The Denver
OBSERVER
SEPTEMBER 2018

New DAS member Steve Smith saw the chart for Vesta's path through Ophiuchus in last month's *Observer*, and photographed the minor planet as it passed by the star c Ophiuchi on the evening of August 20th.

Image © Steve Smith.

SEPTEMBER SKIES

by Zachary Singer

The Solar System

If you've been watching the sky after sunset in August, then you've likely noticed **the striking vista of *four* bright planets—Venus, Jupiter, Saturn, and Mars**—lined up from southwest to southeast. Even without a telescope, their sweep makes a memorable view, and the arrangement will continue well into September; if you haven't seen it *you should*—get outside about a half-hour after sunset and look for the planets to start coming out. As the month progresses, Venus will get lower in the west, so you'll need a clear horizon.

Mercury continues as a pre-dawn object in early September, rising about 1½ hours before the Sun. Around 5:30 AM, an hour before sunup, Mercury sits 4° above the eastern horizon, rising to about 7° some 15 minutes later. Look soon though, because the planet's on its way to superior conjunction (where it lines up with the Sun in the sky) on the 20th, and it will be lost in the sun's light well before then.

Early in the month, **Venus** appears only 10° above the horizon 30 minutes after sunset, and as noted above, it will get lower daily. Though this will make telescopic observations increasingly challenging, the upside is that by mid-month, the planet will also appear as a stunning, large and *bright* crescent, reaching magnitude -4.6 at its peak, according to SkySafari software (the folks at *Sky and Telescope* say -4.8!).

The dust storms on **Mars** are reported to be abating, but visibility of the planet's

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Sky Calendar

2	Last-Quarter Moon
9	New Moon
16	First-Quarter Moon
24	Full Moon

In the Observer

The Observer is available in color PDF format from the DAS website: https://www.denverastro.org/das/?page_id=13

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PRESIDENT'S MESSAGE

by Ron Hranac

Sometimes, You Don't Need a Telescope

The peak of the annual Perseid meteor shower has come and gone, and this year's was by most accounts a pretty good one. The peak occurred at the same time as our August dark sky weekend. Throw in pleasant summer weather and a new Moon, and we had nearly ideal observing conditions. Smoke and haze from wildfires in the western U.S. notwithstanding, quite a few Denver Astronomical Society members and their guests trekked to the Edmund G. Kline Dark Site (http://www.denverastro.org/?page_id=85) to observe the show. Estimates I heard from some members about meteor counts ranged from 15-20 per hour to as many as 50 per hour.

Why am I mentioning the Perseid meteor shower after the fact? Because meteor showers are among things-astronomical that can be enjoyed without optical aid. (Indeed, trying to observe a meteor shower with a telescope would be an exercise in futility.) It's easy to forget that there is much in the sky one can enjoy without a 'scope. Here's a list of some of my favorites, in no particular order.

Meteor showers: Meteors are the visible streaks of light that are often called "shooting" or "falling" stars. They're produced when a meteoroid enters Earth's atmosphere, becoming visible when it's 50 to 75 miles or so above the surface. Meteor *showers* occur when Earth passes through streams of debris left behind by comets and perhaps some asteroids. Surprisingly, most meteoroids that produce visible meteors are no larger than the size of a pea. The American Meteor Society has a calendar of major meteor showers available on their web site at https://www.amsmeteors.org/meteor-showers/meteor-shower-calendar/.

Sporadic meteors: These are also produced when meteoroids (or small asteroids) enter Earth's atmosphere, but are not associated with meteor showers.

Observation of meteor showers and sporadic meteors is best done away from bright lights, preferably between about local midnight and sunrise. Dress for the weather, apply insect repellant if necessary, grab a reclining lawn chair, and lie back and look up to get the best view of as much of the sky as possible.

Constellations: A fun way to enjoy the night sky is to observe the constellations, groups of stars that form familiar patterns (the

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DAS SCHEDULE

September 2018

8	Dark Sky Weekend—EGK Dark Site & Brooks Observatory
15	Open House—DU's Historic Chamberlin Observatory—Starts at 7:30 PM
21	DAS General Meeting—DU's Olin Hall, Rm. 105—Starts at 7:30 PM
28	E-Board Meeting—At DU's Historic Chamberlin Observatory, 7:30 PM. All members welcome.

(October 2018)

6	Dark Sky Weekend—EGK Dark Site & Brooks Observatory
6-14	Okie-Tex Star Party (near Kenton, Oklahoma)
13	Open House—DU's Historic Chamberlin Observatory—Starts at 7:30 PM

During Open House, volunteer members of the DAS bring their telescopes to the Chamberlin Observatory's front (south) lawn, so the public can enjoy views of the stars and planets, try out different telescope designs, and get advice from DAS members. The Observatory is open, too (costs listed below), and its historic 20-inch telescope is open for observing with no reservations necessary.

Open House costs (non-members): If the skies are clear, $2/person ($5/family), $1/person in inclement weather. DU students with ID, and DAS members free.

Public Nights feature a presentation on astronomical subjects and a small-group observing session on the historic 20-inch telescope (weather permitting), at Chamberlin Observatory on Tuesday and Thursday evenings (except holidays), beginning at the following times:

March 10 - September 30 at 8:30 PM

October 1 - March 9 at 7:30 PM

Public Night costs (non-members): $4/adult, $3/child and students with ID. DAS members and DU students with ID: free.

Members of the public (non-DAS/DU, as above), please make reservations via our website (*www.denverastro.org*) or call (303) 871-5172.

DOES LIGHT POLLUTION HAVE TO HIDE COLORADO SKIES?

by Dr. Bob Stencel

Light-pollution solutions (LPS) is a phrase that's been in circulation for a decade or more, signaling that we don't have to quietly endure increasingly bright skies at night. Happily, engineering solutions can produce a win-win result for all (cost-effective lighting without glare and skyglow), if we have the will to pursue them. In spite of that, metro Denver and Colorado's Front Range are awash in skyglow. Why?

First, what is skyglow? Arguably, it is the summation of all of the glare and light seen all around us in metro areas—this glare and "light-trespass" result from mis-aimed light. The night sky over DU's historic Chamberlin Observatory has reached *100 times the natural night skyglow level*; in astronomical terms, that's *five magnitudes* brighter than the background level. If you'd like to survey city night-lighting worldwide, astronauts on the Space Station took a series of images that you can download from: https://eol.jsc.nasa.gov/.

What's happening regionally in terms of light-pollution solutions? The biggest trend is the adoption of LED lighting. "Hotter" LED lights (i.e., with a color temperature of at least 3000 K) emit excessive amounts of blue light and those blue photons easily scatter into the sky, making those lights visible in Space Station images and obscuring the night sky. As Jack Eastman, of the Denver Astronomical Society, points out, flat-panel LED lighting could be made less harmful with a simple yellow filter overlay to attenuate the blue photons.

Regionally, there is some encouraging news: Westcliffe, Colorado is an International Dark Sky Association-designated dark-sky-friendly community. You can find their progress reports at: https://www.darkskiescolorado.org/. Boulder is facing a mandate to begin enforcing their lighting codes, and will revisit the topic this autumn, according to activist Richard O'Brien. Northern Laramie county's Soapstone Prairie Open Space is applying for dark sky park designation: https://www.fcgov.com/naturalareas/finder/soapstone. (This could be a possible site for future star parties.)

How can *you* help with light-pollution solutions? Here are a few ideas:

1.Whenever and wherever possible, talk up light-pollution solutions, and the beauty of the natural night sky. Also, share a view through your telescope with the public, and provide LPS messages to the viewer.

2. Ryan Parker has presented a strong idea, that homeowner associations may be far more effective at controlling glare and light-trespass than municipal regulators, because enforcement comes about from residents, rather than code-enforcement folk working after hours. Many neighborhoods already have (less-than-smart) lighting in place, so persuading a group to invest in lower-impact lights may be a hard sell; nonetheless, advocating smarter lighting can pay off over the long run, because these light fixtures will eventually get replaced.

3. When you see a construction fence appear, it often has signage, allowing you to contact the owner/builder and to advocate for smarter lighting *before* they invest in excessively bright, inferior equipment that adds to glare and skyglow. Concerned DAS volunteers could investigate which LED lamp suppliers these builders are buying from. They could also track down and report on what specific equipment is being added to roadways and up-lighted buildings. In that case, we might be able to talk with the suppliers and manufacturers about their product and why lower-temperature LEDs or yellow-filtered LEDs are preferable.

4. Join the International Dark Sky Association: http://darksky.org/ and get active with your local section by contacting colorado.ida@gmail.com. Thank you!

Dr. Bob Stencel is the Director of DU's historic Chamberlin Observatory.

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ABOUT THE DENVER ASTRONOMICAL SOCIETY

Membership in the Denver Astronomical Society is open to anyone wishing to join. The DAS provides trained volunteers who host educational and public outreach events at the University of Denver's Historic Chamberlin Observatory, which the DAS helped place on the National Register of Historic Places. First light at Chamberlin in 1894 was a public night of viewing, a tradition the DAS has helped maintain since its founding in 1952.

The DAS's mission is to provide its members a forum for increasing and sharing their knowledge of astronomy, to promote astronomical education to the public, and to preserve DU's Historic Chamberlin Observatory and its telescope in cooperation with the University of Denver. The DAS is a long-time member in good standing of the Astronomical League and the International Dark Sky Association.

The DAS is a 501 (c)(3) tax-exempt corporation and has established three tax-deductible funds: the Van Nattan-Hansen Scholarship Fund, the DAS General Fund, and the Edmund G. Kline Dark Site Fund.

***JOIN US!** More information about DAS activities and membership benefits is available on the DAS website at www.denverastro.org.

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ASTRO UPDATE

Selected Summaries of Space News

by Don Lynn

Martian Lake

The ground-penetrating radar aboard Mars Express has detected a layer below the Martian south polar cap that is likely a liquid water lake at least 12 miles wide. There are lakes buried deep within Earth's south polar cap, so this would not be without precedent. The layer has different radar reflectivity than ices or dirt, and matches what is expected of liquid water. Estimates of the temperature and pressure under Mars' polar cap indicate that a lake there would have to be extremely salty to remain liquid, but it is within the range of possibility.

Mars Express has been radaring the polar caps for over a decade, but it didn't have the resolution to see this layer until spacecraft controllers recently reprogrammed the radar to raise its sampling rate (and therefore resolution). Only a small area of the polar cap has been examined with the radar at high resolution, so other lakes may exist.

Martian Dust

Every few years, on average, Mars has a planet-wide dust storm. One is occurring now as I write this. So where does that much dust come from? A new study of Mars Odyssey data shows that the sulfur and chlorine content of Mars' Medusae Fossae Formation (MFF) fits the makeup of the dust that fell on the rovers. No region other than MFF was found to have those elements in matching amounts.

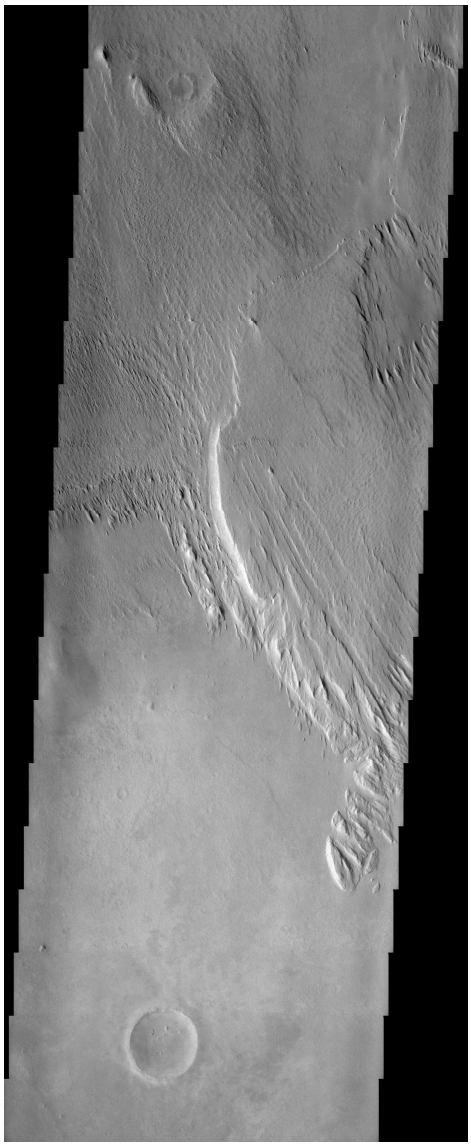
MFF was formed by huge amounts of gassy volcanic eruptions about 3 billion years ago. Since then, wind erosion has reduced a large amount of this lava to dust.

Solar Probe Launched

In 1958, astrophysicist Eugene Parker predicted that scientists would find particles being thrown off from the Sun at fairly high speeds, later called the "solar wind."

This wind was found and measured by many probes over the past 60 years, so a few years ago NASA decided to develop a spacecraft that would examine the solar wind where it formed in the upper atmosphere of the Sun.

Last month, Parker, now age 91, watched his first rocket launch, that of the Parker Solar Probe. It is the first time NASA has named a spacecraft after a living scientist. After several flybys of Venus to alter its orbit, the probe will make it 96% of the way from Earth to the Sun. That's as close as NASA engineers dare to get, considering the tremendous heat and particle radiation.



Mars' Medusae Fossae Formation is the wind-blown plateau appearing in the top 2/3 of this 2002 image.

Image credit: NASA/JPL/ Arizona State University

In October, after testing, the probe should begin returning data on the Sun. At about the same time, it will make its first flyby of Venus. In November, it will make its first fairly close pass by the Sun and continue in a very elliptical orbit that allows further Venus flybys. Its closest pass by the Sun, a few years from now, will be seven times closer than any other spacecraft has endured. It will then be traveling about 430,000 mph, far faster than any previous spacecraft.

The mission will try to answer questions such as why the Sun's corona and wind are far hotter than the surface and how particles are accelerated away from the Sun to very high speeds. The craft's instruments measure magnetic fields, plasma and energetic particles, and take images.

Galaxy Collision

A new study of the halo of stars about M31 the Andromeda Galaxy and its companion M32 show that M31 was hit by another galaxy about two billion years ago, and M32 is the core of that collider. The rest was shredded and thrown out into the M31 halo. The collider was large, somewhere between the sizes of M33 and the Milky Way.

It had been thought that the stars thrown into the M31 halo came from numerous collisions with small galaxies, but this study showed that most of those stars came from a single galaxy. M31 was known to have had a burst of star formation about 2 billion years ago, and it was likely triggered by this collision.

CHIME

The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is a new radio telescope with an unusual design in the province of British Columbia. Its semi-cylindrical antennas are permanently fixed to the ground, with no moving parts or pointing ability, but offering a very wide angle of view.

The facility was designed to map the hydrogen gas over much of the Universe. It continuously monitors a large range of radio frequencies and a large portion of the sky. This makes it perfect for searching for fast radio bursts (FRBs). Only a few dozen FRBs have ever been seen by all the radio telescopes in the world, because they occur at random places in the sky and last only milliseconds. CHIME has been in operation for only a few months and has already seen a few FRBs.

DAS NEWS

September General Meeting

Join us for our **September General Meeting, on Friday, the 21st, at 7:30 PM**, when we will present a talk by **DU's Dr. Toshiya Ueta** on planetary nebulae.

"Planetary nebulae are evolved stars of low-to-intermediate initial mass (0.8-8 solar masses; i.e., like our Sun) that experience the last throes of mass loss near the end of their lives," he writes. "Supposedly, these stars are to become white dwarfs whose average mass is 0.6 solar masses. If so, we would 'naively' expect to find 0.2 to 7.4 solar masses of ejected matter from the central star in the circumstellar space. However, have we ever observationally accounted for the total amount of mass that has been ejected? My collaborators and I have recently attempted this by collecting data, from X-ray to radio, analyzing them for each component, and using the results of the analyses as inputs and constraints for dusty photo-ionization modeling. I will talk about how that simple question turned out to be an epic."

Professor Ueta graduated with a PhD in Astronomy from the University of Illinois Urbana-Champaign in 2002. After spending time as an assistant astronomer at the Royal Observatory of Belgium, as a US National Research Council research associate, and a NASA post-doctoral fellow at the SOFIA Science Office at the NASA Ames Research Center, Ueta joined DU in 2006 as an assistant professor and became an associate professor in 2012. His research interests include circumstellar phenomena such as mass loss and circumstellar wind and their effects on the chemical enrichment of the interstellar medium.

A reception following the meeting will be held at DU's Historic Chamberlin Observatory. Coffee and light refreshments will be served.

Dr. Toshiya Ueta

President's Message

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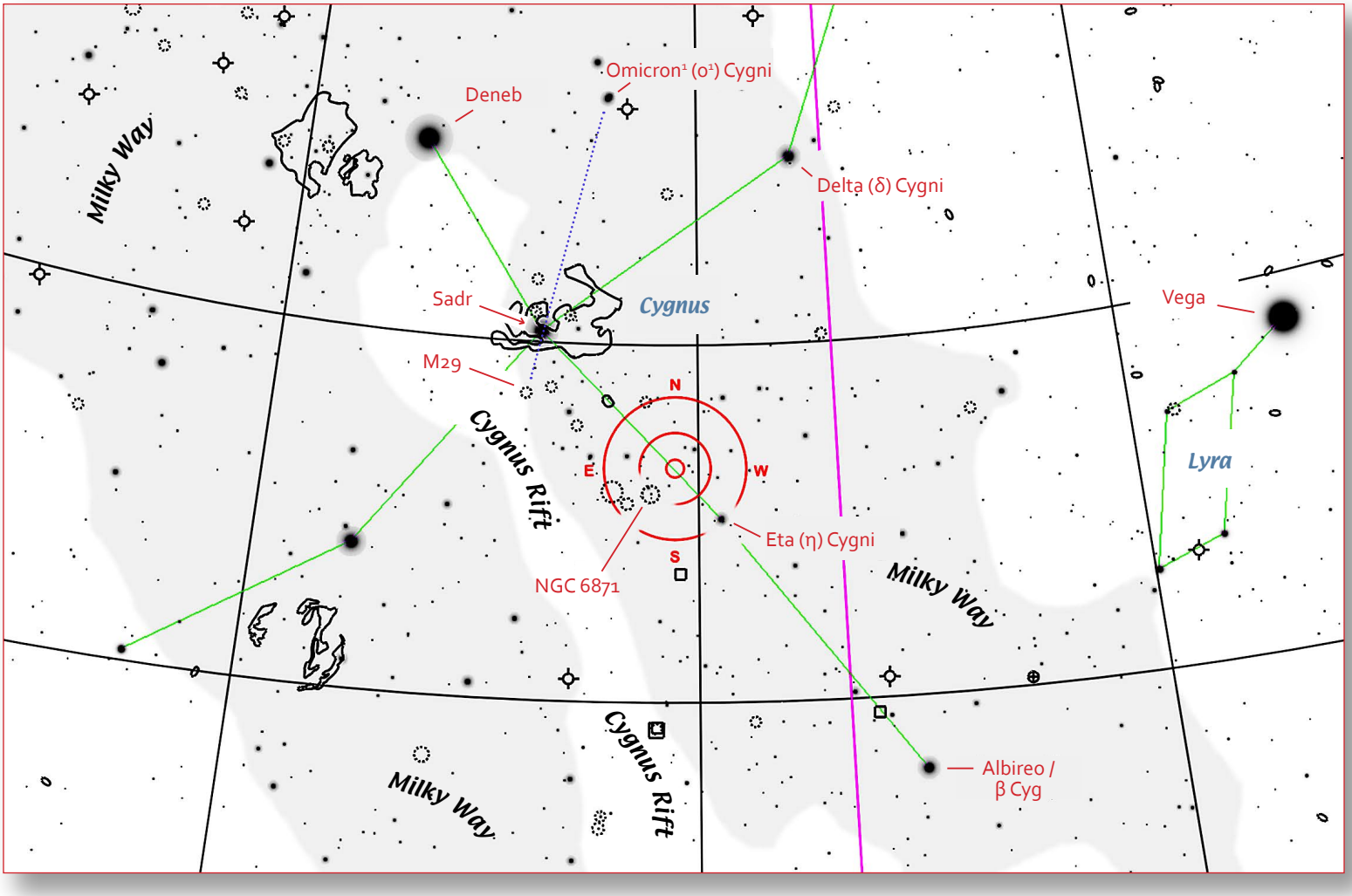
International Astronomical Union officially recognizes 88 constellations). A few examples with which you're likely familiar include Ursa Major, home of the asterism we call the Big Dipper; Cassiopeia; Orion; Hercules; and Sagittarius, where you'll find the Teapot asterism. What's nice about observing constellations is that you can do so from just about anywhere! Granted, dimmer stars in a given constellation may be difficult to spot from the city, but it's not absolutely necessary to be under pristine, dark skies. Don't know your way around? A handy reference is *A Constellation Album: Stars and Mythology of the Night Sky*, by P.K. Chen (©2007, Sky Publishing).

Moon: One of my favorite naked-eye objects is the waxing crescent Moon—a thin crescent just after sunset is hard to beat. Another is lunar eclipses, which happen when the full Moon passes through Earth's shadow. Often called a "blood moon" in the popular media, a total lunar eclipse can be various shades of orange to copper in color, depending in part on how much dust and other stuff is in Earth's atmosphere, and how deeply into our planet's shadow the Moon passes.

Planets: OK, you're not going to see anything other than a star-like object, but step outside and take a quick peek at the planets when they're visible. Those that can potentially be seen naked-eye include Mars, Saturn, Jupiter, Venus, and Mercury. Under dark skies—if you know where to look—you should be able to spot Uranus, too.

Sun: *To prevent eye damage, observing the Sun requires appropriate and safe solar filters, eclipse glasses, or some kind of projection (think pinhole projector). Only during the totality phase of a total solar eclipse can you safely look at the Sun without a filter.* During solar maximum, it's sometimes possible to see large sunspots through a filter with the otherwise-unaided eye. Partial solar eclipses, annular solar eclipses, and the partial phases of total solar eclipses can also be enjoyed without magnification (*again, using a filter for safety*).

And don't forget planetary conjunctions, the International Space Station, Iridium flares, various satellites, and even a few dim fuzzies such as the Andromeda Galaxy that can be seen from dark locations. There's definitely plenty to see without a 'scope.



Viewing almost straight up in Denver at 9:00 PM on September 15th. Telrad circles are shown positioned to put NGC 6871 near the center of a finderscope field, after centering on Eta (η) Cygni and slewing toward Sadr. From here, a 1° slew to the southeast (perpendicular to the swan's "neck," or the line from Sadr to Albireo) will get the cluster in or near your low-power eyepiece field. Note position of Eta Cygni at trailing edge of the 4° Telrad circle. Also note the dotted line showing the alignment of M29, Sadr, and Omicron¹ Cygni.

The Cygnus Rift, illustrated above, is an area of dust and gas that obscures the Milky Way's stars and nebulae. It is the same type of structure as the "dust lanes" often seen in edge-on galaxies.

Object positions, constellation and meridian lines charted in SkySafari, and then enhanced.

September Skies

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surface from Earth remains sub-par: In a moderate telescope in the penultimate week of August, the southern ice cap could be seen, with only a *hint* of detail around dark surface features in the mid-latitudes. At that time, the Martian disk spanned about 22"; by early September, it will be down to about 21" and will shrink to roughly 16" by the end of the month. That's still large enough to see detail clearly if the planet's atmosphere continues to clear, so keep an eye (and a 'scope) on the red planet.

Jupiter starts off September only 20° up in the southwest, 45 minutes after sunset, and gets far lower by the end of the month—in short, conditions are already less than great for observing this planet and will worsen dramatically by month's end. Jupiter disappears into the sunset in November.

Saturn, though, still looks great! It's now a little farther from us than a few months back, but the difference is negligible to visual observers, and the planet will remain a good target all month. As a plus, leaving Saturn behind us (as Earth moves quickly in our smaller orbit) means that sunlight no longer strikes Saturn straight-on from our point of view, so we see a large shadow on the rings from the planet itself, creating a deeper sense of *dimension*. The effect was already noticeable in a 4-inch Maksutov 'scope in late August and will intensify this month.

Uranus is now well-enough up at midnight, about 27° above the eastern horizon, to be a reasonable target. By the end of the month, you can get the same altitude about two hours earlier, but midnight views will instead offer a much higher altitude of almost 49°. Look for the planet about 4° northeast of Omicron (o) Piscium mid-month—about a half-degree farther from the star in early September and about a half-degree closer at the end. (Uranus will appear closer and closer to Omicron through late January, making the planet easy to find.)

Neptune is at opposition on September 7th, so it's visible all night, and highest in the south around 1:00 AM on that date—a prime opportunity for Neptune fans, especially before the weather turns cold. (By the end of the month, Neptune is at its highest before 11:30 PM.) Look for the planet about

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midway between Hydor (Lambda [λ] Aquarii) and Phi (ϕ) Aquarii throughout September—closer to Phi early on, and right in the middle at month's end.

Stars and Deep Sky

At the time of writing, we've had several months of smoke and haze, making targets with low surface brightness, like some nebulae and galaxies, much more difficult or impossible to see. Similarly, carbon stars, known for their deep orange or red coloration, won't be appreciated as much when even the Moon looks like a pumpkin, as we've seen so often lately. For these reasons, I have chosen two open clusters this month, instead of other targets I'd had in mind. They're interesting objects, to be sure, but it is hard to ignore the underlying reason for choosing them—much of the West, including the Canadian West, has been ablaze this year—as it was last year, *and the year before*…

First up then, is **M29**, at **20h 25m, +38° 34'**, in the constellation of Cygnus, the Swan. Unlike some open clusters we've seen, this one is quite young, with an age of about 10 million years. That's long enough for almost all of the hottest and brightest, O-class stars to have burned themselves out already (they die the quickest) but the still-very-hot B stars are still with us. These stars vastly outshine the others in the cluster, and most of M29's visible light comes from them.

Many write-ups for observers suggest there's not much to see here in a telescope. Perhaps so, but visual observing is highly subjective, and I disagree with the common view for a number of reasons. For one, M29 is easily visible in the city, even in a 4-inch Mak at low power (50x) and with less-than-perfect skies. At about 100x, the inner "butterfly" shape is easy; 10-15 stars will be visible. To me, M29 in a 'scope is much nicer than, say, the Pleiades in a binocular field, yet many folks are unimpressed with the former and thrilled with the latter…

Many common sources say the number of visible stars (under dark skies) is about 50, but that's only half the story—M29's actual structure is more complex, with vast tracts of dust and gas from the Cygnus Rift concealing the cluster's true nature. A deeper investigation reveals studies counting 100 to 250 members, and there are more stars hidden behind the dust; they become readily apparent on infrared images, such as those taken during the 2MASS survey.

M29 is actually a very bright cluster, intrinsically, but the intervening dust obscures and reddens the light, dropping its apparent brightness by roughly *three magnitudes*—more for bluer stars, less for redder ones. Without this light loss, M29 would be a fairly easy naked-eye object; as it is, it still manages magnitude +7.1, just beyond the limits of vision for most of us.

Now, here's something to think about—the Cygnus Rift, mentioned above, is part of a much larger system of gas and dust running all the way to the center of our Galaxy, in Sagittarius. As much as we might consider this large, dark area an inconvenience for hiding stars, there's another way to look at it—*it's the same kind of structure that we go out of our way to see in other galaxies*—a dust lane! In short, here's a chance to see a would-be brilliant cluster, dimmed by a nearby dust lane, and all within our own galaxy and the grasp of a small 'scope—or even binoculars… (The Rift is marked on the chart on page 6.)

To find M29, first look for the bright star Sadr, *aka* Gamma (γ) Cygni; it's where the "wings" of Cygnus meet its "body." (If you're not familiar with Cygnus, or you don't know how to find it, it's part of the Summer Triangle, a great landmark and an area rich in targets—for an overview of this region, check out "Getting Your Bearings," on page 4 of the August 2015 *Observer*, at http://www.denverastro.org/xobserver/august2015_denverobserver.pdf. Note that the chart is set for August; it will be the same for any given September too, but just shifted westward about 30°.)

Next look for even brighter Deneb, *aka* Alpha (α) Cygni, and then Delta (δ) Cygni—the latter is where the Swan's wings bend. Now imagine a star centered between them. If you can see it, you'll conveniently find a star almost in that location—it's Omicron[1] (o[1]) Cygni—but if you can't, just keep its would-be position in mind. M29 lies *directly on the opposite side of Sadr* from Omicron[1]; since a straight-through, inverted finderscope will flip its image 180°, centering Sadr in your finderscope's crosshairs should include M29 in its field, in the same direction from the center as Omicron[1] (or its imagined position) is when viewed naked-eye.

If you can't make out M29 in the finderscope, use your Telrad instead—center it on Sadr, then move it *away* from Omicron[1] until Sadr is *almost* at the trailing edge of the outer, or 4°, Telrad circle.

Our second cluster, **NGC 6871**, lies farther down the "neck" of the swan, at **20h 07m, +35° 49'**. To be sure, this is a less well-known cluster; it's of some aesthetic and scientific interest though.

Aesthetically, it has a few bright stars at its center, arranged in a somewhat "butterfly-shaped" figure, rather like M29 (they're mostly hot and bright, too), but with a lovely Milky Way background.

In small 'scopes in the city, the cluster itself is very small but easy to see, and arguably best at around 100x, where the extra magnification helps brighten the stars. The central stars become even more obvious and easily separated at about 150x. In the city, naturally, the Milky Way won't be visible, but out in the country, especially in a larger telescope, it can be impressive—I got my first look at this cluster years ago, and I still remember it even though I made no observing notes. (The cluster had a simple grace to it.)

Scientifically, the main star in the brightest of the cluster's two brighter pairs is a rare **Wolf-Rayet star, WR 133.** (The star might be easier to find by its other names, V1676 Cygni, HD 190918, or SAO 69402.) Reputedly, WR 133 is the brightest Wolf-Rayet visible in the northern hemisphere; at magnitude +6.78, though, it pushes the edge of naked-eye visibility. Still, that's pretty impressive for a star estimated to lie about *5,000 light-years* from us—our own Sun would appear about that brightness when just 75 light-years away, and that's not accounting for any dimming of WR 133 by intervening dust.

Essentially, Wolf-Rayets are "old" class-O stars. They've blown off their outer envelopes, so their underlying helium, oxygen, carbon, and nitrogen show in spectra, with little or no hydrogen. Those elements glow as *emission* lines in the spectrum, instead of the more usual dark absorption lines—that's because these stars are

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so hot that they radiate a lot of UV light, causing those gases to light up like a fluorescent tube.

Wolf-Rayet stars are nearing the end of the line before they explode as supernovae. These stars are rare because the massive, O-class stars they came from have short lives, as noted earlier, and the "WR" part of their evolution is even shorter—just a few hundred such stars are catalogued, out of the *billions* of stars in our galaxy.

Start the approach to NGC 6871 by looking for Eta (η) Cygni; it's a moderately bright, magnitude +3.9 star about halfway between Sadr and Albireo (the latter is the bright star marking the "nose" of the Swan). You shouldn't have any trouble spotting Eta under dark country skies, but on a very good night in southern Denver, light-pollution leaves it right at the edge of visibility—if you can't see Eta, guesstimate the halfway point between Sadr and Albireo, and you should see Eta as the brightest star in your finderscope's field.

Once you have Eta centered, slew your telescope about 2° towards Sadr. If you can see Eta in your Telrad, stop slewing when it touches the trailing side of the outer, 4°, circle, and look in your finderscope—you'll see a few bright stars perpendicular to the center, about 1° towards the *southeast* side—that's the same side of the swan's body as M29 or the Veil Nebula, but remember your straight-through finderscope's view is inverted!

If Eta wasn't visible in the Telrad, and you had to use the finderscope to find it, slowly slew your telescope in the direction of Sadr, and start to watch the incoming field for noticeable stars—you'll see just a few pinpoints, including WR 133, instead of a whole cluster. These should come near to the finderscope's midpoint (offset from the very center as mentioned above), around the time Eta begins to approach the trailing side of your finderscope view.

A quick note for the Dobsonian folks: At our chart's time of 9 PM (after the first week or so of the month), our targets will lie close to the zenith, making pointing your telescope difficult. It's best to wait for an hour or two, until you're comfortably past the need to point your 'scope straight up.

—See you next month.

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