2024

MAY ISSUE

CLEAR SKIES

BROWN
Department of Physics

A LADD OBSERVATORY
MONTHLY PUBLICATION

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Welcome to Clear Skies!

This issue of *Clear Skies* is a bit different, in that it is mainly made up of exquisite images and firsthand accounts of many members of the community who were able to look up on April 8th, and witness all, or a significant amount, of the total solar eclipse. Many traveled to the path of totality, and were gifted with several minutes of one of Nature's most beautiful sites; yes, there were some who were clouded out, or who witnessed it for just a few brief moments, but the numbers of people who were at all observing places, even the relatively unfortunate, were caught up in the thrill of knowing that the eclipse was happening right above them.

Those who stayed in Ladd land, although not seeing the entire phenomenon, did have over 90% of the Sun disappear, enough to witness a significant change in temperature and daylight.

If you do desire to see a total solar eclipse, there are options: in 2026, travel to Greenland, Iceland, or Spain; Africa will have one of the longest totality times in 2027; and, if you'd rather stay home in the U.S., there are two coming up: in 2044 and 2045. Or, if you'd truly desire to stay home, Rhode Island will be in the path of totality on May 1st, 2079. Keep your eclipse glasses handy.

We do have Jim Hendrickson's monthly star chart. Hope you take the time to go outside with it and enjoy the beauty of the night.

Curator Michael has looked through the archives for a fascinating eclipse tour with Winslow Upton, before he became Ladd's Director. In addition, Mike has an article on eclipses and weather, both on the latest total solar eclipse, and Winslow Upton's observations.

Oh, and, if you'd ever wondered what animal has "seen" the most eclipses throughout history, the result may surprise you.

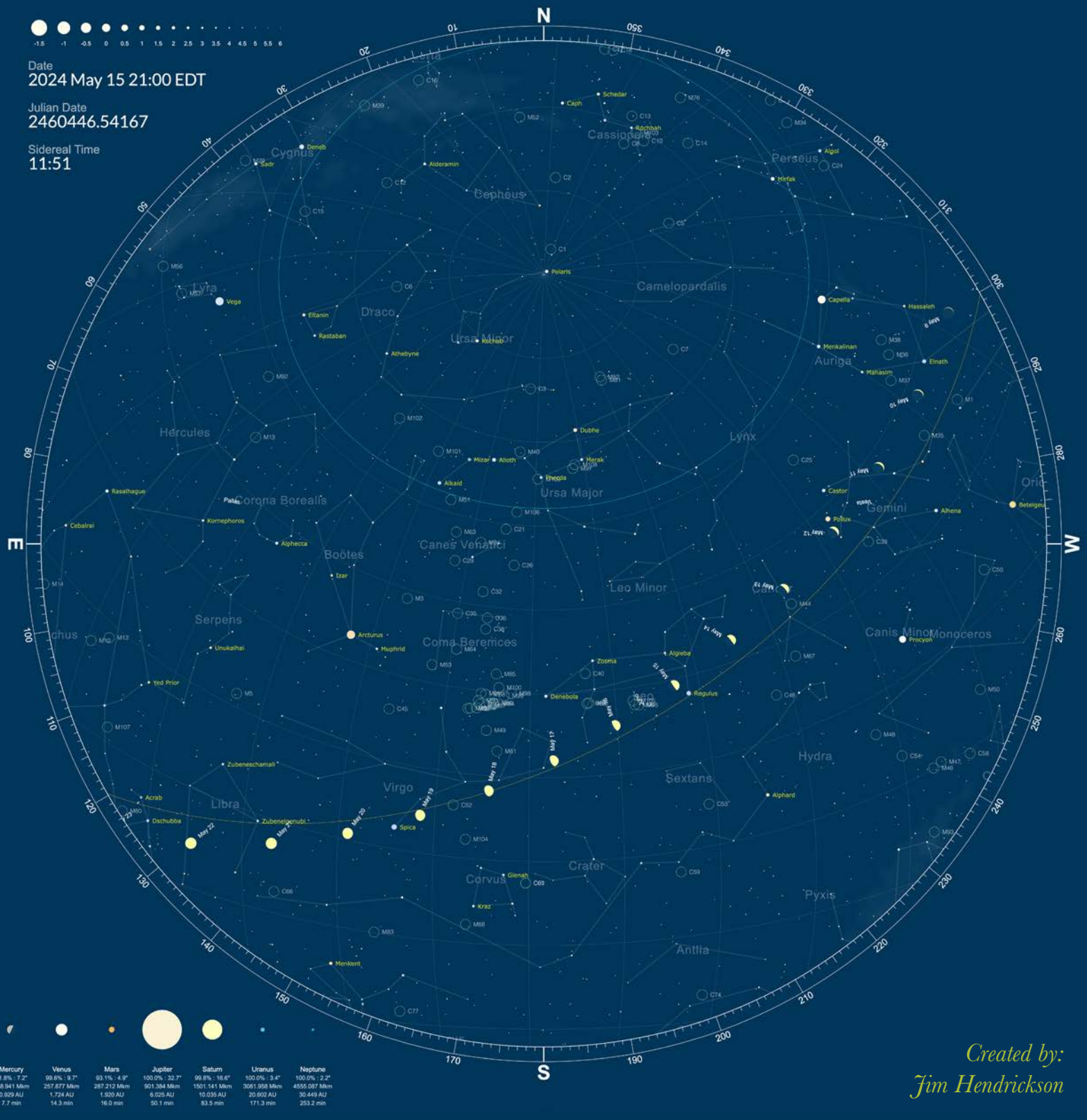
For those of you who haven't seen a total solar eclipse, Mahmond has given us a cover showing some of the beautiful scenes that make so many people want to see solar eclipses again and again.

In this issue, we can't say enough about the incredible layout and design work Indigo Mudbhary and Kate Kuli have had to do to make this issue as beautiful as it is. Thanks again for all you do.

Last month, Ryan Seeb's interview on LunaSCOPE contained information concerning NASA. Ryan wanted to clarify that the NASA section was not written by him, just the terrific interview.

Enjoy this month's beautiful *Clear Skies*!

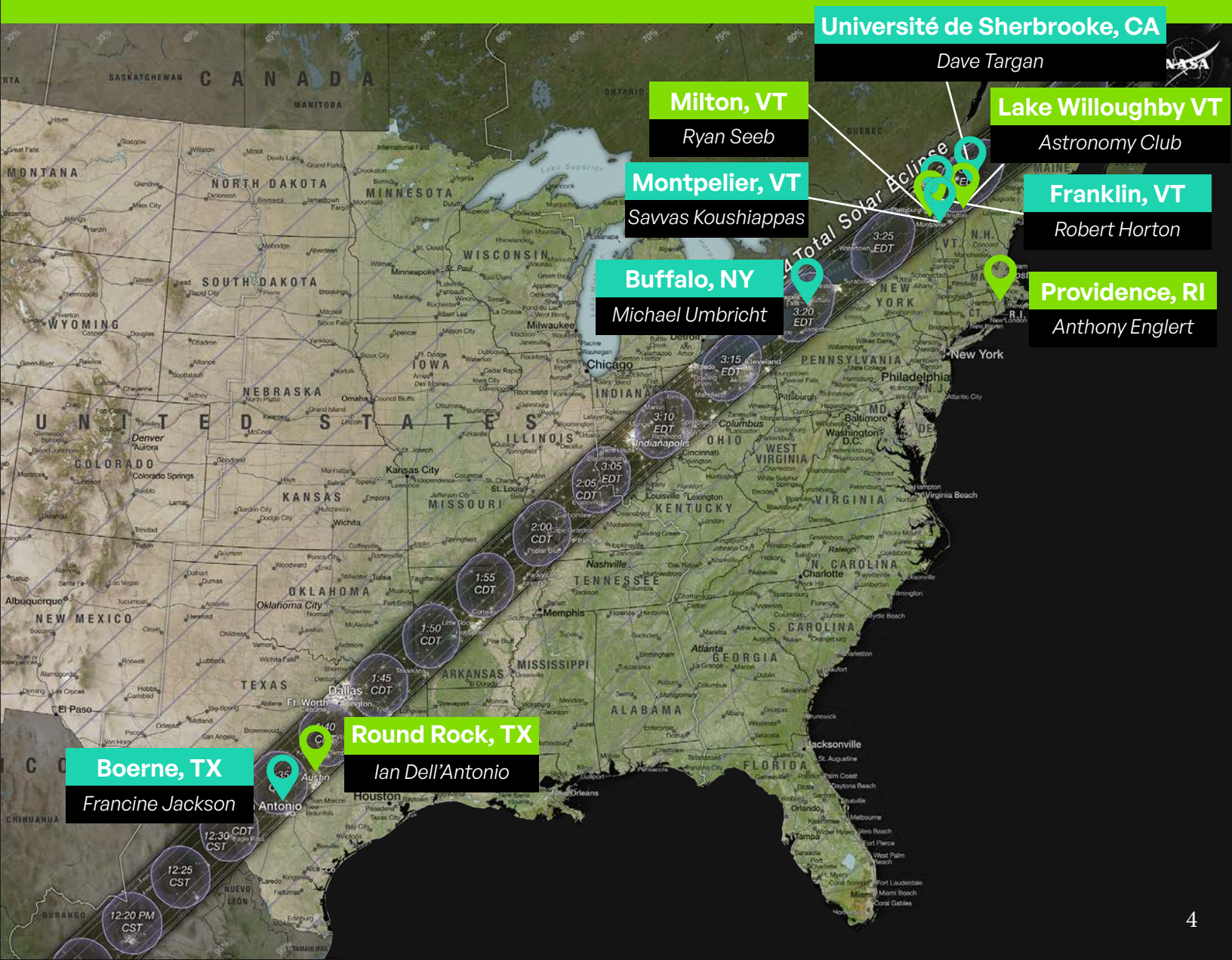
May Sky Chart



Created by:
Jim Hendrickson

Eclipse Photos and Reports

By Various Contributors



The Eclipse from Université de Sherbrooke, Canada *by Dave Targan*

More than 50 years ago, I was a high school student and amateur astronomer aboard the SS Canberra, sailing to the path of totality off the coast of Africa, for one of the longest-lasting solar eclipses in modern history. The lead astronomer of the ship's "Voyage to Darkness" was Brown astronomer Charles Smiley, Ladd's Director and the world's preeminent eclipse expert. When he wasn't lecturing to the hundreds of passengers, I asked him for career advice. He suggested that I to apply to attend Brown, saying I would enjoy the attention of a smaller program, in contrast to huge departments such as those found at the universities in Arizona or California. Years later I myself became Ladd's director, and my role in astronomy education allowed me to share my love of the sky, the universe, and astronomy with students of all ages. While I had shared wonderful experiences of transits, aurorae, meteor showers, and spectacular comets, I hadn't seen a total eclipse since 1973.

Then several months ago, I took a chance, betting against the climatological odds, that northern New England and eastern Canada would be clear for the April 8 eclipse. I signed up to stay near a lake just north of Vermont, in Quebec, joining a group of friends, including amateur astronomers, former students, and fellow Brown alumni.

For about a week prior to the eclipse I read and re-read the online technical forecast discussions of New England's NWS meteorologists. I was as astonished as they seemed to be, to read their incredulous statements, that every computer model they consulted for more than a week placed the region in the middle of a high pressure system for April 8.

As we arrived at the lake house, there was suddenly some mild concern by those forecasters that a front travelling from west to east would push some high clouds into the region. Concerned that cirrus clouds would diminish our view of the corona, we packed up our instruments and headed east for the city of Sherbrooke, where we found parking near a grassy hill at the Université de Sherbrooke. There was a small crowd of students, faculty, and visitors like ourselves. We were the only group that had a sizeable telescope, so a line of mostly French-speaking Canadians waited in line to view sunspots and the partial eclipse as the black silhouette of the Moon grew in size. Someone brought a colander, which projected a hundred little solar crescents upon the ground, making for some interesting views as we anxiously waited for totality to begin.

As the Moon was about to cover the remaining sliver of Sun, the lighting around us began to appear different, brownish and tinny, and time seemed to stand still. The odd hue made people appear almost two-dimensional, and it seemed that I was not viewing, but a part of, one of those old rust colored and faded photographs, capturing past moments of Ladd's historic astronomy expeditions, dating back to the 1890s.

The temperature dropped suddenly, a still chill that felt odd because it just came about, not carried to us by a wind. We looked up at the western horizon and there it was, a looming darkness, coming at us, below it a strip of sunset-colored sky. Suddenly, although I knew better, it felt like I, we, were about to be drowned by a gigantic, inevitable, apocalyptic wave. Usually the Moon feels so remote in the sky, so far that often it's hard to really think of it as real. But for an instant I felt that the Moon itself was so real that it was now on the Earth, rolling our way.

Suddenly, the temperature plummeted further as darkness arrived, and a chill went up my spine. Then I looked up, and there it was, the searingly brilliant, pure white beam from the diamond of the "diamond ring" encircling the black Moon, as the rays of sunlight poured through valleys on the Moon's edge.

I realized that in the excitement I had forgotten to locate my glasses, so I used my binoculars to view the eclipse in sharper focus. I quickly glanced around, and unlike the 1973 eclipse, I could see no stars, just Venus and Jupiter. I forgot to look for the comet. Instead, I looked once more through the binoculars and just took in the experience of totality - the jet-black disk of the Moon, the ghostly glow of the corona, an H-alpha-red prominence, and the gasps and shouts amidst the hushed silence of the crowd. As totality concluded, the exclamation "diamond ring!" came from my mouth, and it was over.

As the familiar lighting of day returned, members of the group from the grassy hill, transformed by the shared experience of awe, queued up for final views of the Sun, many themselves newly converted amateur astronomers.

Photos by Mahmoud Hallak

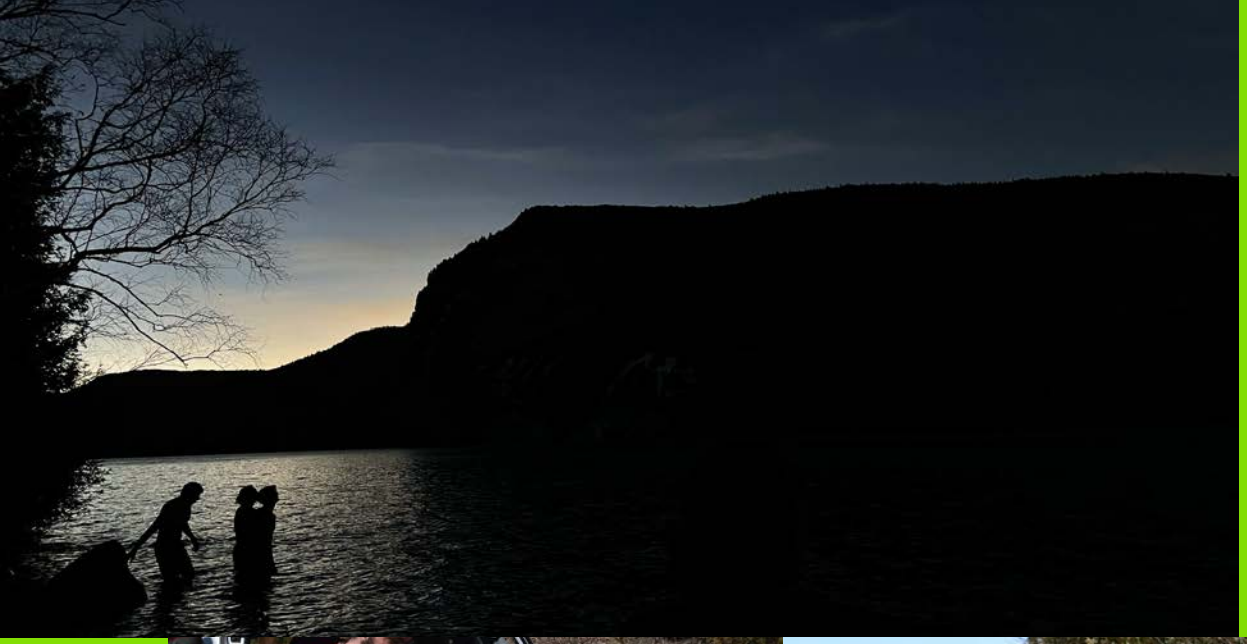
The Astronomy Club Observes the Eclipse from Lake Willoughby, Vermont *by Mahmoud Hallak, Donovan Davino, and Willow Smith*

We observed from Lake Willoughby, VT. Right next to the Peter Gilman Waterfall.

The group consisted of Astronomy Club members, mainly those involved with leadership positions for the club. The list includes Mahmoud, Alexis, Phillip, Aster, Ahing, Sam, Willow, Etc.

For the eclipse, our Astronomy club caravaned their way among four cars to the clear skies of Lake Willoughby, VT. This being my first eclipse, I wasn't really sure what to expect. All I knew was that people I trusted told me it was something I had to experience with my own eyes. Looking back, I feel the event is not something that can be summarized in writing but was of a different order entirely. The darkness rolled in fast, unsettlingly fast, to the extent you could easily make out Jupiter and Venus ahead in mid-afternoon. A surreal wisplike radiance shining from above, shared by the company of friends on either side reduced to tears, and bats flying overhead perhaps trying to make sense of such a mysterious occurrence. One thing I know for sure is that when the next eclipse rolls around, there will now be one more encouraging others to experience the eclipse with their own eyes.

— Donovan Davino



I am an astronomy club coordinator and physics PhD student.

I had seen 99% before, barely missing the path of totality back in 2017. The dimming and desaturation of color as well as the sharp shadows I had expected. But the real sight to behold was totality itself; it was the most gorgeous thing I'd ever seen and likely will ever see. When the moon covered the sun, it looked precisely like a black hole with the edges of the moon acting like an event horizon separating it from the solar corona. If I weren't a scientist, I'd say it looked like the mouth of god spewing tendrils of light, and the fact it was flanked by Jupiter and Venus both only added to this vaguely divine aspect. It was really just a shame that Mars and Saturn, which were also out, were behind a mountain from our viewing point.

— Willow Smith

The Eclipse from Franklin, Vermont *by Robert Horton*

What a trip to see the eclipse! Our family traveled out to western NY, about an hour south of Rochester, to see the total solar eclipse from the comfort of a rented farmhouse in Nunda, NY. Our group included our kids and three of our grandchildren. We chose this location based on weather statistics suggesting it had the best chance of clear skies in the Northeast.

By Sunday, it was obvious that clouds would prevail over the Great Lakes, so we packed up the cars Sunday night, and got up very early Monday morning to make the long drive eastward to beat the clouds pushing in from the west. Our hope was to join up with a group of students from the Brown Astronomy Club, along the shore of Lake Willoughby in Vermont, but that proved to be just a little too far away to reach in time. About eight hours after leaving NY, we came upon Lake Carmi, in Franklin, Vermont, about a mile from the Canadian border. Many people had already gathered along the roadside overlooking the lake by the time we arrived, but there was just enough room left for the three cars our family traveled in to park there, and set up on the shoreline. And what a view we had!

The partial phase was already well underway when we arrived, so I quickly unpacked my photographic gear and set up as quickly as possible. I took one image with my cell phone, which then died, because it had not been charging properly during the car ride. I had an app on my phone that would alert me with timings for the beginning of the diamond ring effect and Baily's beads, which last only a few seconds, and the alert would allow me enough time to remove my solar filter and take those shots. Lucky for me that we set up right next to another photographer that had that app running on his phone with audio alerts, so everything worked out just perfectly.

When the eclipse timing app called out that we were 20 seconds from total eclipse, I removed the filter from my 1,000mm telephoto lens attached to a mirrorless camera and starting taking many images using a remote, capturing both Baily's beads and the diamond ring effect. During totality, I varied my exposures, to capture a wide range of detail, from bright prominences to the fainter outer corona.

Eclipse over Lake Carmi, Vermont. Photo by Robert McMenamin.

I made it a point to spend no more than one minute taking photos. While I wanted some keepsake photos of the eclipse, no photo can compare to just enjoying the beauty and magic of visually observing something so wondrous. Just looking up and seeing that last glint of sunlight – the diamond ring effect, which is quickly followed by the Moon completely covering the Sun, and seeing the silvery corona suddenly appear, surrounding the inky black of the Moon, is something I wish everyone could see at least once in their lifetime. The larger prominences could be seen with the eye alone, and through a small telescope that I had set up for my family to use, seeing the black Moon with ruby red chromosphere and prominences around it, along with the corona was simply incredible. Looking around the sky, which was about as dark as what you see during twilight, the planets Jupiter and Venus shined brightly, but we did not notice any stars. Along the horizon over the lake was a narrow, bright band of orange-yellow light, signaling a new dawn that was fast approaching as the shadow of the Moon passed over us.

So, we started off with a well-planned trip to comfortably observe the eclipse from a farmhouse in NY, and ended up at a lake we never heard of, hundreds of miles away, and just in time to witness such a beautiful and magical celestial event. There's nothing like hearing the collective sound of awe-struck people witnessing a total solar eclipse!

These are just a few images I took of the solar eclipse. I have many more, with varying exposures, that will be used to create an HDR composite image to bring out all of the details, from bright to faint. For example, the outer corona is much fainter than the prominences, so a longer exposure is necessary to capture the corona.

Partial phase (Robert Horton)

Diamond Ring appearing (Robert Horton)

Diamond Ring – the last glints of sunlight shining through gaps in the lunar mountains. (Robert Horton)

Baily's beads (Robert Horton)

Totality. Note the prominences along the left edge of the Moon, soon after the start of totality, and the prominences just emerging along the right side. (Robert Horton)

Long Exposure showing the Solar Corona. (Robert Horton)

Nearing 3rd contact. Note the incredible prominences, now fully revealed, along the right of the Moon. (Robert Horton)

Diamond Ring at 3rd contact. (Robert Horton)

Observing the Eclipse from Milton, Vermont

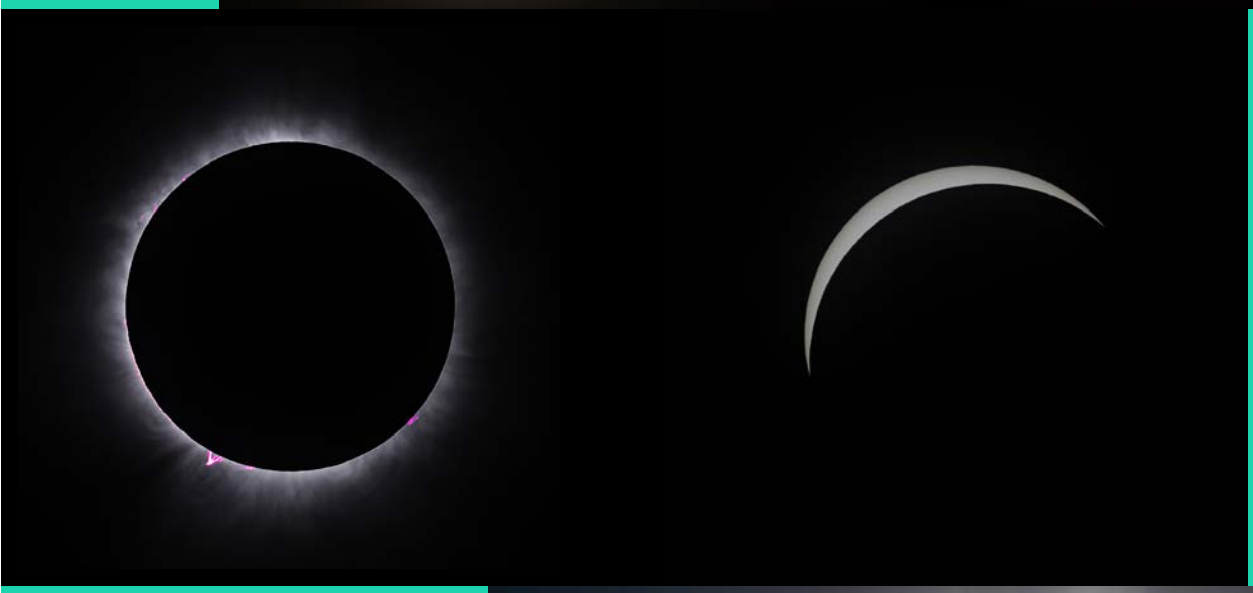
by Ryan Seeb

Totality and partial phases as seen from Milton, Vermont, taken with a Nikon camera with a 300 mm lens.

The other half are sunset pictures on the same day as the eclipse on Lake Champlain from my trip with a group of fifteen Brown first-year students.

The Eclipse 15 Miles from Montpelier, Vermont *by Savvas Koushiappas*

We were about 15 miles north of Montpelier, I was there with my family and friends. The most magnificent celestial phenomenon I ever observed!



Brown Observes the Eclipse in Providence, Rhode Island *by Anthony Englert*

This image is made from some of the best shots of the eclipse I captured from Providence at Brown University's Main Green during the NASA Rhode Island Space Grant Consortium viewing event. All of these images were taken with Ladd Observatory's 90mm Coronado SolarMax I Hα telescope paired with a ASI ZWO1600MM monochrome camera. It happened that during this eclipse, the chromosphere was brimming with activity that could only be captured in Hα. But, many of the sunspots and even the prominences featured here can be seen in other white-light images of the eclipse.

The Eclipse from Buffalo, New York *by Michael Umbricht*

Images of the partial and total phases of the eclipse were taken with a cell phone in Buffalo, NY. The sky was completely overcast. The Sun, and the eclipse, could still be seen through the thinner parts of the clouds. I distinctly saw a pinkish prominence that was "V" shaped. I've seen many prominences through sophisticated telescopes with filters. This was the first time that I've seen one naked eye. Credit: Michael Umbricht.

Observing the Eclipse from Round Rock, Texas *by Ian Dell'Antonio*

For the April 8th eclipse, our family had long planned on traveling to Texas, based on the expected weather forecast, and the availability of "free" housing with my Brother's family. As the date approached, and the weather forecast for Texas kept getting worse, we grew pessimistic. Nevertheless, we flew down on the 6th. The original plan had been to travel from Round Rock to Leander to be closer to the centerline of the eclipse, but the weather forecast the morning of the eclipse was for clouds and thunderstorms, so we decided to stay put and hope against hope. About the time of first contact, small breaks in the cloud appeared, and then larger patches, and then, about 20 minutes before totality, the clouds (mostly) parted, giving us a clear 3 minutes of totality. My phone does not take good pictures, and we had not set up any telescopes, but my daughter Fiona managed to get a decent picture of totality.

The Eclipse from Boerne, Texas *by Francine Jackson*

It was a beautiful day in San Antonio when we arrived, ready to begin our preparation for the April 8th total eclipse. The entire state was getting prepared, as every sign on every major highway reminded every driver to start our trips early, stay long, then leave late.

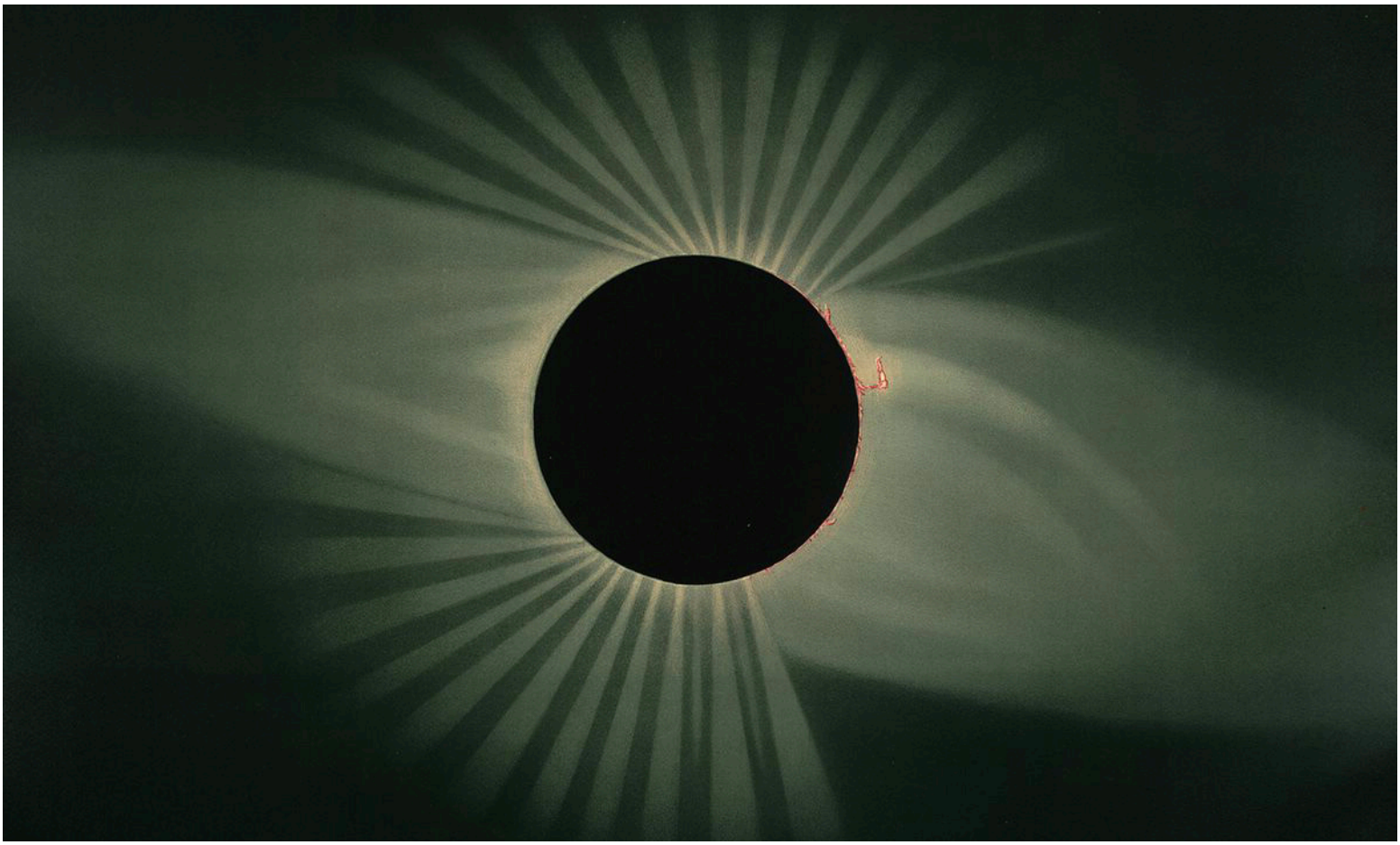
Our observing site was a field next to a boutique clothing store and restaurant. The manager of both put together the day, in Boerne, Texas; there was plenty of parking, many food and souvenir trucks, and even a place for those such as we who had registered early and became designated as VIPs. The weather was perfect, and, although there were some high clouds, the hundreds of us there were very optimistic.

Until later in the day: Clouds began to thicken, and at times started to darken. From first contact to second, we were only able to observe a couple times where the Moon was moving toward totality. And, then, when the time for totality did happen, the cloud covered the entire event.

However, suddenly, the sky opened up, and we were all able to witness what we had come for: totality! For us, it lasted about 10 seconds, not long enough to take a few images, but long enough to add this number to our eclipse notes.

After totality, when the crowd started to thin, there was talk of us meeting in 2026, either in Spain or Iceland. For any first-timers, even that short view was enough to want to see another, and it does appear that everyone there fully intends to.

TROUVELOT ECLIPSE



Before my journey to Quebec to witness the total eclipse, I, as the Director of Ladd Observatory, engaged with the local news media to discuss safe viewing methods for the eclipse in Providence, where the Moon would obscure 91% of the sun at the peak of the event.

Explaining why nearly all of Ladd's staff and students were traveling to the path of totality was challenging. To many, 91% might seem nearly as spectacular as 100%. I certainly did not wish to diminish the experience of those in Rhode Island; an almost total eclipse is indeed a breathtaking sight. Yet, I struggled to articulate why totality is a fundamentally different phenomenon.

The clarity I sought came only after the eclipse, when I viewed a magnificent color lithograph housed at Ladd, created by the artist Etienne Trouvelot. It depicted the 1878 "Great American Eclipse," which was observed across several western states.

The U.S. Naval Observatory had dispatched five teams to various points along the path of totality. Trouvelot, who worked

at both Harvard and the U.S. Naval observatories, was on one of those teams. He saw his role as translating the natural world into a form comprehensible to the human spirit, merging precise scientific observation with artistic sensibility. Although astronomical photography was developing at the time, Trouvelot's artwork communicated with audiences in ways that photographs simply could not, something that is sometimes true even 150 years later, even with vastly improved imaging techniques.

Though physician, astronomer, and pioneering astrophotographer Henry Draper successfully photographed the eclipse,[1] Trouvelot's lithograph stands out for its exquisite detail and beauty. Each total eclipse is unique, and Trouvelot and other observers noted the coronal "streamers" and broad bands of light portrayed on his lithograph. What strikes me about Trouvelot's work, much like his other lithographs, is how it captures the splendor, mystery, and otherworldliness that most photographs and descriptions fail to convey. His portrayal underscores that experiencing totality is a unique phenomenon, a profound human experience, distinct from witnessing a partial eclipse.

The astronomer Maria Mitchell observed the 1878 eclipse from Denver and later shared her insights in Providence, in her first major public lecture about the event. She is often credited with emphasizing the importance of this blend of science and art. One astronomer quoted her as saying: "We especially need imagination in science. It is not all mathematics, nor all logic, but is somewhat beauty and poetry."[2] Trouvelot's vision of totality, like many of his lithographs, embody this perspective.

—*Dave Targan*

1. From the Draper Family Collection, National Museum of American History. Photograph of the Corona, photograph reprint (accessed May 9, 2024).

2. Street, L., and Elmegreen, D. M. 2016. Catalog of the Exhibition at Vassar College Library, "Seeing the Sun: Maria Mitchell's Observations, 1868-1888." Poughkeepsie: Vassar College Library, p. 6.

Which Animal Has Seen the Most Total Solar Eclipses?

As this month's issue shows, total solar eclipses are one of nature's most beautiful phenomena; and many travel great distances to see them. This recent eclipse path passed through over a dozen states, and was seen by an incredible number of people.

It has been noted that animals, although not directly aware of what is happening, experience reactions to the change in daylight: Birds go back to their nests or coups; mammals tend to slow down, believing night is upon them; and, of course, crickets begin their evening chirps.

Even though humans do experience the greatest knowledge and experience in viewing solar eclipses, we are far from the animal that has witnessed the most through history. As reported in the April 4, 2024 UNIVERSE TODAY, reporter Mark Popinchalk researched which animal has seen the most solar eclipses. It appears, horseshoe crabs have seen 138 trillion solar eclipses across their entire species! For humanity to catch up, we will have to continue for another 10 million years.

If the number seems incredible, we have to remember that these "living fossils" have roamed (crawled?) the planet for over 445 million years. That's given them a terrific head start in being around for such an event as an eclipse, although they may not have been totally aware of one happening; but, they were present when it took place. So, if we estimate a population of horseshoe crabs at 120 million at any time, they would have witnessed 1.5 million eclipses. They then would have collectively experienced 130 trillion eclipses. Humans, on the other hand, during our time on Earth, have only witnessed 320,000 eclipses. Over about one million years, that's only 320 billion experiences.

Often we forget that we are only one in a vast number of animals on this Earth. Although we are the only species that apparently understands what's happening above us, all other animals are here to enjoy it, too, and the horseshoe crab, although not even really able to observe it with its unique system of eyes, still is part of the natural world, and present when they occur. —*Francine Jackson*

FROM THE ARCHIVES: USS HARTFORD

Prof. Winslow Upton traveled to Caroline Island, an atoll in the middle of the Equatorial Pacific. He sailed on a Navy ship named USS Hartford. He observed the 6 May 1883 total solar eclipse from Caroline. The roundtrip voyage lasted 101 days.

He then traveled to North Carolina to view the 28 May 1900 total solar eclipse. This photo of Hartford was taken there on 30 May 1900.

Hartford was launched in 1858 from the Boston Navy Yard. The ship has both sails and steam engines. This sloop-of-war was active during the Civil War. It patrolled the Pacific from 1865 to 1899. During the cruise to Caroline only the sails were used. The steam power was only needed to maneuver near port or during a battle. After 1899 it was used as a training ship in the Atlantic.

Credit Brown University Library / Archives — *Michael Umbricht*

Eclipse Meteorology: Then and Now

The 2024 total solar eclipse as seen from Buffalo, NY.

During an eclipse there is a distinct drop in temperature as Earth's Moon blocks the sunlight. This is often quite noticeable. According to NASA, during a 2001 eclipse in Zambia the temperature fell by 15 F.

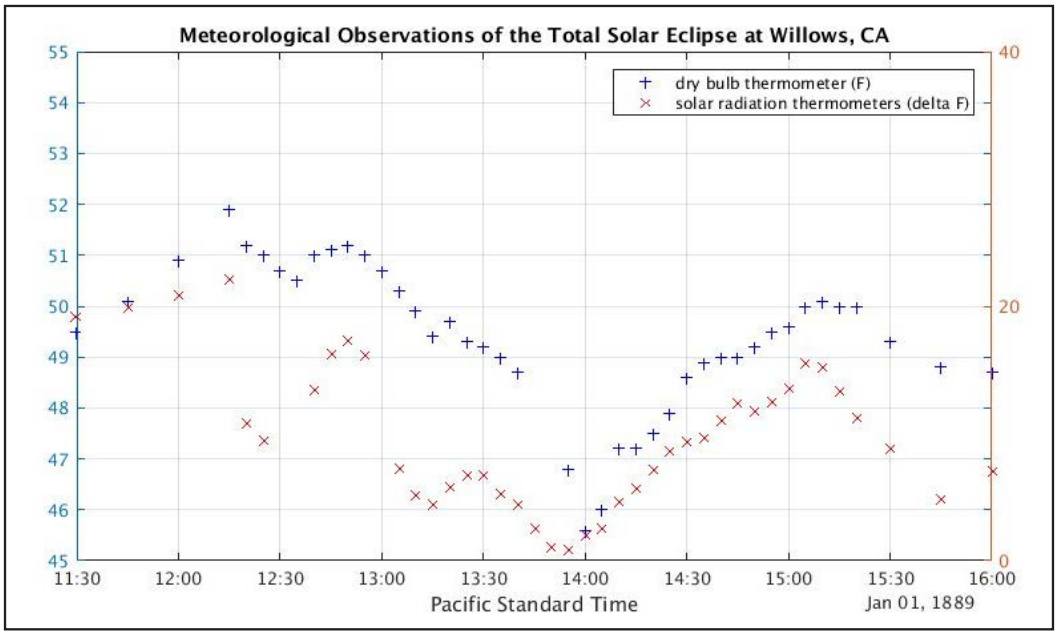
The scientific study of meteorological phenomena has been conducted since the late 19th century. Astronomer Winslow Upton, the first director of Ladd Observatory, was a pioneer in the field of weather observations during solar eclipses.

Upton travelled to Caroline Island, a small atoll in the Equatorial Pacific, to view the 6 May 1883 total solar eclipse. This was before Upton came to Brown University. At the time, he was with the U.S. Signal Office. Among the participants for this expedition was Charles S. Hastings. Hastings was a physicist at Johns Hopkins University and, later, at Yale. He specialized in optics. He would later design the lens for the refracting telescope at Ladd Observatory. The lens was fabricated by John A. Brashear. Brashear and Hastings collaborated on a number of large telescopes. This included the 72-inch aperture Dominion Astrophysical Observatory reflector. Another project they worked on was the 30-inch aperture photographic refractor at Alleghany Observatory.

Another participant was C. Ray Woods. He was a photographer and spectroscopist. His notebook includes scientific observations written in verse. This was partly a memory aid. It was also an amusement to relieve the boredom of the long ocean voyage from Caroline to return to the United States. They sailed on a Navy ship named the USS Hartford. The roundtrip expedition time was 101 days; 70 of those days were spent at sea.

> "Magnetic variations taken 1879
> Were Six degrees, no minutes East for Island Caroline.
> Six degrees & minutes 20-East were they for Flint,
> How well these figures would appear in poetry & print!
> The latitude of Caroline - mark well these simple data,
> 9 degrees & minutes fifty-four below the Equator,
> One, Five, 0 degrees 8 minutes West the Longitude.
> Alas! Sweet Muse, methinks these figures make our verses crude..."
> - C. Ray Woods, 1883

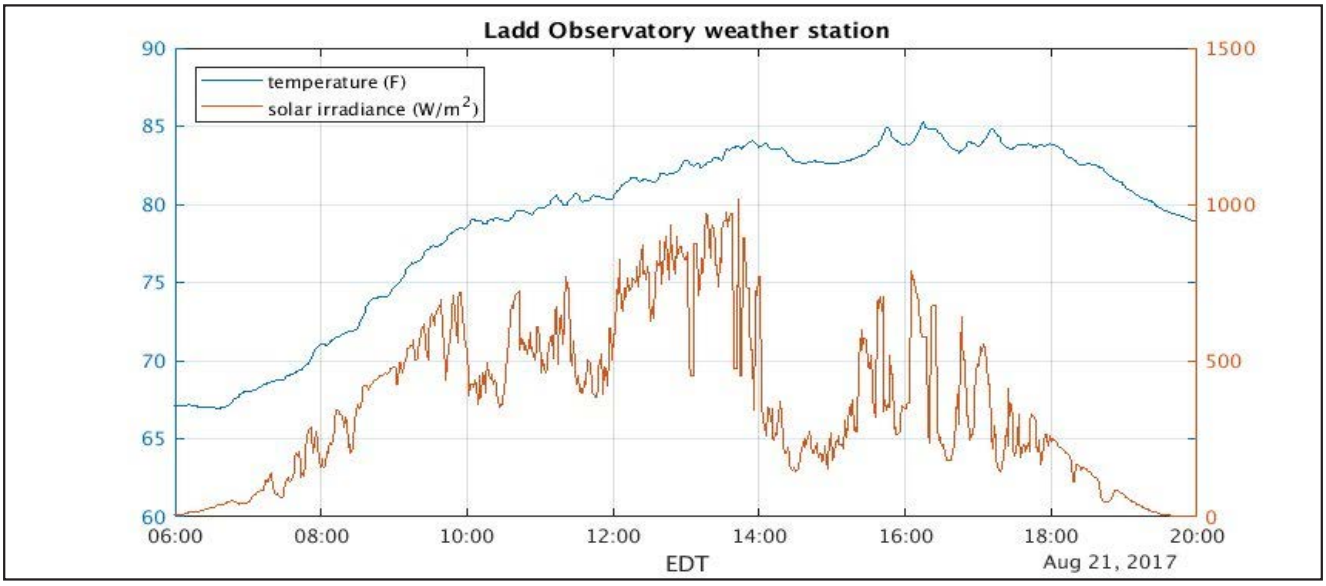
At Caroline Island Upton made detailed observations of the weather before, during, and after the eclipse. He later collaborated with another scientist named Abbott Lawrence Roche, who founded the Blue Hill Meteorological Observatory in Massachusetts in 1884. Roche and Upton made further meteorological observations during eclipses from Russia in 1887. They also had meteorological instruments in California for the 1889 eclipse.



Observations by Upton and Roche of temperature (labeled dry bulb thermometer) and the intensity of sunlight (labeled solar radiation thermometer) during the eclipse of 1 January 1889. The total phase of the eclipse was just before 14:00 PST.

Ladd Observatory operated a weather station during the partial solar eclipse of 21 August 2017. I decided to replicate the observations of Upton and Roche.

The weather was partly cloudy and somewhat hazy that day. The maximum moment of the eclipse was at 14:47 EDT. A drop in temperature of a couple degrees was noted before and after maximum. The weather station also had a solar irradiance sensor to measure the intensity of sunlight. The erratic nature of the irradiance data was caused by thinner or thicker clouds moving in front of the Sun.



Measurements from the Ladd Observatory weather station.

For the 8 April 2024 eclipse I made observations of the weather at two locations. Automated sensors in Providence recorded the temperature and humidity, while I travelled to view totality in New York. In Buffalo I made manual measurements using a digital thermometer and an app from NASA called GLOBE Observer. This is a citizen science project to learn how the sudden decrease in sunlight impacts our atmosphere. I also reported cloud cover estimates through the same app. The observations were made at the moment that a NOAA weather satellite passed over my location.

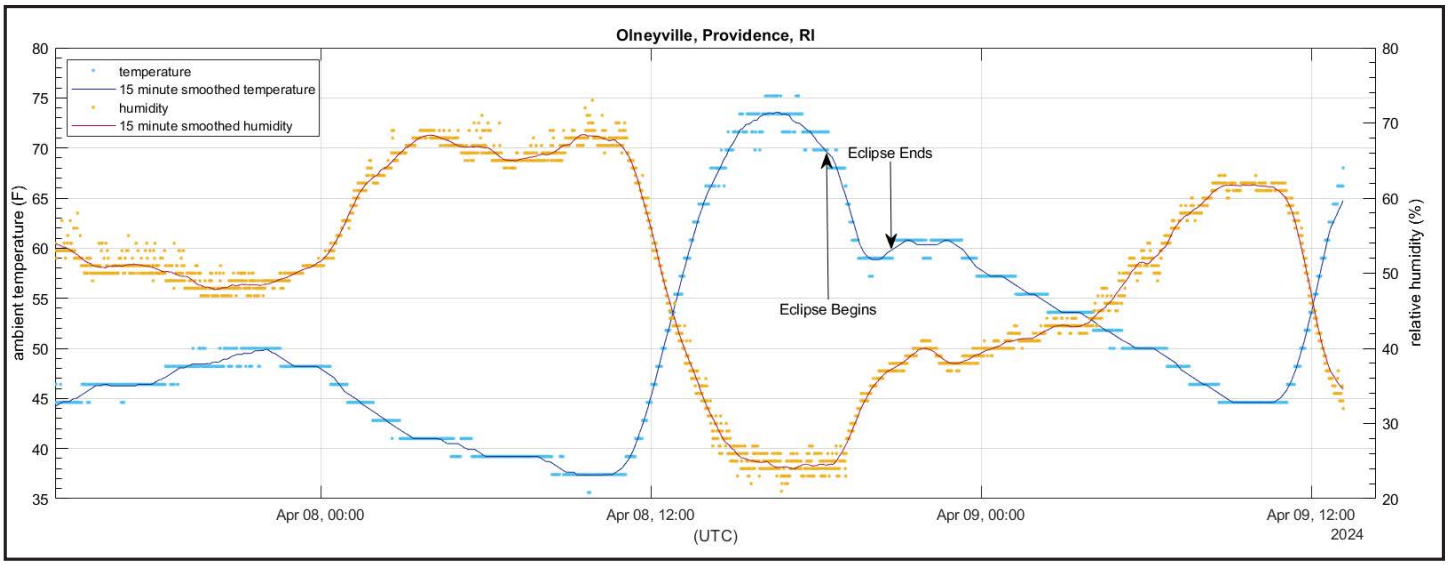
3:06 pm	14.5° C
3:11 pm	12.9° C
3:23 pm	13.6° C
3:46 pm	14.1° C
3:53 pm	14.5° C
3:59 pm	14.5° C
4:11 pm	15.3° C
4:37 pm	19.2° C
4:49 pm	18.9° C
6:05 pm	21.7° C
6:10 pm	20.3° C
6:15 pm	18.6° C
6:25 pm	18.8° C
6:35 pm	17.9° C
6:46 pm	16.7° C
7:27 pm	15.2° C
7:37 pm	15.0° C
7:49 pm	14.3° C
8:01 pm	13.5° C
8:11 pm	13.0° C

Left: The author's measurements of temperature just before and after totality at Buffalo, NY. Totality was from about 3:18 to 3:22 PM EDT.

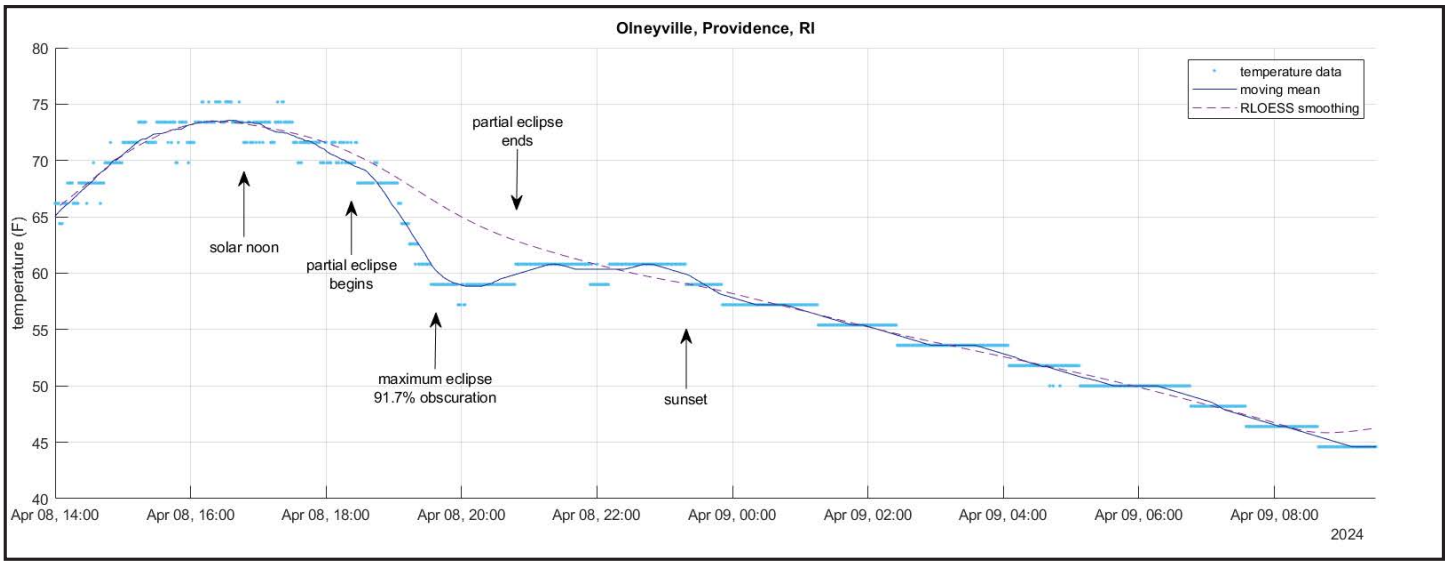
Right: A graph of the temperature measurements at Buffalo, NY. The first dip is slightly after totality. The sun set after the peak in temperature. The time range is from 11:41 AM to 11:57 PM EDT.

The mid-day high temperature before the eclipse was 16.1 C, or 61 F, about an hour before totality. During totality the lowest reading was 12.9 C, or about 55 F. Even given the cloudy conditions it was a 6 F drop during the eclipse. There was enough cloud cover that I couldn't see my own shadow. The Sun (and the eclipse) could be seen through the clouds.

The skies were clearer in Providence for the partial eclipse. The sensors reported temperatures, rounded to the nearest degree, and relative humidity to the nearest percent.



The solid line is the moving mean through the individual measurements. The temperature was recorded once each minute. The dashed line approximates what the temperature would have been in the absence of the eclipse. Before and after maximum the temperature is estimated to be about 5 to 7 F below the trend line.



One thing to note: The minimum temperature usually occurs slightly after the maximum. The atmosphere has thermal inertia and doesn't respond immediately when the sunlight is at minimum.

It will take some time for NASA and NOAA to analyze the data from the citizen science project. We'll report on the results, when available. —*Michael Umbricht*

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