

OBSERVER



Messier 33, the Triangulum Galaxy, one of the deep-sky objects featured in this month's "Skies."

Image © Alan Erickson

NOVEMBER SKIES

Solar System

This month promises to be a quiet one for the solar system. One unusual opportunity, for what it's worth, is the **daytime occultation of Regulus, at 10:15 AM Denver time, on Saturday, November 11th**. Timings are approximate and optimized for the area near the Denver Tech Center, so make sure to start observing early, as always.

Technically, the Moon's motion will cause its northeastern edge to cover the star, but from our point of view, Regulus will appear to sit "on top" of the lunar disk in the minutes before the event. An observer in Denver facing the west will see the Moon about 36° above the horizon; looking just above the Moon's "12 o'clock" position in a telescope should show Regulus, too. Because the star

by Zachary Singer

is so near the Moon's northern edge, the Moon's passage in front of it will be brief—Regulus will reappear on the Moon's dark limb at about 10:46 AM. (A determined observer would look for this between the 1 and 2 o'clock positions of the lunar disk, as seen in Denver.) Observing such occultations is generally taken to be difficult, but in this case, the ease of determining the position of Regulus beforehand may help a bit.

As a quick note, you might have heard about an occultation of Aldebaran on the 5th, but when the Moon first covers the star around 6 PM our time, the pair will still be below our eastern horizon. As the Moon uncovers it around 6:55 PM, Aldebaran will be only 3° up. The Moon will also be only two days past full, which won't help, either, so in a

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Sky Calendar

3	Full Moon
10	Last-Quarter Moon
18	New Moon
26	First-Quarter Moon

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PRESIDENT'S MESSAGE

by Ron Hranac

Getting Ready for Colder Weather

The first day of winter (technically winter solstice in the northern hemisphere) isn't until Thursday, December 21st, but October 9th brought the Denver Metro area wet, heavy snow and what meteorologists called a hard freeze. That was a quick reminder that Mother Nature doesn't always use a calendar. For those of us who enjoy astronomical observing year 'round, it was also a reminder that it's time to make a few preparations for the winter season. However, there is more to getting ready for winter-like observing conditions than simply bundling up. Here are a few tips that you may find helpful.

Clothing

You've probably heard that dressing in layers is recommended for enjoying the Colorado outdoors. Just what does that mean? For cold weather, there are three main layers: base, middle, and outer.

The base layer can be thought of as long johns, but not the cotton long johns you may have worn growing up. One of the most important purposes of the base layer is to wick moisture away from the skin, which is best done with materials such as merino wool

(this is the non-itchy kind), synthetics (polypropylene or similar), or silk. Cotton long johns retain moisture, and will contribute to making you feel colder, not warmer. Modern base layers are available in light-, mid- and expedition-weight. Since people generate less body heat when standing still, and we don't usually move around a lot when observing outdoors, the heavier weights are arguably a better choice.

The middle layer is the insulation layer. Here, too, avoid cotton materials because of their tendency to retain moisture. Desirable materials include wool, goose down, and synthetics such as fleece. The middle layer can comprise more than one component, depending on how cold the weather is.

The outer layer is to block the wind and perhaps precipitation. An important consideration is breathability of the outer layer, especially if it's water-resistant or waterproof. Some people like to use snowmobile suits or ski pants/bibs and coats as a combination of the middle and outer layers. Hats and gloves should provide the same layer-like protection from the elements.

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DAS SCHEDULE

November 2017

- 3 DAS General Meeting—DU's Olin Hall, Rm. 105—Starts at 7:30 PM
- 11 **E-Board Meeting—At DU's Historic Chamberlin Observatory, 3:00 PM. All members welcome.
- 11 Open House—DU's Historic Chamberlin Observatory—Starts at 5:00 PM
- 11 Member In-Reach—DU's Historic Chamberlin Observatory—Starts at 7:00 PM
- 18 Dark Sky Weekend—EGK Dark Site & Brooks Observatory

(December 2017)

- 3 DAS Holiday Party—Embassy Suites Tech Center—Starts at 6:00 PM. The speaker will be Karly M. Pitman, Ph.D., Executive Director of the Space Science Institute. Details to follow on our website later in November.

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.

President's Message

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The chief advantage of layers is their adaptability. If the weather warms up, some of the layers can be shed; if it gets colder, add more.

What about keeping your feet warm? Start with polypropylene or similar socks, covered by wool socks (there are combination types available), followed by warm boots. I have a pair of boots made by Baffin that are popular with ice fishermen (they don't move around much, either). Overkill, perhaps, but my feet stay toasty even while standing for long periods of time in the snow.

Automobile

If you observe at a remote location—say, the DAS dark site—you'll want to make sure your vehicle is winterized. Consult the owner's manual for specific recommendations, and have your mechanic do a thorough check. Here's a partial list: make sure the battery and charging system are working properly; the antifreeze is up to snuff for the cold temperatures expected; windshield washer fluid is topped off and of the *winter* variety; the wiper blades are in good shape; heater and defroster are in working condition; inspect the exhaust system for leaks and fix as needed; and make sure the tires are properly inflated and at least all-season rated (dedicated snow tires are even better) and have a safe amount of tread. Carry some emergency supplies just in case, including a small shovel. (Safety note: If you plan on sitting in the car with the engine running to help stay warm, open a window or two for ventilation and make sure the tailpipe is clear of obstructions.)

Astro Gear

If your 'scope has a dew shield, use it. In colder temperatures, dew heaters/strips are handy for preventing (or at least, delaying) the objective end of refractors and compound 'scopes such as Schmidt-Cassegrains and Maksutovs from dewing up or frosting. Some people like to use hair dryers to get rid of dew or frost, too.

If your observing site gives access to electricity, it's generally preferable to use it instead of batteries to run your mount and other electronics. Why? Cold temperatures reduce batteries' capacity, sometimes a lot. If AC isn't an option, just remember that in most cases your battery won't last nearly as long as it does in warmer weather. A spare battery (or *batteries*) is a good idea. Keep smaller batteries in your pocket, so they stay warm until they're needed. (Be sure to keep the contacts away from metal, including other batteries, so they don't short out.)

When setting up for an observing session, make sure you give your telescope plenty of time to cool down to the ambient temperature—remember, it'll take longer in the cold!

Some Quick Ideas

Finally, there are certainly other tried-and-true methods for dealing with cold weather: bring a thermos of your favorite hot beverage (coffee, cocoa, etc.); use chemical hand warmers; consider electrically heated socks (usually battery powered, but a bit cumbersome in my opinion); and so on. Don't take unnecessary risks—if it's too cold, stay inside where it's warm! The bottom line? Prepare ahead of time, *be safe*, use common sense, and enjoy those winter nighttime skies!



November Skies

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single word: "Meh."

Soon after mid-month, **Mercury** will be visible about a half-hour after sunset—but it will be low—just 4° above the horizon. That will improve to 6° at month's end—if that helps any. On the bright side, at least the disk's 7.8" apparent diameter and half-lit phase will be interesting.

Venus is low on the horizon before dawn, and getting lower. It's also more than 90% illuminated, so if you observe the planet

telescopically, expect a big, bright, blurry ball... Venus will finally surrender to solar glare in December; superior conjunction (when the planet is "behind the Sun," from our point of view) is January 8th.

Mars remains a small, 4" disk, visible before dawn, and it will stay that way all month. By New Year's, it will be subtly larger (5"), a hint of the great observations to come next year.

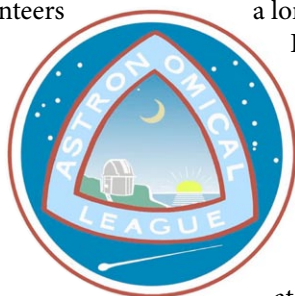
Jupiter rises just before the Sun at the beginning of November, but climbs higher each morning. **It passes within about 20" (1/3°)**

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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.



ASTRO UPDATE

Selected Summaries of Space News

by Don Lynn

Merging Neutron Stars Observed

On August 17th, gravitational waves were detected by all three gravitational-wave instruments, determined to be from two merging neutron stars. Two seconds later, two space telescopes detected a short gamma-ray burst in the same general direction. About 70 ground-based and space telescopes followed up, observing the roughly defined source area in the sky, and a new object was found in galaxy NGC 4993, located about 130 million light-years away in Hydra. The object was the predicted brightness and spectrum for a kilonova, a theoretical explosion 1000 times as bright as a nova, but dimmer than a supernova.

This object was detected in every type of light: radio, infrared, visible, ultraviolet, X-rays, gamma rays. It faded across most of the spectrum over the next days, but in mere seconds in gamma-rays. Many observations were made while the object was visible, providing a long list of accomplishments:

- * First detection, *in light*, of a gravitational-wave event
- * Confirmation that gravitational waves travel at the speed of light
- * First detection of gravitational waves from merging neutron stars
- * The firmest detection of a kilonova, and confirmation that a kilonova can be caused by merging neutron stars
- * Confirmation that a kilonova is a major cause of the generation of heavy elements such as gold, lead, and uranium, and their subsequent distribution through the Universe
- * Confirmation that a short gamma-ray burst can be caused by merging neutron stars
- * Closest gravitational wave event observed, and one of the closest gamma-ray bursts observed

And finally, new mystery emerged: the gamma-ray burst was unexpectedly weak considering its close distance.

Related: Nobel Prize

The Nobel Prize in Physics this year was awarded to three of the key people involved in developing LIGO, which first detected gravitational waves in September 2015: Kip Thorne, Barry Barish, and Rainer Weiss. They are emeritus professors of Caltech (Thorne and Barish) and MIT (Weiss). The Nobel rules allow sharing of a prize by no more than 3 people. A press release from Caltech named 16 people who had key roles in the discovery of gravitational waves. The team who built LIGO and the team who run and analyze it are believed to each have over 1000 members.

Tabby's Star

Tabby's Star (aka KIC 8462852) has shown highly unusual, short-term and long-term variations in brightness. A wide variety of theoretical models have been proposed in attempts to explain these variations, including theories as bizarre as an intelligently-built (that is, *alien*) megastructure. A new study in ultraviolet, visible light and infrared shows that a huge uneven dust cloud orbiting around the star about every 700 days could probably explain the long-term variations. Observations used in the study included many made by a group of Belgian amateur astronomers using a 27-inch telescope. Scientists are still working on explaining the short-term variations. The star was nicknamed after Tabetha

Boyajian, lead author of the original paper describing its bizarre light variations.

Haumea

Haumea, the third-brightest dwarf planet in the Kuiper Belt, was observed by a string of telescopes last January when it transited (passed in front of) a star. A lot was learned from this: Haumea is larger than previously estimated, it's less reflective, it's much less dense, and *it has a ring around it*. The new, 1442-mile size measurement puts Haumea's longest dimension at 97% of the diameter of Pluto. The lower density estimate puts also it much closer to Pluto's, and thus Haumea probably has a similar makeup of roughly equal amounts of ice and rock. The ring has a radius of 1431 miles (2287 km) and lies in the same plane as Haumea's rotational equator; it's dark and narrow, and its particles orbit with exactly 3 times the period of Haumea's rotation.

Pluto's Ice Blades

Among the strange features that New Horizons spacecraft found at Pluto is bladed terrain, where jagged sheets of methane ice jut from the surface. A new theory explaining this terrain is that it is similar to the much smaller blades of water ice that are found on Earth (in Chile). Large areas freeze, then erosion shapes the ice into blades. The Earthly ones are only a few feet high, but the Plutonian ones stand hundreds of feet high. The different material, different temperatures, different gravity, and different time scales of temperature change probably explain the height difference. The bladed terrain is found on Pluto only in the highest equatorial regions where methane snowfall or frost accumulation is expected to be heavy.

Hypervelocity Stars

Hypervelocity stars travel so fast that they may leave the galaxy. (It's thought that they achieve their high speeds partly through gravitational interactions with the supermassive black hole at the center of the Milky Way.) Only about 20 of them are known in our Milky Way. Two more have recently been found by the LAMOST spectroscopic survey, both of class B, and the project will continue.

Milky Way Mass

It's difficult to precisely measure the mass of the Milky Way, including its halo of dark matter. A new method using computer simulations to match the motions of hypervelocity stars (see above) produced a Milky Way mass somewhere in the range 1.2-1.9 trillion solar masses. These are tighter bounds than previous methods.

Martian Aurorae

On September 11th, the Sun threw off a huge coronal mass ejection. It missed Earth, but not Mars. The MAVEN Mars orbiter subsequently detected Martian aurorae 25 times brighter than anything it has seen before. The Curiosity rover recorded radiation levels at the surface double anything seen previously, and three other Martian orbiters also detected effects of the Sun's ejection. Mars would have then been a pretty place to observe aurorae, but with dangerous radiation.

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DAS NEWS

November General Meeting

On Friday, November 3rd, at 7:30 PM, DAS members will share their experiences, observations, and images of the Great American Eclipse of August 21st, 2017.

The meeting will be held at DU's Olin Hall, Room 105, and all present will be invited to a reception following the meeting at DU's Historic Chamberlin Observatory. Coffee and light refreshments will be served.

Time-lapse of the August 21st solar eclipse, as seen from Casper, Wyoming.

Image © Sorin



“How to Buy a Telescope: What You Need to Know”

Please join us for our **DAS In-Reach at Chamberlin Observatory, on Saturday, November 11th, 2017, beginning at 7:00 PM.**

We'll show and discuss refractors, reflectors, and Dobsonian telescopes, and tell you what factors to consider if you are contemplating your first telescope purchase or planning an upgrade. There will be time for Q & A, so bring your questions!

This is a good opportunity for everyone, including new members and folks new to the hobby, to learn about telescopes and get acquainted with some of our veteran members, who are well versed in most, if not all things related to telescopes and astronomy.

Hands-on demonstrations and practice with each type of 'scope will follow on the lawn; in the event of inclement weather, we'll do the demonstrations in the dome.

Please join us for what we are sure will be an interesting and worthwhile presentation. Light refreshments will be served, and if you want, bring something to share.

For any questions and for additional information about the program, please **contact Digby Kirby, odigby@gmail.com, (970) 301-2287.**

Volunteer Opportunities

Friday, Nov 10th, 2017, two classes 8:20-9:10 AM & 10:45-11:35 AM: Arvada High School, 7951 W. 65th Ave., Arvada, CO 80004. Solar Viewing and/or Astronomy presentation. (Coffee and doughnuts will be provided, and a lounge area for volunteers.)

**To volunteer, please contact Julie Candia:
external@denverastro.org
—and thanks!**

Dark-Sky Highway's Pothole Update

The recent severe potholes along the 6-mile stretch of eastbound County Road 34, between Deer Trail and the last turnoff for the dark sky site, have been repaired by the county.

Keep in mind, especially with upcoming winter weather, that new potholes could develop, and that colliding with wildlife, especially at dusk, remains a risk as always—so keep your speed down out there.

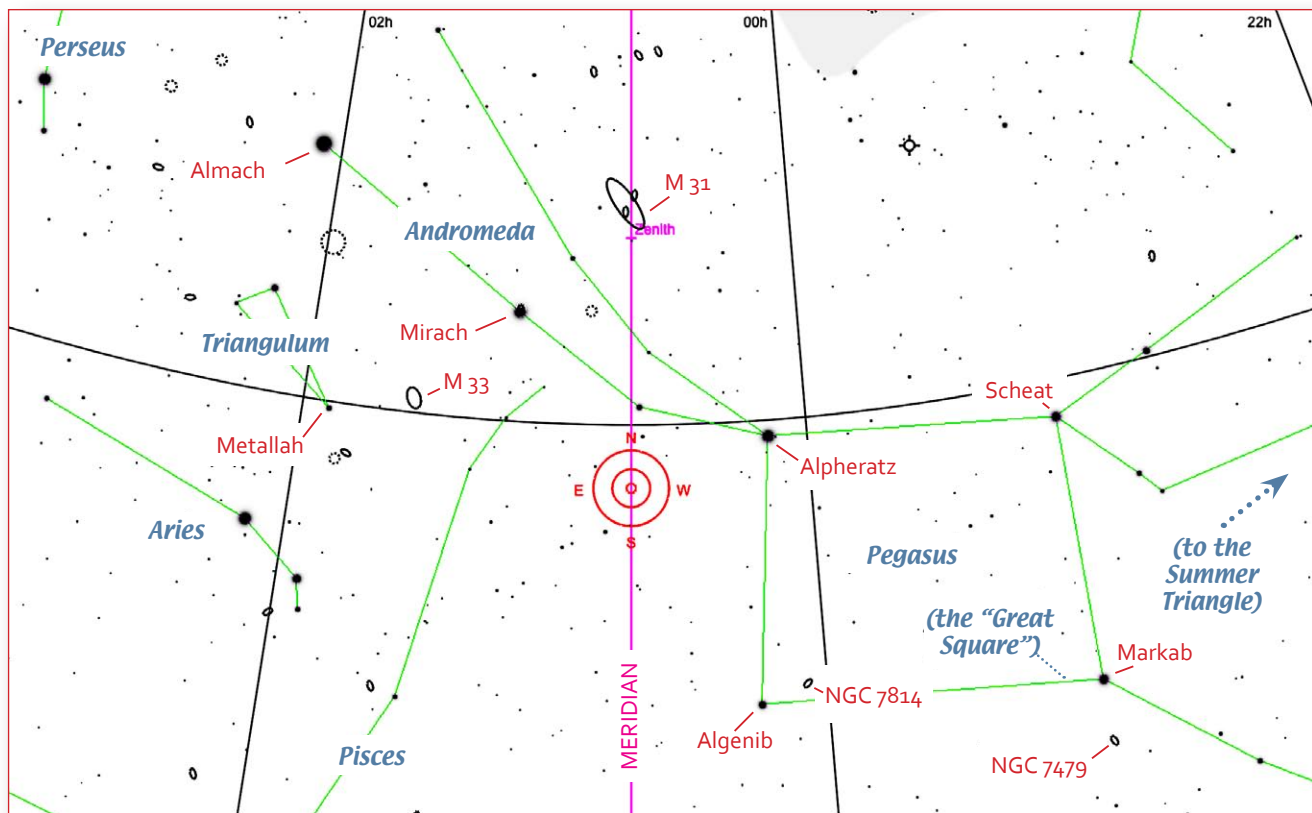
Are you skilled at editing videos?

If you're familiar with iMovie (or more advanced software like Final Cut Pro or Adobe Premiere Pro), the DAS would like you to consider contributing your skills to editing videos of our General Meetings for posting on YouTube.

We need someone who can use an existing on-screen format for creating a title frame, combine

videos of the speakers with PowerPoint presentations, and post them on the DAS YouTube channel. A “how-to” guide has been created by Jeff Tropeano.

If you're interested, **please contact Darrell Dodge at dmdodge@aol.com.**



View of the southern sky in Denver at 9:00 PM in mid-November. Telrad circles included for scale and reference; their center is 77° above the horizon.

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

November Skies

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of Venus on the morning of the 13th—the pair will be about 8° up in the southeast a half-hour before sunrise.

Saturn begins November less than 20° above the southwestern horizon, a half-hour after sunset. That already-minimal height declines to just 7° by month's end, and the ringed planet will achieve superior conjunction in December. Bottom line: Get your last, blurry observations in while you can, and look forward to Saturn reappearing as a pre-dawn object in the new year.

Uranus and **Neptune** don't move across our sky very quickly, so they're about where we left them last month. They are, however, observable at very convenient hours this month! At mid-November, Uranus is near the meridian around 9 PM; look for it about 2½° due west of Omicron (ο) Piscium (it'll be a touch closer to the star at the beginning of the month, and a bit farther at the end). Neptune is less than ⅓° from Hydor, aka Lambda (λ) Aquarii, all month; due south early on, and slightly westward later in the month. My mid-October observations of Neptune showed a gull-gray disk, rather than the expected pale blue—this is likely a result of lingering haze from western fires. That may improve soon, but in the meantime, don't let the lack of color fool you.

Stars and Deep Sky

For November, we have a tale of three galaxies, all in or not far from the Great Square of Pegasus and the adjacent constellation Andromeda. If you're not familiar with them, there's an explanation of how to find these constellations in "Getting Your Bearings," on page 4 of the November 2015 *Observer* (http://www.denverastro.org/newsletters/november2015_denverobserver3.pdf).

Of the three galaxies, one is fairly well known, large, and bright—but a challenge for those with high-powered scopes that

can't provide a wide field. The second galaxy is smaller and dimmer, and therefore right up the alley of the scopes that had trouble with the first one—there's a galaxy for everyone this month. And finally, the third one is dimmer still, a target for advanced observers, who might appreciate its subtleties.

Our first stop is **M33**, which is also known as the **Triangulum** or **Pinwheel Galaxy**. As you might expect from one of its names, you'll find it in the constellation of Triangulum; it's at **01h 35m, +30° 45'**. (As a side note about names, "Pinwheel Galaxy" also refers to M101 in Ursa Major—don't let that throw you!)

M33 is sometimes referred to as the farthest object visible to the naked eye—but then again, so is M31, the nearby Great Andromeda Galaxy. In a way, both references are right—on one hand, M33 is indeed the more distant of the two, at 2.8 million light-years, while M31 comes in at "only" 2.5 million. On the other hand, M31's glow is easily visible under a mediocre dark-sky, while M33 remains hidden from unaided vision on all but the darkest, clearest nights. (Like many observers, I can't remember seeing M33 naked-eye.)

Both M31 and M33 are spirals, but M31 has more than double M33's physical diameter, and M31 is intrinsically more than two magnitudes brighter than its smaller cousin, accounting in large part for the relative ease or difficulty in viewing these two galaxies. Though both galaxies' distances are daunting on a human scale, they're quite nearby as galaxies go—both are members of the Local Group of galaxies that also includes our own Milky Way. Because of M33's relative proximity, astronomers have long been able to study it in detail. For one, its Cepheid variables (which are "standard candles" for judging distance) provided some of the first

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evidence that other galaxies are exactly that, and not “nebulae” inside our own galaxy.

For amateur astronomers, M33 presents a conundrum—because it’s so much closer than most other galaxies, M33 should be simple to observe, but it has a reputation for being difficult. That’s because it’s fairly broad, compared to the width of telescopic fields of view—and also because M33’s brightness falls off gradually towards the edges. Photographically, the galaxy spans somewhat over a degree; but visually, it’s perhaps half that, with very vague edges and only subtle texture—if you were to peer through an eyepiece covering a $\frac{1}{2}^\circ$ field, you could easily look right at the galaxy and not realize it, especially on a less-than-perfect night.

I had that experience myself recently, with my 12-inch Newtonian on a mediocre night under dark skies. The galaxy was easily seen in a wide eyepiece that gave me 40x and a 1.8° field, and it looked even better at 60x and a 1° field, because of the extra magnification and contrast boost. Sure enough, though, at 125x and $\frac{1}{2}^\circ$, the overall view suffered—the galaxy’s glow extended across the entire field, and the lack of a distinct edge or details made getting a feel for the target difficult.

Interestingly, further magnification improved things again—the view narrowed enough to “zoom into” individual galactic arms, improving the separation between the galaxy and its background. As the saying goes, “your mileage may vary,” depending on whether the skies are better or worse, the design and quality of your eyepieces, how experienced you are, and so forth—but it’s certainly worth a try. I’d still recommend the wide view first, if your ‘scope can accommodate one, so that you get a sense of M33’s terrain beforehand; but if your ‘scope only manages $\frac{1}{2}^\circ$ on the wide end, try jumping in with higher powers instead. (The galaxy *should* show up in a 9x50 finderscope, but it failed to on my last run at the dark sky site.)

M33 lies about $4\frac{1}{2}^\circ$ eastward of Metallah, aka Alpha (α) Trianguli or α Tri, just off a line running from Metallah to Mirach (also known as Beta Andromedae, or β And for short). If you’re familiar with these two stars (or you can find them on a chart), *skip down to the next paragraph*. Otherwise, find Mirach first, by starting at Markab, aka Alpha (α) Pegasi, the “lower-right” star in the Great Square of Pegasus. Then run *diagonally* “up and left,” relative to the Square, to Alpheratz (it’s actually considered to be part of Andromeda, and thus its other name of Alpha [α] Andromedae). Extend the diagonal, for about the same distance, to Mirach, the next similarly bright star past Alpheratz (see chart). From Mirach, make a similar hop for Almach, the last bright star at the foot of Andromeda—now look south (in a direction parallel to the side of Pegasus), for the same distance as from Mirach to Almach, and you’ve got Metallah. (The two other obvious stars that make up Triangulum’s triangle lie to Metallah’s northeast—they’ll be easily recognized after comparing the area with a chart.)

Now that we all have our bearings, center your Telrad on Metallah, and slide it along the line to Mirach—you’re *close* when the part of the outermost Telrad circle between Metallah and the Telrad’s center lies halfway between them. On a clear night, the galaxy should appear in 9x50 finderscope’s field, and you can take it from there—but if not, nudge your telescope slightly towards Algenib (the “lower left” or southeastern star in the Square of Pegasus), until the mid-sized, 2° Telrad circle is on the original line between Metallah and Mirach. M33

should then lie inside a 1° telescopic field; if you don’t see it, orbit around that position carefully and you should find M33 without much trouble.

In deep photographs, our next target, the edge-on galaxy NGC 7814, in Pegasus at **00h, 04m, +16° 15’**, resembles the famous Sombrero Galaxy, M104—both are notable for their thickness across their mid-section, and for a thin but pronounced dust lane. Visually, through a telescope, that impression of NGC 7814’s thickness is lessened somewhat (and the dust lane will be out of reach), but it’s still an interesting target! On a good, *clear* night, the galaxy should appear in a 6-inch ‘scope, and easily in an 8-inch.

NGC 7814 isn’t a “showpiece” object—it appears more than two magnitudes dimmer than the Sombrero, partly because 7814 is 67% farther from us, at a distance of 47 million light-years. On the other hand, it’s easy to find, and it makes a good step forward for beginners who haven’t yet progressed to more challenging targets—and at just over 2x4 arc-minutes in size, you won’t need a wide field! Observing this lesser-known galaxy also can broaden your sense of what’s out there, and that’s a good reason to get out and look. Try a magnification of 10-15x per inch of aperture (60-90x with a 6-inch, 120-180x with a 12-inch) to start, and experiment with other eyepieces as necessary—the “best” combination will depend not just on your gear, but on seeing conditions and your eyesight.

NGC 7814 lies just $2\frac{1}{2}^\circ$ westward of Algenib, aka Gamma (γ) Pegasi, the bright star making up the “lower left” or southeast corner of the Square of Pegasus. To start, imagine a line between Algenib and Markab; the line runs directly east-to-west, and makes a good guide for direction when Pegasus is seen at an angle. Place the “bottom,” or *south-facing*, edge of your Telrad’s mid-sized, 2° circle on Algenib. Then slide that edge along the Algenib-Markab line until the part of the *outer*, or 4° , Telrad circle nearest to Algenib is about $\frac{3}{8}^\circ$ from that star. If you were careful, that ought to do it—you probably won’t see NGC 7814 in your finderscope, but it should appear in a moderate-power ($\frac{1}{2}^\circ$) telescope field. If not, make gentle motions around the area and you should soon pick it up. (If you’ve got an eyepiece that gives a wider field, that will make it easier, of course.)

I’ve included NGC 7479, a face-on, barred-spiral galaxy, and our last target this month, for more experienced observers. Located at **23h, 06m, +12° 25’** in **southwestern Pegasus**, this galaxy intrinsically outshines M31, the Great Andromeda Galaxy—but we see it at a dim magnitude +10.9, because of 7479’s distance, roughly 98 million light-years from us. (It’s roughly 40 times farther than M31.) The main attraction for amateur observers, quite frankly, is that central bar—it’s among the most prominent, easily seen examples that I can think of.

In the 12-inch ‘scope, the central bar is clearly visible, though it was better with averted vision. A great deal of staring on the first observing run produced the slightest hint of one of the arms, but it was marginal at best, and could well have been “averted imagination” as much as a real view. Follow-up observations many days later were dimmer—our recent mediocre sky conditions, rather than improving, had gotten worse. Based only on what I saw, I *can* promise you that you’ll see the bar in a 10- or 12-inch instrument, and the *possibility* of glimpsing an arm in the larger ‘scope if or when conditions improve.

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Given the situation, I chose not to attempt a view with the 6-inch, because the sky conditions just didn't warrant it; various sources, though, suggest that an 8-inch 'scope *should* get you the bar, if dimly. Consistent reports from 17- and 18-inch 'scopes agree that at least one arm is visible, so to our users of 14- and 15-inch apertures, here's a challenge for you!

Ironically, this tough target is fairly easy to find—it's just slightly less than 3° from Markab. Imagine a line running from Scheat, aka Beta (β) Pegasi or β Peg, straight through Markab, and continuing onward to NGC 7479. Put your Telrad's center along that line, and slide downward (relative to Pegasus's square) until the top (or northernmost) part of the outer Telrad circle is about a degree below Markhab (make it a touch less), and you're in. 7479 never appeared in my 9x50 finderscope, so you'll need good technique with the Telrad—use a low-power eyepiece at first, to pick up the galaxy's glow and give yourself a reasonably wide field.

Equatorial-mount users: Since NGC 7479 is almost perfectly south of Markab, you can simply center that star and slew just in declination to pick up the galaxy.

One last note: Observing conditions along the Front Range have been negatively impacted by weather, fires, and other problems for months. With luck, things will improve sometime soon—but if our current hazy conditions continue, these galaxies will remain more difficult than they otherwise would be. Keep this in mind if you

try observing them, and if need be, stash them until conditions improve. Galaxies can be tough under crummy skies.

—See you next month.



Astro Update *Continued from Page 4*

Martian Volcano

Analysis of six meteorites (of nakhlite variety) known to have been blasted off of Mars by an impact 11 million years ago showed that a single Martian volcano continued to erupt over a time span of 90 million years. Typically, Earthly volcanoes remain active for only a few million years, due to tectonic movement shutting down eruptions—but Mars does not have tectonic movement. It's believed that the eruptions of the Martian volcano continued much longer than 90 million

years, but we have only a small sample in the six meteorites. The volcano involved is believed to be Elysium Mons, and the scientists participating in the new analysis think they have identified the impact crater left when the meteorites were blasted off.

Launch Delay

Due to testing taking longer than scheduled, the launch of the James Webb Space Telescope has been pushed back from October 2018, to March-June 2019.

