AOH Newsletter

Summer 2024

News and Notes

AOH Meetings

We had a full complement of Spring Zoom Meetings in March, April, and May. Club members can find reports of these meetings on the website at https://www.astrohum.org/members_only/reports.php.

Unfortunately, observing sessions for April, May, and June were all canceled by overcast skies.

Eclipse!

April 8 marked the second "Great American Eclipse" of the millennium. While Humboldt County was limited to a 26.5% partial eclipse, several Club members traveled to the path of totality. Jeff Schmitt was in Mazatlán, Mark Wilson in Texas, Allison and Johann Waltberg were in Indiana, and Ken Yanosko went to Ohio.

Kneeland School

Prior to the eclipse, AOH did an outreach event at Kneeland School. Telescopes were set up to observe the photosphere (using a solar safe white light filter) and chromosphere (H-alpha telescopes). We also talked about the solar cycle, sunspots, the magnetic field, what the sun looks like with different filters. We gave the students solar glasses to view the partial eclipse safely. Participating were Grace, Allison, Rick, and Joy.

—Grace Wheeler

Daytime observing at Kneeland School, April 1, 2024. —Greta Turney

More from Kneeland School outreach. —Solar disk by Grace Wheeler. Astronomers and kids by Greta Turney.

Humboldt Hill

We had a neighborhood eclipse viewing party. A telescope with a white-light solar filter was used to look at the photosphere, and a hydrogen alpha was used to look at the chromosphere. Most had never seen the sun through a telescope. I got a chance to talk about solar cycle 25 and about sunspots, filaments, and prominences. There was a lot of excitement when visitors used the eclipse shades to view the sun during the eclipse. I told them to keep their ears open for news about giant sunspots, and that they could use the eclipse shades to view these with the unaided eye.

—Grace Wheeler

Hydesville School

I loaded up my telescope and set it up at Hydesville Elementary School to wow 225 kids plus 22 staff with a 26% totality. It was not as good as my friends saw who went to Mazatlán, but we had beautiful clear skies.

—Bob Zigler

Mazatlán, Sinaloa, Mexico

We started planning our 2024 eclipse trip in 2017, but the real planning started in early 2022. We were looking at Fredericksburg, Texas. Our group included many people, but ended up with Lisa, my son Jasper, and myself, along with Jon Hafstrom, Kim Munz, Lynne Sarty, Teal Sarty, Joe, Tyla, Gavin, & Alina Miller. Tyla was adamant about going to Mazatlán instead of Texas, and after a good deal of thought, we decided on Mazatlán, which turned out to be a great decision. We decided on Hotel Playa, Mazatlán, on the north end of the city, a little farther from the center line, but a real comfortable hotel. Lisa, Jasper, and I drove to Reno on April 2, and flew to Mazatlán on the 3rd. The hotel was great, very mid century modern with a Mexican flair. We went for the all inclusive (Tyla's idea and highly recommended), all food and drink was paid for. The days were sunny and warm, not hot. Early on, the prognosis for weather for the eclipse day was not great. It was looking like we were going to get the O'Connell nebula, but the closer we got to the day, the better our chances looked. The 7th was a bit iffy, with clouds coming and going, but the forecast was for sun through high clouds for the 8th. Monday morning arrived with iffy conditions, but they improved as the eclipse progressed. Totality found us with the sun and moon seen through high clouds, and a completely unbelievable sight!

Our room opened up to the large patio, which was the best place to observe the eclipse at the hotel. Bob Zigler had set me up with his Canon D5 Mark IV, his 150 mm – 600 mm lens, and his lightweight tripod. I had

thought about bringing my new Celestron 8SE, but the extra baggage and weight were too daunting. I shot at ISO 400, and bracketed 1.3 and 2.6 stops in either direction. I shot 5 images with every press of the remote shutter. This worked out very well, except that the initial setting was too low. I tried to change the aperture during totality, but it did not work, and time was short as I only had 4 minutes. I think eclipse time is different than real time, because that 4 minutes went by in about 30 seconds! I would like to have had some longer exposures to show more of the corona, but you take what you get, and I am very pleased with the results. The skies were not crystal clear, but they were good enough for the eclipse. The skies were completely cloudy a few hours later.

—Jeff Schmitt

Texas

Two solar eclipses in six months. How lucky can I be? Last October I ventured up to Klamath Marsh Wildlife Refuge east of Crater Lake, Oregon on the center line for the annular eclipse. The weather forecast predicted clear skies. After a few highway delays, an overturned log truck, I made it to a campsite about 1:00 am of the big day. I picked an observing site at a wildlife interpretive pull-off that I had used several times when driving to Montana. I pulled up and saw several vehicles already there. More arrived with about 25 people total. How did they know about this place? There were clouds in the east, but everyone was confident they would blow out by eclipse time. Cameras were set up. I got out my trusty 3.25 refractor. Oh no! I forgot the ring clamps to attach the scope to the mount. Now what? I brought along my spotting scope to watch birds during the down times and after the eclipse. It turned out that my solar filter fit on the spotting scope and was secured with some blue tape. I was ready, but the pesky clouds just sat there. We could see that it was clear to the south near Klamath Falls, and some folks started talking of packing up and heading there. I thought about charging down there, but decided annularity would happen before I could get there. My fellow eclipse watchers came to the same conclusion. We did see about 2-3 seconds of annularity through a thin patch in the clouds. Later I called my friends in Klamath Falls to check if they saw it. They said it was great from their front yard. I spoke with a few of my fellow observers at the wildlife pull-off about the total eclipse in April and quite a few indicated they were going to Texas. Just like Davy Crockett said, "I am going to Texas and the rest of you can go to hell".

I could have gone to my home town, Harrisburg, a small town in southern Illinois. It was on the center line. As it turned out, I went there in 2017 for the eclipse as it was near the centerline. Perfect weather then but the 2024 event was going to be in April, and there is a saying in the Midwest that April showers bring May flowers. I did my homework and it looked like Texas had the highest probability of clear skies. I decided to join Davy Crockett, Texas or bust! I wanted to make a road trip adventure but, Joan was not into it. We started making accommodation and airline ticket purchases in the summer of 2023. We planned on spending eight days exploring Texas around the eclipse. We settled on flying into San Antonio then going northwest about 40 miles to Kerrville on the centerline. Kerrville accommodations were sold out, but Joan found a vacancy in a small town on the western edge of totality.

San Antonio was just outside the eastern edge of totality. Our first day in Texas we drove to Kerrville and the path of totality to find a suitable viewing site. The town of Kerrville was having a three day eclipse festival in a park on the river. With a population of 2.5 million people in San Antonio, we figured that Kerrville would be mobbed on eclipse day. The town of 25,000 was expecting 100,000 eclipse watchers. The spot we chose was 10 miles west of Kerrville at a roadside picnic area. I though no one would be there, but that was what I thought about my site at Klamath Marsh last October.

Once we had a site figured out, we set about exploring Texas. I had marked out a few frontier forts, McDonald Observatory, Sierra Madre

Meteor Crater, and the much smaller but well known Odessa Meteor Crater. We headed out to the desert of west Texas to the Davis Mountains, home of historic Fort Davis, and a few miles away is Prude Ranch, home of the Texas Star Party. Then a few miles further up the road is McDonald Observatory, home of the largest optical telescope in North America, the Hobby-Eberly, 10 m, with 91 hexagonal mirrors. There is a twin sister scope in South Africa. We had tickets for a self-guided tour of the site.

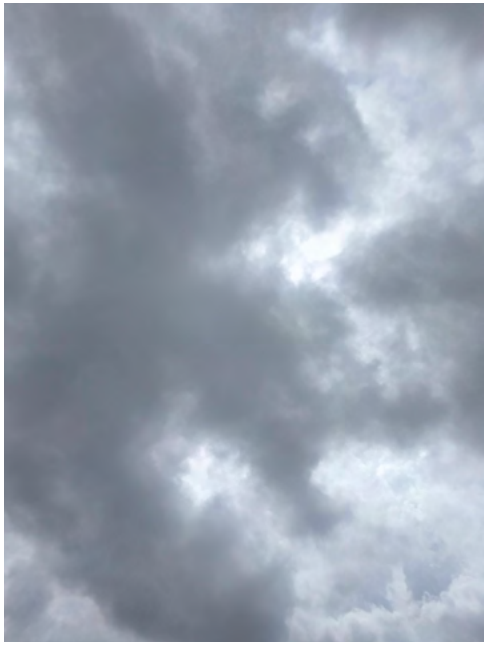
The next day we headed north toward Odessa, to see the crater. On the way we drove through the eight mile diameter Sierra Madre meteor crater. This crater is mostly filled in by erosion debris, but what landscape hole would not fill in after 100 million years. One still can detect the rim and there is a central mountain range. We drove 20 miles further north to another frontier fort, Fort Stockton, and something cold to drink at a Sonic drive-in. Then the rental car died. Panic set in as visions of not making it back to Kerrville for the eclipse filled my mind. Luckily there was an auto parts store next to the Sonic, and Joan jumped into action and got a guy to come over to check out the situation. It was a dead battery. The closest Budget rental agency was 100 miles away in Midland, and it was closed. Now I was really getting worried. The auto parts store guy jump-started the car, and we headed

north toward Odessa and Midland. We made it to the motel in Odessa, unpacked with the car still running, then I took off to an auto parts store I saw down street from the motel. It was now 7:00 pm on Saturday night, but luck was on my side; it was still open, and it had the correct size battery. The down side to all this was we did not get to visit the Odessa crater.

The next day, Sunday, we headed back south to Kerrville with a stop at Fort Concho in San Angelo. We arrived in Kerrville in the early evening and chatted with other eclipse tourists, several from San

Antonio. The weather had been mostly clear for the trip so far, but on eclipse morning the sky was full of low clouds. Not to be deterred and full of hope the eclipse tourists at the motel set up their chairs, cameras and scopes on the nice lawn in front of the motel. The sun broke through occasionally. I handed out sky charts of how the stars and planets would look at totality, and set up the club's Coronado solar scope to give the folks a few glimpses of the solar disc. One of our group had a friend report from Mazatlán that totality was perfect. As totality approached our site the clouds got thicker. We did experience a drop in temperature and the lights in town coming on during totality. No howling dogs. Next I contacted my buddy in southern Illinois to see how the sky was, and he told me it was perfect. I also contacted Ken Yanosko to see how Cleveland skies were. You can read his eclipse story. Was the experience a disappointment, of course, but I was not alone. After the eclipse we went back to the room and turned on the news to see how the eclipse was experienced by people along its path. As it turned out Bill Nye, the science guy, was reporting on CNN from Fredericksburg, TX which is 20 miles north of us. I know he did his weather probability homework. He told viewers that it was cloudy there also. I did not feel too bad.

The next day we headed back to San Antonio via Fredericksburg and the Texas hill and wine country. Back in San Antonio we looked for a place to eat on the river walk which was mobbed. The next couple of days we explored the Alamo, also mobbed, and the several missions that make up a national park. What could have been a great trip turned out to be a good trip. Maybe Greenland, Iceland or Spain in 2026. Egypt is an option for 2027. Luxor is fantastic that time of the year, August. Anybody interested?



—Mark Wilson

Indiana

Our eclipse trip to Indiana was a success! We flew to Louisville, Kentucky to spend a day at Mammoth Cave National Park before heading north to the eastern suburbs of Indianapolis for the night. We

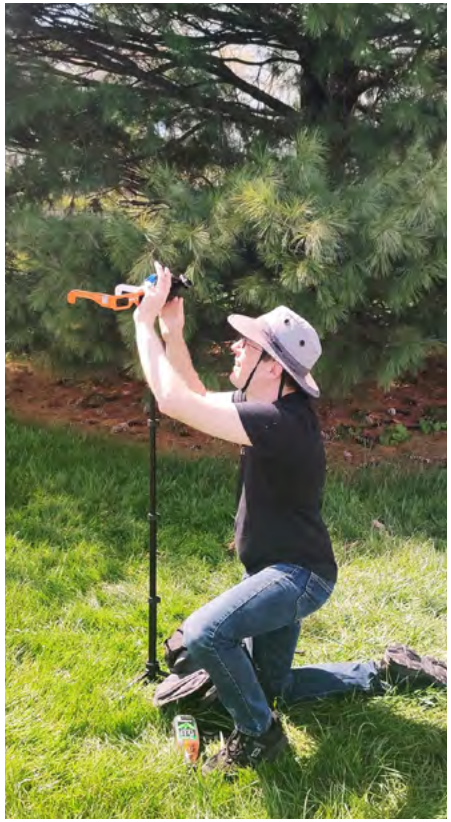
went to bed prepared to hit the road early Monday morning if we woke up to clouds, but the big day dawned bright and sunny, so we found a community park in the little town of Morristown, Indiana located just a mile from the center line, scoring us four full minutes of totality.

The shady spot in the grass we picked happened to

be near a family with several school-aged kids, their mom, and their grandfather. I started out answering questions about why eclipse glasses are important and what eclipses look like from space, and later ended up doing a full pinhole shadow demo, using a pizza pan we bought at Walmart in Kentucky (because our colander wouldn't fit in our luggage).

Totality arrived as scheduled to cheers from all over the park, and the temperature drop was immediate and very welcome. Four minutes was enough time to point out Venus, bright pink solar prominences, and the "360 degree sunset" to the kids, not to mention take a bunch of blurry photos and generally bask in the eerie mid-afternoon/evening. And in an exact repeat of the 2017 eclipse, as soon as totality ended, we started planning when and where we'll catch up with the Moon's shadow again!

—Allison & Johann Waltberg

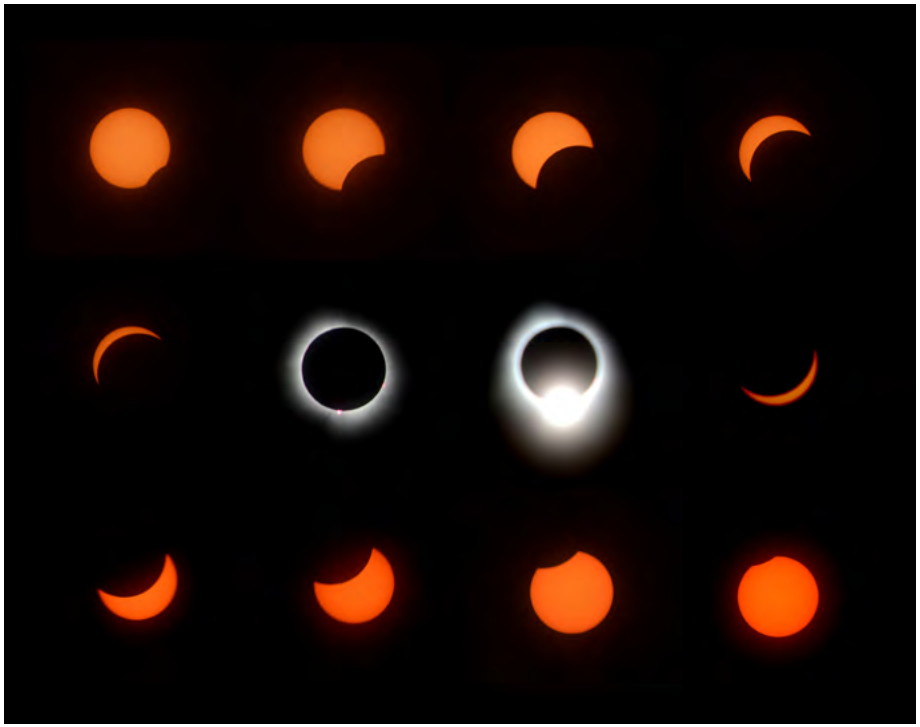


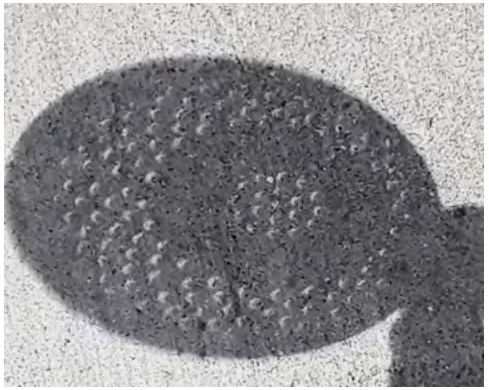
Ohio

In 2017 we went to Oregon to see totality from Susan's brother's house near Salem, so it seemed only fitting that in 2024 we go to Ohio to see totality from my sister's house near Cleveland. The sky was overcast in the morning, but with a glimmer of brightening to the west; and by noon it had cleared, with very thin high-altitude haze, but with sharp shadows.

I didn't take a telescope, and my flimsy suitcase-packable tripod was too hard to set up properly, so I was stuck using my 200 mm lens in hand-held mode. Fortunately I had practiced getting the focus and exposure right with my solar filter before leaving home. Of course you can't practice photographing totality unless you're experiencing totality; the internet said to maximize aperture and iso and shoot somewhere between 1/10 and 1/100 sec so I just clicked away and managed to luck out with a few reasonable shots.

I remembered to borrow my sister's colander for the obligatory "shadow" shot, and my niece surprised us with her partial/total eclipse manicure.





Colander shadow and manicure.

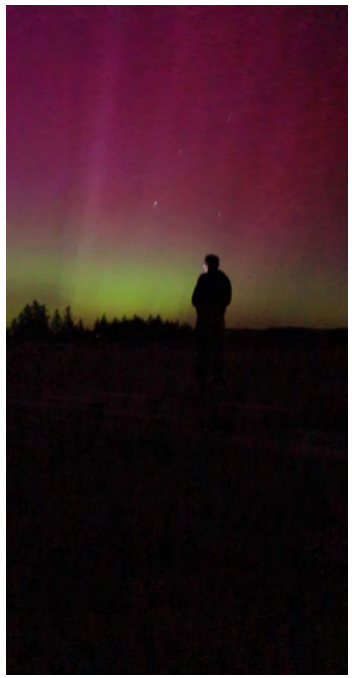
This was my third opportunity to photograph totality (I was in Baja in 1991 with Bob and Jeff and a few other AOH old-timers). Believe me—or believe the fanatics who have seen dozens of eclipses—it never gets old.

If you haven't been to a path of totality, do whatever you have to do—fly, drive, or crawl—to experience it for yourself.

—Ken Yanosko

Aurora!!

Right here in Humboldt County! In early May a huge sunspot group came around the edge of the Sun and lined itself up with us. The associated Active Region then sent a Coronal Mass Ejection hurtling toward Earth, and on May 10 the planet's magnetic field funneled the stream of charged particles right down on top of us. [See Grace Wheeler's article on page 12.] The skyglow was definitely visible to the naked eye, with a hint of color and occasional streaks appearing. A few seconds of exposure time allowed our cameras to capture the reds and greens and unmistakable streaks.



Above: Don Wheeler, from Kneeland;

Right: Ken Yanosko, from Arcata;

Below: Allison Waltberg, from Kneeland;

Left: Ben Shaeffer from Kneeland.

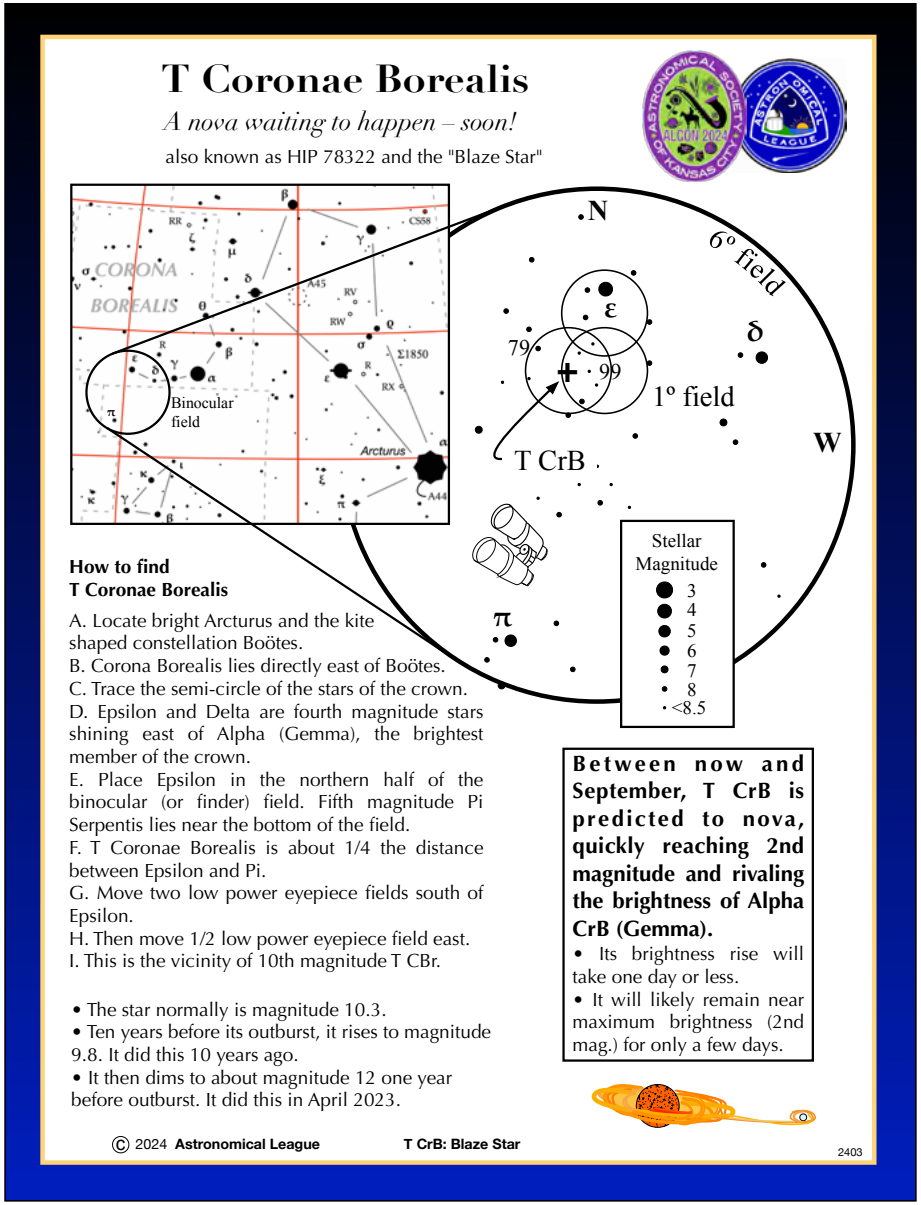
And a Comet!!!

Almost forgotten after the April eclipse and May aurora display, Comet 12P Pons-Brooks put in an appearance in March. [See the Spring Newsletter for a detailed article]. This later photo was taken on March 30 when PB was a half degree from Hamal (Alpha Arietis). I didn't think I would get the image because PB was low in the horizon (19 degrees) and setting quickly behind some trees. It was a lucky shot because for once there was no fog on the horizon.

—Grace Wheeler

And (maybe) a Nova!!!!

It is predicted that the recurring nova T Coronae Borealis will erupt sometime this Summer. The AstroLeague has published a finder chart and recommends that you first find the star in its quiescent state so that you know where to look when the news comes that it has erupted.



Summer Outreach

AOH will hold several outreach programs this summer. Check the "Upcoming Events" list on the website for up-to-date activities. We are always looking for volunteers to help out. No experience is necessary. Contact Brent (president@astrohum.org) if you would like more information about any of the following.

Pal Camp

The Discovery Museum sponsors a Day Camp for local youth; we will have an afternoon session with them on Wednesday, June 26.

Albee Creek Star Parties

We will have evening observing sessions at Albee Creek Campground in Humboldt Redwoods State Park on Saturdays, June 29, July 27, and August 24. See the poster at right.

Summer Observing

Our regularly scheduled observing sessions, on the Saturday nearest the New Moon, are scheduled for July 6, August 3, and August 31. (The latter is the nearest Saturday to the New Moon of September 2.) We will meet at Kneeland Airport if sky conditions and Cal Fire operations permit. The website will be kept up-to-date, and Club Members will get timely emails regarding any changes.

IOMN

Save the date! International Observe the Moon Night is Saturday, September 14, 2024. Everyone on Earth is invited to participate in this NASA-sponsored event. See https://moon.nasa.gov/observe-the-moon-night/, and check our webpage for AOH activities.

Summer Meteors

The Perseid Meteor Shower will peak on the night of August 11-12. Below is an annotated photo of last year's shower taken by local photographer Jack Hopkins at Horse Mountain. Details: Canon 5D Mark 3, Canon 16-35 mm f/4.0 @ 16 mm/f4, 15 sec, 6400 iso set on continuous high speed shooting. About 2200 hrs August 12 until about 0400 hrs August 13. About 40 meteors overlaid on a base frame.

The Remarkable AR 3664

by Grace Wheeler

In January, I was telling a friend that even though Solar Cycle 25 had been exceptional for its sunspot activity, I was afraid that it was just going to be an ordinary above-average solar cycle. What would make it memorable would be a Jupiter-sized sunspot and an aurora stretching down to southern California. Sunspot region AR 3664 nearly delivered on both of my wishes. While AR 3664 never reached the size of Jupiter, it was still substantial at sixteen Earth diameters. It supplanted the previous record holder, AR 3590 (nine Earth diameters), as the largest sunspot for Solar Cycle 25. For the aurora part of the story, AR 3664, which had been quiescent since it appeared on the disk on May 1, suddenly came to life and produced four sizable solar flares (X- and M-class) in a 24-hour period. Each flare was strong enough to trigger a coronal mass ejection (CME) of plasma and magnetic fields toward the Earth (Figure 1). The four fast-moving CMEs arrived on May 10 and generated a G4 (severe) geomagnetic storm that was later upgraded to G5 (extreme), the highest level for this type of storm (https://science.nasa.gov/science-research/heliophysics/how-nasa-tracked-the-most-intense-solar-storm-in-decades/). The storm produced an aurora that was seen in most of the U.S. (Figure 2). This was the most potent geomagnetic storm in 20 years, with the last one being the Halloween solar storms of 2003.

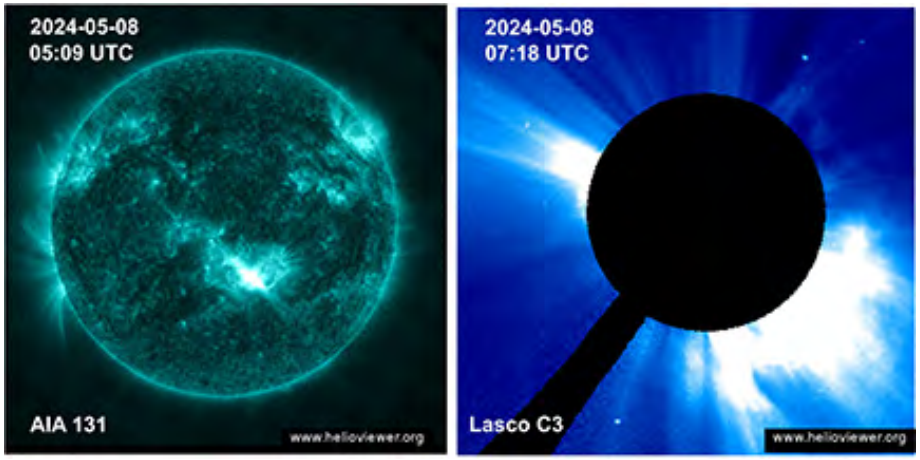


Figure 1. On May 8th, AR 3364 produced a X1.0 solar flare as seen by the AIA 131 instrument (SDO/GSFS.) This was followed by a coronal mass ejection (CME) of plasma material as detected by the coronograph Lasco C3 (SOHO).

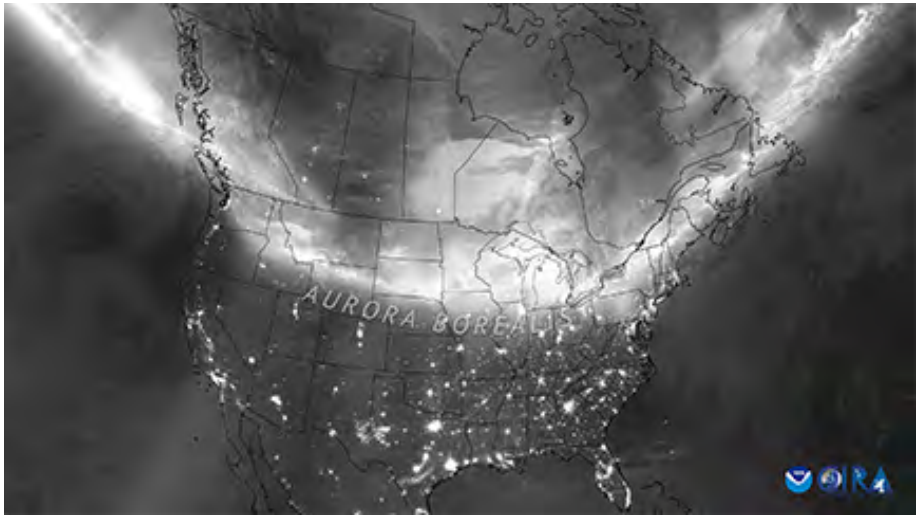


Figure 2. On May 10-11, Earth experienced an intense geomagnetic storm caused by multiple coronal mass ejections from the Sun. This event led to the emergence of breathtaking auroras, visible in regions worldwide where the northern lights are seldom observed.Text and Image Credit: CSU/CIRA & NOAA (with modification by GW.)

The Evolution of AR 3664:

Sunspot AR 3664 appeared on the disk on May 1 as a small cluster of sunspots with a simple β magnetic classification. Early on in its transit, AR 3664 seemed unremarkable, producing mostly C-flares and a few M-flares. At that time, more attention was being given to the development of AR 3663, another transiting sunspot that was a prolific producer of X- and M-flares. Whereas AR 3663 stalled in its growth, AR 3664 continued to grow and change in its magnetic complexity. Between May 7 to 10, AR 3664 grew rapidly and ballooned from 630 MH to 2400 MH. Sunspots in AR 3664 developed the magnetic classification of β-γ-δ. These types of sunspots give rise to magnetic fields that are complex, volatile, and prone to eruptions. This, in part, explains the sudden production of a large number of potent M- and X-flares by AR 3664. (https://www.spaceweatherlive.com/en/help/the-magnetic-classification-of-sunspots.html)

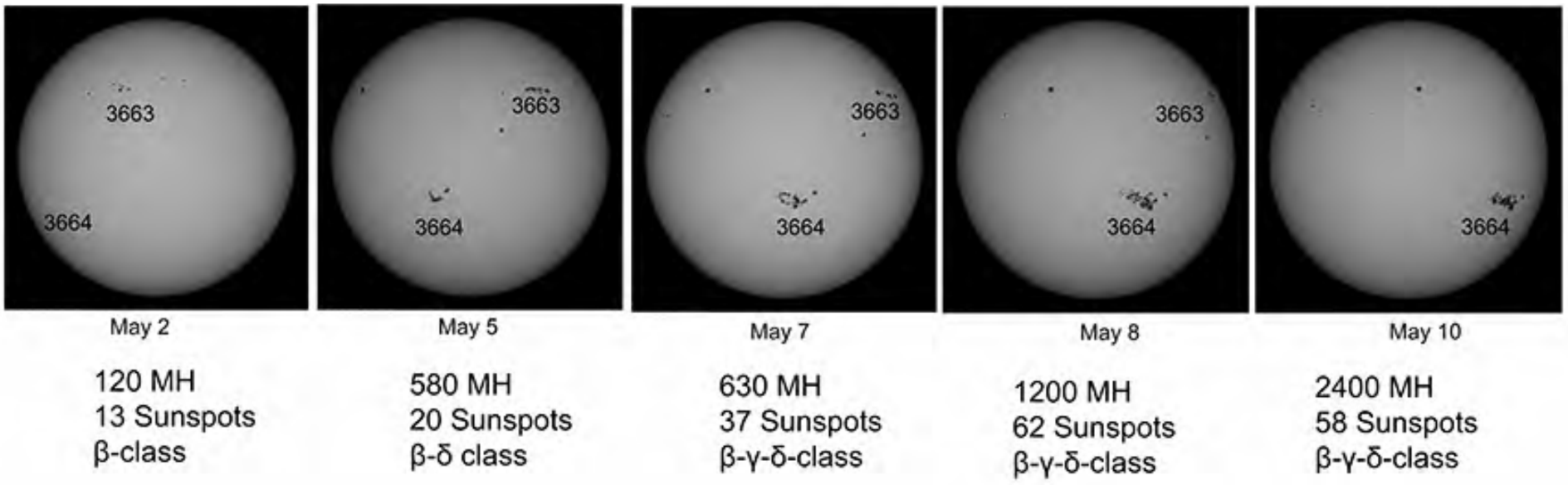


Figure 3. Photosphere of the Sun showing the growth of AR3364 between May 2 to 10. For each date, the size of the sunspot in MH (1 MH=600,000 square miles), the number of sunspots, and the magnetic classification is the sunspot region is given. Also shown in the figure is AR 3363, a sunspot region that was transiting ahead of AR 3664. Values for the sunspot size, number, and magnetic classification was from Space Weather live.com. Image Credit: images of the solar disk is from https://sdo.gsfc.nasa.gov/data/aiahmi/

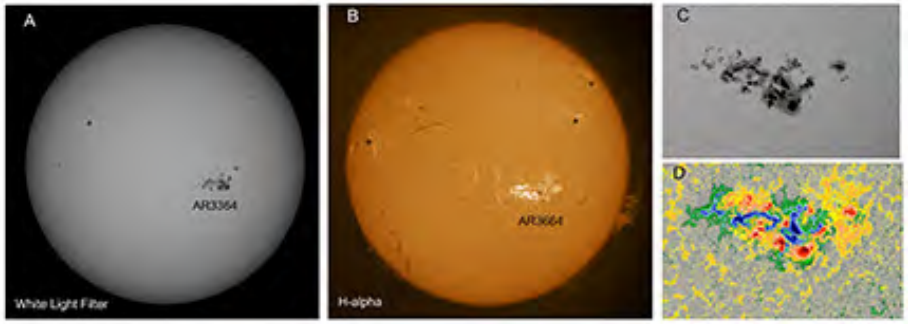


Figure 4: The sun on May 8, 2024 in (A) white light solar filter, (B) hydrogen-alpha showing AR3364. In hydrogen-alpha, AR3664 is brighter compared to other active regions on the solar disk (marked with asterisks.) (C) is a close up of the sunspots in AR3664. (D) is the magnetogram for AR3664. Red and yellow areas represent negative polarities while blue and green are positive polarities. Image credit: Images A and B are from GW. Images C and D are from https://sdo.gsfc.nasa.gov/data/aiahmi/

The Active Region of AR 3664

The sun was observed with a hydrogen-alpha telescope on May 8; on this date, the rapid growth of sunspots, along with an uptick in solar eruptions, was observed in AR 3664. Notably, intense brightness was observed in AR 3364, especially when compared to other active regions on the solar disk (marked with asterisks). As previously mentioned, the sunspots of the β-γ-δ class produce highly stressed magnetic fields and, thus, are energetic. The brightness observed in the active region is presumably due to an elevated emission of hydrogen-alpha. The complexity of the sunspots and the magnetic field contained in AR 3664 are depicted in Figure 4CD.

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This article is distributed by the NASA Night Sky Network, a coalition of hundreds of astronomy clubs across the US dedicated to astronomy outreach.

Binoculars: A Great First Telescope

by Kat Troche

Do you want to peer deeper into the night sky? Are you feeling the urge to buy a telescope? There are so many options for budding astronomers that choosing one can be overwhelming. A first telescope should be easy to use and provide good quality views while being affordable. As it turns out, those requirements make the first telescope of choice for many stargazers something unexpected: a good pair of binoculars!

A pair of good binoculars can show craters on the Moon around 6 miles (10 km) across and larger. How large is that? It would take you about two hours to hike across a similar-sized crater on Earth.
Photo by Jay Tanner

The two most popular types of binocular designs are shown here: roof-prism binoculars (left) and porro-prism binoculars (right). Roof prisms tend to be more compact, lighter, and a bit more portable, while porro-prisms tend to be heavier but often offer wider views and greater magnification. What should you choose? Many birders and frequent fliers often choose roof-prism models for their portability. Many observers who prefer to observe fainter deep-sky objects or who use a tripod with their observing choose larger porro-prism designs. There is no right answer, so if you can, try out both designs and see which works better for you.
Astronomical Society of the Pacific

Binoculars are an excellent first instrument because they are generally easy to use and more versatile than most telescopes. Binoculars can be used for activities like stargazing and birdwatching and work great in the field at a star party, along the hiking trail, and anywhere else where you can see the sky. Binoculars also travel well, since they easily fit into carry-on luggage – a difficult feat for most telescopes! A good pair of binoculars, ranging in specifications from 7x35 to 10x50, will give you great views of the Moon, large open star clusters like the Pleiades (M45), and, from dark skies, larger bright galaxies like the Andromeda Galaxy (M31) and large nebulae like the Orion Nebula (M42). While you likely won't be able to see Saturn's rings, as you

practice your observing skills you may be able to spot Jupiter's moons, along with some globular clusters and fainter nebulae from dark sites, too.

What do the numbers on those binocular specs actually mean? The first number is the magnification, while the second number is the size in millimeters (mm) of the lenses. So, a 7x35 pair of binoculars means that they will magnify 7 times using lenses 35 mm in diameter. It can be tempting to get the biggest binoculars you can find but try not to get anything much more powerful than a 10x50 pair at first. Larger binoculars with more power often have narrower fields of vision and are heavier; while technically more powerful, they are also more difficult to hold steadily in your hands and "jiggle" quite a bit unless you buy much more expensive binoculars with image stabilization or mount them to a tripod.

Would it surprise you that amazing views of some astronomical objects can be found not just from giant telescopes, but also from seemingly humble binoculars? Binoculars are able to show a much larger field of view of the sky compared to most telescopes. For example, most telescopes are unable to keep the entirety of the Pleiades or Andromeda Galaxy entirely inside the view of most eyepieces. Binoculars are also a great investment for more advanced observing, as later on they are useful for tracking down objects to then observe in more detail with a telescope.

If you are able to do so, real-world advice and experience is still the best for something you will be spending a lot of time with! Going to an in-person star party is a great way to get familiar with telescopes and binoculars of all kinds! ... And inspire your binocular stargazing sessions with NASA's latest discoveries!

Originally posted by Dave Prosper: November 2022
Last Updated by Kat Troche: April 2024

Kat Troche is Project Coordinator and Night Sky Network Administrator at the Astronomical Society of the Pacific

The universe's biggest explosions made some of the elements we are composed of. But there's another mystery source out there.

by Robert Brose

After its "birth" in the Big Bang, the universe consisted mainly of hydrogen and a few helium atoms. These are the lightest elements in the periodic table. More-or-less all elements heavier than helium were produced in the 13.8 billion years between the Big Bang and the present day.

Stars have produced many of these heavier elements through the process of nuclear fusion. However, this only makes elements as heavy as iron. The creation of any heavier elements would consume energy instead of releasing it.

NASA/Swift/Cruz deWilde

The James Webb Space Telescope observed the aftermath of the 'BOAT'.
Emmett Given/Nasa/MSFC

In order to explain the presence of these heavier elements today, it's necessary to find phenomena that can produce them. One type of event that fits the bill is a gamma-ray burst (GRB) — the most powerful class of explosion in the universe. These can erupt with a quintillion (10 followed by 18 zeros) times the luminosity of our Sun, and are thought to be caused by several types of event.

GRBs can be subdivided into two categories: long bursts and short bursts. Long GRBs are associated with the deaths of massive and fast-rotating stars. According to this theory, the fast rotation beams material ejected during the collapse of a massive star into narrow jets that move at extremely fast speeds.

The short bursts last only a few seconds. They are thought to be caused by the collision of two neutron stars — compact and dense "dead" stars. In August 2017, an important event helped support this theory. Ligo and Virgo, two gravitational wave detectors in the US, discovered a signal that seemed to be coming from two neutron stars moving in for a collision.

A few seconds later, a short gamma-ray burst, known as GRB 100817A, was detected coming from the same direction in the sky. For a few weeks, virtually every telescope on the planet was pointing at this event in an unprecedented effort to study its aftermath.

The observations revealed a kilonova at the location of GRB 170817A. A kilonova is a fainter cousin of a supernova explosion. More interestingly, there was evidence that many heavy elements were produced during the explosion. The authors of a study in Nature that analysed the explosion showed that this kilonova seemed to produce two different categories of debris, or ejecta. One was composed primarily of light elements, while another consisted of heavy elements.

We've already mentioned that nuclear fusion can only feasibly produce elements as heavy as iron in the periodic table. But there's another process which could explain how the kilonova was able to produce even heavier ones.

Rapid neutron-capture process, or r-process, is where the nuclei (or cores) of heavier elements such as iron capture many neutron particles in a short time. They then rapidly grow in mass, yielding much heavier elements. For r-process to work, however, you need the right conditions: high density, high temperature, and a large number of available free neutrons. Gamma ray bursts happen to provide these necessary conditions.

However, mergers of two neutron stars, like the one that caused

A jet of particles pierces a star as it collapses into a black hole.
Nasa Goddard Space Flight Center

the kilonova GRB 170817A, are very rare events. In fact, they may be so rare as to make them an unlikely source for the abundant heavy elements we have in the universe. But what of long GRBs?

A recent study investigated one long gamma ray burst in particular, GRB 221009. This has been dubbed the BOAT — the brightest of all time. This GRB was picked up as a pulse of intense radiation sweeping through the Solar System on October 9 2022.

The BOAT sparked a similar astronomical observation campaign as the kilonova. This GRB was 10 times more energetic then the previous record holder, and so close to us that its influence on the Earth's atmosphere was measurable on the ground and comparable to a major solar storm.

Among the telescopes studying the aftermath of the BOAT was the James Webb Space Telescope (JWST). It observed the GRB about six months after it exploded, so as not to be blinded by the afterglow of the initial burst. The data JWST collected showed that, despite the event's extraordinary brightness, it was caused by a merely average supernova explosion.

In fact, previous observations of other long GRBs indicated that there is no correlation between the brightness of the GRB and the size of the supernova explosion associated with it. The BOAT seems no exception.

The JWST team also inferred the number of heavy elements produced during the BOAT explosion. They found no indication of elements produced by the r-process. This is surprising as, theoretically, the brightness of a long GRB is thought to be associated with the conditions in its core, most likely a black hole. For very bright events — especially one as extreme as the BOAT — the conditions should be right for the r-process to occur.

These findings suggest that gamma ray bursts may not be the hoped-for crucial source of the universe's heavy elements. Instead, there must be a source or sources still out there.

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May the AR 3664th Be with You**

By the time AR 3664 rotated behind the sun on May 15, it had set a number of records:

(1) It is the largest sunspot of Solar Cycle 25.

(2) It produced 12 X-flares during its transit across the solar disk. This sunspot region produced the most X-flares of any during this solar cycle.

(3) It produced an X8.7 flare on May 14; this was the largest solar flare for this cycle.

(4) AR 3664 is responsible for producing the CMEs that generated a G5 geomagnetic storm. This was the largest storm since the "Halloween storm" of November 2003.

For a personal point of view, AR 3664 has made this solar cycle a memorable one, and it's not over yet.

**borrowed from Solarham.com

Grace Wheeler is an Active Region in the Astronomers of Humboldt, contributing not only to the Newsletter on a regular basis, but also to our outreach programs, our social events, membership recruitment, and club management.

After Words

"My view is that if your philosophy is not unsettled daily then you are blind to all the universe has to offer."

— Neil deGrasse Tyson

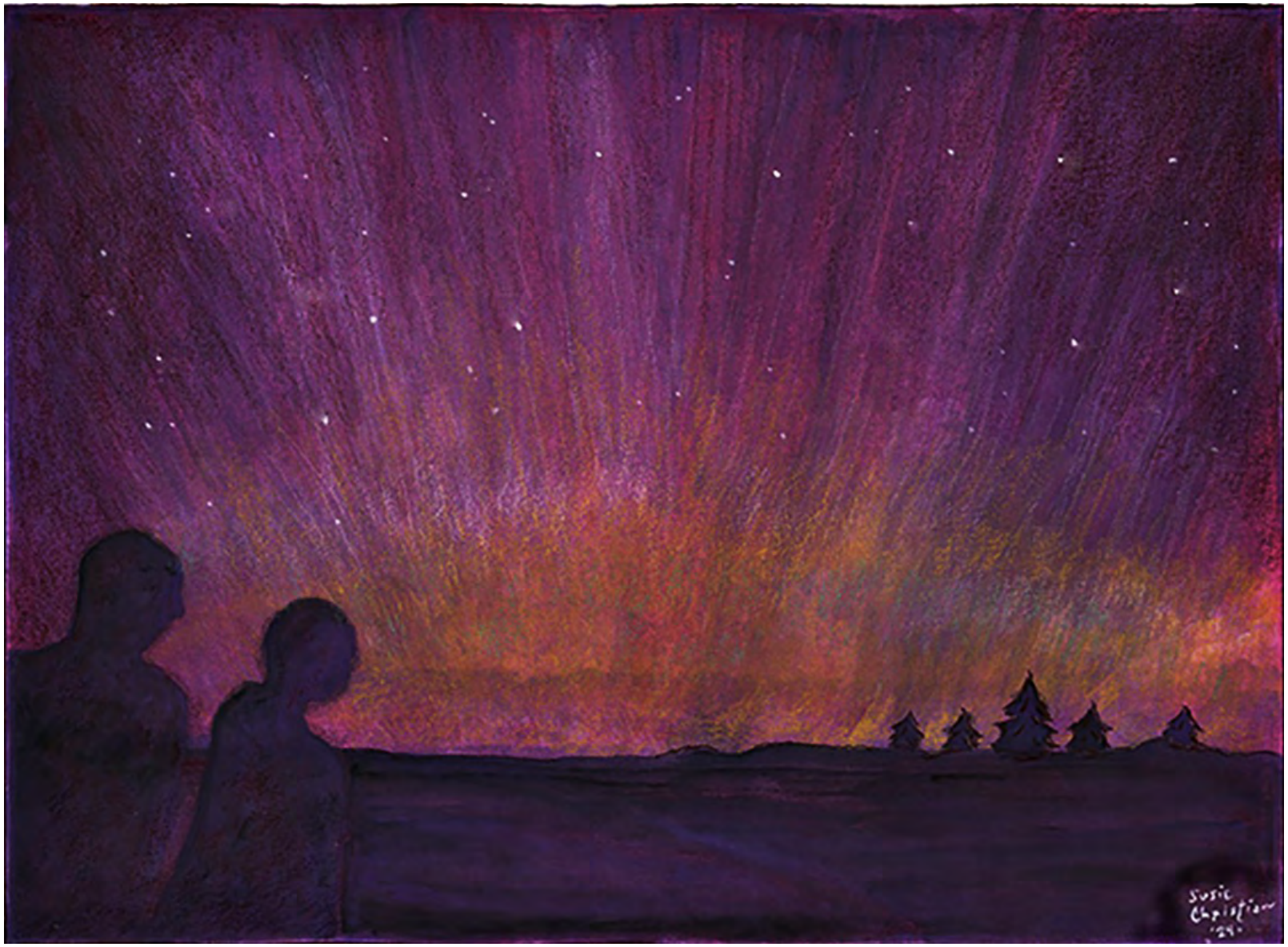
Thanks

... to Allison & Johann, Ben, Bob, Don, Grace, Jack, Jeff, Mark W, Mary, Susan, and Susie for all their help.

—Ken

Heavenly Bodies

by Susie Christian



When Everything Goes Right in the Land of Humboldt

—inspired by a photo by Allison Waltberg