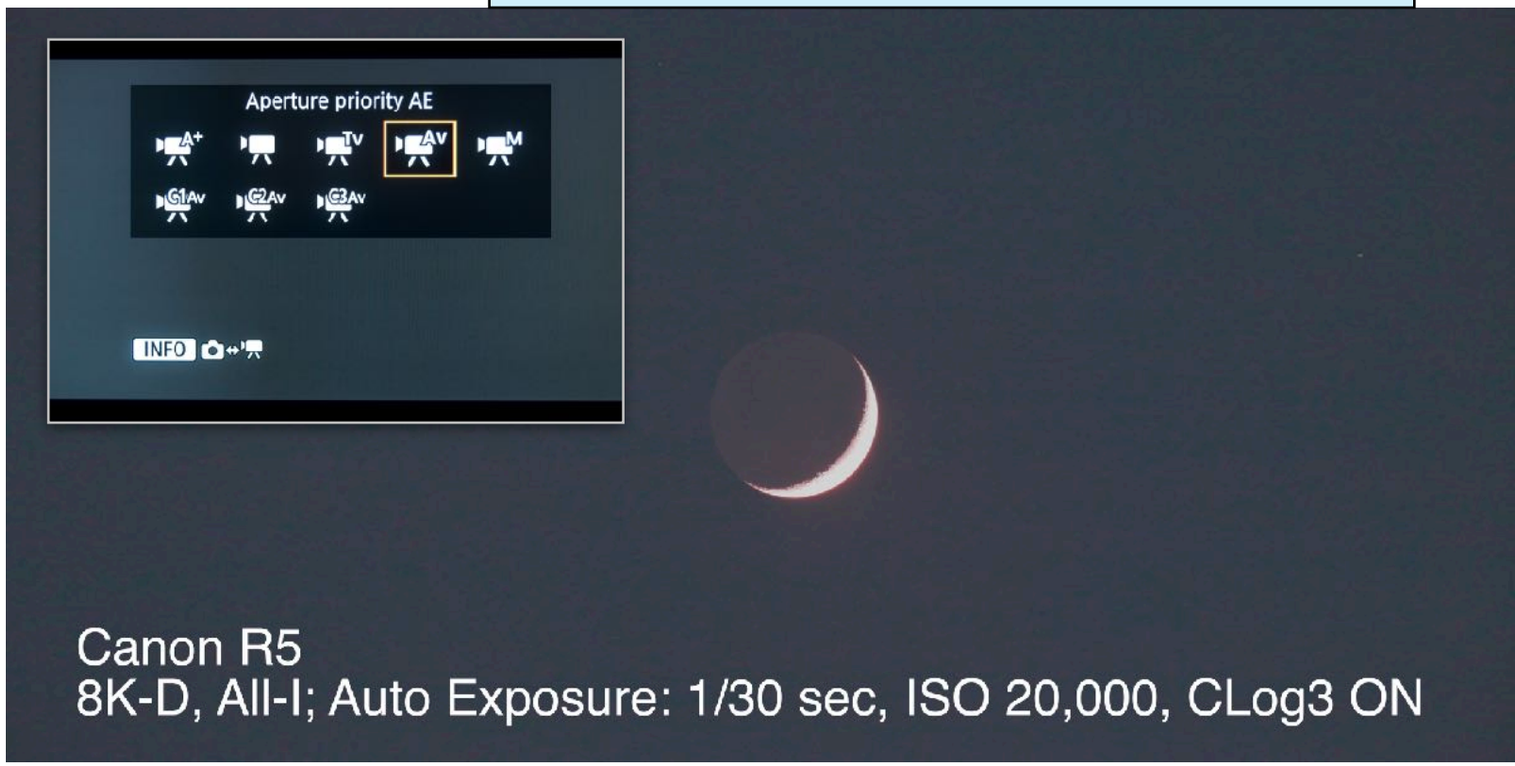
TIP: Look up what your camera uses as its "base ISO" for video. For the Canon R5 it is 800 when using CLog3. That can introduce more noise. Test!

While Auto Exposure can work well, once totality is well underway, the camera might crank up the ISO leading to noisy video.

These two examples show what can happen as the background sky darkens and the brightest area of the image is the inner corona. When set on Auto Exposure in this test, and with the shutter speed at the normal 1/30 second, the camera did expose well enough to show the dim Earthshine, standing in here for the faint outer corona. But to do so the camera raised the ISO to 20,000. The sky looks visibly grainy.

By comparison, a few minutes earlier with the twilight sky brighter, a manually set shutter speed of 1/15 second and ISO of 1600 yielded a much smoother image with less noise.

It is possible to manually "drag" the shutter speed down to 1/8 second with many cameras, a gain of 2 stops in light, which might help keep the ISO down. Any motion blur the longer shutter speed produces shouldn't be an issue for totality, but could blur the diamonds rings.



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OTHER VIDEO SETTINGS

The newer your camera the more the options it offers for video settings. Here are my suggestions for the best quality vs. manageable file sizes.

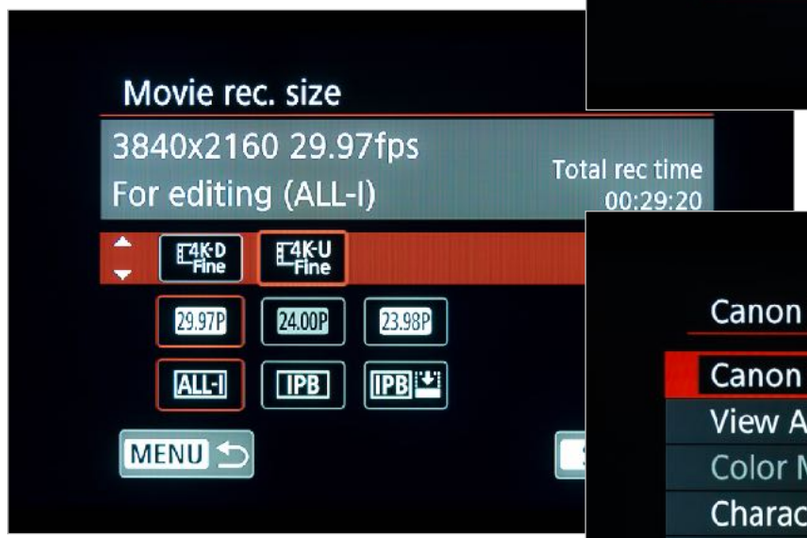
- ☑ Frame rate – Stay with 24 or 30 fps. You could shoot diamond rings at 100+fps for slow motion, possible at 4K with some cameras.
- ☑ 17:9 DCI format? – Stay with 16:9 Ultra HD.
- ☑ Compression – With Canons, All-I is better than IPB. Higher bit rates will apply less compression for higher quality but bigger files.
- ☑ Raw *vs*. H.265/MPEG – Some cameras can record or export Raw video. Raw video files have the highest quality but are massive!
- ☑ Color space – Cinema Gamut is wider (better) than BT.2020, which is wider than BT.709

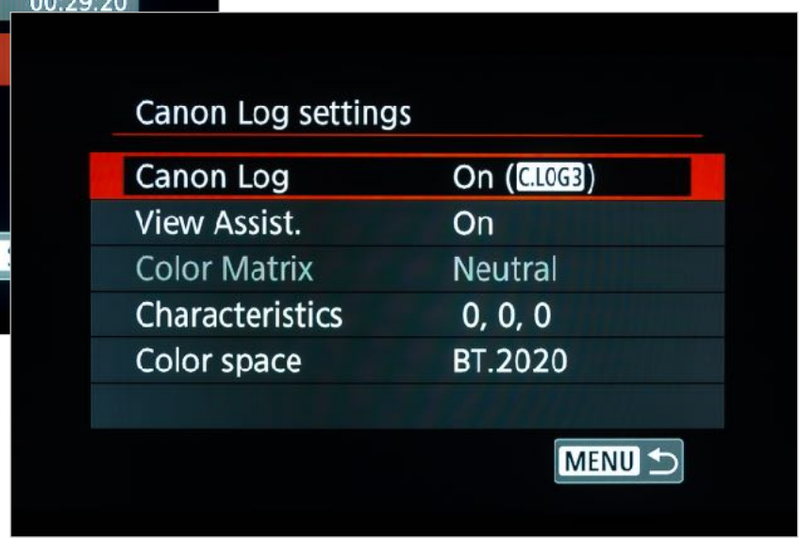
Test! Shoot video for several minutes to see how big a file each format creates, and whether your computer can handle the processing.

Very important! Test shoot during a warm day to check if your camera will overheat and shut down just when you need it the most.

Cameras offer a choice of frame rates (~60, 30 and 24 are common), and compression levels. The Canon R5 is at left, and the Canon R6 is below.

Some cameras offer 4K DCI Digital Cinema Initiative (called 4K-D here) which is 4096 x 2160, wider than Ultra HD.





If you turn on a Log profile, there may be a View Assist that makes the preview image look normal and not as flat.

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PRACTICE OPPORTUNITIES

Do I need to remind you to practice on the Moon? But also practice on the Sun to ensure your filter works and you can focus on the Sun's disk.

When shooting video, the limited ability to adjust exposure (because of the restricted shutter speeds) makes it imperative you practice on the Moon, with the camera in Auto Exposure, to see how well it performs on the crescent and Full Moon when it is as large in the frame as it will be during the eclipse with the lens you've selected.

Practice adjusting the exposure, using the controls available to you. You can stop down the lens to decrease the exposure, but how do you increase the exposure? It can only be by upping the ISO, which makes the image noisier and with lower dynamic range.

If you intend to switch between shooting movies and stills, practice performing the switch by feel. With some cameras it takes just one click. With others it takes turning a Mode dial all the way around full-circle. That's not eclipse friendly! It takes too much time and risks getting it wrong.

For shooting video of the partially eclipsed Sun you will need a proper solar filter. A glass type (as above) will yield the sharpest optical quality. There is no need to refocus *after* removing the filter, but focus precisely *before* totality. Keep the lens filtered or capped until the last minute before totality. Then replace it ASAP after totality.

November 13, 2012, Lakeland Downs, Queensland

In Australia in 2012, Lukas is well set with a DSLR and telephoto on a solid tripod. Such a set up could be used to take stills, or video, or both. Some cameras in video mode allow you to snap full-resolution still frames while also taking a movie. That's great, but the limitation is that the stills might be at a higher ISO than you might like, one needed for shooting video at 1/30th second, but higher and noisier than is ideal for a still image. And the still interrupts the movie briefly. Test your camera to see if that might be an option you want to make use of. I did here, in 2012. Images in the book are the result.

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CHAPTER 10

10

WHAT CAN GO WRONG?

Supplementing the lessons learned at the annular eclipse in Chapter 4, here I review what else I've found can go wrong, with advice on how to avoid mistakes. Clouds are the biggest worry! Because operating multiple cameras invites errors, I deal with that option here, with suggestions for shooting using two or more cameras.

July 21, 2009, South Pacific, north of Cook Islands

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SECTION 1

ECLIPSE DAY

What can go wrong on eclipse day? Quite a bit, even if you are able to stay at your Plan A site. I've arrived at a centerline site only to realize I'd forgotten a tripod back at the hotel, tucked neatly away behind the door. Equipment that had worked fine, suddenly breaks. Cameras decide to give Error messages. Tiny set screws come loose so the camera falls off the telescope. Or more often than not, the photographer gets in a muddle and forgets what to do!

July 21, 2009, South Pacific, north of Cook Islands

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THE EXCITEMENT OF THE MOMENT

The biggest challenge is dealing with distractions at the eclipse site: people asking questions, media wanting interviews, not to mention the eclipse!

Here's a list of some of what can go wrong:

- ☑ Second contact comes too soon You aren't ready, and miss it or blow the exposures.
- ☑ The tripod moves and the camera shifts off the Sun and you can't get it back aimed right.
- ☑ You forget it will get dark so you can't see anything. You drop your glasses and can't find them, and now really can't see anything!
- ☑ You accidentally shift focus, perhaps not realizing it, and all your images end up fuzzy.
- ☑ You fire off shots too fast, creating vibration that never damps down. Ditto on fuzzy pix.
- ☑ Someone – or you! – steps on or trips over a camera placed off to one side.
- ☑ Electrical stuff fails: Cables, batteries, connectors
- ☑ You just stare up and forget to do anything!

Does it look like Jeff is working hard? You bet! It was +45°C (112°F) in southeast Turkey this eclipse day in 1999. It cooled to a pleasant +35°C (95°F) during the eclipse! Despite the heat and chaos of the site, and obvious distractions – there's an eclipse happening! – people have to concentrate on the task at hand, going over their checklists. Don't bother other people, innocently asking, "Gee, nice scope! Can I look through it?" On the other hand sometimes the offer of a helping hand, literally, or a loaned tool or spare part might be very much appreciated.

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FORGETTING TO REMOVE THE FILTER

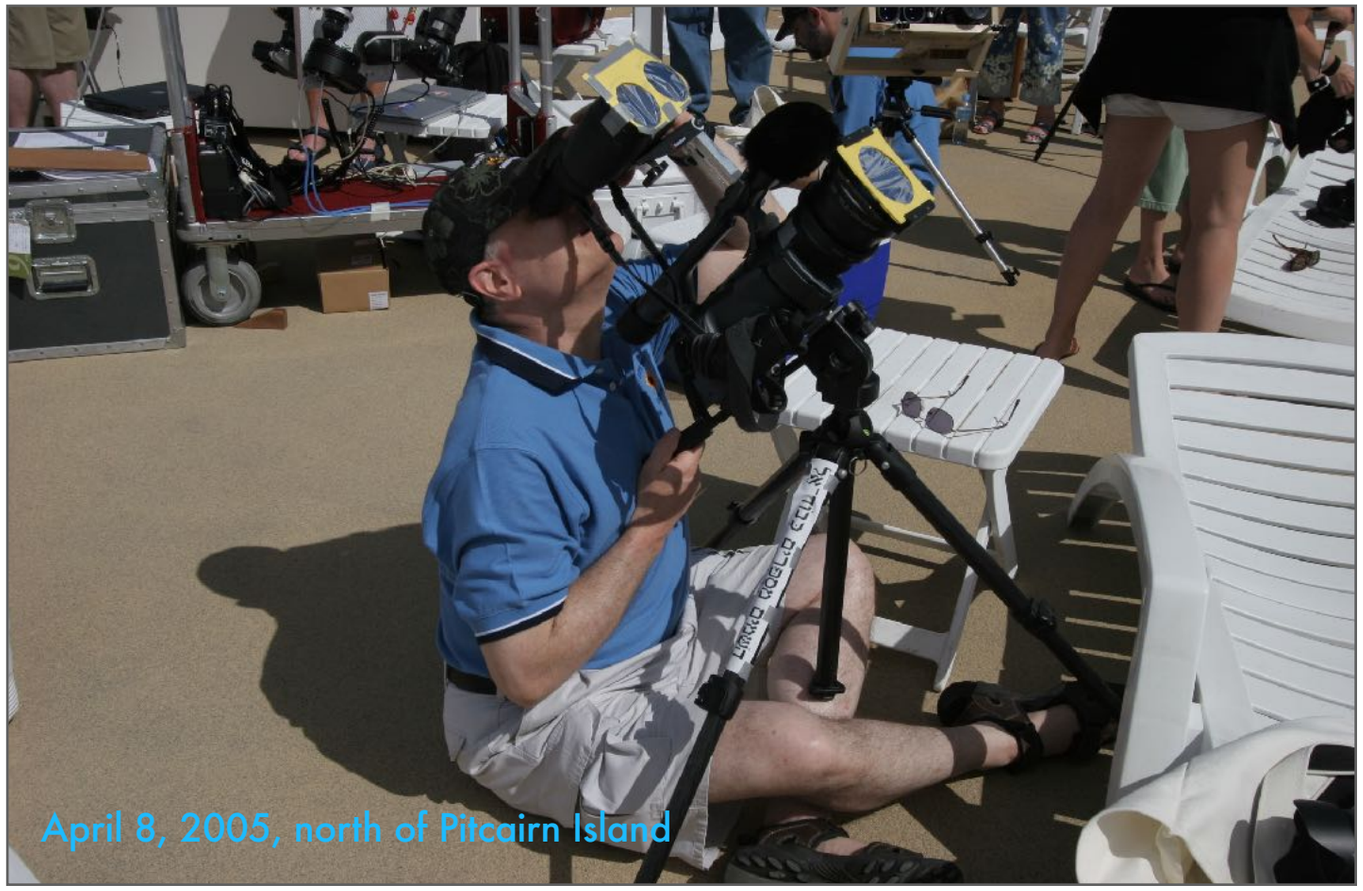
Of all the dumb mistakes people make – and I've done it – the most common is forgetting to remove the filter at totality.

If you are shooting through one lens or telescope and are using Live View to watch the eclipse, you aren't likely to forget the filter. With it on once totality begins you won't see anything!

Forgetting a filter happens when you are shooting with two or more cameras, or if you are busy looking through one set of optics while a carefully programmed camera is shooting through another set of optics. It might be firing away as programmed, but through the filter.

For all the automation you can apply to cameras, no app or hardware device will remove the filter for you. You have to remember to do it.

Practice removing and replacing the filter. It must be on secure enough to not blow off in the wind, but not get stuck at the critical moment. That happens all too often – people remember to remove the filter, but realize they can't. Panic!



April 8, 2005, north of Pitcairn Island

Joel had a nifty setup here for the shipboard 2005 hybrid eclipse, using one of the first affordable HD video cameras, plus co-aligned binoculars. While this didn't happen – Joel got great footage – such a dual system does risk forgetting to remove the solar filter from one of the lenses. How do I know? Because it happened to me at this eclipse! I forgot to remove the filter from my little video camcorder. It recorded the partial phases just beautifully, but during totality it showed nothing but black. After C3 the Sun returned, still centered, despite the rolling ship. However, the audio was great, so it wasn't a total loss.

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EQUIPMENT MALFUNCTIONS

TIP: On cameras with dual card slots, assign the 2nd slot to back up the first.

Whether this is your first eclipse, or your 20th, some human malfunctions are inevitable. Equipment malfunctions can be avoided.

Here's advice on avoiding some of the common equipment issues:

- ☑ Tripod shifts or collapses – This can happen when you bump it to remove the filter!
- ☑ Blur from vibration – Same solution: Use a solid tripod + use mirror lock-up or Live View.
- ☑ Camera locks up – Practice firing shots as quickly and for as long as you expect, i.e. 5 to 15 seconds for the diamond rings.
- ☑ Remote release fails – Test it is connected securely. Have a second unit handy.
- ☑ Loss of images – Don't delete the images off the memory card until you know you have them safely stored – and backed up! Check here for a good article on caring for cards.
- ☑ Batteries die – Have spares for all batteries.

July 11, 1991, Baja Mexico

This set up is inviting disaster. A lightweight tripod with a heavy lens aimed high in the sky is likely to shift and will be hard to aim and keep aimed at the moving Sun. It could collapse at the last moment. Even if it doesn't, vibration from wind and from operating the camera will blur the image in longer exposures.

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CREATING AUDIO PROMPTS

Some eclipse photographers, knowing the day will be exciting, record a series of audio prompts to calmly remind them what to do.

I've not done this but you might want to. Record a series of reminders of what you need to do to execute your photo plan, including reminders for filter removal and end of totality. Record them with the right timing between events. Use earbuds so only you hear your audio.

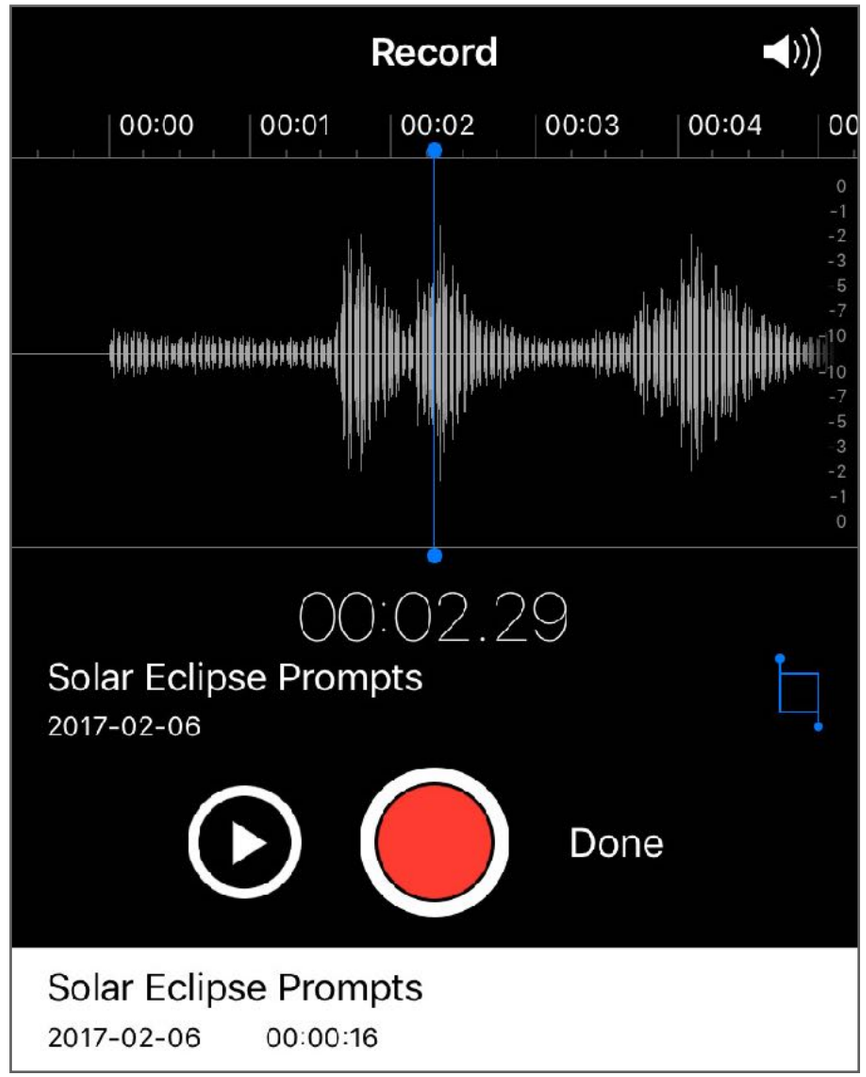
The trick is that you'll need to remember to start your audio playback at the right time, or all the effort will be wasted.

Keep in mind that the timing won't apply if you move north or south off the centerline or wherever your Plan A site is. Totality will be shorter. Nor will the start time of totality apply if you move well west or east up or down the path.

Perhaps a better option is to have one person in your group call out "Filters Off!" at second contact, then a call at the halfway mark during totality, and 20 seconds before third contact.

A series of audio prompts into your ear might help you stay calm and get the shots. On the other hand, the audio program is another thing that can go wrong, throwing off all your other actions.

However, even if you don't use it, the very act of preparing and recording a list of prompts will help you remember what to do, such as the following:



T–2 minute to C2: Look for shadow bands!

T–1 minute: Remove filter. Shutter speed OK? On video mode or Continuous?

T–15 seconds to C2: Shoot Diamond Ring! Fire away!

T=0: Start stepping up the shutter speed range to longer exposures

T=Mid-Totality (for your site): Middle of eclipse! Longest shutter speed?

T–1 minute to C3: Look up!! Look around!!

T–20 seconds before C3: 20 seconds to Diamond Ring. Shutter speed OK?

T+1 minute after C3: Looks for shadow bands! Filters ON camera.

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SECTION 2

LISTS AND CONTINGENCIES

Based on my experience from 16 TSEs, I present some ideas for checklists for gear and preparation, and for a Plan B contingency set of equipment, should you have to move and set up at a new location at the last minute.

Throughout the book I have suggested opportunities for rehearsing your techniques. Lest I sound preachy ... Practice and test!

December 4, 2002, Ceduna, South Australia

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EQUIPMENT CHECKLISTS – WHAT NOT TO FORGET!

Forgetting one of these can ruin your eclipse day.

Prepare a list of stuff you'll need at the eclipse site, and review it before departing on eclipse morning, or the day before on "eclipse eve."

Of course, you'll need **cameras, lenses, filters, and tripods.** It's the little things you forget!

- ☑ Tripod mounting plates – easy to forget them!
- ☑ Tools – wrenches, screwdrivers, and duct tape!
- ☑ Flashlight or headlamp. Use it only when needed. Don't light up other people's photos.
- ☑ A chair. And sustenance. It will be a long day!
- ☑ Spare memory cards and batteries for all gear. All batteries should be charged.
- ☑ Spare intervalometer or remote release.
- ☑ Lens & sensor cleaning supplies – if you think it might be dusty at your site.
- ☑ Spare camera – even a point-and-shoot or camera phone, which also supplies the time.
- ☑ Binoculars for looking. And handheld filters.

Chances are you'll be at an eclipse site with lots of other people. That can add great excitement, which is good and bad. It adds energy to the event but also distraction. Don't expect anyone else to be able to supply you with missing bits you've forgotten. And bothering people, other than close friends and family, for assistance only serves as an unwelcome distraction for them. Plan to be self-sufficient.

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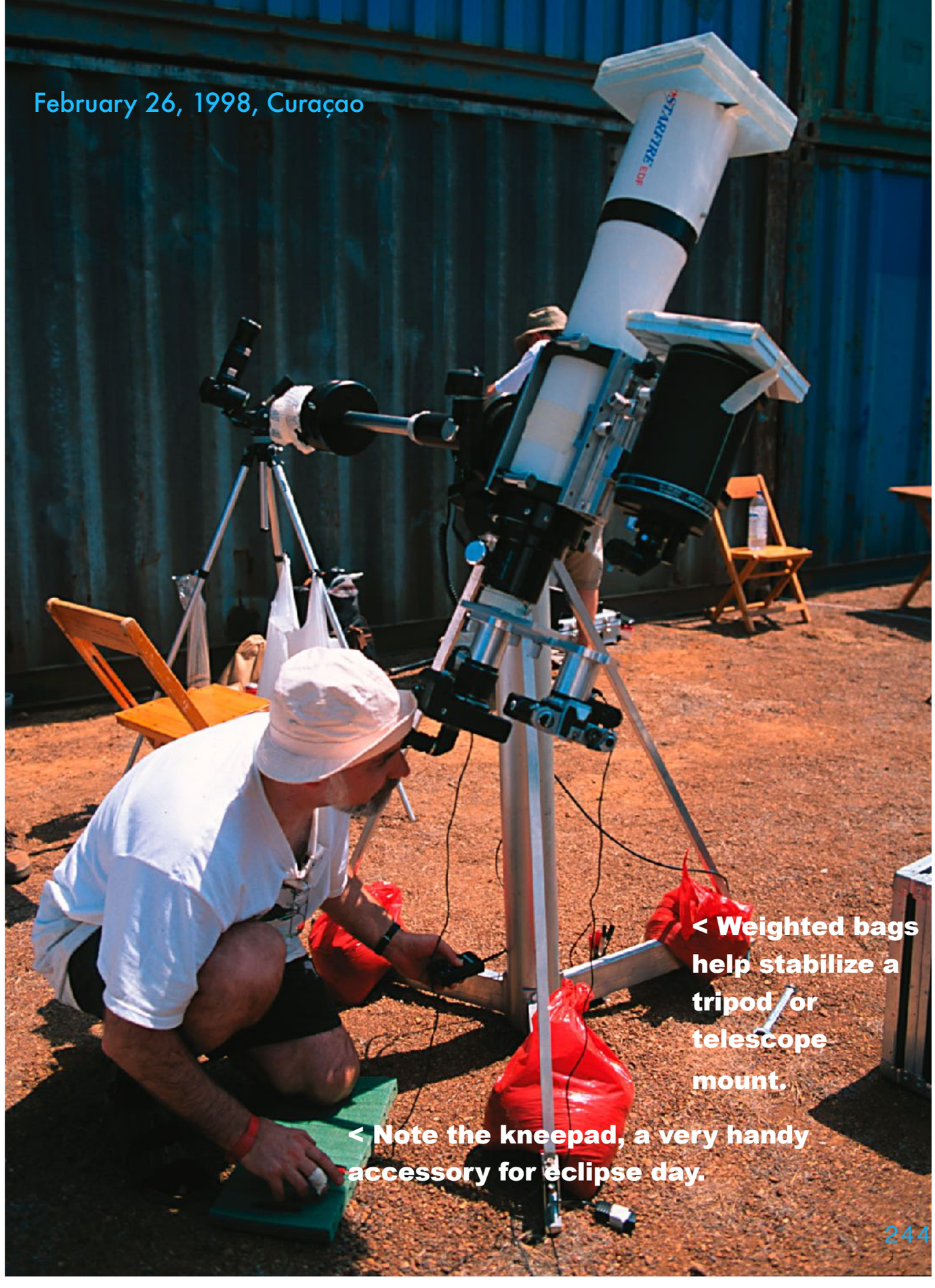
ECLIPSE SITE CHECKLIST

Once on site, go through a checklist to ensure all is set right and ready for totality.

Your setup will demand its own checklist, but here are a few suggestions:

- ☑ Are sensors and lenses clean? Dust can add flares or spots that are hard to remove later.
- ☑ Are cameras secured to adapters and lenses OK? Little setscrews on T-rings and other bolts can come loose in transport.
- ☑ Are tripods secure? Are all fittings tight? Weighting down a tripod with sand- or rock-filled bags, as Andreas has done, helps.
- ☑ Are filters securely in place? But not so tight you cannot take them off quickly. Where will you put the filter? You'll need to grab it again.
- ☑ Are cameras set OK as planned?
- ☑ Do you have binoculars or another telescope handy for your visual looks? And filters?
- ☑ Do you have the times written down?



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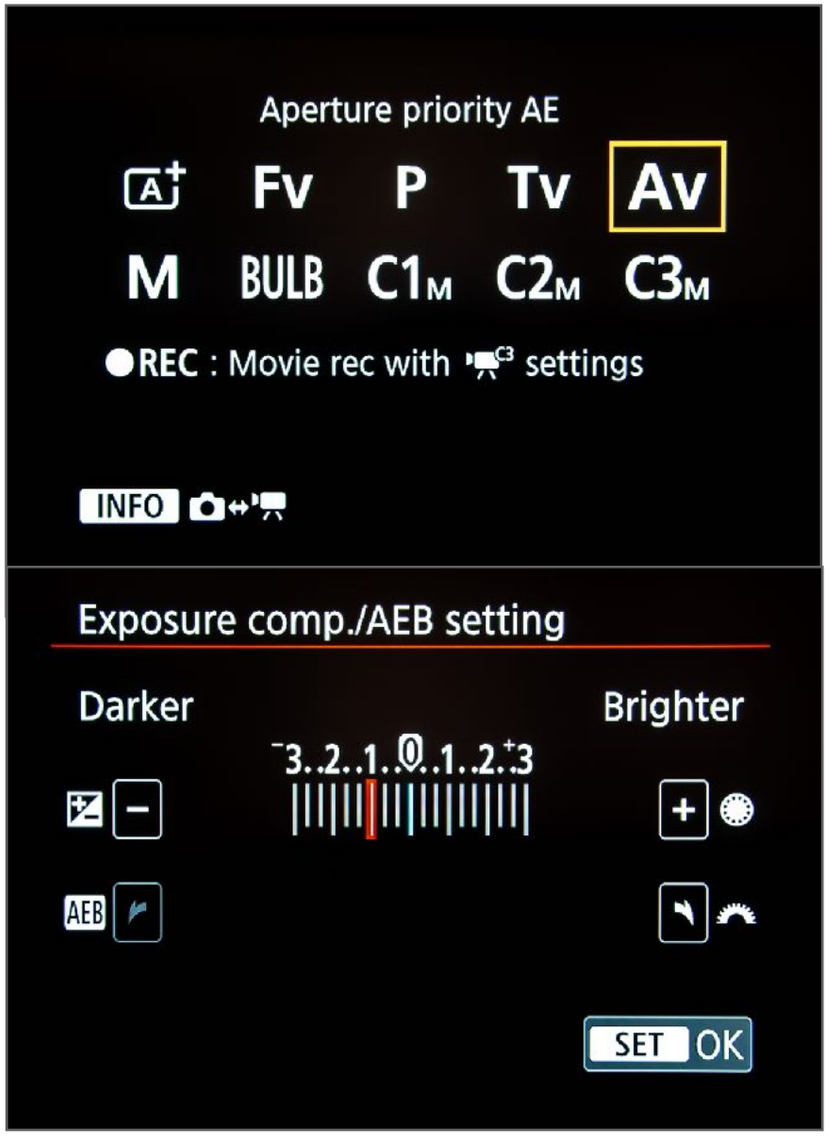
CAMERA PRE-FLIGHT CHECKLIST

Here's a summary of the many camera settings I've suggested throughout the book. Not all will apply to your shooting plan or camera.



- ☑ **Battery:** Charged! A spare is handy? Other batteries for telescope drives OK?
- ☑ **Memory Card:** Ample free space? Second card slot assigned as a back-up?
- ☑ **Image Quality:** On RAW, or RAW + JPG
- ☑ **Focus:** Pre-focused with Live View, and on Manual (lens and camera)
- ☑ **Drive:** On Continuous if you intend to shoot rapid-fire stills of the diamond rings
- ☑ **ISO:** To where you want it, likely 100 to 400.
- ☑ **Exposure:** On Auto-Aperture Priority for wide shots or video, or on Manual, set to a short shutter speed for pre-C2 partials and diamond ring close-ups.
- ☑ **Exposure Compensation:** Set to -1 Stop, if you wish, for wide-angle time-lapses to slightly underexpose all Auto Exposure frames.
- ☑ **Auto Exposure Bracketing:** Set to increments and number of shots you want, should you choose to use AEB. Custom Modes assigned for quick changes.
- ☑ **Metering Mode:** Average or Evaluative, not Spot (for wide-angle time-lapses)
- ☑ **White Balance:** Daylight or Fixed 5200K
- ☑ **Long Exposure Noise Reduction:** Off (High ISO NR not important on Raw)
- ☑ **Flash:** OFF! Please!
- ☑ **Video Settings:** Movie Size to 4K? Compression? LogCurve? Audio On?
- ☑ **Intervalometer (In-camera or Outboard):** INTERVAL set to 1 second, LONG set to 0 (exposure is set in the camera). No DELAY. NO LIMIT on number.
- ☑ **Mirror Lockup:** With DSLRs I suggest not using it if you use Live View.
- ☑ **Self Timer:** Off, unless you are using it to fire bracketed sets of exposures.

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POWERING GEAR

Of all the things that can go wrong, dead batteries top the list. The more ambitious your plans, the more likely it is you need more power!

Cameras themselves should be fine running on a fully-charged internal battery. Current models last for 2 to 4 hours of shooting. But telescopes and computers are power hogs and require larger external batteries, and the adapter cables needed to power items such as laptops in the field from DC sources.

You can use big “jump-start” car batteries. But a new generation of lithium batteries are much more portable and still pack 10 to 20 amp-hours of juice. Celestron has their PowerTank units designed to fit on and power telescopes.

Many companies, such as Bluetti, GoalZero, Jackery, PowerTraveller, RAVPower, and many others offer portable power stations. To run a telescope, be sure the battery outputs 12-volts DC, with the right connector for your telescope mount’s cable. Ditto on laptops. Will it run off the power bank’s 120-volt outlet for several hours?

Celestron PowerTank

When buying an external battery to power a telescope, you want an output port with 12 volts, and the right cable and plug to fit your telescope, usually a 2.1mm barrel connector, as shown above. Many external batteries offer just 5-volt USB ports for charging mobile devices, of no value for telescopes.

Always test that your chosen battery will power your telescope for the length of the eclipse and much more. You don’t want it dying just before totality.

Jackery 500

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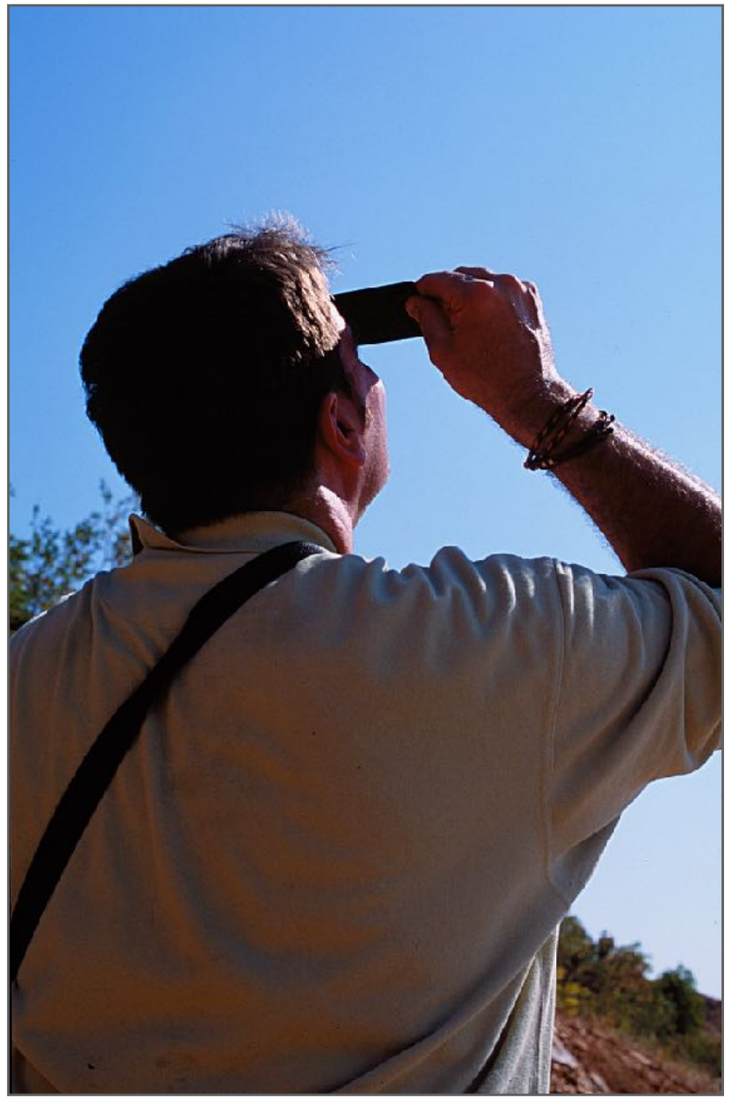
CONTINGENCY GEAR



Have a plan for what gear you might resort to if you need to move at the last hour, leaving no time to set up the full array of stuff you brought.

While a handheld phone camera might work as a camera of last resort, plan to use nothing less than a wide lens or telephoto on a decent camera on a tripod. The next step up might be a small telescope on a portable alt-azimuth mount, in lieu of a fancier polar-aligned tracking mount. If all else fails, the fall back is to a pair of binoculars for just looking. Always have a pair with you.

Don't forget your eclipse glasses or handheld solar filters (like the #14 welding glass Garth is using here). You'll want them for visual checks during the partial phases.

For a hasty portable setup, forget aligning tracking mounts and powering lots of gear. Go with a simple tripod or alt-azimuth mount, and a shooting plan suitable for a no-frills setup.

Telephoto on solid and adjustable tripod

Small telescope on alt-azimuth mount

Binoculars! Any size will do. But image-stabilized units like the Canon 12x36 at center are very nice!

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PRACTICE, PRACTICE, PRACTICE

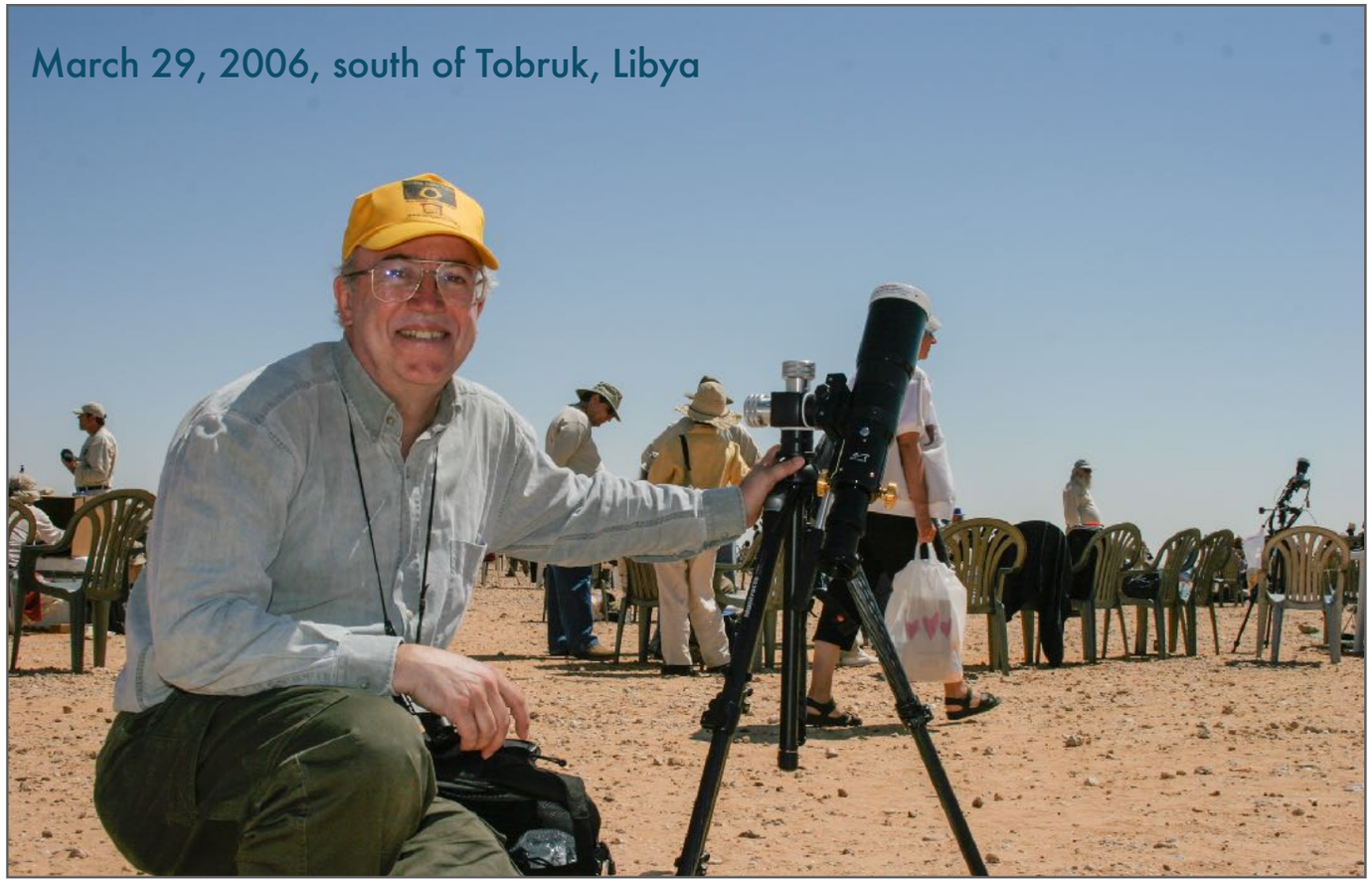
You are inviting trouble by buying a fancy new camera or telescope "just for the eclipse," but also just in time for the eclipse.

It's the curse of new gear, bought just for the big day, but not soon enough to learn how to use it.

How do you get great eclipse pix? Like playing at Carnegie Hall – you **practice**! Try out the gear, even indoors. Rehearse setting it up, using it aimed up as high as it will be for the eclipse. Time yourself. Can you get it all done in four minutes? Be conservative! Factor in excitement, brain malfunctions and looking time!

Practice fiddling with the camera's dials, wheels, and menus to make any manual adjustments you plan, or to switch from video to still images. You should be able to work those in the dark without looking, by feel – how many clicks does it take to shift shutter speeds by 1 stop?

But more than anything, practice shooting the Moon. If you can get sharply focused and well-exposed lunar images you're half way there!



Eclipses have taken me to places we could not have visited a few years earlier, or a few years later: northern Chile to an Army base (1994), southeast Turkey in Kurdish territory near the Syrian border (1999), to Mugabe's Zimbabwe (2001), and here in Libya (2006) where Col. Khadafi's representative greeted us with an hour-long speech! In all cases we were welcomed and well-treated.

Many shots I use as illustrations were shot here, with this little 66mm apochromatic refractor on a solid alt-azimuth mount. I may use it again in 2024 as a contingency rig. Staying simple works!

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TEST AND RETEST

Throughout the book I have extolled the virtue of testing many aspects of your gear. This table summarizes my advice. Many points apply only to using a telescope on a tracking mount like this compact rig – an Askar V 60mm refractor on the Sky-Watcher Star Adventurer GTi mount, a nice combo for an airline portable setup.

TEST...	WHAT TO CHECK
Indoors	☑ Do any obtrusive lights on your camera flash in the dark?
	☑ Can you remove and replace solar filters easily?
	☑ How long can your camera shoot on Continuous/Burst mode?
	☑ How long will your batteries power scopes, cameras, and computers?
	☑ Is your complete setup solid when aimed up high?
	☑ Can you access controls and screens with the camera aimed up high?
	☑ Does nothing collide as the scope and mount tracks across the sky?
	☑ Practice operating the camera & adjusting shutter speeds on manual.
Shooting the Sun	☑ Does your camera reach focus on your telescope?
The Sun will be the same brightness during the partial phases. During totality the sky will be dark as twilight. The Full Moon is the same brightness as the inner corona.	☑ Practice focusing on the Sun (its edge or sunspots) in bright daylight.
	☑ Establish the best exposures with your intended solar filter.
	☑ Check framing of scenes on dates/times with the Sun at same altitude.
	☑ Practice finding the Sun with the filter in place.
	☑ Practice aligning on the Sun with Go To telescopes.
	☑ For composites, plan a shoot with planetarium software and shoot a test sequence over 3 hours – did the Sun move as expected?
	☑ Polar align mounts roughly as you might have to do by day, to see how much the Sun drifts out. You can also do this with the Moon by night.
Shooting in Twilight	☑ How does your still or video camera behave when on Auto Exposure?
	☑ How do wide-angle twilight images look for noise?
Shooting the Full Moon	☑ Check that the camera reaches focus on your scope (or use the Sun).
	☑ Check how much the Moon moves across the frame over minutes.
	☑ Check video cameras to see how well their Auto Exposure works.
Shoot Crescent Moon	☑ Check video cameras on Auto Exposure and how varying exposure works for picking up the bright crescent and the dark side / Earthshine.
The crescent Moon presents a range of brightness, similar to the solar corona. It's a good target to test exposures.	☑ Compare various video modes and LogCurves. Which works best?
	☑ Does vibration blur images in longer exposures or in Continuous?
	☑ Practice firing shots rapidly while adjusting exposure – sharpness OK?
	☑ Check for lens flares from the bright crescent in long exposures.
	☑ Check for image blur during long exposures in untracked setups.
	☑ Plan a time-lapse sequence, then see if reality matches your plan!

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SECTION 3

OPERATING MULTIPLE CAMERAS

While I suggest this with some trepidation to eclipse newbies, it is possible to shoot the eclipse successfully with more than one camera, but only if the second camera is working automatically on its own. If you intend to shoot close-ups, you'll likely need to attend first and foremost to that camera. Use a second camera to shoot wide-angles. Bring in a third camera if you have an assistant, or can also have that camera run on its own, perhaps for a video.

July 21, 2009, South Pacific, north of Cook Islands

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WHY SHOOT WITH MORE THAN ONE CAMERA?

Every total solar eclipse presents such a range of phenomena no one camera, indeed, no one person, can take it all in.

I've presented a wealth of options for shooting the eclipse:

- ☑ Wide-angles stills and time-lapses
- ☑ Multiple exposure composites
- ☑ Close-ups through telephotos and telescopes
- ☑ Movies of totality
- ☑ Site shots and "B roll" footage

You can't do it all. Not on your own!

But with planning you can – at the very least if you feel ambitious enough – capture two views of the eclipse as I show here: a classic close-up of the corona, and a wide image of the naked eye view of the eclipse sky.

The close-up could be stills or a video. Or perhaps both – if you practice the switch.

Two views taken at the same time show different aspects of the eclipse. That's the best reason for running two cameras.

August 21, 2017, Idaho

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ASSIGNING CAMERA DUTIES

Documenting the eclipse in all its glory is easier to do if you have a second camera person or assistant in the field.

Here are some suggestions for assigning duties to your eclipse film crew. Other people could:

- ☑ Look after the wide-angle time-lapse camera, perhaps starting and stopping it, using settings you've preset.
- ☑ Shoot videos of shadow bands on white ground sheets.
- ☑ Shoot wide-angle selfies of your group during totality (but no flash!!).
- ☑ Shoot tripod-mounted telephoto shots while you shoot through the big scope.
- ☑ Shoot site shots of people. Grab interviews.
- ☑ Record audio using any mobile device.
- ☑ Call out times to warn when totality is half over and almost over – 20 seconds to go!
- ☑ Call out if shadow bands become visible.

November 13, 2012, Lakeland Downs, Queensland

Murray and Joanne are skilled eclipse chasers and photographers. By both shooting the eclipse, a couple can capture simultaneous stills and video, or close-ups and wide shots. Or eclipse views and "B roll" site shots and videos. Or one serves as back-up for the other.

And one person can prompt the other for what to look for and when totality is about to end. No one person can think of everything to look for. It took me a dozen eclipses before I saw shadow bands, or rather, thought to look for them!

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SECTION 4

SUGGESTED PLANS

Here I outline some suggested shooting plans, from a simple unattended camera, to a multi-camera shoot for the truly ambitious.

But do be careful about taking on too much. Better to come away with a few well-focused and exposed images shot by one method, than cards full of bad images shot by too many methods that all fail for one reason or another. Poor exposure, framing, and focusing are the downfalls.

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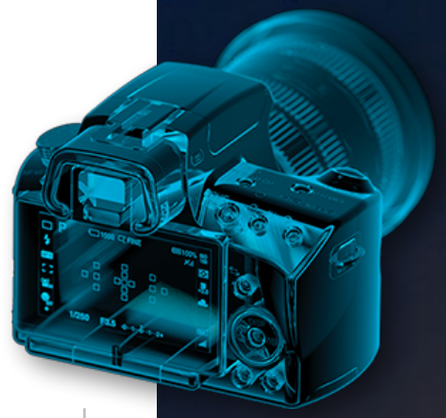
SINGLE CAMERA



One camera is all you need. And if this is your first eclipse it is all I would suggest you use. These methods allow increasingly less time to look...

You really, really want to see the eclipse. And not just through a camera viewfinder or screen.

EASY – ALLOWING THE MOST LOOK TIME!

- ☑ Wide-angle stills or time-lapse running on Auto Exposure. (Chapter 5) OR ...
- ☑ Telephoto or telescope close-up with the camera shooting video on Auto Exposure. (Chapter 9)

MORE DIFFICULT

- ☑ Telephoto or telescope close-ups with the camera manually stepped through a range of exposures. (Chapter 6)

VERY DEMANDING OF TIME

- ☑ Multiple-exposure composites, especially wide views of the entire eclipse from C1 to C4. (Chapter 7)

July 21, 2009, South Pacific

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TWO CAMERAS

Two cameras allow for close-up and wide views, or stills and movies. Here are a few possible combinations of techniques described earlier.

You can employ two cameras in a variety of options. Options 1 and 2 require filter removal on one camera. Option 3 demands it on both.

☑ **OPTION 1:**
Wide-angle stills or time-lapse on Auto Exposure
+
Telephoto or telescope close-ups on manual

☑ **OPTION 2:**
Wide-angle stills or time-lapse on Auto Exposure
+
Eclipse composite or panorama manually shot

☑ **OPTION 3:**
Telephoto or telescope close-ups requiring manual exposure adjustments
+
Telephoto or telescope close-ups using a video camera (or still camera in video mode) running on Auto Exposure

December 4, 2002, Ceduna, South Australia

In the days of film when cameras had to be manually advanced, shooting with more than one camera was demanding and not a little bit crazy. But I did it, shooting close-ups, then moving to the wide-angle camera to bang off some shots. It worked! But did I have time to see the eclipse? Not much! Especially as totality at this eclipse lasted only 30 seconds! Today, digital cameras allow for automated shooting, making a multi-camera shoot possible.

The stickler is removing and replacing a solar filter on more than one camera. Avoid that if you can.

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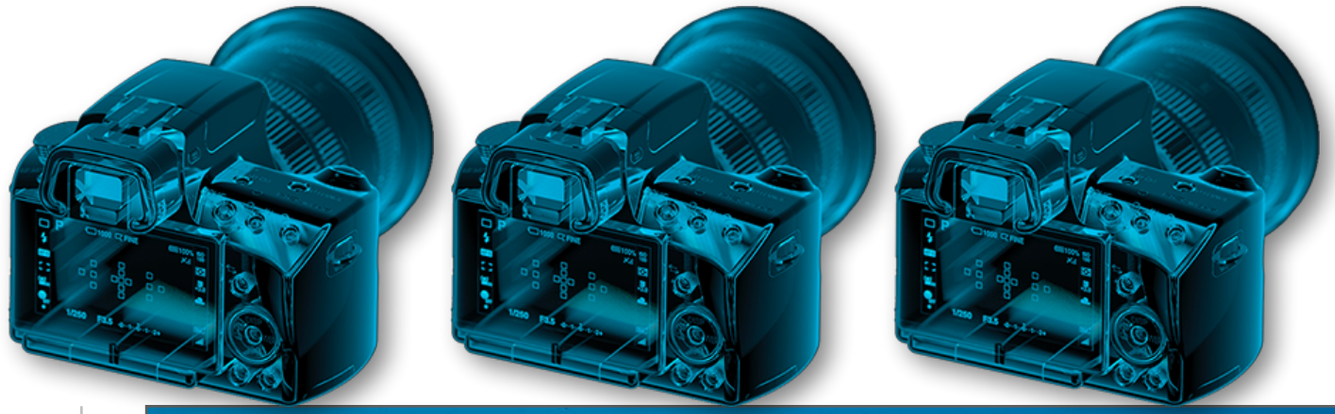
THREE CAMERAS



If you are very ambitious or experienced (even then mistakes can be made, trust me!), or if you have an assistant, you can use three cameras.

Here are some suggestions for a multi-camera shoot:

☑ **CAMERA ONE:** (Stills or Video or both) Telephoto or telescope close-ups requiring manual control, or using computer automation for the truly experienced.

☑ **CAMERA TWO:** (Stills or Video on Auto Exp.) Very wide fish-eye views of the shadow and twilights, either time-lapse stills or on video.

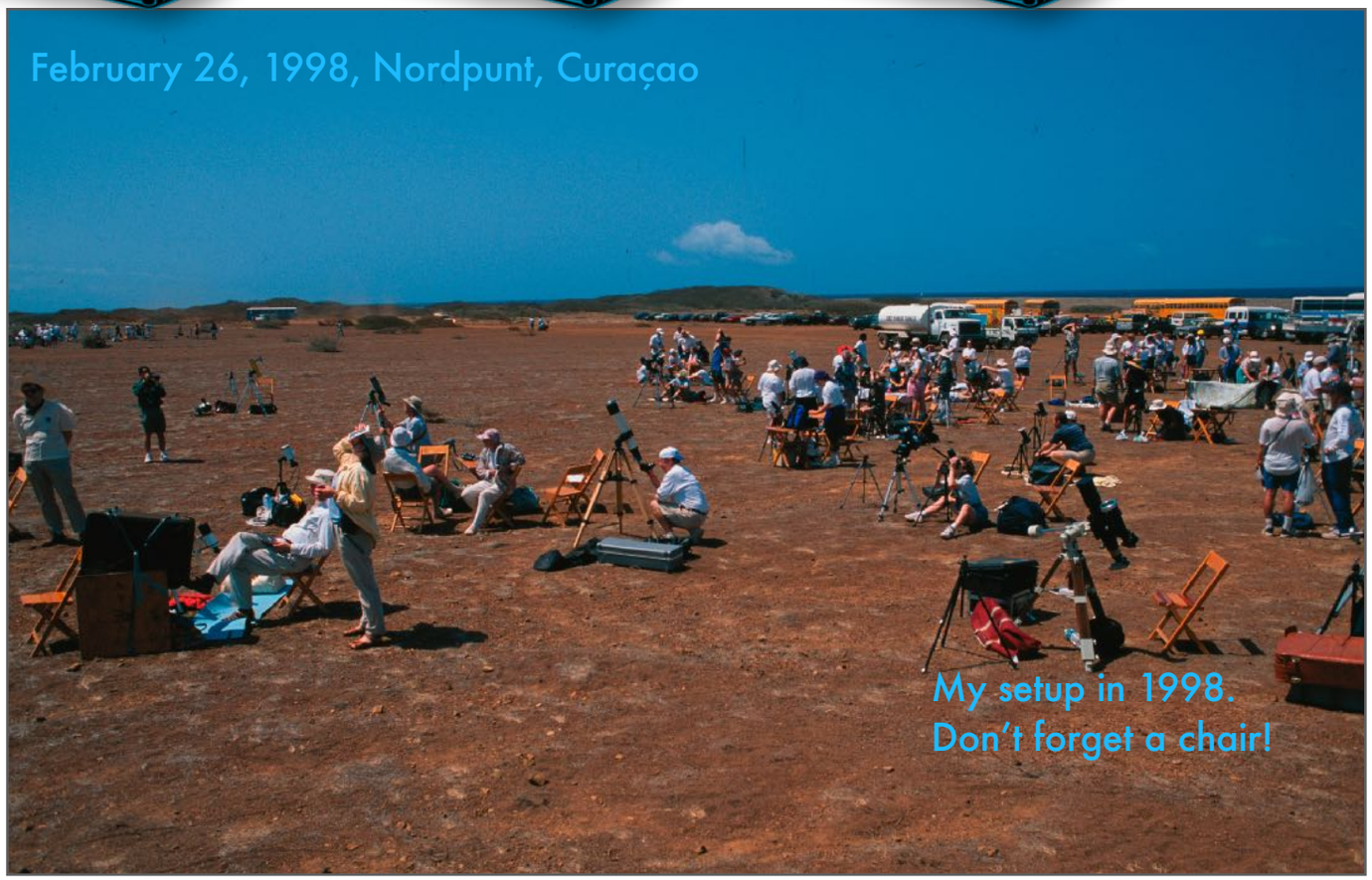
☑ **CAMERA THREE:** (Stills or Video on Auto) Tighter images of the eclipsed Sun over some landscape scene or architectural icon.

OR ... Multiple exposure composite.

OR ... Shadow bands pre- and post-totality.

OR ... Site and people videos and sounds.

OR ... Eclipse site panorama manually shot.



This might be the scene at your eclipse site, with a field of people, tripods and telescopes. Images in Chapter 2 and Chapter 4 are examples of what I got from this 1998 eclipse, with both a telescope and a wide-angle lens, with manually-operated cameras on film.

But I failed to realize that the 1998 eclipse would feature both Mercury (then very bright, unlike on April 8) and bright Jupiter close to the Sun, a sight of two bright planets near the eclipsed Sun we will not see again in our lifetimes. Did I shoot it with a telephoto? Nope! It remains one of my eclipse regrets.

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CUSTOMIZING FOR YOUR SITE – TIMES

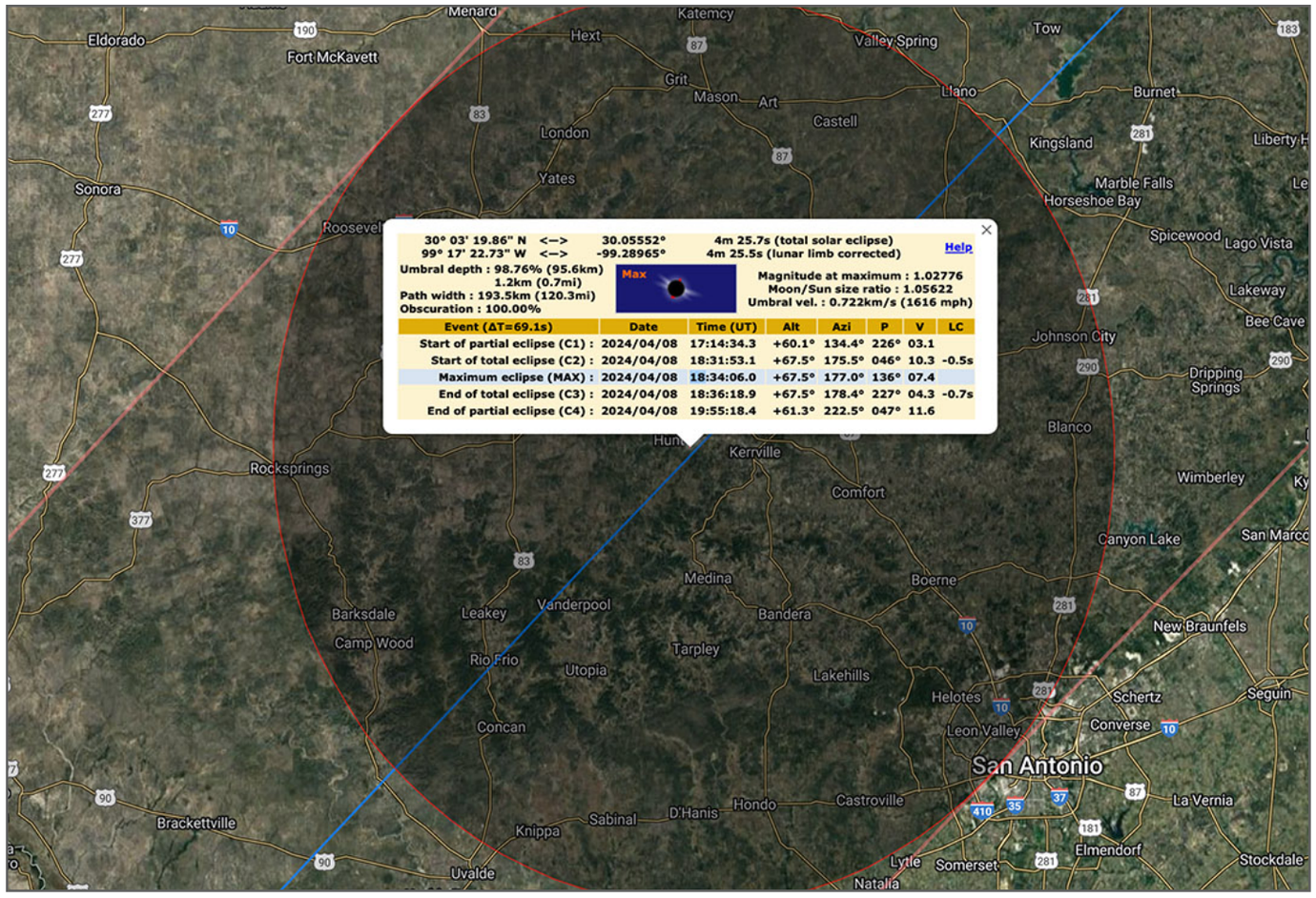
I've provided lots of options and ideas on shooting and framing. But these all have to be customized to your chosen eclipse site.

All the diagrams and illustrations I've supplied on how to frame scenes were for generic locations in the west and east, such as Kerrville, Texas and Fredericton, New Brunswick. I can't provide exact diagrams for your site to show how you should frame the Sun with your lens.

Nor have I provided exact times of the eclipse, not even for a select number of locations. That information is readily available on the web (see the Conclusion for links), either in tabular form for hundreds of cities, or through interactive Google® Maps, such as here. Clicking on your site brings up the circumstances for that site.

Write the information down on a pocketable cheat sheet. And note how times will vary for any Plan B sites. On eclipse day be sure to have an accurate watch or phone with you for the precise local time. And don't mix up time zones or whether Daylight Saving Time is on or off!

Tap on the image to load the interactive map (internet required).



I show a similar example in the final chapter. This interactive map from Xavier Jubier overlays the eclipse path onto a Google Map. Clicking on any location brings up the local circumstances: The start and end of the partial phases, the start and end of totality, the height (altitude) and east-west direction (azimuth) of the Sun, and the duration of totality. Times are UT (Universal Time). Subtract 3 hours for ADT, 4 hours for EDT, 5 hours for CDT, 6 hours for MDT. Very important!! Clicking on the blue "Help" hyperlink button brings up more details. Or see Chapter 12.

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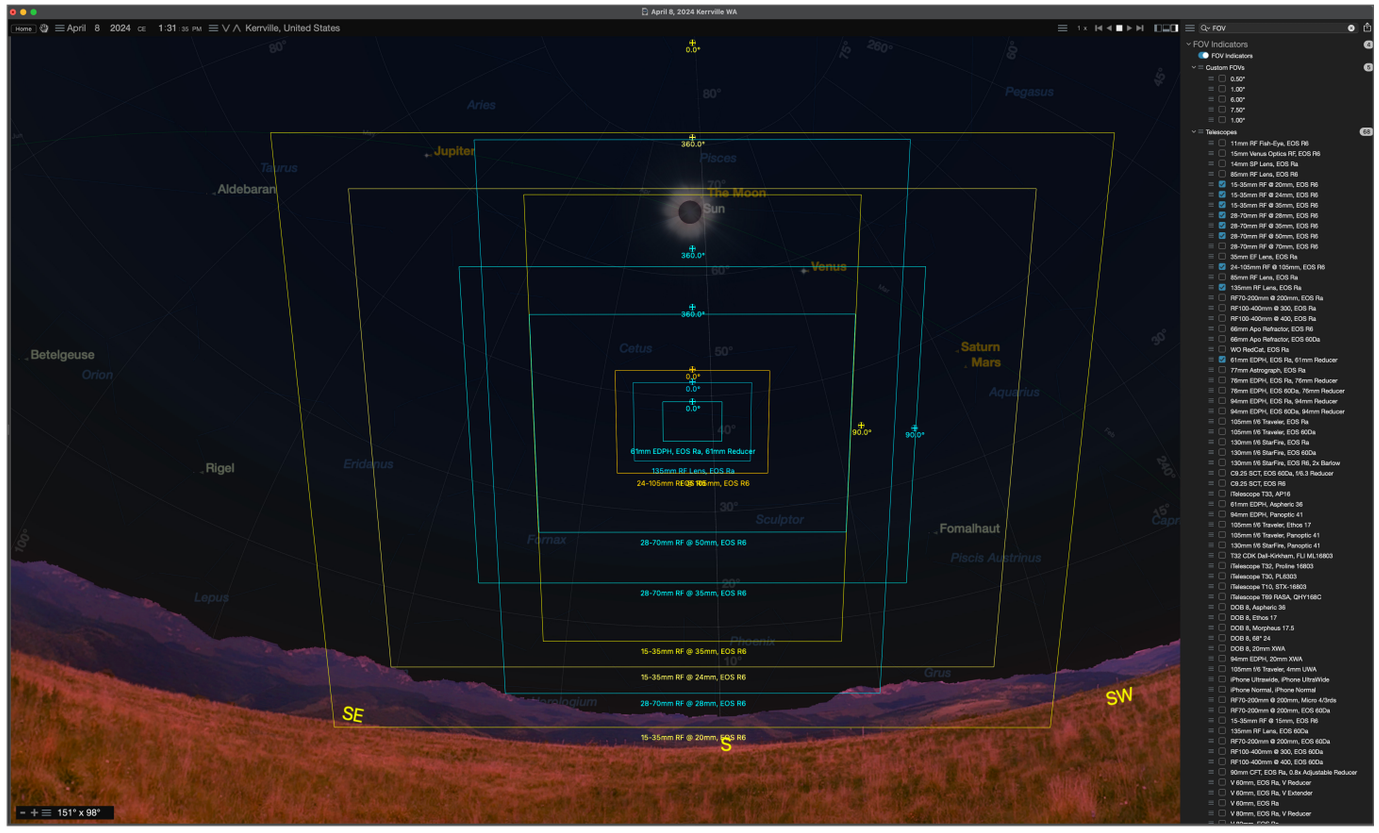
CUSTOMIZING FOR YOUR SITE – FRAMING

For planning your framing, many planetarium programs will simulate the scene. I like Starry Night™ for its excellent Field of View Indicators.

Planetarium software like this is essential for planning the framing of scenes, especially complex multiple-image eclipse composites. You don't want the Sun moving off frame because you miscalculated how much it would travel during the eclipse.

Starry Night allows you to create Field of View (FOV) indicators for every camera, lens and telescope you own. You can step back and forth in time to see how the sky and Sun will move ... and set your location to wherever you plan to be.

Starry Night is available in several versions for MacOS and Windows. But for eclipse planning the Enthusiast edition ($80) is sufficient. The Pro editions allow control of "Go To" telescopes, a function not needed for eclipse planning. Another similar program from the same company, SkySafari, works equally well, and is available in mobile apps for iOS and Android.



You've seen illustrations throughout the book created with this software: *Starry Night™*, from Simulation Curriculum. Many programs can provide excellent simulations, and provide some Field of View Indicators (FOVI) – the multiple boxes shown here for different lenses and cameras.

But *Starry Night* (in Version 8 as of this writing) provides the most choices for adding cameras, lenses and telescopes in whatever number and mix-and-match combinations you wish. The FOVI and equipment are shown selected at right. Their *SkySafari* software for desktop and mobile devices has the same feature, and via the LiveSky option, FOVI are synced between their apps.

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SECTION 5

AUTOMATING THE CAMERA

For all the automatic features of today's cameras, none allow you to program in a series of exposure settings that the camera will execute dutifully on its own. Doing so is possible but requires outboard hardware and software, the skill to set it up correctly, the time to practice using it, and the confidence it will all work right on the big day. A new program that shows promise is CaptureEclipse, free but only for MacOS. EclipseOrchestrator is available for Windows.

July 21, 2009, South Pacific, north of Cook Islands

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USING A CAMERA CONTROL APP

Interest in time-lapse photography has brought an immense number of third-party devices to market. None, however, are designed for eclipses.

Many outboard intervalometers are available, from brands such as Arsenal, CamRanger, Foolography, and MIOPS, with features for time-lapse shooting.

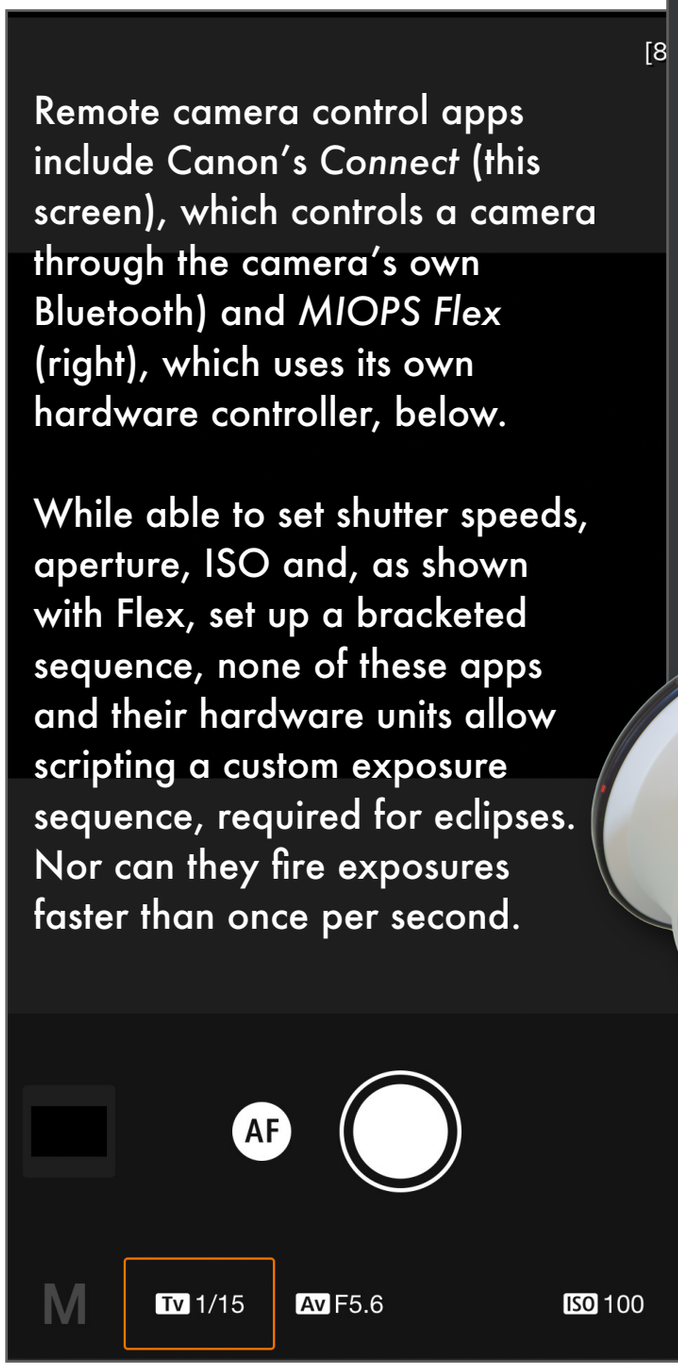
However, none have an “eclipse mode” allowing you to program in a series of specific and timed shutter-speed changes, ramping from short to long, then back to short again over a specific duration.

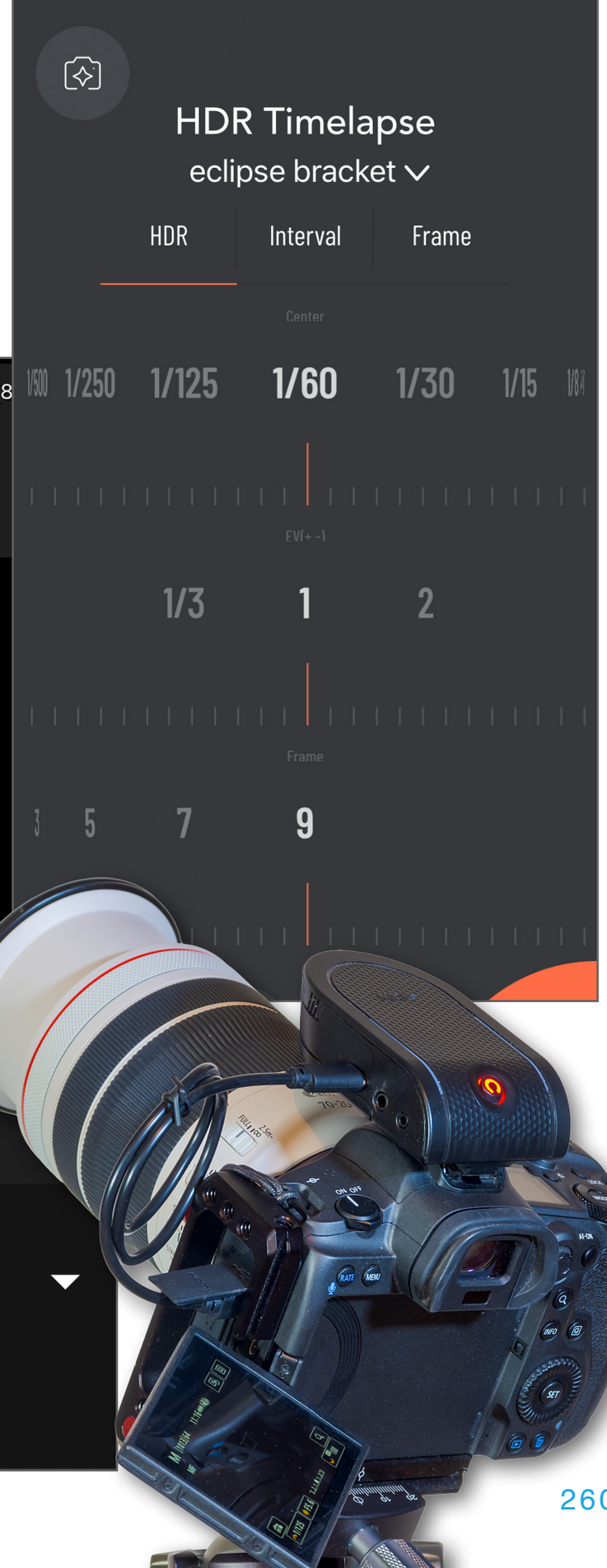
What most time-lapse apps do allow is manually adjusting camera settings remotely. Control apps from the camera manufacturers can perform the same functions. These might be good for reducing vibration.

But ... I find the linking to the camera or device can be unreliable. I would not depend on a wireless link to work at an eclipse. Keep it simple. And test!

Remote camera control apps include Canon’s *Connect* (this screen), which controls a camera through the camera’s own Bluetooth) and *MIOPS Flex* (right), which uses its own hardware controller, below.

While able to set shutter speeds, aperture, ISO and, as shown with Flex, set up a bracketed sequence, none of these apps and their hardware units allow scripting a custom exposure sequence, required for eclipses. Nor can they fire exposures faster than once per second.





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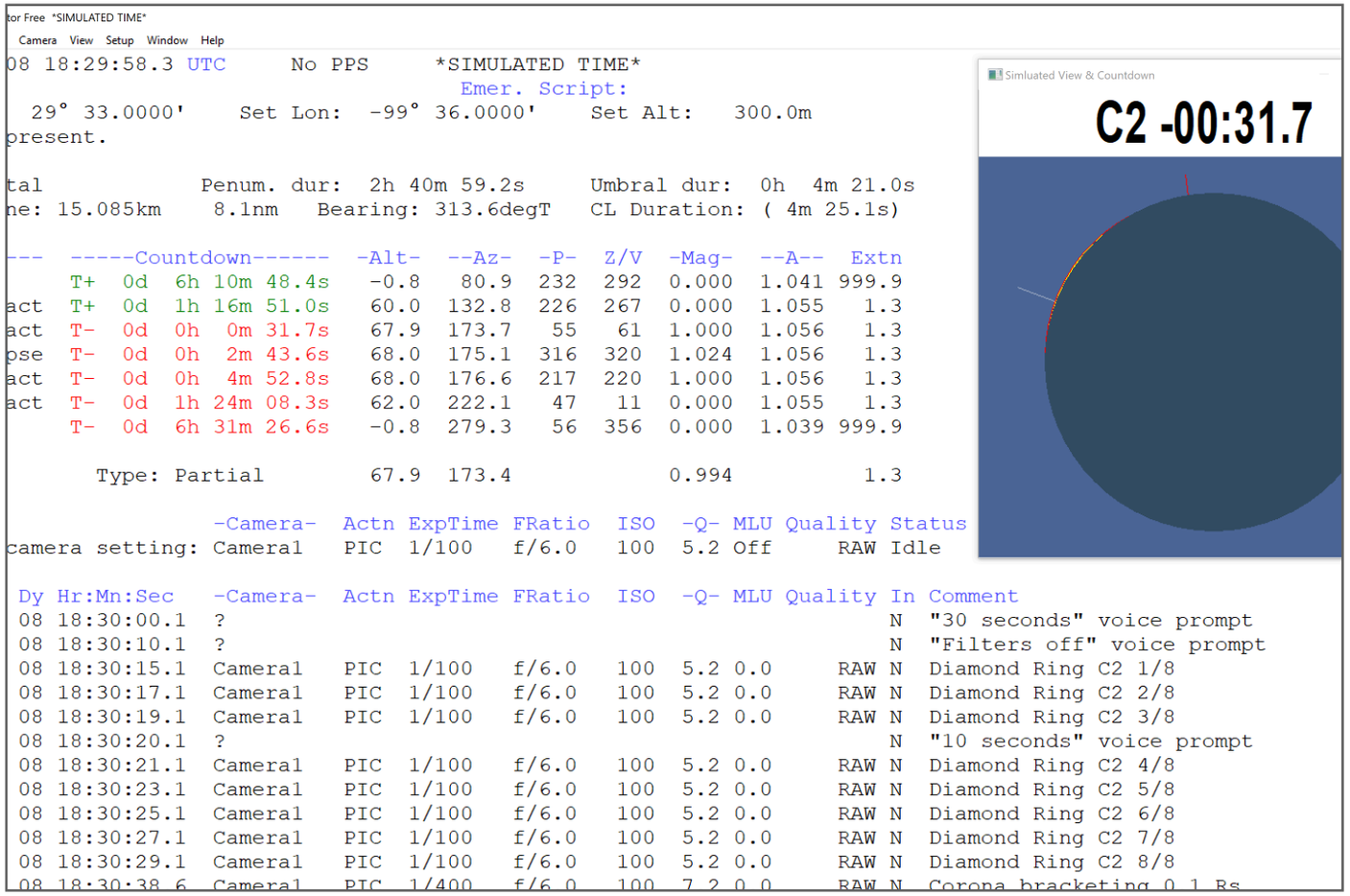
ECLIPSE ORCHESTRATOR

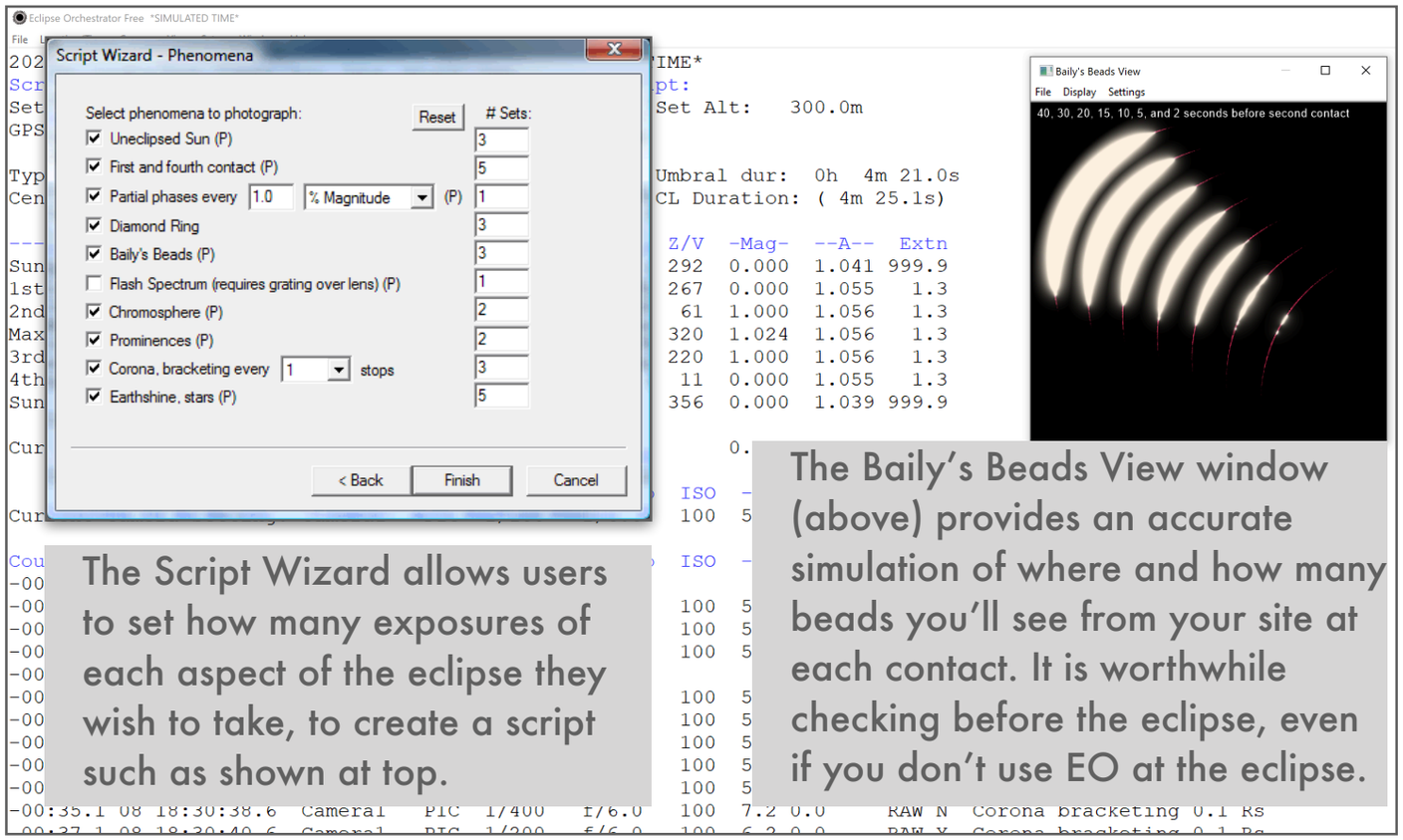
Unlike the previous apps, this free (or paid) Windows program is designed for eclipses, to shift camera settings on time using a script you design.

Eclipse Orchestrator by Fred Bruenjes (of DayStar Filters) is a Windows-only program that is specifically designed for eclipses. Like the MacOS programs on the next page, once EO is given your location (manually entered or with a GPS accessory), it knows exactly when to fire the shutter for each aspect of the eclipse. In theory, once it is set running before totality, it will automatically take all the images you requested in the script. It is designed to work with Canon and Nikon DSLRs only, but Fred suggests it may work with Canon and Nikon mirrorless cameras. Get the free version and test. A paid ($100) version offers more advanced features.

Even if you don't use it at the eclipse, its various preview modes are helpful to plan your shoot.

Other Windows choices are SETnC just for Canon cameras and DigiCamControl, for a wide range of cameras, but it is not designed for eclipses per se. I have not used any of these at an actual eclipse to vouch for them personally.





The Script Wizard allows users to set how many exposures of each aspect of the eclipse they wish to take, to create a script such as shown at top.

The Baily's Beads View window (above) provides an accurate simulation of where and how many beads you'll see from your site at each contact. It is worthwhile checking before the eclipse, even if you don't use EO at the eclipse.

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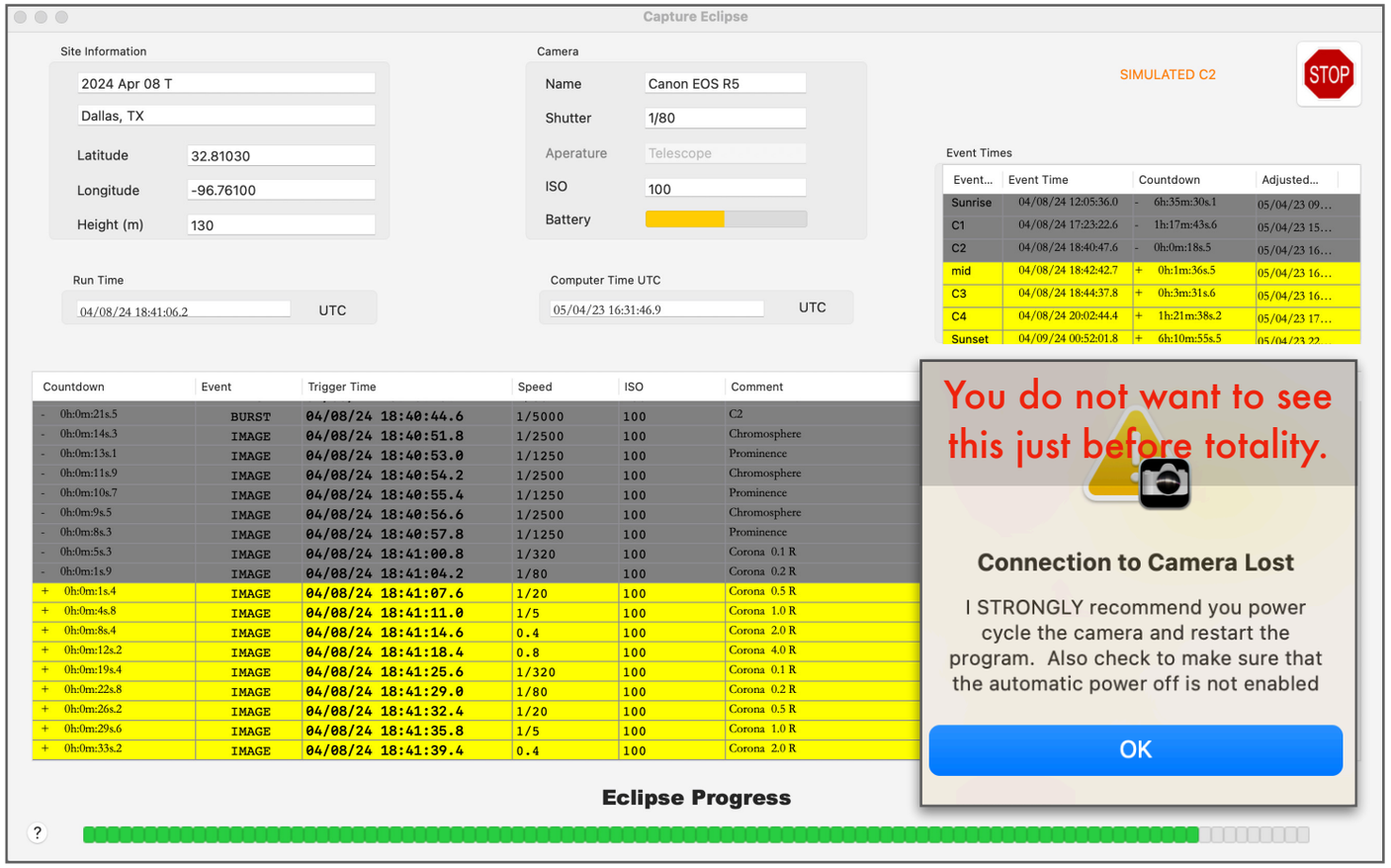
CAPTURE ECLIPSE

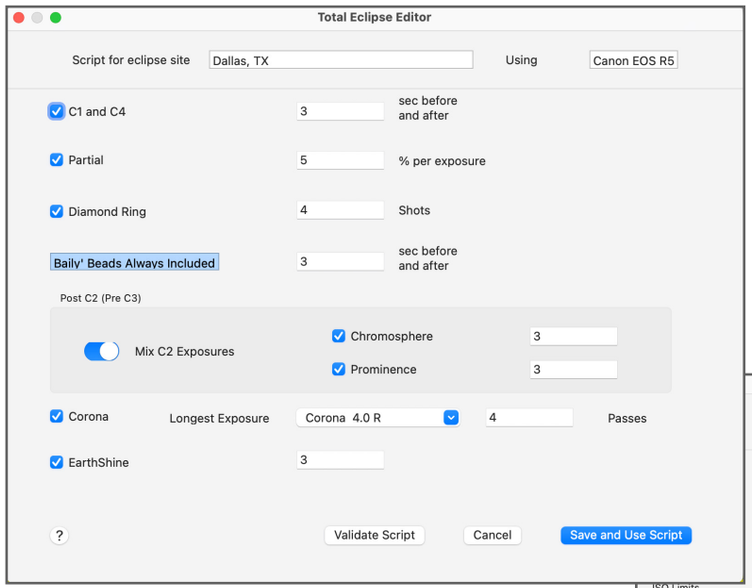
Like Eclipse Orchestrator (EO), this free MacOS program is designed for eclipses, with the ability to create a script to fire the shutter at the right times.

CaptureEclipse from eclipse chaser Rob Hawley allows automated control of Canon cameras only, firing the shutter for a complete sequence of varied but preset exposures at the correct times calculated for the location you enter. Like EO, the program provides audio prompts at key moments, such as “Filters Off!” You can test by using the simulation modes, as shown here.

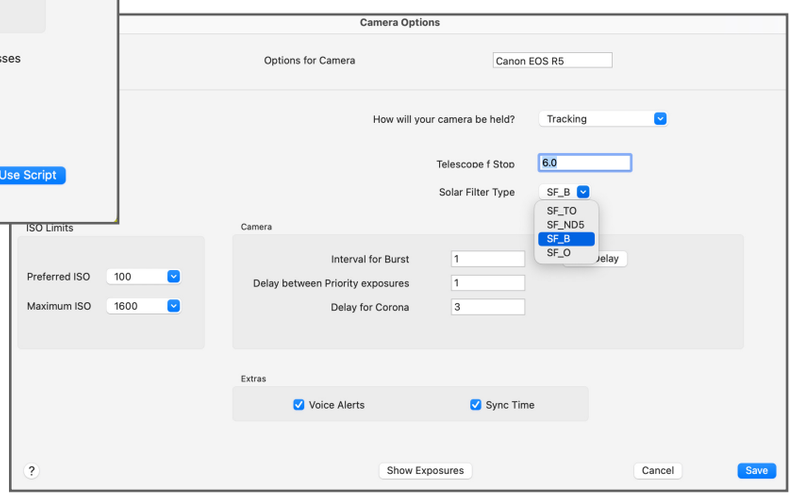
In tests it did work, but could glitch. Your choice of intervals is limited and it steps exposures by two stops, too much I feel. Try it to see if you can trust it, and if it provides a sequence of images you like. The advantage is that it can automate the shoot from C1 to C4; the risk is that you get poorly timed or exposed images.

NOTE: A more advanced but older MacOS program from Xavier Jubier, Solar Eclipse Maestro, is also popular. But as of January 2024, the latest version of SEM was compatible with MacOS only up to Mojave (OS 10.14) released in 2020. A minor update is promised.





You can alter a script’s parameters, but within narrow limits to the number of frames. With all such programs, enter your location precisely in the dialog box or the shutter activation times will be off.



You can set the focal ratio, filter type for the partial phases, and ISO. However, intervals can be no less than one second; no rapid-fire burst modes are possible.

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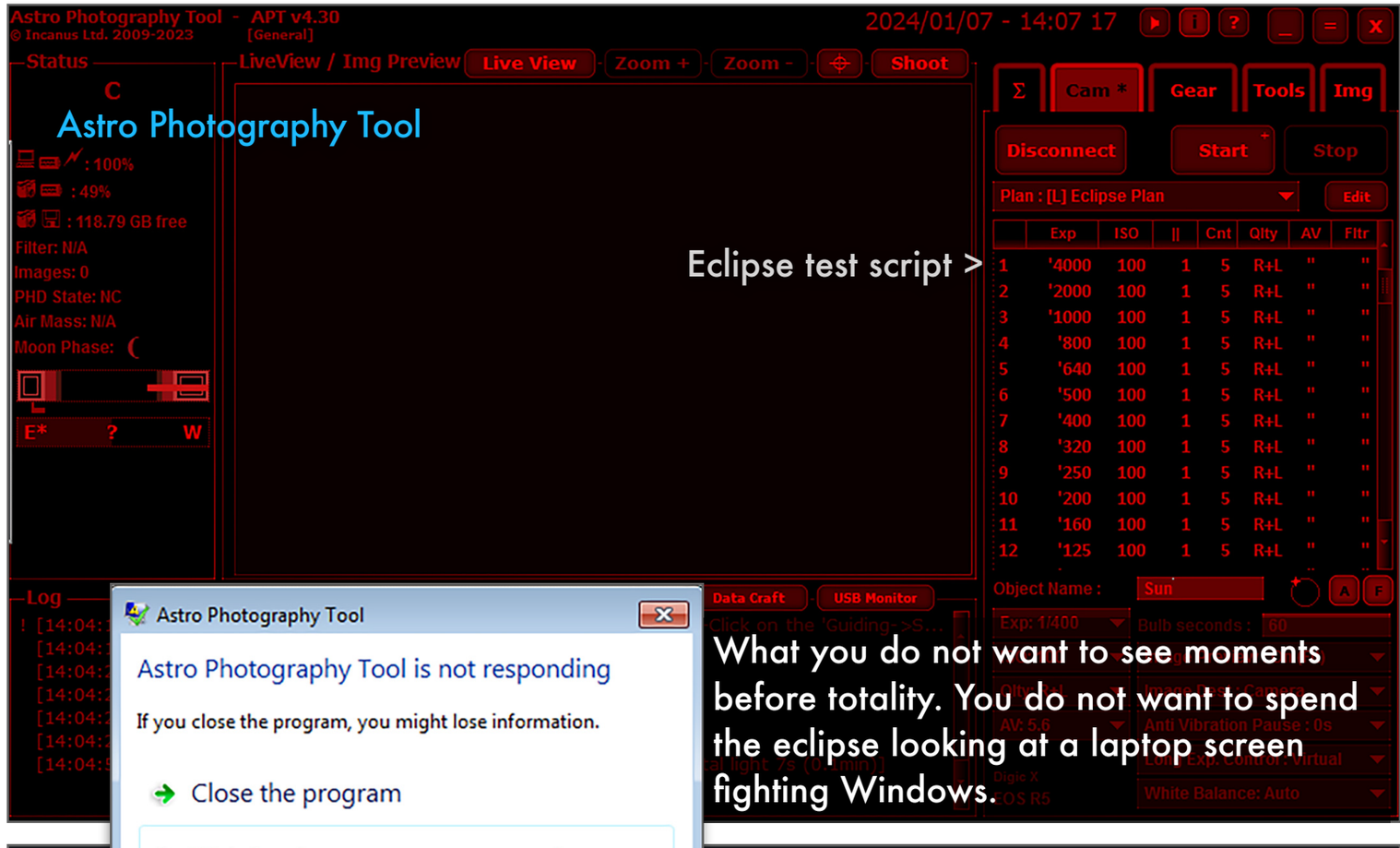
WHAT ABOUT … DEEP-SKY APPS?

Deep-sky astrophotographers will think about turning to their favorite Windows laptop program they use to control their cameras. Think again!

Programs such as Astro Photography Tool BackyardEOS, BackyardNikon or N.I.N.A. are popular with deep-sky imagers for controlling DSLRs or cooled CMOS astro-cameras. While they work very well for that purpose, I would not recommend using one for the eclipse. You need a program to be able to script a sequence of exposures (and save that script for easy recall) from 1/4000th second down to 1 or 2 seconds, at 1/2- to 1-stop increments. But, the exposures have to be taken as quickly as possible, to aid blending them later, to minimize alignment issues from the motion of the Moon. These programs often can't fire the shutter faster than several seconds apart. They also must be started at precisely the right time for the exposures to match what is actually happening.



PLAN B:
Even if you can trust one of these programs to work, have a Plan B ready, to disconnect the camera (assuming it is a DSLR or DSLM) and take over its operation manually should the technology fail. Always practice in the field, during the day, to be sure you can even see the screen!

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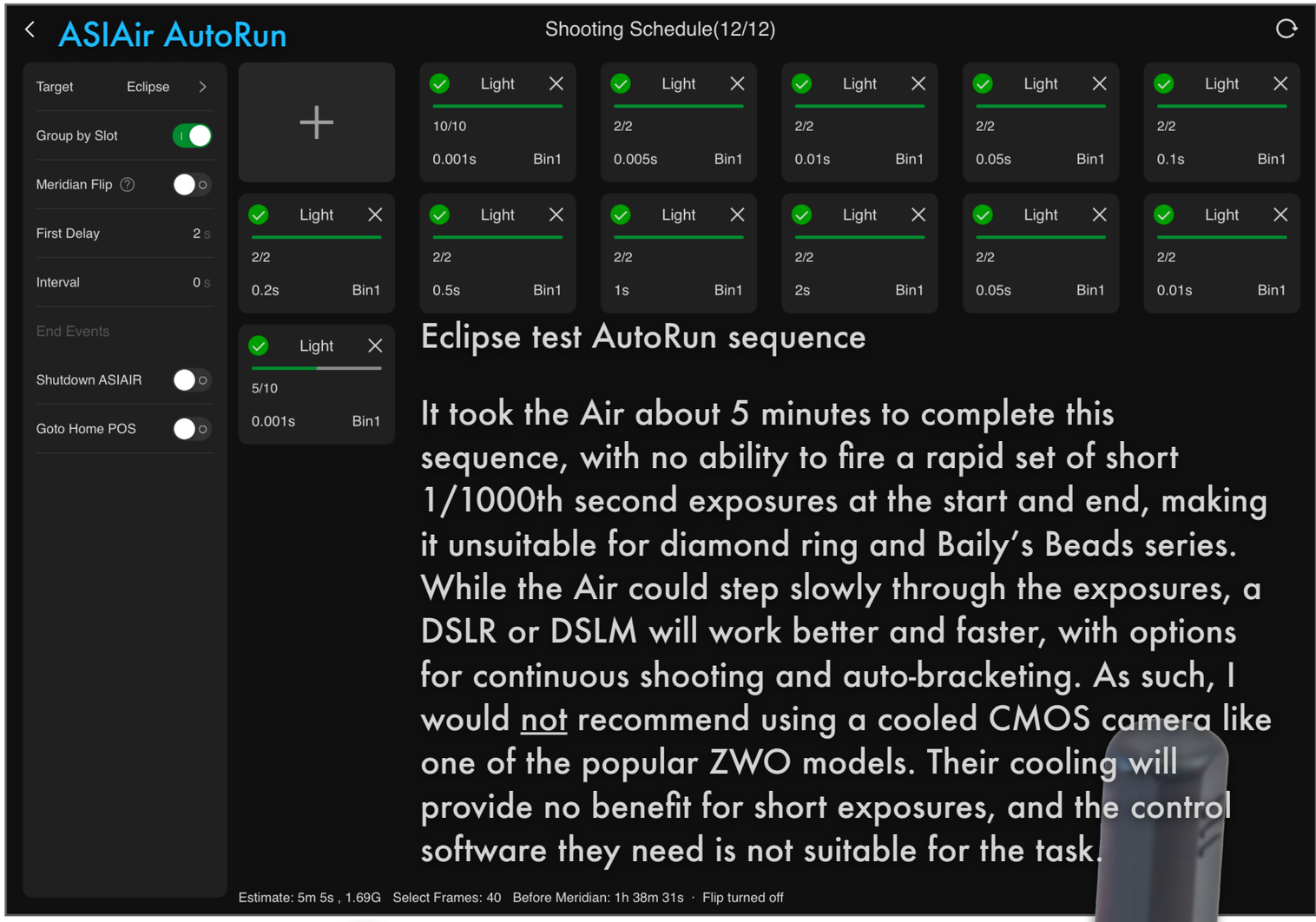
WHAT ABOUT … THE ASIAIR?

A popular mini-computer for deep-sky imaging, the ASIAir from ZWO can control ZWO astro-cameras, as well as Canon, Nikon and Sony cameras.

If you've entered the world of astrophotography in the last 3 or 4 years, chances are you use, or have considered using, one of ZWO's very popular ASIAir mini-computers to control your camera, mount, and auto-guider system. They work great! But not for eclipses. Yes, the accompanying app, shown at top, can set the exposures over a wide range, from 1/1000th second to as long as you wish. But it cannot fire the shutter faster than about once every 5 to 6 seconds. Like the previous programs I show, that's much too slow for a total eclipse. You will likely miss the diamond rings, and perhaps only get a handful of shots during totality. Why use gear not suitable for the task? DSLRs and DSLMs are much better suited than any other cameras for the demands of a total eclipse.



IF YOU INSIST:
I suspect deep-sky photographers will insist their deep-sky cameras and software will do the job! OK. But test if the gear will actually work reliably on command and fast enough on eclipse day. I suspect there will be many disappointed deep-sky photographers who will learn the hard way!

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SECTION 6

WHAT IF IT'S CLOUDY?

The dreaded C word. I've largely ignored this prospect up to now, but it will be the concern first and foremost on your mind prior to the eclipse. Keeping mobile is the best plan. But if clouds form too late to move, then what can you do? As you see here, some clouds can add to the scene. And it is possible to shoot the eclipsed Sun through some clouds – the camera can sometimes see things your eye cannot. All is not lost. Or you resign yourself to watching the day go dark.

July 21, 2009, South Pacific, north of Cook Islands

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SHOOTING PARTIALS THROUGH CLOUDS

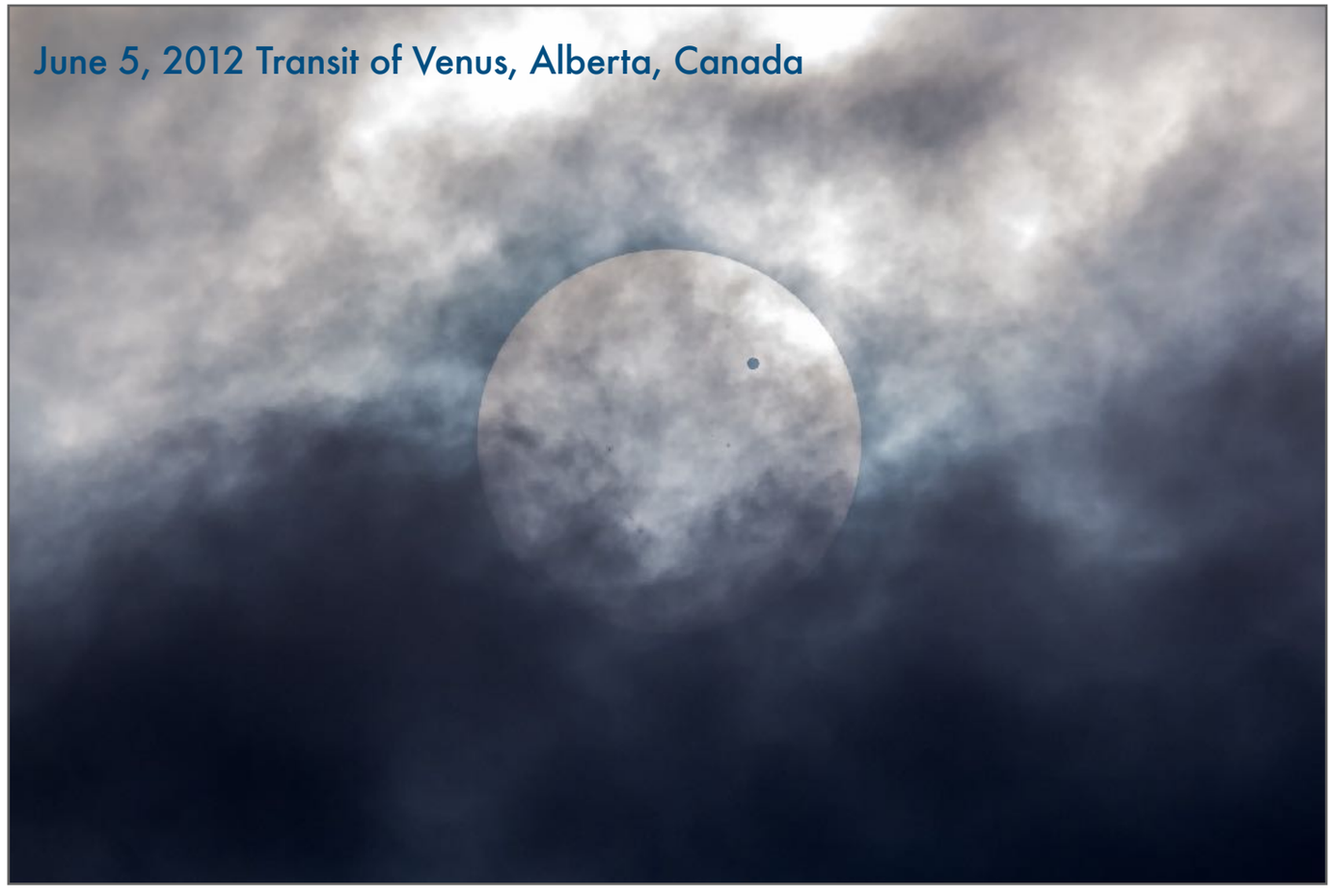
Watching the partial phases come and go through clouds is pretty common. If the clouds are dense enough you can shoot through them unfiltered.

The worst clouds are ones too thick to allow using a filter – you see nothing! – but not thick enough to allow you to shoot safe unfiltered images.

However, if the clouds are the right density, you can shoot unfiltered images of the partially eclipsed Sun. But carefully! As with the diamond rings, view the Sun on your Live View screen, not through an eyepiece. The clouds can thin without warning, letting through the sunlight.

Exposures under such constantly changing conditions are a guess. Shutter speeds will be short, perhaps 1/8000 second, as it was here.

This might allow you to get shots of the partial phases, though the set will not work well for a good composite. You could also shoot a movie of the moving clouds. Be ready for the diamond ring — it can be captured through clouds.



This was a much rarer event than a total solar eclipse – Venus crossing the face of the Sun, something it will not do again until December 10, 2117!

Clouds were too thick to use a solar filter. So for this shot, I did not have a filter on the telescope, possible with caution. I used the 80mm f/6 apo refactor depicted on the last page of Chapter 8, and a Canon 60Da cropped-frame camera. Exposure was 1/8000 second at ISO 100. Time your shots carefully!

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SHOOTING TOTALITY THROUGH CLOUDS

You'd be surprised what the camera can pick up through clouds. The diamond rings and Baily's Beads might still be shootable.

I've seen some remarkable images from friends who managed to grab success from the clutches of the clouds.

What you might be able to get are shots of the diamond rings. And perhaps prominences and inner corona. Any shots of the outer corona will be out of the question.

Planned exposure settings will be out the window. Be prepared to adjust the shutter speed fast, to something much longer than the usual exposure tables would suggest.

During totality shoot exposures several seconds long. What have you got to lose? If your camera is tracking the Sun you can be sure it's in the frame. And be prepared for a miraculous clearing that might bring views of the corona or final diamond ring. It has happened many times to friends. What looked hopeless turned around.

Despite clouds, Murray got this shot in 2010 from our South Pacific atoll, calling it "the best Baily's Beads I have ever got!" He used a 400mm lens at f/6.7, but had to use an exposure of 1/30th second at ISO 400, much longer and higher than needed in a clear sky. The lesson: Be flexible. If clouds look likely, be ready to shift your exposure program to longer exposures. It also helped that Murray had his lens on a tracking mount, which meant he could be assured the Sun was still in the frame, from his framing earlier in the eclipse when it was clear. Even if you can't see anything, the camera might! Shoot anyway.

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SHOOT THE CHANGE IN LIGHTING

If the eclipsed Sun is totally blocked by clouds, all you can do is watch as the lighting changes. You might see and capture the shadow on the clouds.

Unless you are committed to a site, and are unable to travel, or unless the country is beset by huge weather systems, you should be able to chase to clear skies with a day or two notice. What can happen is that clouds in unstable air form at the last minute, literally. Should inescapable clouds form, shoot anyway.

Use a very wide lens to capture the sweep in and out of the lunar shadow on the clouds. You might still see this effect very well. If you can see clear sky toward the horizon you'll see the lighting and colors change. Set the camera to Auto Exposure. Let it run with an intervalometer to grab what it can. A time-lapse movie with frames every second might still be an interesting consolation prize. Or, shoot the site and people. There's still a story to tell.

Don't despair. If you miss out there are more eclipses to come, if you are prepared to travel.

Here's what we could see in 2010. Where's the Sun? Clouds rolled in just minutes before totality. And rolled out after totality. Of course!

All we could do was look at the changing lighting on the clouds and in the parts of the sky we could see in the distance where the twilight colors were obvious. If this happens, resign yourself to the view and enjoy the fact you are still standing in a special place – the shadow of the Moon. It still counts toward your total accumulated time in the umbra.

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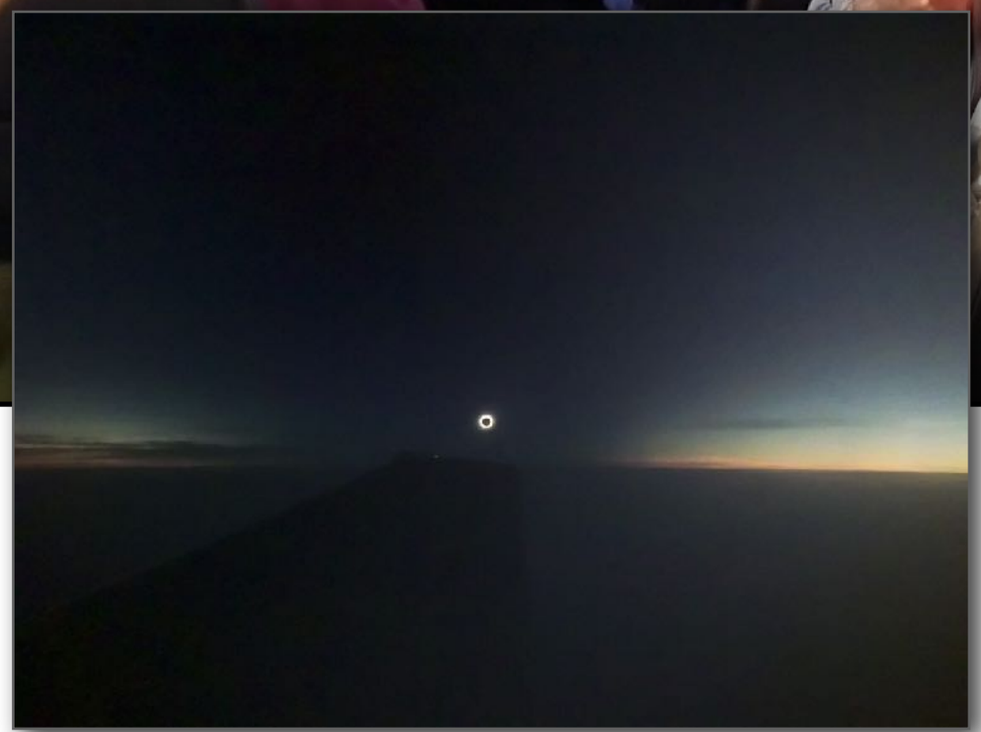
SHOOTING FROM AN AIRCRAFT

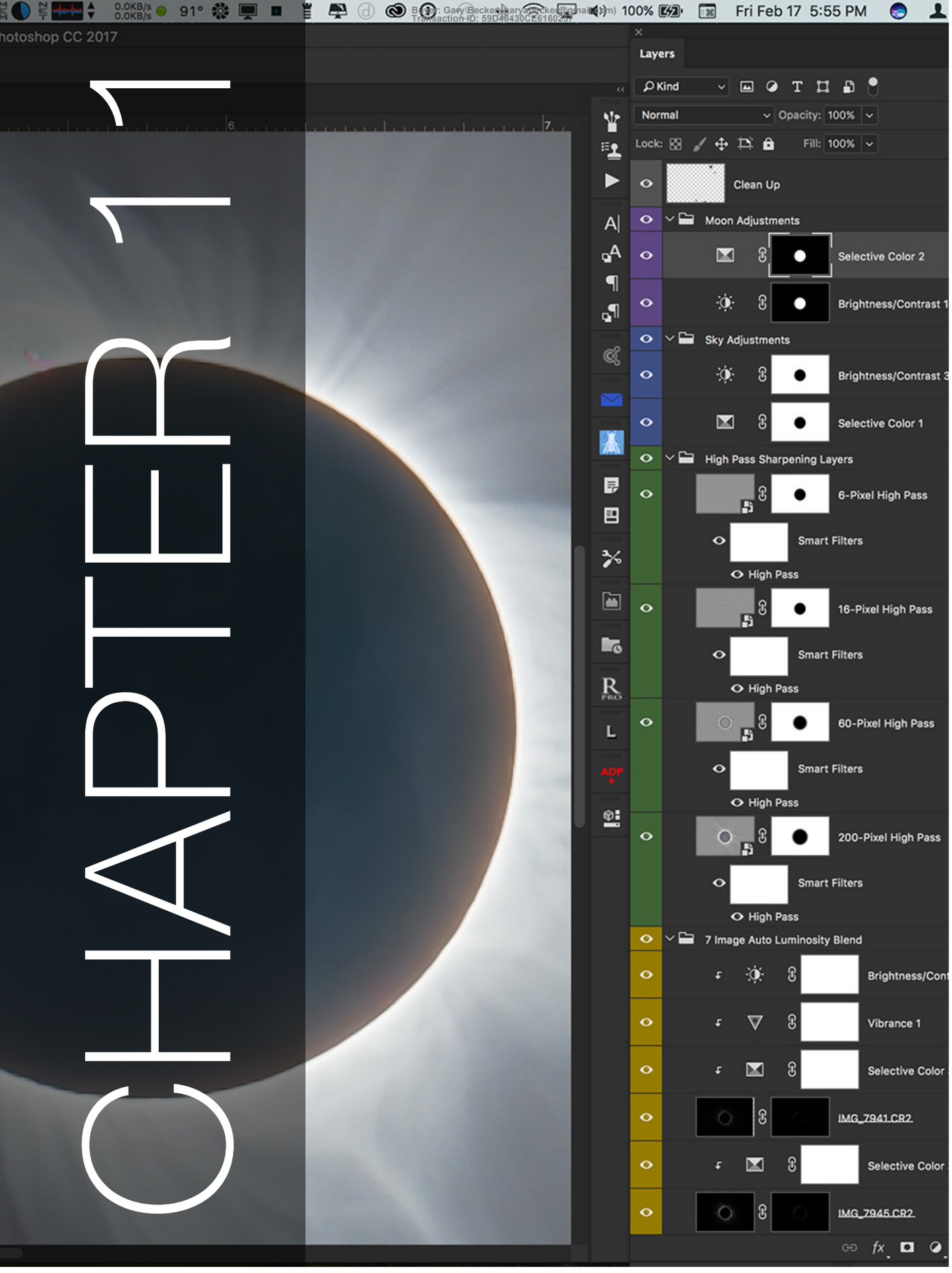
For cloud-stricken sites, a Plan C of taking to the air might be considered by some umbraphiles. But this likely isn't a practical option for 2024.

I've seen two TSEs from the air – over Antarctica in 2003 and over the Canadian Arctic in 2008. The photos here are from that eclipse. However, both eclipses involved low-altitude Suns, as you can see. Indeed, in 2008 our group was the first to see this eclipse, just after sunrise as the lunar shadow first touched the Earth.

However, for 2024 an air intercept over most of the U.S. isn't practical – the Sun is too high, making it tough to see out aircraft windows. From sites in Atlantic Canada it might be an option. Should you have a suitable small aircraft booked as a backup contingency then make sure its windows are cleaned. And plan on who will get the choice window seats. While handheld shots are possible, using a small monopod or tripod would be best for steadying the camera propped up at the window. But the high angle might make this impractical. Just enjoy the view!



This was the last TSE seen from North America before 2017, on August 1, 2008.



11

PROCESSING ECLIPSE IMAGES

The more complex imaging techniques I explained also require the most complex processing. So in this chapter I provide tutorials on all the types of eclipse images, from simple wide-angles, to time-lapses, and complex composites and stacks.

I show **Lightroom Classic, Camera Raw** and **Photoshop CC 2023/24** in most examples.

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SECTION 1

INTRODUCTION TO IMAGE PROCESSING

First, before we plunge into tutorials on how to process typical eclipse images, I'll explain the fundamental idea of a processing "workflow," then illustrate a few of the key features we'll employ when using Photoshop.

In a few pages, I can't provide complete "soup-to-nuts" tutorials on using Lightroom or Photoshop, but I will explain the essential functions we'll need for eclipse images, from basic to advanced techniques.

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RAW DEVELOPERS – 1

The first step in processing any image is to "develop" the Raw file. This step may be all the processing that many images need.

You have many options for working with Raw files. Software came with your camera to do the job. Here and on the next page, I compare six programs: Adobe Camera Raw, Affinity Photo, Capture One, DxO PhotoLab, ON1 PhotoRAW, and the free Raw Therapee. For my tutorials I'll be showing Camera Raw and Adobe Lightroom as the most popular, and I feel the best for astrophotography. All are non-destructive programs – when working with Raw files, the original data is never altered. Instead, all these programs store your settings in their proprietary database or in separate "sidecar" text files.

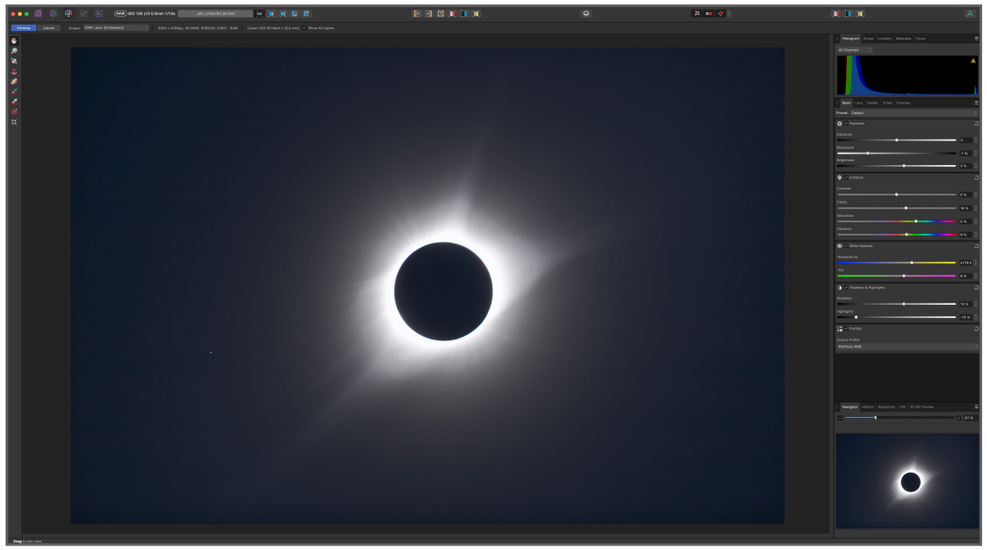
Only when you export the image to a TIFF, JPG, or PSD Photoshop file do the pixels get altered and your settings "baked into" the image. To produce composites and exposure stacks we import those developed raws into a layer-based program. ON1 Photo RAW and Affinity will work, but the most widely used is Photoshop.

Adobe Camera Raw

ACR offers identical adjustments to Adobe Lightroom. I use both programs in my processing examples in this chapter.

Affinity Photo

Affinity Photo offers basic Raw developing with good dynamic range recovery. Its main feature is the ability to stack and layer images. It is low cost yet the most like Adobe Photoshop in features.



Capture One

This premium program is a Raw developer only, but it works very well, with excellent dynamic range recovery, but only average noise reduction. It can't layer images for composites.

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RAW DEVELOPERS – 2

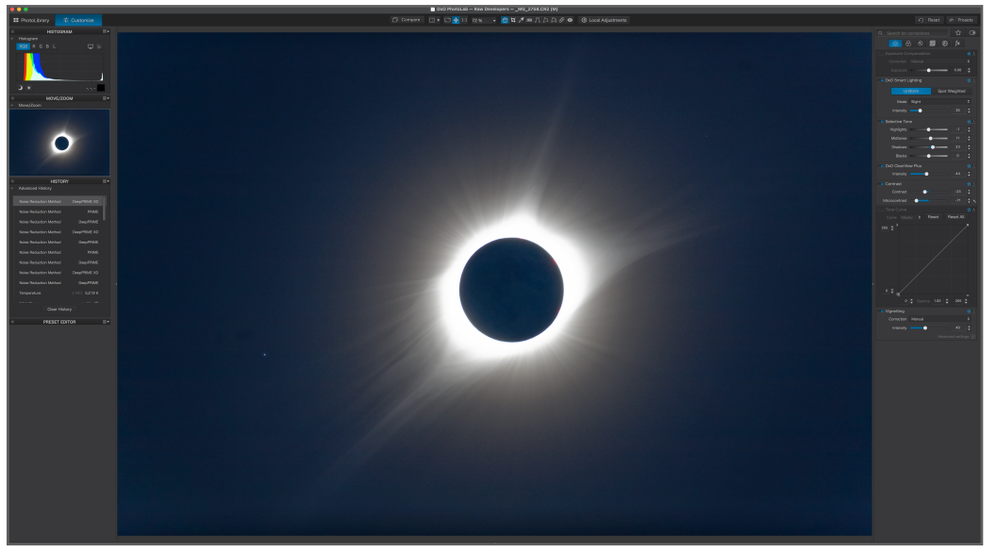
The key is getting it right at the early stage of Raw development. Poor results here cannot be corrected later when layering images.

Eclipse close-ups are very demanding of any Raw developer. The dynamic range is high. Good highlight recovery is important, even in images intended to be stacked and exposure blended later. These examples all show a single exposure of the 2017 eclipse, shot with a Canon 6D MkII. In my comparisons, I found ACR and Capture One the best of the bunch. Other programs tended to posterize the corona.

Despite shooting at a low ISO, the sky and corona can show a surprising level of noise, especially when attempting to bring out subtle outer structures. ACR/Lightroom's new AI Denoise, shown later, does a fine job, as does DxO's DeepPrime NR, also available separately in DxO's PureRAW³ app and plug-in. Other Raw developers have good noise reduction. Trial copies are available for all programs (Raw Therapee is free), so test for yourself.

DxO PhotoLab

This is also just a Raw developer. Its Clear View can reveal coronal structures but also bring out noise. It Deep Prime noise reduction is good.

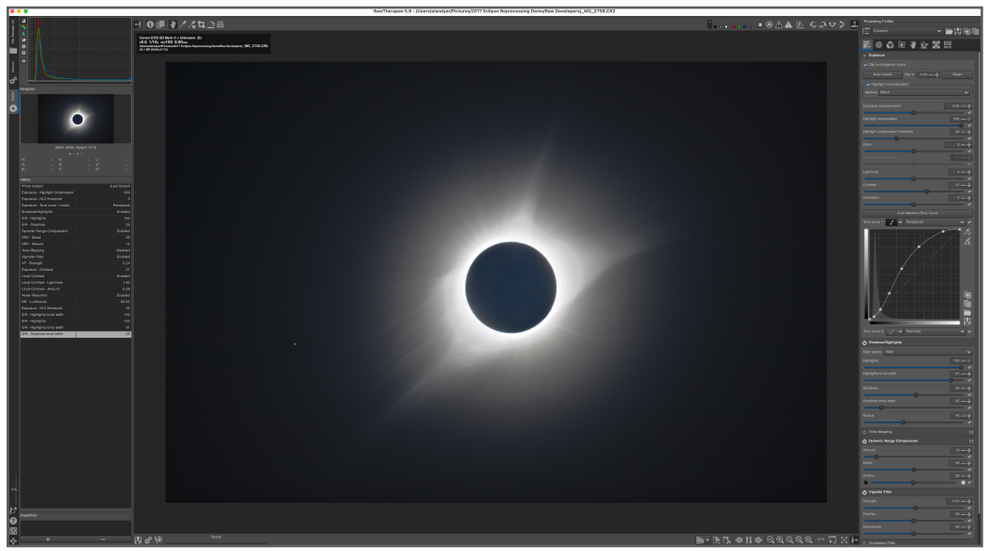


ON1 Photo RAW

Photo RAW can replace both Lightroom and Photoshop, as it can layer and mask images. It tends to over-sharpen; its highlight recovery and noise reduction are only average.

Raw Therapee

This free open-source Raw developer is overwhelming in its complexity, settings and options. It can produce good results if you are patient and persistent, though it tends to posterize the corona.



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WORKFLOWS

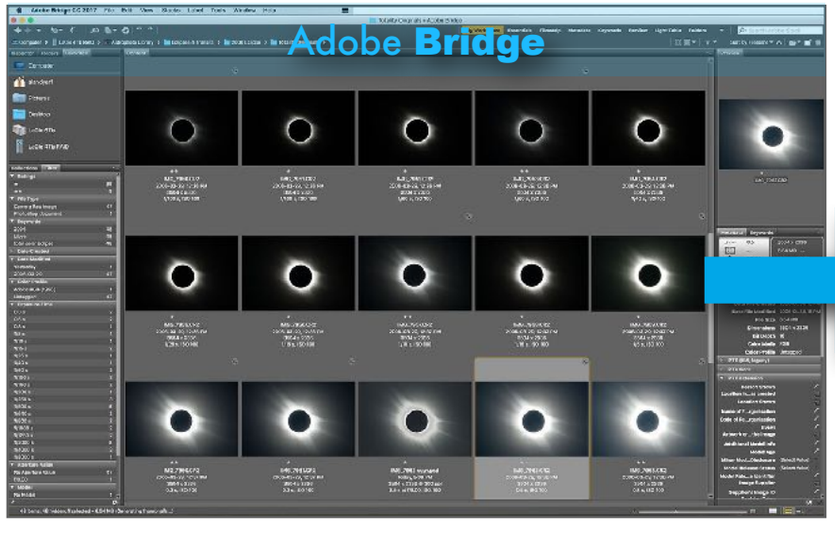
TIP: Throughout the image processing section, I am emphasizing a "non-destructive" workflow. It means never having to say "I wish I hadn't done that!" Or having to re-do steps. Everything is editable at any time.

My examples will use Adobe products, as they are the most widely used. Even so, you have a choice of workflows.

For some examples, I'll show developing the Raw image in Lightroom, then sending the files to Photoshop when needed for layering. You can also use Adobe Bridge and Camera Raw to perform the same functions as Lightroom's Library and Develop modules. ACR is identical to Lightroom's Develop module.

WORKFLOW OPTION 1

Here we import and inspect images with Lightroom's Library module, then develop the Raw files with the Develop module.



WORKFLOW OPTION 2

Here we import and inspect images with Adobe Bridge, then develop the Raw files with Adobe Camera Raw (ACR).

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PHOTOSHOP 101: TOOLS AND ADJUSTMENT LAYERS

Before

After

When a tool is picked, the **Tool Bar** at top changes to reflect the properties of that tool. The brush here has a 40% Opacity.

Tools are selected from the palette at left. The **Brush** tool is selected here. We'll use this to paint on masks.

The color of the brush is always the **Foreground Color**. But when painting on masks, brushes are either black or white.

Once we get into Photoshop we'll employ its non-destructive features, the key being "adjustment layers," at right. But we also need to learn to use its basic array of tools, at left. Later tutorials will explain tools as needed. This shows Photoshop 2017 but the same tools apply now.

When developing Raw files, the original pixels are never touched. But in Photoshop, we can do permanent harm to pixels. Using "adjustment layers" prevents cruelty to pixels. We can always re-work any adjustment at any time. Apply them here, by clicking on icons in the **Adjustments** panel.

Adjustment layers for **Vibrance**, **Selective Color**, and **Brightness/ Contrast** are applied. They affect the image below.

The actual image is a "Smart Object," to which non-destructive "smart filters" can be applied, such as **Reduce Noise** here. These are discussed in later tutorials.

Adjustment layers have a white mask added by default. We can paint on these masks to hide the adjustment from selected areas of an image.

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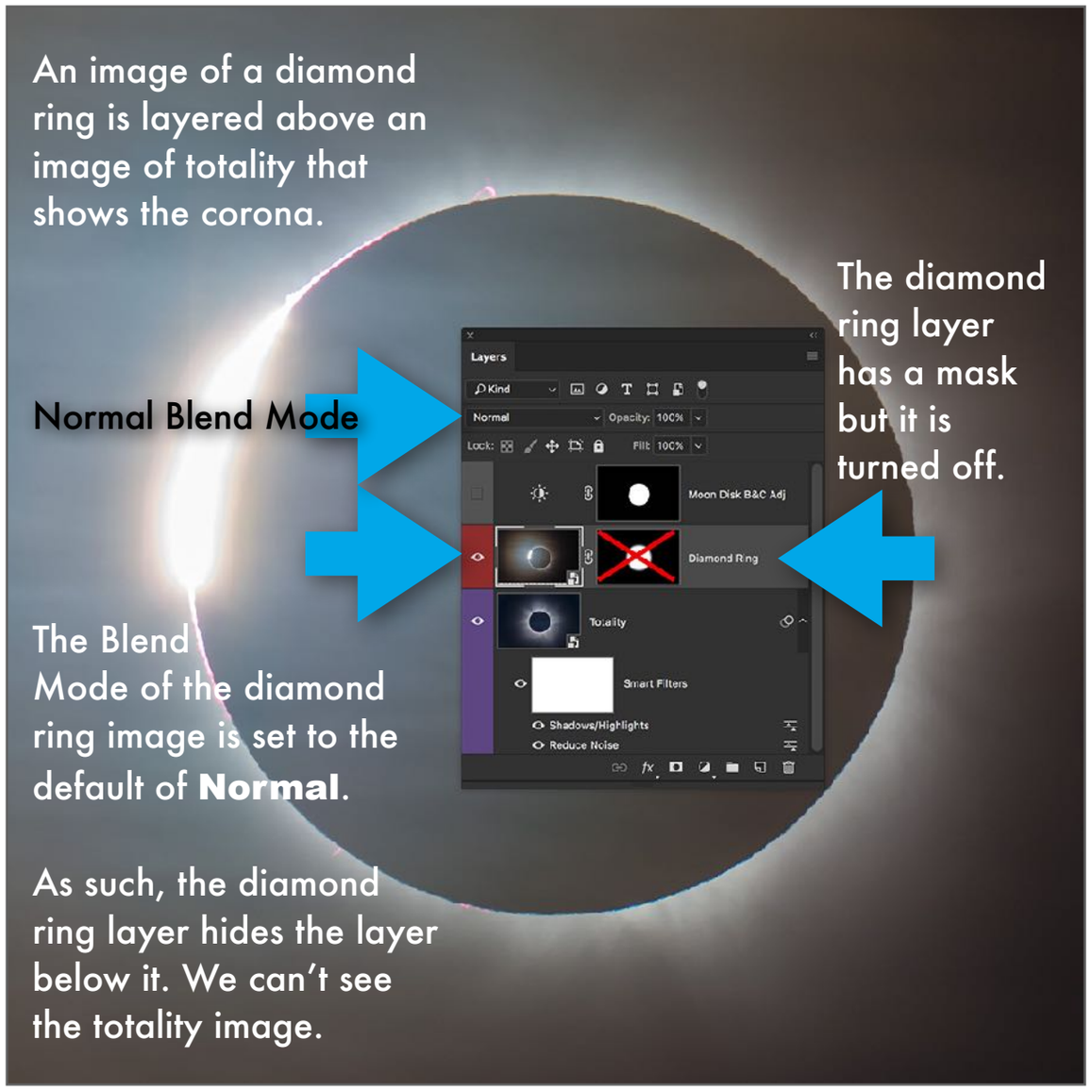
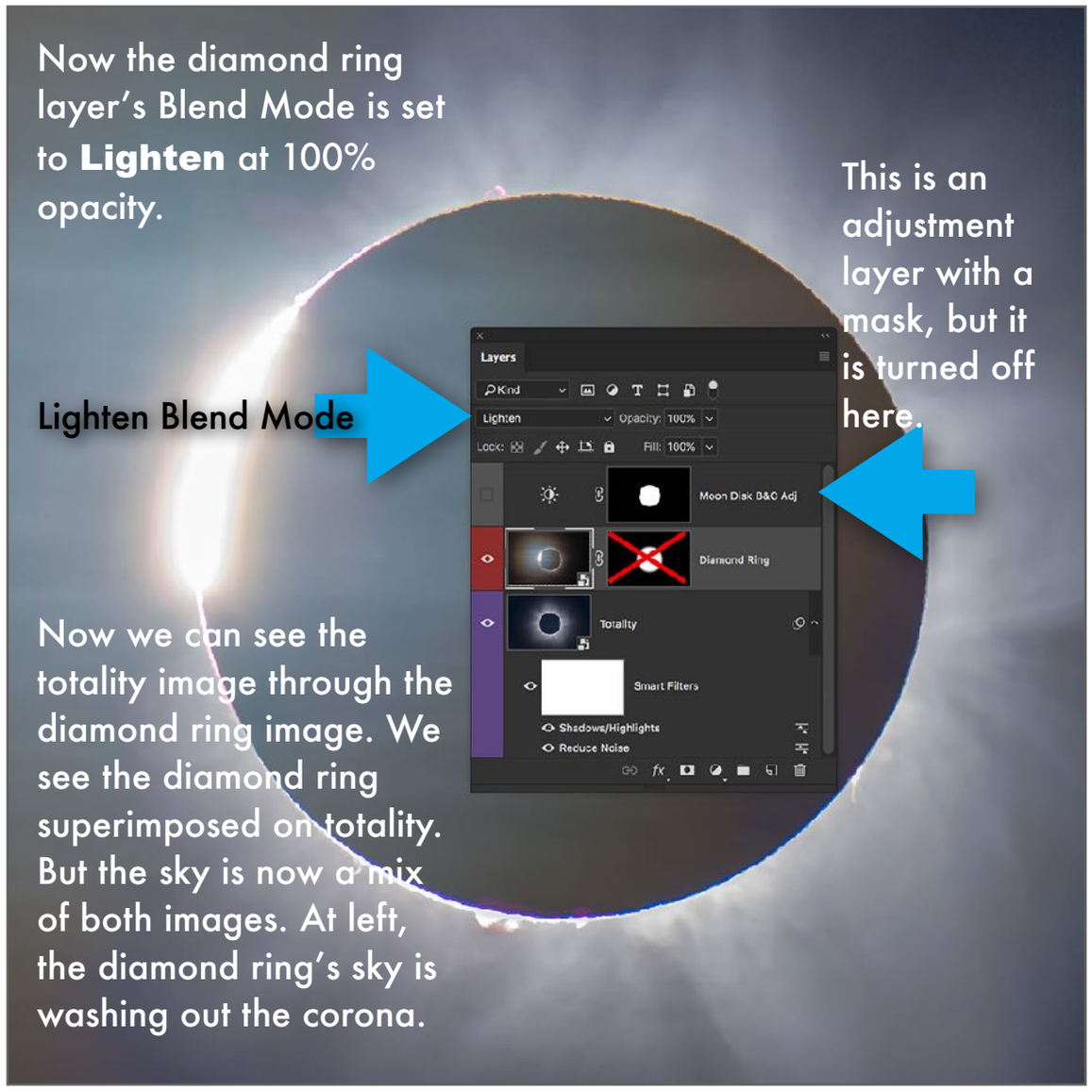
PHOTOSHOP 101: LAYERS AND BLEND MODES

While some single images might require nothing more than developing the Raw file, eclipse portraits often benefit from stacking or compositing images in layers, then using masks to hide and reveal selected areas.



Adjustment layers are a form of layer that affect the image below. But we can also stack images into multiple layers. We then use **Blend Modes** to affect how an image on the top blends with images below. Next, I'll show Masks for more precise work.



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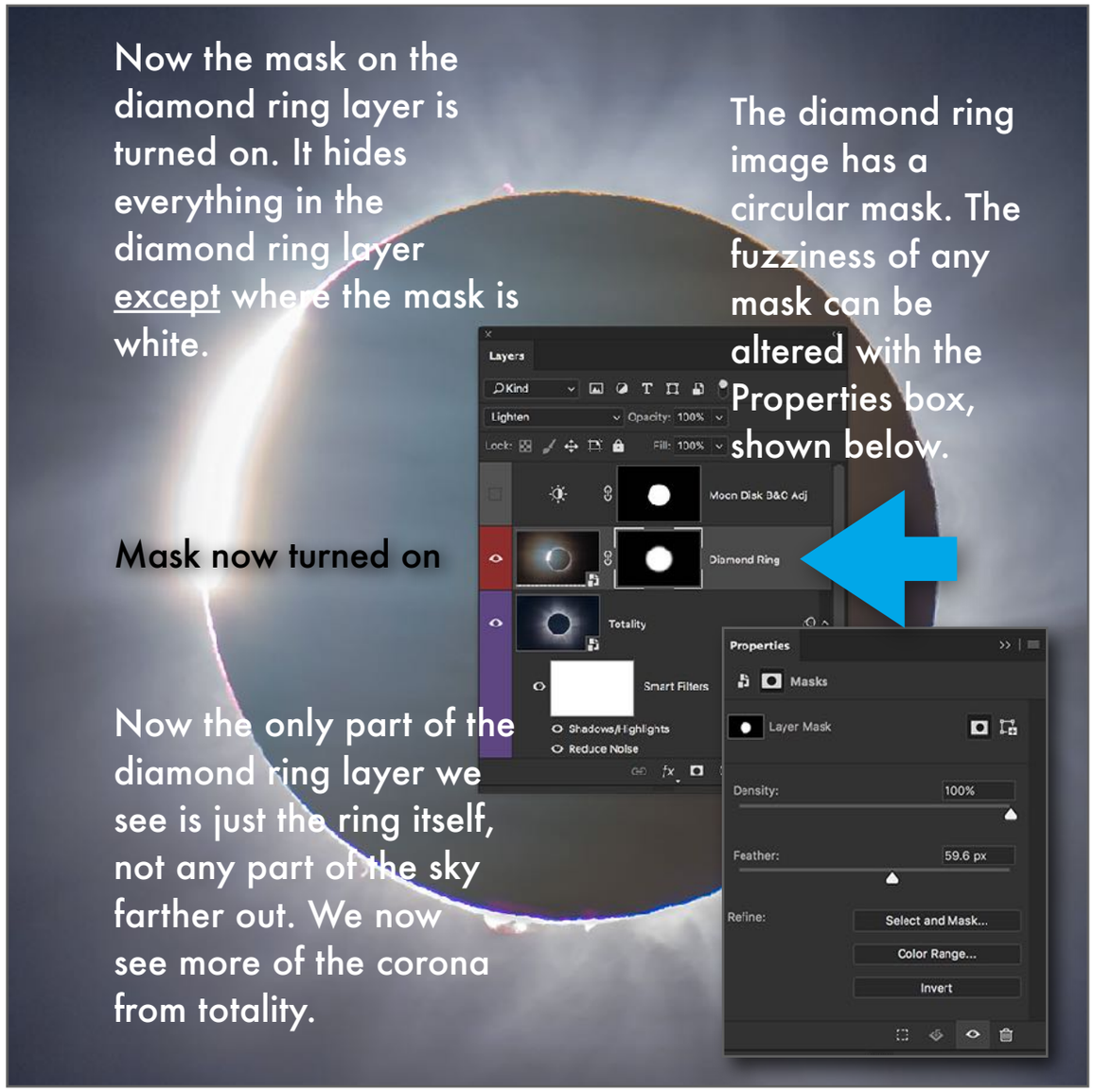
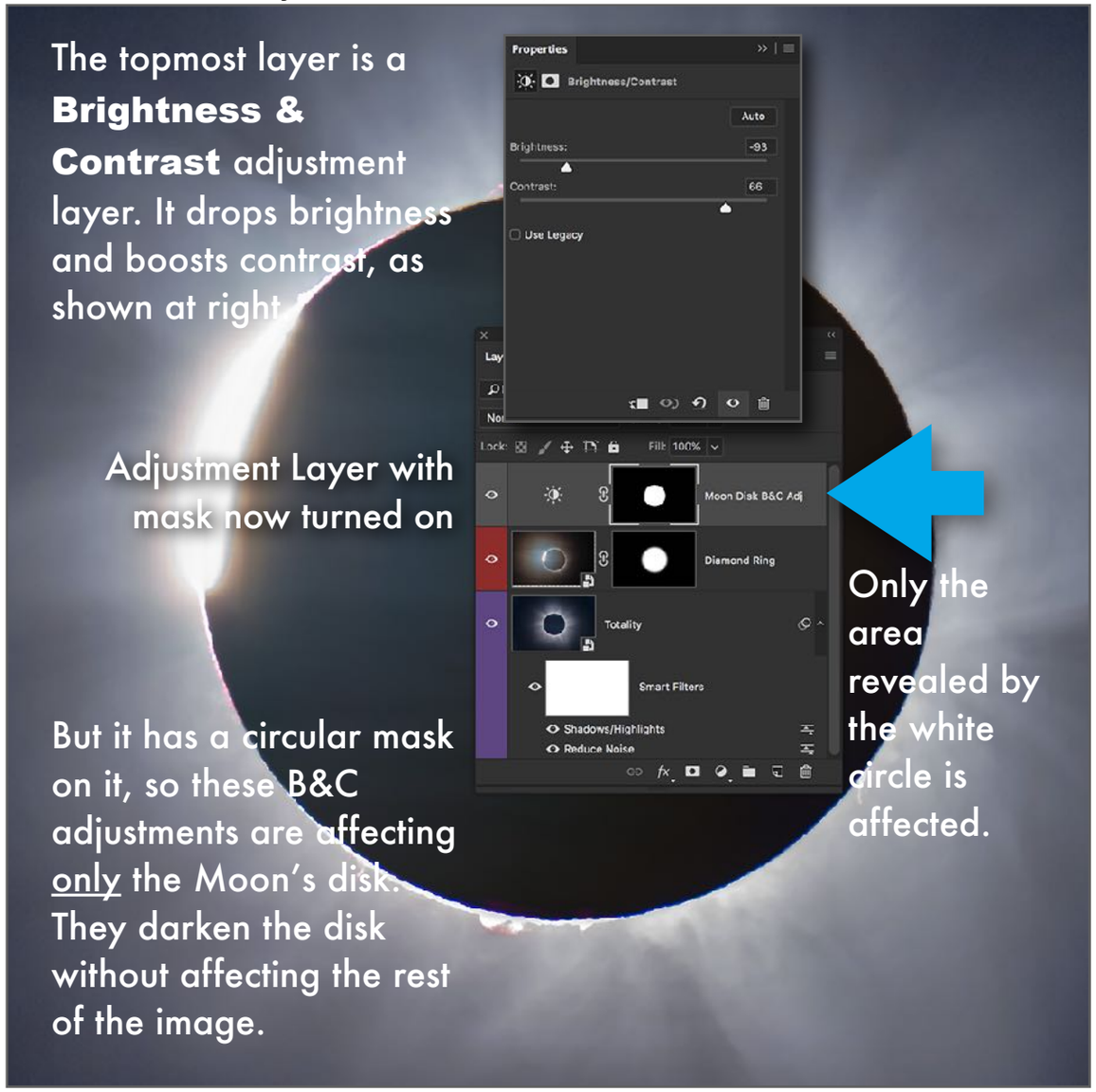
PHOTOSHOP 101: MASKS

Stacking images and changing the Blend Mode may not be enough to produce a good image. We usually need to selectively hide parts of the top image so, in this case, it contributes only the diamond ring itself.



To hide and reveal parts of an image, we use **Masks**. What's Black on a mask conceals; what is White on a mask reveals. Masks can also be applied to adjustment layers, so their changes in brightness or color affect only selected areas, as with the Moon's disk here.



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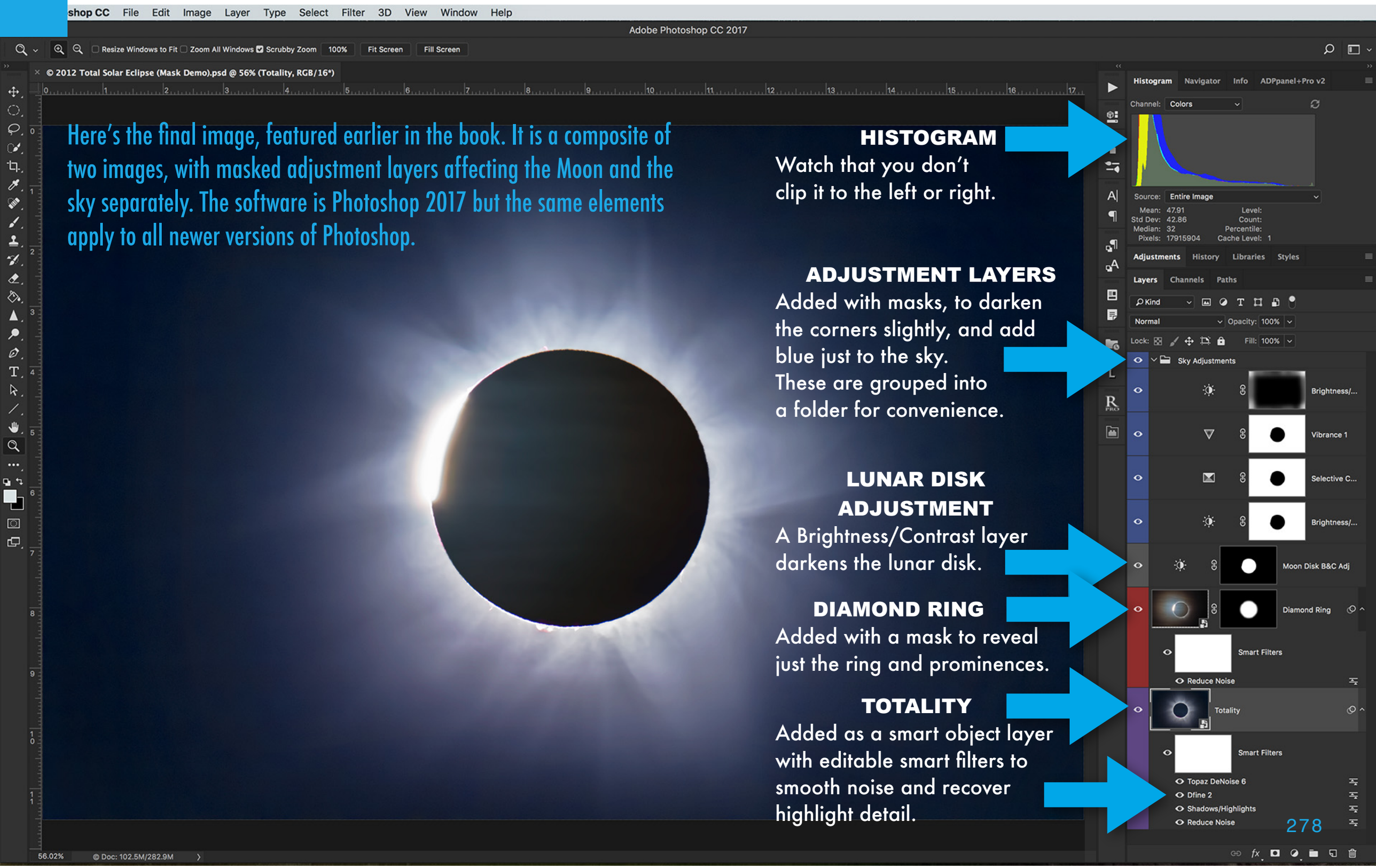
A FINAL IMAGE DECONSTRUCTED



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Zoom All Windows | Scrubby Zoom | 100% | Fit Screen | Fill Screen

e Over Bryce Canyon.psb @ 46.2% (_RA_6870 – Main Base Sky, RGB/16)

SECTION 2

PROCESSING ANNULAR ECLIPSE IMAGES

In this new section, I demonstrate how I processed and assembled my sets of images from the October 14, 2023 annular eclipse: the wide-angle composite, the telephoto composite and time-lapse, and the telescopic images, both singles and composites.

Select subject | Remove background

Layers

Kind | Normal | Opacity: 100% | Lock: | Fill: 100%

- Smart Filters
  - Luminar Neo
- Dodge / Burn
- M Brightness/Contrast
- Selective Color Ground
- Selective Color SKy
- Generative Fill
- Clean Up
- Selective Color 1
- Composite Suns Sub-Master
  - Smart Filters
    - Unsharp Mask
- _RA_6867 - Bright Landscape
  - Smart Filters
    - Smart Sharpen
    - Reduce Noise
- _RA_6865 - Sunrise Horizon
  - Smart Filters
    - Smart Sharpen
    - Reduce Noise
- _RA_6870 - Main Base Sky

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ASSEMBLING THE WIDE-ANGLE COMPOSITE – 1

Here I show my steps for assembling the composite taken with a wide-angle lens framing the motion of the Sun, shown in Chapter 4.

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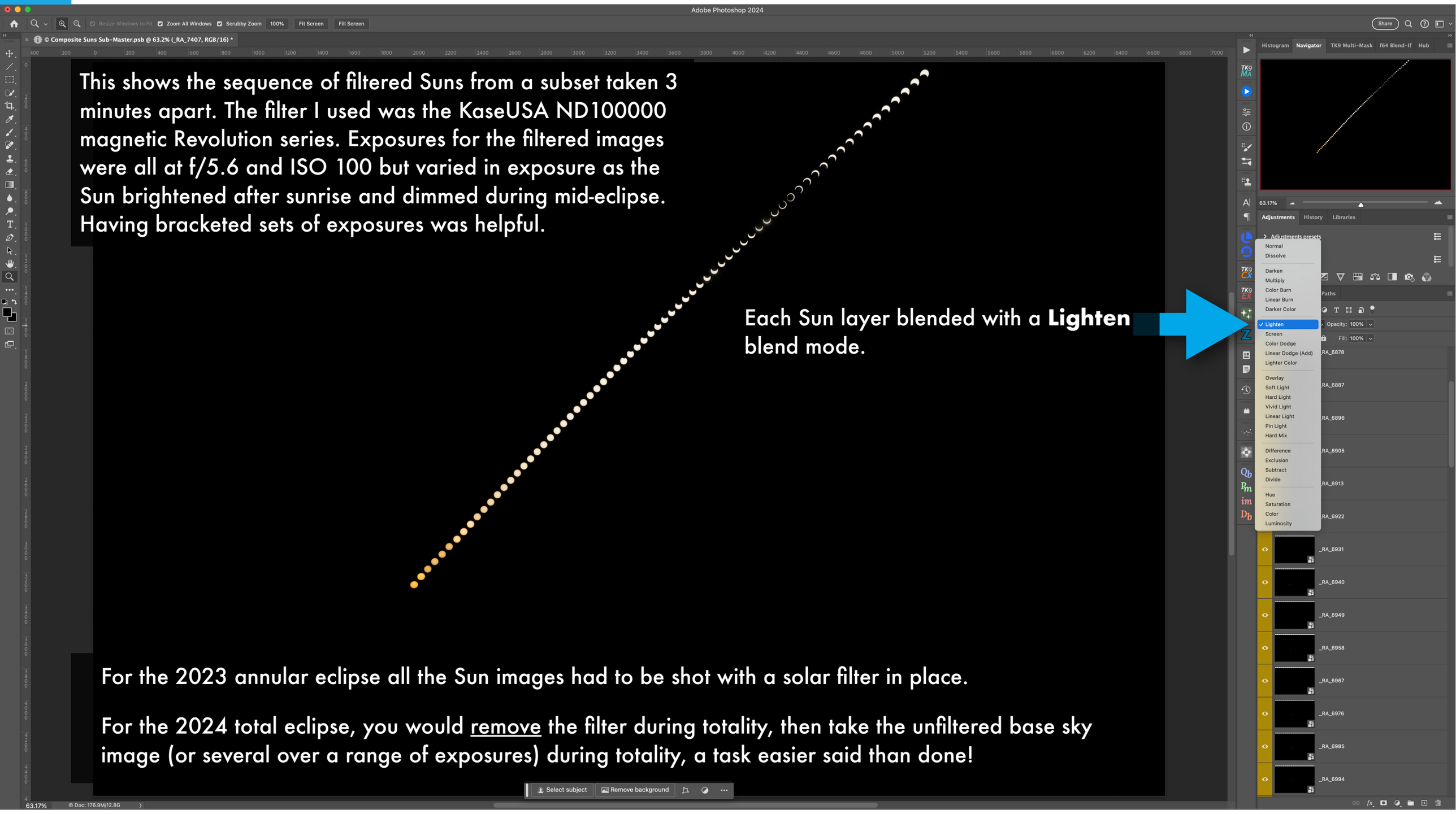
ASSEMBLING THE WIDE-ANGLE COMPOSITE – 2

First, I created a sub-master file out of the subset of frames for just the Suns, 66 images from just after sunrise until the Sun left the frame.



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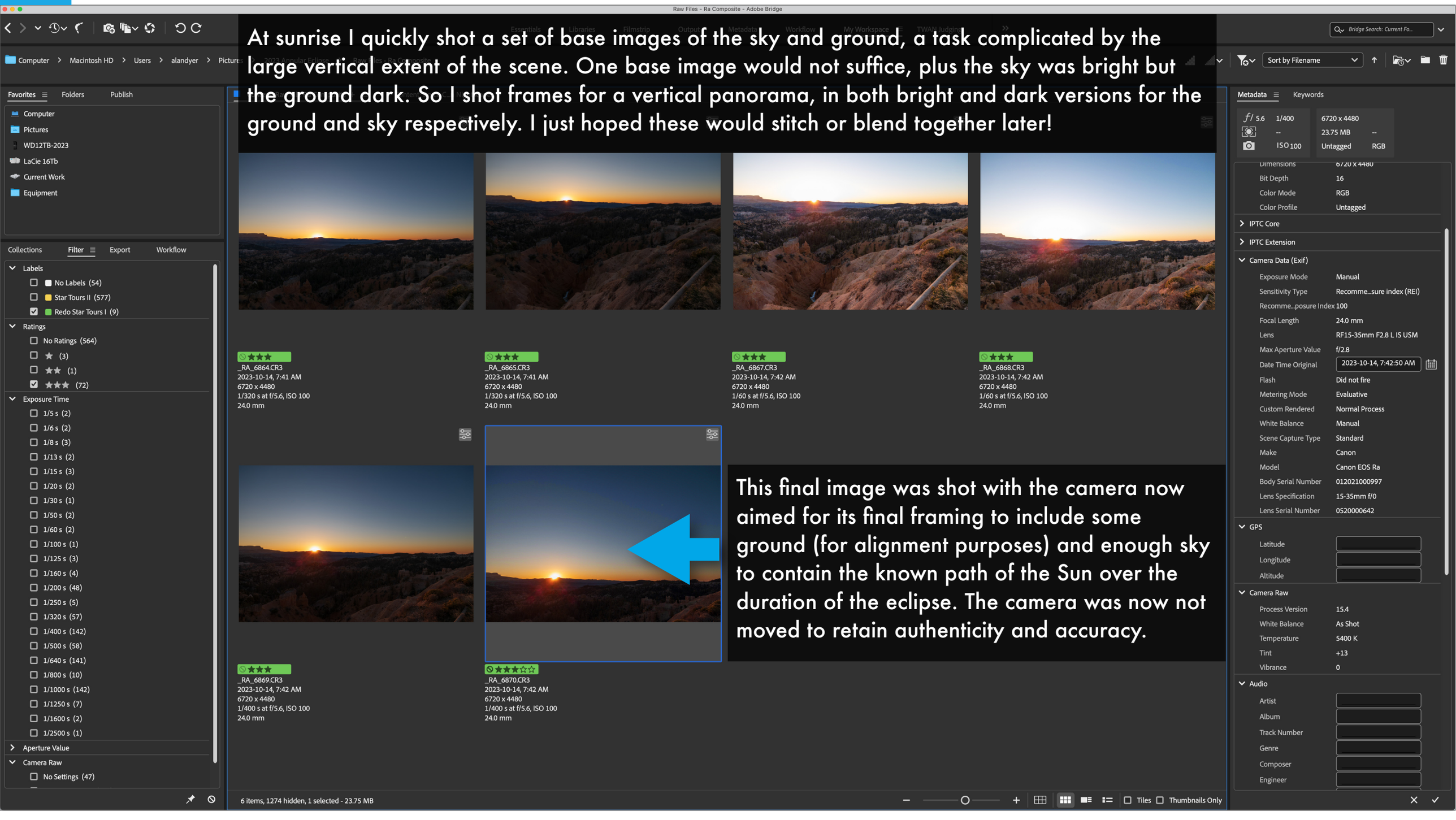
ASSEMBLING THE WIDE-ANGLE COMPOSITE – 3

I then selected the images to serve as the base layers – frames shot at sunrise with exposures for the dark ground and bright twilight sky.



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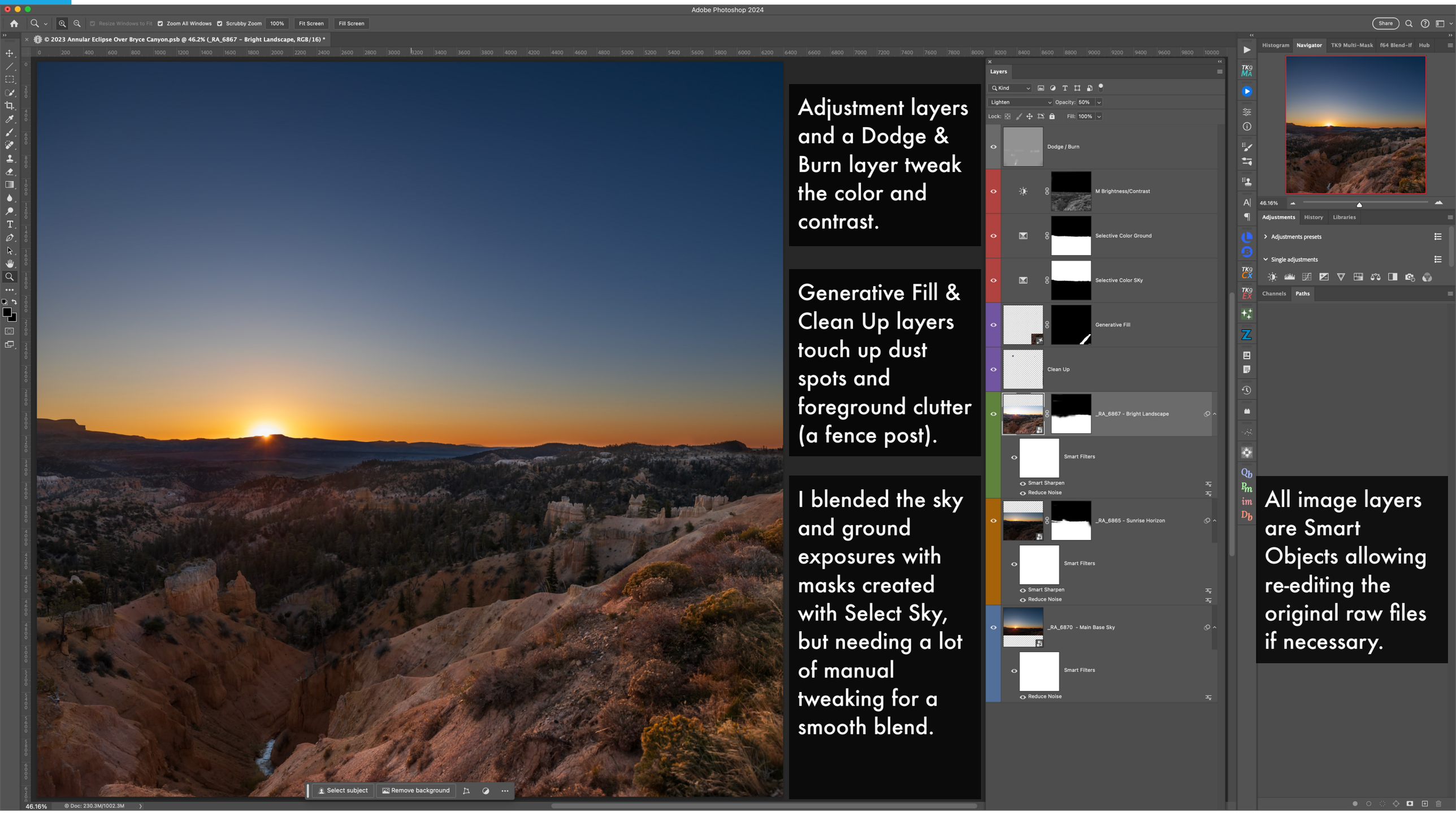
ASSEMBLING THE WIDE-ANGLE COMPOSITE – 4

With ad hoc alignment and masking I blended the base images to create a seamless sunrise scene with a believable balance of lighting.



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ASSEMBLING THE WIDE-ANGLE COMPOSITE – 5

With the base scene prepared, I then layered in the Sun sub-master image as a single smart object layer using the Place command in Bridge.

The layered Suns sub-master image is selected then the command **Place ... in Photoshop** is used to bring this image into the base image that is also open in Photoshop. This brings the Suns image into the final file as an editable smart object with access back to the individual Sun layers if needed for minor adjustments.

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ASSEMBLING THE WIDE-ANGLE COMPOSITE – 6

The Suns sub-master is blended with a Screen blend mode. A special "Orton effect" layer on top adds a finishing touch.

At top is a stamped layer merging all of what's below. I turned this into a Smart Object to apply an editable Orton effect created with the third-party Luminar Neo plug-in, to add some glow. It is blended in with a Lighten mode at reduced Opacity to make it subtle.

Here is the Suns image layered on top of the base image set, and blended with a Screen blend mode. With a Lighten blend mode the Suns close to the bright sunrise were too dim and were lost in the glare. A Selective Color adjustment layer clipped to the Suns image layer tweaks their color.

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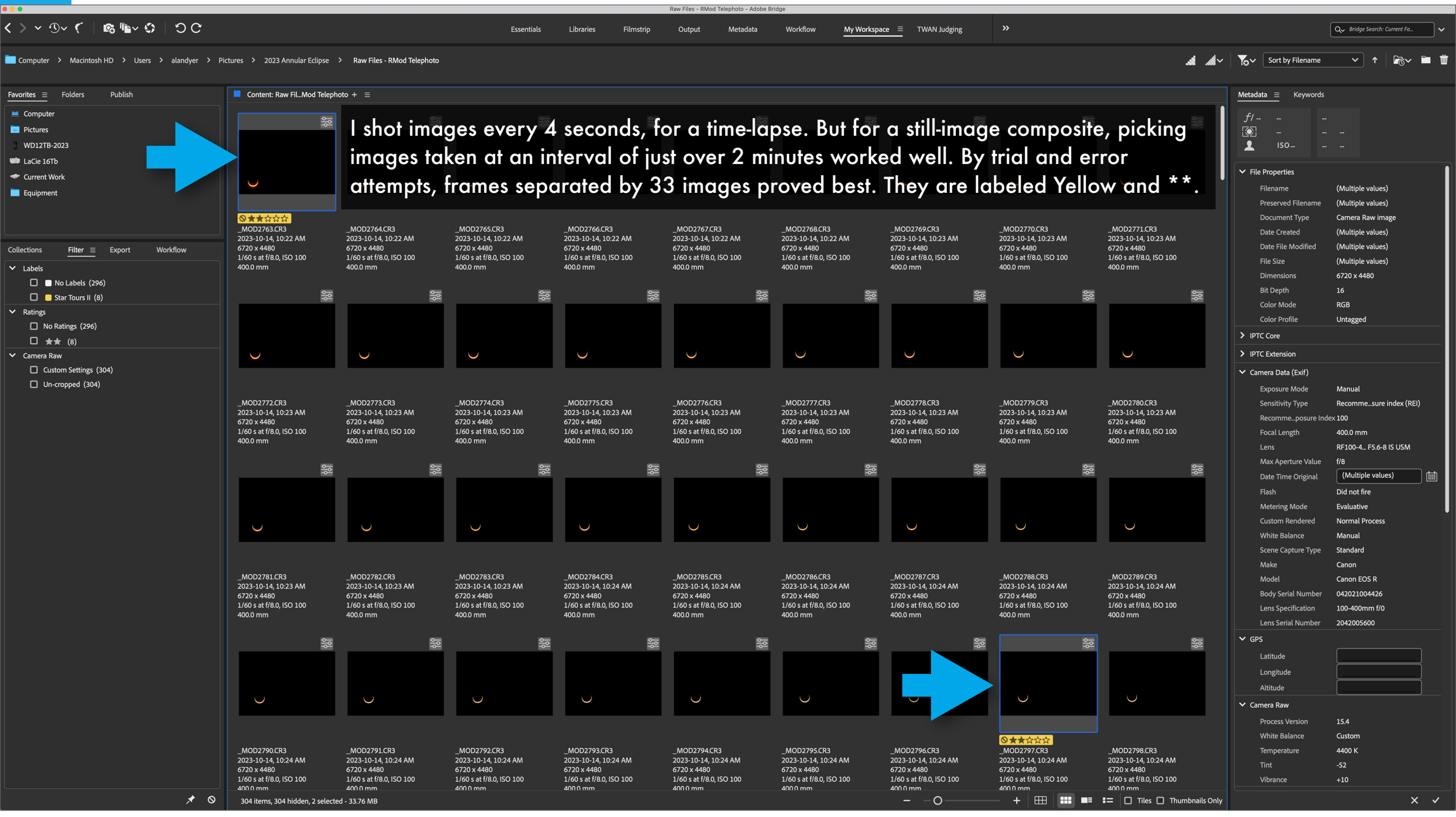
ASSEMBLING THE TELEPHOTO COMPOSITE – 1

For the still-image composite taken with the 400mm telephoto lens, I used Bridge to first select a set of images out of the 304 taken.



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ASSEMBLING THE TELEPHOTO COMPOSITE – 2

Then with the set selected that will yield the desired spacing, they are brought into Photoshop as layers.

The final set of 8 images were labeled Yellow and ** for easy selection. Then **Tools > Photoshop > Load Files into Photoshop Layers ...** could be used to bring then into Photoshop. But in my case I used the **Place ...** command so that every image came in as an editable Smart Object.

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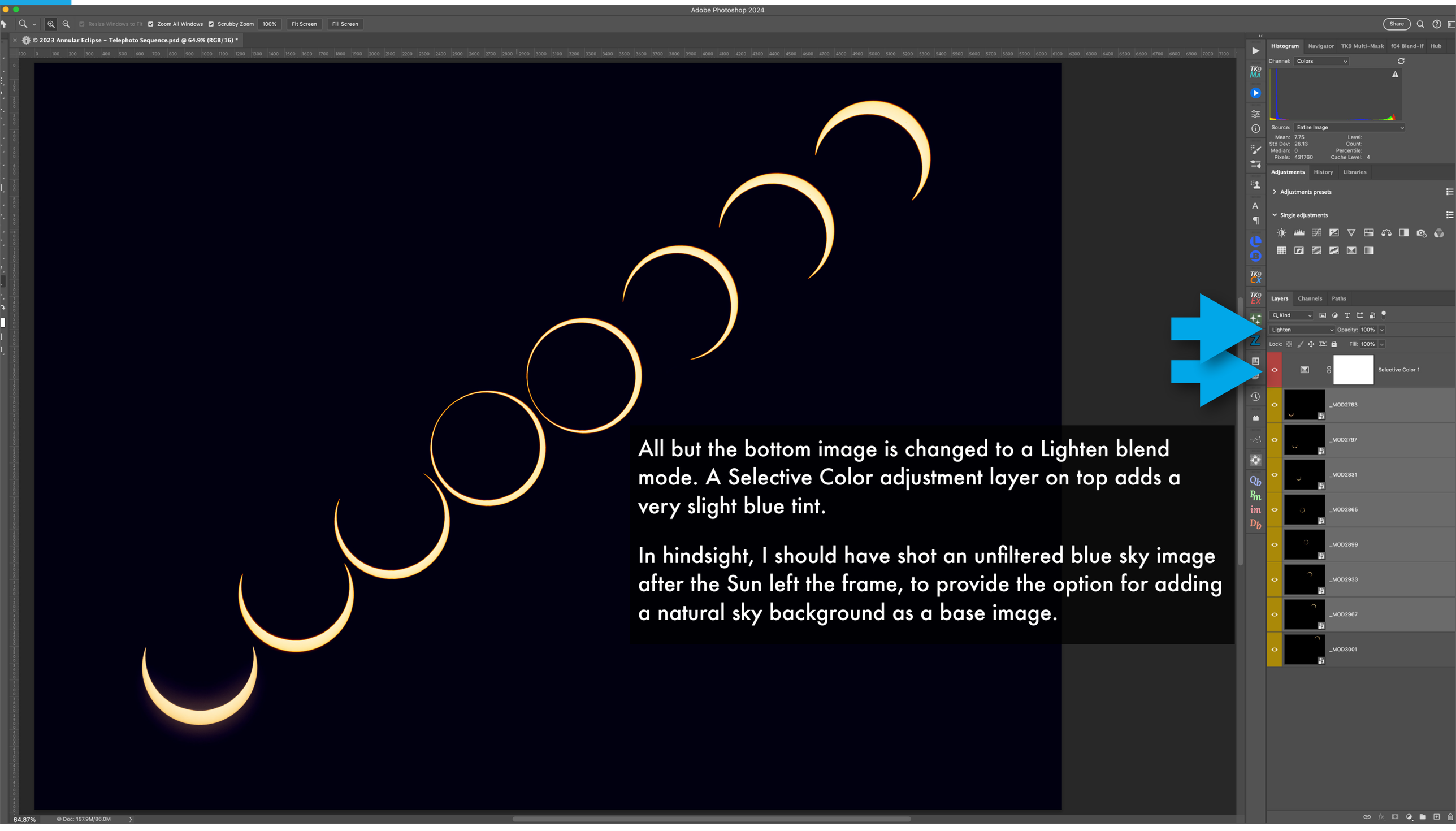
ASSEMBLING THE TELEPHOTO COMPOSITE – 3

The image layers are blended with a Lighten blend mode. No manual positioning of the Suns is required – the sky did the moving for me!



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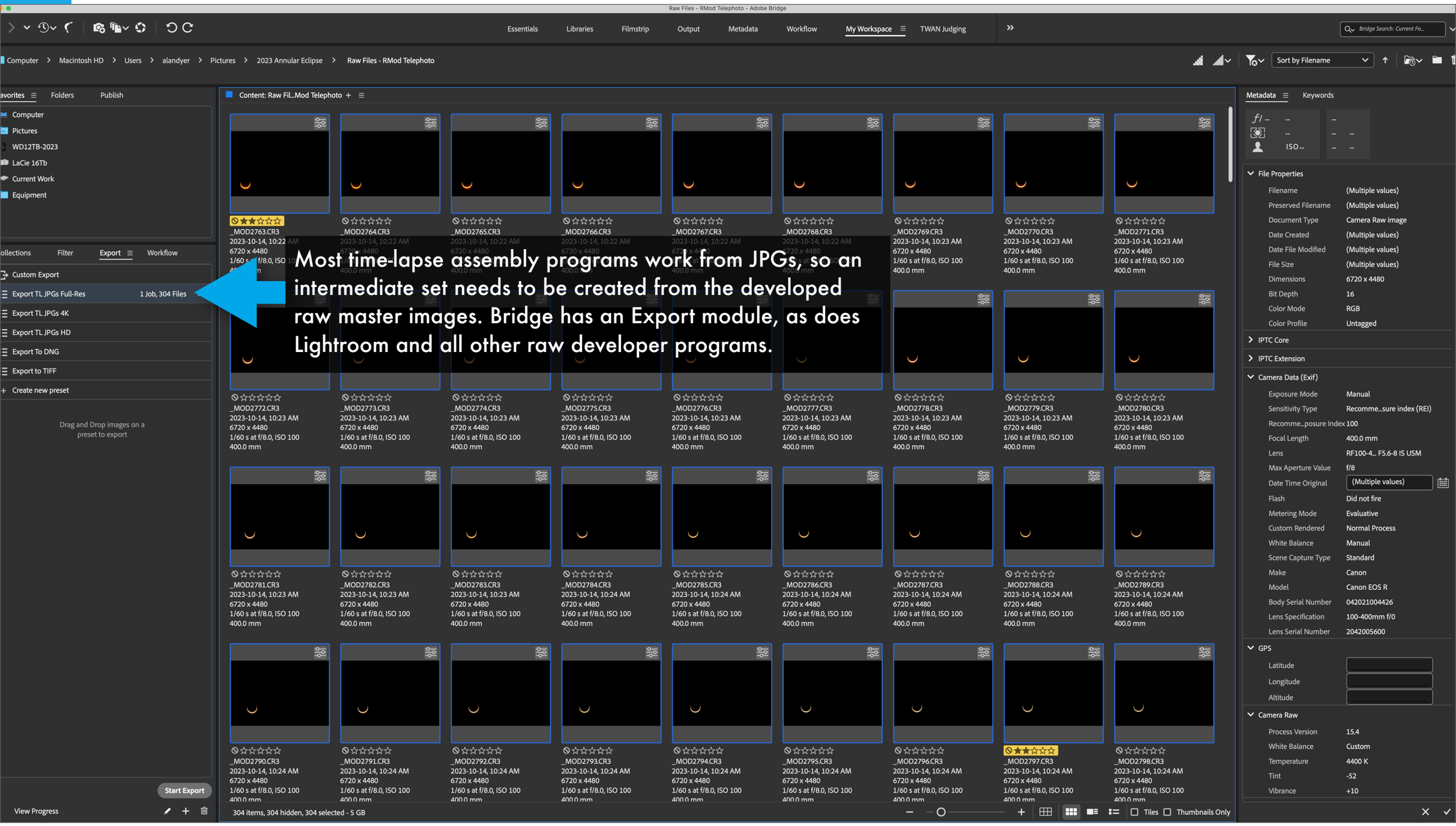
ASSEMBLING THE TELEPHOTO TIME-LAPSE – 1

To create a time-lapse out of the 304 images I used Bridge to export all the frames as intermediate full-res JPGs, to assemble into a movie.



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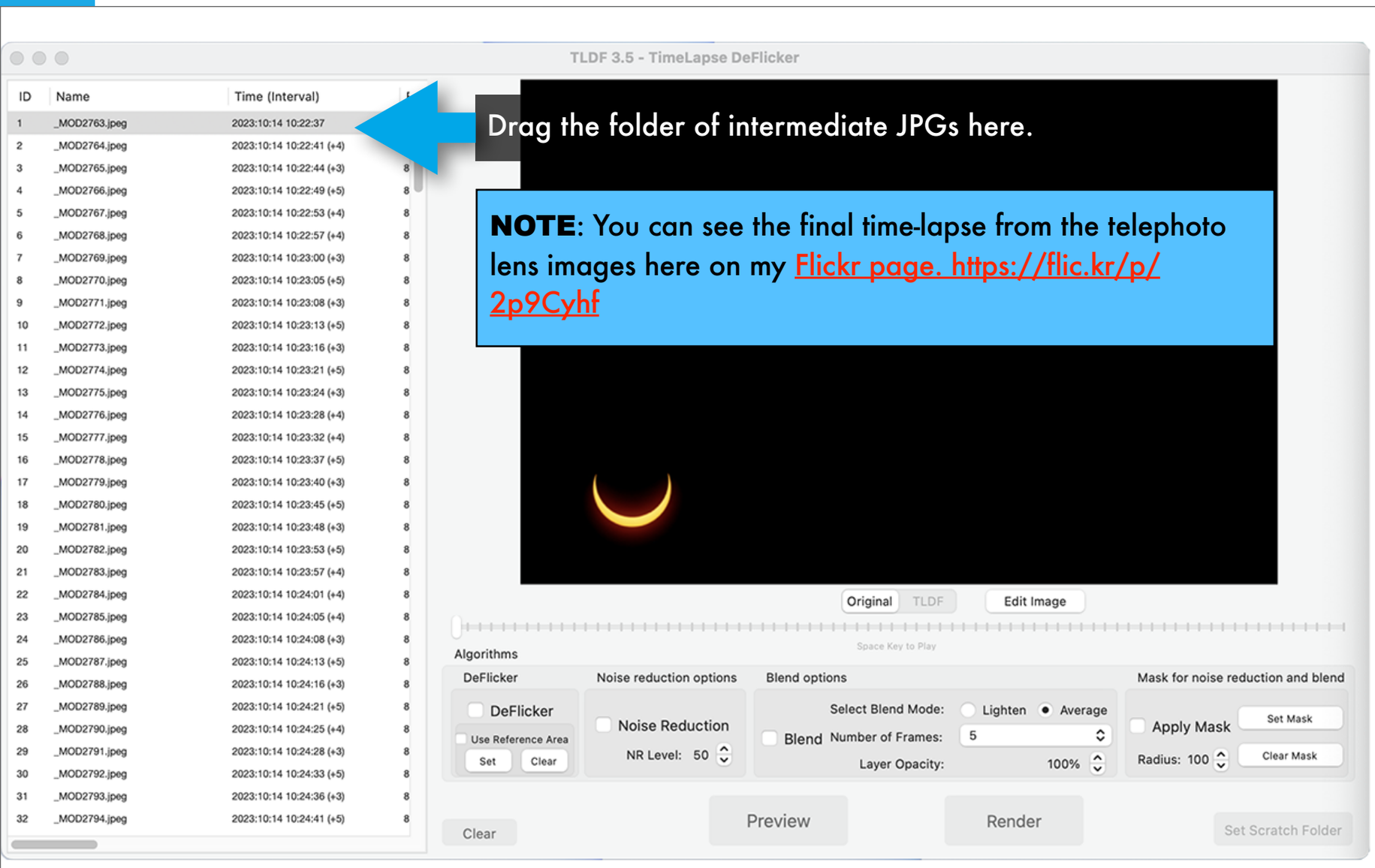
ASSEMBLING THE TELEPHOTO TIME-LAPSE – 2

For assembly of time-lapse movies I usually use the program TimeLapse DeFlicker, available for MacOS and Windows here.



In the **Render** dialog box, select the size of the desired movie (likely 4K) and the frame rate (24 or 30 fps usually). For this type of sequence there is no need to add any frame blending or deflickering. The Codec and Color Gamut can also be selected, but the lower-grade choices shown are likely best for web publication. TLDF can export up to 8K movies. Having intermediate JPGs that are full-res gives you the choice of rendering movies in any size desired from the same set of JPGs.

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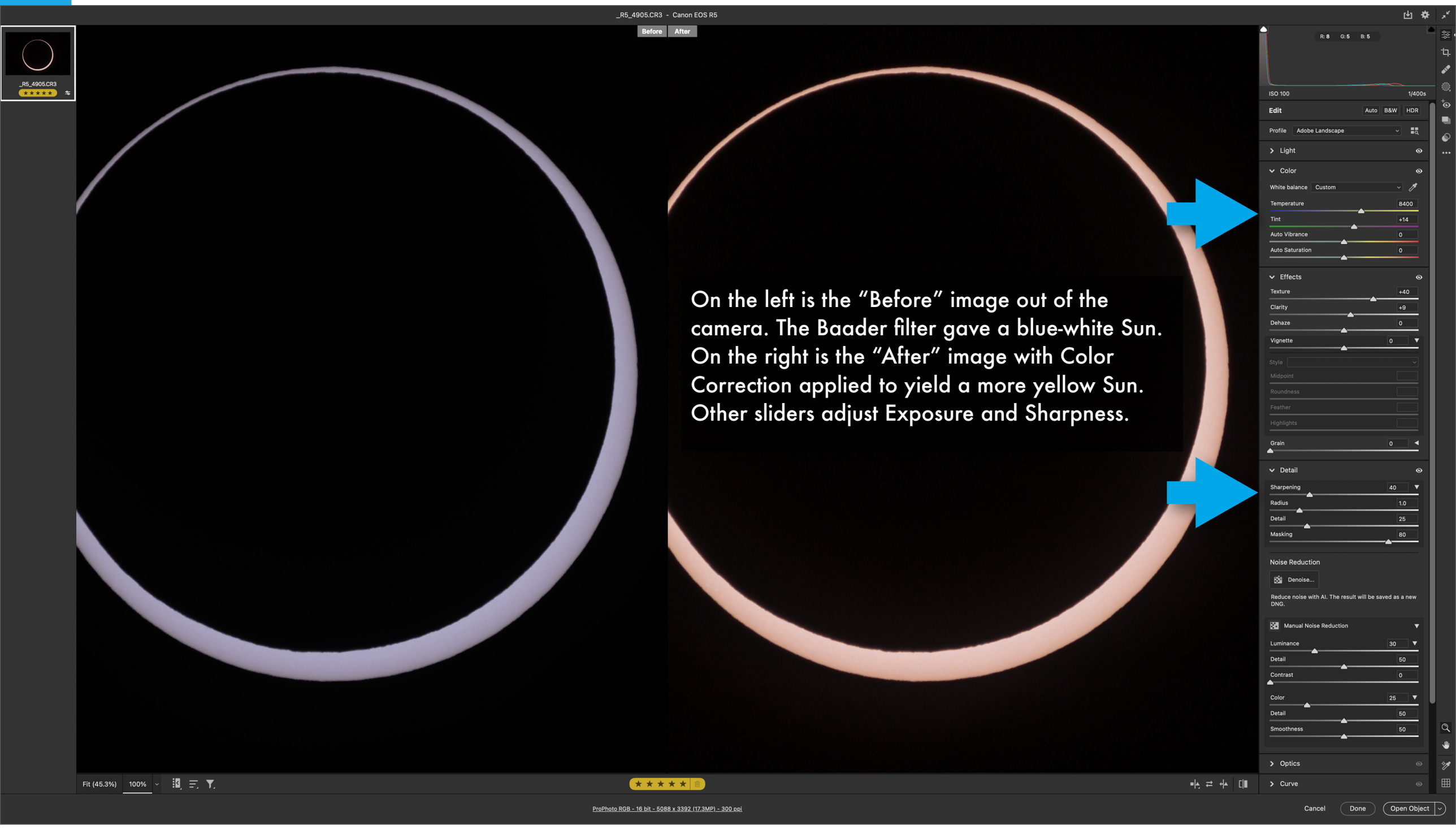
PROCESSING INDIVIDUAL TELESCOPE IMAGES – 1

While I show other options for colorizing the Sun in Section 4, for my 2023 telescopic annular images I used Camera Raw and the Color sliders.



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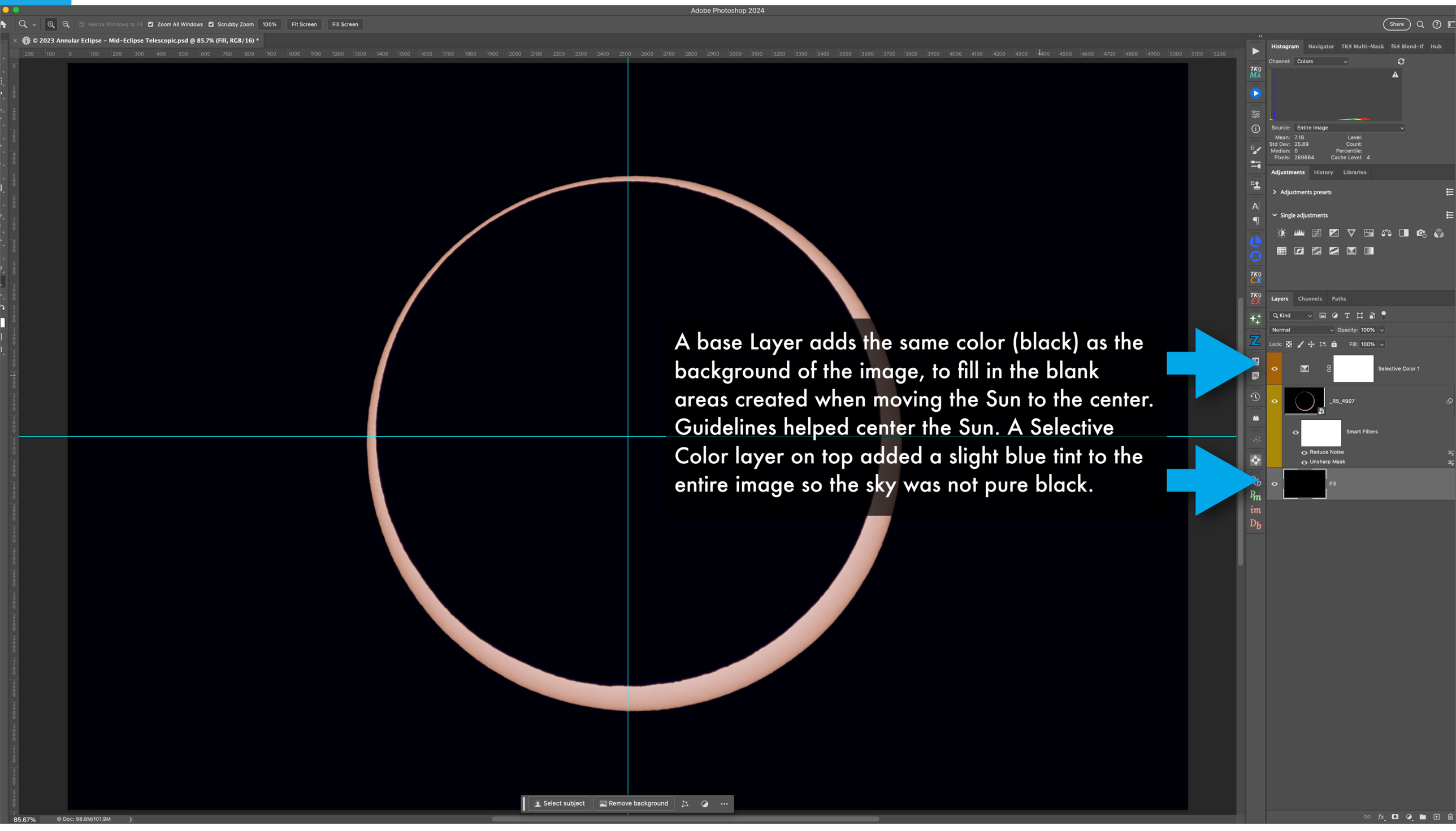
PROCESSING INDIVIDUAL TELESCOPE IMAGES – 2

In Photoshop, I had to manually re-center most images, as the telescope mount was not able to track because of my dumb mistake!



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ASSEMBLING THE TELESCOPIC COMPOSITE – 1

To create a composite montage of images from C1 to C4, I first developed all the images, copying the settings from one image to all others.

I color-labeled each of the 645 telescope images, indicating the C1 to C2 set, C2 burst images, annularity images, and C3 to C4 images. At each interval I set the camera to take a bracketed group of 3 exposures. I picked the best one for the final composite. The final set is rated ****.

This is the mid-eclipse image shown on the previous pages.

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ASSEMBLING THE TELESCOPIC COMPOSITE – 2

I selected images taken at similar intervals for a symmetrical set for the composite. These were then brought into Photoshop layers.

I selected 15 images: one at mid-eclipse and 7 flanking that one for pre- and post-annularity images.

While I could have just **Loaded them Into Photoshop Layers**, I chose to **Place** each into the final master Photoshop file, to bring each in as a Smart Object, to allow editing the original raw file.

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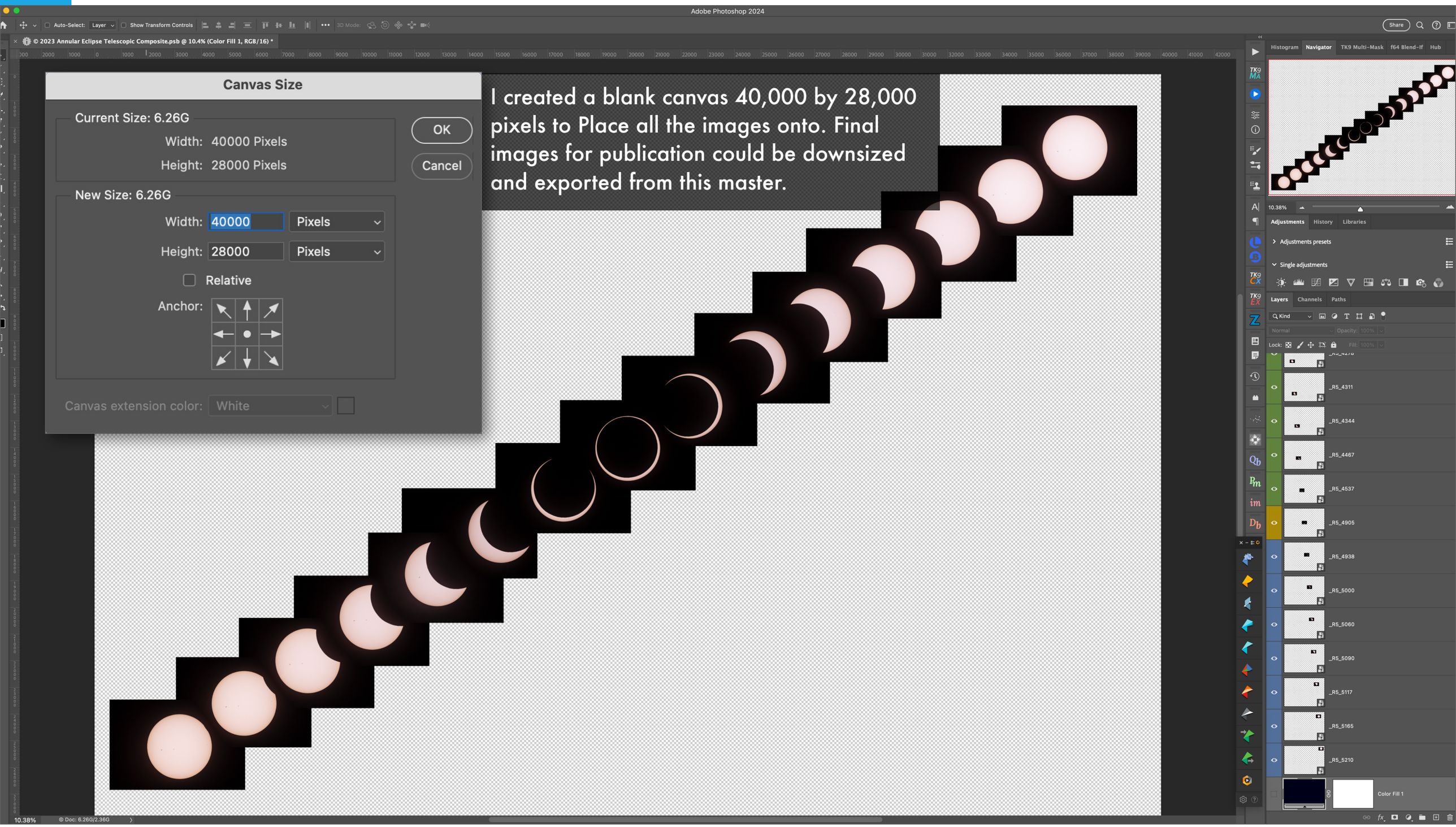
ASSEMBLING THE TELESCOPIC COMPOSITE – 3

I did not want to degrade resolution of the master image, so to contain all the full-res images the Canvas had to be very large!



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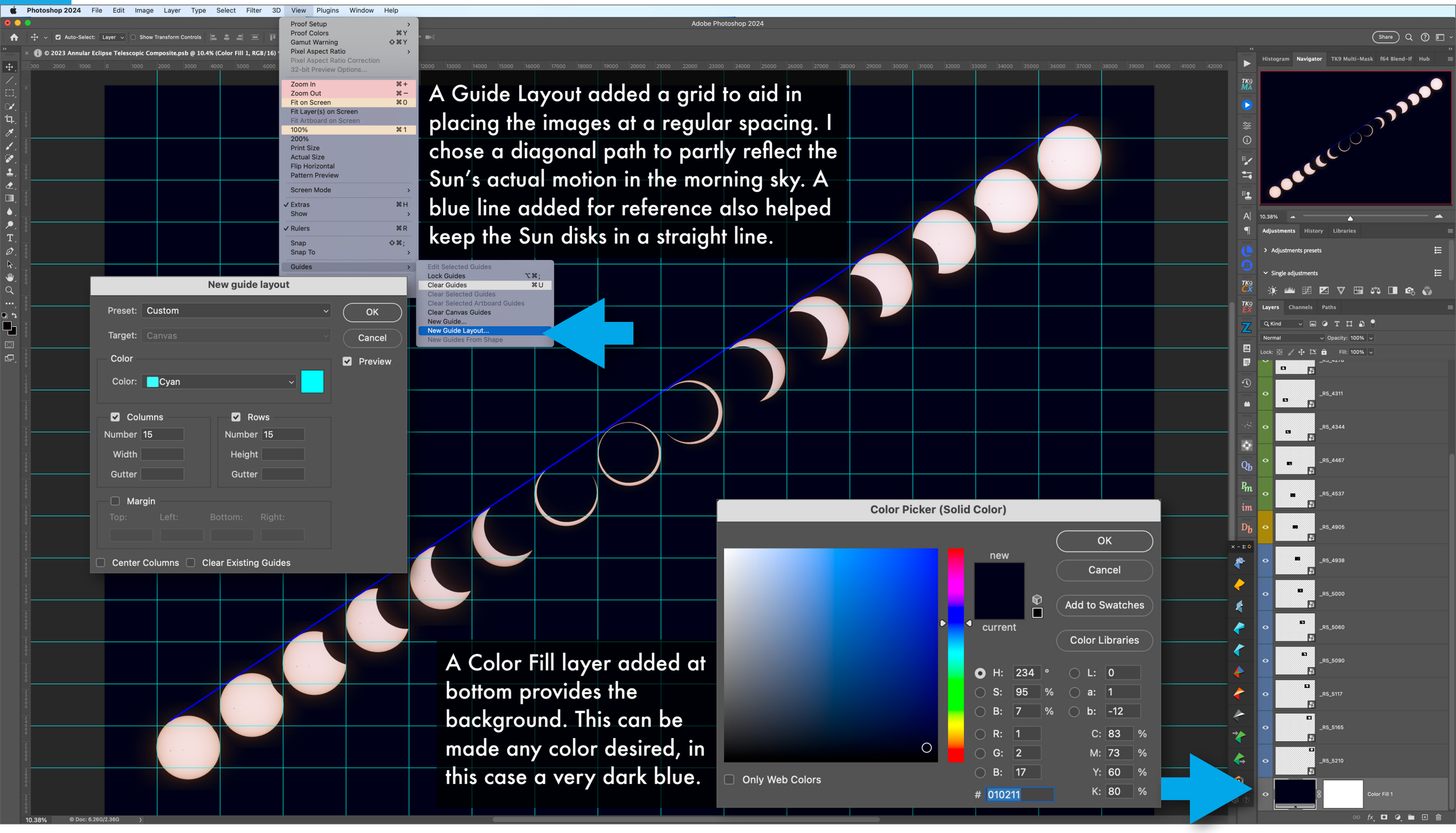
ASSEMBLING THE TELESCOPIC COMPOSITE – 4

Guides that can be set to any number and spacing help in placing the images as desired. I like a linear flow but it's your choice!



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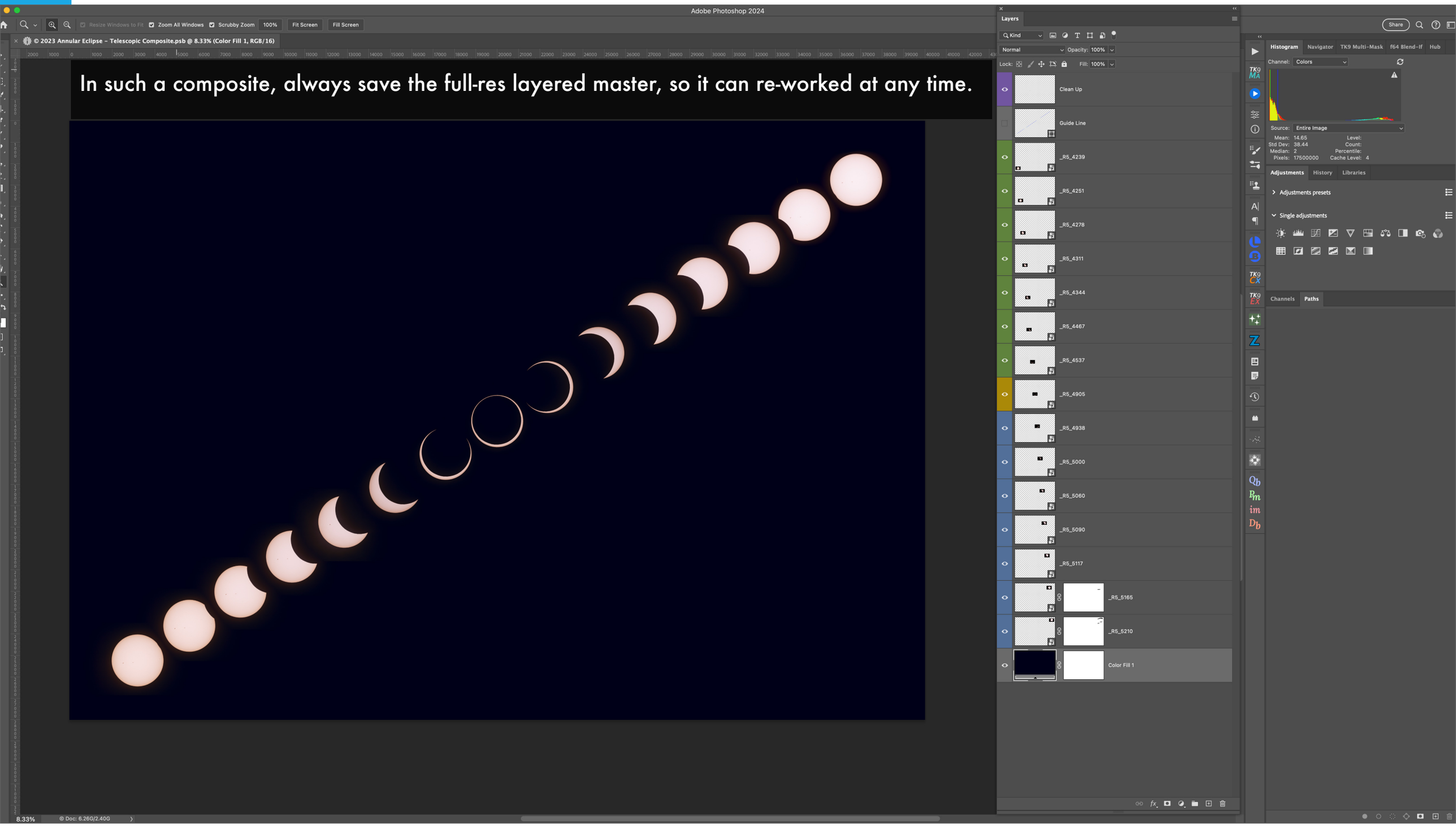
ASSEMBLING THE TELESCOPIC COMPOSITE – 5

The final image was huge, 7.3 gigabytes, and had to be saved as a .PSB file. Even flattened it was too large to save as a TIFF in this canvas size.



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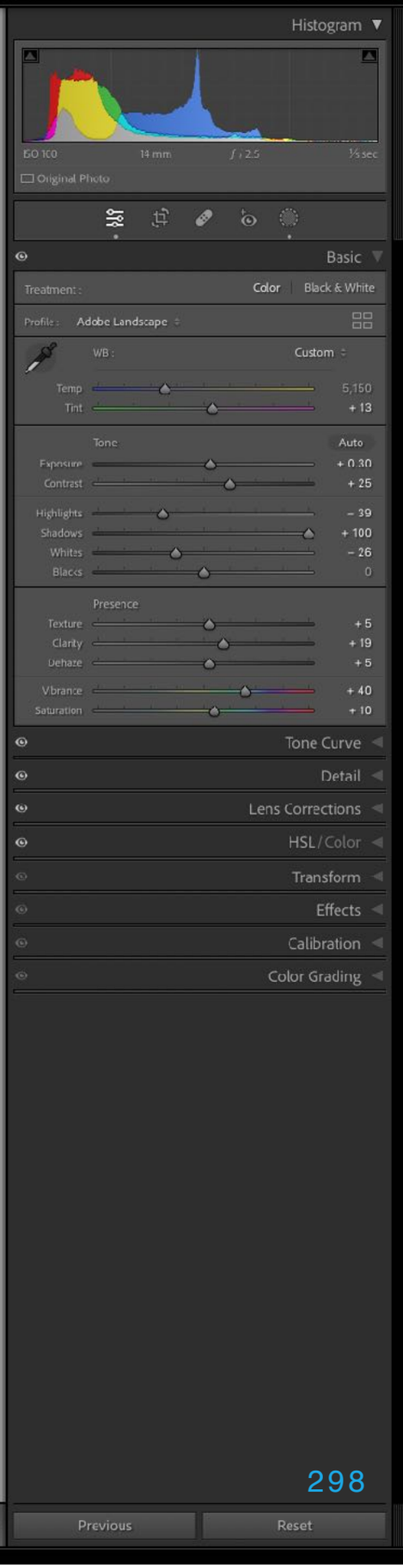
SECTION 3 – 2024 Total Eclipse

PROCESSING A WIDE-ANGLE STILL

Now we move to processing total eclipse photos, using images from 2017. In this first tutorial, I deal with the simplest of TSE images to process. What came out of the camera might look good, but can be improved upon, to bring out more of the detail that the camera captured and that your eye saw. I'll demonstrate Raw development using Adobe Lightroom, but similar steps apply to other Raw developers, including Camera Raw.



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DEVELOPING RAW IMAGES IN LIGHTROOM

On the left is the Raw image as it came from the camera. On the right is after applying the settings shown.

Avoid clipping the **Histogram** left or right.

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MASKING RAW IMAGES IN LIGHTROOM – SKY

Here we make use of Adobe's AI masking tools to automatically select the sky for adjustment that affect just the sky. ACR has the same tools.

The Sky mask that was automatically generated is shown here with a magenta overlay to indicate what areas it includes. It might miss the Sun!

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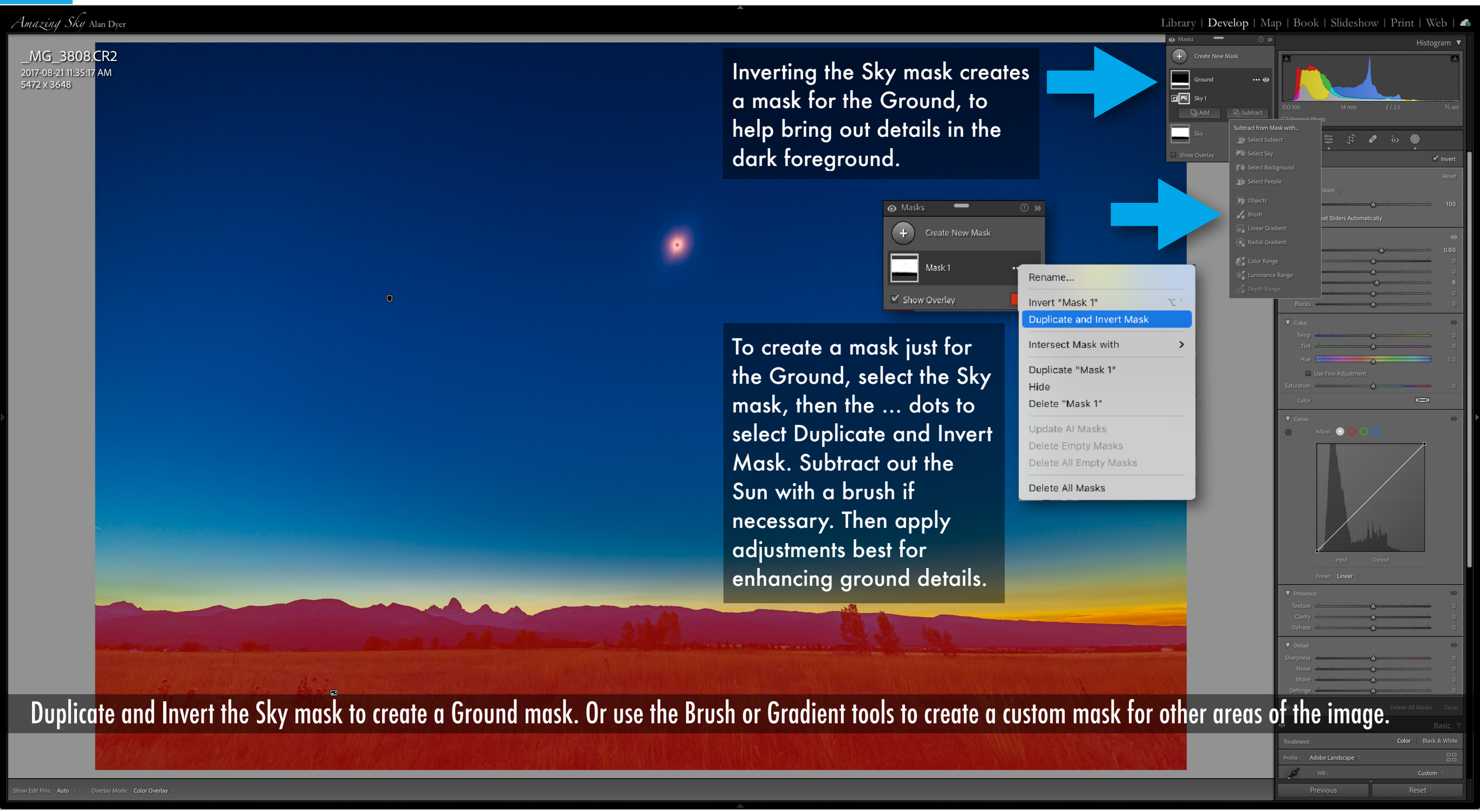
MASKING RAW IMAGES IN LIGHTROOM – GROUND

Once we have a sky mask, we can Duplicate and Invert it to create a mask for just the ground. But watch that it does not include the Sun.



Duplicate and Invert the Sky mask to create a Ground mask. Or use the Brush or Gradient tools to create a custom mask for other areas of the image.

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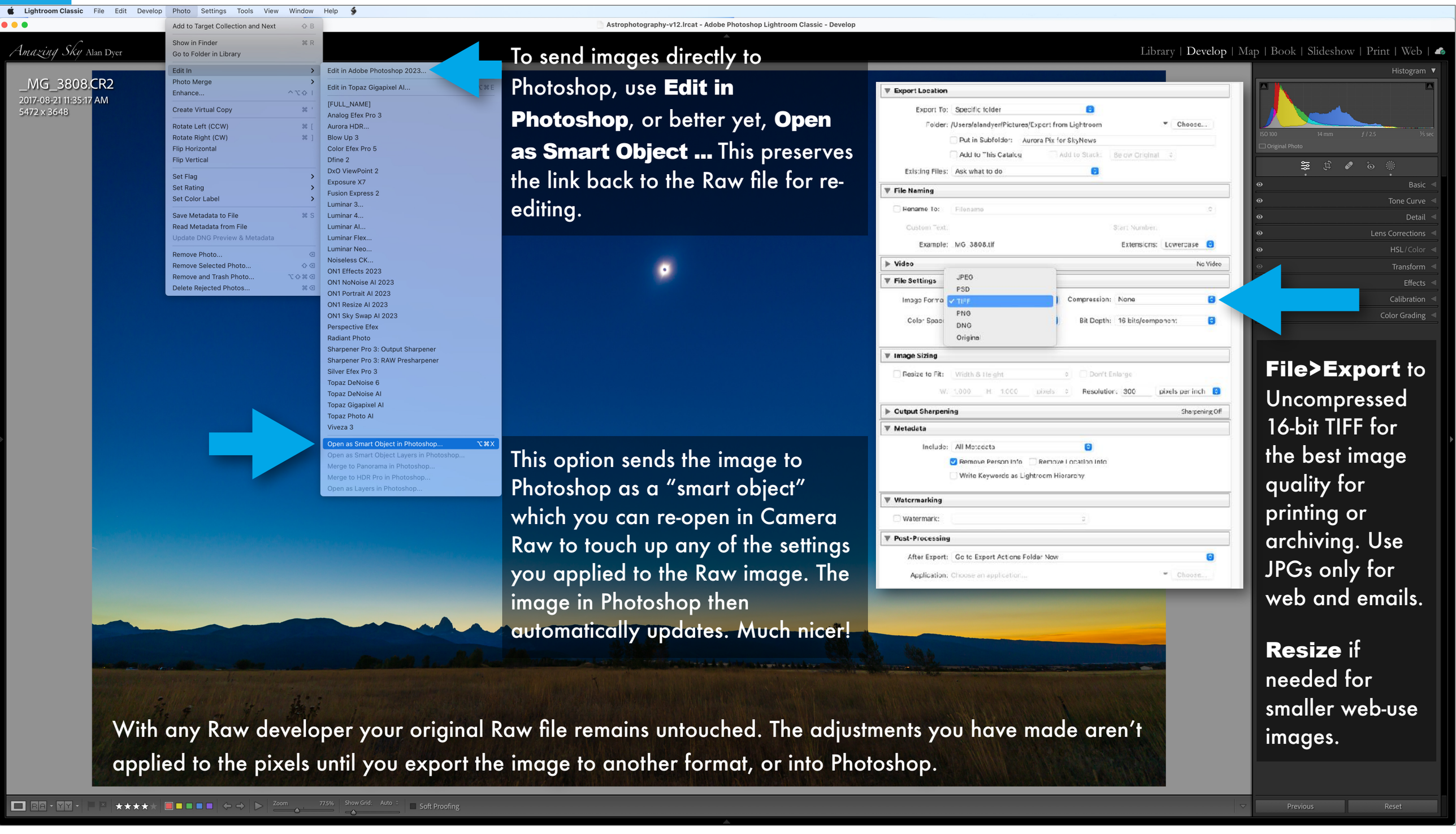
EXPORTING ... TO FINAL FILES OR TO PHOTOSHOP

Files can be exported to a variety of image formats or to Photoshop for further non-destructive editing.



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IN PHOTOSHOP – NON-DESTRUCTIVE PROCESSING

Here we make use of Photoshop's most powerful features for non-destructive editing: Smart Filters and Adjustment Layers.

STEP 3: Use **Select>Sky** to automatically select the sky! As in Lightroom, it might not include the Sun. But that might be OK in this case.

STEP 2: Apply **Reduce Noise** filter for subtle noise smoothing. Or apply other filters such as **Smart Sharpen**.

STEP 4: With selection active add masked adjustments using adjustment layers. These can be opened and edited at any time. I used **Brightness/Contrast** and **Selective Color**.

STEP 1: Image was brought into Photoshop as a smart object.

With the power of AI masking in ACR/Lightroom there is less need for performing separate adjustments to the sky and ground in Photoshop. But here's how to do it.

B&C and Selective Color masked for the sky and ground tweaked the image a bit.

Filters applied to a smart object are "smart" and can be re-opened and edited at any time.

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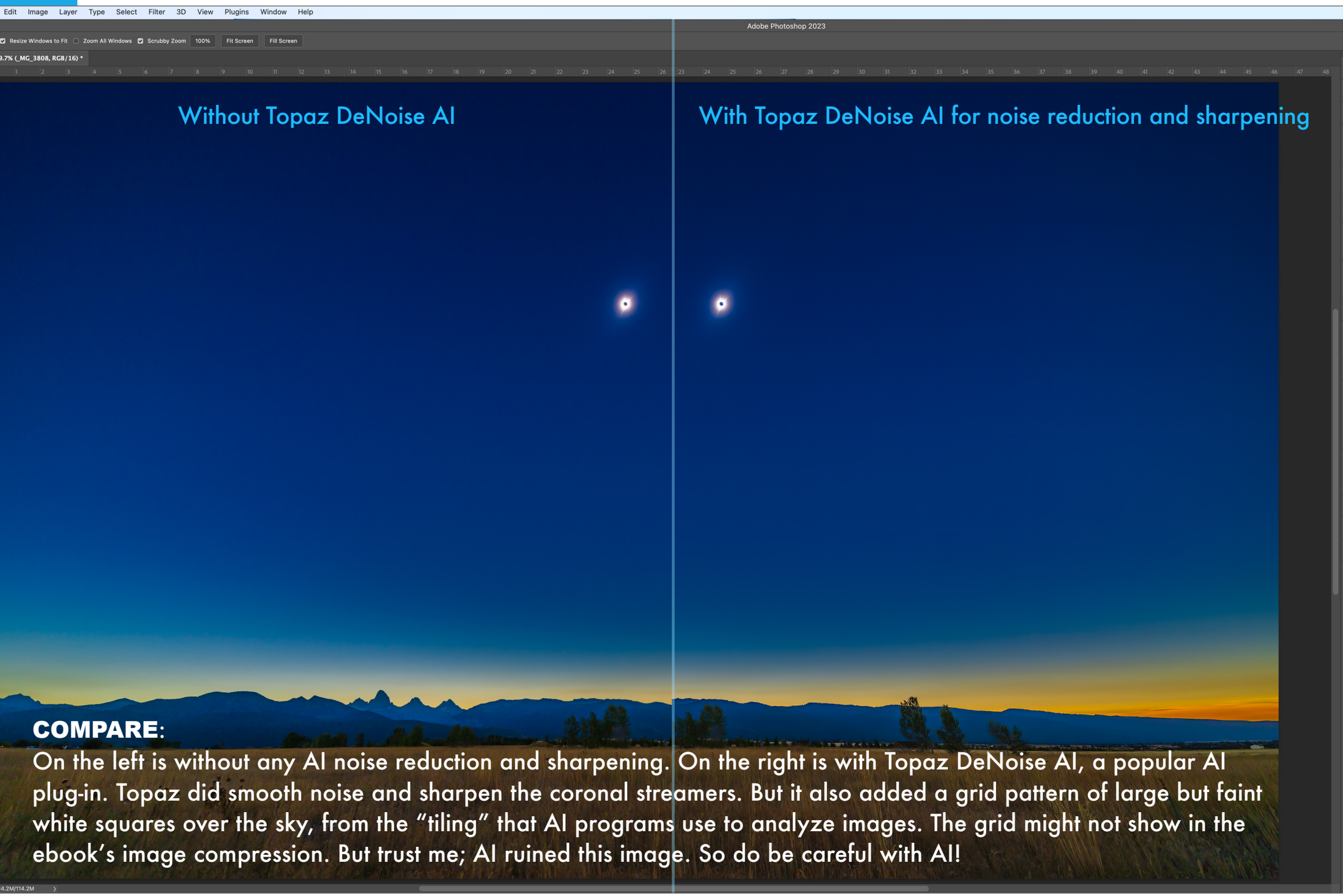
IN PHOTOSHOP – BEWARE AI ARTIFACTS!

AI (Artificial Intelligence) tools can be wonderful additions. But beware what some might do to the image. They are not trained on eclipse pictures!



COMPARE:
On the left is without any AI noise reduction and sharpening. On the right is with Topaz DeNoise AI, a popular AI plug-in. Topaz did smooth noise and sharpen the coronal streamers. But it also added a grid pattern of large but faint white squares over the sky, from the "tiling" that AI programs use to analyze images. The grid might not show in the ebook's image compression. But trust me; AI ruined this image. So do be careful with AI!

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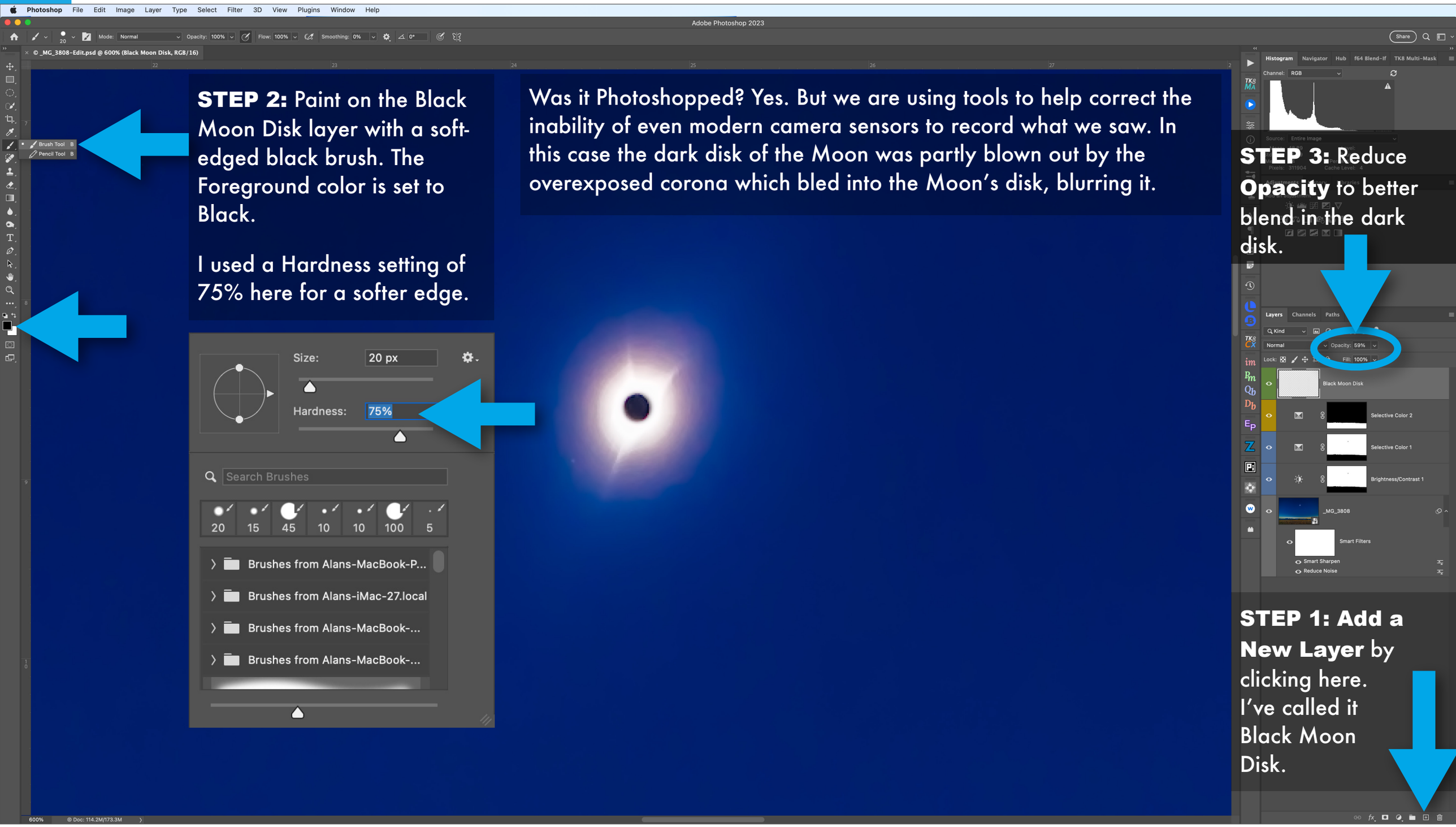
IN PHOTOSHOP – DARKENING THE MOON'S DISK

Here we add a new image layer with a black dot to darken the lunar disk to create an image that looks more like what your eye saw.



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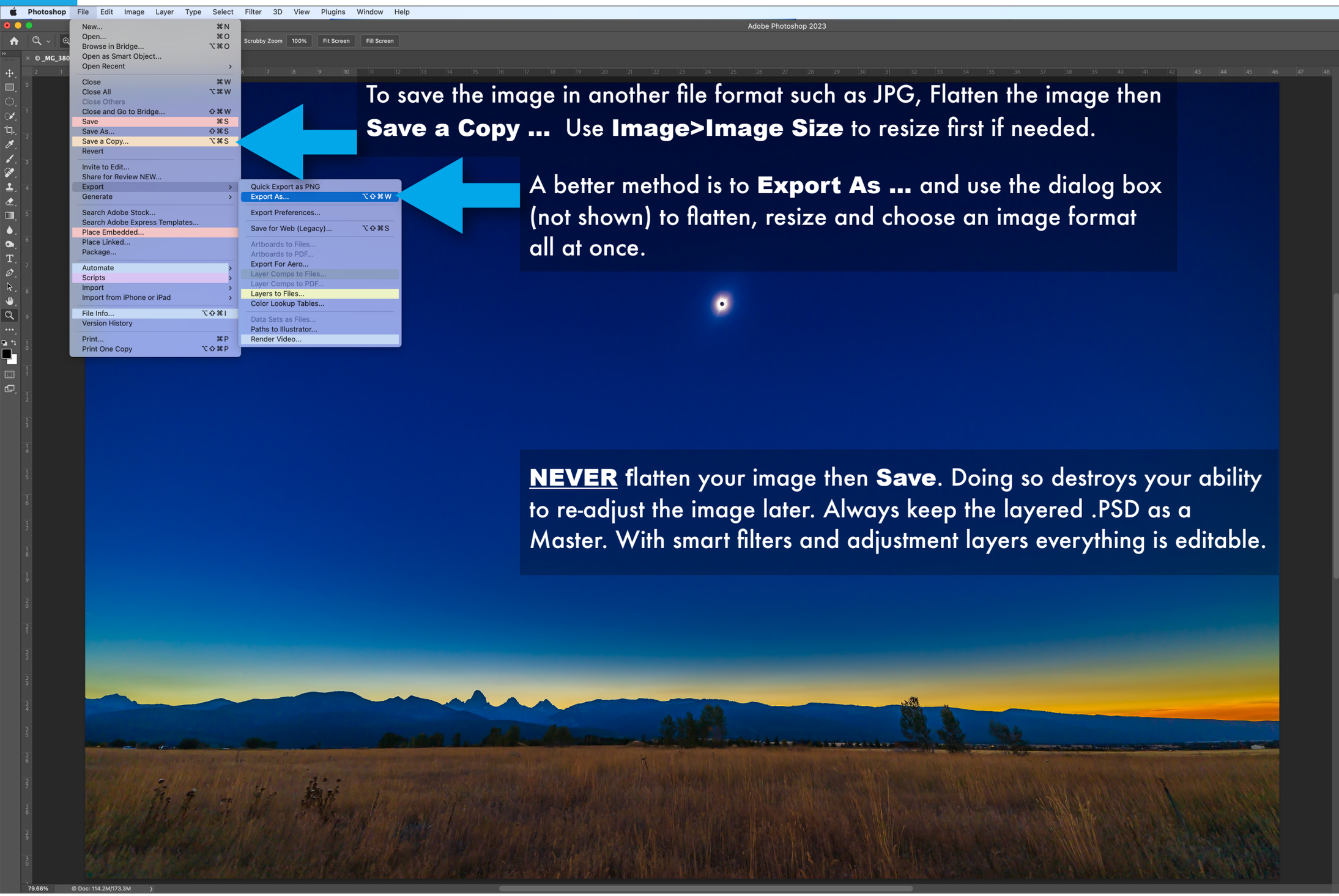
IN PHOTOSHOP – SAVE! THEN EXPORT OR SAVE AS

Always SAVE your layered Photoshop image as a .PSD master file. It retains all the non-destructive editing features we're employing.



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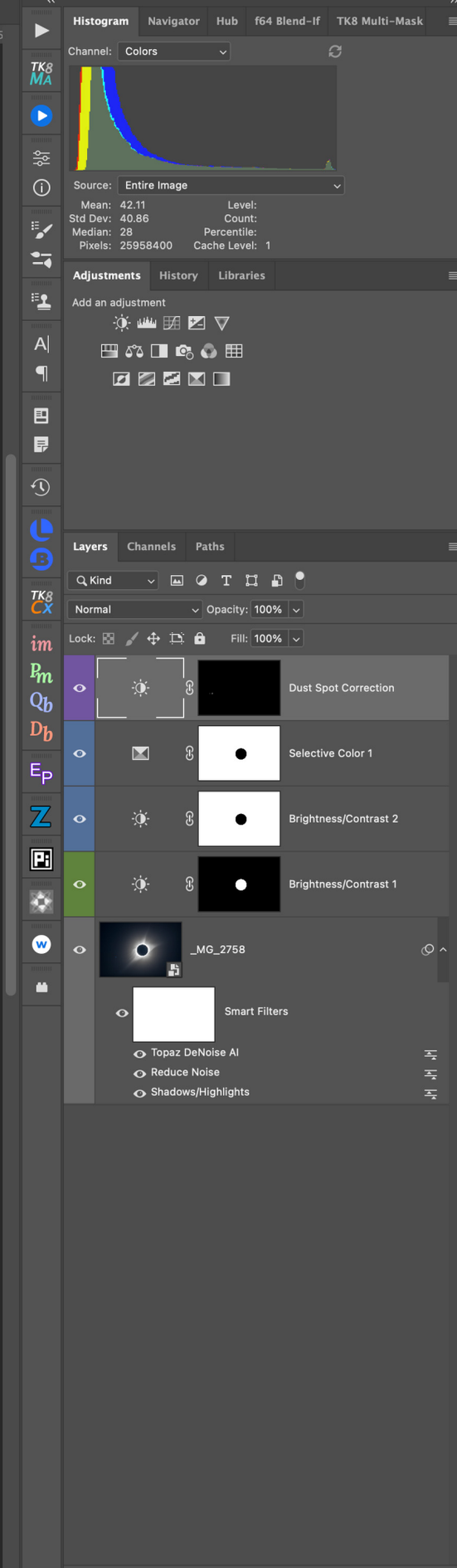
SECTION 4 – 2024 Total Eclipse

PROCESSING A CLOSE-UP STILL

Shooting Raw really comes into its own when processing close-ups of the eclipsed Sun. The range in brightness is so great only a Raw file has any hope of capturing the detail you saw through an eyepiece. Even then, one exposure can't do it all. But we can make each exposure look as good as possible, both at the Raw stage with either Lightroom or Camera Raw (shown next), then later in Photoshop using masks and adjustment layers.



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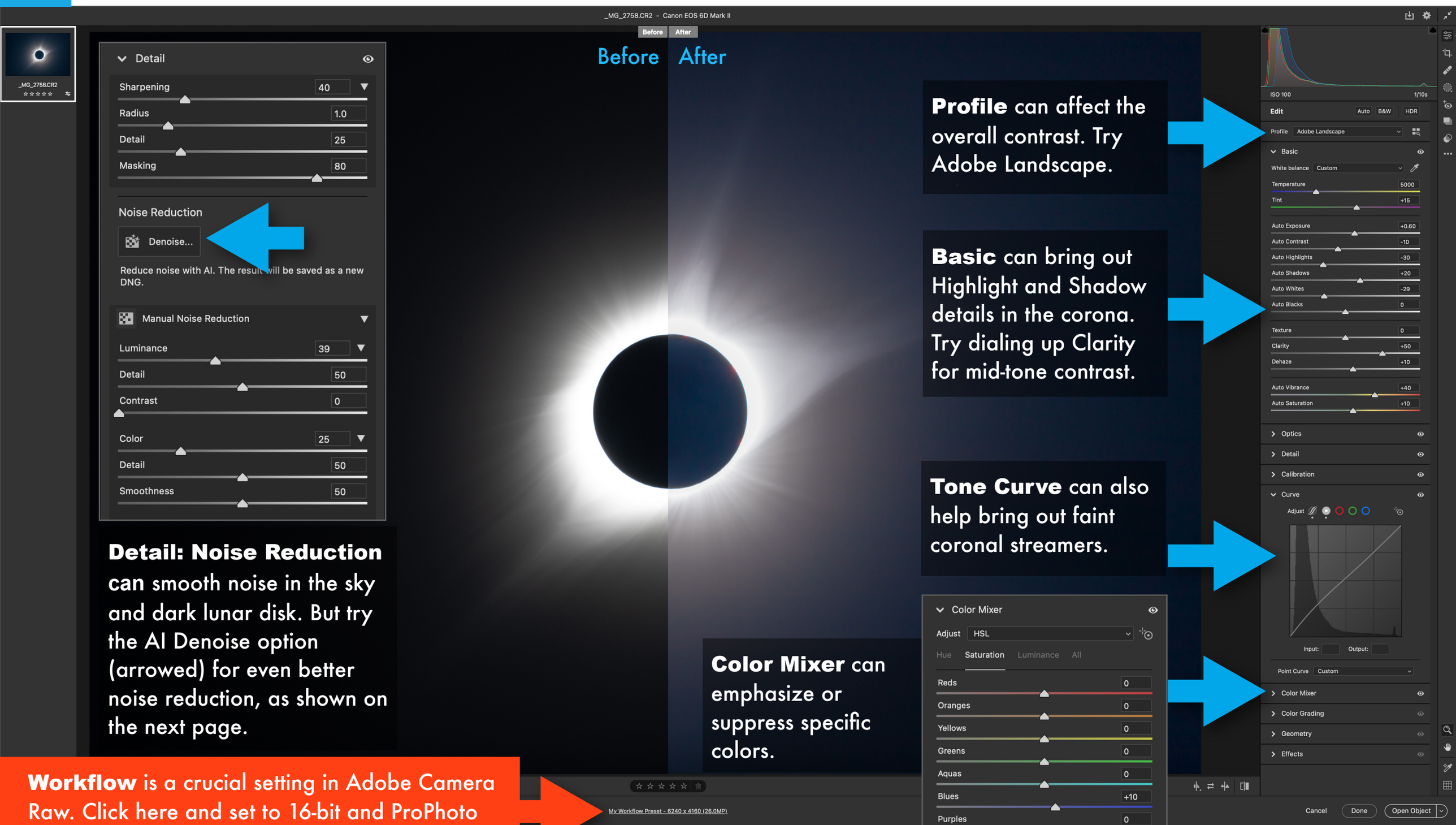
DEVELOPING RAW IMAGES

On the left is the Raw image as it came from the camera.
On the right is the developed version with the Adobe Camera Raw settings shown applied – a big difference.



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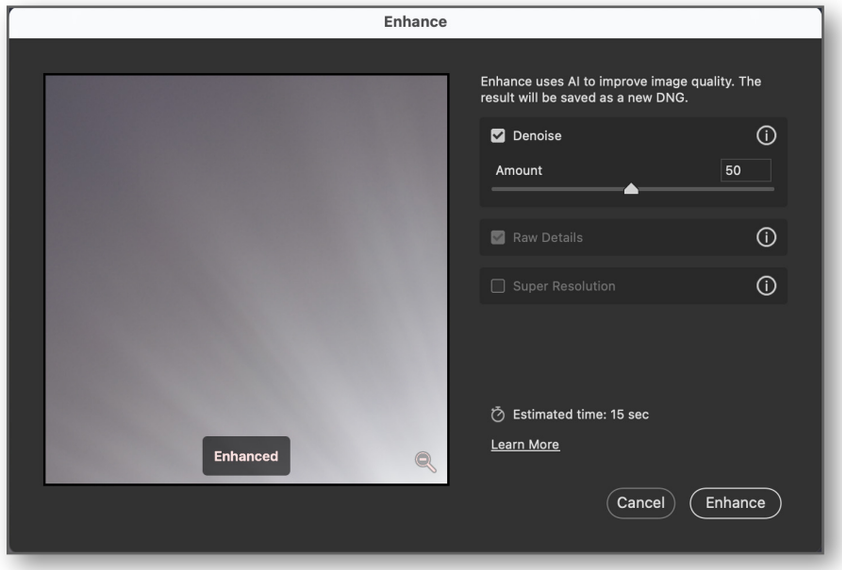
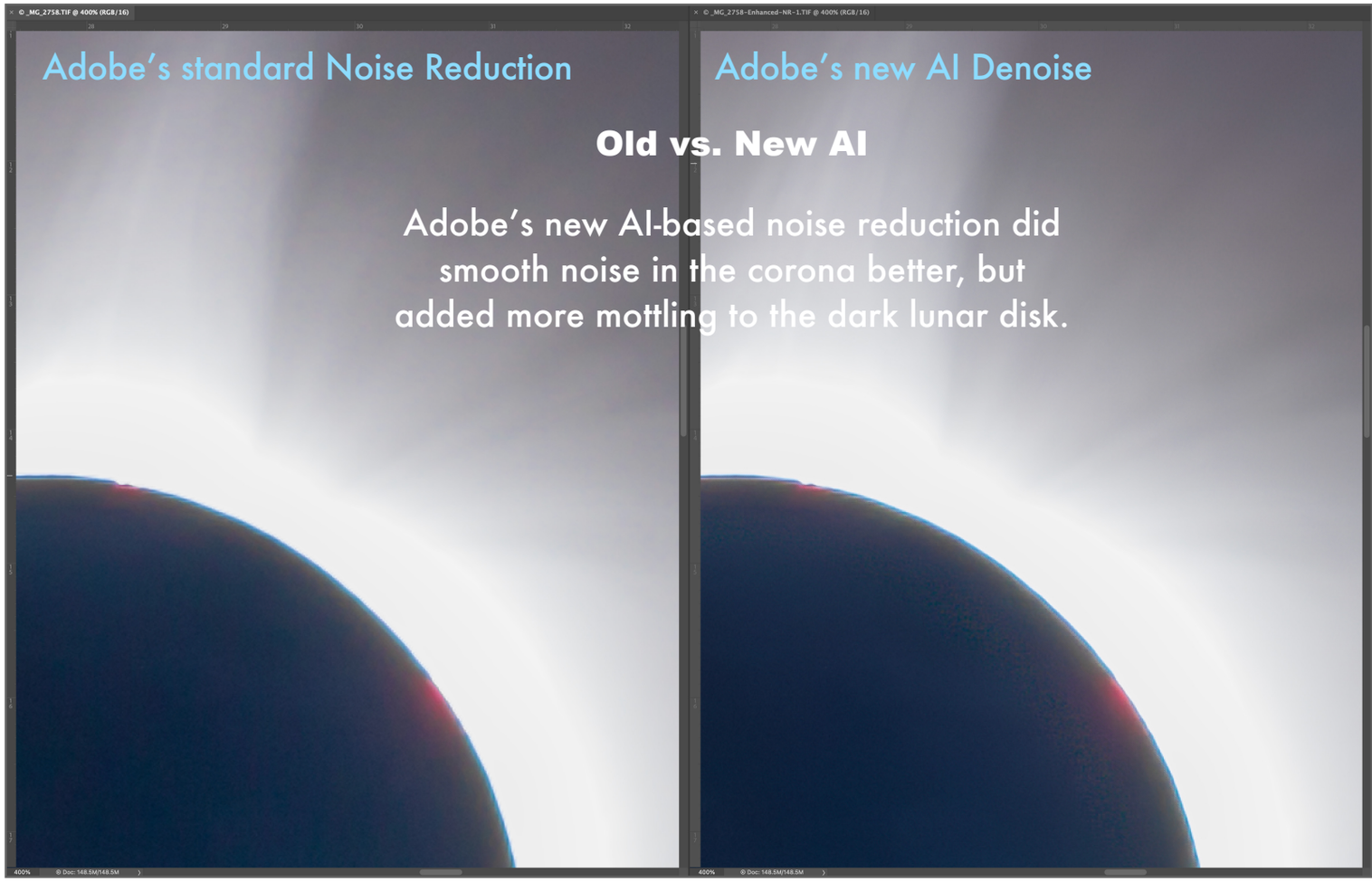
AI NOISE REDUCTION – ENHANCE!

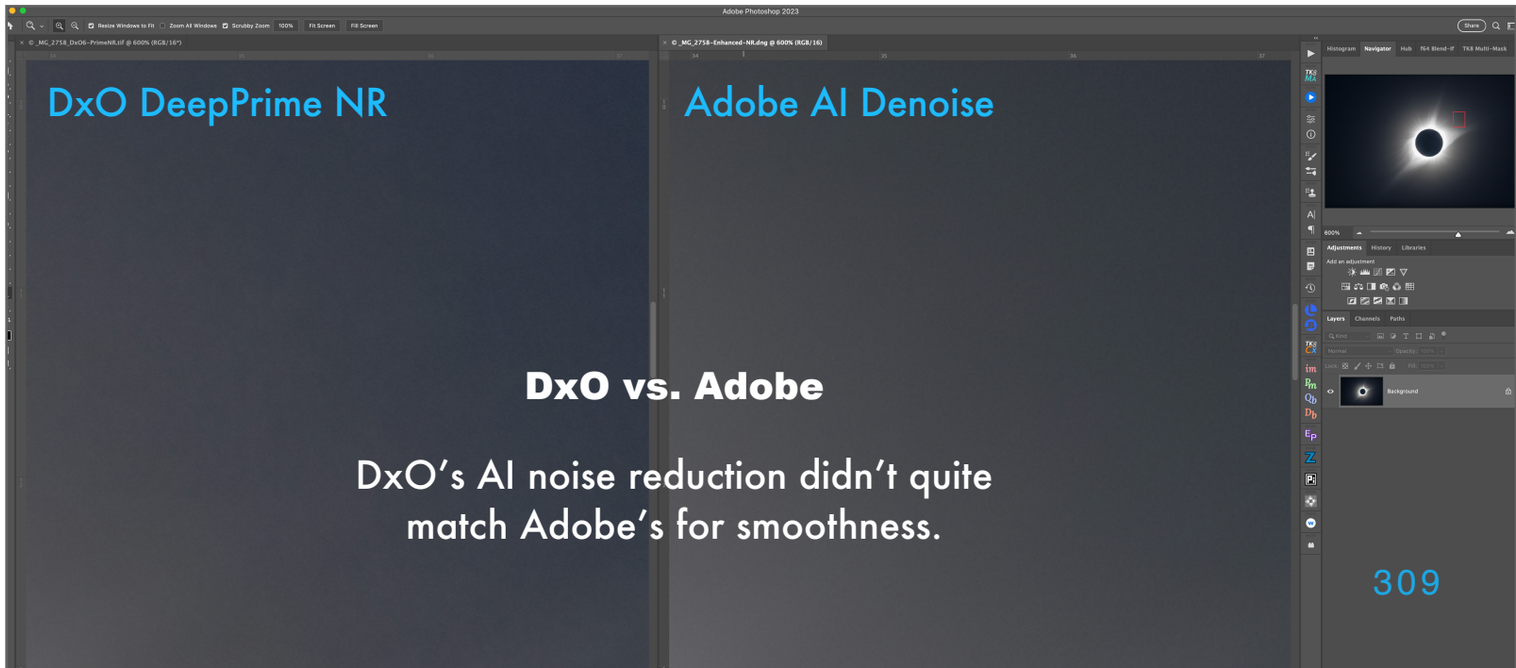
Reducing noise can be critical in corona close-ups. Noise reduction is best done early in a Raw workflow. New AI programs can work well. Or not!



Adobe's new AI Denoise option in ACR and Lightroom (shown above) can work wonders. But it can also introduce some artifacts compared to the old "normal" noise reduction.

The closest competitor for AI-based noise reduction is DxO's DeepPrime NR, also offered in their PureRAW³ plug-in. I found it did not do as good a job on noise in the sky and corona as Adobe's AI Denoise. DxO's DeepPrimeXD option tends to over-sharpen and add artifacts to the sky. Be careful with all AI programs – they can add odd linear patterns or invent details.





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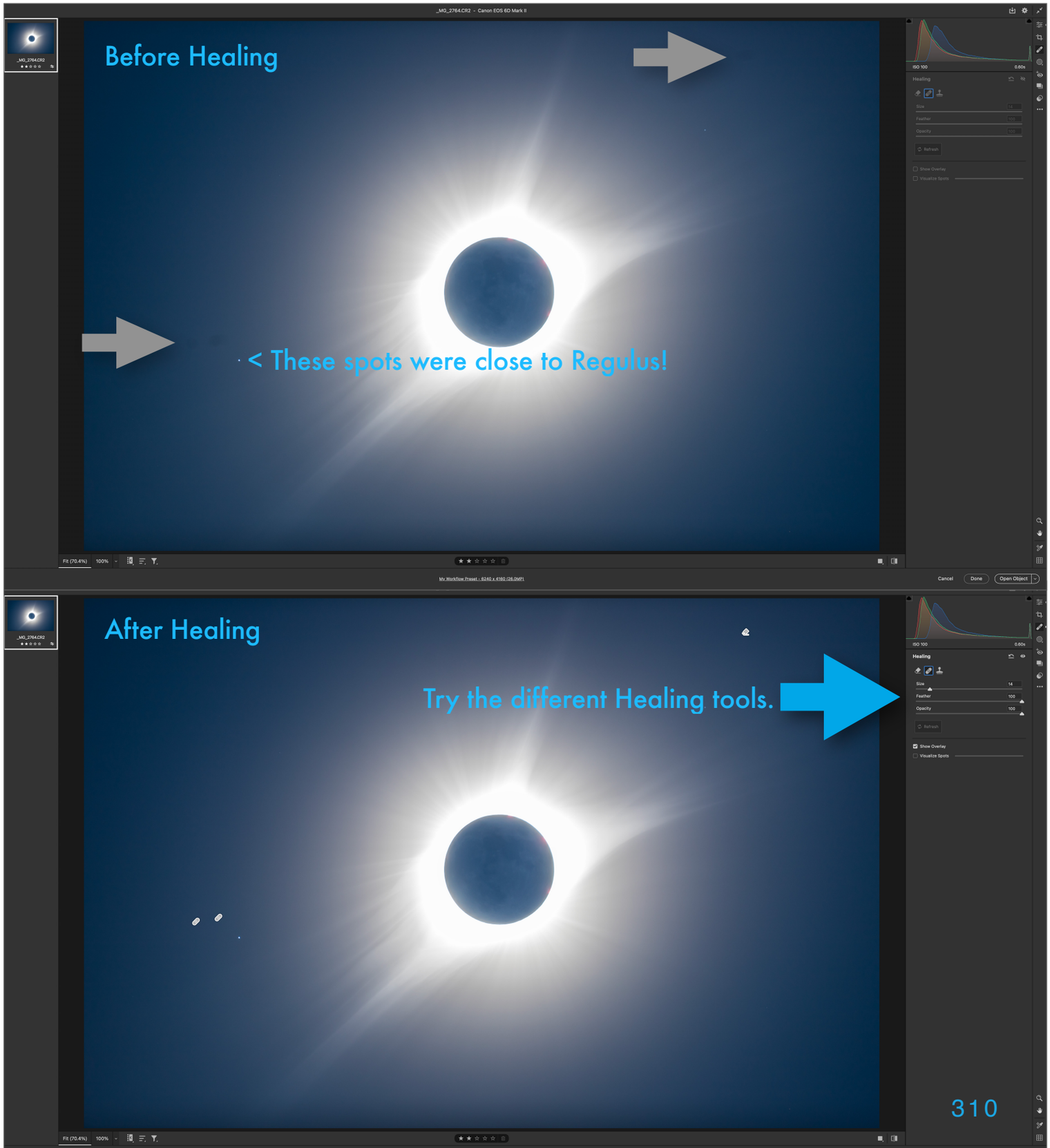
REMOVING DUST SPOTS

You can get it all right at the camera under the stress and pressure of an eclipse, only to be faced with annoying blemishes on your hard-won photos.

Clean your sensor! Put it on your checklist to give your camera sensors a clean before the big day and be careful after that when changing lenses or mounting your cameras on telescopes.

But no matter how careful you are, dust spots can still spoil your images. Dust can fall down onto the sensor from the tubes of telescopes during a shoot. You hope any blemishes they cause end up on a blank area of the image.

Use the content-aware clone and healing tools to retouch them out at the Raw development stage. It can be more difficult later as the gradations of tones and colors in a corona close-up are so subtle that spot healing tools might not work well later in Photoshop. I've found they still leave posterized artifacts. But retouching Raw files works better. The cloned corrections can be copied from one image to another if the dust doesn't move from frame to frame. But check each image to be sure they applied cleanly.



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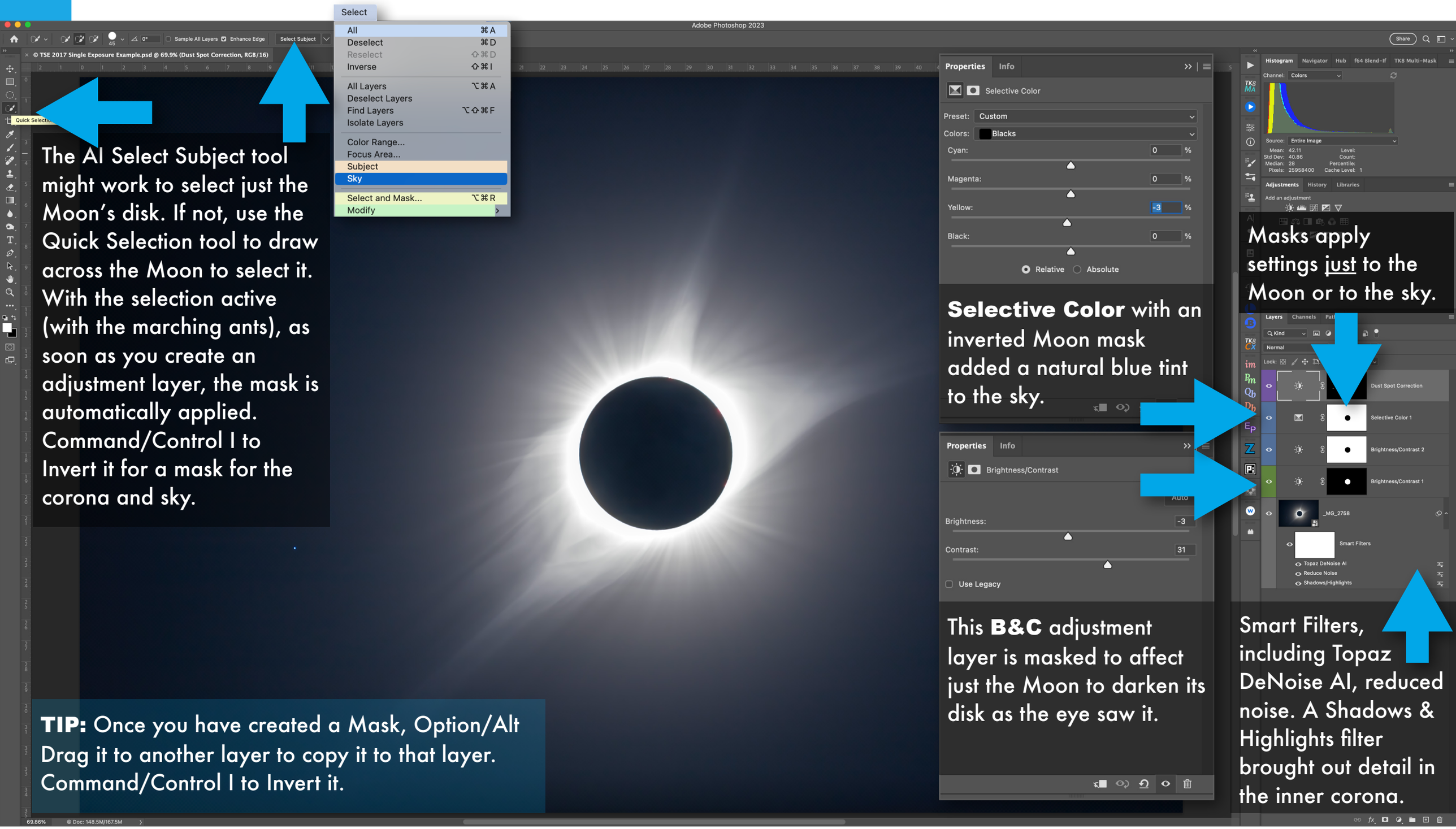
PROCESSING IN PHOTOSHOP – ADJUSTMENTS

A single image can still benefit from work in Photoshop, particularly by masking the Moon, possible in ACR/Lightroom but easier in Photoshop.



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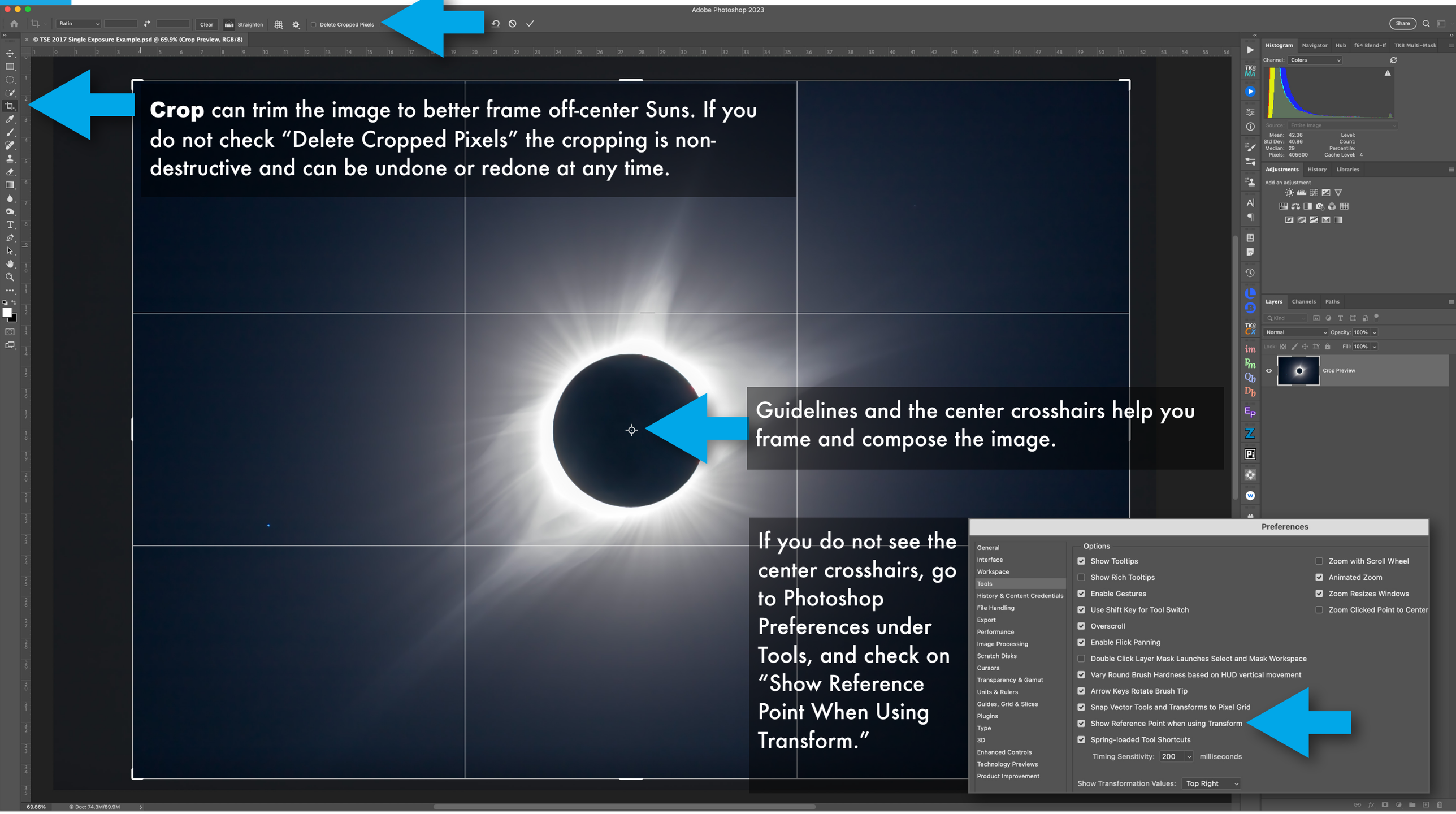
PROCESSING IN PHOTOSHOP – CROPPING

Cropping is often a final step here in Photoshop. Or it can be done earlier in Lightroom or Camera Raw, always non-destructively.



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COLORIZING CRESCENTS

If you shoot the partials through a Mylar filter, you'll get a blue-white Sun, not the color people expect the Sun to be. Here are two of many methods for shifting the Sun's color in Photoshop.

METHOD 1: Using a Solid Color Layer

Add a **Solid Color** adjustment layer. Then pick the color you want. Blend the layer in with **Color Burn** blend mode.

Add a **Solid Color** layer here.

METHOD 2: Using a Levels Layer

Shift the mid-tone indicator for the Blue channel far to the right. Play with the Red and Green sliders for a shade you like.

Add a **Levels** adjustment layer, then shift the red, green and blue channels. It works, but it can hurt detail, as you can see. This version is fuzzier than Method 1.

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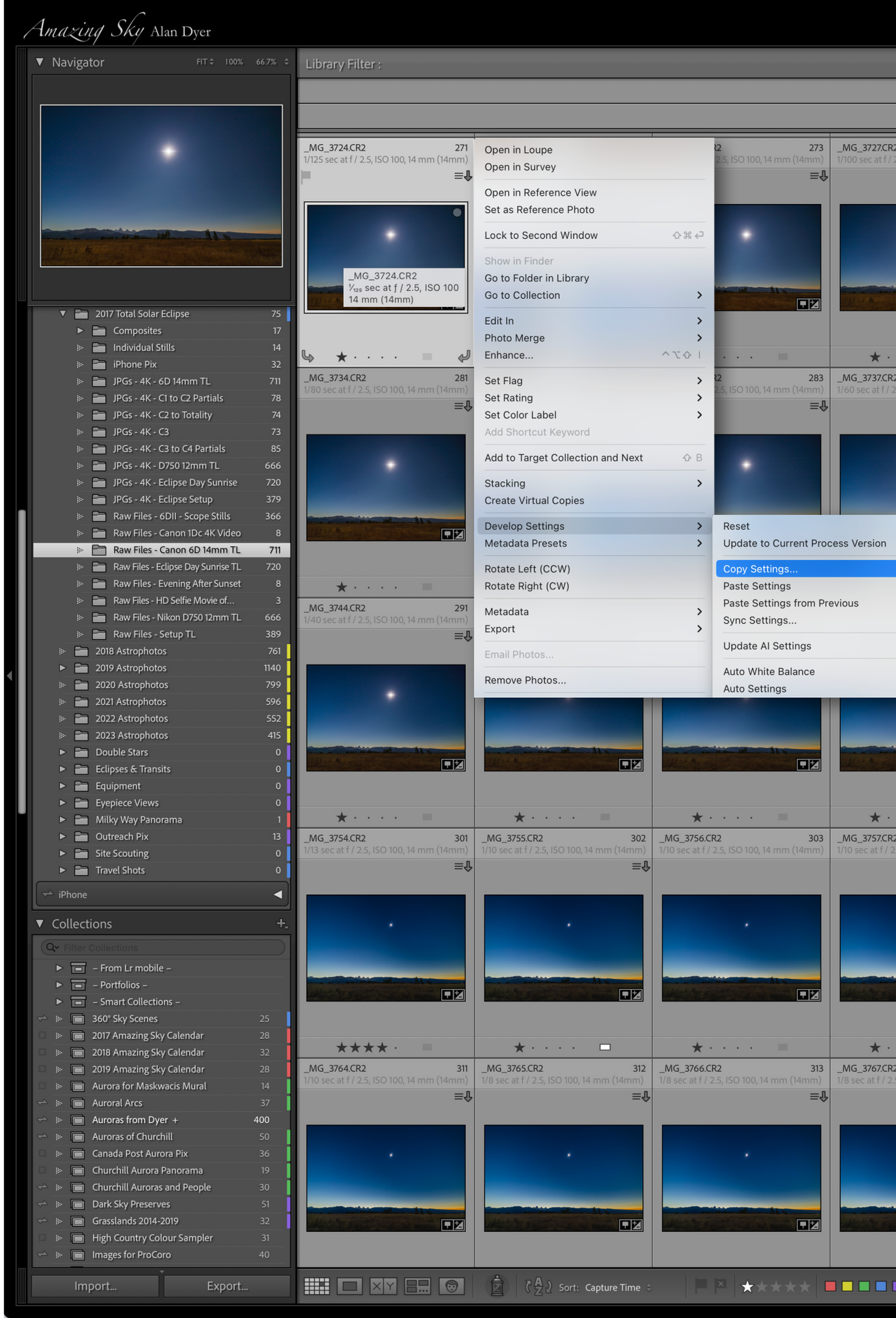
SECTION 5 – 2024 Total

PROCESSING TIME-LAPSES AND VIDEOS

Time-lapse movies are made of hundreds of well-processed still images strung together in rapid sequence. We've already covered the basics of developing the still frames. The trick now is to apply those settings to all the images in a time-lapse folder, then export them into another format – JPGs in this case – to assemble into a movie. Lightroom can do the exporting, but not the assembly. Pity! But, Photoshop or other third party programs can.



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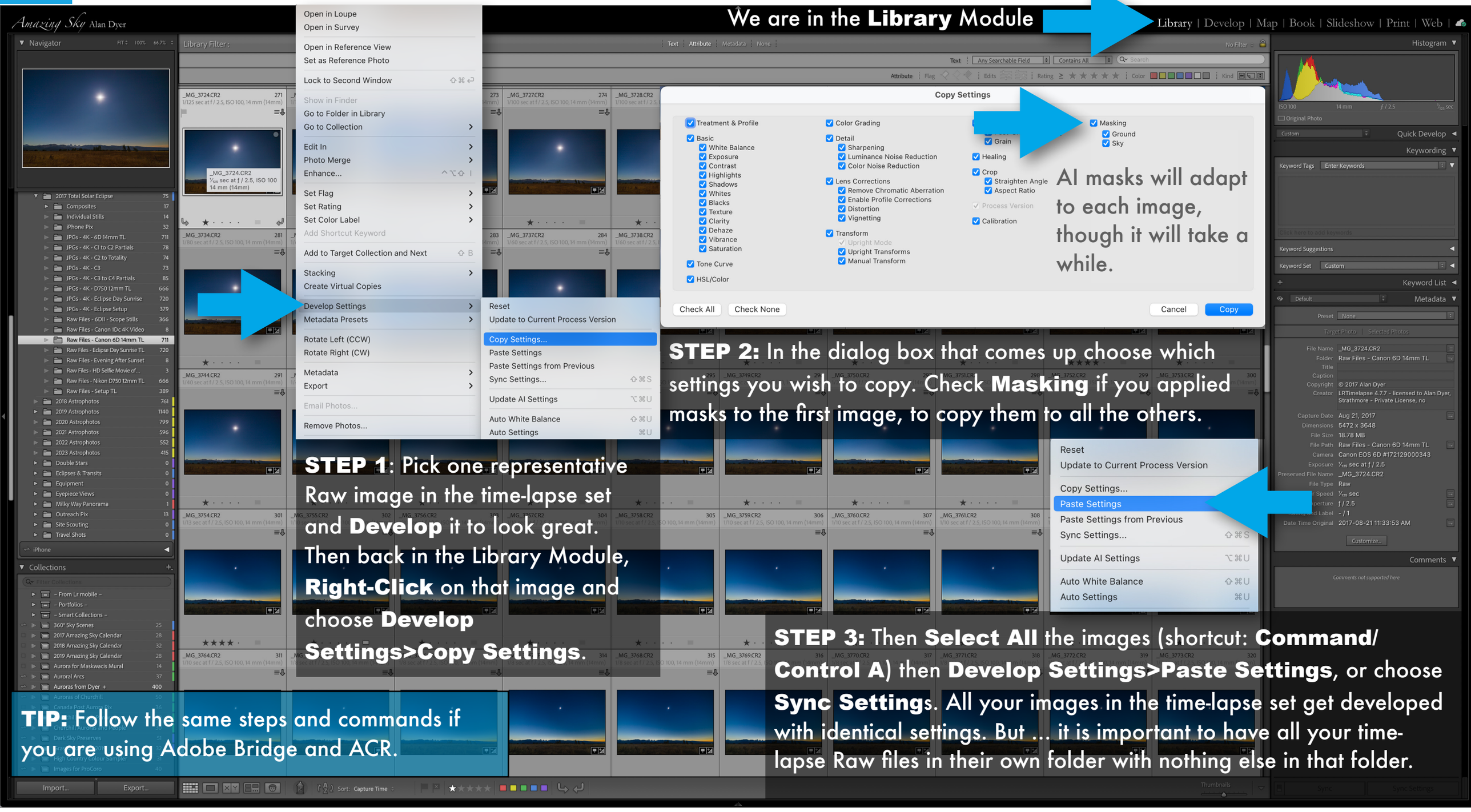
DEVELOPING A TIME-LAPSE SET IN LIGHTROOM

First we develop one image, then apply those settings to all the images in the time-lapse set in one easy step.



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EXPORTING A TIME-LAPSE SEQUENCE – LIGHTROOM

To create a movie we first have to create an "Intermediate" set of JPGs to be used to actually assemble the final movie.

Most programs, Lightroom included, cannot assemble movies directly from developed Raw files. To create a movie we must first export out a set of high-quality Intermediate JPGs.

If you have many sets to export, create a Preset that saves all the settings shown.

In **Lightroom's Library** module select **Export.**

In the Export dialog box choose or create a folder for the exported JPGs.

Choose JPEG Highest Quality and Adobe RGB or sRGB Color Space

... and resize to 3840 pixels on the Long Dimension for 4K UHD frames. If you have not cropped the images this will create JPGs all 3840 x 2560 pixels, retaining the 3:2 aspect ratio of the original still images. You can crop down to a 16:9 4K video aspect ratio in video editing software, keeping in mind you will lose content off the top and/or bottom of the frame. Or you can crop the Raw files before exporting to JPGs.

When ready, hit **Export** and go for coffee or lunch! This can take a while.

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EXPORTING A TIME-LAPSE SEQUENCE – BRIDGE

If you are using Adobe Bridge and Camera Raw to process Raw files, use Bridge's Export function to create the Intermediate JPGs.

Create Presets for various exported formats.

Bridge 2023's Export module has similar functions to Lightroom's.

You can set up presets with settings for the output format (JPG here) and the size of the frames (4096 pixels on the long side here for 4K DCI frames).

Select all and hit **Start Export** – the process works in the background. It is a better way to export images than Photoshop's Image Processor utility, which I had suggested in the past – it tends to occupy your computer, allowing you to do little else while it works.

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ASSEMBLING TIME-LAPSES WITH PHOTOSHOP

Little known, but Photoshop can assemble and render time-lapse movies from Intermediate JPGs. It can also process video clips, shown later.

STEP 1: Go to **File>Open** and drill to your folder of JPG intermediates, as here.

Select the first image and check **Image Sequence** revealed under **Options**. Then click **Open**.

STEP 2: Choose a **Frame Rate**. 24 or 30 fps are normal or you could use a slower rate.

STEP 3: Movie appears as a Video Group layer in Photoshop.

STEP 4: Under **Window**, turn on the **Timeline** to see the movie as here with Play controls.

STEP 5: Create the movie file with **Export>Render Video.** Choose H264.

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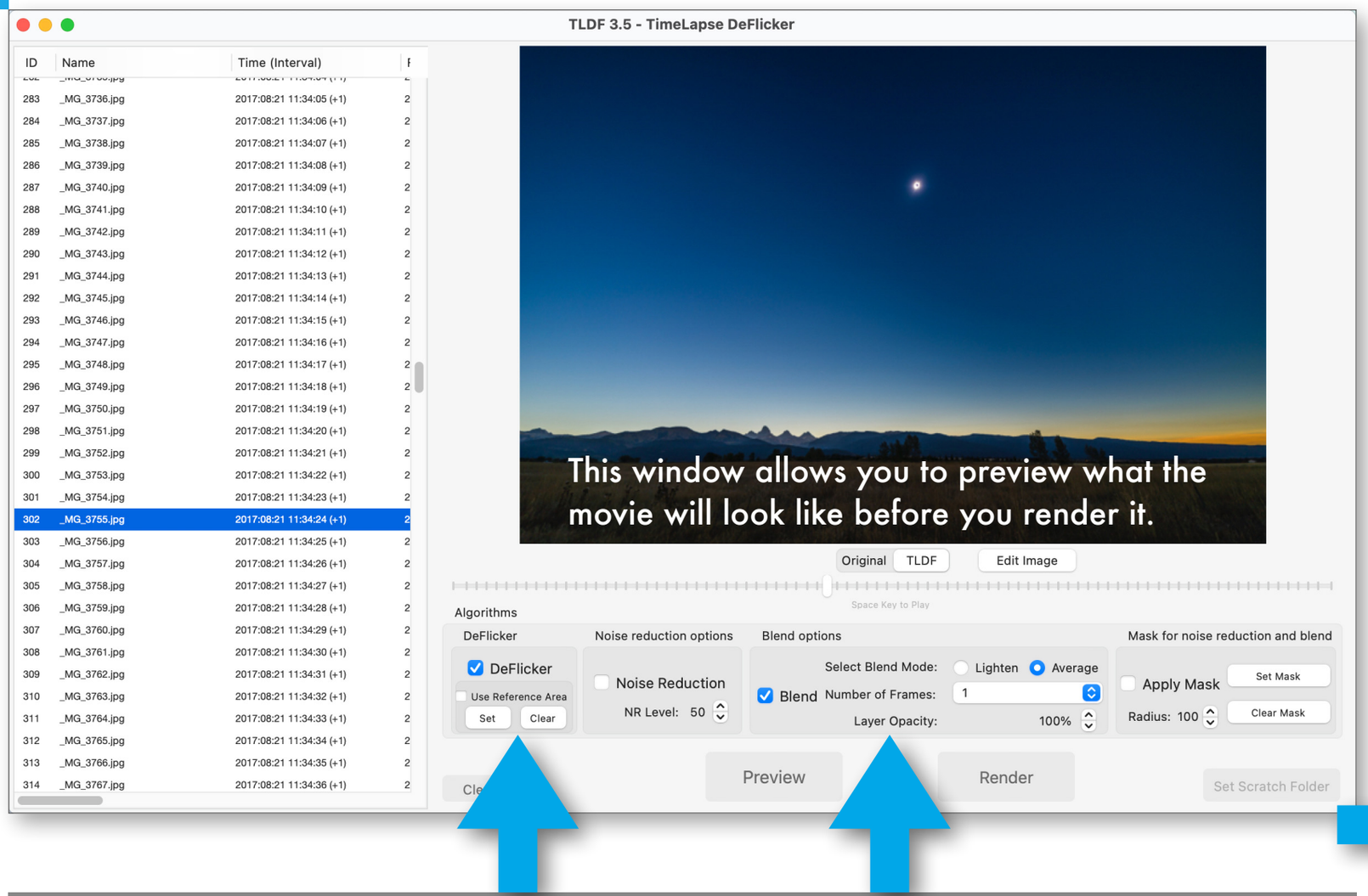
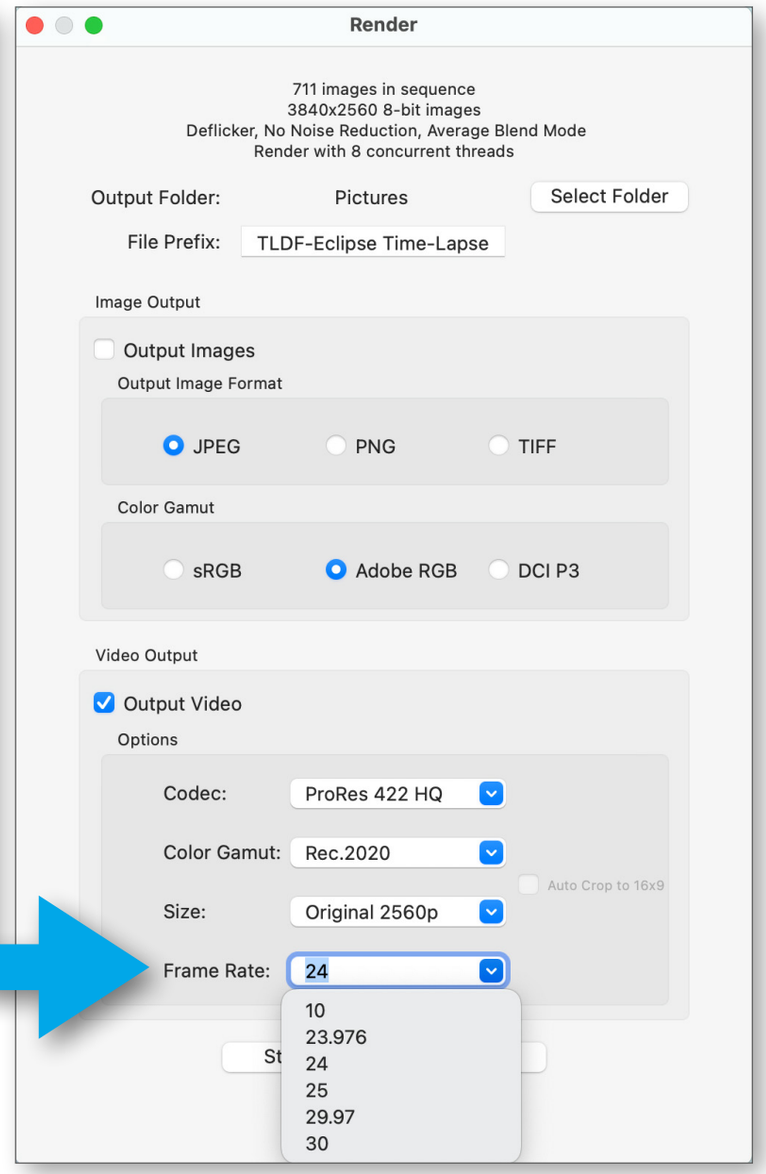
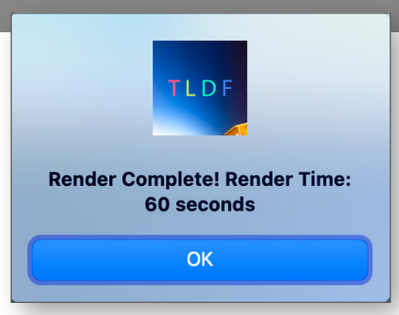
ASSEMBLING TIME-LAPSES WITH OTHER PROGRAMS

Many third party programs can assemble movies from JPG frames. I show a favorite I use, TimeLapse DeFlicker, for MacOS and Windows.





TIMELAPSE DEFLICKER can assemble a folder of JPGs, with options to Deflicker (smoothing frame-to-frame exposure variations) and for Frame Blending, which will average adjacent frames, again for smoother motion. That's especially useful for auroras.



Hit **Render**. Then as above, choose the codec, color space, frame rate, and video size, retaining the original size or reducing to a smaller format.

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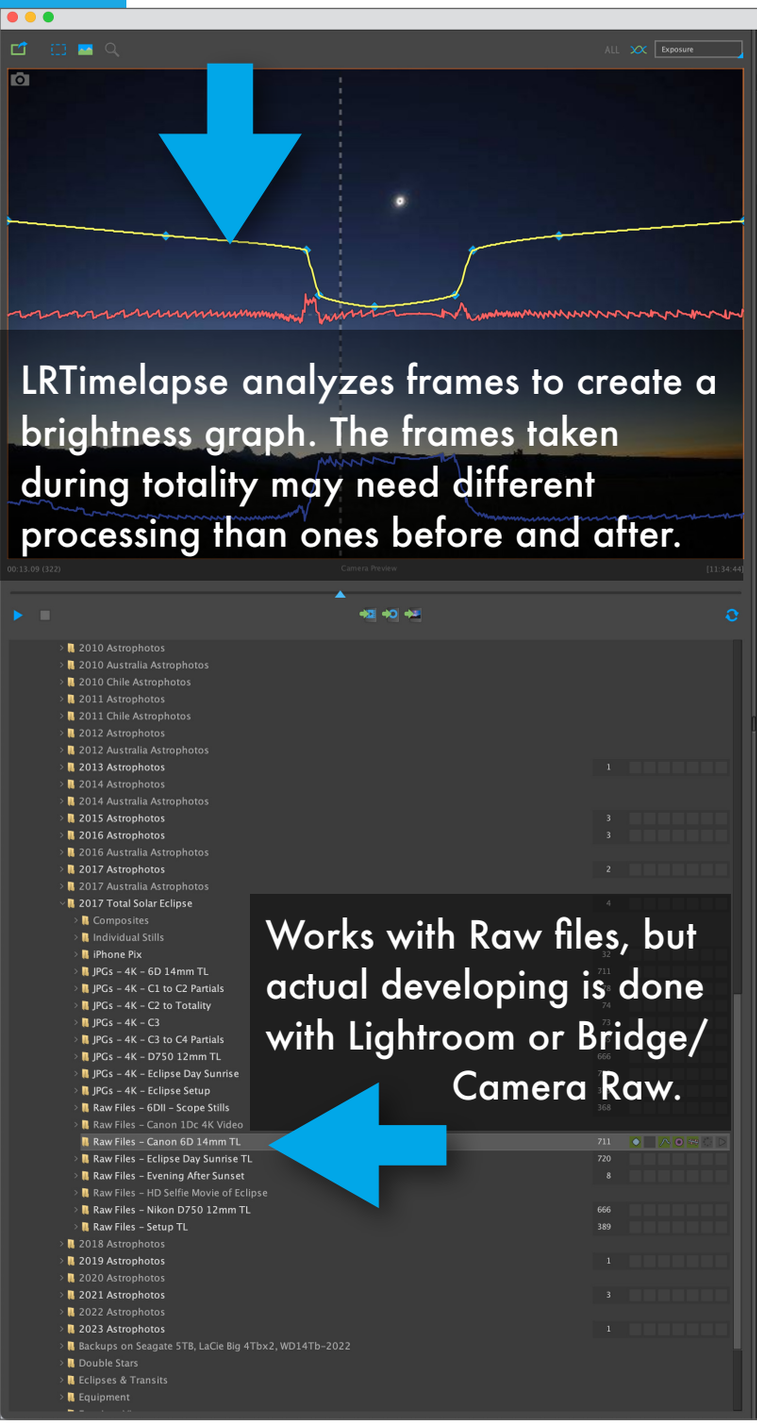
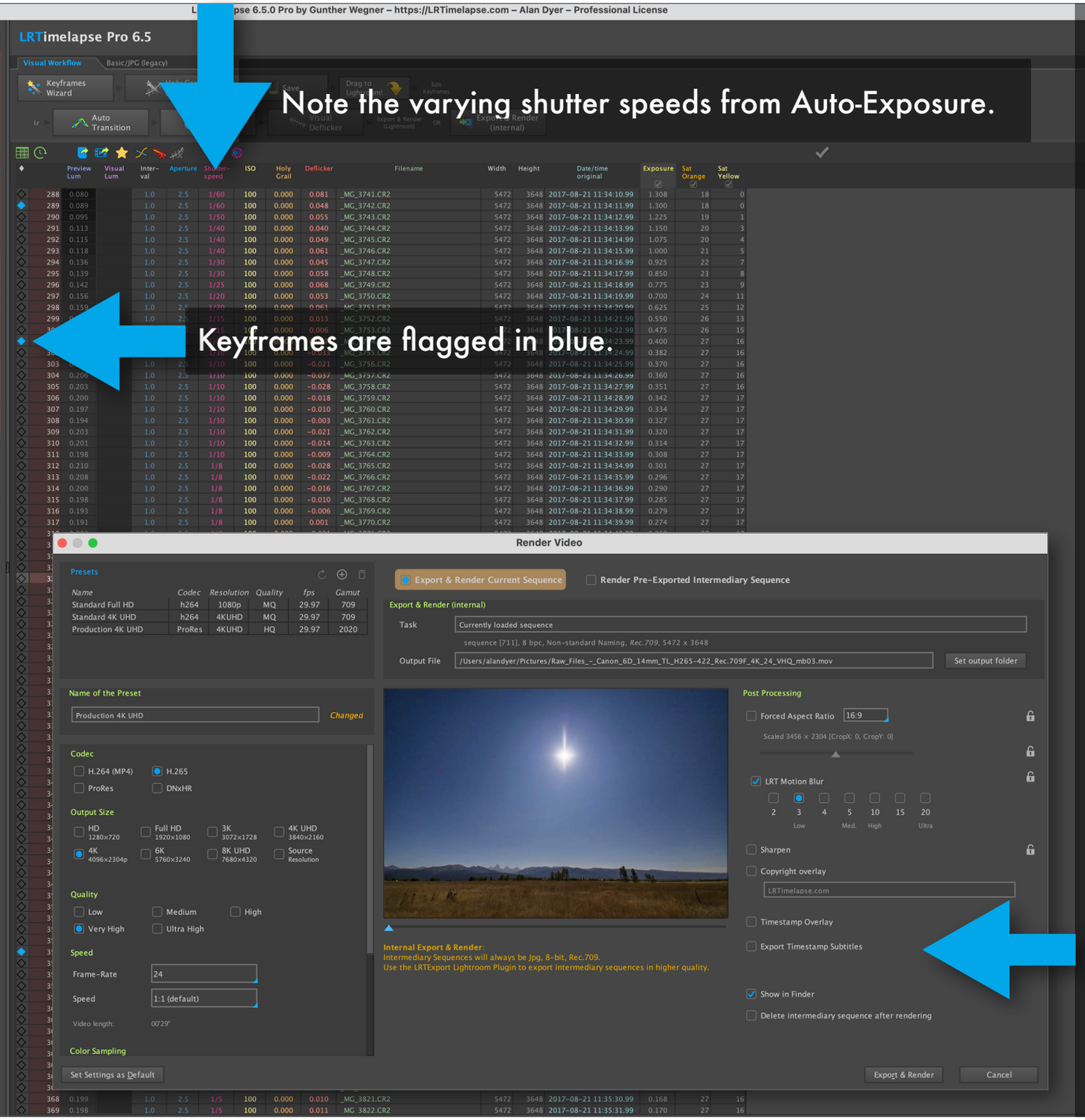
PROCESSING & ASSEMBLING WITH LRTIMELAPSE

A program for advanced time-lapse processing, LRTimelapse allows you to vary the processing settings over the duration of a sequence.





Workflow:
A full tutorial on its use would take its own chapter, but briefly:

LRTimelapse analyzes frames and applies "Keyframes" to selected images where the brightness changes.

You develop each of those Raw Keyframes. LRTimelapse then interpolates those settings to all the intervening images to create a smoothly varying set of frames.

It can then **Export** out master Intermediate JPGs which LRTimelapse can assemble into a final pro-grade movie, as shown at left in the **Render Video** dialog.

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PROCESSING A VIDEO WITH PHOTOSHOP

Photoshop can also process movie files using the same adjustment layers and smart filters used for still images.

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SECTION 6 – 2024 Total

BLENDING AN EXPOSURE STACK

The most complex eclipse image involves layering a range of exposures, each masked to show more of the corona. The resulting image displays the full dynamic range present that your eye saw, but that was beyond reach of any single exposure to capture. Using HDR software can work, and I demonstrate several programs. However, I also show other methods, such as stack modes and applying “luminosity masks” to selectively hide and reveal regions of the corona.

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SELECTING AN EXPOSURE SET TO BLEND

For the demos in this section of the processing chapter I'm using a set of 12 images, shot at the 2017 eclipse with a then-new Canon 6D MkII.

The set of 12 exposures range from 1/1600 second for the prominences, to 1 second for the outer corona and Earthshine on the Moon's disk. All were shot within a span of 30 seconds. But that was still long enough for the motion of the Moon to play havoc with aligning images, as you will see next.

Each Raw image was developed in Adobe Camera Raw (as at right) to recover detail in the highlights. Each image was passed though Adobe's AI Denoise routine to create a new set of DNG files. Those DNG files, or in some cases another set of TIFFs created from them, were sent into HDR software.

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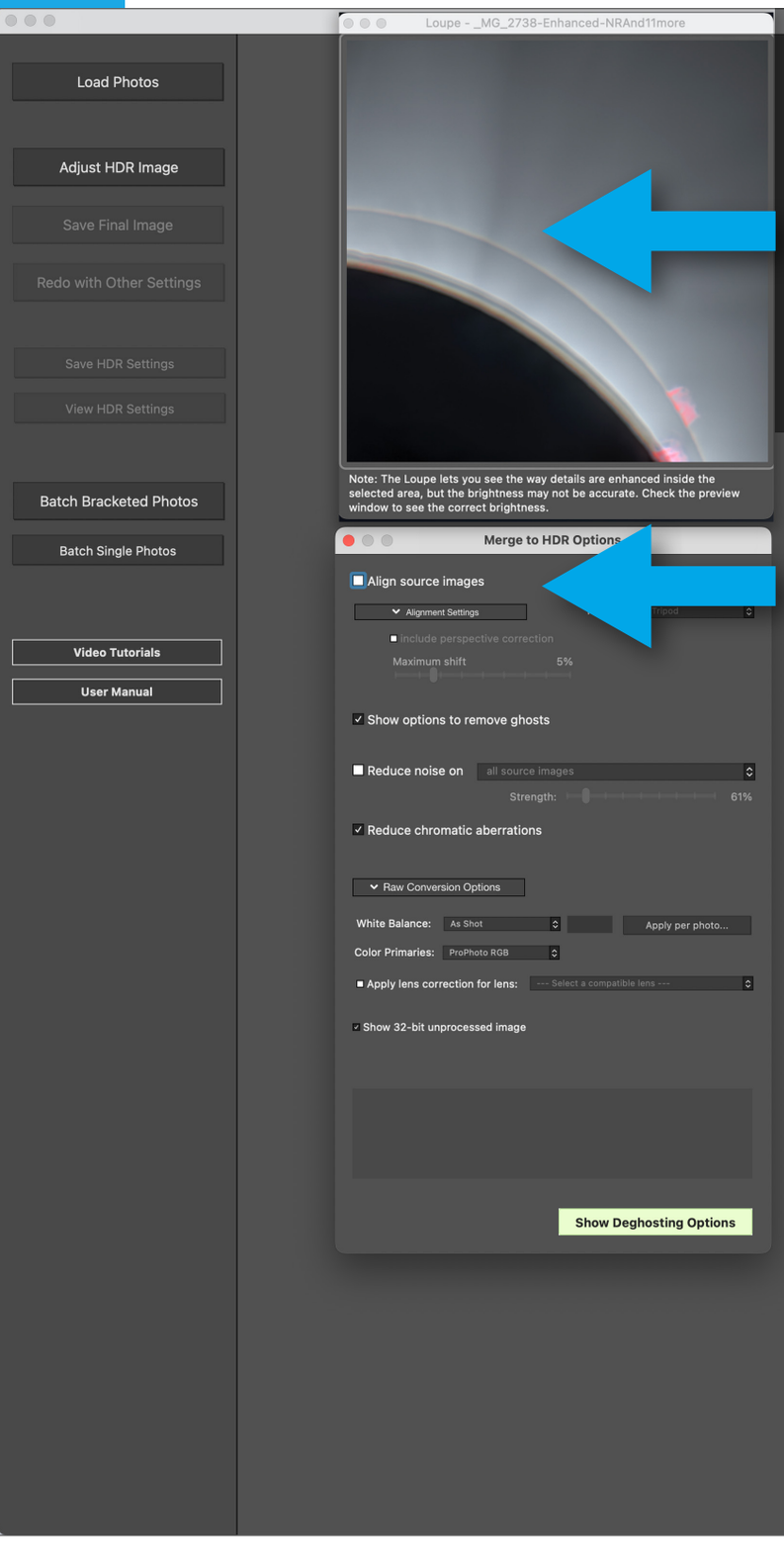
BLENDING WITH HDR SOFTWARE – PHOTOMATIX

First, I'll show examples using specialized HDR (High Dynamic Range) software, in this case Photomatix 7.

If you shot your images on a polar aligned tracking mount your images should be already aligned. If so, do not check Align Source Images (as shown below) or you might get a mess, as Photomatix (and other programs) attempts to align images it can't because the Moon is moving relative to the Sun.

If your images are not aligned because they were shot on a tripod without tracking, then to use an HDR program you must first align all the images you want to merge. Bring all the images into a single layered Photoshop file to manually align them (as shown later in the chapter). Then use **File>Export>Layers to Files** to export out an aligned set. While all HDR programs offer Auto Align, it likely will not work on eclipse images.



HDR programs all offer a Deghosting option for reducing artifacts from content that moved from image to image. It likely won't be needed or do much of value. But test with and without.

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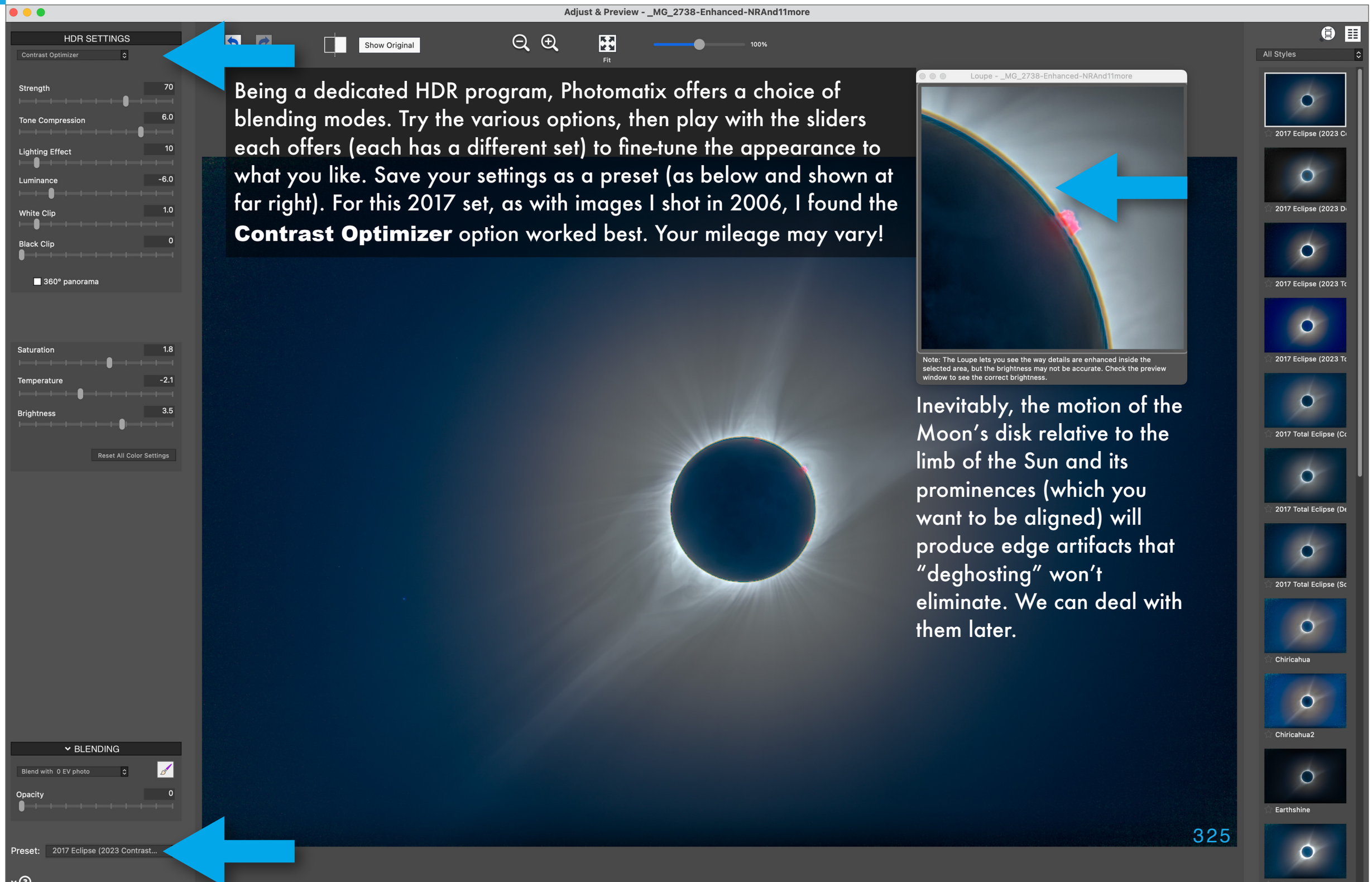
BLENDING WITH HDR SOFTWARE – PHOTOMATIX

Photomatix offers a lot of choices, many with awful results! But with care it can do a good job blending eclipse sets.



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BLENDING WITH HDR SOFTWARE – NIK HDR EFEX

This specialized HDR program also can do a fine job, with good adjustments for fine-tuning the blend and level of detail.

HDR Efex Pro is one of the applications (or it can run as a plug-in from Photoshop) included with the Nik Collection offered by DxO. I tested the version included with Nik Collection 6, released May 2023. This is from the same 12 images used in the other examples. Keep in mind you can vary the final look greatly by adjusting the **Tone Compression** and **Method Strength**. But best to start with a Default natural look.

Increasing the **Tone Compression** reduces the brightness of the inner corona, while boosting the **Method Strength** reveals more fine detail in the corona. But go too high and the result can look artificial and overdone. Ditto on **HDR Method**. I've used "natural" settings here. **Structure** can bring out details, but also enhance artifacts like banding.

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BLENDING WITH HDR SOFTWARE – ON1

ON1 Photo RAW offers a fairly complete suite of functions to replace both Lightroom and Photoshop. But its HDR utility did a poor job here.

I sent the same set of Enhanced DNGs created with Camera Raw into ON1 Photo RAW (rather than use ON1 itself to develop the original Raw images). So perhaps that's the problem here. But its HDR utility did a poor job blending the images, producing a posterized effect with poor recovery of the bright inner corona, no matter how I adjusted the sliders in its tone mapping panel, at right. Eclipse images are the most challenging to blend!

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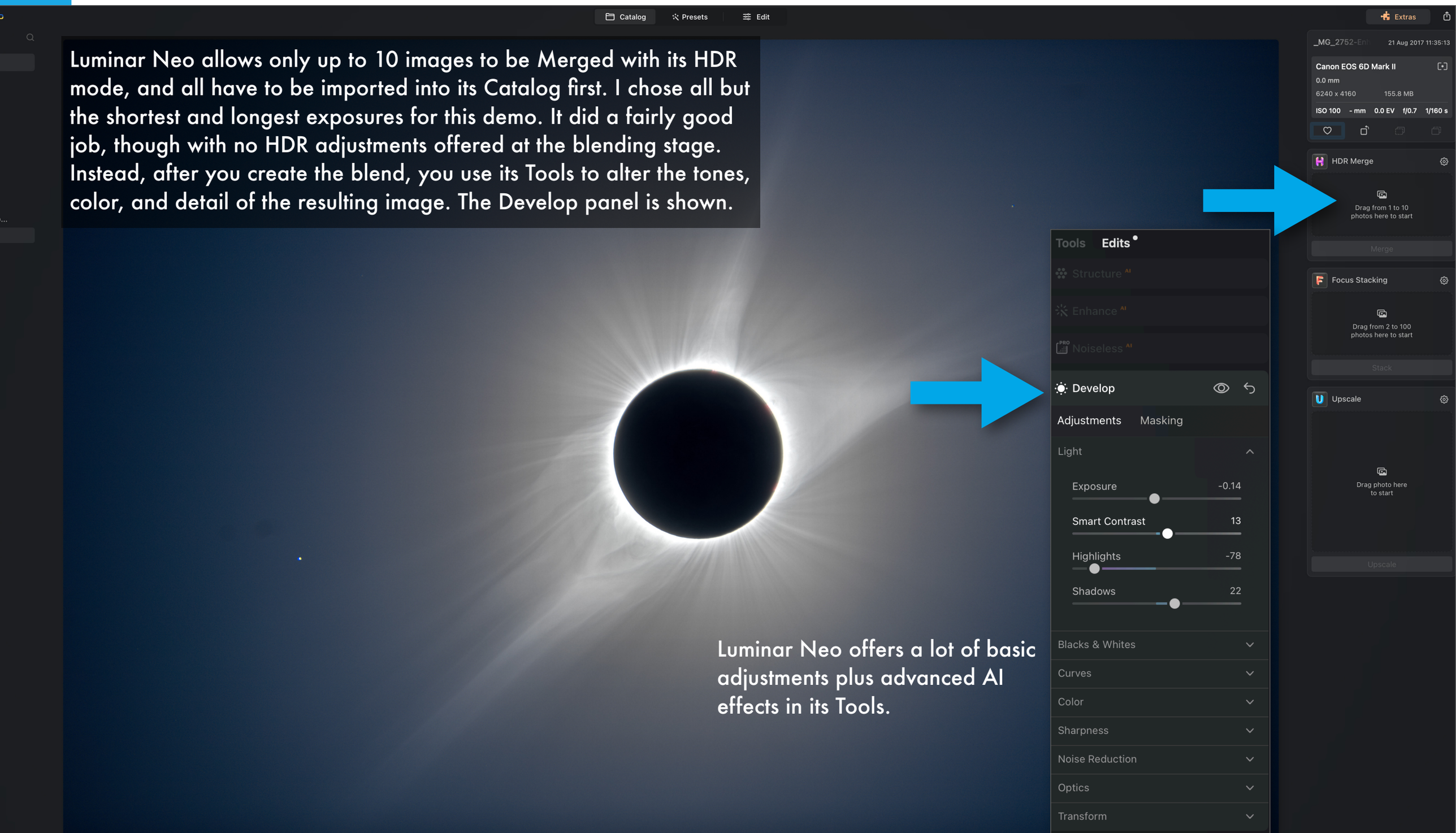
BLENDING WITH HDR SOFTWARE – LUMINAR NEO

A new image processing program, Luminar Neo offers many filters and functions, many AI-based, and among them an HDR Merge.

Luminar Neo allows only up to 10 images to be Merged with its HDR mode, and all have to be imported into its Catalog first. I chose all but the shortest and longest exposures for this demo. It did a fairly good job, though with no HDR adjustments offered at the blending stage. Instead, after you create the blend, you use its Tools to alter the tones, color, and detail of the resulting image. The Develop panel is shown.



Luminar Neo offers a lot of basic adjustments plus advanced AI effects in its Tools.

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BLENDING WITH HDR SOFTWARE – AFFINITY PHOTO

Affinity Photo is a layer-based editor like Photoshop. It offers an HDR blending mode you can use to open a set of developed images to stack.

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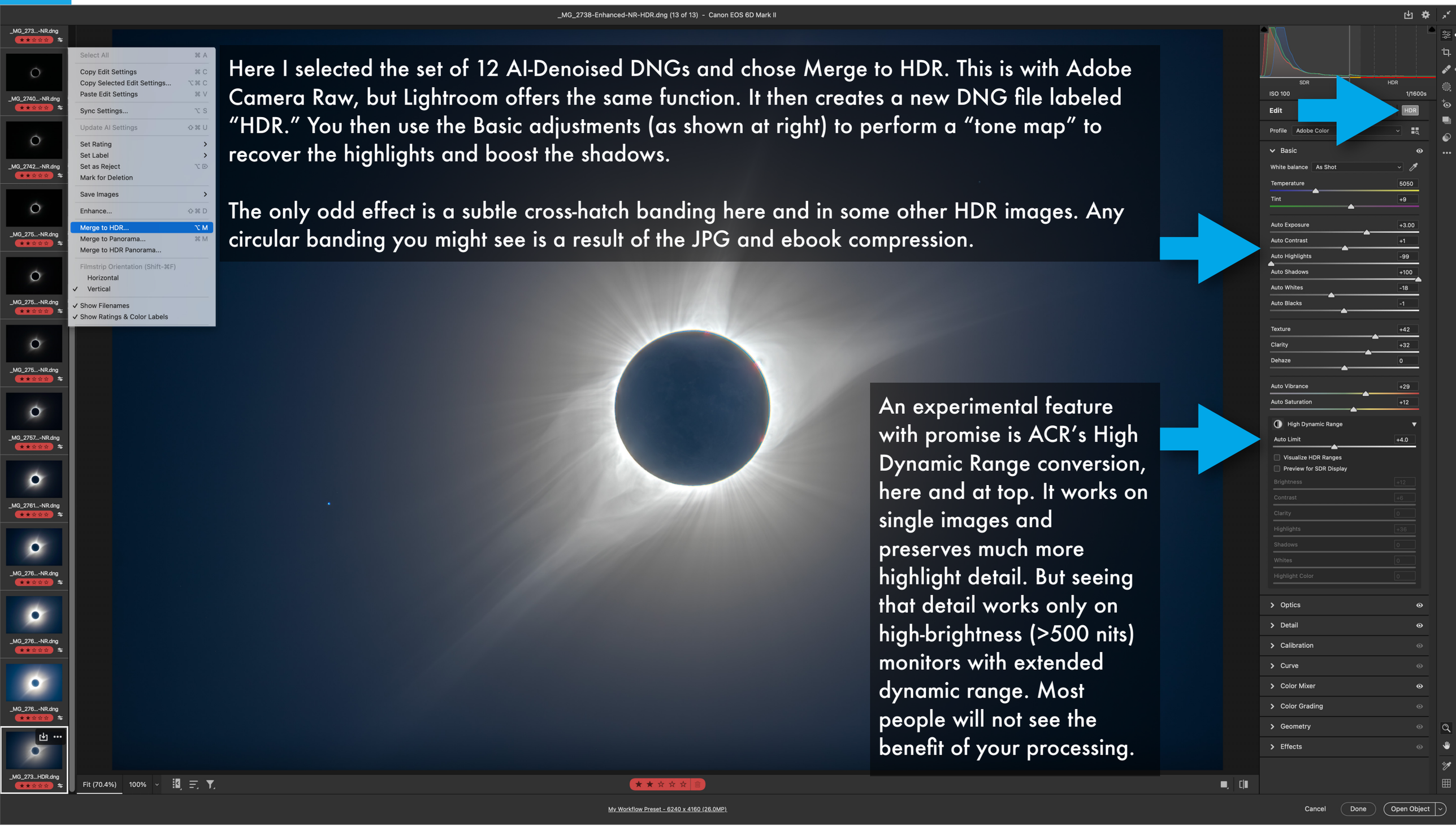
BLENDING WITH HDR SOFTWARE – CAMERA RAW

Adobe Camera Raw and Lightroom also offer a Merge to HDR mode, which also worked quite well. It will work best on aligned Raw images.



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FIXING THE LIMB ARTIFACTS – A BIT OF A CHEAT!

No matter what method you use to blend exposures, the motion of the Moon over the time it took to take the shots will create ghost images.

Here's the previous image from the HDR set blended with Adobe Camera Raw, on the left. The motion of the Moon's disk creates the ghosted limb artifacts. If you aligned the Moons, then the solar prominences would be misaligned. To minimize this mismatch take any images intended for blending as quickly as possible at totality. So how to fix this? I layered in the longest exposure above the HDR blend, selected just the Moon to mask out all but the Moon (as shown at right). I then enlarged that image by 2%, so the lunar disk covers the offending edge artifacts. Yes, it's a bit of a cheat, so don't tell anyone!

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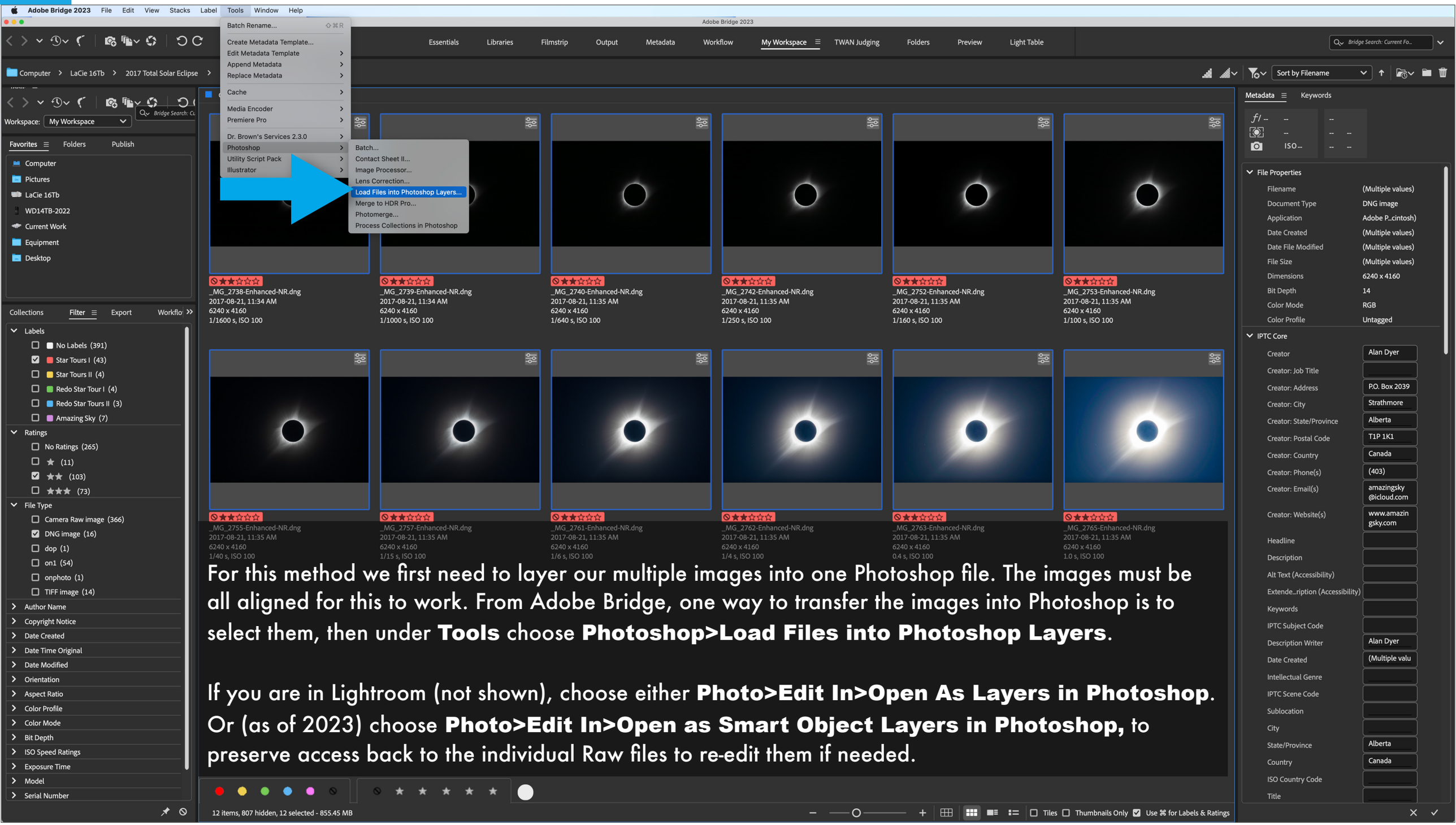
EXPOSURE BLENDING WITH MEAN STACK MODE

Here's an easy and fairly effective way to blend multiple eclipse exposures using Photoshop's Stack Modes. It mimics HDR results.



For this method we first need to layer our multiple images into one Photoshop file. The images must be all aligned for this to work. From Adobe Bridge, one way to transfer the images into Photoshop is to select them, then under **Tools** choose **Photoshop>Load Files into Photoshop Layers**.

If you are in Lightroom (not shown), choose either **Photo>Edit In>Open As Layers in Photoshop**. Or (as of 2023) choose **Photo>Edit In>Open as Smart Object Layers in Photoshop,** to preserve access back to the individual Raw files to re-edit them if needed.

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EXPOSURE BLENDING WITH MEAN STACK MODE

To perform this type of blend we first layer the images into Photoshop, then pack them into a single "smart object."

Once all the images are in Photoshop as separate layers, as shown at right, select them all. Then go under **Layer>Smart Objects>Convert to Smart Object.**

That creates a single layer with (in this case) all 12 images contained within that single smart object. We can now mathematically manipulate or blend those images via "Stack Modes."

All images selected

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EXPOSURE BLENDING WITH MEAN STACK MODE

We then mathematically average the images together with a Mean Stack Mode, to perform the actual blend of exposures.

Once the images are in a single smart object, change its **Stack Mode** via **Layer>Smart Objects>Stack Mode** and select **Mean**. This averages the images together and produces a good result with few artifacts.

All images in a single smart object layer, now blended with a Mean Stack Mode

TIP: Users of Affinity Photo have the same options as it also offers stack modes under its **File>New Stack...** command. And it has the same mathematical operations, or stack modes, as Adobe Photoshop.

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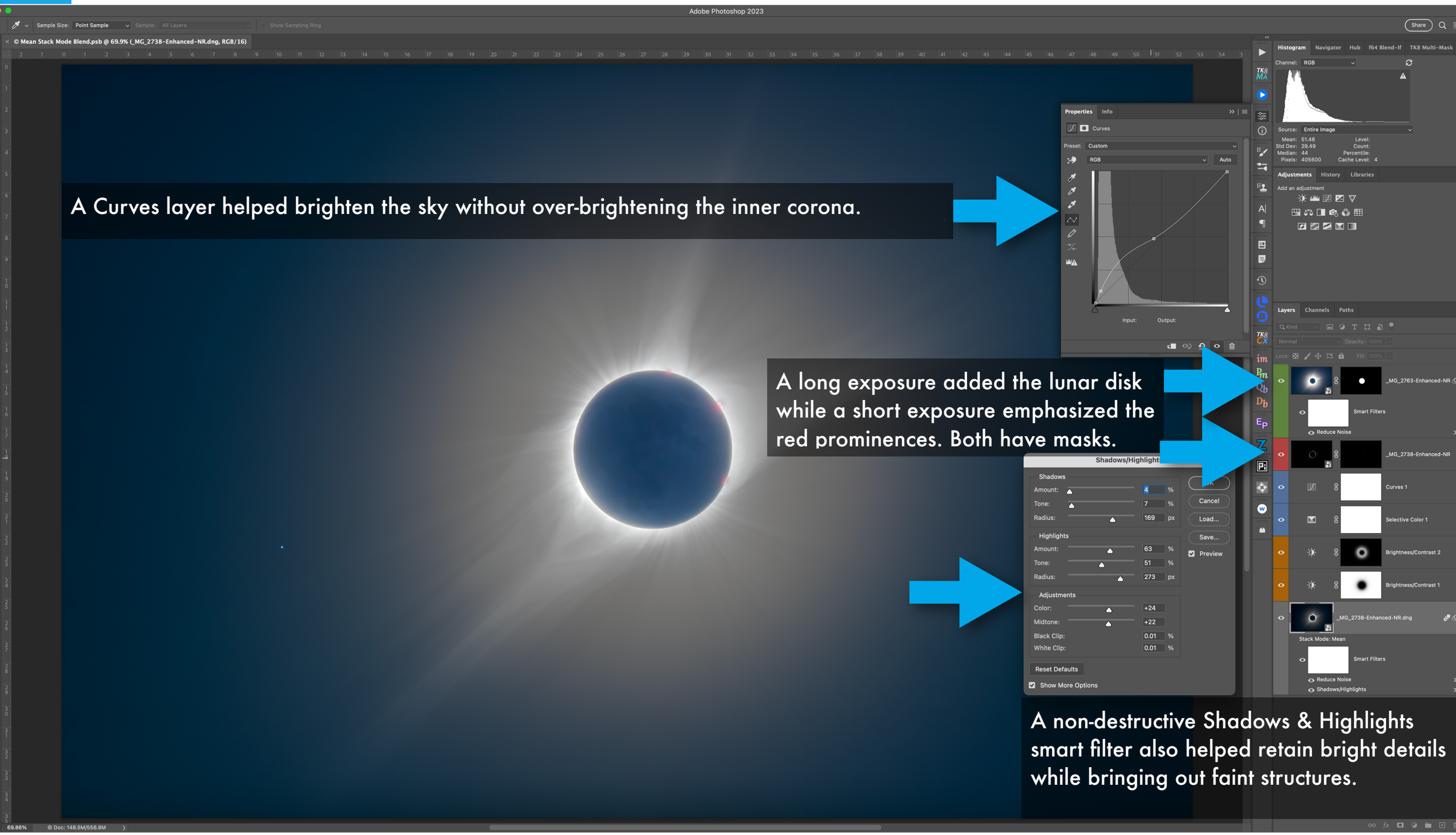
EXPOSURE BLENDING WITH MEAN STACK MODE

We can then go to town with smart filters, adjustment layers and, in this case, blending in two more exposures with masks.



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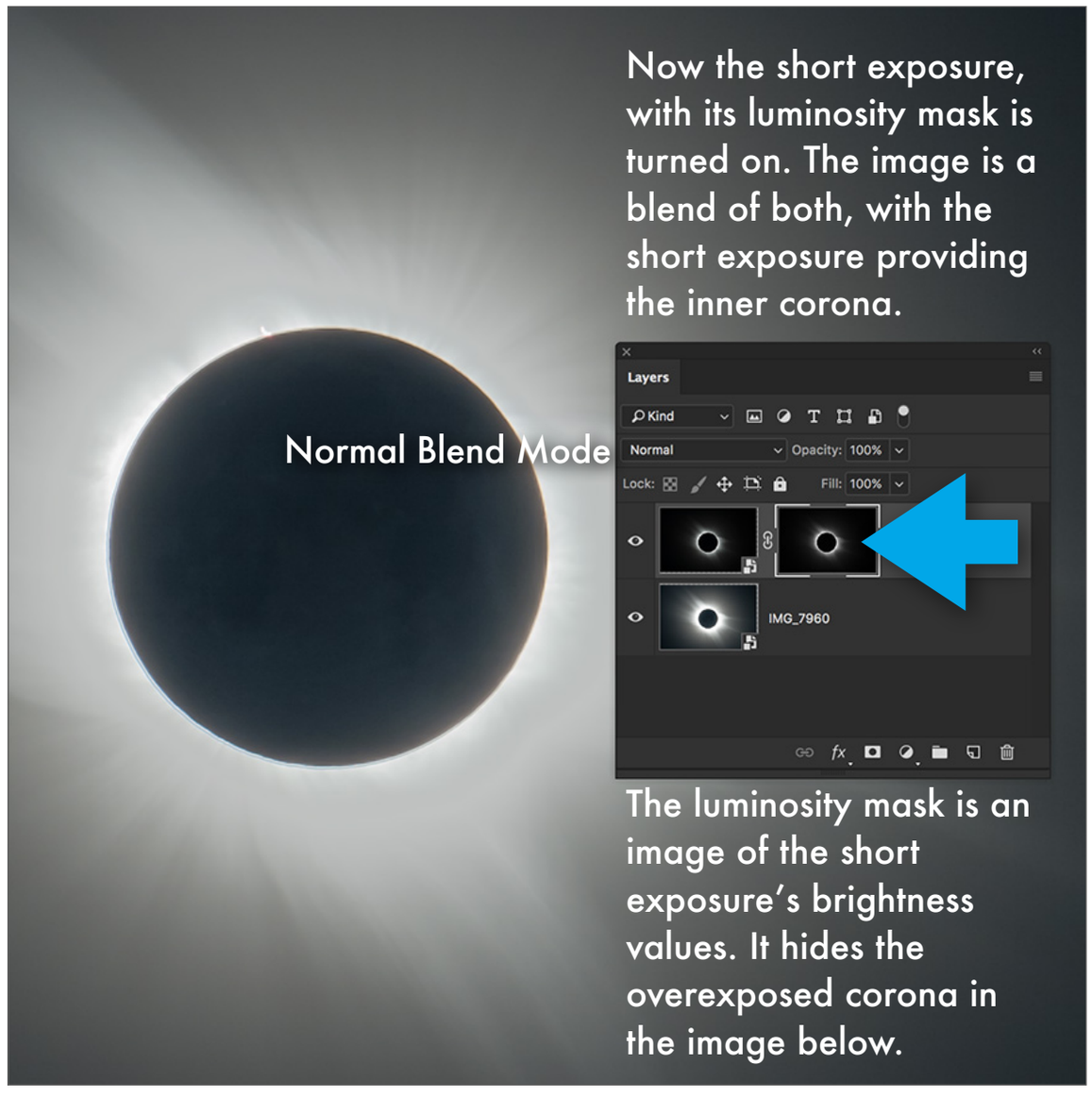
PHOTOSHOP 201: LUMINOSITY MASKS

As a final blending method, we'll employ the advanced technique of "luminosity masks" to blend multiple exposures. Here are the basics.

In all the previous tutorials all the masks shown were black or white, to hide or reveal all. But masks can have shades of grey, so they only partially reveal or conceal. We can create a mask based on the brightness, or "luminosity," of the image. By applying a luminosity mask we can seamlessly merge two or more exposures, with one image's content smoothly blending into the other.



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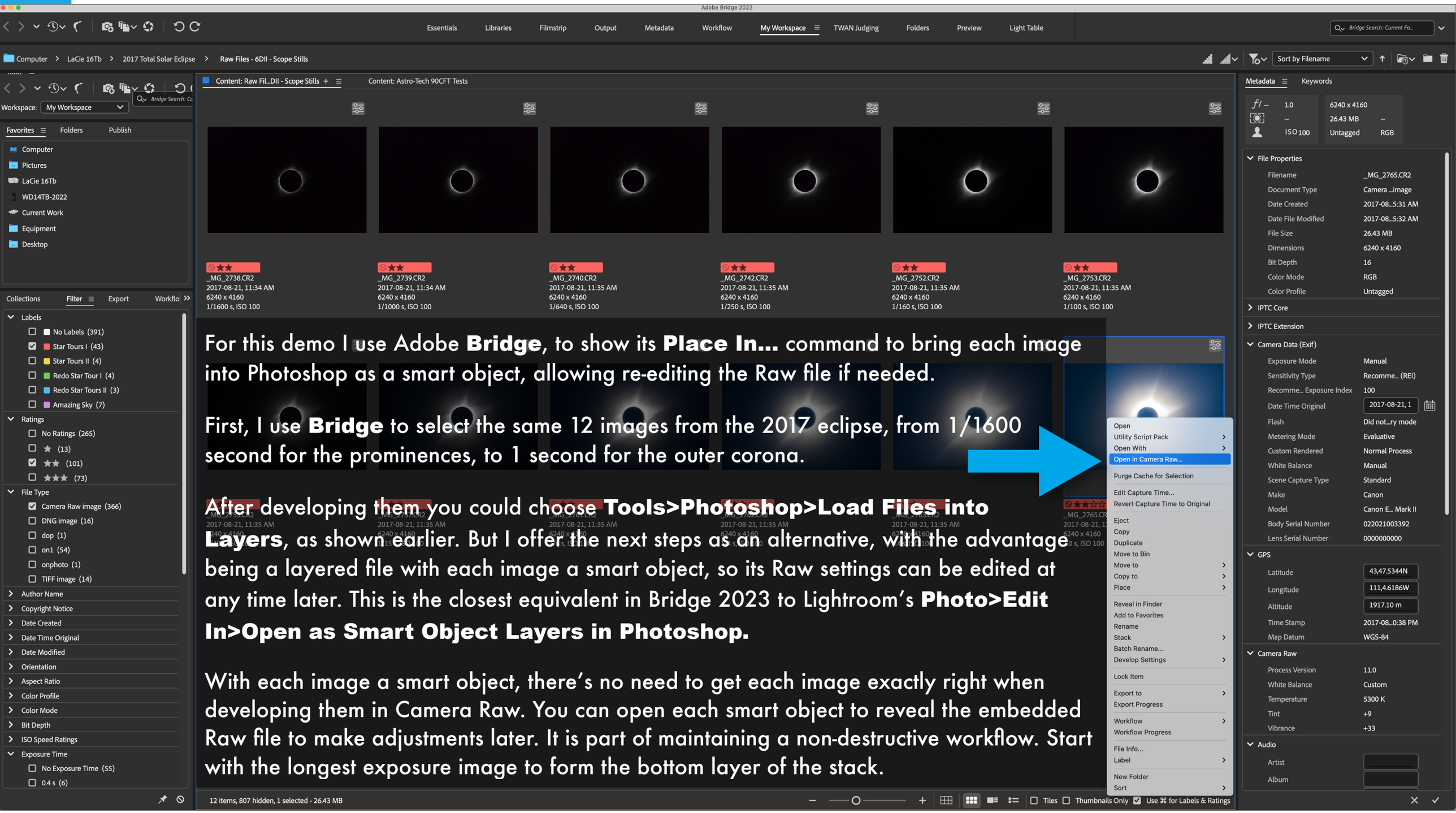
LUMINOSITY MASKS: CHOOSING IMAGES TO STACK

Luminosity masks are often preferred over HDR. But applying them is one of the most advanced techniques. We begin by stacking images.



For this demo I use Adobe **Bridge**, to show its **Place In...** command to bring each image into Photoshop as a smart object, allowing re-editing the Raw file if needed.

First, I use **Bridge** to select the same 12 images from the 2017 eclipse, from 1/1600 second for the prominences, to 1 second for the outer corona.

After developing them you could choose **Tools>Photoshop>Load Files into Layers**, as shown earlier. But I offer the next steps as an alternative, with the advantage being a layered file with each image a smart object, so its Raw settings can be edited at any time later. This is the closest equivalent in Bridge 2023 to Lightroom's **Photo>Edit In>Open as Smart Object Layers in Photoshop.**

With each image a smart object, there's no need to get each image exactly right when developing them in Camera Raw. You can open each smart object to reveal the embedded Raw file to make adjustments later. It is part of maintaining a non-destructive workflow. Start with the longest exposure image to form the bottom layer of the stack.

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LUMINOSITY MASKS: OPEN AS A SMART OBJECT

Each time we open an image, we go through Adobe Camera Raw to perform any last minute adjustments. But we can return to the Raw file later.

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FIRST, STACKING FOR LUMINOSITY MASKING

This method of bringing each image into its own layer retains each image as a smart object, so that the Raw file can be re-edited at any time.

- With the first "longest exposure" image opened in Photoshop, we now place each of the other images into the same Photoshop document as a new layer.
- Work from the longest to shortest exposures.
- Choose one image, and Right-Click to **Place>In Photoshop** (shown at right)
- Or from the **File** menu choose **Place>In Photoshop** (as at left).
- Either way, the image will reopen in Camera Raw. Hit **OK**.
- The image comes into Photoshop with Transform controls for re-sizing the image. No need to do that, so just hit **Return**.
- The image gets "placed in" as a new layer and as a smart object.
- Repeat for each image, from longest to shortest, to put the shortest exposure on top, required for the masking to work later.
- It's tedious to have to do this for each image, but Bridge lacks any "Place All as Smart Object Layers" command. Pity!

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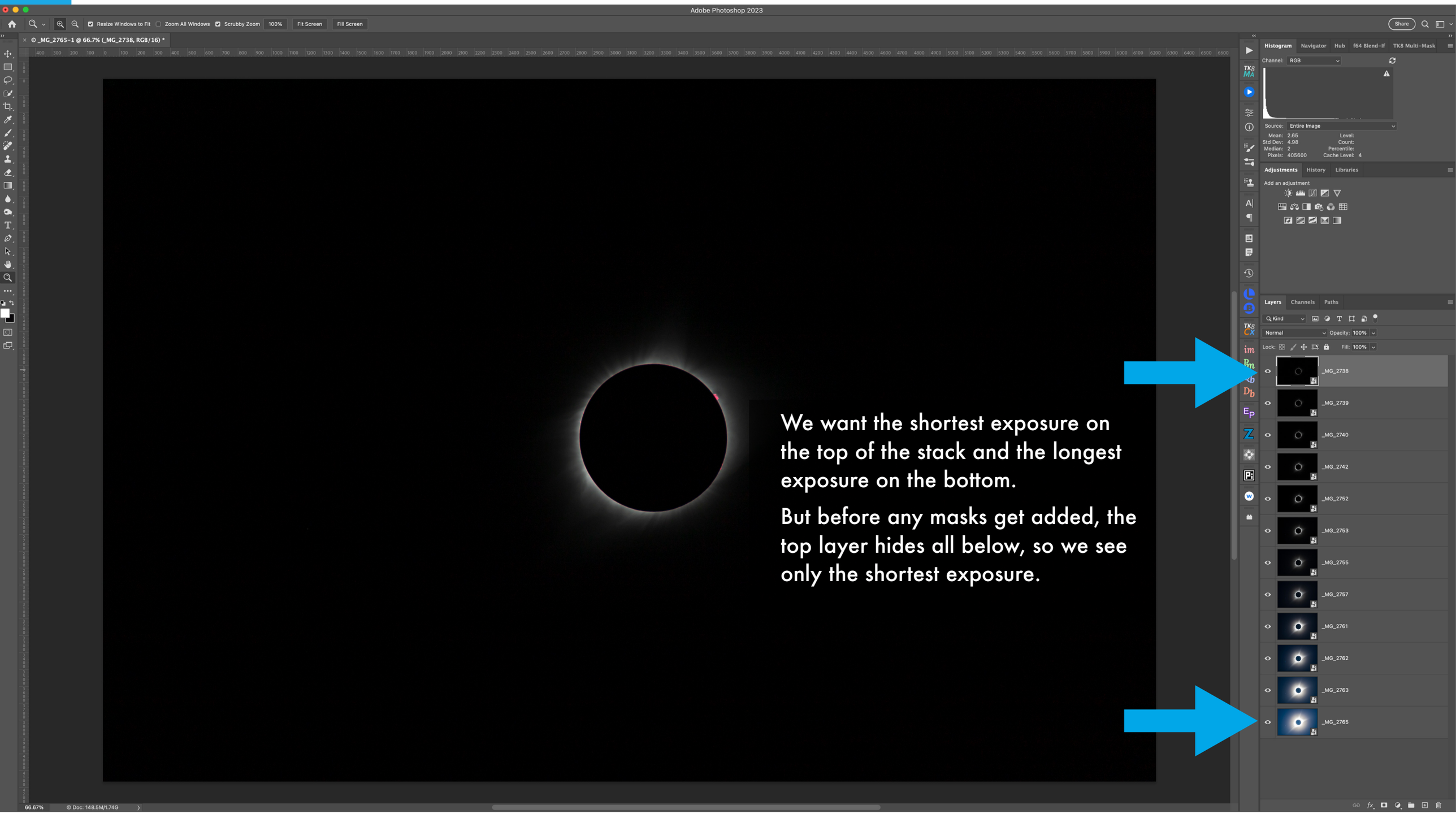
THE STACK FOR LUMINOSITY MASKING

The result of all the Placing commands is a single Photoshop document with each image on its own “smart object” layer.



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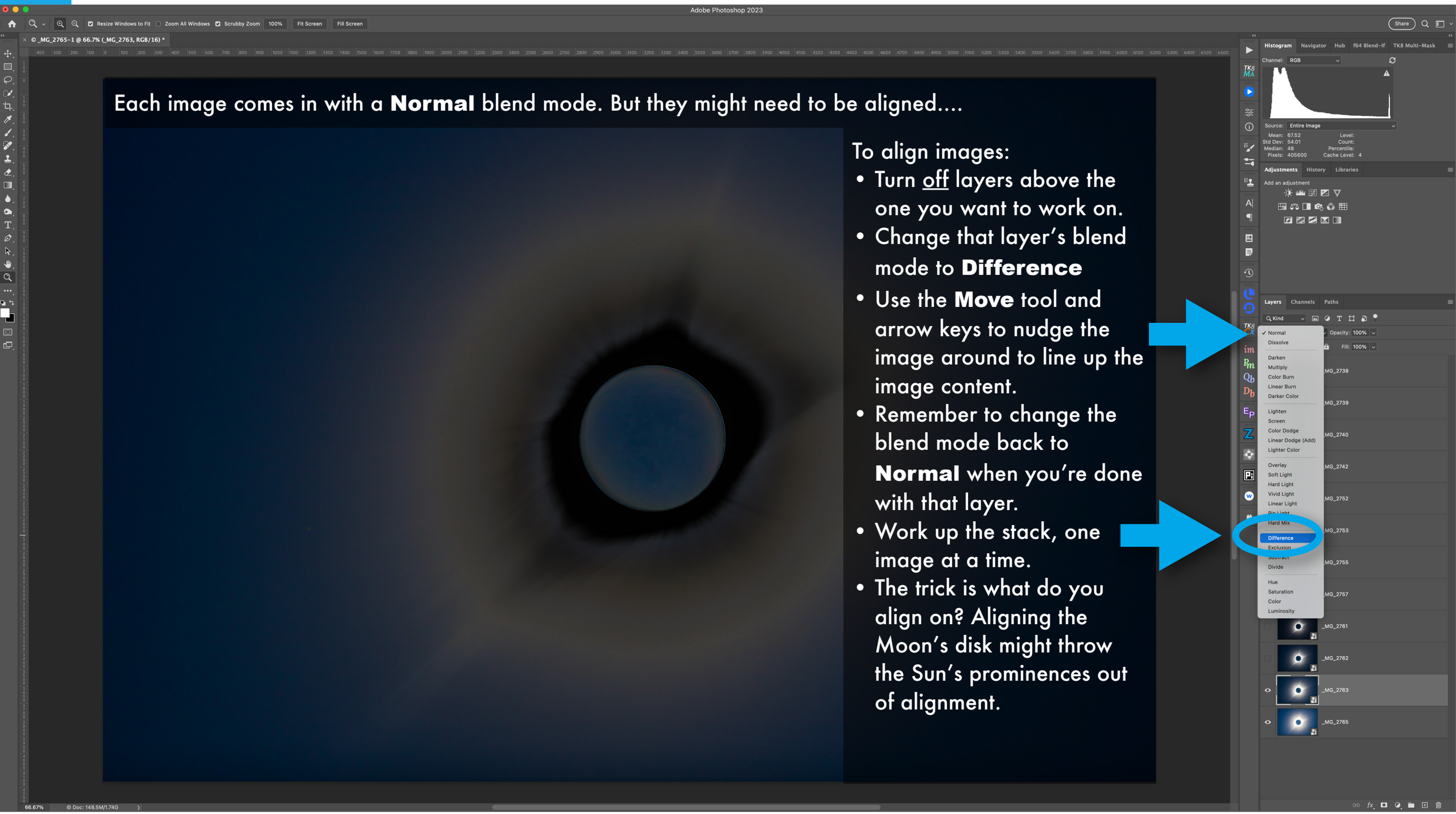
REQUIRED: MANUALLY ALIGNING IMAGES

Before you can do blending by any method, you must manually align images. Don't count on Auto Align to work on eclipse images.



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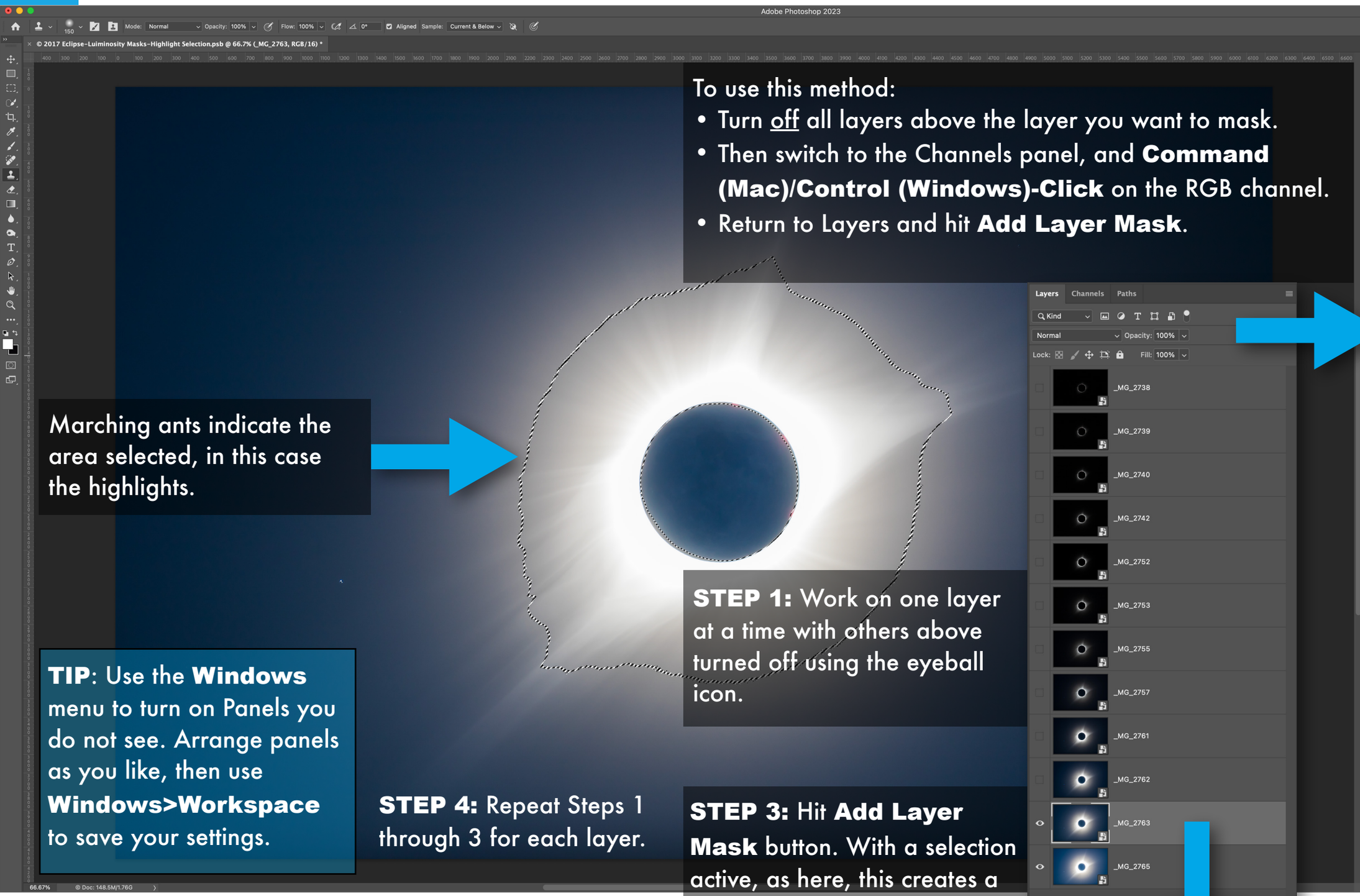
LUMINOSITY MASKING – METHOD #1: MANUAL

Here's the standard method of creating "luminosity masks," masks that reveal only the parts of the corona we want from each image.



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LUMINOSITY MASKING – METHOD #2: APPLY IMAGE

This alternative method uses the Apply Image command to generate a luminosity mask using fewer clicks and panel swapping.

This method makes use of an obscure Photoshop function to produce the same result, but in fewer steps:

- First, use **Add Layer Mask** to add a blank white mask to each of the image layers above the base layer.
- Turn off all layers above, and select a layer to work on.
- Be sure to select the Mask as indicated, not the image.
- Hit **Image>Apply Image**, with the dialog box set as shown.

STEP 2: With the mask selected **Apply Image.**

STEP 3: Repeat for each image layer's mask.

The result of the Apply Image commands is also a luminosity mask that reveals only the highlights – the brightest parts – of that image.

NOTE: Remember, with masks – **White** reveals, and **Black** conceals.

STEP 1: Add Layer Mask button.

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LUMINOSITY MASKING – RESULT OF METHODS 1 & 2

Both manual methods generate a similar set of luminosity masks on the image layers, each revealing only the desired area of each image.

The result are masks on each image that reveal only that part of the image we want – i.e. the part of the corona best recorded by that image. So the short exposures contribute the inner corona and the longer exposures contribute more and more of the outer corona.

If the result looks too soft, try:

- Changing the **Blend Mode** to Lighten (as here).
- Lowering the **Opacity** might also improve the appearance.
- Or open Mask Properties (as at left) to feather the mask.
- Or double-click on an image to open the Raw file to re-edit.

Luminosity masks are another way of merging images for an HDR effect. But you have more control of each image, to fine-tune what each layer contributes to the composite, and for aligning images.

The base layer does not have, nor need, a mask.

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LUMINOSITY MASKING – METHOD #3: PANELS

Here is a trio of third-party plug-in Extension Panels that offer detailed control panels for generating luminosity masks automatically.

Lumenzia from Greg Benz offers buttons for creating all kinds of luminosity masks revealing or hiding selected areas of an image. As with the other panels, masks can be created based on the Darks (D), Mid-Tones (M) or Lights (L).

TK8 from Tony Kuyper offers many powerful actions and effects in addition to the masking panel shown above, which can mask based on luminosity, zones, color, saturation, or even edges of objects.

These three programs are low-cost and automate what are otherwise complex steps in Photoshop for creating luminosity masks best for each image.

Raya Pro from Jimmy McIntyre has a handy **Precision Masks>Auto Dark** function which worked well for the eclipse example, but produced results similar to manually creating Highlight masks with previous methods.

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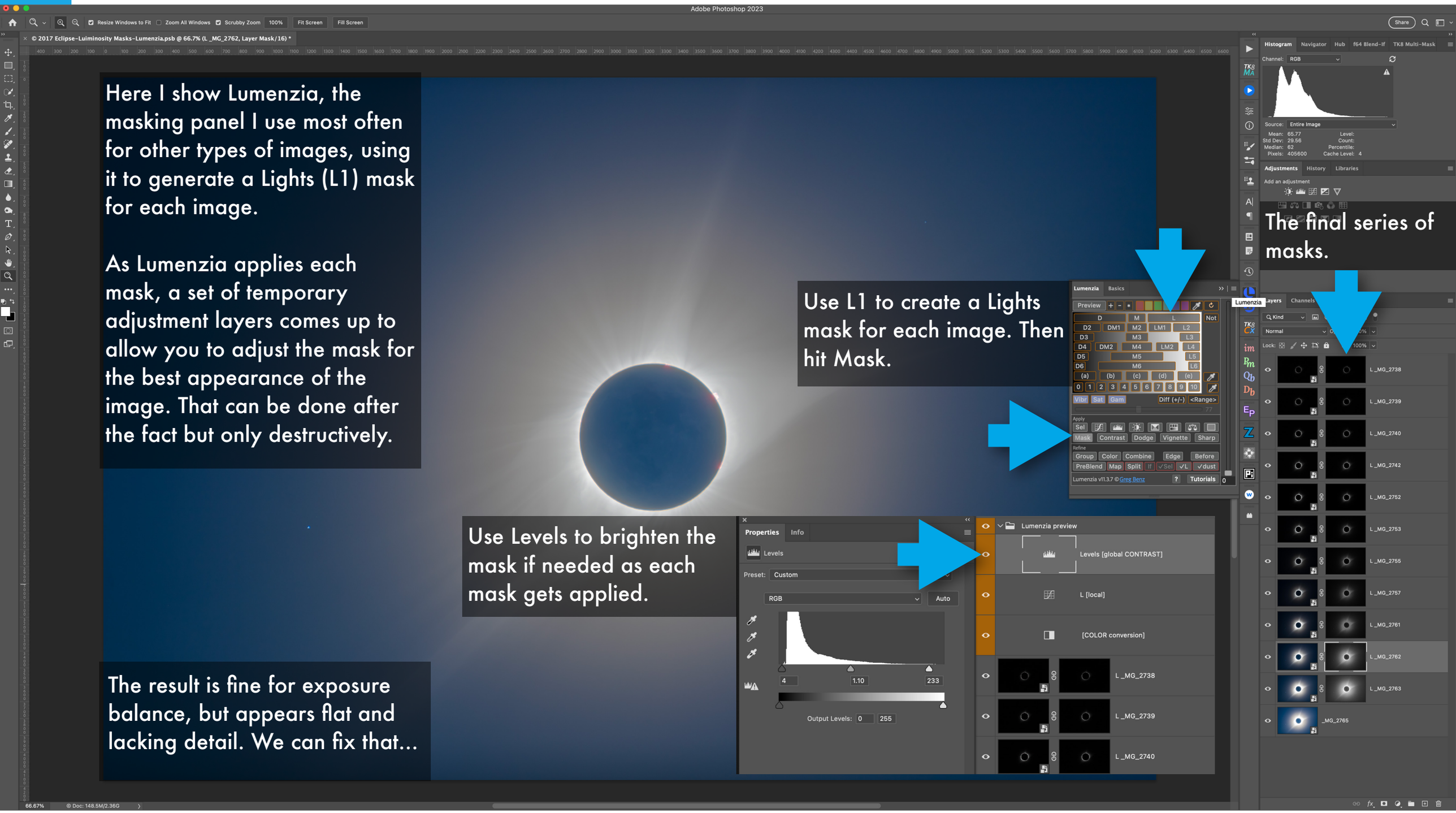
LUMINOSITY MASKING – METHOD #3: LUMENZIA

Here I use one of the third-party Extension panels, Lumenzia, to generate a set of luminosity masks, one by one on each layer.



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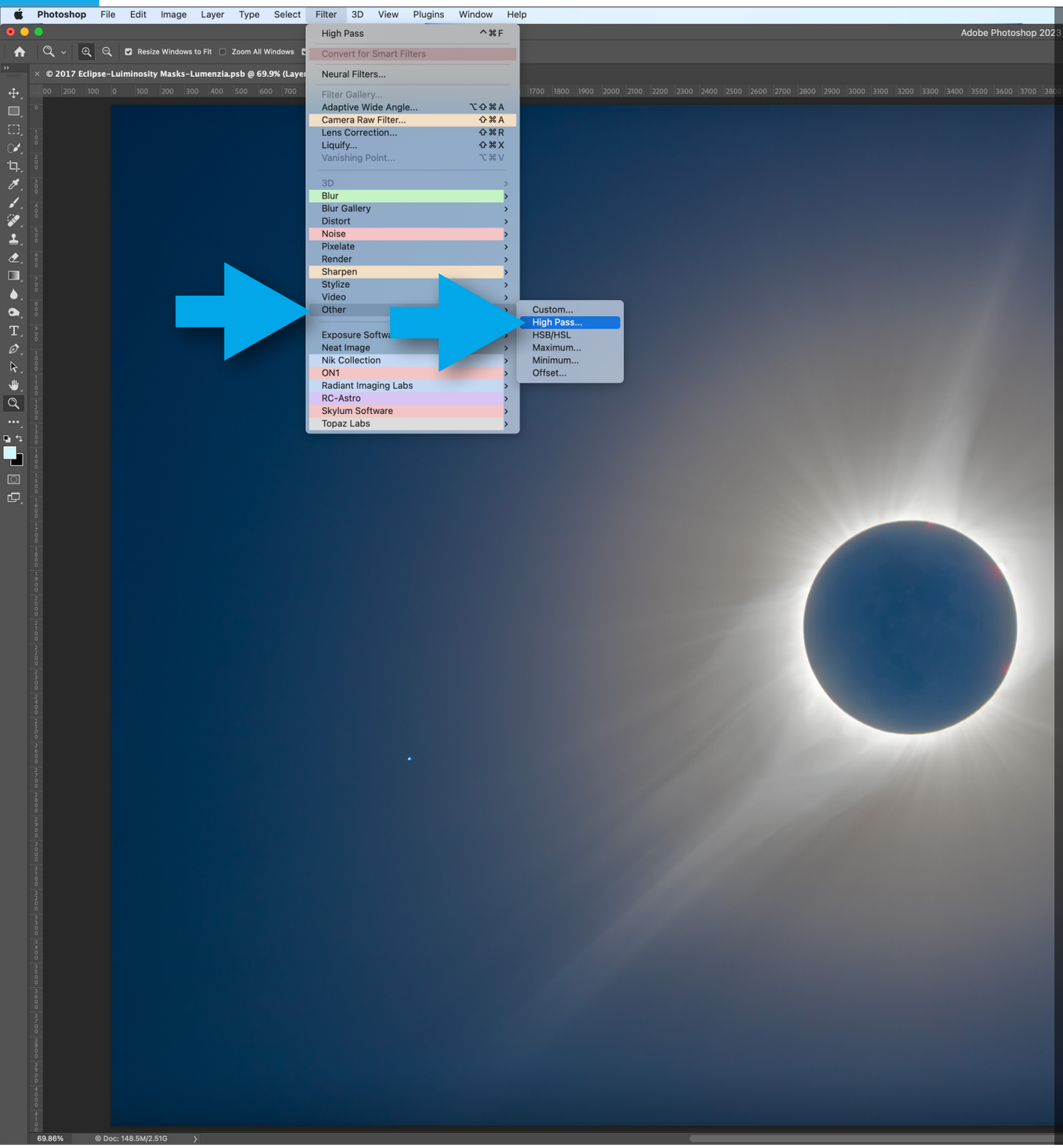
HIGH PASS SHARPENING TO ENHANCE DETAILS

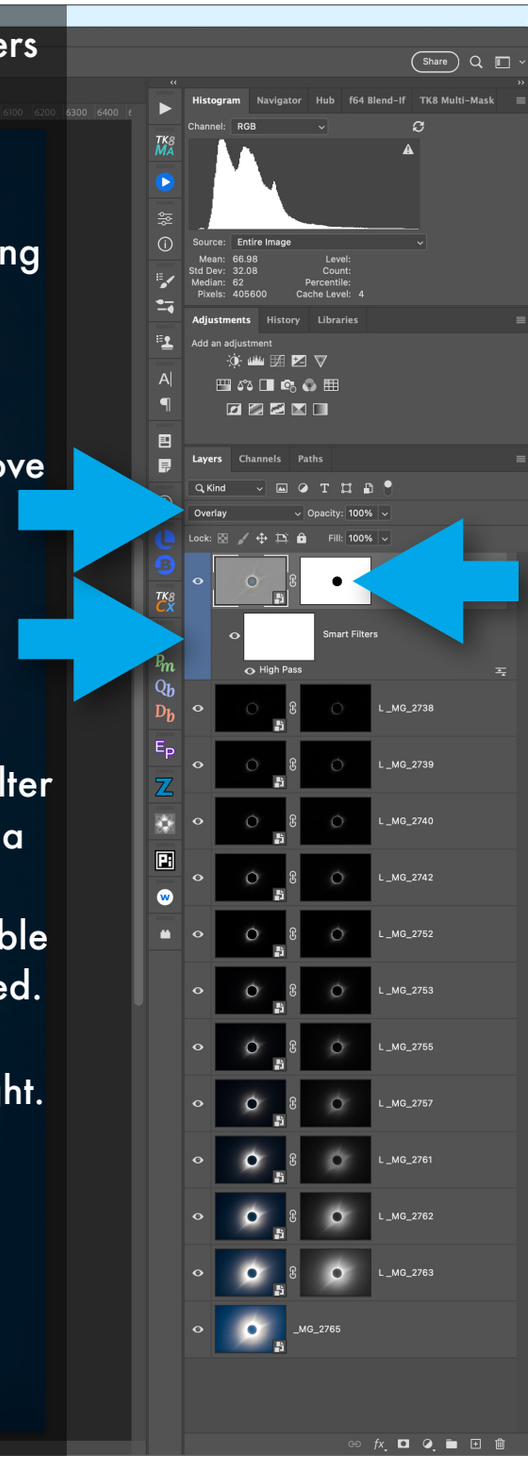
To enhance detail in the corona, we apply High Pass sharpening. This is an obscure filter, and is tricky to apply, but works well.



To bring out structures in the corona, filters in the Sharpen menu won't do much. Instead, we use a **High Pass** filter.

To create a High Pass filter layer, assuming your file has just masked image layers:

- Hit **Command+Option+Shift+E** (**Control+Alt+Shift+E** on a PC) to create a merged "stamped" layer above the image layers. This obscure command does <u>not</u> exist in the menus.
- Change that layer into a smart object (**Filter>Convert for Smart Filters**).
- Apply a **High Pass** filter (from the Filter menu at left) as a smart filter. Choose a high pixel radius (~200).
- We apply this as a smart filter to be able to adjust the pixel radius later if needed.
- Then change the Blend Mode to **Overlay**, or try Soft Light or Hard Light.
- Add a mask to the filter layer with a black circle to cover the Moon, so the sharpening is applied <u>only</u> to the corona, <u>not</u> to the lunar disk.



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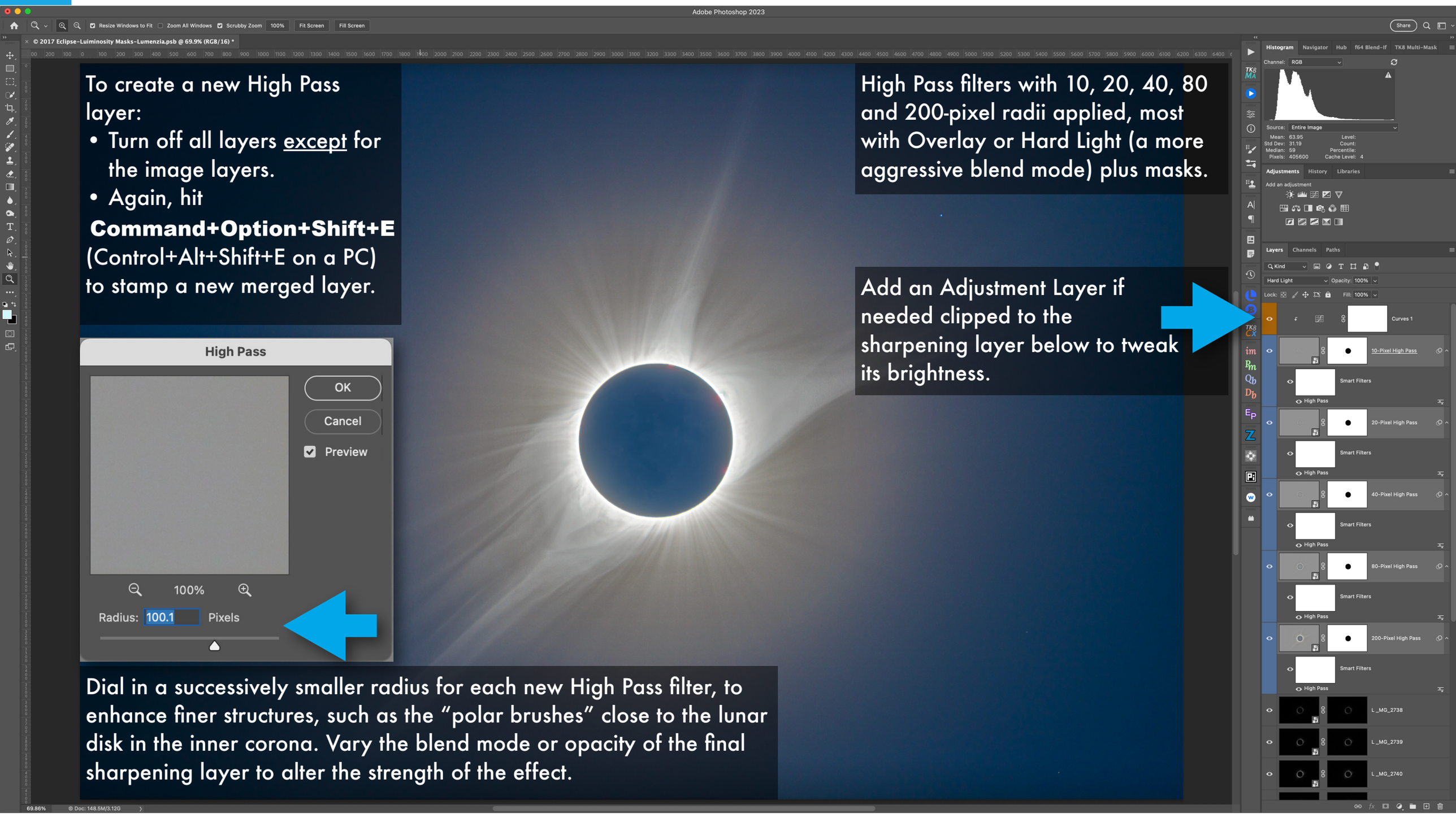
MORE HIGH PASS SHARPENING!

If one High Pass filter layer looks good, why not add more? Rinse and repeat, using filters with a smaller radius to sharpen smaller structures.



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FINISHING TOUCHES

Adding masked adjustment layers touches up the brightness and color of the lunar disk and sky. A “Clean Up” layer spots out blemishes.

Adjustment layers for the Moon and for the sky tweak color and brightness. Each has a circular mask to protect the area of the image we don’t want the adjustment applied to. A Clean Up layer on top is for retouching any pesky dust spots that show up now!

Organize the many layers by grouping them into folders, labeling and colorizing them. Always Save as a layered PSD file to preserve all your work. Never flatten!

While the result looks good, it is quite noisy, from all the sharpening. The initial Raw files need to be de-noised at the start.

Prominences also still tend to get washed out, and might need to be added back with their own layer.

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CHOOSE YOUR CORONA

Which method you use to blend exposures is up to your personal taste on what you like: a corona with sharp detail or a softer look?

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SECTION 7 – 2024 Total

CREATING A MULTI-IMAGE COMPOSITE

Here we take the compositing one step further, with an exposure-blended image of the eclipsed Sun as the central element. Then we layer in flanking images of the diamond rings or partial phases to create a time-blend depicting the different aspects of the eclipse on one frame. To retain some semblance of reality I prefer to place those additional images in more or less their correct orientation and position relative to the center-piece total eclipse image.

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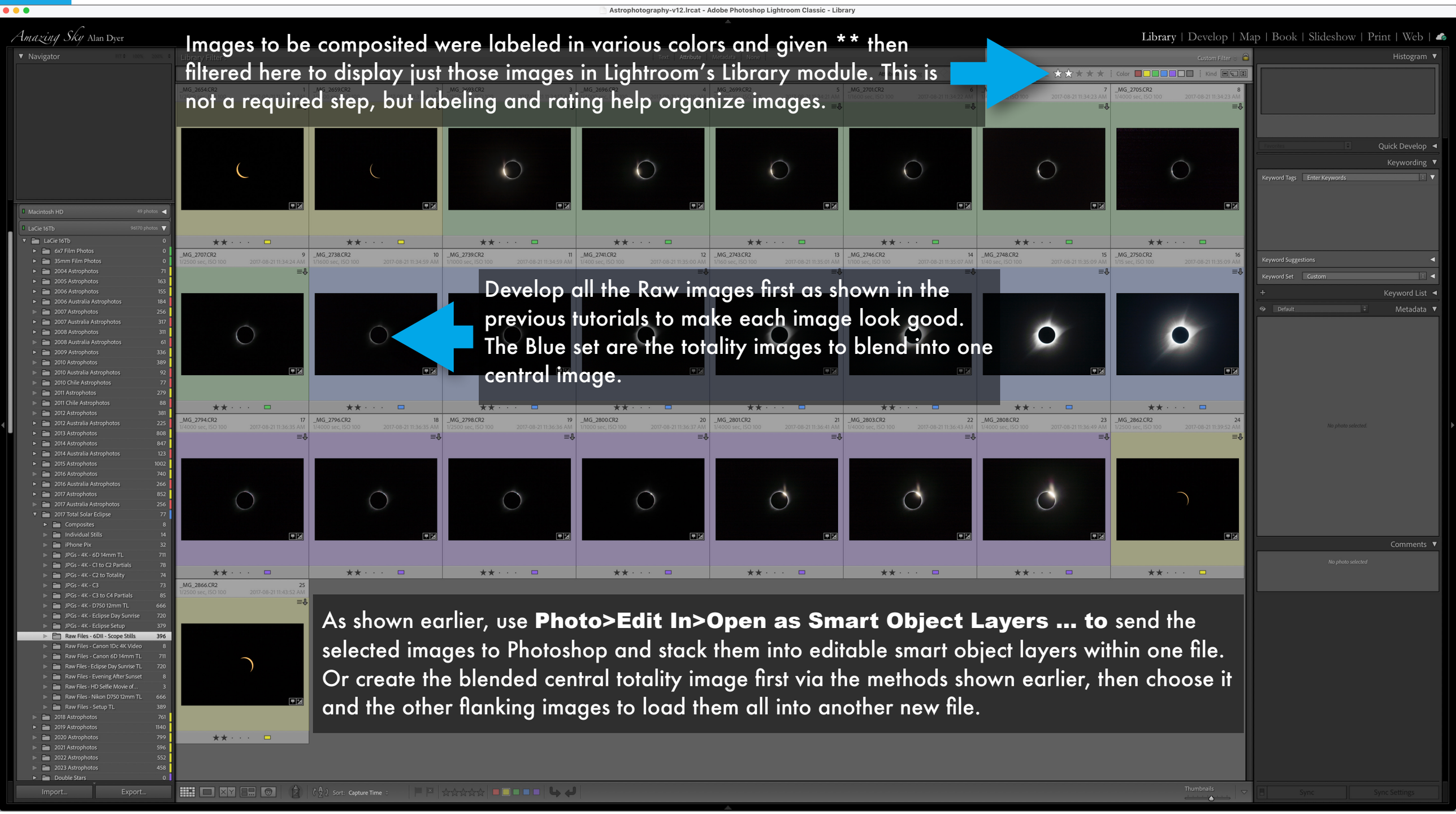
SELECTING IMAGES TO STACK – LIGHTROOM

To composite images we first select the developed Raw images we wish to layer into stack, rating and labeling them for ease of selection.



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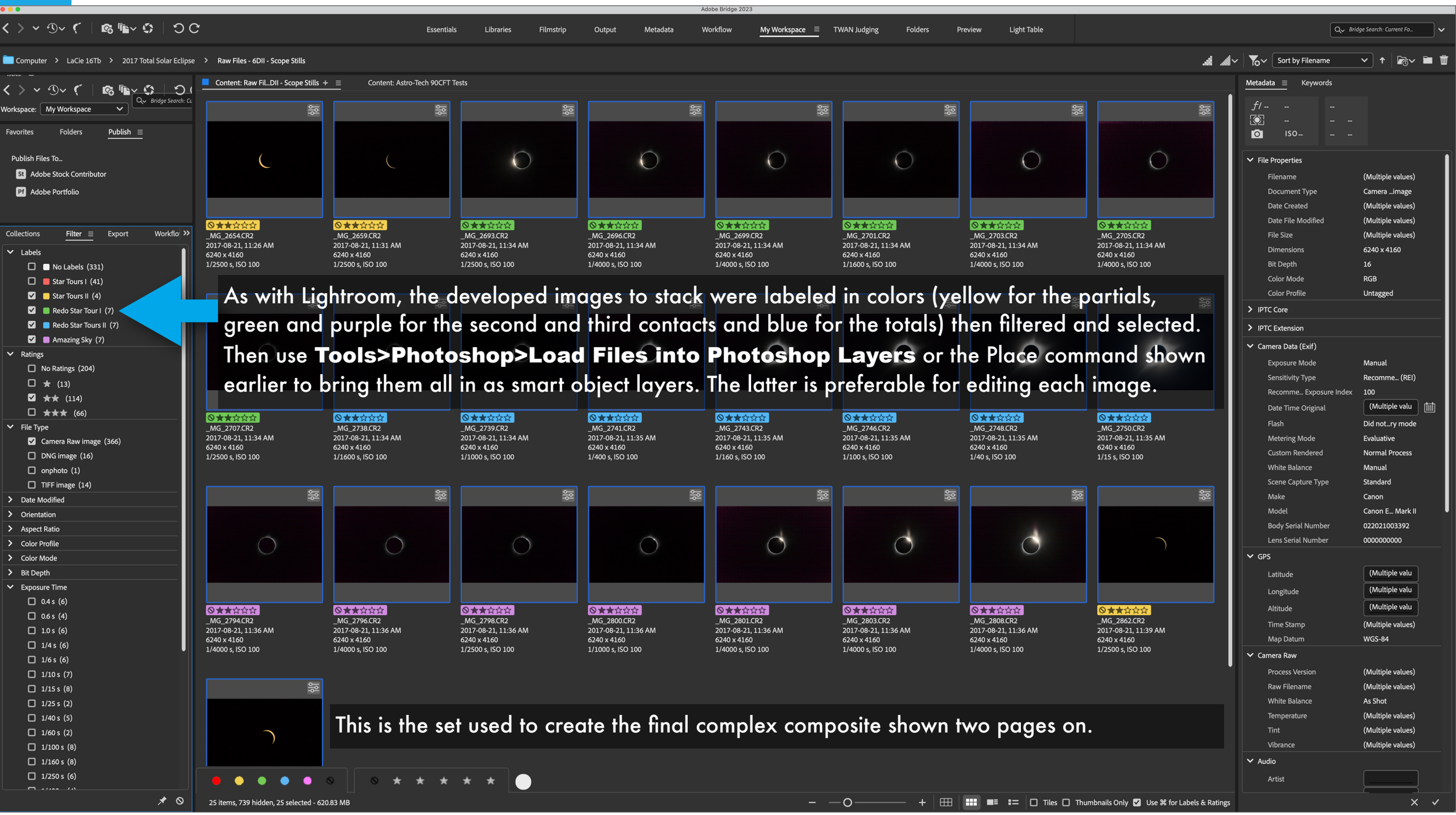
SELECTING IMAGES TO STACK – ADOBE BRIDGE

This is the same step, but using Adobe Bridge instead of Lightroom, to rate, label and select, then stack the images in Photoshop.



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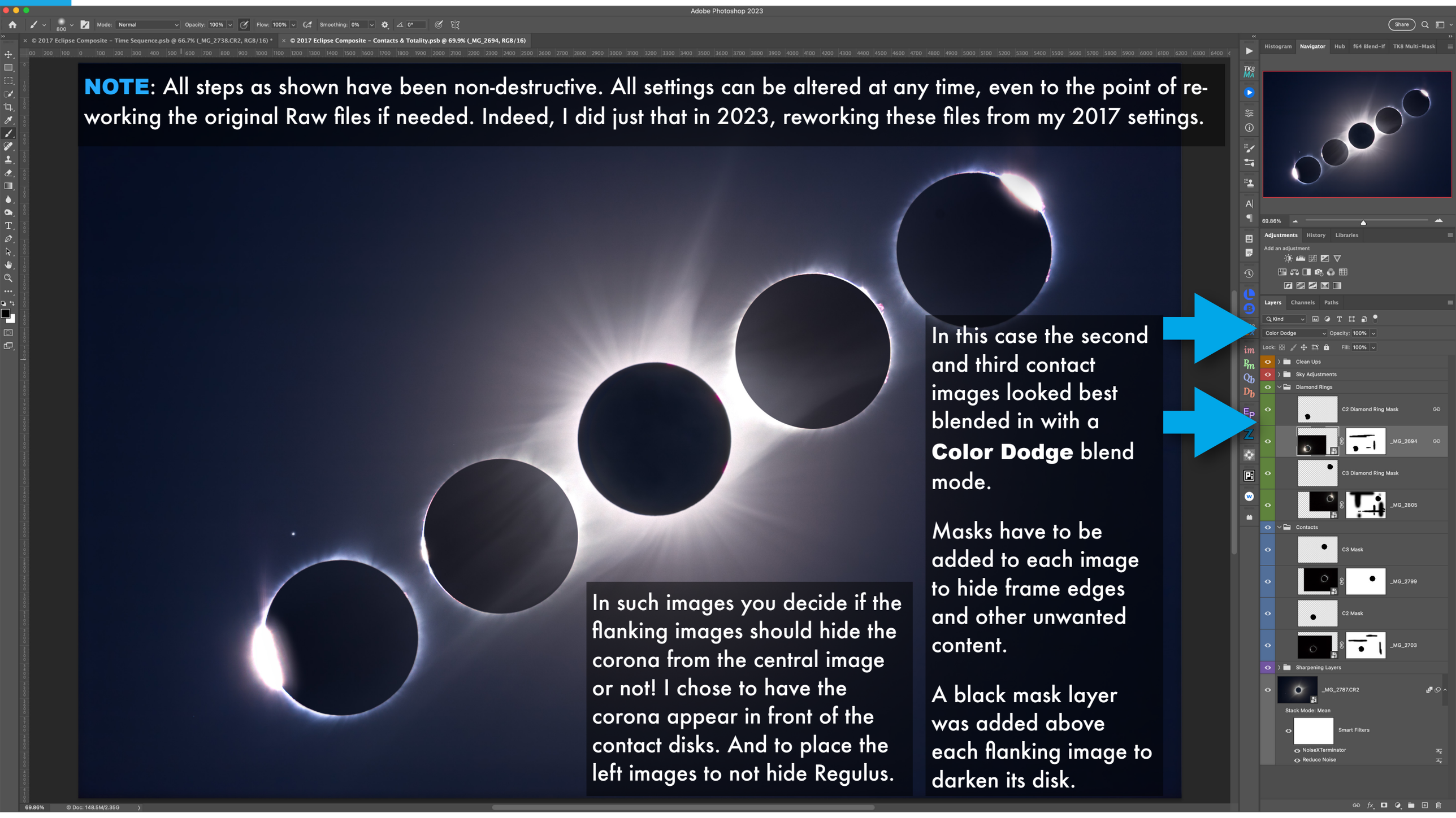
A “SIMPLE” COMPOSITE – 2017

This shows a central exposure blend (using a Mean stack mode) flanked by a pair of 2nd and 3rd contact images, each masked single images.



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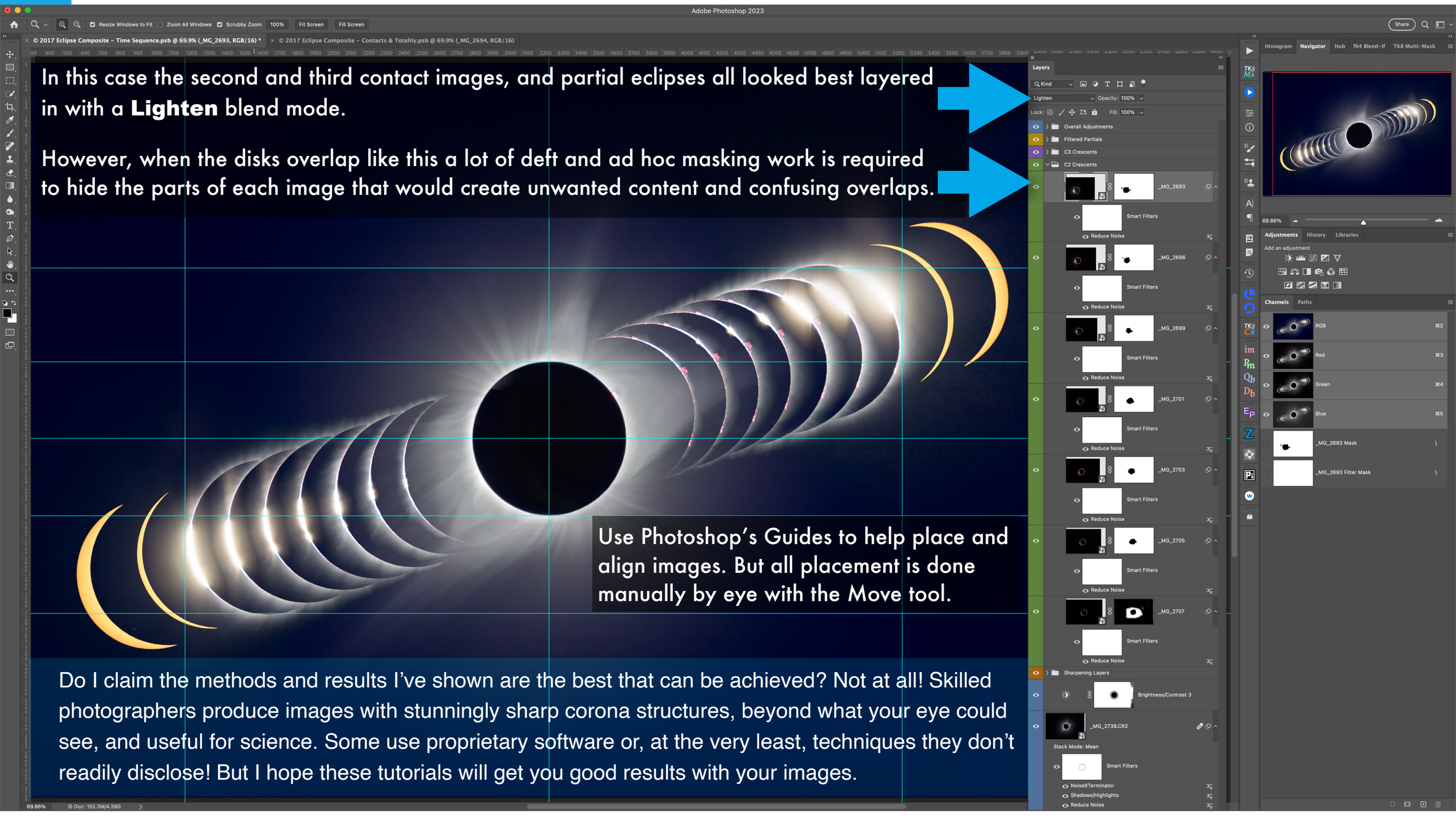
A "COMPLEX" COMPOSITE – 2017

This shows the book's cover image, made of a complex stack of 2nd and 3rd contact sequences, plus flanking filtered partial phases.



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SECTION 8

HOW NOT TO CREATE A COMPOSITE

After every eclipse, the internet is plagued with horrible fakes. People might take the eclipse images fine, but they create composites with the Sun or Moon cartoonishly large, moving along impossible paths, in places where they could never have appeared.

The great height of the Sun in the sky in 2024 will tempt many to stick huge telephoto Suns above wide-angle landscapes. Please don't do that. Honor nature. Preserve reality. And your reputation for honesty.

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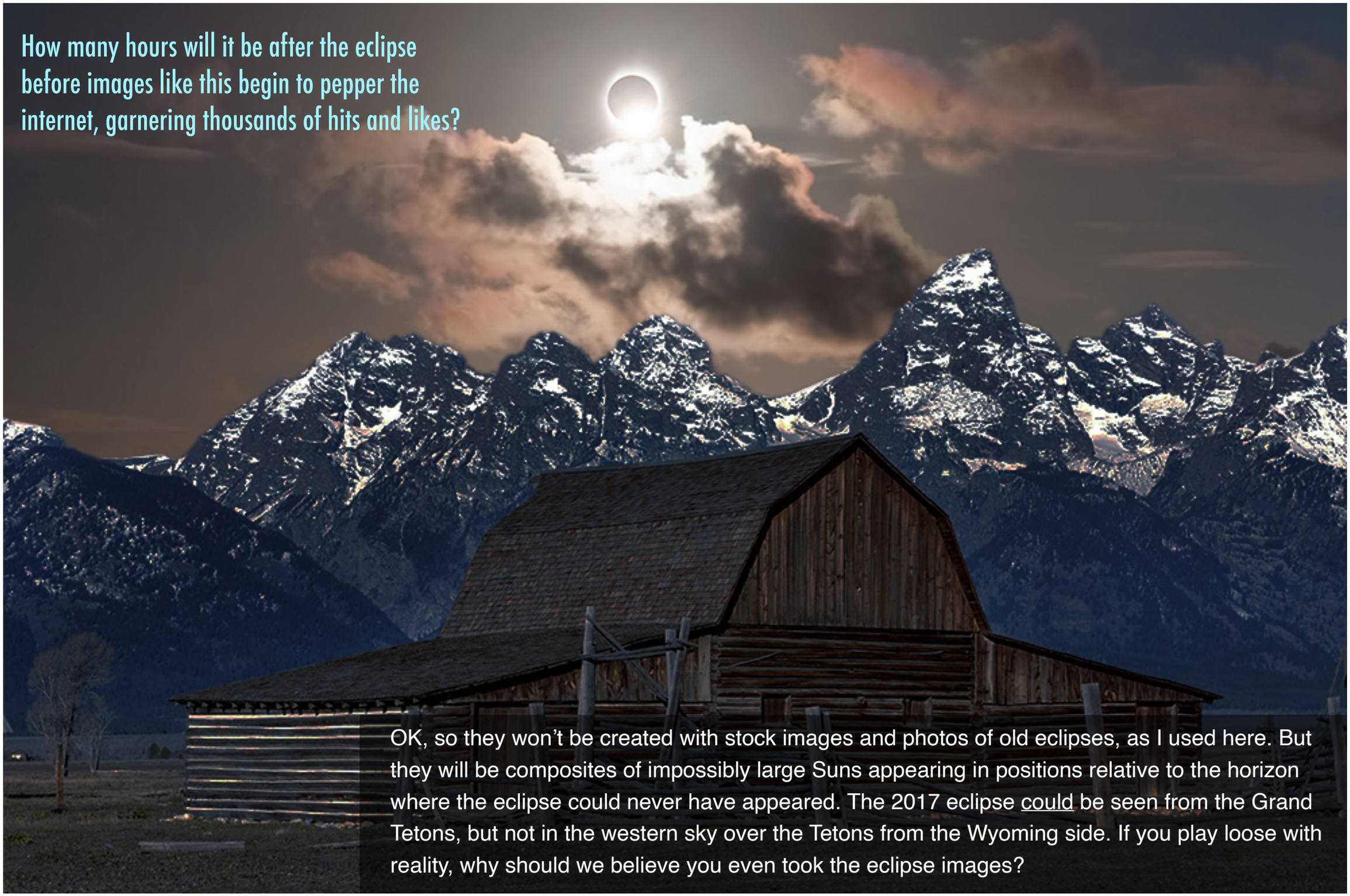
FAKING A SCENE FOR CLICK BAIT



OK, so they won't be created with stock images and photos of old eclipses, as I used here. But they will be composites of impossibly large Suns appearing in positions relative to the horizon where the eclipse could never have appeared. The 2017 eclipse could be seen from the Grand Tetons, but not in the western sky over the Tetons from the Wyoming side. If you play loose with reality, why should we believe you even took the eclipse images?

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CONCLUSION

August 21, 2017, Idaho

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IS THIS YOUR FIRST ECLIPSE?

As this will be the first eclipse for many readers, I have to end as I began, suggesting that you consider not even taking photos! That might be the best advice you'll get from me, worth the money you spent on the book. Follow it, and you might enjoy the eclipse far more than if you had tried to take photos. At the very least, keep your photo plans simple. Don't even think about multiple cameras run by a computer! Grab some quick shots and spend most time looking.

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CAPTURING *VS.* SEEING

Whatever your photo ambitions, plan your gear and sequence to leave enough time to look. Don't see the eclipse only through the camera viewfinder.

As I've pointed out before, the eclipsed Sun will be high in the sky. To frame and focus the camera you might need to use a right-angle finder, as here, or a tilting LCD screen. Great!

But don't do all your looking that way. Plan to look away from the camera and up to the Sun. And to look around at the twilight, the shadow's arrival and departure, and shadow bands.

Use a tripod or mount solid enough that it won't budge as you operate the camera. And learn to change settings blind, just by feel. Remember, it will get dark, and you want to look up. Or plan to shoot just a wide-angle time-lapse you can set running well before totality and forget until totality is over. But remember it at some point.

You do not want to go to the eclipse, have clear skies, and still not see it! Believe me, it happens. You'll have photos but no memories.

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A RECOMMENDED PLAN FOR ECLIPSE FIRST-TIMERS

Here's a final suggestion, summarizing my earlier advice, on how to shoot the total eclipse ... and still see it!

Chapter 10 had details on shooting plans. But the best suggestion I can make for eclipse newbies is: Set up a camera with a suitably wide-angle lens to take in the Sun and scene below. Perhaps place it behind you, to frame you and your group under the Sun. Pre-focus the lens on the distant horizon and leave the lens on manual focus. Put the camera on Auto Exposure Aperture Priority, with the lens at f/2.8 to f/4 and the camera at ISO 100 to 200. About 5 minutes before totality uncap the lens and use an intervalometer to get the camera going on its own, taking a shot every second. You'll end up with several hundred. Don't worry about a filter on the lens. It'll be fine as long as it is not left aimed at the Sun for hours. Then enjoy that 5 minutes leading up to totality – a lot happens in that time! As these folks do, have binoculars handy for close-up views during totality. Just remember to stop the camera after totality.

March 29, 2006, Libya

You might think the couple here is looking at the Sun with unfiltered binoculars, but these are special solar binoculars with filters built-in or added over the front lenses.

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JUST ENJOY THE VIEW!

Your ultimate back-up plan is to simply not worry about photos and gear, and just sit back and enjoy the experience unencumbered by photo phobias.

There's nothing wrong with coming away from an eclipse with no photos. The worst sin is not having seen it at all because you fussed with equipment and didn't look up!

Plan B: Just look! There are always more eclipses still to come. That's the next topic.

November 3, 2013

October 23, 2014

August 11, 1999

July 21, 2009

February 26, 1998

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FUTURE ECLIPSES

A successful eclipse, or perhaps even an unsuccessful one, usually inspires plans for seeing the next eclipse. Indeed, talk of traveling to the next one is usually a prime topic of conversation even before last contact. Total solar eclipses come every 12 to 24 months. You never have long to wait. But you will have far to travel. However, you might find yourself becoming an “umbraphile” and an avid “eclipse chaser.”

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AUGUST 12, 2026 – GREENLAND, ICELAND OR SPAIN?

Whatever high price you might have paid for your hotel or campsite in 2024, the cost of getting to the next total eclipses might be higher.

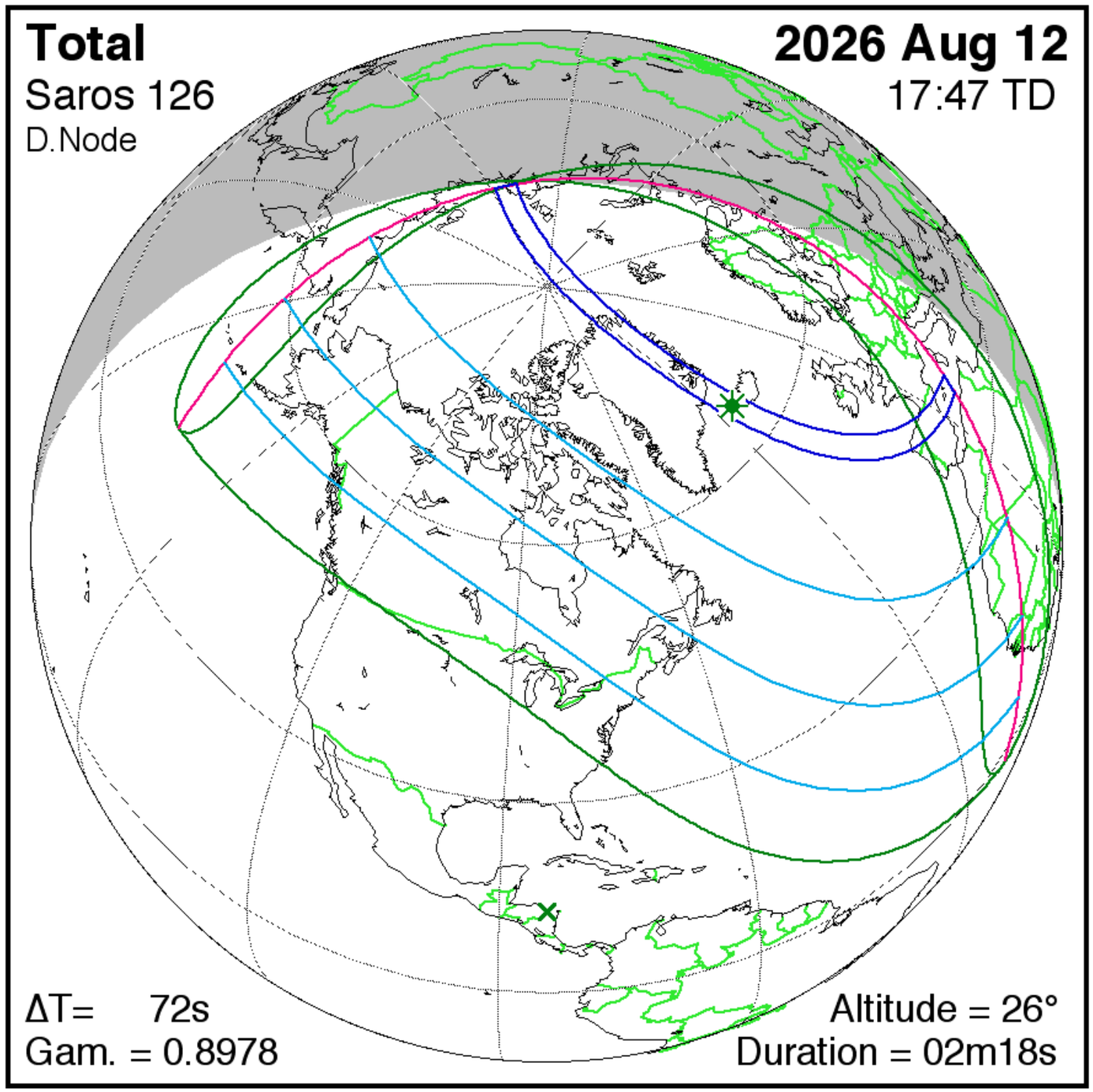
The next TSE after the “Great North American Eclipse” is more than two years later (there is no TSE in 2025).

How does Greenland sound? It is August! Or the well-heeled might be able to board an icebreaker bound for the North Pole.

Iceland will be a popular destination, if only for the spectacular scenery. Reykjavik is in the path. Stay on into late August and you might see auroras, though the night sky will be bright. Daytime auroras, which do exist, are usually too dim to show up in a darkened eclipsed sky.

The path also crosses Portugal and Spain, just grazing Madrid. Valencia is in the path with the Sun low in the west (not east over the ocean) at eclipse time. The Balearic Islands lie at the end of the path and enjoy a sunset eclipse lasting one minute 36 seconds at Palma on Mallorca.

Map courtesy Fred Espenak/EclipseWise.com



Thousand Year Canon of Solar Eclipses
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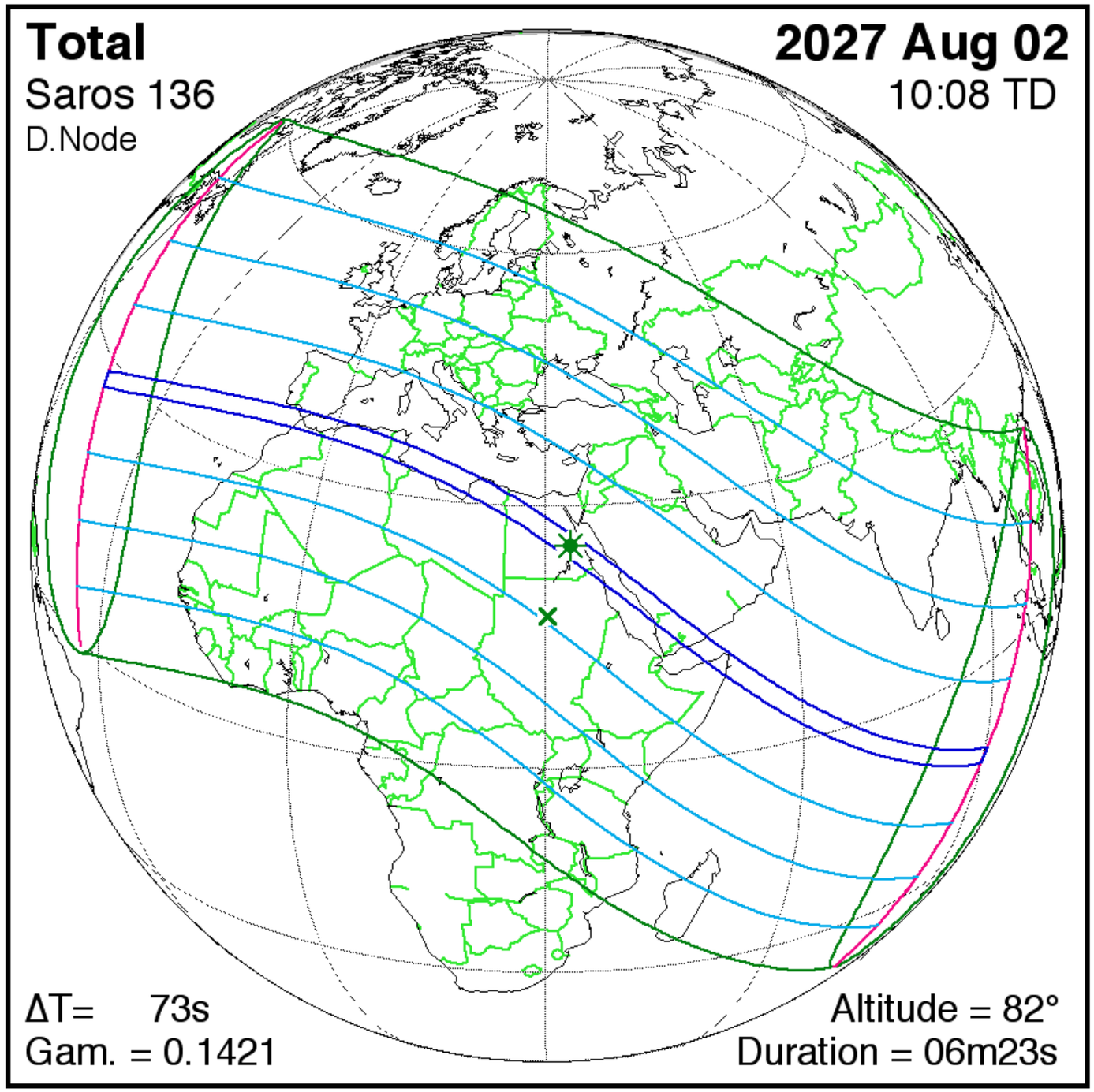
AUGUST 2, 2027 – A LONG ECLIPSE IN LUXOR

You won't get a longer eclipse than this in your lifetime. Totality lasts up to 6m23s, a duration that won't be exceeded until 2114.

For many this will be the North African eclipse, as the umbral shadow crosses Egypt, with Luxor almost on the centerline. The Temple of Karnak and sites on the west bank of the Nile will be hugely popular destinations. At Luxor totality lasts 6m20s, with the Sun 80° up at high noon. If that sounds familiar then you were in Mexico for the July 11, 1991 eclipse. The 2027 eclipse belongs to the same Saros cycle where similar eclipses repeat every 18 years. Tours for 2027 are being advertised now by the major operators, usually offering Nile cruises.

But you could also go to British-owned Gibraltar, or Ceuta across the Strait, a territory of Spain. The shadow crosses Morocco, Algeria, Tunisia, and Libya. Clear skies are almost a guarantee. But it will be hot! Saudi Arabia and Yemen also lie in the path, with the northern tip of Somalia the last continental landfall for the umbra.

Map courtesy Fred Espenak/EclipseWise.com



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JULY 22, 2028 – ECLIPSE DOWN UNDER IN OZ

Australia is blessed with total eclipses in the late 2020s and 2030s. This one passes right over Sydney, which is on the centerline.

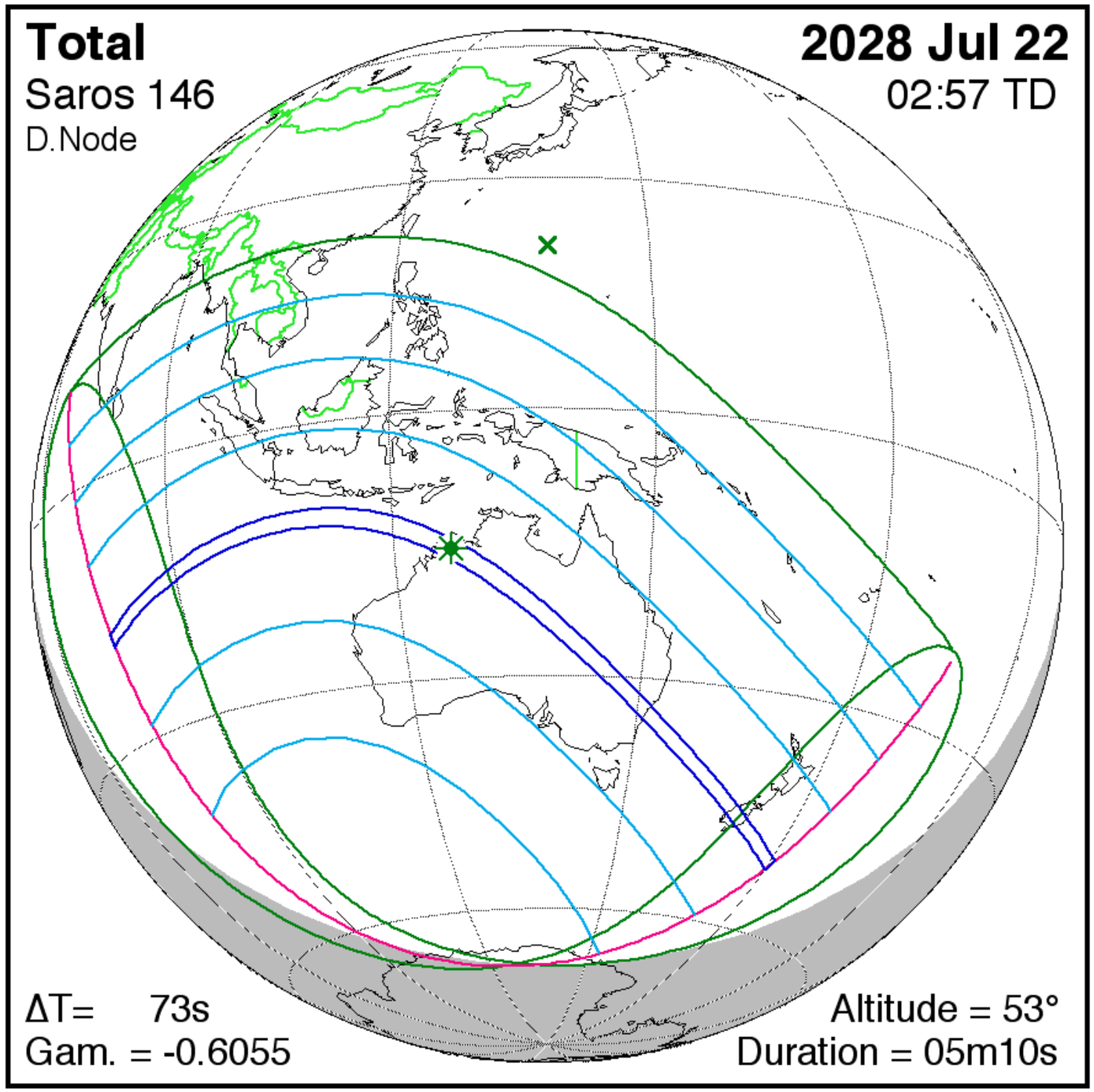
Notice how this eclipse is one year later than the 2027 Luxor eclipse, but less 10 days, after 355 days. That's the length of the lunar year – 12 lunar phase cycles.

This will be a popular eclipse. You could watch it from Circular Quay or while walking up Sydney Harbour Bridge! The Sun will be low in the northwest in the middle of a winter's afternoon.

But if you prefer your Oz experience to be more outback, the path crosses Tennant Creek well north of "the Alice," and just misses Birdsville. The major optical observatories at Siding Spring lie in the path, but "The Dish" radio telescope at Parkes is just south of the path.

For those who prefer the scenery of New Zealand, the lunar shadow crosses the South Island, with Queenstown and Dunedin in the path. But it will be the middle of winter!

Map courtesy Fred Espenak/EclipseWise.com



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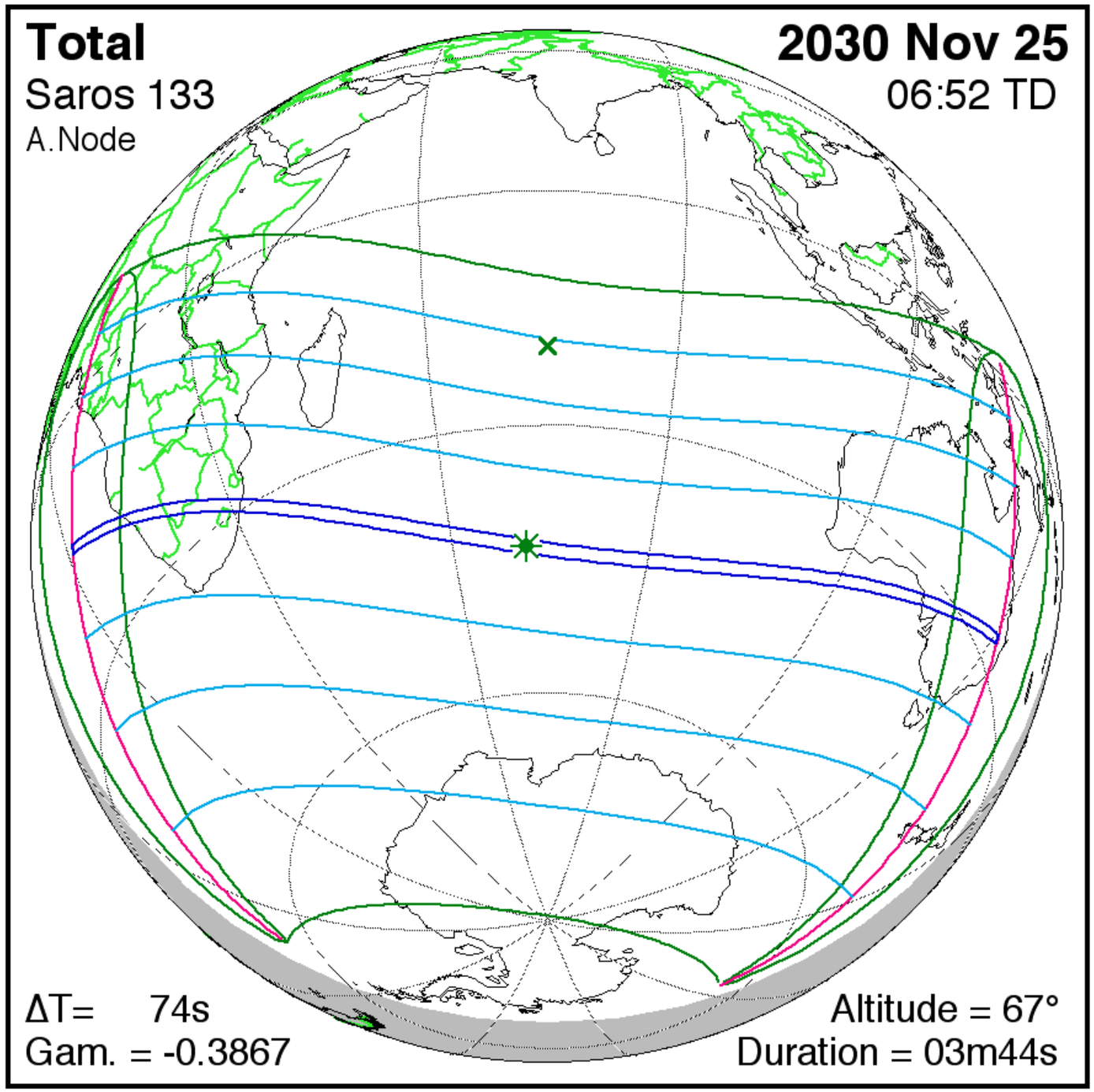
NOVEMBER 25, 2030 – DOWN UNDER AGAIN!

Any excuse to get to Australia is fine by me! This one again touches the great southern continent, bringing totality at sunset.

This eclipse crosses southern Africa (just missing Johannesburg), the vast extent of the Indian Ocean, then reaches landfall again over South Australia. The circumstances are similar to the 2002 eclipse I saw from Ceduna, South Australia. Nearly three decades later the little town on the coast just misses seeing totality again, but the path isn't far away! The path ends with a total eclipse at sunset from northwest of Brisbane, Queensland.

The eclipsed Sun from South Australia, December 4, 2002

Map courtesy Fred Espenak/EclipseWise.com



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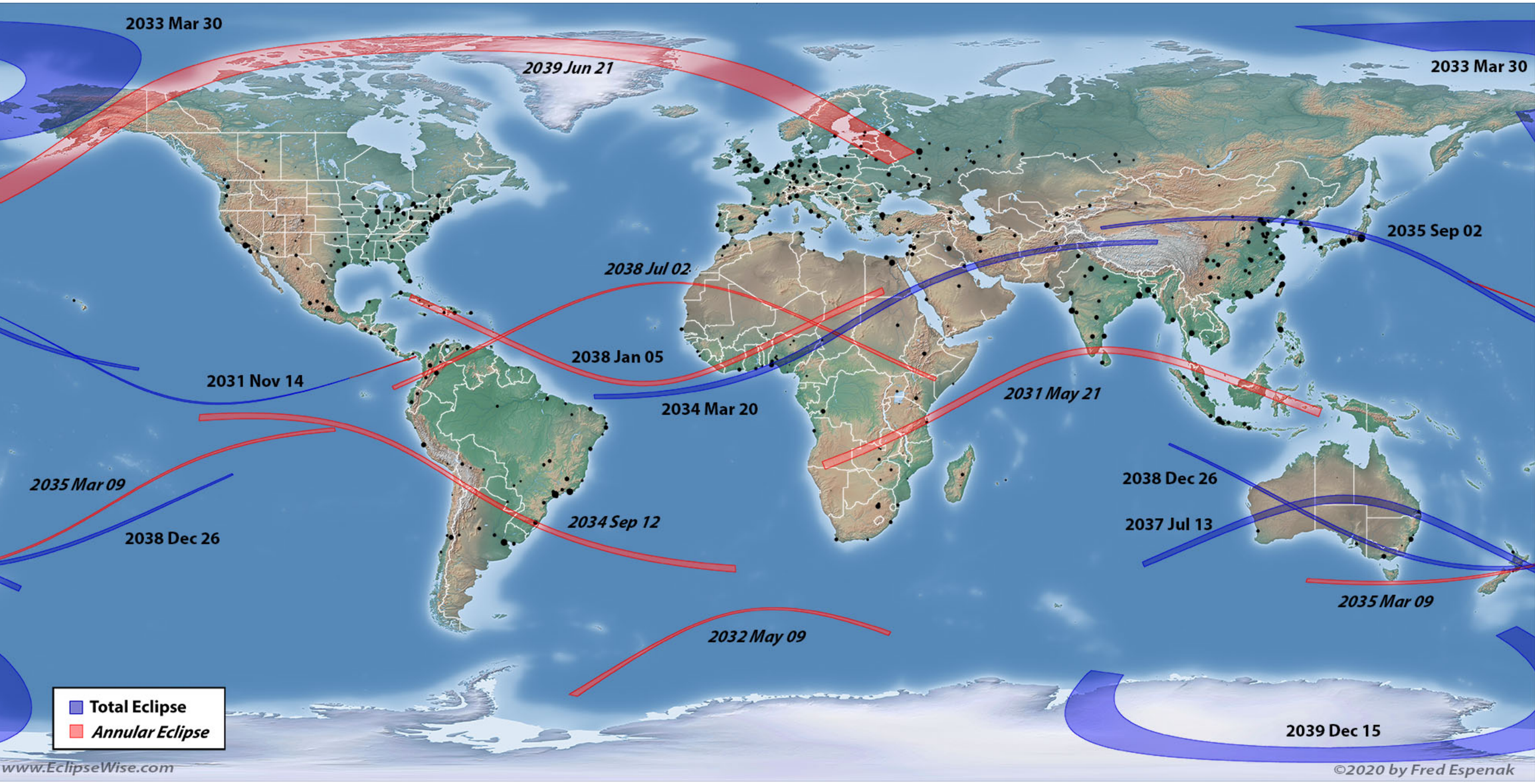
BEYOND, INTO THE 2030s

If you like to plan way ahead here's what you have to look forward to in the next decade for both annular and total solar eclipses.

Note the next total eclipse in North America isn't 2044 or 2045 as some state, but 2033. In Alaska, in March! Great for aurora tours!



Map courtesy Fred Espenak/EclipseWise.com

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FUTURE ECLIPSES IN NORTH AMERICA

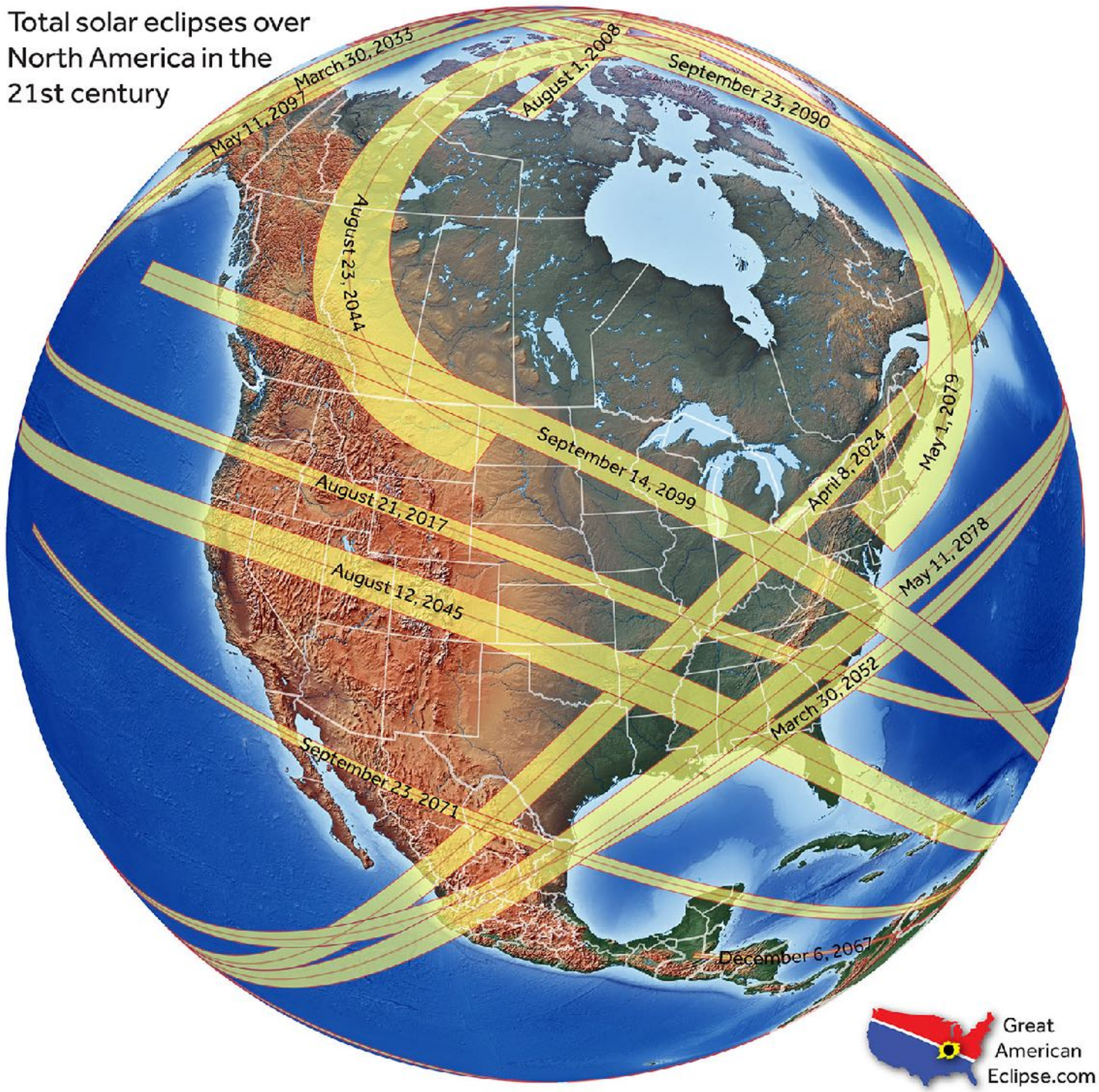
For those who prefer to stay closer to home, you'll have to wait a while. But stick around for 2044, 45, 52, 71, 78, 79, and 99!

Those who eat right and exercise will be able to witness three total eclipses within 8 years in North America, in August 2044 and August 2045 (a lunar year apart), and in March 2052. The 2045 and 2099 eclipses also count as "Great American Eclipses," or "Eclipses of the Century" with the 2099 event also crossing western Canada. In fact, it passes right over my home in southern Alberta.

As does the sunset eclipse on August 22, 2044. That one is unusual, as the shadow sweeps down from the Arctic, traveling from north to south.

We also have two east coast eclipses a lunar year apart in May 2078 and May 2079.

For more details of future eclipses see eclipse chaser extraordinaire Xavier Jubier's wonderful website.



Map courtesy Michael Zeiler/GreatAmericanEclipse.com

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TOTAL LUNAR ECLIPSES

If the solar eclipse sparked your interest in celestial alignments, then mark March 13, 2025 on your calendar. That's the next total eclipse of the Moon.

Total lunar eclipses (TLEs) are not so frequent as TSEs, but when they do occur they can be seen from more than half the planet. So you have many chances in your life to see the Full Moon eclipsed by Earth's shadow. Totality can last a few minutes, but more typically lasts an hour. They can only be seen at night, but can be in progress at moonrise or moonset. TLEs are not as dramatic as TSEs, but have their own beauty with wonderful colors and sky effects.

September 27, 2015 (both)

During a total lunar eclipse, the Full Moon turns deep red as it travels through Earth's umbral shadow. The only sunlight able to reach the Moon is red light filtered and refracted by Earth's atmosphere.

Date	Region Visible
March 13, 2025	North America, South America
September 7, 2025	Africa, Asia, Australia
March 3, 2026	Asia, Australia, Pacific, western North America
August 27, 2026	Deep partial (almost total): North & South America
December 31, 2028	Europe, Africa, Asia, Australia, Pacific
June 25, 2029	North & South America, Europe, Africa
December 20, 2029	Americas, Europe, Africa, Asia

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WHERE TO LEARN MORE

As in 2017, the 2024 eclipse has prompted a wealth of information, on-line and in print. I absolutely recommend referring to one of the websites or books, to get detailed local eclipse circumstances (times, etc.) for your chosen site, and for detailed path maps, essential information for a successful eclipse. Sites and books also provide enriching information about the history and science of eclipses to help you appreciate the spectacle all the more.

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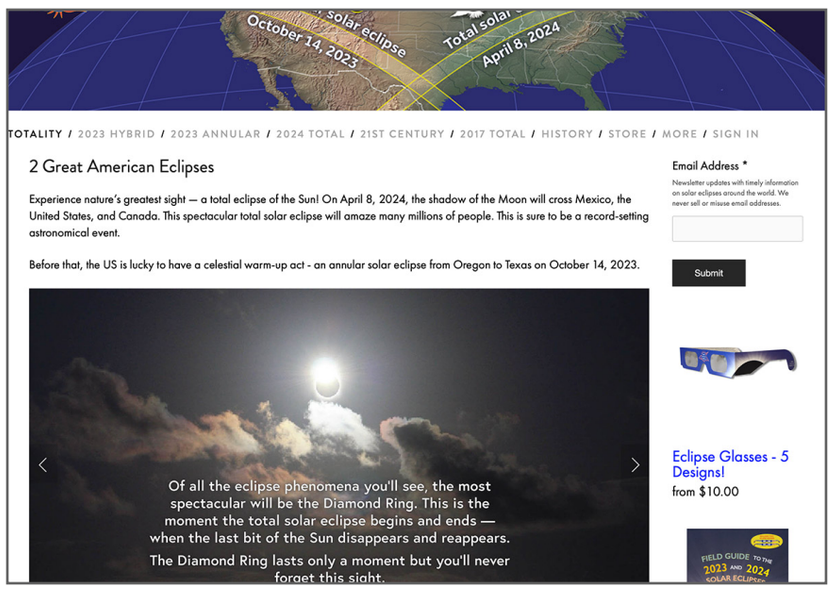
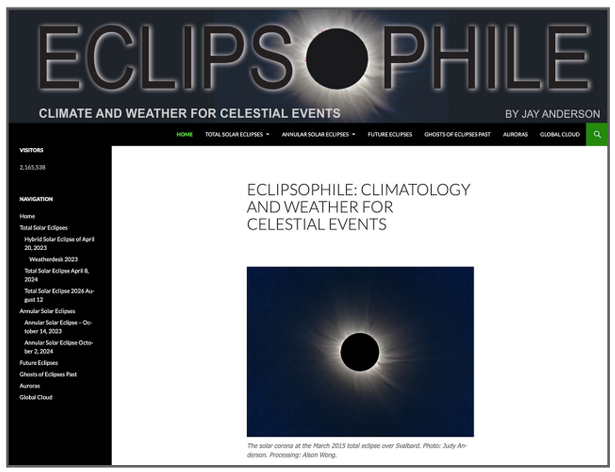
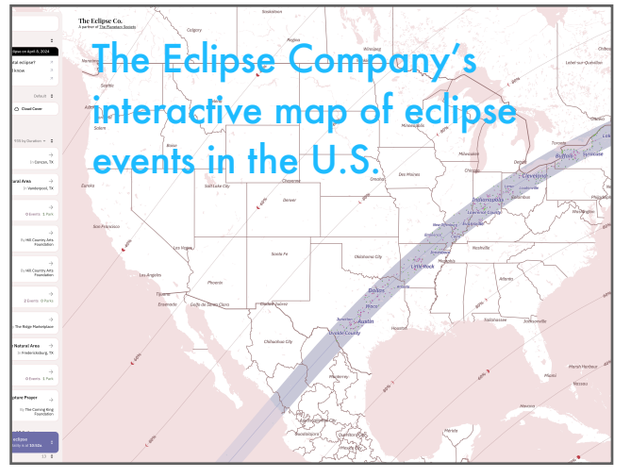
ECLIPSE WEBSITES

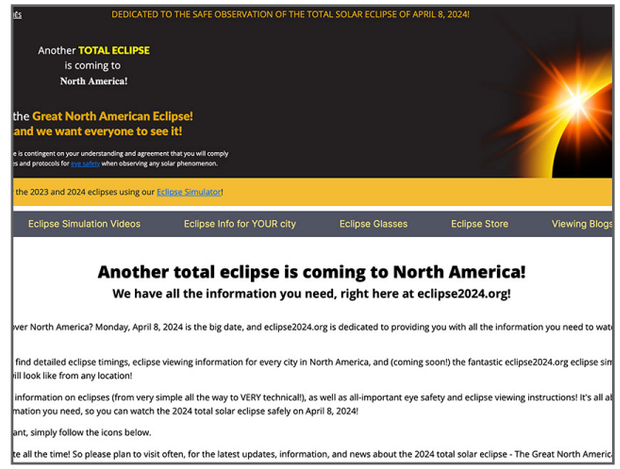
Want all the details, times, and locations for the eclipse? Tap on the image of the website to go to it.

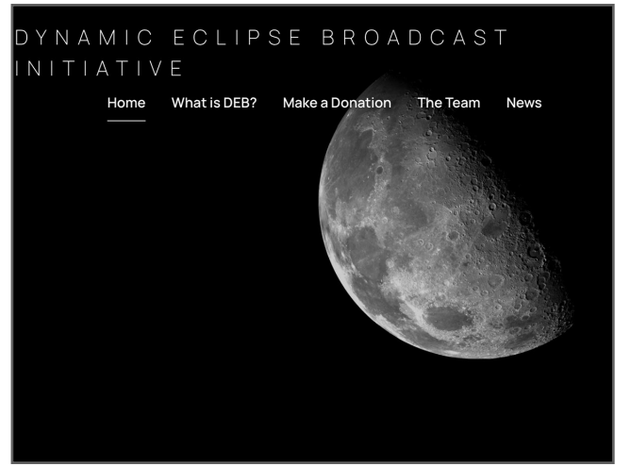
- Detailed eclipse path maps are at Michael Zeiler's site www.GreatAmericanEclipse.com.
- Details on eclipse circumstances are at Fred Espenak's site at www.EclipseWise.com
- Weather prospects are at Jay Anderson's site at www.eclipsophile.com
- Xavier Jubier has information about past and future eclipses at http://xjubier.free.fr/en/site_pages/Solar_Eclipses.html
- The DEB Initiative is a continent-wide program of coordinated images.
- Links to a lecture series I participated in is at the Kalamazoo Astronomical Society's page.
- A map of marking lots of eclipse events across the U.S. is at TheEclipse.company.

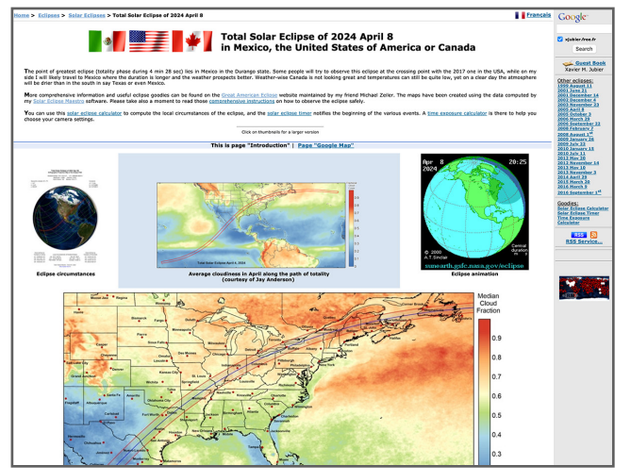












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ECLIPSE INFORMATION AND RESOURCES

Here are more websites that provide a wealth of information about the coming eclipses, ideas for family activities, and links to learn more.

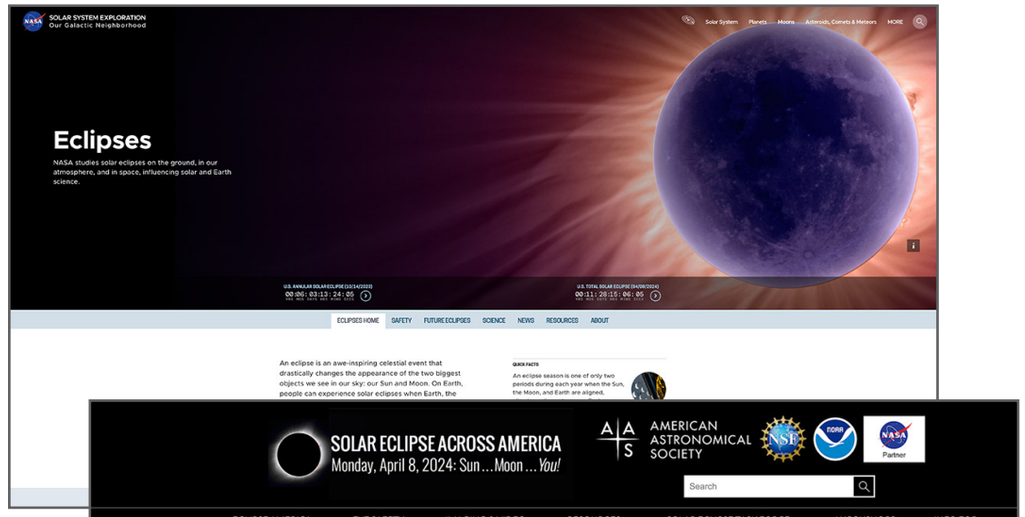
On eclipse day, you'll be able to tune into live feeds from sites up and down the path. Views from the southwest or Mexico will provide a preview; views from the northeast provide replays. Prior to both the 2023 and 2024 eclipses, social media feeds will be advertising links to view the events live.

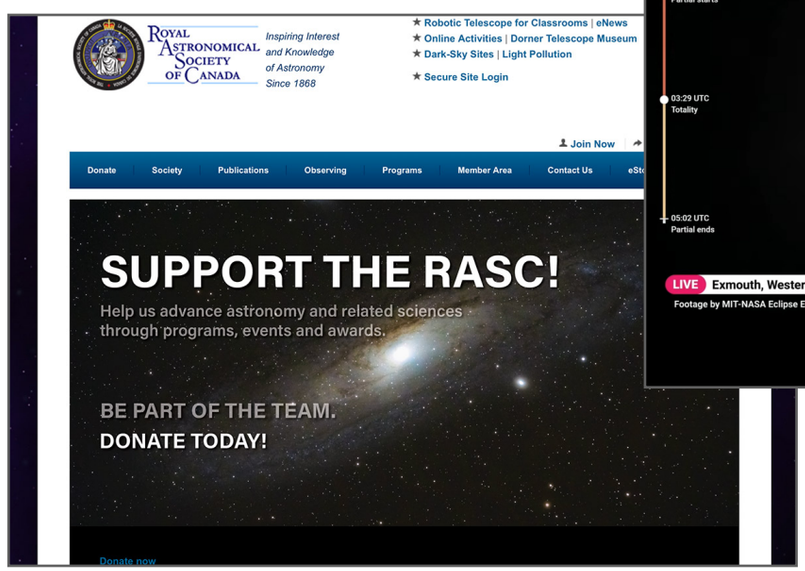
In addition, NASA and the American Astronomical Society (AAS) have websites with lots of accurate eclipse information, listings of eclipse events you can attend, and suggested activities for families.

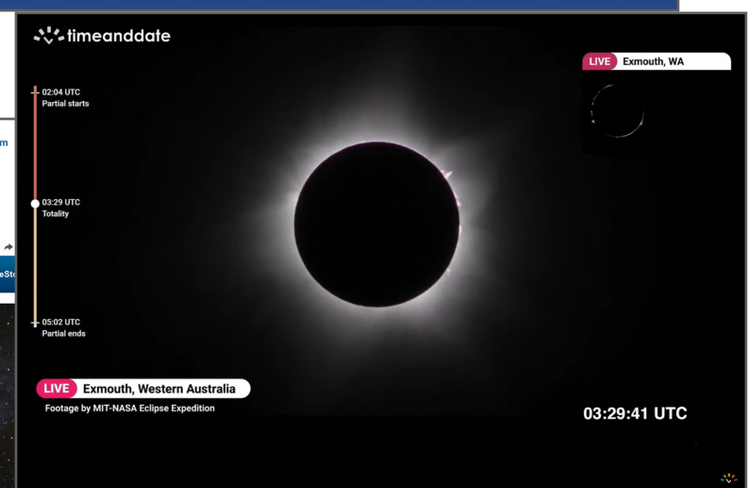
In Canada, the Royal Astronomical Society of Canada (RASC) will be co-ordinating eclipse news and events, and helping local authorities to plan for eclipse day. In whatever city you live, check your local astronomy club, planetarium or science center to see what they might have planned for public events.

Tap on a web page image to go to that site.

URLs for live stream sites were not available as of this writing, but check NASA, Slooh.com, TimeandDate.com, and The Exploratorium. In 2024 there will be many live feeds.







Above: The TimeAndDate feed of the April 20, 2023 hybrid eclipse from Western Australia.

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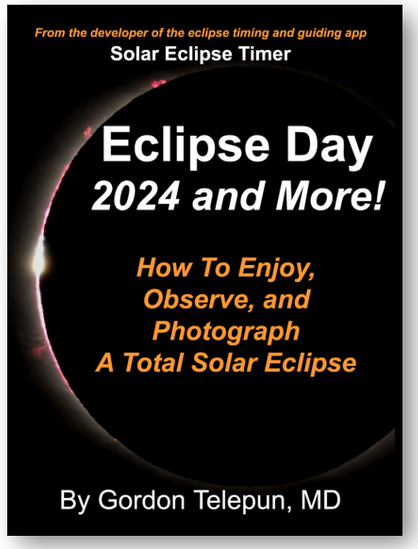
ECLIPSE APPS

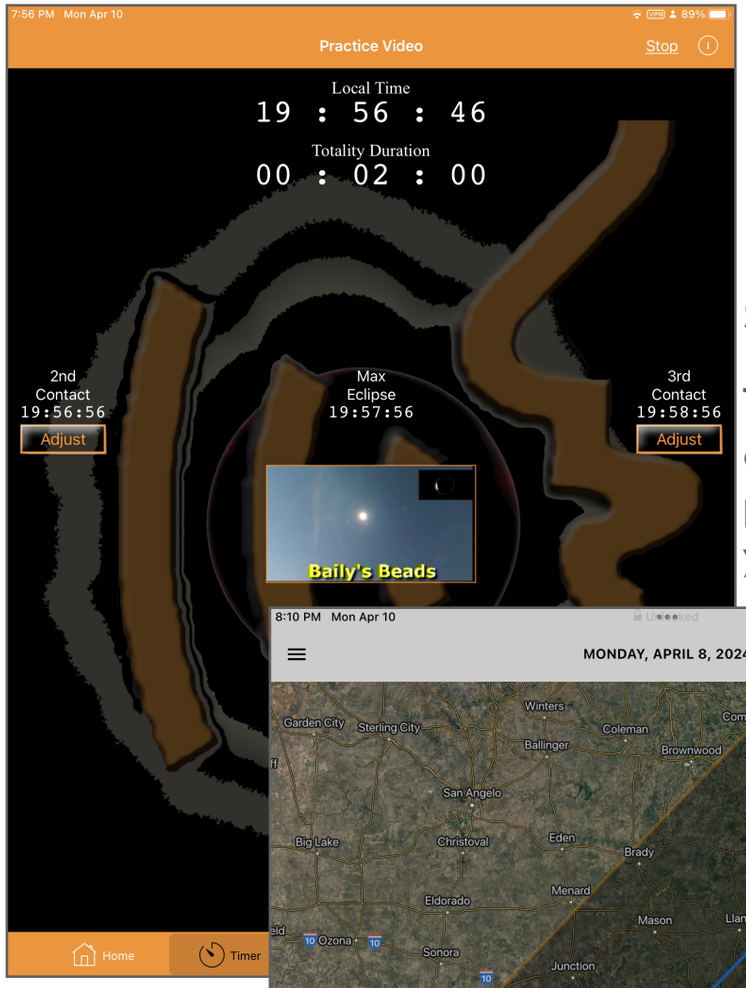
Here are recommended apps to help you plan and execute that plan.

Perhaps the most useful app is Solar Eclipse Timer by Gordon Telepun MD. Have it on your phone on eclipse day. It automatically loads the correct times for your location and provides audio prompts for what to do and what to look for. A companion book (ebook and print) providing very detailed descriptions of what to see is also available from Telepun's website.



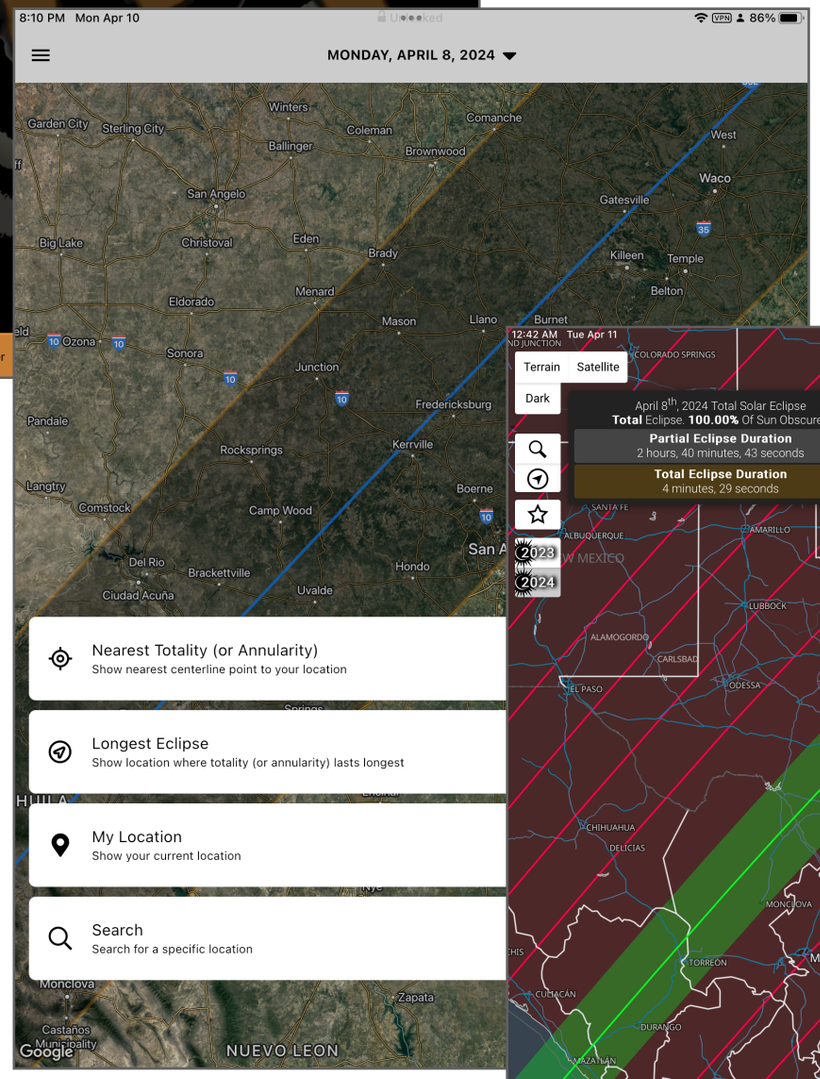
Totality is a free app which provides interactive path maps and times based on your planned or current location. Very handy to have on the road.

Astrospheric, a terrific weather app worth having, also now includes eclipse path maps that you can overlay with predicted cloud cover maps, the most useful information you will want to know pre-eclipse.



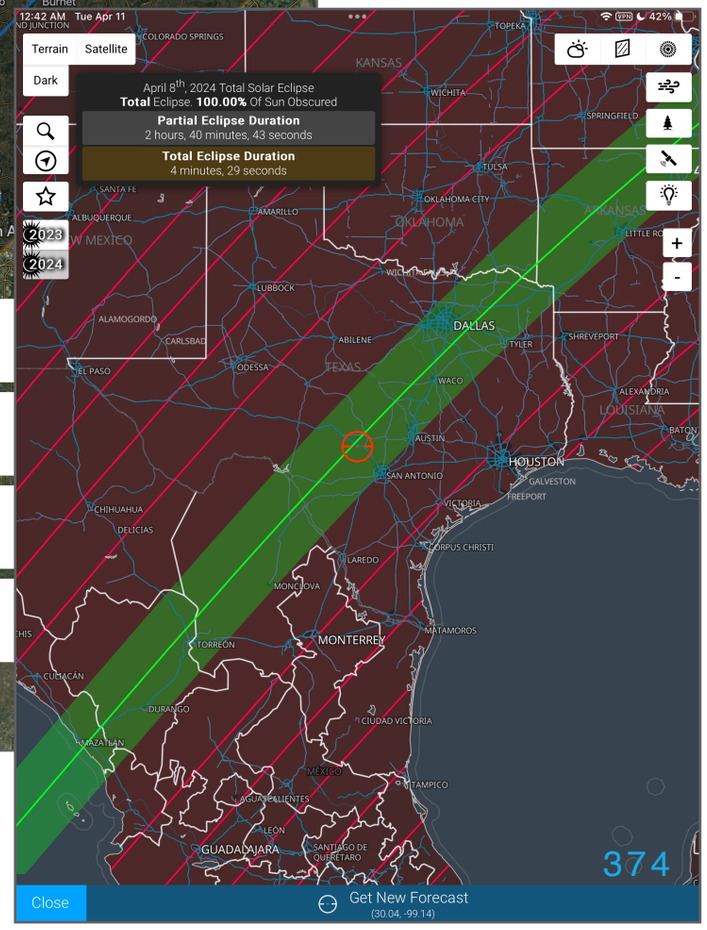
Solar Eclipse Timer (SET)

The demo allows you to hear what SET can inform you about on eclipse day. Its prompts cannot be customized to tell you how to adjust your camera settings.



Totality provides accurate path maps, useful to have for a last-minute chase.

Astrospheric now provides eclipse information.



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INTERACTIVE ECLIPSE MAPS

The best way to determine the exact circumstances for your eclipse site is to use an interactive Google™ map to zoom in and click on your site.

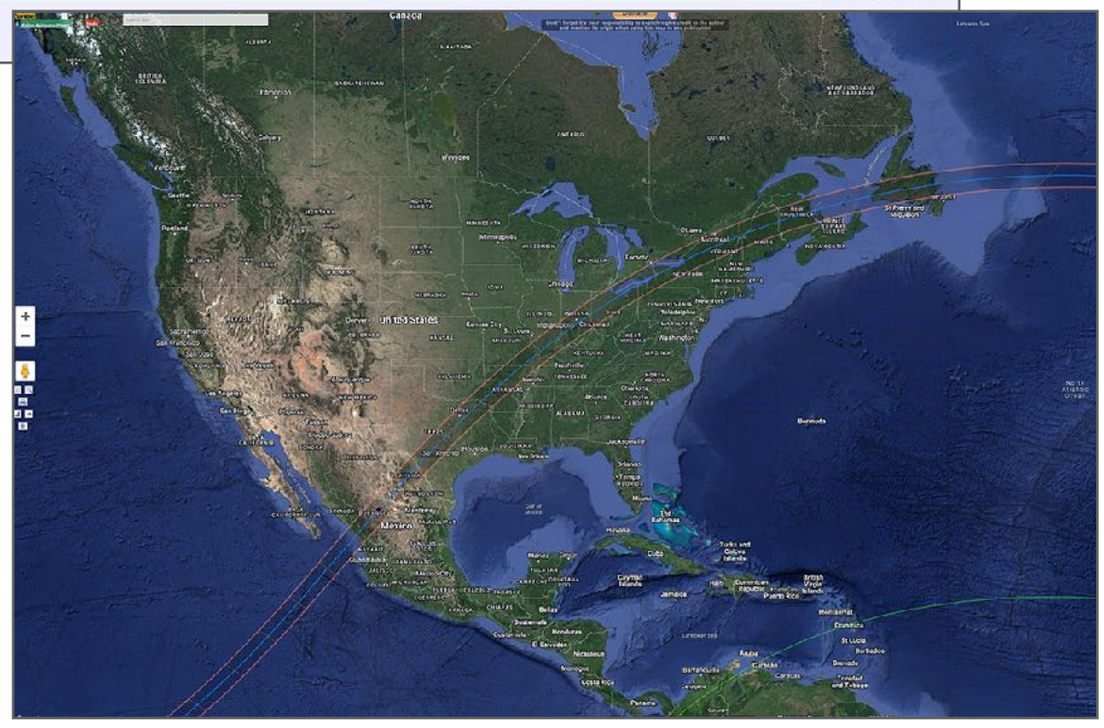
Eclipse experts and veteran shadow chasers Fred Espenak (Mr. Eclipse) and Xavier Jubier both present clickable Google maps with overlays of the eclipse path.

See —

- https://www.eclipsewise.com/solar/SEgmapx/2001-2100/SE2024Apr08Tgmapx.html
- http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2024_GoogleMapFull.html

Add these sites to your device's home screen. Or use one of the apps shown previously to provide real-time updates on where you are in the path on a last minute move.

But it will be best to also have a printed eclipse atlas with you, as shown later in this section.



Tap on the images to go to these websites, if you have an internet connection.

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INTERPRETING INTERACTIVE ECLIPSE MAPS

Here's how to interpret some of the numbers presented in the pop-up box. This example was for Carbondale, Illinois in 2017. Courtesy Xavier Jubier.

C1 = First Contact – Start of Partial Eclipse

C2 = Second Contact – Start of Total Eclipse

C3 = Third Contact – End of Total Eclipse

C4 = Fourth Contact – End of Partial Eclipse

Select that event to display a small image of the appearance of the eclipse at that time.

Hit Help for more details.

Duration of totality at that spot

37° 43' 30.39" N <–>	37.72511°	2m 37.5s (total solar eclipse)		Help
89° 13' 11.89" W <–>	-89.21997°	2m 36.1s (lunar limb corrected)		

Umbral depth : 82.30%
10.1km (6.3mi)
Path width : 114.4km (71.1mi)
Obscuration : 100.00%

Max

Magnitude at maximum : 1.01259
Moon/Sun size ratio : 1.03059
Umbral vel. : 0.660km/s (1476 mph)

Event (ΔT=68.8s)	Date	Time (UT)	Alt	Azi	P	V	LC
Start of partial eclipse (C1) :	2017/08/21	16:52:25.4	+60.1°	145.3°	292°	01.3	
Start of total eclipse (C2) :	2017/08/21	18:20:05.6	+63.7°	191.2°	103°	08.9	-0.7s
Maximum eclipse (MAX) :	2017/08/21	18:21:24.4	+63.7°	191.9°	204°	05.5	
End of total eclipse (C3) :	2017/08/21	18:22:43.1	+63.6°	192.7°	304°	02.1	-2.1s
End of partial eclipse (C4) :	2017/08/21	19:47:27.8	+54.7°	230.0°	114°	09.5	

Time of Event in UT (Greenwich)

Subtract:

4 hours for EDT

5 hours for CDT

6 hours for MDT

7 hours for PDT

Altitude (height) and Azimuth of the Sun at that time.

90° Azimuth = due east

180° = due south

270° = due west

V = Clock position of the point on the solar disk that the Moon contacts the Sun, relative to the horizon

1.3 = near 1 o'clock (near top of disk)

8.9 = near 9 o'clock position (left edge)

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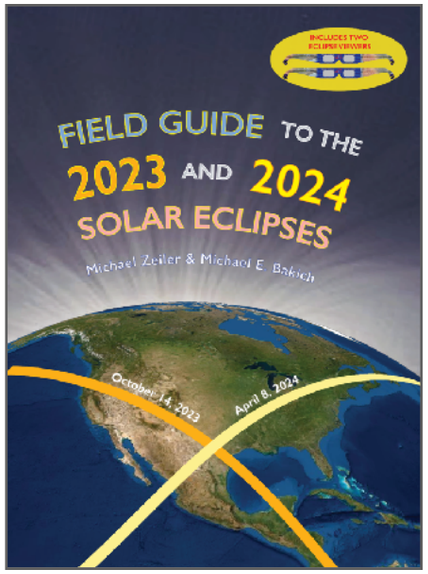
ECLIPSE BOOKS AND ATLASES

Here are books and atlases I can recommend for reference.

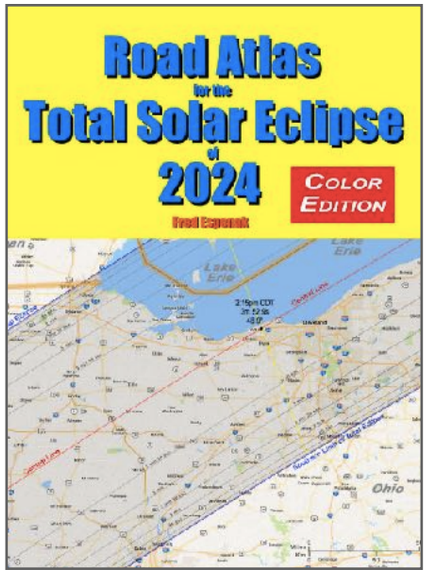
Some books, such as by Littmann and Nordgren, are great background science books. Others serve as travel guides and trip planning aids. The books by Espenak (www.eclipsewise.com) and Zeiler (www.greatamericaneclipse.com) are essential references to eclipse facts and figures.

Search for these books and atlases at your local shop or on-line booksellers. I don't provide links to each title here.

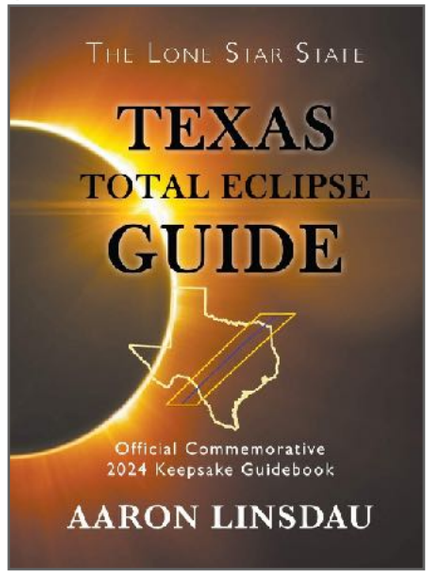
An excellent travel guide with maps. By Zeiler and Bakich.



Nothing beats detailed printed atlases and road maps. Get it!

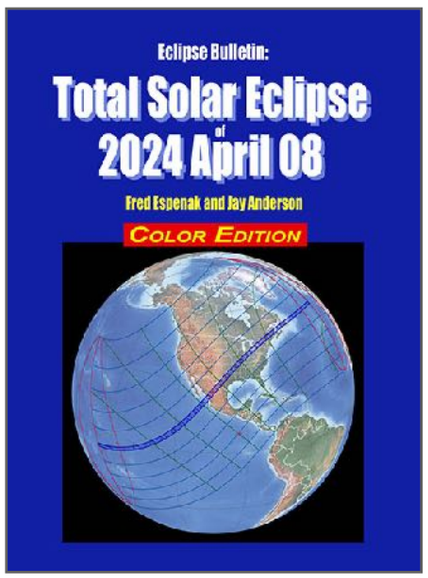


One of a series of short state-by-state travel guides for 2024.

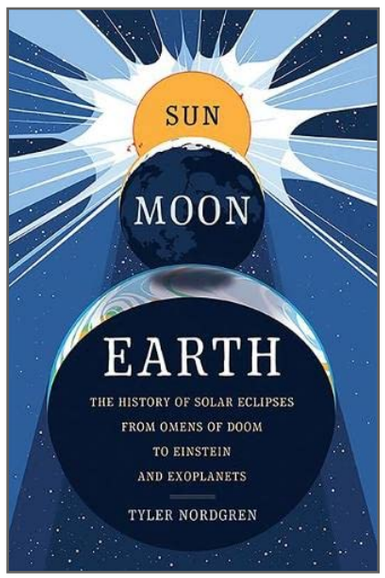


Lots of advice and tips on sites along the path. By Jamie Carter.

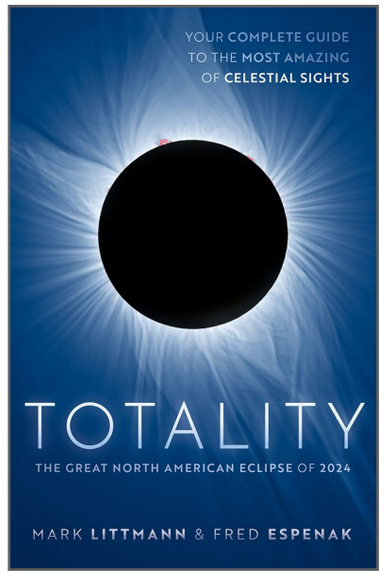
The bible of eclipse books with all the facts, figures & tables.



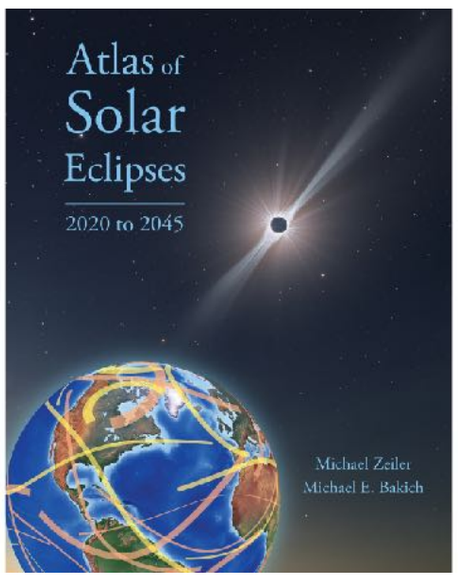
A fine history of eclipse lore and science. By Tyler Nordgren.



The definitive book, revised in 2023. By Littmann & Espenak.



Beautifully illustrated atlas of upcoming eclipses until 2045.



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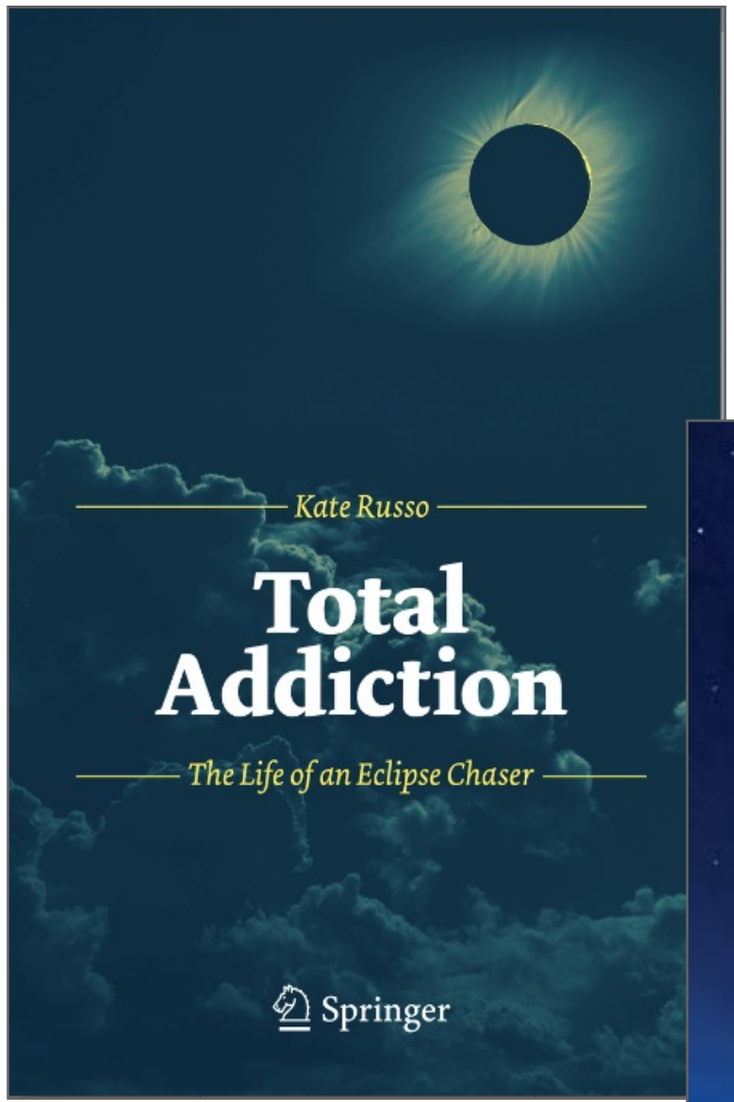
ECLIPSE BOOKS – ECLIPSE CHASER STORIES

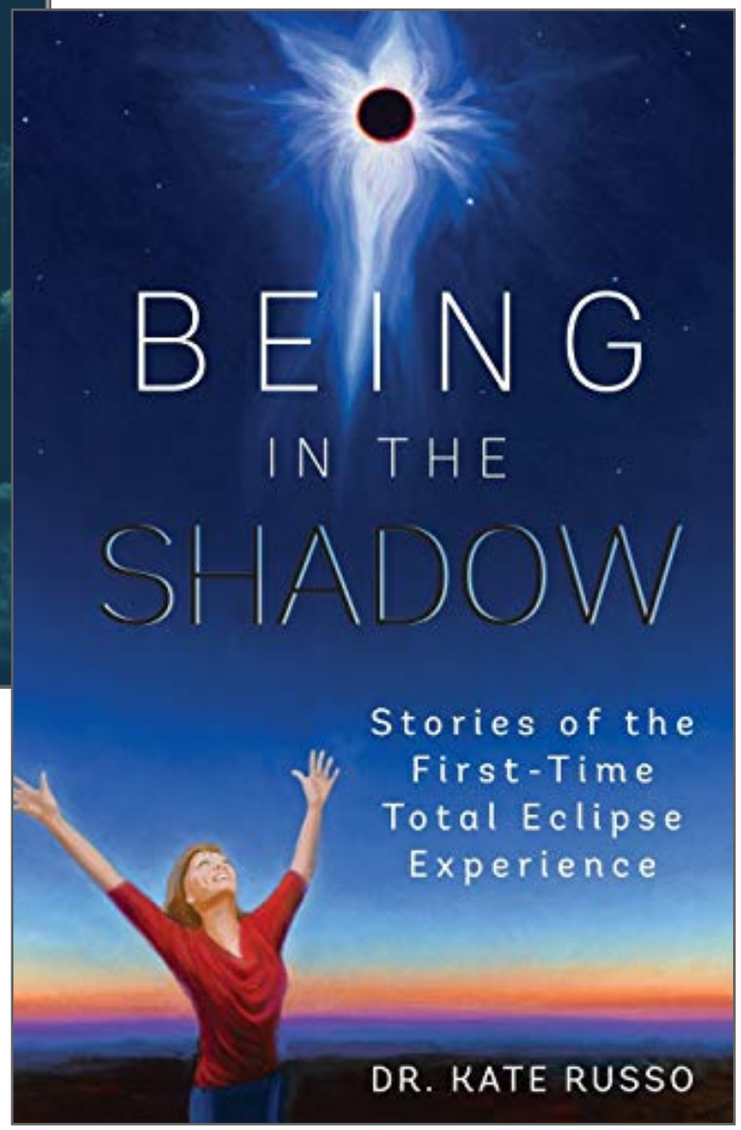
If you become an eclipse addict, here is some therapy from eclipse chaser and psychologist Kate Russo.

Lots of eclipse books – like mine! – talk in tremendous technical detail about the eclipse. But none, up to now, have talked about the eclipse chasers. Just why do people pursue the Moon's shadow around the world no matter where it might take them? It is an addiction, to which you might succumb.

If so, you are in good company, as author and eclipse chaser Kate Russo documents in interviews with numerous eclipse chasers. Highly recommended.

Check out Kate's website at http://www.beingintheshadow.com





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INSPIRING IMAGES AND MOVIES

Here are websites for just a selection of the inspiring photographers and videographers who shoot eclipses.

Mr. Eclipse

Fred Espenak not only calculates eclipses better than anyone else (we depend on his works) but he shoots them beautifully, too!

EclipseGuy

I've had the pleasure of standing in the shadow a couple of times with David Makepeace. No one creates eclipse videos better than David.

Alson Wong

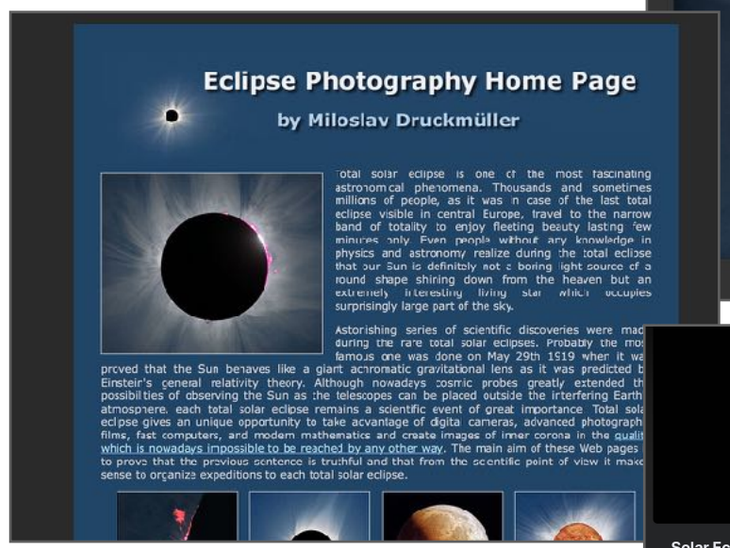
Stunning images of the corona created with great compositing techniques.

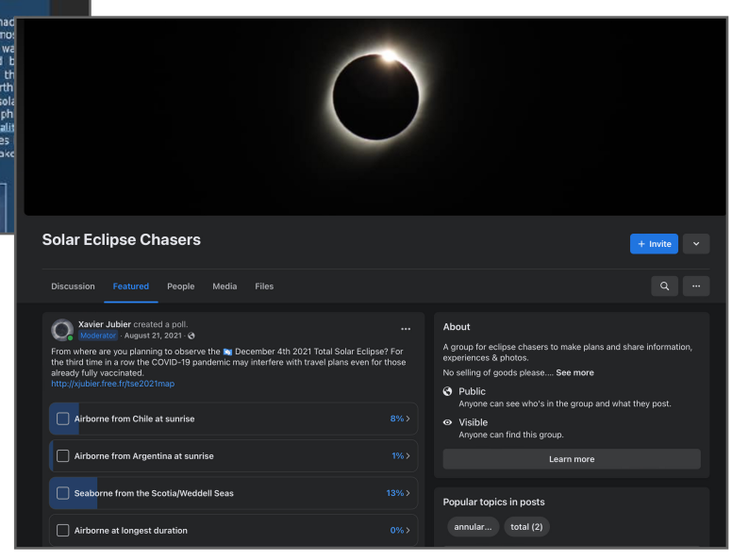
Miloslav Druckmüller

Don't expect to duplicate Miloslav's works – he uses complex and custom software to merge his eclipse exposures for breathtaking results!

Solar Eclipse Chasers

A Facebook group where chasers hang out and post images and stories.





Tap on the page images to go to that website.

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QUESTIONS?

I've attempted to provide a very complete guide to shooting the eclipse, but ...

... questions might remain. You may email me at

amazingsky [at] icloud.com

However, my time and expertise extends only so far! What I likely cannot answer are questions about how to adjust specific camera models. Point-and-shoot cameras are notorious for burying their manual exposure and ISO settings in obscure menus, if they even have them. Read the camera's instruction book.

Nor can I provide advice on the best place to go, the best scenery to include, or where to stay.

And don't fuss about buying the "best" camera or telescope. Any DSLR or DSLM camera can do a great job, as will any telescope that can accept a camera body. For details on how to align your telescope mount, check its manual or consult the manufacturer.

Strange sights are seen in the shadow of the Moon!

Click the icons to go to my social media sites.

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CLEAR SKIES!

You will never be so conscious of the weather as you will be on April 7. And on the morning of April 8. Some will experience triumph; some will experience heartbreak. All in the path will experience totality. It will get dark very quickly.

But with luck, good planning, and the ability to move you should be able to witness this sight – the Moon hiding the disk of the Sun to reveal only its stunning corona. I hope you'll capture the sight for posterity.

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HAPPY ECLIPSE DAY!

Whether the day be cloudy or clear, enjoy the experience of standing in the shadow of the Moon.

It's great to travel with a small group of friends and family, to enjoy the experience together. My ideal is a group small enough to allow agility and mobility. Being in too large a group makes it hard to move the day before – or the hour before – the eclipse, and you may need to do so.

Every family group will include one or two people along for the ride, skeptical, and needing to be convinced this is really going to be a worthwhile sight. "So it's going to get dark? It gets dark every night! So what?"

After the eclipse they will need no convincing. They will be the first ones to ask, "Where's the next one? Can we go!!?"

The eclipse will be an event you, your friends, and your family will remember for the rest of your lives. Capture images and video, yes. But if stuff goes wrong, just capture happy memories!

Our band of eclipse chasers in 2012. Don't forget the post-eclipse group photo! Be sure to take champagne and cups for the traditional post-totality celebration.

This is also the time to break out the flags. You'll likely meet eclipse chasers from around the world.

With all the excitement, if you think you'll be able to continue to shoot a series of partial eclipse images until the bitter end, think again! I've done it just once!

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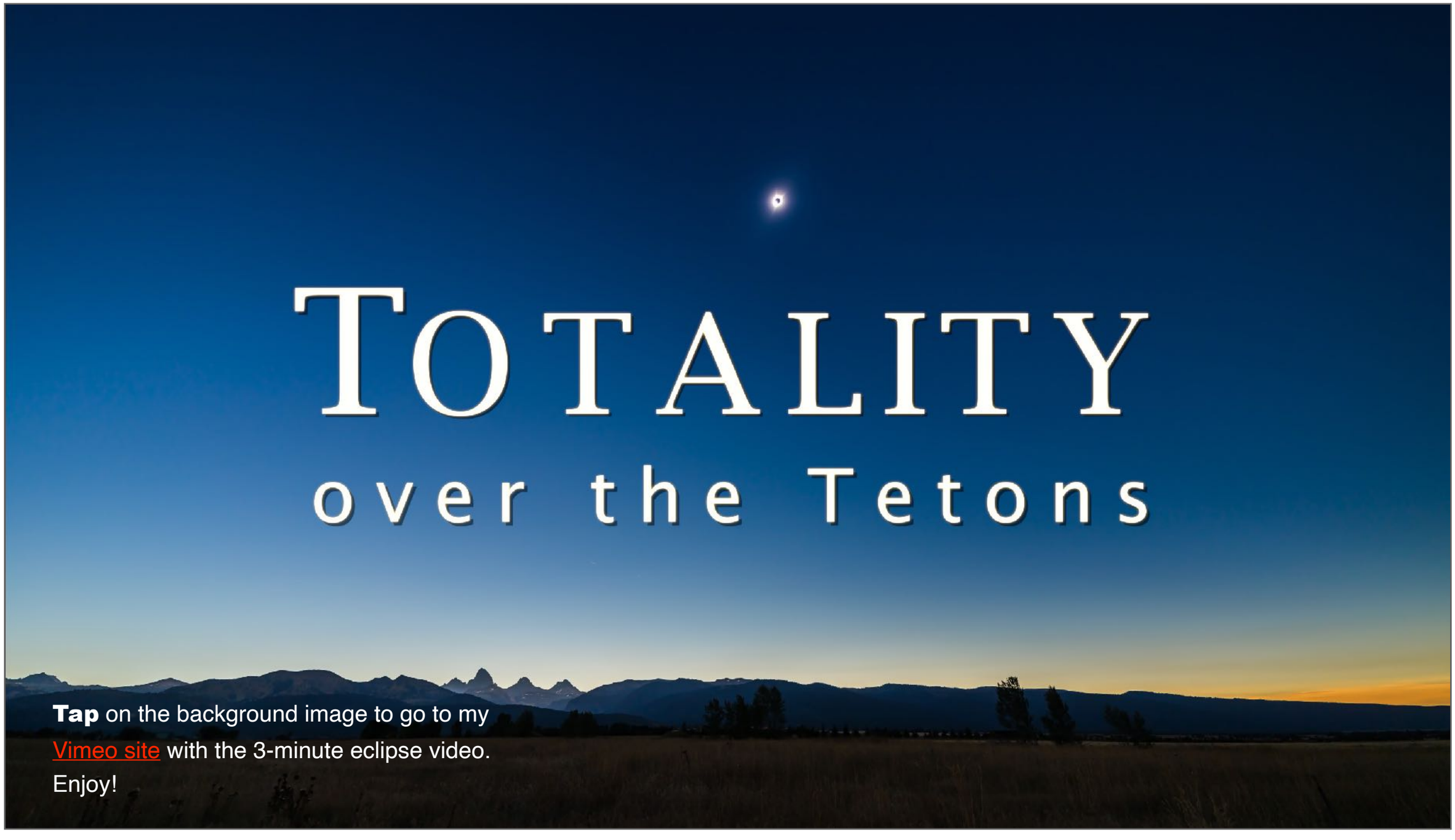
THE 2024 TOTAL ECLIPSE EXPERIENCE

To conclude I present a montage of still images, videos, and time-lapses I shot with five cameras at the August 21, 2017 TSE. I hope we are all so fortunate as I was this day to see a perfect eclipse.



Tap on the background image to go to my Vimeo site with the 3-minute eclipse video.
Enjoy!

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MANY THANKS TO …

Many thanks to fellow eclipse chasers for their images and inspiration.

While the majority of images are my own, special thanks are due to fellow eclipse chaser Murray Paulson for the use of his excellent image examples. Special thanks also to:

- Michael Zeiler for the use of his superb maps of the 2023, 2024 and other eclipses.
- Fred Espenak for his charts of future eclipses.
- Simulation Curriculum for the great Starry Night™ software. I use it daily.
- And thanks to the companies Betchart Expeditions, Ring of Fire Expeditions, and TravelQuest Tours and the Calgary Centre of the Royal Astronomical Society of Canada for the opportunities to get to places far and wide to see eclipses. Do watch Robert Stephen's fine video of TQ's expedition to the 2023 eclipse in Australia.

Perhaps this was the last – or only – eclipse you saw, on a summer's day in 2017. Perhaps you had clear skies or had to endure clouds and disappointment.

With good luck and clear skies, you will have another chance on April 8, 2024. If you don't, you will have to wait 20 years for your next chance from southern North America, as the Moon's shadow crosses western Canada on August 22, 2044. It'll pass right over my home, as the shadow did in 1979.

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ABOUT THE AUTHOR

This will be my 17th total solar eclipse, since #1 in 1979 on the snow-bound highway median in southern Manitoba, the province where I grew up.

For many years I produced planetarium shows in Canada – first in Winnipeg, Manitoba and then in Edmonton and Calgary, Alberta.

For a few years in the early 1990s I was an associate editor at *Astronomy* magazine. I served as a contributing editor to our Canadian *SkyNews* magazine and still do to *Sky and Telescope* magazine.

I travel to eclipses when I can, and to the southern hemisphere (Chile and Australia) to enjoy the fabulous southern skies. Increasingly, I am also involved with groups traveling to see the Northern Lights, second only to an eclipse for spectacle and high ranking on the “bucket list.”

Asteroid #78434 is named Dyer in my honor.

— Alan, January 2024 / AmazingSky.com

I am a member of The World at Night photography group.

This was my selfie at the last total solar eclipse I saw, in 2017. I passed on the 2019 (Chile), 2021 (Antarctica) and 2023 (Australia) TSEs. Of course, COVID intervened, but also 2017 was just so good. The eclipse was in ideal skies and at a site I could drive to with all the gear I could pack into the Toyota.

I’m looking forward to 2024. I hope you have success on eclipse day. It will be an adventure, even if you are lucky enough to see it from home, as many will.

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ALSO AVAILABLE ...

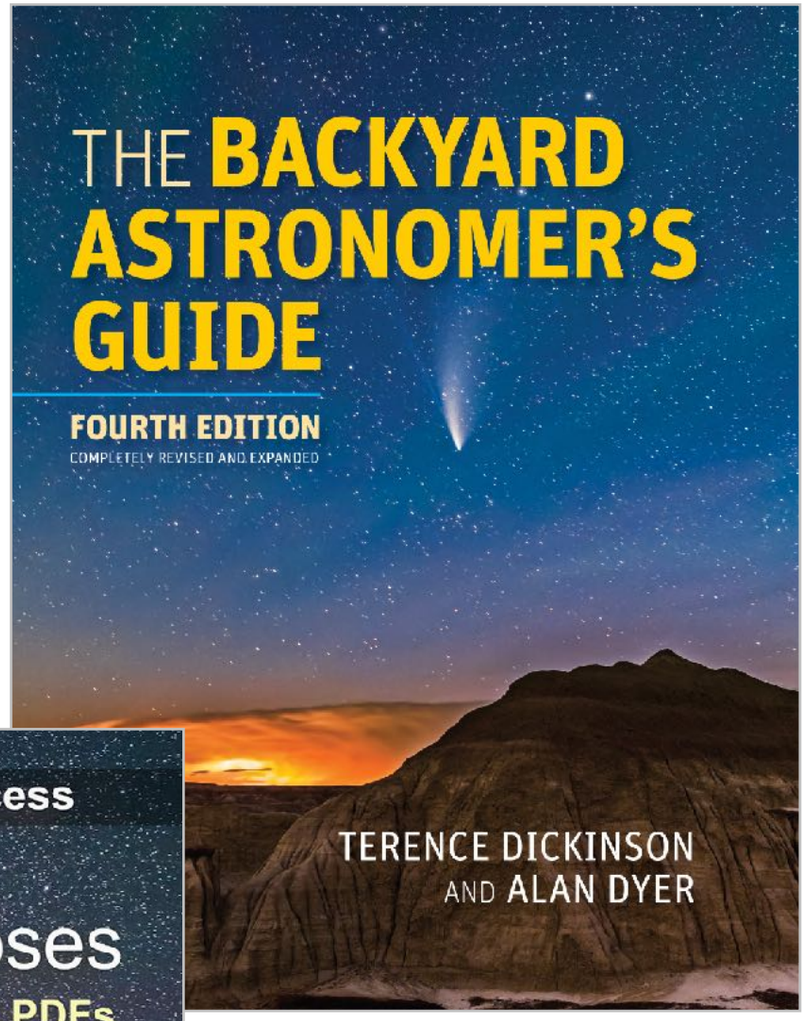
If seeing and shooting sights in the night sky interests you, may I recommend ...

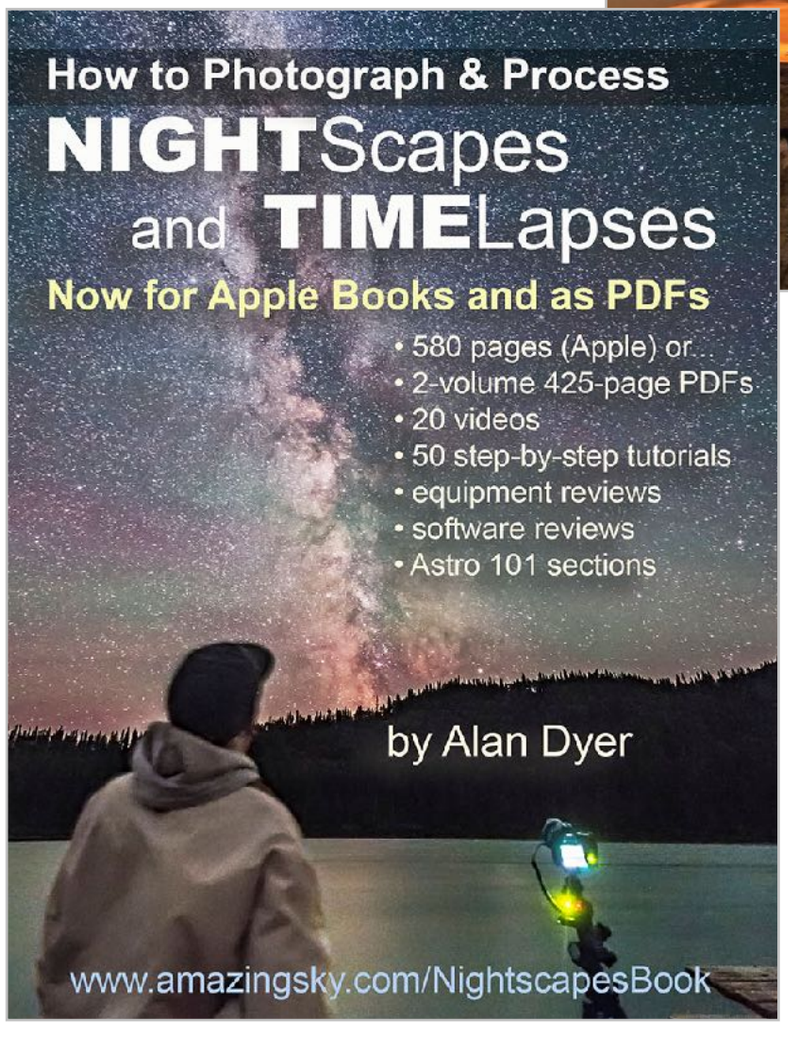
Co-authored with Terence Dickinson, The Backyard Astronomer's Guide is a 416-page print book that provides a detailed guide to amateur astronomy. It is available through all bookstores and on-line retailers.

I have also produced an ebook on the topic of shooting still images and time-lapse movies of the night sky, an area of photography that has become hugely popular in the last decade.

This books covers it all, from equipment selection and use, to detailed step-by-step tutorials on image processing. It is available on the Apple Books Store as a single interactive volume for iPads and Macs, and as a two-volume PDF for all other devices.

Details and links to purchase the ebook are at my site AmazingSky.com





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O dark, dark, dark

Amid the blaze of noon

Irrecoverably dark, total eclipse

Without all hope of day!

– John Milton, 1671