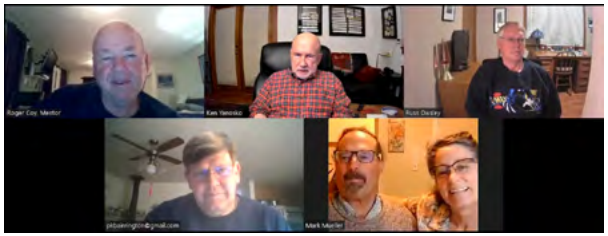
AOH Newsletter

Winter 2023

News and Notes

AOH has continued with its series of Zoom meetings through the Fall. In November, the election for the Board of Directors was held; all the current Members: of the Board: Bernie Christen, Dan Eaton, Rick Gustafson, Brent Howatt, Catrina Howatt, Mark Mueller, Mark Wilson, Ken Yanosko, and Bob Zigler, were re-elected. And at the same meeting, the current officers: President Brent Howatt, Vice President Mark Wilson, co-Treasurers Catrina Howatt and Bob Zigler, and Secretary Ken Yanosko, were also re-elected for another year.



We have been able to resume some outreach programs as well.

Hoopa Elementary School invited the Astronomers of Humboldt to an Astronomy night at their school. Grace and Don, Mike, and Brent and Catrina had the pleasure of attending. We had a table with activities like Planet Masks and Solar System stickers along with a hands on Gravity Well to see how gravity and the planetary orbits work. There were other activities for students including fireside storytelling about our night skies. We had three telescopes set up for folks to view the Moon, Saturn, and Jupiter. It was a beautiful clear night! —CH

Mark Wilson and Brent and Catrina Howatt went to Northcoast Preparatory Middle School to share the night sky through our telescopes. We looked at Jupiter, Andromeda, the Owl Cluster and other night sky objects. The students had questions to ask the astronomers for their studies. There was a great turnout and it was fun! —CH

Brent and Catrina Howatt went to the Kneeland School Fall Festival Trunk and Treat Event. We opened up the observatory and gave tours to the students, parents, and community. We had planet masks, moon maps, solar system handouts; and we also passed out UV light changing beads to students to demonstrate the effects of UV light. We were able to use the small Dobsonian telescope to view the moon. There was a great turnout at the school! It is nice to be out in the community with our telescopes again!
—CH

In November our regular observing session at Kneeland Airport was managed by Mark W and Bernie. A teacher, parents, and a student from Blue Lake Elementary represented the newly-formed Astronomy Club at their School. The visitors were introduced to the night sky; the student was given some pointers on the use of his own scope, and the possibility of a visit to the school was discussed. —MW

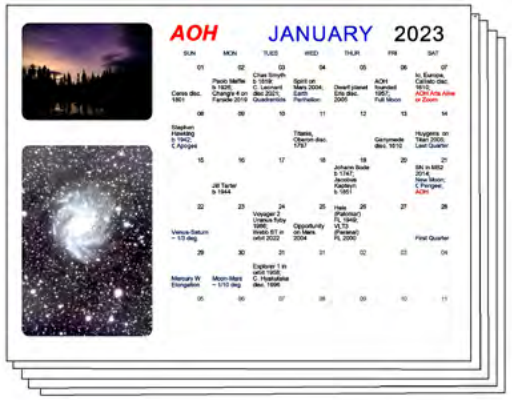
It's That Time of Year

Dues

Dues are now due. Go to the Membership Form at https://www.astrohum.org/membership.html, fill it out, and either print and mail it with your check, or use the link on that page to go to a secure web site to pay by credit card, debit card, or paypal.

Calendar

The 2023 AOH Calendar is available for AOH members to download from https://www.astrohum.org/members_only/calendar.php. You get the tentative schedule of AOH activities, as well as historical notes, astronomical events, and photos taken by our own members,



Outreach Awards

Since we have had no opportunity this past year to hand out our Night Sky Network Outreach Awards for 2021, we have been distributing them privately. Award pins, and the sincere thanks from the Astronomers of Humboldt, are being presented to the following: Brent Howatt, Mark Wilson, Catrina Howatt, Bob Zigler, Ken Yanosko, Bernie Christen, Dan Eaton, Mark Mueller, Grace Wheeler, Lisa Hockaday, Susie Christian, Yoon Kim, Rick Gustafson, Susan Frances, Russ Owsley, Don Wheeler, Johnny Thomas, and Mark Pedley.

Potluck

Plans are underway to hold an in-person Potluck Anniversary Dinner in 2023. The proposed date is Saturday, February 4. Mark the date on your calendar and watch your Inbox and the Website's Upcoming Events page for details.

Quadrantid Meteor Shower

According to the American Meteor Society, "The Quadrantids have the potential to be the strongest shower of the year but usually fall short due to the short length of maximum activity (6 hours) and the poor weather experienced during early January. The average hourly rates one can expect under dark skies is 25. These meteors usually lack persistent trains but often produce bright fireballs....The Quadrantids will next peak on the Jan 3-4, 2023 night. On this night, the moon will be 92% full."

Planetary Conjunctions

This winter, as Earth moves around to the side of the Sun opposite where slow-moving Jupiter and Saturn are, the two giant planets appear to draw closer to the Sun in the evening sky. Meanwhile, Venus, moving faster than Earth, will have zoomed around the Sun and and will appear to be moving away from the Sun. The result is that from our terrestrial point of view, Venus goes past Saturn (they will be 1/3 degree apart on January 22) and then past Jupiter (1/2 degree apart on March 1).

Thank you

To all of you who helped put this Newsletter together—your efforts are greatly appreciated: Catrina, Mark W, Grace, Barry, Susie, Yoon, and Susan.

And thank you in advance to all who will help with the next Newsletter. Consider this an invitation to submit anything: pictures, stories, ideas, or whatever you would like.

Ken

Winter Objects

by Mark Wilson

ID	Common Name	Const.	Object	Mag.	Source
7331	Deer Lick Group	Peg	G Sbc	10.3	MOP
Stock 2		Cas	OC	4.4	SA-stb
225		Cas	OC	7	HT
281	Pacman Nebula	Cas	N	7.8	HT
457		Cas	OC	6.4	SA-stb
7789		Cas	OC	6.7	SA-stb
1027		Cas	OC	6.7	SA-stb
663		Cas	OC	7.1	SA-stb
457		Cas	OC	6.4	SA-stb
7789		Cas	OC	6.7	SA-stb
891	Milky Way Twin	And	G Sb	10.9	MOP
404	Mirach's Ghost	And	G		HT
752		And	OC	5.7	ITS
869	Double Cluster	Per	OC	5.3	SA-stb
884	Double Cluster	Per	OC	6.1	SA-stb
869		Per	OC	4.3	SA-stb
884		Per	OC	4.4	SA-stb
Mel 20		Per	OC	1.2	SA-stb
1342		Per	OC	6.7	SA-stb
1528	M&M Double Clus.	Per	OC	6.4	SA-stb/HT
1545	M&M Double Clus.	Per	OC	6.6	HT
133	Embryo Nebula	Per	N	5.7	HT
2403		Cam	G SAbc	8.9	ITS
2403		Cam	G SABc	8.9	ITS
1502	Kemble's Cascade	Cam	OC	6.9	MOP
1501	Oyster Nebula	Cam	PN	10.6	HT
IC 3568	Theoretician's Neb.	Cam	PN	10.3	HT
1647		Tau	OC	6.4	SA-stb
1746		Tau	OC	6.1	SA-stb
1535	Cleopatra's Eye	Eri	PN	9.6	MOP
1360		For	PN	7	SA-stb
1981		Ori	OC	4.2	ITS
1973	Running Man	Ori	N	7	MOP
1977	Mermaid's Purse	Ori	N	6.3	HT
Cr 70		Ori	OC	0.4	SA-stb
Cr 70		Ori	OC	0.4	SA-stb
IC 418	Spirograph Nebula	Lep	PN	9.1	HT
2392		Gem	PN	8.6	SA-stb
2232		Mon	OC	4.2	ITS
2237	Rosette Nebula	Mon	OC/N	9	MOP
2244		Mon	OC	4.8	ITS
2232		Mon	OC	3.9	SA-stb/ITS
2244		Mon	OC/N	4.8	SA-stb
2264	Christmas Tree Clus.	Mon	OC/N	3.9	SA-stb/HT
2301	Hagrid's Dragon	Mon	OC	6	SA-stb/HT
2362	Tau Canis Maj. Clus.	CMa	OC	4.1	SA-stb
2354		CMa	OC	6.5	ITS
2477		Pup	OC	5.8	SA-stb
2451		Pup	OC	2.8	SA-stb
2477		Pup	OC	5.8	SA-stb
2539		Pup	OC	6.5	SA-stb
2546		Pup	OC	6.3	SA-stb
2903		Leo	G Sbc	9.6	MOP
3628	Hamburger, Leo Trio	Leo	G SBb	9.5	SA-stb/ITS
3077		UMa	G S	10.1	ITS
6643		Dra	PN	8.3	SA-stb

All objects are visible in an 8 inch scope.

Object Key: OC = Open Cluster, N = Nebula, PN = Planetary Nebula, G = Galaxy with Hubble classification.

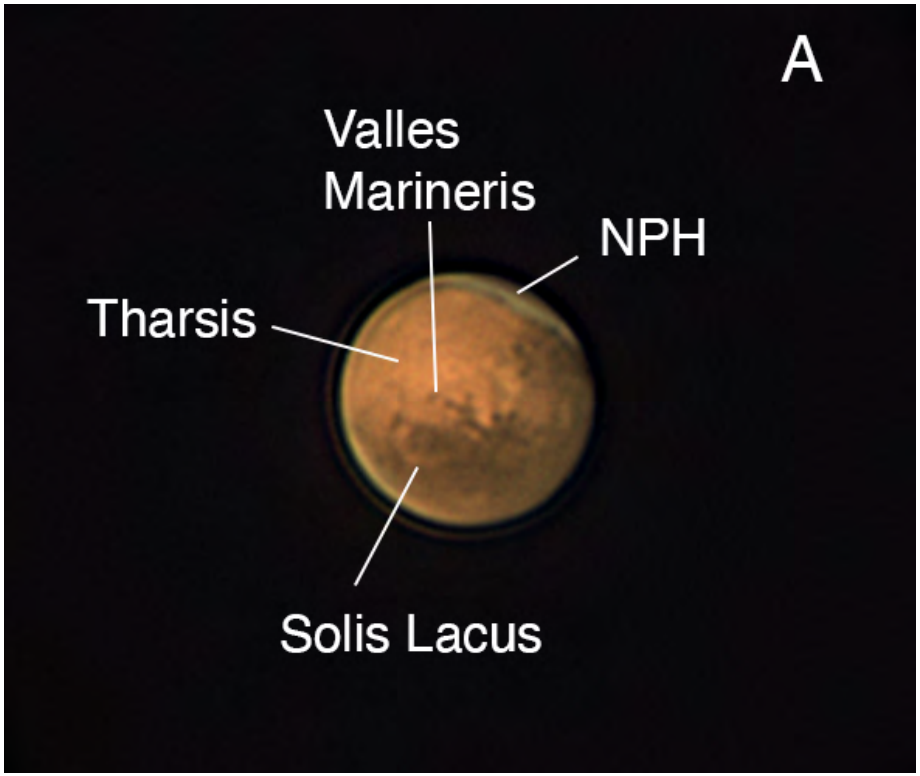
Source key: SA-stb = Sky Atlas for Small Telescopes and Binoculars, MOP = Messier Observers Planisphere, HT = Hidden Treasures, ITS = In-The-Sky (web site).

Mars Opposition, 2022

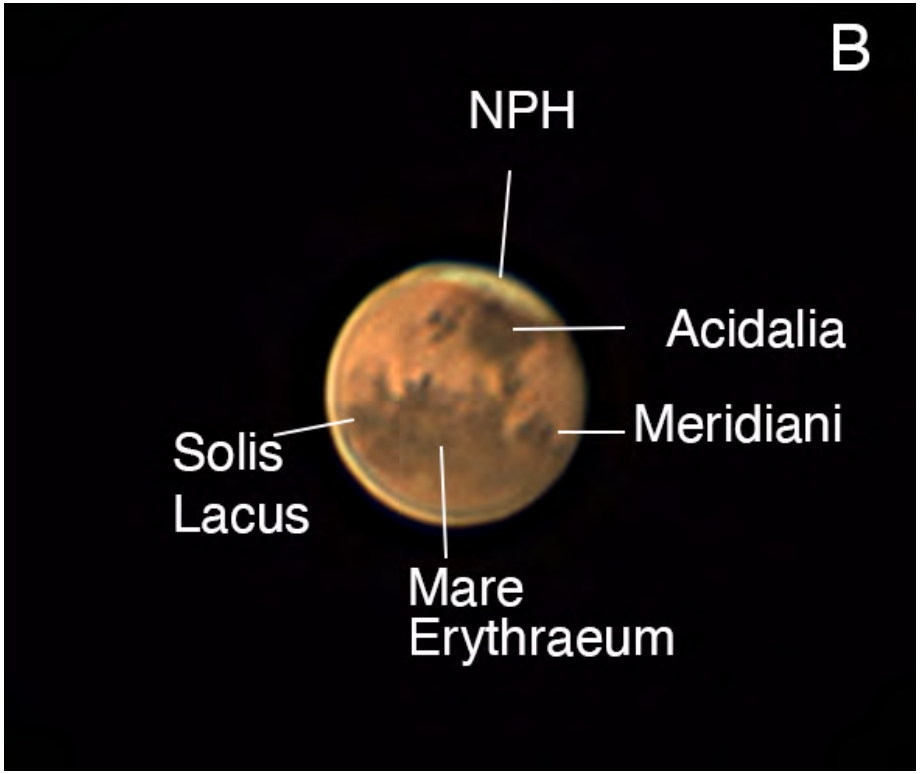
by Grace Wheeler

The 2022 Martian Opposition was on December 7th and marked the first of four aphelic oppositions occurring between 2022 to 2031 (aphelic refers to the farthest distance of an orbiting body from the sun). The last three Martian oppositions (2016 to 2020) were perihelic, and the observed diameters were between 20 to 24 arcseconds at Mars' closest approach. The maximum size of this year's disc was 17.2 arcseconds. While this may seem small, it is still decent, especially in comparison to the next three oppositions when the Martian disc will be 13.8 to 14.4 arcseconds at its closest approach.

Visual observations of Mars are usually done with large telescopes although some large albedo features such as Syrtis Major, Hellas Basin,



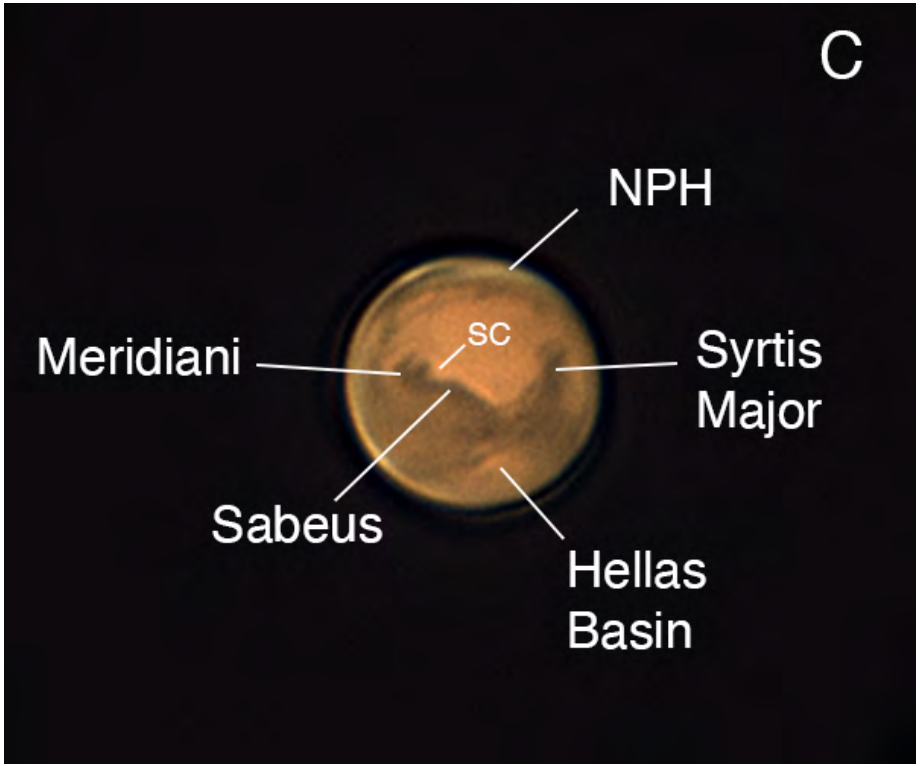
Solis Lacus is also known as the "Eye of Mars" because its dark center resembles the pupil of an eye. Noted astronomer and Mars observer Percival Lowell thought he could see canals traversing Solis Lacus and surmised that this was the Martian capital. Valles Marineris is a cracklike structure running above Solis Lacus. Valles Marineris is a network of canyons spanning about 2,500 miles in length and is one of the largest canyons in the solar system. The Tharsis is an expansive volcanic plateau that is home to Olympus Mons, and Tharsis Montes, a chain of three volcanoes.



This image shows two large dark albedo areas that can be seen in moderately sized telescope: Acidalia Planitia and Mare Erythraeum. Acidalia is part of the northern lowlands and is thought to have once contained an ocean. (For fans of "The Martian", this is where Mark Watney was marooned). Mare Erythraeum ("red sea") was thought to be a body of water and was given its name by Giovanni Schiaparelli. Meridiani Planum is named for its proximity to the prime meridian on Mars which divides the planet into the western and eastern hemispheres. Mars Global Surveyor showed evidence that water once flowed in Meridiani Planum and it was thus chosen as the landing site for the Mars rover Opportunity.

and Mare Erythraeum can be seen with small scopes. Astrophotography is an effective method for observing the planet as it allows for the magnification of features. Astrophotography software is used to further enhance and sharpen Martian features.

For the 2022 opposition, images of Mars were taken between November 21-28 when the disc was 98-99% illuminated and the diameter was 16.9-17.2 arcseconds. The images were captured using a ZWO ASI294mc planetary camera and a 2.5x Powermate on an 8-inch SCT. For each image, about 6000 frames were aligned in PIPP and then stacked in Autostakkert. The stacked image was sharpened in Registax and Photoshop.



Part of the eastern hemisphere of Mars is shown in this image. Sinus Sabeus is a heavily crater volcanic highlands that abuts Meridiani Planum to the east. The notch between Sabeus and Meridiani is Schiaparelli Crater (SC), a large impact crater that was created during the late heavy bombardment. Syrtis Major is the remnant of a large shield volcano and is easily seen in small telescopes. The basaltic surface and lack of dust give Syrtis Major its intense dark color. It was the first surface feature to be described on another planet (Christiaan Huygens, 1659). Hellas Basin is one of the largest impact craters in the Solar System was formed during the late heavy bombardment when a giant asteroid collided with Mars. Because of its large size and brightness against the dark Martian terrain, Hellas Basin was also one of first features to be mapped on the Martian surface.

Panels A and B on the previous page show features in the western hemisphere of Mars, and Panel C is of the eastern hemisphere. Notable albedo features are marked in the panels. As of this writing, the north polar cap is obscured by a dense cloud layer called the "north polar hood" (NPH). These clouds form during the late Martian summer and fall and are actually raining down water- and carbon dioxide-snow onto the ice cap. By the onset of spring in the northern hemisphere (January 2023), the hood will disappear and the north polar ice cap will become visible.

As I mentioned in the first paragraph, the next three oppositions of Mars will not be favorable because Mars will be at aphelion. That said, it will probably be worth the effort to image Mars during these opposition because of the challenge of taking pictures of such a small target. It will be good preparation for the 2035 opposition when Mars will be an impressive 24.5 arcseconds.

References:

https://www.skyatnightmagazine.com/advice/best-free-astronomy-software/

https://skyandtelescope.org/astronomy-news/mars-mesmerizes-at-december-8th-opposition/

https://en.wikipedia.org/wiki/Classical_albedo_features_on_Mars

https://mars.nasa.gov/resources/24729/map-of-nasas-mars-landing-sites/

Grace Wheeler is a former President, Newsletter Editor, and Outreach Chair for AOH. When not collecting photons with one of her astrocams attached to one of her telescopes, she can be found at the computer organizing and enhancing the many image files she has collected.

And Mars Occultation, 2022

by Grace Wheeler

As a bonus to Mars' opposition this year, on December 7 we were treated to the spectacle of a Martian occultation: Earth's Moon passed in front of Mars.

We were fortunate that the mostly cloudy forecast for Eureka turned into partly cloudy skies, at least for Humboldt Hill. Although it wasn't totally clear, the clouds were thin enough that we could clearly see the moon. Mars wasn't visible with the unaided eye (maybe because of the thin clouds and glare from the Moon), but it could be seen through the C-6. I tried to image Mars as it went behind the Moon, but missed it by 30 seconds. We were lucky that sky conditions held for another hour and we were able to see Mars come out of occultation. This time, I did manage to get a few photos of Mars. Between the clouds and our lack of preparation, we felt lucky to see the occultation of Mars at all. Getting images was an extra perk!

The Moon and Mars at two minutes after occultation (7:41 p.m.) This is a single image taken with image capture function on Sharpcap.

Closeup of the lunar surface and Mars (7:42 p.m.) This is a stacked image of the Moon and Mars. Dark albedo markings were visible in the southern hemisphere of Mars (south is at the top).

Equipment: C-6 SCT on a Celestron Evolution mount. Imaging was done with a ZWO ASI294mc planetary camera. Capture software was Sharpcap. For the second photo, frames were stacked in Autostakkert, and the final image was sharpened in Registax.

Me 'n' My eQuinox

by Barry Evans

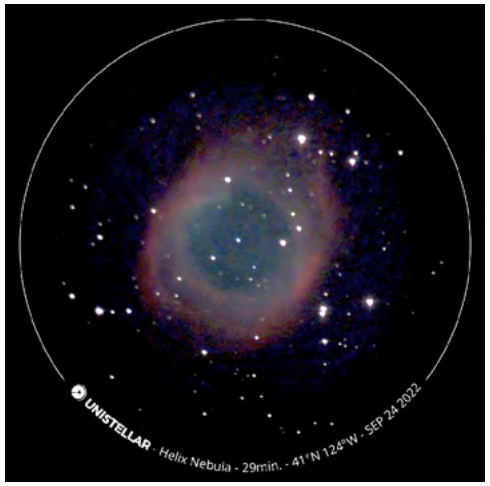
Coming up to 80, I never thought I'd be buying another telescope. I already had my ancient, trusty Astroscan plus nice 15x63 binocs. I'd done the overpriced Questar route, lugged a 10-inch Dob around the hills above Palo Alto, taken my sweet-but-heavy four-inch brass refractor to Baja for the nearly 7-minute total solar eclipse in 1991 (great photos—prominences!). So if you'd told me, a few months ago, I'd be buying a 4 1/2 inch Newtonian that cost about as much as all my previous 'scopes combined, I'd have told you I had to go, I was late for an important appointment.

That was then. Now, as the song goes, I'm a Believer. For those unfamiliar with the Unistellar eQuinox—currently on sale for a mere couple of grand (!)—let me give you the specs, then tell you why I love it. As I say, 4 1/2 inch mirror (115 mm), 450 mm focal length; alt-az mount; 30 arc-minutes view at 50x magnification (no interchangeable eyepieces…actually, no eyepiece. (Surprising how fast I got used to that!). No secondary, just a 4.8 megapixel CMOS at the top of the tube. 64 Gb storage, 10 hour battery, 20 lb, 27 inches long.

I love it because:

It sets up in five minutes.

Honest! Level the sturdy (custom) tripod, plonk the scope on top, don't forget to tighten the set screws, turn on, find its wifi router on my iPhone, open up the app and orient. I remember how long that last step used to take. Now it's <30 seconds, the magic of plate-matching ("Autonomous Field Detection"). This rascal knows exactly where and when it is without me doing a darn thing.



Above: Image on phone as sent directly from the eQuinox.
Below: The same image after processing with the phone's own software.

It finds pretty much anything I'm interested in.

This is steroidal GoTo. Helix? (NGC 7293) Oh c'mon, you can't see the Helix with a 4 1/2 incher! But you can. I tell it, in the app, to go find the Helix and off it goes, stopping to check every few seconds until it announces it's there. "There" at this point all my iPhone shows is a blank sky with a few stars at the edge of the field of view. No Helix, of course, far too faint. But:

It has "Enhanced Vision"…

…AKA stacking. All automatic, real time, right in the scope. The eQuinox saves an image every 4 seconds, so you see the result of 4-8-12-16… seconds worth of photon collecting as it adds successive pics to

what it's already stored. You get to see it as it happens (not the next day on your PC).

So after about 20 seconds, a faint dim gray circle appears against the black background. As you watch, traces of color appear, red on the outside, blue inside. Nothing too spectacular—see this 29-minute image from Kneeland as downloaded to my iPhone—but it's all I need. Give me a just a minute (literally) with Apple's built in photo editing, and there she is, a gorgeous planetary nebula 600-odd light years away. (If I'm trying to impress, wanting more or less instant results to show off to bystanders, I'll show 'em the Whirlpool in just a couple of minutes.)

Fun fact: William Parsons, 3rd Earl of Rosse, drew M51 on the night of April 26, 1848, proving for the first time that some of those so-called nebulae were galaxies in their own right. See my story in the North Coast Journal, July 28, 2022. [https://www.northcoastjournal.com/humboldt/island-universes-part-2/Content?oid=24199268]

Its usability is mind-boggling.

We all know about the best telescopes being the ones that get used. Here's the thing: Louisa and I live in Old Town Eureka, with a tiny backyard, neighbors' lights all around, just a wedge of sky visible. Yet even with all these barriers to Great Viewing, I can set up and in minutes M57, the Ring, begins to sparkle on my iPhone screen. A bit chilly, you say? Not a problem, I'm inside within its wifi range, sipping my Jaegermeister while the scope does all the work out there in the cold.

So yeah, for someone who never thought he'd be imaging all those faint Messiers in one short lifetime, seeing the eQuinox's second-hand photons is a fantasy come true.

Barry Evans is a relatively new member of AOH. He is a retired civil engineer, and writes regular columns for local news outlets: "Field Notes" in the North Coast Journal *and "Growing Old Ungracefully" in the* Lost Coast Outpost. *This is his first, but hopefully not the last, contribution to our Newsletter.*

The Charioteer and the Nanny Goat

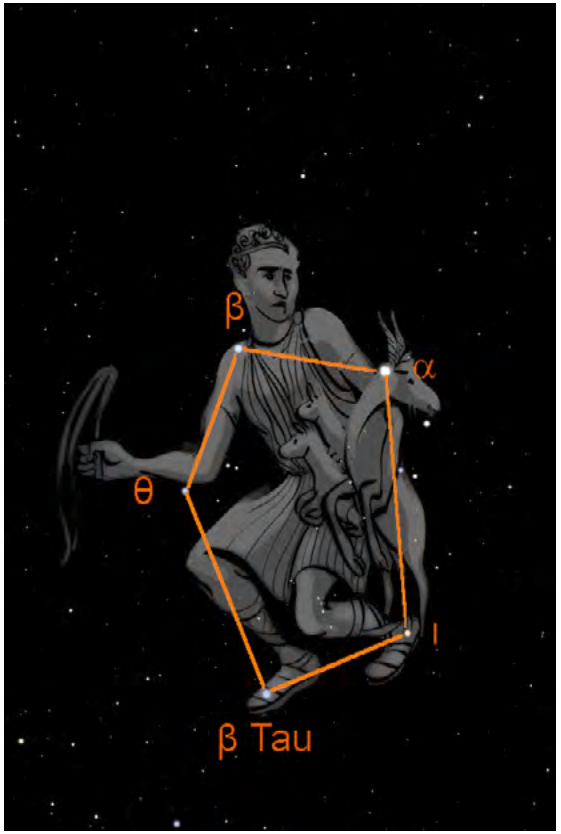
by Ken Yanosko

Auriga is one of our circumpolar constellations, always above our horizon. In midwinter in the evening it's almost directly overhead. Lean back in your recliner and look for a pentagonal shape with a bright star at its "shoulder." This is Auriga, the Charioteer. That's not his name, of course; "Auriga" is Latin for "Charioteer." We don't really know his name. Ian Ridpath, author of Star Tales, whom we usually cite for stories about the Classical Constellations, says "Maybe the Charioteer in question was Erichthonius, or maybe Myrtilus, or maybe Hippollytus ... " rattling off various ancient stories about guys who did something noteworthy while driving a chariot.

But what we know for sure about our guy is that he is holding a Goat. Auriga's brightest star, at magnitude zero, is Alpha Aurigae (α Aur). It is also known as "Capella," which is Latin for "She-Goat." Why a charioteer is carrying a goat is anyone's guess. Ridpath admits that in none of his stories does the charioteer have a goat. Furthermore, the goat has babies. Right next to Capella is a pointy isosceles triangle. The two stars at the base are called "The Kids." (Some people call all three stars "The Kids" but in Ptolemy's Star Catalog he clearly says there are only two Kids.)

My best guess is that long ago there were two separate asterisms, based on two separate myths, whose stars overlapped and whose stories got garbled and then forgotten.

Auriga carrying the goat and kids as depicted in Urania's Mirror, *a set of constellation cards illustrated by Sidney Hall, London, 1824. Public Domain.*

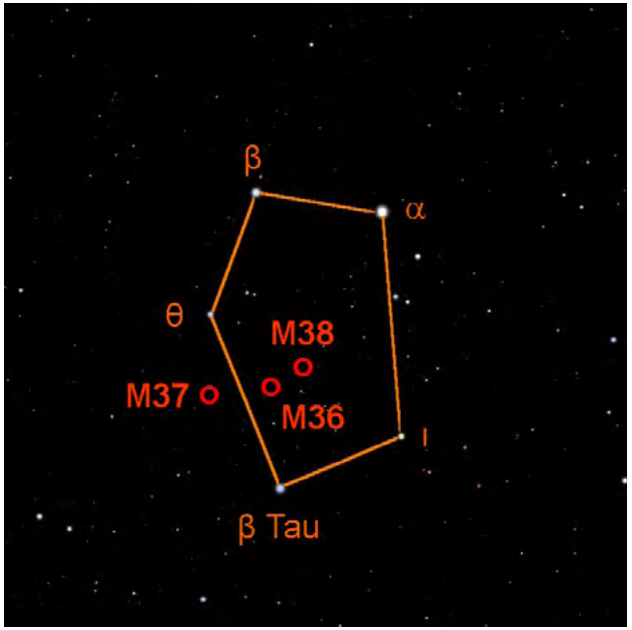


Auriga, the Charioteer, with his Goats. From Stellarium. Click the picture to see a modern crouched figure. (Or click here to get the alternate picture.)

It's interesting to note that only the Charioteer is depicted; there's no sign of the chariot itself or the horses. My theory is that since the constellation is short and stocky, not tall like Hercules waving a club or statuesque like the Lady Andromeda, so the ancients had to imagine someone in a crouching position, which is how I imagine a charioteer had to drive to keep his balance. In modern times we'd find some other crouching figure (see picture).

Going around the pentagon counter-clockwise, we come to Beta Aurigae (β Aur), which the Arabs called "Menkalinan," or "Shoulder of the Rein-Holder." Artists don't seem to agree which shoulder Beta represents though—some draw the head of Auriga to the right of Beta and some put it to the left. Next is Theta Aurigae (θ Aur), which is usually the hand that is holding the reins, and then we come to The Star Formerly Known As Gamma Aurigae. This is one of those stars shared by two constellations; it is not only Auriga's right foot, it is also the tip of one of the horns of Taurus the Bull. The Bull has won out; the Star's formal designation is now regarded to be Beta Tauri (β Tau), and it also bears the Arabic name "El Nath," meaning "The One Who Butts." So modern star charts don't give Auriga any "Gamma" star at all. Finally we have Iota Aurigae (ι Aur), whose Arabic name is "Al Kab" or "The Ankle."

Auriga contains three Messier objects: M36, M37, and M38. All are small open clusters, and all should be easily visible in binoculars. M38 is right about at the midpoint of a line joining Theta and Iota. M36 is on the line joining the two Betas, but about a third of the way from Beta Tau to Beta Aur. And M37 is just outside Auriga's pentagon. To find it, locate the Kids-like triangle right next to Theta just inside the pentagon; it points toward M37, which is about two of these triangle-lengths away.



Auriga, with its Messier objects. From Stellarium.

"Why aren't there any globulars around here?" you might ask. Well, globulars are located in the galactic halo, centered around the center of the Galaxy. And Auriga happens to be in the direction exactly opposite the Galactic Center, as seen from Earth. If you imagine a line from Theta Aurigae to M37, and extend it this same distance, you will be at the so-called Galactic Anticenter.

In the Far East, Auriga's pentagon was known as, coincidentally, the "Five Chariots" (五車). The pentagon's stars represented the Five Heavenly Emperors. These are not historical emperors, but figurative, associated with the Five Elements (Earth, Wood, Fire, Water, and Metal) and with the Five Directions (North, South, East, West, and Center). The pointy triangles were poles for tethering the horses, and some fainter asterisms (we don't know exactly which) were ponds where the horses could pause for a drink.

So the next time you get a clear winter evening, look up high, and let Auriga take you for a ride.

Three Views of the Sun

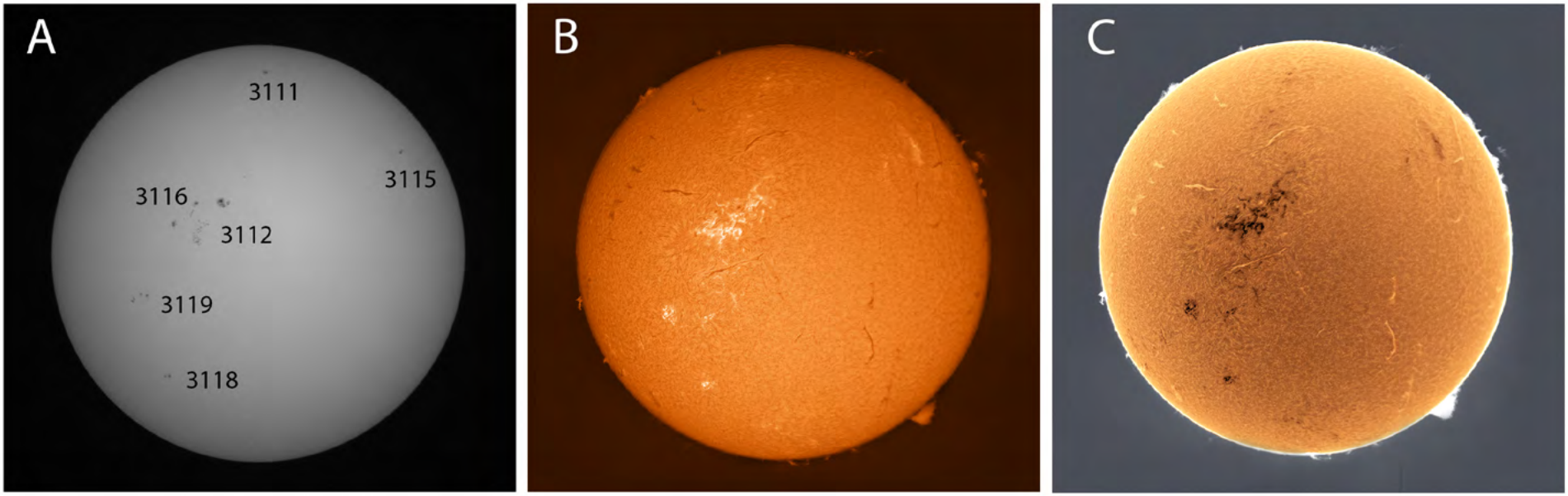
by Grace Wheeler

Images of the sun were taken on October 7, 2022. Shown in (A) is the photosphere with sunspots corresponding to the numbered active regions. AR 3112 was one of the largest groupings of sunspots seen in 2022 and was the fifth most active region of the year. (B) shows the sun imaged with a hydrogen-alpha telescope which detects the chromosphere, the thin atmosphere overlying the photosphere. The active regions are given their brightness by the underlying plage which are areas of intense heat and magnetic instability. Scattered on the surface of the chromosphere are the filaments which are relatively cool threads of plasma that are tethered to the surface by the magnetic field. At the limb are several large prominences; prominences are equivalent to filaments except these are found on the limb. (C) is the same image as in B but has been inverted to make a negative image. The inverted picture has a three-dimensional quality and we can better see the surface of the chromosphere. The carpetlike texture of the chromosphere is made up of tiny jets of gas called dark mottle. Filaments can now be seen floating above the surface, and in some cases, the anchor points can be seen. In the active regions, the plage is now black in color while sunspots are white. A radial pattern of fibrils surrounds the sunspots. These fibrils are jets of plasma like the dark mottle but more elongated and follow the magnetic field lines of active regions.

December 2022 marks the third anniversary of the beginning of Solar Cycle 25. In 2022 we saw numerous sunspots and active regions on the solar disk. So far, the amount of solar activity for this solar cycle is tracking a bit higher than what was predicted by NASA/NOAA.

Equipment: The images of the photosphere and chromosphere were taken with a ZWO ASI294 monochrome planetary camera. A 6-inch SCT with a white light solar filter was used to image the photosphere. The chromosphere was imaged with an 80-mm double-stacked hydrogen-alpha solar telescope. Frames from the SER videos were stacked in Autostakkert and sharpened in IMPPG. For the monochrome images of the chromosphere (B, C), color was added in Photoshop.

See Grace's article on Solar Viewing in the Autumn 2022 Newsletter.



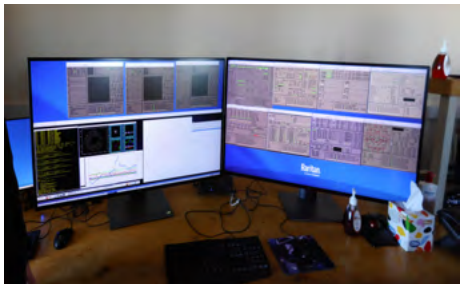
A Visit to Las Campanas Observatory

by Ken Yanosko

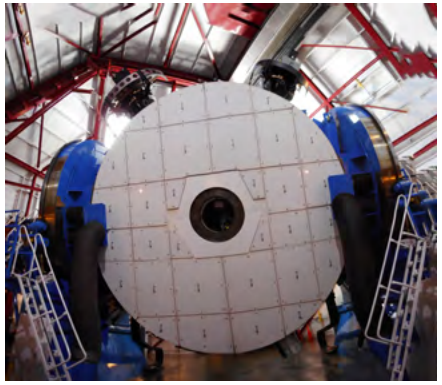
Last October Susan and I had the pleasure of taking a tour entitled "Chile and the Skies of the Southern Hemisphere." The tour was sponsored by the University of Chicago Alumni Association, and was led by Dr. Rocky Kolb, Professor of Astrophysics at Chicago. The highlight of the tour was a daytime visit to Las Campanas Observatory, high in the Atacama Desert. Here are some snapshots.

The twin 6.5 meter Magellan Telescopes.

Left: looking down the mountain to the Astronomers' dormitory complex, and across to the adjacent peak. That flattened-out area is the future home of the 30-meter Giant Magellan Telescope, projected to see first light in 2029. Below: an Andean condor soaring overhead.



Inside one of the domes. Left: the operator's control panel, with one screen for the telescope control and one to monitor the data capture. Middle left: the mirror cell (white cylinder) at the bottom and the secondary cage at the top. Middle right: the bottom of the mirror cell showing panels that access the actuators for the adaptive optics system. Bottom: the primary 6,5 meter mirror at the lower right, and the secondary cage at the upper left. There are two secondary mirrors: one directs light to a Newtonian focus outside the truss, and one directs light back down to the Cassegrainian focus below the primary.

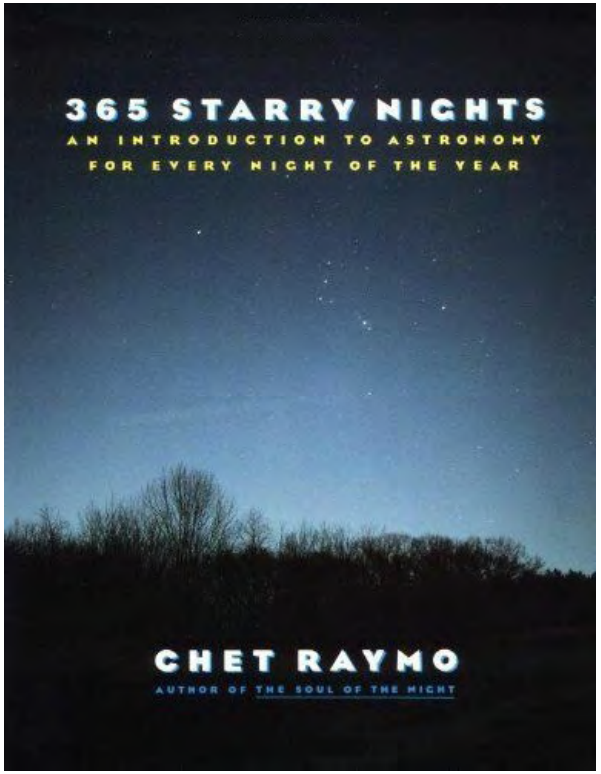


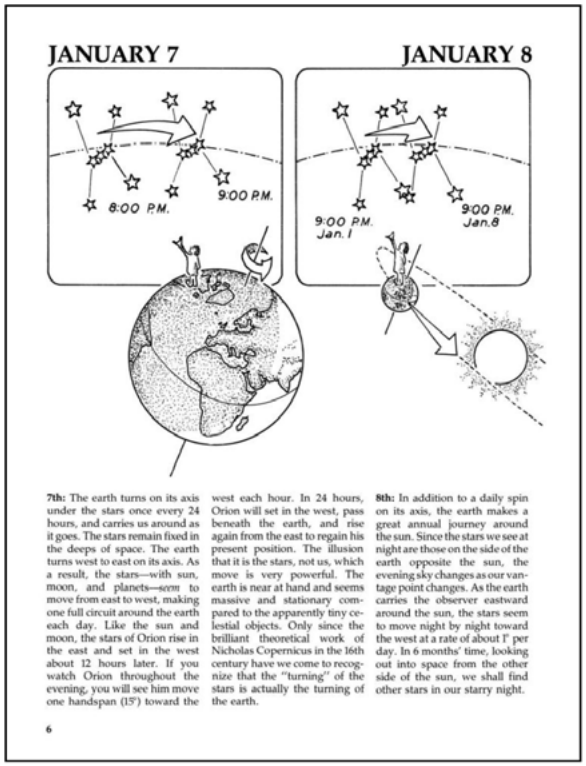
Book Review: *365 Starry Nights an Introduction to Astronomy for Every Night of the Year,* by Chet Raymo

by Ken Yanosko

This is a delightful book containing a combination of drawings and text, organized into a collection of 365 brief essays. Each essay is labeled with a day of the year, and is about something visible in the sky on that date.

For example, for January 7th and 8th, the author compares the apparent motion across the sky of Orion, first in the course of one hour on a given evening, and then in the course of a week, if you compare where it is at the same time of night but seven days apart. The drawings show the difference in appearance to the observer, and illustrate the two different causes of these effects. In one hour, the Earth spins through 1/24 of a revolution, which is 1/24 of 360 degrees, or 15 degrees. That's how much Orion, or anything else in deep space, appears to move in an hour. But in one week, the Earth goes about 1/52 of the way around the Sun, and 1/52 of 360 degrees is about 7 degrees. That's what the drawings show. It's pretty easy to understand when you think about it; but it's not something *I've* ever thought about. Have you?





The author is Professor (now Professor Emeritus) of physics at Stonehill College, in Easton, Massachusetts. In the introduction, he writes "This book is designed to be a kind of companion to the night. It is full of science, but only because (as the old catechisms used to say) knowledge is a prerequisite for love. Knowing the night sky is a different thing from knowing, say, the mechanism of a clock or a computer. The clock or the computer is finite, to know it is to exhaust its potential for exciting wonder. The night sky is more like a human being, inexhaustibly complex and finally beyond reach. Knowledge only whets our interest and increases our wonder."

Later, he goes on "It should be possible to pick up this book and begin reading on almost any page. Terms that may not be familiar are printed in boldface type and you will find them defined in the glossary, together with helpful cross-references. If you make it through all 365 starry nights, you will have completed a kind of mini-course in descriptive astronomy."

My copy of the book is the 1982 paperback edition; still available is the original hardback coffee-table edition ($65), and the 1990 re-printed paperback ($13.50). If you can lay your hands on one, it is well worth looking into.

NASA and the Astronomical Society of the Pacific are inviting amateur astronomers to become official Eclipse Ambassadors to prepare communities off the central paths for the upcoming solar eclipses in October 2023 and April 2024. This article is distributed to Astronomy Clubs to announce this program. You can get more information at eclipseambassadors.org.

Become a NASA Partner Eclipse Ambassador!

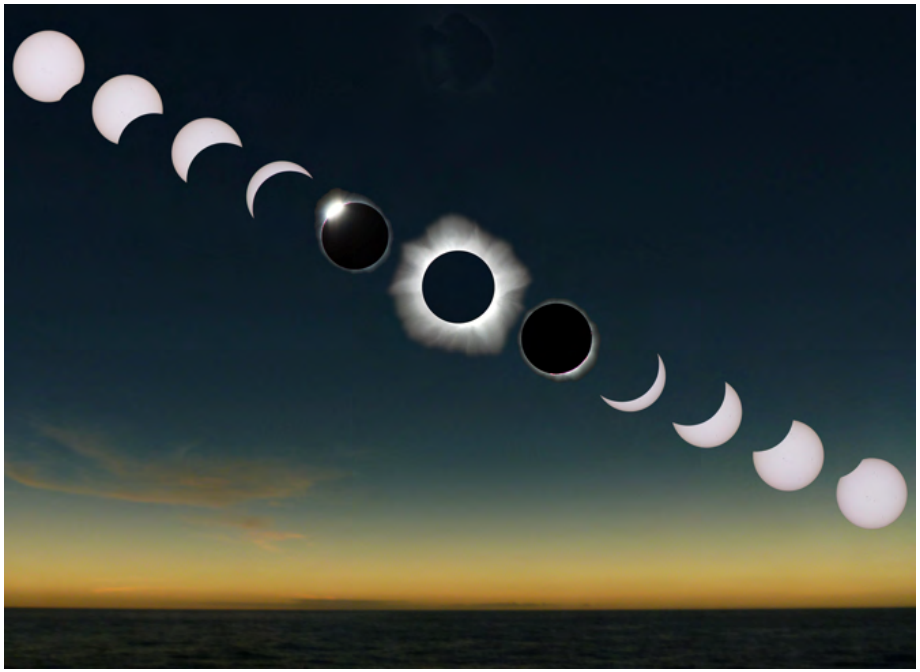


Image Credit: R Fienberg, 2012

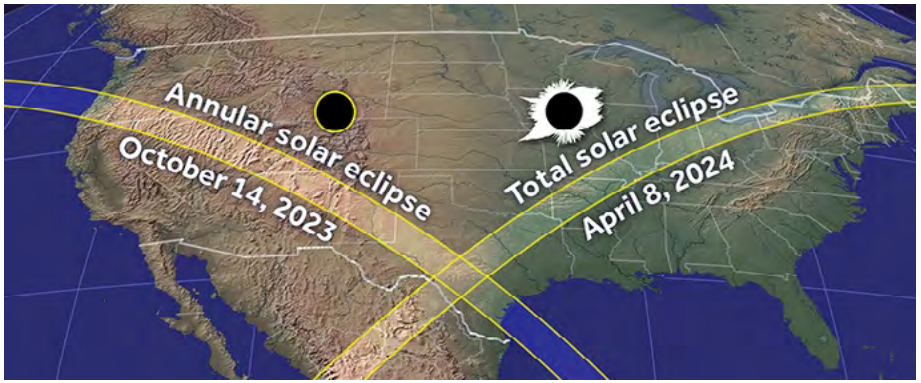
Make a difference in your community while celebrating solar science: apply now to become an official NASA Partner Eclipse Ambassador!

In 2023 and 2024, both an annular and total solar eclipse will each cross the United States. Through an exciting new partnership, NASA is partnering amateur astronomers with undergraduate students to engage 500 underserved communities off the central paths of the eclipses, both before and between these incredible events.

Partner with a local undergraduate student and train together with others across the country in a three week workshop. Learn new tools and techniques for explaining eclipses and inspiring awe. Then, engage underserved audiences in your community with effective outreach! You will receive a toolkit full of materials to enhance your outreach, including hands-on activities and hundreds of safe solar viewing glasses!

As a NASA Partner, you will be partnered with local organizations that will connect you to underserved communities, and recognized for your commitment to public astronomy engagement with a special badge and certificate. Your efforts will be supported by a dedicated team at the Astronomical Society of the Pacific, who are committed to helping everyone enjoy the wonder and science of solar eclipses, everywhere!

Learn more and apply today at eclipseambassadors.org.



The eclipse paths for 2023 and 2024. This image, from the American Astronomical Society, is courtesy of GreatAmericanEclipse.com.

BlueWalker 3, an Enormous and Bright Communications Satellite, Is Genuinely Alarming Astronomers

by Michael J. I. Brown

The night sky is a shared wilderness. On a dark night, away from the city lights, you can see the stars in the same way as your ancestors did centuries ago. You can see the Milky Way and the constellations associated with stories of mythical hunters, sisters and journeys.

But like any wilderness, the night sky can be polluted. Since Sputnik 1 in 1957, thousands of satellites and pieces of space junk have been launched into orbit.

Trail from BlueWalker 3 above Kitt Peak telescope in Arizona. KPNO/NOIRLab/IAU/SKAO/NSF/AURA/R. Sparks

For now, satellites crossing the night sky are largely a curiosity. But with the advent of satellite constellations – containing hundreds or thousands of satellites – this could change.

The recent launch of BlueWalker 3, a prototype for a satellite constellation, raises the prospect of bright satellites contaminating our night skies. At 64 square metres, it's the largest commercial communications satellite in low Earth orbit – and very bright.

Pollution of the night sky

While spotting satellites in the night sky has been a curiosity, the accelerating number of satellites in orbit means pollution of the night sky could become a serious problem.

On a clear night, particularly near twilight, you can see satellites travelling across the night sky. These satellites are in low Earth orbit, just a few hundred kilometres above Earth and travelling almost 8 kilometres every second.

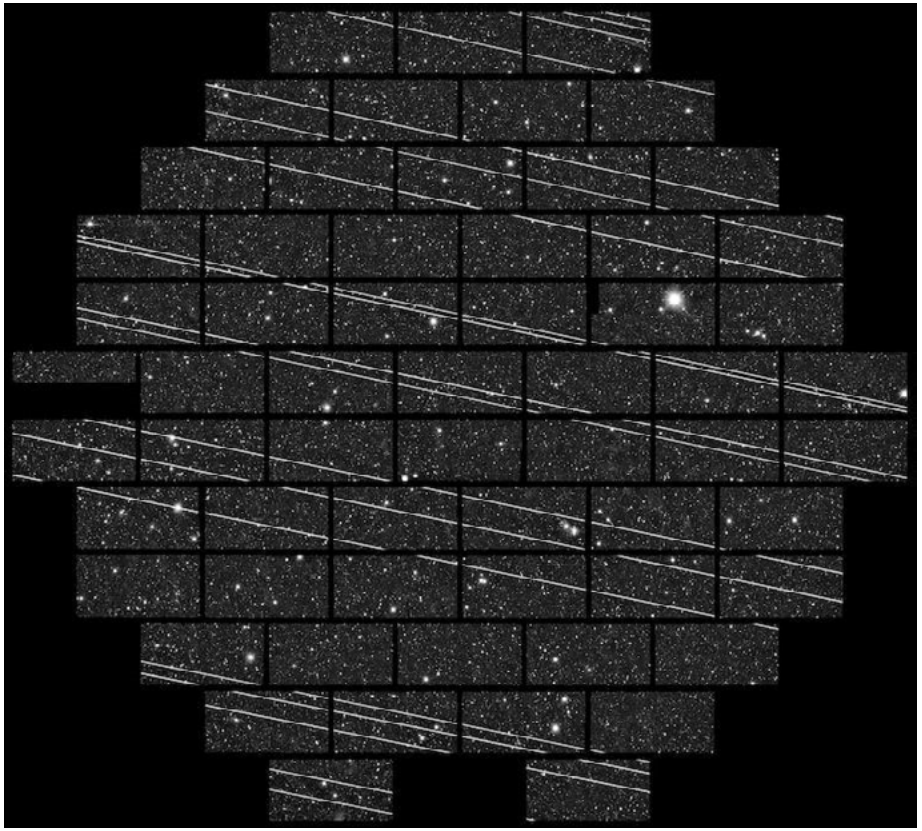
Apps and websites allow you to identify or predict the arrival of particular satellites overhead. And it is genuinely fun to see the International Space Station travelling by, realising that on that speck of light there's a crew of astronauts.

But in the past few years, the pace of satellite launches has accelerated. SpaceX has made satellite launches cheaper, and it has been launching thousands of Starlink satellites that provide internet services.

Roughly 50 Starlink satellites are launched into orbit by each Falcon 9 rocket, and initially produce a bright train of satellites. These initially produced UFO reports, but are now sufficiently common to not be particularly newsworthy.

Once the Starlink satellites disperse and move to their operational orbits, they are near the limit of what can be seen with the unaided eye.

However, such satellites are bright enough to produce trails in images taken with telescopes. These trails overwrite the stars and galaxies underneath them, which can only be remedied by taking additional images. Short transient phenomena, such as a brief flash from a gamma ray burst, could potentially be lost.



An image from the Blanco 4-meter Telescope with 19 trails from Starlink satellites. CTIO/NOIRLab/NSF/AURA/DECam DELVE Survey

BlueWalker 3

While Starlink is the largest satellite constellation in service, with thousands of satellites in orbit, others are planned.

Amazon's Blue Origin plans to launch more than 3,200 Project Kuiper satellites, and AST SpaceMobile plans to launch 100 BlueBird satellites (and perhaps more).

The recently launched BlueBird prototype, BlueWalker 3, has produced genuine alarm among astronomers.

While BlueWalker 3 was initially quite faint, it unfolded a 64 square metre communications array – roughly the size of a squash court. This vast surface is very good at reflecting sunlight, and BlueWalker 3 is now as bright as some of the brightest stars in the night sky.

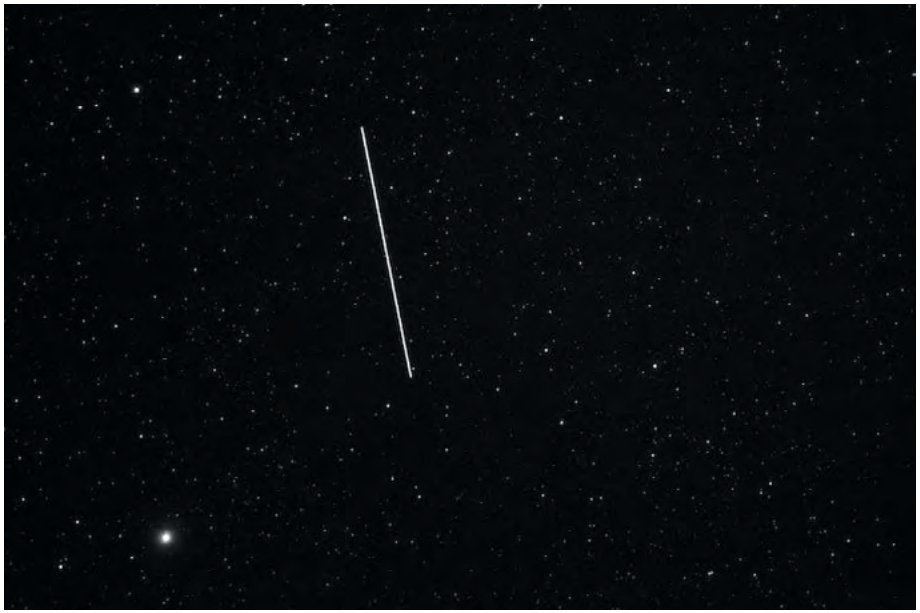
It's possible the operational BlueBird satellites could be even bigger and brighter.

Large numbers of satellites this bright could be bad – very bad. If there were thousands of satellites this bright, sometimes you would be unable to look at the night sky without seeing bright satellites.

We would lose that sense of wilderness, with an almost constant reminder of technology in our sky.

There could be a big impact on professional astronomy. Brighter satellites do more damage to astronomical images than faint satellites.

Furthermore, many of these satellites broadcast at radio frequencies that could interfere with radio astronomy, transmitting radio waves above remote sites where radio observatories observe the heavens.



BlueWalker 3 passing over Oukaimeden Observatory on November 16 2022. At its brightest, BlueWalker 3 is brighter than all but a few stars in the night sky. CLEOsat/Oukaimeden Observatory/IAU CPS/A.E. Kaeouach

A precipice?

What happens next is uncertain. The International Astronomical Union has communicated its alarm about satellite constellations, and BlueWalker 3 in particular.

However, the approval of satellite constellations by the US Federal Communications Commission has had relatively little consideration of environmental impacts.

This has recently been flagged as a major problem by the US Government Accountability Office, but whether this leads to concrete change is unclear.

We may be on the edge of a precipice. Will the night sky be cluttered with bright artificial satellites for the sake of internet or 5G? Or will we pull back and preserve the night sky as a globally shared wilderness?

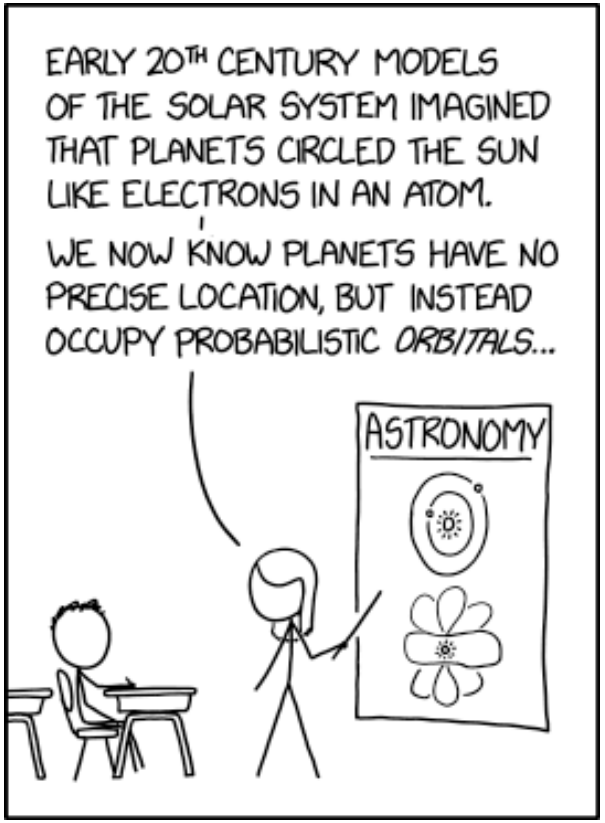
Michael J. I. Brown is an Associate Professor in Astronomy, Monash University

For now, under dark skies, we can see the Milky Way and Dark Emu as people have seen them for millennia. cafuego/Flickr, CC BY-SA

After Words

Astronomy affords the most extensive example of the connection of physical sciences. In it are combined the sciences of number and quantity, or rest and motion. In it we perceive the operation of a force which is mixed up with everything that exists in the heavens or on earth; which pervades every atom, rules the motion of animate and inanimate beings, and is as sensible in the descent of the rain-drop as in the falls of Niagara; in the weight of the air, as in the periods of the moon.

—Mary Somerville
On the Connexion of the Physical Sciences (1858)



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Heavenly Bodies by Susie Christian

Santa, I want a 14-inch telescope