

## A Study of the Solar Eclipse

The “Great American Eclipse” was an event unlike any other in American history. Crossing the continental states on August 21, 2017, over the course of a few hours the moon’s hulking shadow bisected the country on a path from Oregon to South Carolina. This solar eclipse, striking a well-populated and technologically connected continent, easily became the most viewed one in human history. My dad and I were among these millions of witnesses, and here I’ll try to put into words an astronomical event which words cannot fully describe.

Our viewing location was, plainly, the middle of nowhere. The wind-battered high plains of Lysite, in central Wyoming, are a barren landscape, accessible only by long stretches of gravel road. They fall under the purview of the Bureau of Land Management, which organizes federal land not associated with a park, monument, or recreation area--essentially, the “leftovers” of public land. Yet there were few other places my dad and I would rather have been for the eclipse. Of locations where the moon would completely cover the sun, it had on average among the clearest skies, and was away from bustling areas such as Grand Teton National Park, over which the moon’s shadow was also to pass. Despite the remoteness, RVs, trailers, and trucks lined up alongside the primitive roads as far as we could see, most spaced out by a hundred yards or so. My dad and I joked that more human feces had been left on those plains in the last few days than in the entire previous history of human activity there.

The appointed Monday began ordinarily, with some high, thin clouds, and the sun appearing as normal as ever. On the ground, however, the atmosphere was full of tension and excitement. People assembled lawn chairs, temporary shelters, telescopes, cameras, and binoculars near their vehicles. Our setup consisted of my dad’s Canon 6D camera and two pairs

of binoculars covered in solar filter film, which blocks out over 99% of incoming light, dimming the sun to a level safe to observe. While the Canon snapped a time lapse of the eclipse from start to finish, we planned to use the binoculars to observe the progression of the moon's disk across the sun.

At 10:20 AM Mountain Time, our natural satellite began its slow crawl across the face of our star. Through the solar filters, the uncovered sun appeared as a monochrome white disk, with occasional black sunspots dotting its face as freckle-like splotches. Soon, another black form appeared, uncannier than any sunspot. Because the sun is so much brighter than the moon, the latter vanishes when viewed through a solar filter. Thus, observation of this partial eclipse phase is not so much watching the moon slide in front of the sun, but instead seeing the sun have progressively larger, circular bites taken out of it. First a small dent, then a longer arc, then a large semicircular chunk of star is lost to the darkness.

It's important to note that an eclipse is not some quick hit-and-run between two celestial objects. There was an eighty-minute difference between first contact and totality, when the sun is entirely obscured. To the naked eye, then, it doesn't seem as if much is happening during most of the first partial phase: ambient lighting does change, but too slowly for our eyes to notice. This is what made our solar-filter binoculars so essential in seeing the whole eclipse.

Still, late into the partial eclipse, we began to notice subtle but disquieting changes in the environment around us. The sun itself was still quite bright, but the distribution of light coming from it seemed off, as if it indeed was morphing into a different shape. Our shadows lost form and distinction, and eventually disappeared completely. Minutes before the start of totality, a cold breeze picked up, giving us both physical and psychological chills; the temperature had

plunged noticeably since the first contact between sun and moon. It seemed as if an ominous, relentless force was approaching, and we were right in the middle of its path.

Seconds before totality, the most shocking sight yet appeared: miles west of us the moon's shadow was surging towards us, gobbling up the distant mountains and plains without hesitation. This is when we and our neighboring eclipse-viewers started to make noise, composed of exclamatory shouts and cries of "Look!"--not so much to let others know what was happening, but more to convince ourselves that what we saw was actually real. One might expect some earth-shattering rumble to accompany the coming darkness, but there was none--the shadow raced silently along until its edge was too close to discern. Then, finally, it was upon us, and sky and earth were plunged into twilight darkness. Gone was our familiar parent star, and in its place loomed a circular rupture, as if opening to a foreign dimension, crowned by a fierce halo of broken sunbeams.

Sol and Luna, day and night, fire and ice, light and darkness--total and irrevocable opposites to ancient and modern peoples alike--had merged into one utterly alien, majestic, and terrifying entity. No amount of studying star charts, time tables, and viewing locations could have prepared me to behold the astonishing astronomical fusion then before my eyes. Upon reflection, I was reminded of a unique battle between the ancient kingdoms of the Medes and the Lydians. The Greek historian Herodotus describes how, during the battle, "day was on a sudden changed to night." A popular, but perhaps legendary, interpretation is that this event was the solar eclipse of 585 BC, supposedly predicted by the philosopher Thales. Whatever the reality, the two warring parties were spooked enough to immediately cease fighting and sign a peace treaty. Moderns might chuckle at the irrational superstition of Iron Age peoples. But after seeing

the eclipse for myself, and experiencing that indescribable awe and terror, it's plain to me that we are far more like our ancient ancestors than we may care to admit.

Witnessing the sun's snuffing-out shocked my dad and I into a sort of frantic trance. Totality would only last for 2 minutes and 20 seconds, and we were keen on observing a few predetermined targets and relishing the miracle of syzygy. Now that it was safe to pop off the solar filters from our binoculars, we gazed at the corona, the upper atmosphere of the sun, which is visible only during an eclipse. It is twisted into intricate patterns by the sun's magnetic field, and looks similar to how a bar magnet shapes nearby iron filings, except the corona paints its patterns with stunning streams of light instead of flecks of metal. On the limb of the sun, we watched the gaseous filaments of the chromosphere--a layer of the sun's atmosphere below the corona--blaze with tempestuous energy, like a bonfire consuming twigs on a dry evening.

The obscured sun was the star of the show, but the whole firmament had changed dramatically. Under the moon's shadow, the sky appeared similar to mid-twilight conditions, and revealed the bright planets and stars as quickly as the sun's light had disappeared. Mercury was now visible near the limb of the sun as a starlike point, and Jupiter and Saturn also made prominent showings. Normally invisible during August, the winter constellations--Orion, Canis Major, Taurus, and others--spanned the sky. Undoubtedly the most breathtaking feature was the sunset colors that lit up all 360 degrees of the horizon. Think of the most vibrant sunset you've seen, and imagine it stretching around the entire sky in every direction you look, like a giant halo of warm radiance surrounding you for tens of miles around. The combined spectacle of the blackened sun, daytime stars, and omnidirectional sunset is seared into my memory, yet was so exotic that I still have difficulty believing what I saw.

However long we might have wanted to watch, the celestial procession remained indifferent to our gawking stares, and was rapidly bringing about the end of totality. But it gave us one last flourish: just as the sun and moon began to split, we witnessed a brilliant flash known as the “diamond ring”. The irregular terrain on the moon meant that the sun’s disk did not re-emerge smoothly; instead, while most of the sun’s edge was still blocked by lunar mountains, some sunlight suddenly streamed through a valley, causing the flash. At this point the corona still visibly encircled the silhouetted moon, leading to the appearance of a ring of light set with a massive, dazzling diamond. The phenomenon lasted for a fleeting moment, before the sun became too bright to look at safely any longer. Then, as we brought our eyes away from the binoculars, the sky washed out with sunlight, and the sublime solunar union was finished.

We and our fellow eclipse-watchers burst into applause and cheers to acclaim the greatest show any of us had seen. From that time onwards, the eclipse continued in the same manner as it did before totality, except reversed; the moon’s disk slowly slid away from the sun’s, and our star regained its familiar shape. In about an hour the sky returned to a sunny, humdrum state, as if nothing strange ever happened that morning.

That two-and-a-half-minute period of totality was the culminating event in a much longer journey for me through astronomy and a fascination with the universe. Ever since I became interested in astronomy as a child, I’d been anticipating that eclipse by reading countless books and magazines. Somehow that passion was contagious, and my dad came to share it with me. Even with all the anticipation, it was more magnificent and awe-inspiring than either of us could have imagined. It remains one of my fondest memories, perhaps most of all because I got to share it with my dad.

As a Christian, I believe this eclipse is God's natural revelation speaking to us, and in this case louder than almost any other natural event. Indeed, my faith is bolstered whenever I reminisce about my experience. I am in awe of God's power and majesty, that this sun which the ancients worshiped and which moderns so take for granted, which within its core fuses the equivalent of six hundred million hydrogen bombs every second, is like a toy in his hands. He spoke into existence its life-giving light, and he can snuff it out at any time without effort. It is humbling to see with our own eyes our lack of understanding and control over this universe we have been placed in, but radically comforting to know that our Father has complete knowledge and authority over it all. He set the sun, moon, and stars on their courses to display his glory and to reveal to us his character in ways too profound to be fully articulated.

“He speaks to the sun and it does not shine;

he seals off the light of the stars.

He alone stretches out the heavens

and treads on the waves of the sea.

He is the Maker of the Bear and Orion,

the Pleiades and the constellations of the south.

He performs wonders that cannot be fathomed,

miracles that cannot be counted.”

--Job 9:7-10

On April 8, 2024, another solar eclipse will cross the United States. God will speak to the sun once again, and I intend to hear his voice. I hope you, too, will be listening.