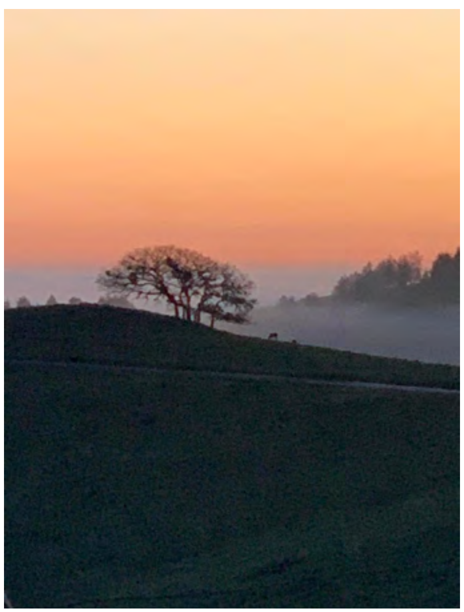
# AOH Newsletter

## Summer 2022

## News and Notes

**Recent Activities:**

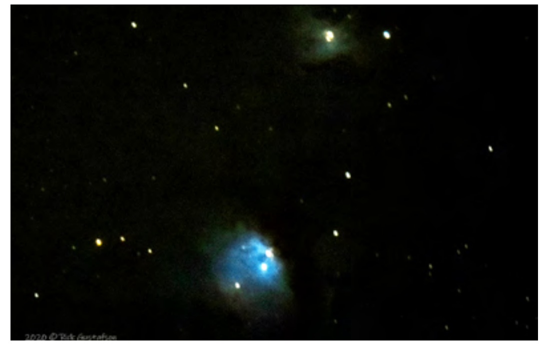
AOH members met on Zoom and in person, and did some individual observing, throughout the Spring. Here are some pictures.

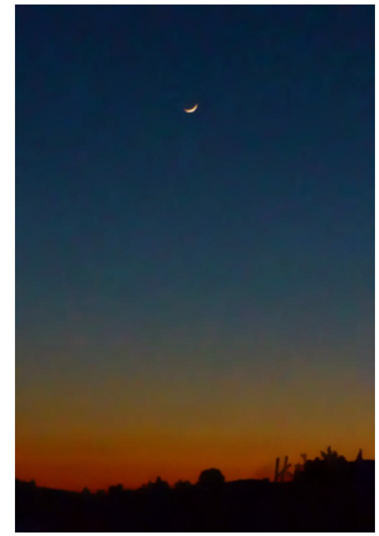



*Above: Zooming in April and May.*

*Left: Dusk at Kneeland in April. Look closely to see the deer to the right of the tree. Catrina Howatt.*

*Below: Brent aligning his scope. Catrina Howatt.*



*Clockwise, from above:*

*M78, reflection nebula in Orion, from Kneeland in April. Rick Gustafson.*

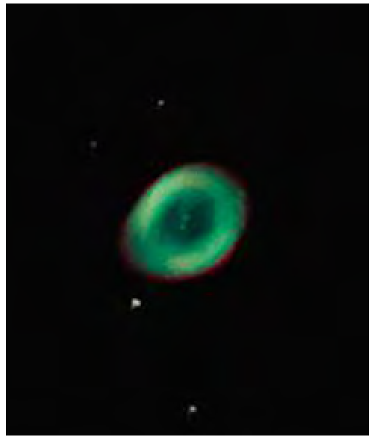
*Day-old Moon from Kneeland in April. Ken Yanosko.*

*Mark and Ken setting up at Kneeland in April, Catrina Howatt.*

*M51, the Whirlpool Galaxy, from Orick in April, Rick Gustafson.*

*Left: some constellations (Crater and Corvus over the lake and Ursa Major among the trees) from Lake Eleanor in the Trinity Alps in early May. Kai Cook.*

*Below: M57, the Ring Nebula, from Kneeland in late March. Rick Gustafson.*



## Upcoming Activities:

We will continue Zooming around the time of the full moon and observing at Kneeland around the new moon. Check the website for up-to-the-minute updates. Some things to watch out for are:

**Meteors**. Back-to-back showers peak on the nights of July 29-30 (the Southern delta Aquariids) and July 30-31 (the alpha Capricornids). Both are relatively minor showers but they occur this year during the dark of the moon, so they may be worth going out for. The star of the Summer is usually the Perseid shower (peaking this year on the night of August 11-12). Unfortunately, this coincides with the night of the full moon, so all but the brightest meteors will be washed out. The Perseids usually provide a number of nice bright streaks, however, so you probably won't be totally disappointed.

**Planets.** The Earth catches up with the slower-moving outer planets during the summer, so the morning lineup that was so spectacular this spring breaks up and Saturn and Jupiter become evening planets once again. By August 1 Saturn and Jupiter rise at 9 pm and 11 pm respectively, and by September 1 it's 7 pm and 9 pm. Saturn is at opposition on August 14 and Jupiter on September 26. Mars stays hidden until after midnight for most of the summer. Venus remains the "Morning Star" all summer, rising before the Sun at 4:30 and 5:30 at the beginning of August and September. Mercury returns to the evening sky in late August, but the ecliptic makes a shallow angle with the horizon at that time so at Mercury's greatest Eastern elongation on August 27 it will be only five degrees high at 8:15 pm. Uranus is in Aries in the morning sky in July through September; it has a conjunction with Mars on August 1. Neptune is in Aquarius and reaches opposition on September 16.

**Deep Sky Objects.** There's a nice website at astropixels.com which lists both the Messier Objects and the Caldwell Objects by season. Click on the word "summer" in the "Viewing Season" column and you'll get a map for objects between RA 14:00 and RA 22:00. And when you're done with these, go for the Wilson Objects: see Mark's article on page 3.

**Sunspots.** Solar activity seems to be picking up again. Make sure you have a reliable solar filter (or a dedicated solar scope) to watch the parade. See Grace's article on page 4.

**Binary Stars.** See the Book Review on page 10 to learn how to get a seasonal list (with finder charts) for the finest binaries visible in binoculars or small scopes.

**Surprises.** You never know when the Comet-of-the-Century or the Local-Supernova or the Aurora-Visible-Down-to-Latitude-40 will occur. Check the website's Astronomy News page (it's updated hourly) to stay informed.

## Thanks:

A big "Thank you!" to all who helped put the Newsletter together—Mark and Grace for sharing articles; Catrina, Kai, Rick, Grace, and Don for photos; Remo and Susie for cartoons; and Susan for proofreading.

*Ken*

# A Summer Encounter

## by Mark Wilson

This list of deep space objects was inspired by a desire to provide an additional challenge in the summer for amateur astronomers who have conquered the Messier objects. Look for them during the summer months: June, July, and August. During that time they should be visible (at 40 degrees north) from the end of Astronomical Twilight to about 1:00 am, so all-night "marathoning" will not be necessary.

These deep space wonders are identified by their NGC (New General Catalogue) numbers in the "ID" column, except for those from the "IC" (Index Catalogue) and "Cr" (Collinder) catalogues.

There were three sources of literature used to prepare this list. First was a list put together by Michael Bakich and published in the March, 2022 issue of *Astronomy Magazine* and indicated by "A" in the column labeled "Source." The second source was *Sky Atlas for Small Telescopes and Binoculars* by David S. Chandler and Billie E. Chandler. This is an introductory atlas with sky charts similar to Norton's. The objects from the atlas are indicated by "S" in the source column. *The Messier Observer's Planisphere* by Mike Krzywonski was used as the third object source. While this large planisphere is oriented to the Messier hunter it also has 27 other deep space objects of interest. The planisphere objects are indicated by "P" in the source column.

The "Name" column contains popular nicknames for the objects, and the "Const" column contains the official constellation abbreviations.

The "Type" column contains abbreviations for "Galaxy," "Open Cluster," "Globular Cluster," "Planetary Nebula," and just plain "Nebula."

Notice that the last 7 items are of magnitude greater (dimmer) than 10, so might be designated "large scope" objects.

It is suggested that the hunter of these objects consult a good sky chart to locate them. Any errors are mine alone; with that in mind, I welcome any corrections, additions, deletions, and suggestions at vicepresident@astrohum.org.

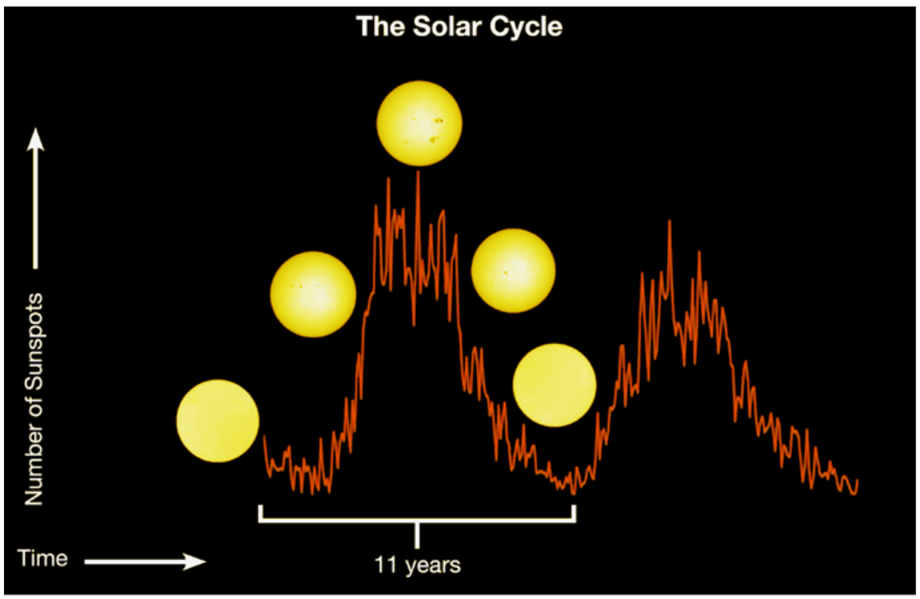
| | ID | Source | Name | Const | Type | Mag |
|---|---|---|---|---|---|---|
| 01 | 2768 | A | | UMa | Gal | 9.9 |
| 02 | 2841 | A | | UMa | Gal | 9.3 |
| 03 | 3184 | A | Little Pinwheel | UMa | Gal | 9.8 |
| 04 | IC 4665 | S | | Oph | OC | 4.2 |
| 05 | 4236 | A | | Dra | Gal | 9.6 |
| 06 | 4435 | A | The Eyes | Vir | Gal | 10 |
| 07 | 4438 | A | The Eyes | Vir | Gal | 10 |
| 08 | Cr 399 | SP | Coathanger Cluster | Vul | OC | 3.6 |
| 09 | 6124 | S | | Sco | OC | 5.9 |
| 10 | 6231 | S | False Comet | Sco | OC | 2.6 |
| 11 | 6242 | S | False Comet | Sco | OC | 6.4 |
| 12 | 6388 | S | | Sco | GC | 6.8 |
| 13 | 6441 | S | | Sco | GC | 7.4 |
| 14 | Cr 316 | S | | Sco | OC | 3.4 |
| 15 | 7009 | S | Saturn Nebula | Aqr | PN | 8.3 |
| 16 | 6709 | S | | Aql | OC | 6.7 |
| 17 | 6541 | S | | CrA | GC | 6.6 |
| 18 | 6811 | S | | Cyg | OC | 6.8 |
| 19 | 6826 | S | Blinking Nebula | Cyg | PN | 8.8 |
| 20 | 7000 | SP | N. American Nebula | Cyg | Neb | 4 |
| 21 | 6723 | S | | Sgr | GC | 7.3 |
| 22 | 6940 | S | | Vul | OC | 6.3 |
| 23 | 6992 | P | Eastern Veil | Cyg | Neb | 7 |
| 24 | 6960 | P | Witch's Broom | Cyg | Neb | 7 |
| 25 | 6888 | S | Cresent Nebula | Cyg | Neb | 10 |
| 26 | 6603 | | | Sgr | OC | 11.1 |
| 27 | 4290 | | | UMa | Gal | 12.9 |
| 28 | 7008 | P | Fetus Nebula | Cyg | Neb | 13.3 |
| 29 | IC 2574 | A | Coddington Nebula | UMa | Gal | 10.4 |
| 30 | 3079 | A | | UMa | Gal | 10.9 |
| 31 | 2787 | A | | UMa | Gal | 10.9 |
| 32 | 2685 | A | Helix Galaxy | UMa | Gal | 12.7 |

# Observing Solar Cycle 25

**by Grace Wheeler**

Records of sunspots have been kept since the 1760s, and observations from the last 260 years show that sunspot formation has a cyclical pattern that repeats itself approximately every 11 years. During the solar cycle, the number of sunspots waxes and wanes. The cycle begins at the solar minimum in which there are few to no sunspots. The minimum is followed by a sharp rise in the number of sunspots and culminates at the solar maximum where the number peaks (average of 179). At the solar maximum, the sun exhibits its greatest solar activity, and there is a marked increase in the number of sunspots, active regions, and solar eruptions (flares and coronal mass ejections). Following the solar maximum, the number of sunspots drops back to the minimum.

The solar cycle is driven by perturbations in the sun's magnetic field which ultimately cause the formation of active regions of intense solar activity. This escalation of solar activity, particularly with sunspots, ultimately drives the reversal of the poles at the solar maximum. (A review can be found here: https://www.youtube.com/watch?v=rx9m6H-6GeLs .)




*Night Sky Network, The Magnetic Sun.* https://nightsky.jpl.nasa.gov/

## Solar Activity in Solar Cycle 25

Solar Cycle 25 began in December 2019 when NASA and NOAA determined that the solar minimum had been achieved between Solar Cycles 24 and 25. During the last two years, the number of sunspots and active regions has steadily grown which confirms the beginning of a new solar cycle. From a personal perspective, I am a novice sun observer and up to now, I have only observed the sun during the solar minimum. It is difficult to get excited about a quiescent sun with tiny sunspots and barely visible prominences. I am looking forward to seeing a more active sun and being able to put my solar observing skills to the test.

## Imaging Equipment and Processing

A six-inch Schmidt-Cassegrain telescope with a white solar filter was used to observe the photosphere in visible light. White solar filters are designed to block out UV, IR, and 99.99% of the visible light. The photosphere is the lowest layer of the sun's atmosphere and is where heat and light from the sun's interior are transferred into space. The transfer of heat is through convection cells called solar granules. In the photosphere, we can observe sunspots, faculae, and solar granules in visible light.

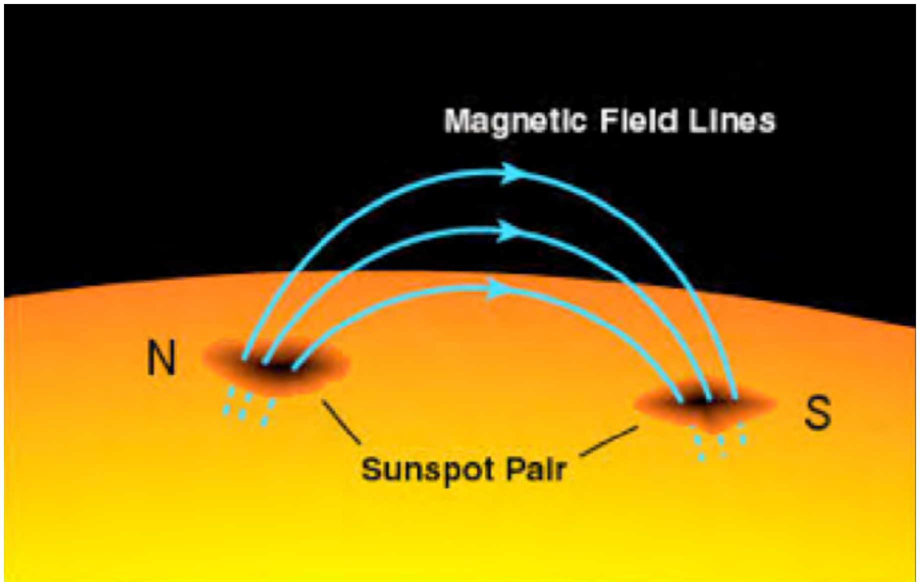
A Lunt 80 mm H-alpha solar telescope was used to view the chromosphere. The chromosphere is the thin layer of atmosphere that lies just above the photosphere and glows red with ionized hydrogen gas in the hydrogen-alpha wavelength (656 nm). Normally we do not see the chromosphere because it is washed out by the brightness of the photosphere. Hydrogen-alpha filtered solar telescopes are designed to block out all of the visible light, UV, and IR, and allow only the transmission of the H-alpha (656 nm). When viewing with an H-alpha filter, we observe filaments, prominences, plages, fibrils, and solar granules.

Images of the photosphere and chromosphere were taken with a ZWO ASI1290MC video camera. The captured images were then stacked with Autostakkert and further processed with Registax and Photoshop.

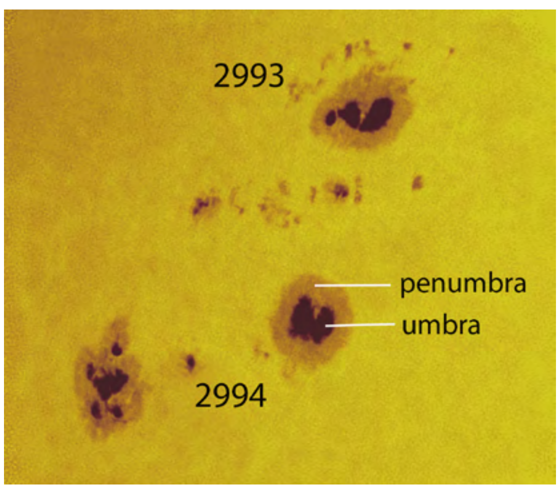
## Sunspots are Areas of Magnetic Disturbances

Of all of the structures that can be viewed on the sun, sunspots are the most distinctive and the easiest to find. Large sunspots, the size of Jupiter, say, can be seen without the use of optical aids. (Never view the sun without protective eyewear or solar filters!) However, most sunspots are the size of Earth or smaller and require at least binoculars or a small telescope for viewing.

Sunspots have strong magnetic fields that are formed when the magnetic field lines become tangled and protrude out of the photosphere. The magnetic fields of sunspots can be 1000 to 4000 times stronger than the global magnetic field of the sun, and they impede the convection of hot gas to the surface. Sunspots appear dark because they are cooler (5000 degrees F) than the surrounding photosphere (6000 degrees F). Eventually, sunspots decay and this can be seen over a number of days as they move across the disc.




*Above: Night Sky Network, The Magnetic Sun. https://nightsky.jpl.nasa.gov/*



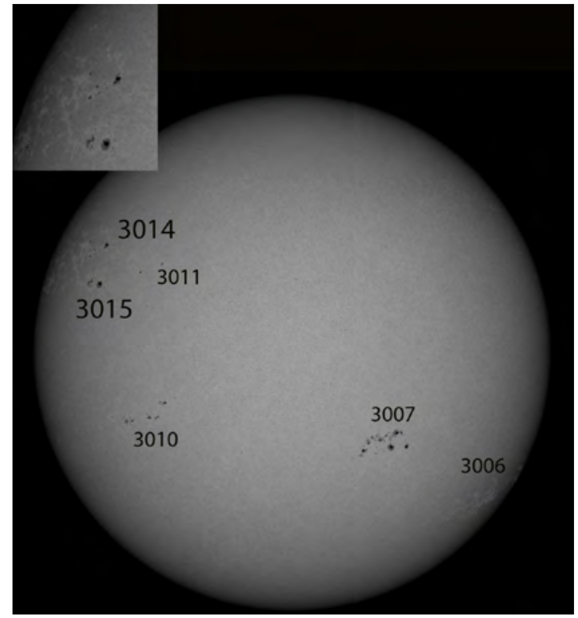

*Left: Image of sunspots in Active Regions 2993 and 2994 (4/19/22). Sunspots have a dark central umbra surrounded by a lighter penumbra made of fibrils. Active Regions 2993 and 2994 contained some of the largest sunspots (earth-sized) seen thus far in Cycle 25. [https://www.livescience.com/swarms-of-giant-sunspots](https://www.livescience.com/swarms-of-giant-sunspots) Photo: Grace Wheeler, 6-inch SCT with white solar filter.*

## Active Regions in the Photosphere and Chromosphere

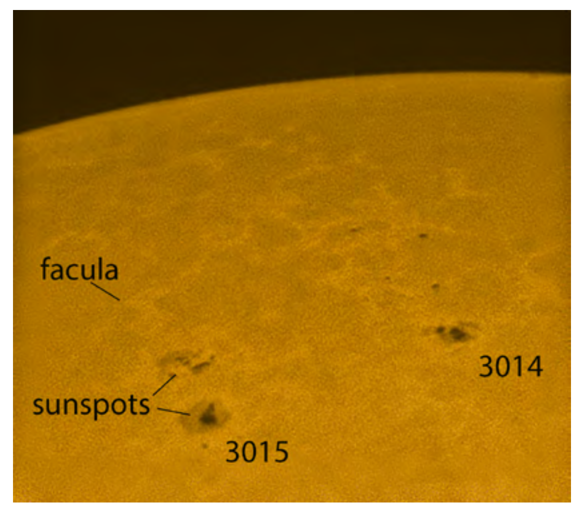
Active Regions (AR) are areas in the sun with strong and unusual magnetic fields and are where most of the solar activity of the sun occurs. On the photosphere, sunspots are the most common way of iden-

*Right: The active regions of the photosphere on 5/15/22. Active Regions 3014 and 3015 in the upper left limb are just rotating into view. Within the active regions of 3014 and 3015 are sunspots and facula. The facula show up as bright web-like structures against the dimly lit limb. We do not see facula in the active regions located in the brighter central region of the disc (e.g.. 3007).*

*The intensitygram of the photosphere was taken by Solar Dynamic Observatory space telescope with the HMI instrument. The HMI images in a narrow range of visible light [https://svs.gsfc.nasa.gov/3988](https://svs.gsfc.nasa.gov/3988).*

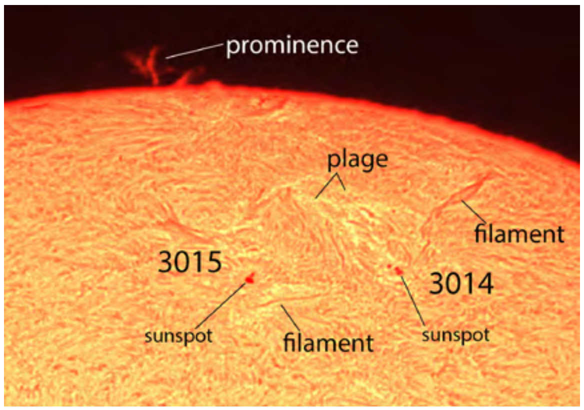



*Right: The Active Regions 3014 and 3015 as viewed against the solar limb on 5/15/22. These active regions contain sunspots and facula. The relative temperatures of these structures can be gauged when viewed against the photosphere: sunspots are cooler than their surroundings and appear dark, and the facula are hotter and appear bright. Photo: Grace Wheeler, 6-inch SCT with white solar filter.*

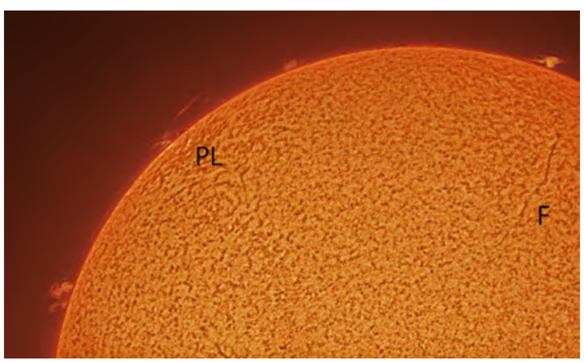


tifying active regions. However, not all active regions produce sunspots. In the absence of sunspots, bright weblike structures called faculae can be used to identify active regions in the photosphere. Faculae are small bundles of magnetic fields that lie between solar granules and have a magnetic field that is 500 to 1000 times that of the global magnetic field. In visible light, faculae can be seen only when viewed on the limb of the photosphere. Faculae are slightly brighter than the photosphere and are more visible when seen against the limb which is dimmer than the central portion of the disc.

In the chromosphere, active regions can be identified by the




*A view of the Active Regions 3014 and 3015 on the chromosphere on 5/15/22. The active regions contain bright patches of plage, filaments, and sunspots. On the edge of the limb is a prominence. In AR 3014, the filament appears to be lifted from the surface. The relative temperatures of the structures can be inferred by their color and relative brightness against the surrounding surface. Sunspots and filaments are relatively cool and are dark red. Plages are hot regions and appear as bright orange. Note: towards the edge of the limb (below the prominence) another active region (AR 3017) is coming into view as seen by its plage.*




*An image from 5/3/2022 of a more quiescent part of the chromosphere that shows several prominences, a filament (F), and a plage (Pl). The plage is from an active region (AR 3007) that is just rotating into view on the solar disc. Solar granules (convection cells) make up the orange peel texture of the chromosphere. These two photos were imaged with an 80mm Lunt H-alpha solar telescope. Grace Wheeler.*

presence of plages, filaments, and prominences. Plages are networks of bright patches and are the extension of the photospheric faculae into the chromosphere. Prominences and filaments are identical structures made of arcs of cooled ionized gas that lie above the chromosphere; these are tethered to the surface by the magnetic field. When the arcs are viewed from above the chromosphere, these resemble long dark threads called filaments. These same arcs appear as fiery plumes of gas when viewed at the limb against the darkness of space.

## The Solar Maximum and the 2024 Eclipse

The solar maximum for Cycle 25 is predicted to occur in July 2025. Observations from the last two years indicate that the solar activity of Cycle 25 is higher than forecast, and that the solar maximum actually might occur in November 2024 (https://www.forbes.com/sites/jamiecartereurope/2021/04/21/why-the-sun-at-its-most-potent-could-now-be-set-to-give-north-americans-a-precious-naked-eye-moment/?sh=42e706e3261a). This would mean solar maximum would happen closer to the date of the April 8, 2024 solar eclipse. During the totality of a solar eclipse, the light from the photosphere is blocked by the moon which allows us to see the chromosphere and the corona without the use of special filters. If there is a large amount of solar activity around the time of the 2024 solar eclipse, the size of the bright halo of the corona and that of chromospheric prominences could be extensive. Yet another reason why the 2024 eclipse will be epic!

*Image of the sun at totality during a solar eclipse (August 21, 2017). The reddish plumes are prominences and the bright halo is the corona. Imaged with a Pentax DSLR. Donald Wheeler.*

*Grace Wheeler is a former President of AOH. Solar photographer by day, at night she can be seen photographing planets with her ZWO Planetary Camera or deep space objects with her Unistellar eVscope.*

# Library Telescope, Part 2

In March Mark Wilson reported on the AOH's donation of an Orion Starblast 4.5-inch telescope to the Humboldr County Library. By the time you receive this update, you will be able to go to the Library's online catalog at https://libcat.co.humboldt.ca.us/; in the search box type Telescope Loan Program; and see what comes up:

**Title** Telescope loan program

Bookmark link for this record

| LOCATION | CALL # | STATUS |
|---|---|---|
| Arcata Branch | | CHECK SHELF |

**Details**

| | |
|---|---|
| **Phys. Description** | 1 Orion StarBlast 4.5" telescope + 1 National Audubon Society Pocket Guide, Constellations; 1 instruction manual; 1 moon map; 1 Astronomers of Humboldt pamphlet; 1 carrying instructions sheet; 1 contents bag. |
| **Note** | Please allow extra time for check-out and check-in of backpack. |
| **Contents** | 1 Orion StarBlast 4.5" telescope -- 1 National Audubon Society Pocket Guide, Constellations (Chanticleer Press, ISBN 0679779981)-- 1 instruction manual -- 1 moon map (The Moon: a guide to the moon, its surface features, phases and eclipses; Waterford Press, ISBN 9781620052792) -- 1 Astronomers of Humboldt pamphlet -- 1 carrying instructions sheet -- 1 contents bag. |
| **Subject** | Space.<br>Telescopes.<br>Constellations.<br>Stars.<br>Astronomy. |

*Left, above: the online catalog "card" for the scope.*

*Left, at bottom: Mark W collecting First Light with the scope just out of the box and aimed at the Moon, and Brent at the drill press preparing the dust cap for use by inexperienced amateurs.*

*Right: Ken replacing the collimating knobs to keep curious folks from wondering "What happens if I twist this?"*

*Below: Susan, Hershey, and Anne at the Arcata Library taking possession of the scope.*

# Scutum Sobiescianum

**by Ken Yanosko**

The Greek mathematician and astronomer Claudius Ptolemy, living in Alexandria, Egypt, in the first century, wrote a book entitled *Mathematical Syntaxis* (more commonly known by its Arabic title, *Almagest*). This work contained a catalog of 48 constellations; with a few modifications, these are all recognized by astronomers today. In the 17th and 18th centuries, various European astronomers identified patterns that were not on Ptolemy's list. Some of these additions stuck, and others fell into obscurity.

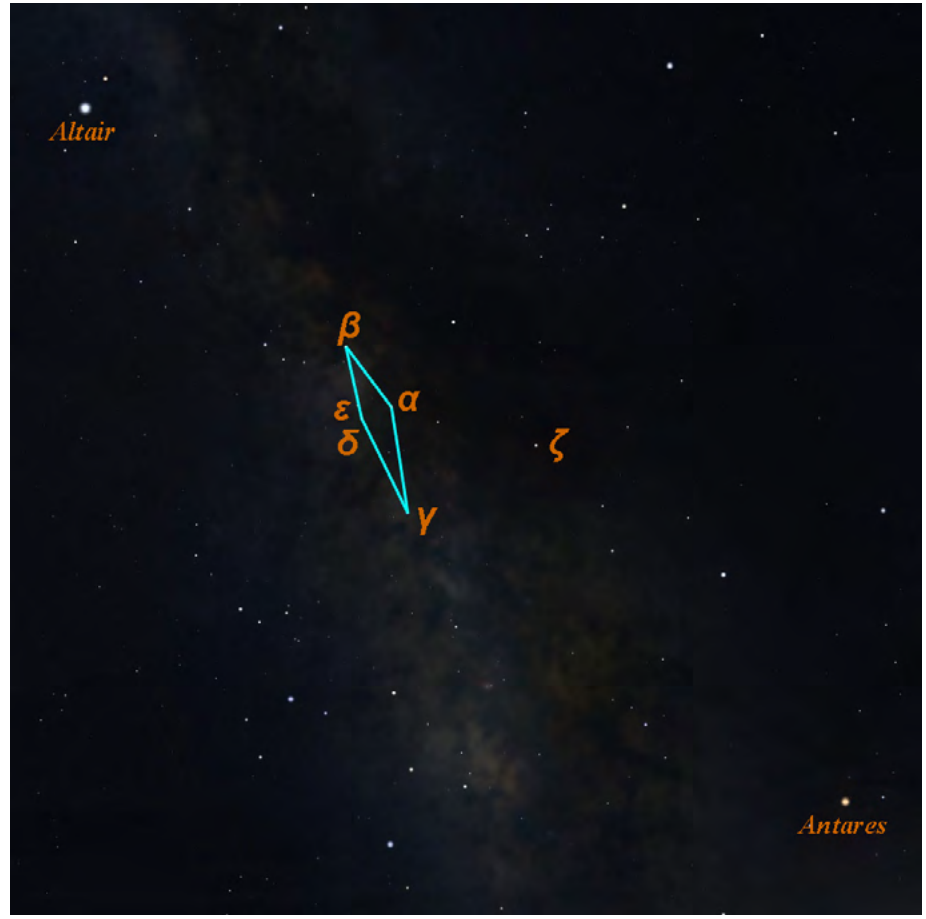


*Top: Astronomer Johannes Hevelius commemorated on a Polish postage stamp. Bottom: King Jan III Sobieski, and his shield, on a 500 Zloty Polish banknote.*

The Polish astronomer Jan Heweliusz, better known by his Latin name Johannes Hevelius, got into the act. After the Polish King Jan Sobieski (Jan III) led an army to victory in the Battle of Vienna in 1683, Hevelius, to honor his king and patron, carved out a section of sky that originally belonged to Aquila and named it "Scutum Sobiescianum," or "Sobieski's Shield."

The Shield, along with several other inventions of Hevelius, was listed in his posthumously-published 1687 atlas.

In the 18th and 19th centuries, Scutum Sobiescianum led a precarious existence, as some celestial cartographers included it in their




*Scutm, from* Stellarium*. It's about halfway between Altair and Antares and just above the Teapot. Click on the map to see Hevelius' Sobieski's Shield.*

catalogs, and others omitted it. (See Ian Ridpath's account at http://www.ianridpath.com/startales/scutum.html.) Finally, in 1922, the International Astronomical Union made it one of today's "official" 88 constellations, shortening the name to "Scutum."

Scutum is very dim; its Greek-lettered stars are 4th and 5th magnitude. And since it lies along the Milky Way, it can be pretty hard to pick out. In the summer sky, look halfway between Altair (Alpha Aquilae) and Antares (Alpha Scorpii); along the "plume of steam" rising from the teapot's spout, a skinny diamond marks the spot.


*Top: [Stellarium] finder chart for M11 and M26. Middle: M11 from the European Southern Observatory. Bottom: M26 from the National Optical Astronomy Observatory.*

Its position in the Milky Way means that Scutum is rich in Galactic Clusters. M 11 is the "Wild Duck Cluster," so called because some claim that its fan-shaped outline suggests a flock of ducks in flight. M 26 (aka NGC 6694) appears to be less dense than M 11. It's conjectured that there's an opaque dust cloud obscuring its core, but it's possible that the cluster just happens to have a hollow spot at its center. What do *you* think?

An interesting but completely random pairing occurs between globular cluster NGC 6712 and planetary nebula IC 1295. These are about a half of a degree apart. The globular has magnitude 9 so should be easily viewable in smallish scopes; the planetary is another story. You probably need a 10 inch scope, but there are claims that six inches are enough if you use a nebula filter. Let me know if you see it.

The star Delta Scuti (δ SCT) is an interesting object in its own right. It is listed both in the AASVO International Variable Star Index and in the Cambridge Double Star Atlas.

As a variable, it is a short-period Cepheid variable with a period of only 4.65 hours and a magnitude range from 4.60 to 4.79. It lends its name to a subclass of Cepheid variables (the "Delta Scuti Variables") which includes Vega, Beta Cassiopeiae, and Gamma Boötis.

And as a multiple, it has a hard-to-see close companion at 12th magnitude and 15 arc-seconds separation, and a readily distinguishable 9th-magnitude companion 53 arc-seconds away.

So the next time you're out under a dark summer sky, take a few minutes to look for the Shield, and add it and its associated objects to your life list.


*Above: Stellarium finder chart for NGC 6712 and IC 1295. They're only a half degree apart. Below: the planetary nebula and globular cluster together. Photo by Rick Johnson, https://www.mantrapskies.com, Creative Commons. Can you see the planetary in your scope? Can you get them both in one field of view?*

# Book Review: Binaries

**by Ken Yanosko**

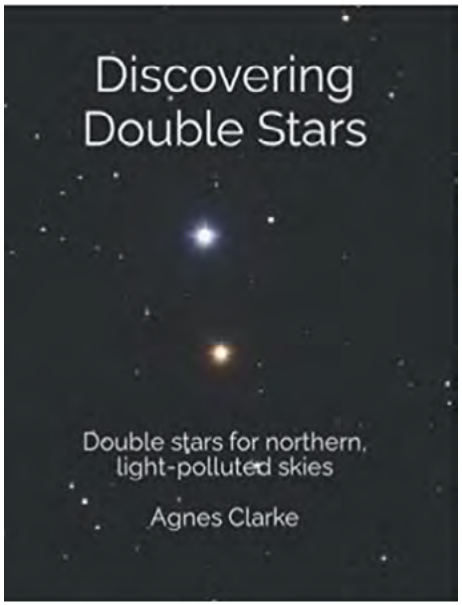
The book in question is *Discovering Double Stars* by Agnes Clarke. And you've got to love the subtitle: *Double stars for northern, light-polluted skies*,

The author writes: "I wrote this book to help myself find the brighter and better double stars visible from my urban location in the Netherlands. The charts and contents of the book have been designed accordingly. I observe with smaller telescopes, the largest being a 150mm Schmidt-Cassegrain, and the smallest being my 50mm finderscope."

Indeed, double stars are great targets for small scopes and hazy skies. Clarke continues: "All 300 doubles in this book have been selected for brightness, color, and uniqueness, and all are within a few degrees of a relatively bright star of at least magnitude 4.0."

While *The Cambridge Double Star Atlas* by Mullaney and Tirion, with its 2,400 pairs, may be the Bible of binaries, Clarke's book makes a fine little breviary for one's nightly devotions.

After some preliminary information, the book launches into a 15-page index, listing binaries by constellation, with brief descriptions, page references to the main entries, and spaces for the user to write in a note about his or her own observation.

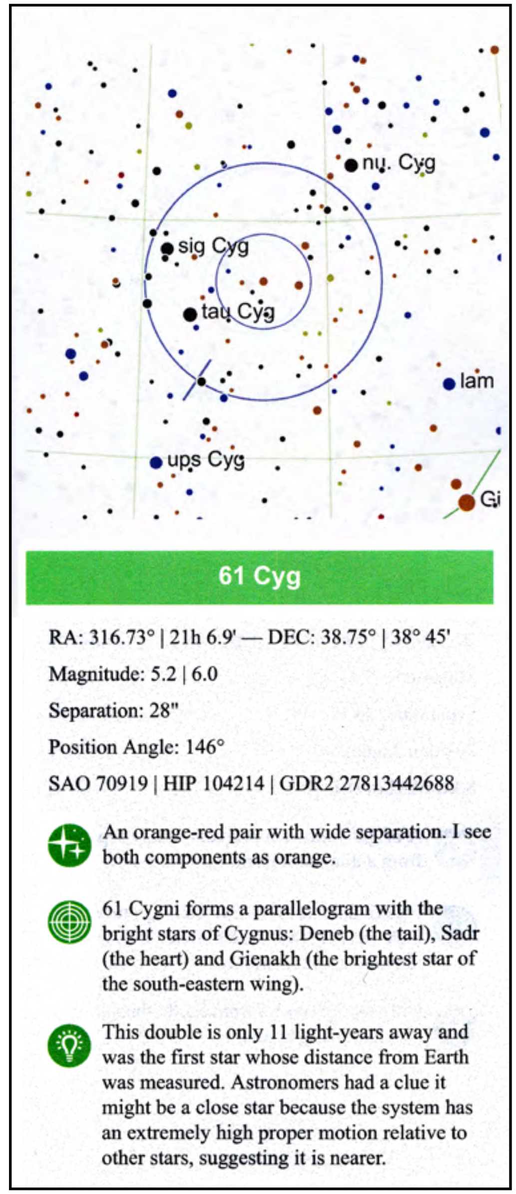



The main body of the text is divided up into 25 sections. After an initial section on the "Northern Circumpolar Sky," the remaining sections are grouped as either early or late in a calendar season, and within each of these half-seasons the sections are labeled "Looking North," "Looking South," and "The Southern Horizon." Each section has one or two wide-angle finder charts, followed by a zoomed-in chart for each binary, accompanied by numerical data and a folksy description.

The finder charts include a two-degree and a five-degree circle, and field stars of magnitude 4 or less are labeled. A unique feature is that the five-degree circle contains a line segment showing the orientation of the pairs (for triple systems there are two such lines).

Also included are magnitudes, angular separations, position angles, and reference numbers to other catalogs. And the author supplies star colors, tips on where to look and what's nearby, and historical tidbits. Even when you're not at the eyepiece the book is fun to page through.

*Discovering Double Stars* comes in several formats: hardcover, softcover, and spiral-bound. The first two are available in bookstores; the spiral version can be ordered directly from the publisher at https://transtextuals.web.app/discovering_doubles.html. Or, if you are a bargain-hunter, you can download a free pdf version from the same website.




*One of the 300 entries for a binary pair, showing a finder chart with two-degree and five-degree circles and other useful information about the stars.*

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

# Observe the Milky Way and Great Rift

## by David Prosper

Summer skies bring glorious views of our own Milky Way galaxy to observers blessed with dark skies. For many city dwellers, their first sight of the Milky Way comes during trips to rural areas—so if you are traveling away from city lights, do yourself a favor and look up!

To observe the Milky Way, you need clear, dark skies, and

*The Great Rift is shown in more detail in this photo of a portion of the Milky Way along with the bright stars of the Summer Triangle. You can see why it is also called the "Dark Rift." Credit: NASA / A.Fujii*

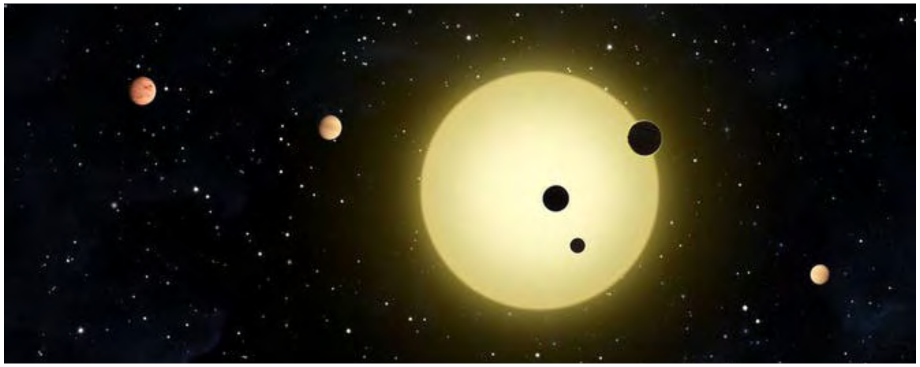
*If the Milky Way were shrunk down to the size of North America, our entire Solar System would be about the size of a quarter. At that scale, the North Star, Polaris, which is about 433 light years distant from us, would be 11 miles away! Find more ways to visualize these immense sizes with the Our Place in Our Galaxy activity: bit.ly/galaxyplace*

enough time to adapt your eyes to the dark. Photos of the Milky Way are breathtaking, but they usually show far more detail and color than the human eye can see—that's the beauty and quietly deceptive nature of long exposure photography. For Northern Hemisphere observers, the most prominent portion of the Milky Way rises in the southeast as marked by the constellations Scorpius and Sagittarius. Take note that, even in dark skies, the Milky Way isn't easily visible until it rises a bit above the horizon and the thick, turbulent air which obscures the view. The Milky Way is huge, but is also rather faint, and our eyes need time to truly adjust to the dark and see it in any detail. Try not to check your phone while you wait, as its light will reset your night vision. It's best to attempt to view the Milky Way when the Moon is at a new or crescent phase; you don't want the Moon's brilliant light washing out any potential views, especially since a full Moon is up all night.

Keeping your eyes dark adapted is especially important if you want to not only see the haze of the Milky Way, but also the dark lane cutting into that haze, stretching from the Summer Triangle to Sagittarius. This dark detail is known as the Great Rift, and is seen more readily in very dark skies, especially dark, dry skies found in high desert regions. What exactly is the Great Rift? You are looking at massive clouds of galactic dust lying between Earth and the interior of the Milky Way. Other "dark nebulae" of cosmic clouds pepper the Milky Way, including the famed Coalsack, found in the Southern Hemisphere constellation of Crux. Many cultures celebrate these dark clouds in their traditional stories along with the constellations and Milky Way.

*David Prosper is Program Manager for Amateur Astronomy Outreach at the Astronomical Society of the Pacific*

THE CONVERSATION



# A quarter of Sun-like stars eat their own planets, according to new research

**by Lorenzo Spina**

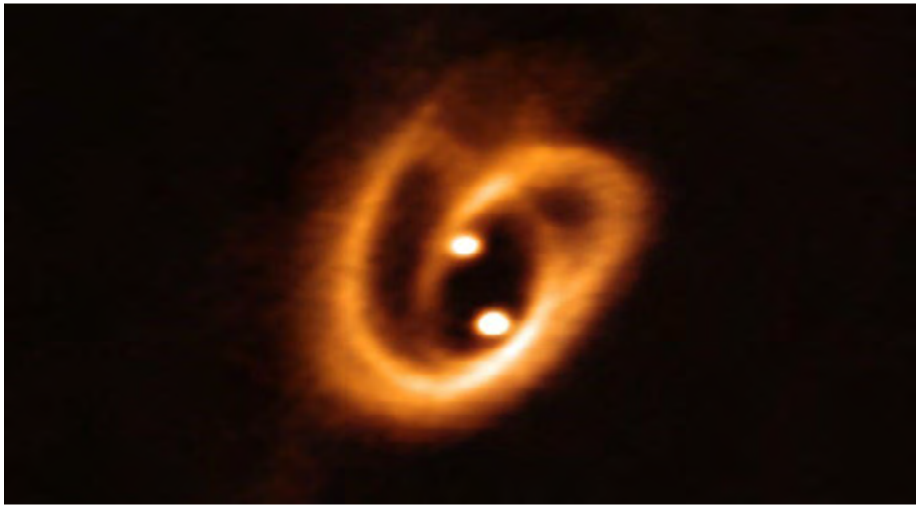
How rare is our Solar System? In the 30 years or so since planets were first discovered orbiting stars other than our Sun, we have found that planetary systems are common in the Galaxy. However, many of them are quite different from the Solar System we know. The planets in our Solar System revolve around the Sun in stable and almost circular paths, which suggests the orbits have not changed much since the planets first formed. But many planetary systems orbiting around other stars have suffered from a very chaotic past.

The relatively calm history of our Solar System has favoured the flourishing of life here on Earth. In the search for alien worlds that may contain life, we can narrow down the targets if we have a way to identify systems that have had similarly peaceful pasts. Our international team of astronomers has tackled this issue in research published in Nature Astronomy. We found that between 20% and 35% of Sun-like stars eat their own planets, with the most likely figure being 27%. This suggests at least a quarter of planetary systems orbiting stars similar to the Sun have had a very chaotic and dynamic past.

## Chaotic histories and binary stars

Astronomers have seen several exoplanetary systems in which large or medium-sized planets have moved around significantly. The gravity of these migrating planets may also have perturbed the paths of the other planets or even pushed them into unstable orbits. In most of these very dynamic systems, it is also likely some of the planets have fallen into the host star. However, we didn't know how common these chaotic systems are relative to quieter systems like ours, whose orderly architecture has favoured the flourishing of life on Earth.

Even with the most precise astronomical instruments available, it would be very hard to work this out by directly studying exoplanetary systems. Instead, we analysed the chemical composition of stars in binary systems. Binary systems are made up of two stars in orbit around one another. The two stars generally formed at the same time from the same gas, so we expect they should contain the same mix of elements. However, if a planet falls into one of the two stars, it is dissolved in the star's outer layer. This can modify the chemical composition of the star, which means we see more of the elements that form rocky planets – such as iron – than we otherwise would.



*Binary stars form at the same time from a single cloud of gas, so they usually contain exactly the same mix of elements. ALMA (ESO/NAOJ/NRAO), Alves et al.*

## Traces of rocky planets

We inspected the chemical makeup of 107 binary systems composed of Sun-like stars by analysing the spectrum of light they produce. From this, we established how many of stars contained more planetary material than their companion star. We also found three things that add up to unambiguous evidence that the chemical differences observed among binary pairs were caused by eating planets.

First, we found that stars with a thinner outer layer have a higher probability of being richer in iron than their companion. This is consistent with planet-eating, as when planetary material is diluted in a thinner out layer it makes a bigger change to the layer's chemical composition.

Second, stars richer in iron and other rocky-planet elements also contain more lithium than their companions. Lithium is quickly destroyed in stars, while it is conserved in planets. So an anomalously high level of lithium in a star must have arrived after the star formed, which fits with the idea that the lithium was carried by a planet until it was eaten by the star.

Third, the stars containing more iron than their companion also contain more than similar stars in the Galaxy. However, the same stars have standard abundances of carbon, which is a volatile element and for that reason is not carried by rocks. Therefore these stars have been chemically enriched by rocks, from planets or planetary material.

## The hunt for Earth 2.0

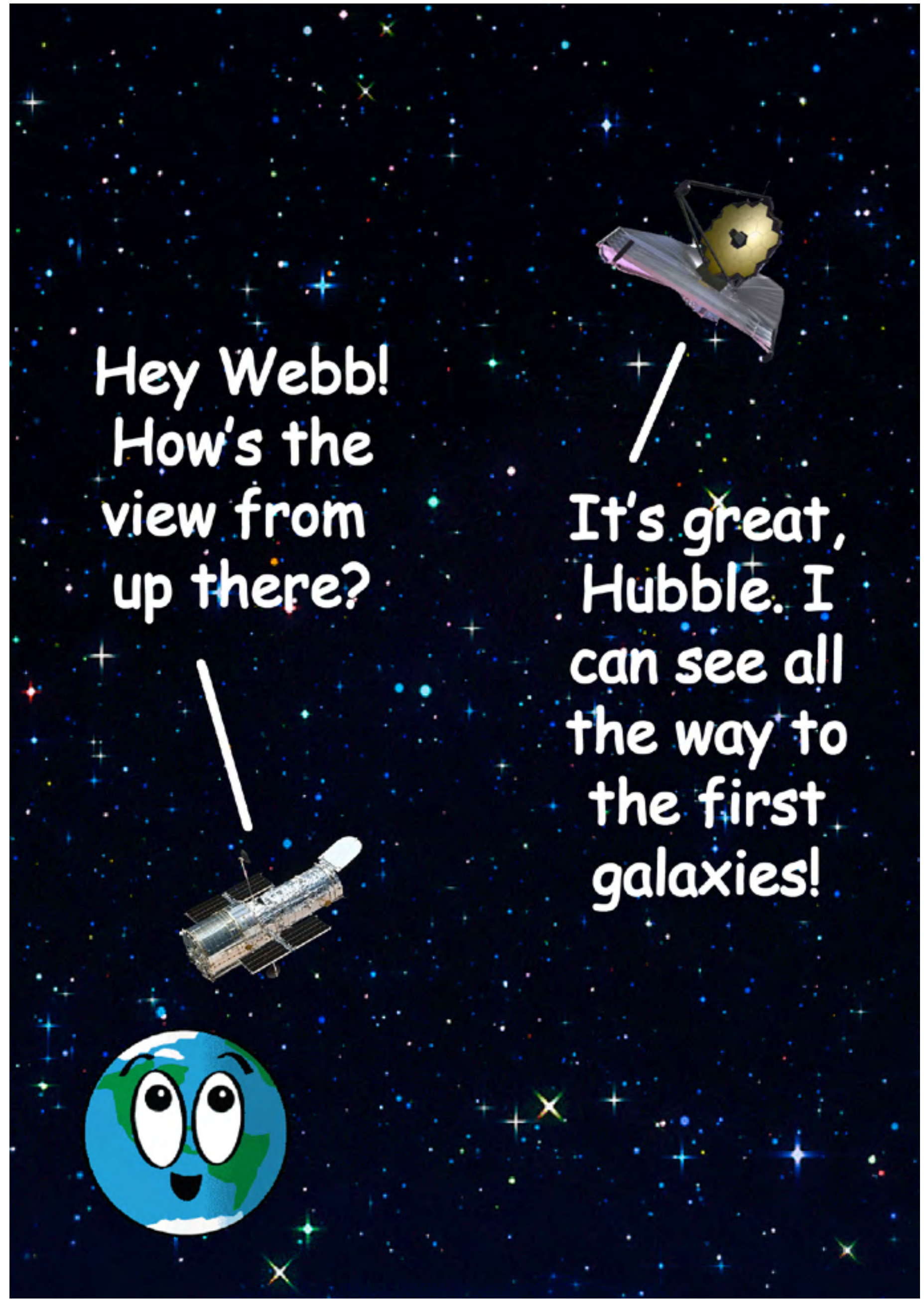
These results represent a breakthrough for stellar astrophysics and exoplanet exploration. Not only have we found that eating planets can change the chemical composition of Sun-like stars, but also that a significant fraction of their planetary systems underwent a very dynamical past, unlike our solar system.

Finally, our study opens the possibility of using chemical analysis to identify stars that are more likely to host true analogues of our calm solar system. There are millions of relatively nearby stars similar to the Sun. Without a method to identify the most promising targets, the search for Earth 2.0 will be like the search for the proverbial needle in a haystack.

*Lorenzo Spina is an astrophysicist and data scientist at the Astronomical Observatory of Padua.*

# What's Up

**by Remo Nortsa**



# 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)

“We are all treasure hunters — storybook pirates searching for riches in the endless sea above. Taking the helms of our telescopes, we lay a course among the stars with the sails of our imaginations open. And what wonders await us as we make our way through the charted territories of the Milky Way: rich, open clusters of hot, young stars, some still swaddled in their nascent nebulosities; ancient globular clusters, the senior citizens of our galaxy whose teeming suns are packed together like gold doubloons in a sea chest; there are galaxies too numerous to mention lurking beyond our forest of stars, living out their lives in various stages of evolution; and then there are the ghosts — the smoky shells of dying stars, whose very nature reminds us of the ultimate fate of our life-giving Sun.”

— Stephen James O’Meara
*Hidden Treasures* (2007)

“So remember to look up at the stars and not down at your feet. Try to make sense of what you see, and wonder about what makes the universe exist. Be curious.”

— Stephen Hawking
*Brief Answers to the Big Questions* (2018)

# Heavenly Bodies
**by Susie Christian**

**The Old Town Gazebo UAP* Surveillance Camera**
***Unidentified Aerial Phenomena**