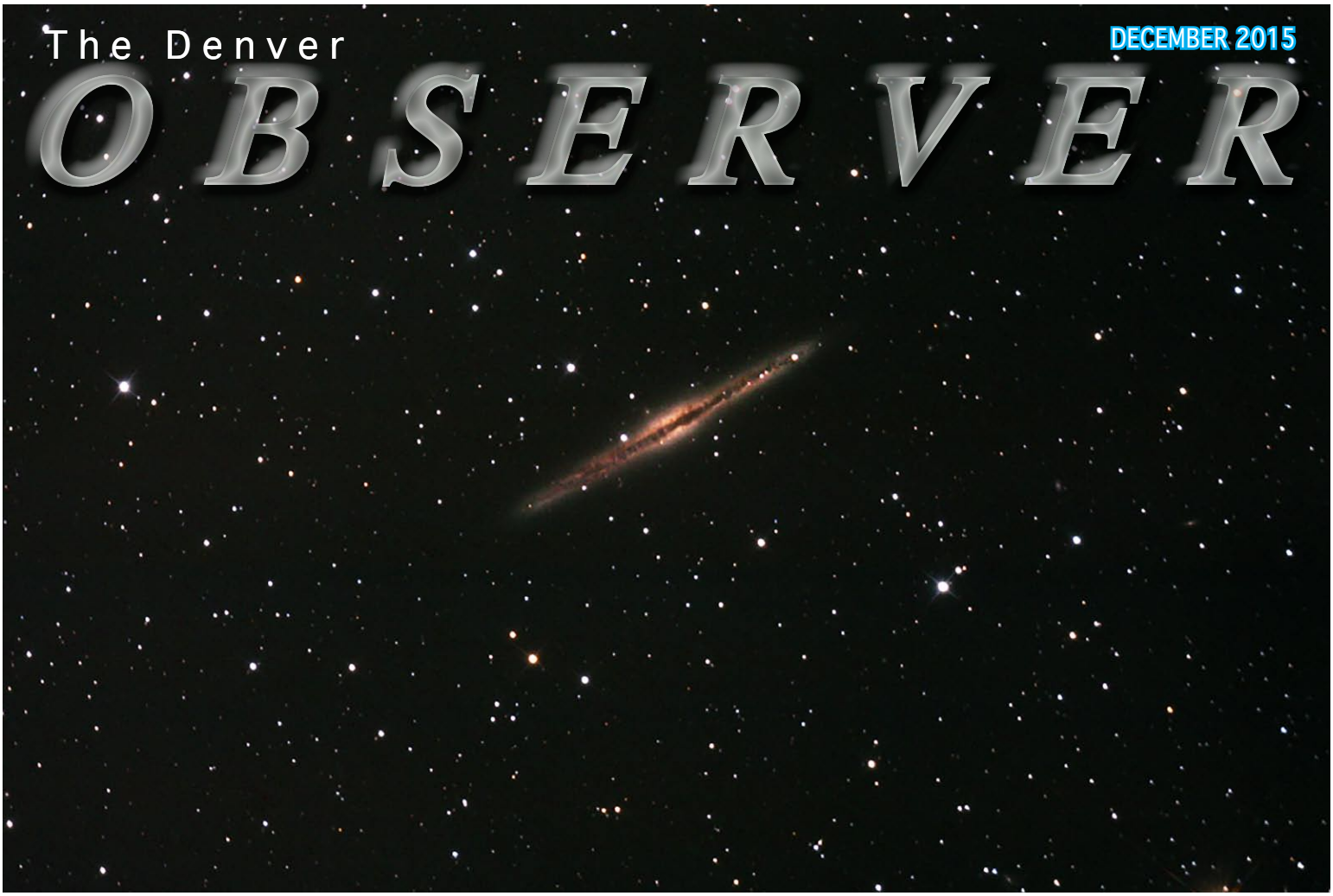
The Denver
OBSERVER
DECEMBER 2015



Galaxy NGC 891 in Andromeda, seen edge-on, is about 32 million light-years away. *Image © Darrell Dodge.*

DECEMBER SKIES

by Zachary Singer

Our Local Sky

We'll start this month's look at the solar system with a quick tip of the hat to **Mercury**. Bright at magnitude -0.6, but very low in the west at 5 p.m. as the month begins, the planet climbs higher, to 11½° above the horizon, by month's end. Its waning-gibbous phase at the start of the month will give way to a "third-quarter" Mercury towards New Year's and a crescent phase next month.

Before we continue outward to the rest of the solar system, take note that our planet's northern skies will play host to a special guest for the next few months. The visitor, **Comet C/2013 US10 (Catalina)**, is expected to be at magnitude 4.8 when we first encounter it as a pre-dawn object in the eastern sky. Look for it below and left of Spica at the beginning of December, roughly 15° above the horizon around 5:30 a.m. As the days progress, the comet will arc through eastern Virgo and then swing sharply northward towards Arcturus. (The comet is currently projected to be within ½° of that star on the morning of January 1st.)

The comet's northward direction means that by month's end, it will rise a little after 12:30 a.m. and stay up well after dawn—not too far into January, the comet will be far enough north to be visible *all night* at our latitude. Have a good look while you can—this tourist from the Oort Cloud will be more than a magnitude dimmer by the end of next month, and progressively dimmer after that. With an orbital eccentricity just a smidge greater than 1, there will not be a second visit.

Venus begins December near Spica, about 20° up at 5:30 a.m., and ends it within a few degrees of Graffias, aka Beta (β) Scorpii. Along the way, Venus meets up with Comet Catalina, appearing within 5° of it from the 6th to the 9th, and closest—at about 4½°—on the mornings of the 7th and 8th.

December 7th, though, is of particular note, because **the Moon will occult Venus** later that same morning. **At approximately 9:35 a.m., both objects will be high in the southern sky**, and in spite of daylight, both will be visible in a telescope. Look for the planet on the eastern limb of the crescent Moon—as seen from Denver, Venus will appear just above the Moon's "9 o'clock" position.

In the Observer

Sky Calendar

3	Last-Quarter Moon
7	Moon Occults Venus, 9:30 AM (Denver)
11	New Moon
18	First-Quarter Moon
25	Full Moon

Continued on Page 6

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The Executive Board conducts the business of the DAS at 7:30 p.m., at Chamberlin Observatory.
Please see the Schedule of Events for meeting dates. All members are welcome.
http://www.denverastro.org

PRESIDENT'S MESSAGE

by Ron Hranac

100th Anniversary of General Relativity

In the late 1600s, Newton's law of gravity provided us with a basic understanding of such things as the earthward acceleration of an apple falling from a tree, and for Newton's time, an accurate mathematical model for the orbits of planets in our solar system. While Newton's law gave scientists the means to calculate the effects of gravity, it didn't explain why gravity works.

In the mid-1800s, astronomers learned that the planet Mercury didn't *precisely* follow the orbital path predicted by Newton's law: As Mercury orbits the Sun, its perihelion point shifts a tiny amount. While some of that shift is caused by the gravitational effects of the other planets, the phenomenon remained mostly unexplained. To account for it, many astronomers thought that there might be an undiscovered planet closer to the Sun than Mercury, but searches for what was called Vulcan came up empty. The problem vexed astronomers for decades.

Meanwhile, there were other challenges to solve in astronomy and physics, like making Newtonian mechanics fit in with theories of electromagnetism (Maxwell's equations). In 1905, Albert Einstein introduced his special theory of relativity, which brought together space and time (think "spacetime"), matter and energy (think the famous equation $E=mc^2$), and joined Newton's work with Maxwell's. Special relativity, though, also required new thinking about gravity—if special relativity is true, then gravity cannot be a "force" like electromagnetism.

Einstein's "Aha!" moment came 100 years ago last month, and he wrote four papers on the subject – one a week. His general theory of relativity not only solved the Mercury conundrum, but gave us a completely new theory of gravity. (Quick side note: If you have trouble remembering which theory applies to gravity, just remember the *"g"* in general relativity.) In November, 1915, Einstein presented to the Prussian Academy of Science what are now called the Einstein Field Equations: some gnarly math illustrating the big insight that *what seems like the "force" of gravity is actually the bending or warping of the geometry of space—and time*—as spacetime interacts with matter and energy.

You've probably seen illustrations showing spacetime represented by a big sheet—perhaps with grid lines on it—and a massive object, such as a star, represented by a heavy ball sitting in the sheet's center. The ball's mass ("weight," in our Earthly, gravity-bound experience) distorts, or bends, the sheet. That ball-in-the-middle-of-a-sheet illustration is a very high-level view of the *why* behind gravity. Visualizing the distorted sheet, imagine rolling a small marble across it. As the marble approaches

Continued on Page 3

DAS SCHEDULE

DECEMBER 2015

11-13 Dark Sky Weekend—EGK Dark Site & Brooks Observatory
19 Open House—DU's Historic Chamberlin Observatory—Starts at 5:30 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.

DAS NEWS

Volunteer Opportunities

Dec. 10, 5:00PM: Star party and/or astronomy lecture for ~52 6th graders at Goldenview Classical Academy in Golden. The teacher has booked a classroom in the event of inclement weather for a presentation. If we have enough folks sign up and the weather holds up, though, he would like to have both. I will put whoever signs up for this event in touch with the teacher to hash out details and logistics.

Dec. 13, 5:30PM - 7:00PM: Star party for Jefferson Unitarian Church Nature Exploration group at Maple Grove Park in Golden. There will be ~30 people in attendance (kids ages 9-12 and their families). The organizer has also invited DAS volunteers to a potluck which begins at 4:30PM at the church, which is 1 block east of the park.

To volunteer, please contact Lindsey Shaw at *external@denverastro.org* —and thanks!

Writers Wanted

The Denver Astronomical Society is looking for good, volunteer writers to contribute articles for *The Observer's* "This Month's Skies."

Are you brimming with ideas about how to describe celestial events? If you are, please contact the editor, Zachary Singer, at *editor@denverastro.org*.

President's Message

Continued from Page 2

the "star" in the middle, its trajectory is increasingly altered. If the marble's path angles it a little closer to the ball, the marble will go into orbit around it. Too close, and well, the marble meets its demise. *Voilà*, gravity!

One consequence of the general theory's bent spacetime is that the light we see from distant stars should be displaced slightly when the stars' lines of sight pass near massive objects. In 1919, an expedition to test Einstein's theory during a total solar eclipse (when the Sun's usual daytime glare wouldn't interfere) did indeed show that the apparent positions of stars in the sky near the Sun had shifted as Einstein had predicted. The discovery made him an instant celebrity.

For the next 40 years or so, the general theory of relativity was confined mostly to the world of mathematics, and was thought by some to be a sort of dormant science. By the 1960s, a renewed interest in general relativity occurred, and it began to see applications in astronomy and astrophysics. General relativity started to be used to explain some of the latest astronomical observations. Out of general relativity came an understanding of black holes, microquasars, gravitational waves, and other phenomena. We can also thank general relativity for increasing the accuracy of our GPS receivers, so we can pinpoint our location on Earth and get from one place to another more easily.

At the time Einstein described general relativity, scientists thought that the universe was stable (neither expanding nor contracting). To make general relativity's math fit that understanding, he included a "cosmological constant." When the universe was discovered in the late 1920s to be expanding, Einstein dropped the cosmological constant, calling it his "worst blunder." Ironically, the cosmological constant might not have been the mistake Einstein thought it was: It could well turn out to be a parameter that describes how dark energy causes the expansion rate of the universe to be on the increase.

Perhaps most amazing is that general relativity has successfully passed every test that scientists have thrown at it during the past century, showing in part the genius behind the theory. Happy anniversary, Dr. Einstein.

ABOUT THE DAS

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 is a long-time member in good standing of the Astronomical League and the International Dark Sky Association. 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 Historic Chamberlin Observatory and its telescope in cooperation with the University of Denver.

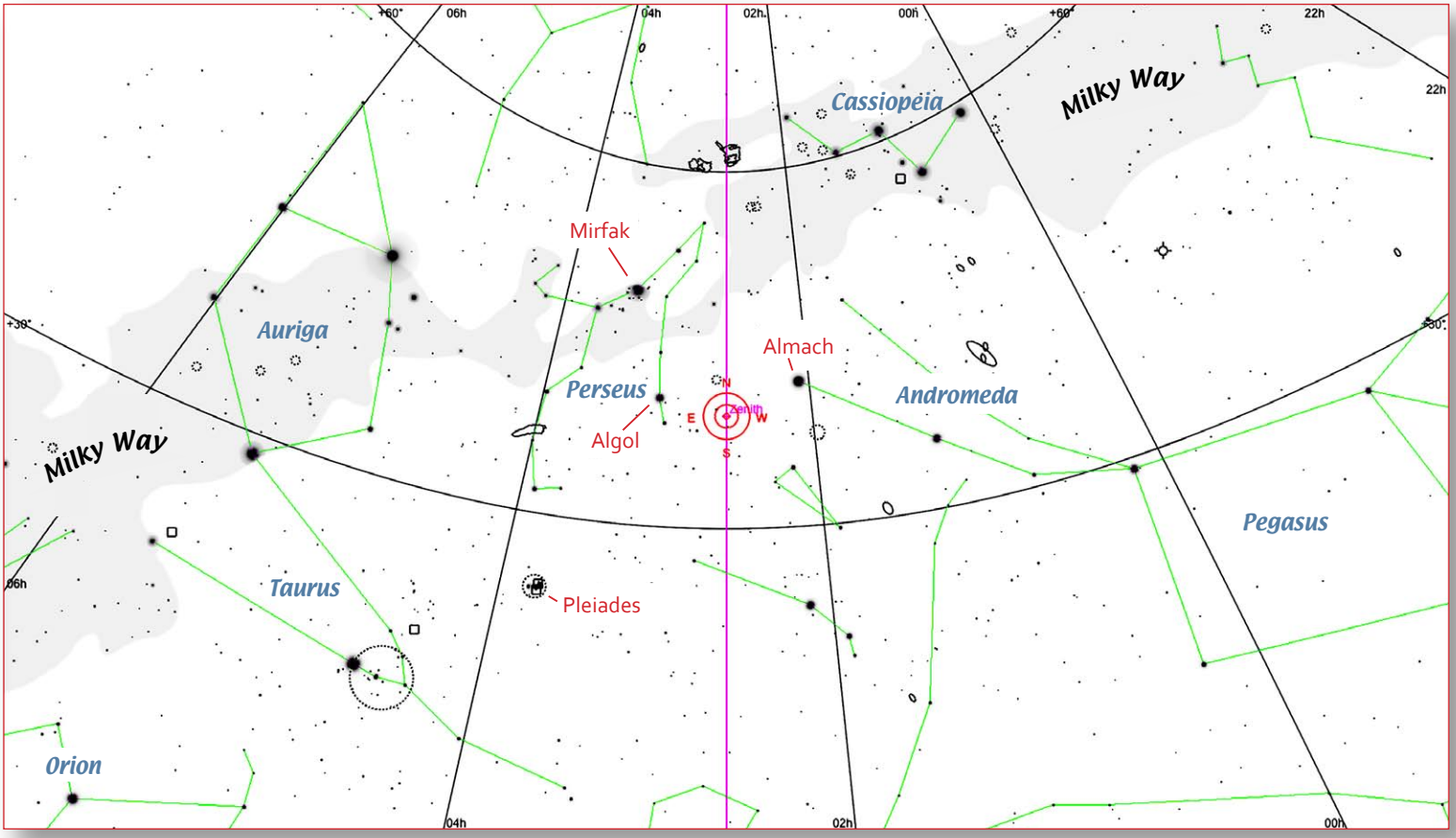
The DAS is a 501 (c)(3) tax-exempt corporation and has established three tax-deductible funds: the Van Nattan-Hansen Scholarship Fund, the DAS General Fund, and the Edmund G. Kline Dark Site Fund.

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

GETTING YOUR BEARINGS

...from the editor

Cassiopeia and Circumpolar Stars

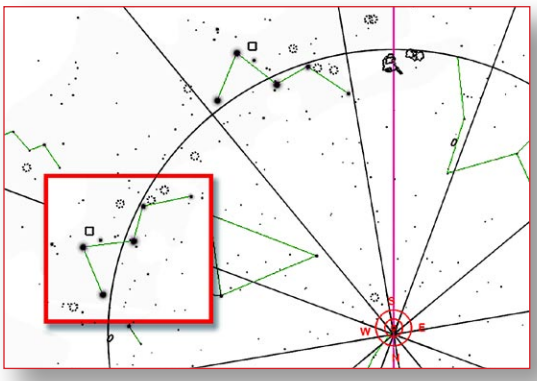


View of the sky overhead in Denver at 9:00 p.m. in mid-December. *Bottom of chart is about 60° up from southern horizon.* (Other stars and constellations are marked for reference.)

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

If we had gone looking for Cassiopeia last month, we would have found it high above Andromeda, which was last month's focus. The constellation's traditional outline comes from the myth of Cassiopeia the Queen—this step-shape, often referred to as a big "W"—was thought to represent her throne's legs, seat, and back. Given the bright stars in Cass, its simple shape, and its location near Andromeda—and the Great Square of Pegasus, a terrific landmark—it should be easy to find. (*See chart above.*)

But Cass comes with some twists—literally. The first is that it's so far north—so high in declination, the number of degrees away from the Celestial Equator—that it's best seen by turning around under the stars and *facing north*. Of course, doing so will also turn the sky 180° from its expected orientation—compared to a paper star-chart, the stars will look upside-down.



The position and *orientation* of Cassiopeia at 9 p.m. (at top) and 12 a.m. (superimposed inside box).

Cass, though, has another twist for you—it's *circumpolar*. At Denver's latitude, any celestial object with a declination of more than +50°, like Cass's stars, never actually sets—it just moves around the North Star, Polaris, as the hours (and seasons) go by. The good side of this is that these objects are visible round-year. Though they're sometimes too low near the horizon to get a good view, they're still much more accessible overall than southern constellations like Scorpius or Sagittarius, which aren't visible at all now.

The bad news is that the *orientation* of circumpolar constellations rotates through a large part of a circle as the hours—or seasons—progress. Cass is a great example: At 9 p.m. this time of year, it looks like a big "M" when you face north to look at it. Wait three hours, though, and it looks more like an "E," or better, a capital "Σ" ("Sigma"—sorry, "it's all Greek to me…"). If you'd looked three hours earlier instead, our M would have looked more like a jagged "3."

Cass's shape, as you can see, is simple enough to recognize once you're in on the trick—it's the same one that the "Big Dipper" (Ursa Major) plays, with its spoon standing on its handle sometimes, and the bowl at others. But other constellations, like Perseus (which is next to Cass and Andromeda and nearly circumpolar), have complicated outlines, and they can be tougher to recognize as they spin around. Being aware of the problem is half the battle; the other half is to seek out a bright star or two for a recognizable "landmark" that you can find, regardless of the orientation. (In Perseus, the bright stars Algol and Mirfak make a handy reference.)

OKIE-TEX REPORT

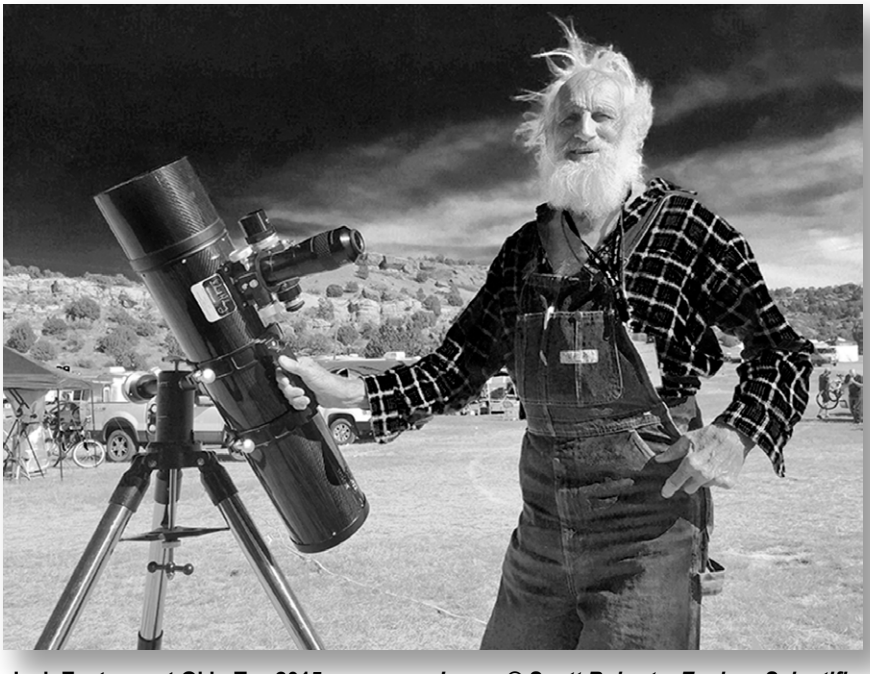
On... The Road Across the Plains, the Stars, and Sharing Astro-Insights

By Jack Eastman

September comes and with it, another Okie-Tex star party in the wilds of the Oklahoma panhandle. I took the same route as the last few, east to Limon then southeast on Highway 287 to Lamar, where I found a really good Mexican eatery, La Mission Villanueva at the south end of town. (I highly recommend the Enchiladas de Taos. Filled me up for the rest of the day.) Continuing on 287 to Boise City, where I spent Thursday night. Up Friday morning, pancakes at the Rockin' A, then on to the camp to help with the setup…

Friday night was totally cloudy, but Saturday was clear enough to try and get a good polar alignment for the 6-inch refractor. The other telescopes I dragged along were the Explore Scientific Maksutov-Newtonian "Comet Hunter" and a couple of my ridiculously tiny 'scopes. Our John Anderson brought his Foucault Siderostat and high resolution spectroscope, which was quite a hit with many folks that got a great lesson on how astronomers know what's in the Sun and stars. There were the usual array of 'scopes, from Joe Meyer's 0.0234-meter (23.4mm) Newtonian to monster 0.813-meter (32-inch) Dobsonians. Tim and Cathie from S&S Optika didn't come this time, so no matched 6-inch Takahashi Binoculars or their .635-meter (25-inch) Dob.

The weather was definitely a mixed bag. Temperatures were really hot the first several days, pushing 100 with nighttime lows around 60. For the first time at Okie, I walked up to breakfast in shorts. It did cool off toward the end of the party; the lowest night was the final Friday, at 45. We had a bit of everything: rather strong winds, clouds (allowing a bit of guilt-free sack time), some very nice clear skies, and even a short-lived bit of rain and pea-sized hail on Tuesday afternoon!



Jack Eastman at Okie-Tex 2015. ***Image © Scott Roberts, Explore Scientific***

(Jack doesn't strike me as one to post "selfies," and he didn't here: *I did.* —*Ed.*)

Seeing was less than ideal, double star observing was somewhat compromised, and views of Saturn looked like Vaseline was smeared on the eyepiece. When it did clear up, the skies seemed brighter than other parties I could recall. SQM measurements confirmed this with readings from 21.37 to 21.55 mag. per square arcsecond. These SQM readings roughly correspond to a Bortle Darkness number around 3 or 4 (*http://www.skyandtelescope.com/astronomy-resources/light-pollution-and-astronomy-the-bortle-dark-sky-scale/*).

There was little evidence of wildlife, no "Howlelujah" Chorus from the coyotes or "Mooooonlight" Sonata from the cattle herd that we had a few years ago. No tarantulas, and very few flies!

As before, there were no formalities until Wednesday, allowing much free time to renew acquaintances, welcome many of the first timers (of which there were quite a few), and just relax. It turns out Okie-Tex was listed as one of the top eight star parties in the world by Astronomy Magazine and the only one on that list in the United States! This, I'm sure, explains the huge attendance, which was well in excess of 400. Even so, all went quite smoothly.

Tuesday, early afternoon, was the first of the two swap meets. I caved in and got two matched binocular eyepieces after all. They were attached to a fine pair of 25X100 binoculars—I couldn't resist them!

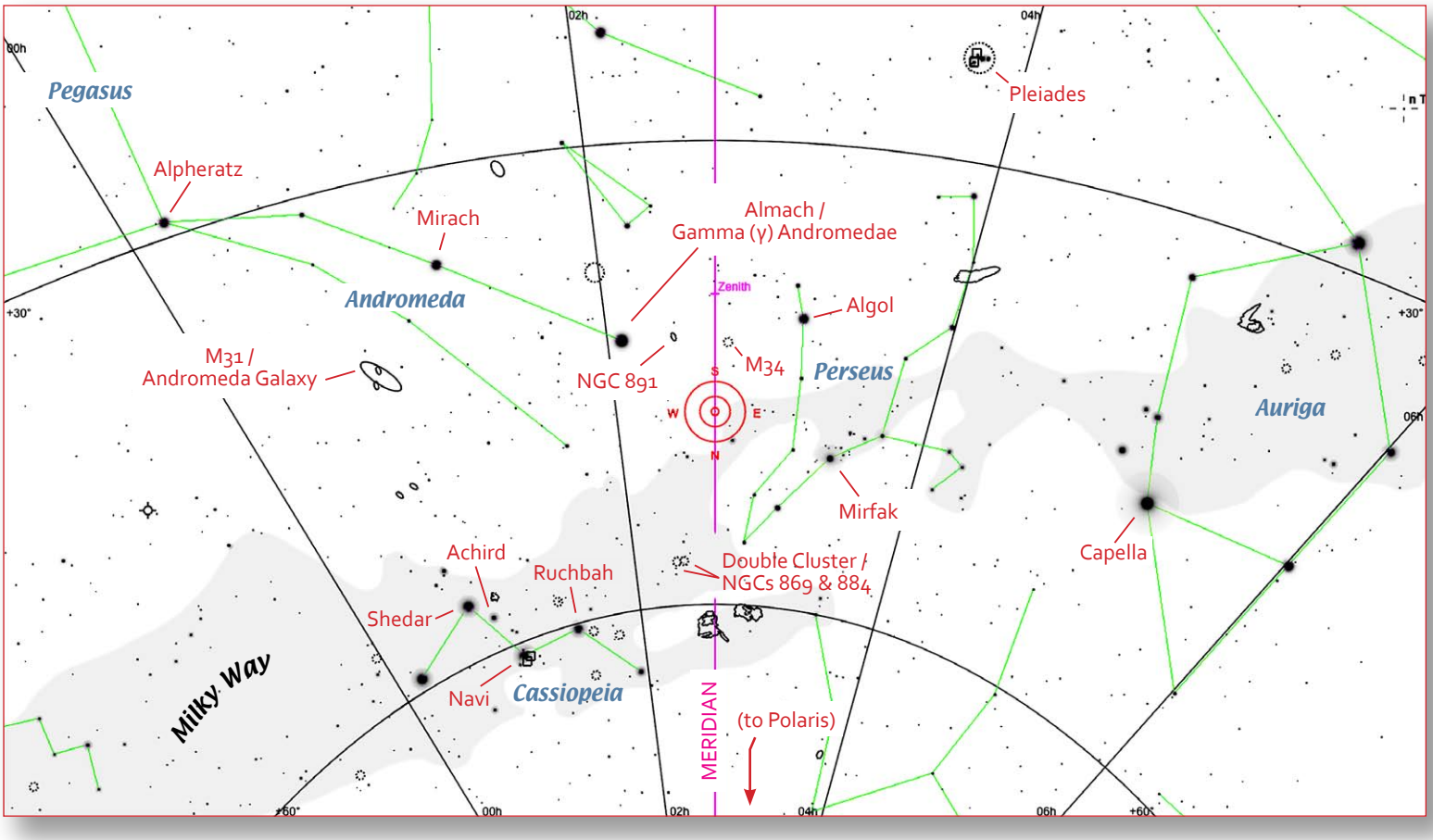
Wednesday, the talks began. First up was Mike Lockwood of Lockwood Precision Optics discussing precise testing of mirrors, and next a discussion of mirror cells and diagonal holders. A lot of insight here on building cells that hold optics firmly but without causing warpage of the optical elements. There was much good advice from Mike on this subject (see *http://www.loptics.com/info.html*). This was followed by John Bozeman's discussion of photo processing using PixInsight. The evening talk was by Jeff Kanipe and Dennis Webb largely promoting their book series *Annals of the Deep Sky*—a series, eventually of 14+ volumes (two published so far), describing all the things to be seen in a dark sky. Reminded me of the excellent three-volume set *Night Sky Observer's Guide* by George Kepple and Glenn Sanner. They expect to publish at the rate of two volumes per year.

Thursday opened with Gil Machin discussing observations in other than visible wavelengths, "Search for the Invisible," followed by Gary Parkerson talking about recent trends in the astro-tech industry and promoting the magazine *Astronomy Technology Today,* which highlights astronomical equipment along with some technical articles. Following Gary, John Bozeman returned with more discussion of the use of PixInsight.

The after-dinner talk was from two educators from Norman North Astronomy, David Davisson and Eileen Grzybowski, talking about their adventure riding along and making observations from NASA's SOFIA flying observatory, a highly modified Boeing 747 carrying a 2.5-meter (100-inch) telescope. The aircraft typically flies at about 41,000 feet, above 80% of the atmosphere, making for excellent infrared observing. The observations on the flight described by Eileen and David were primarily of star-forming regions in Sagittarius. (Eileen and David also bring a number of high school students to Okie-Tex for a couple of nights under the stars. Many kudos to both of them for that!)

Friday's sessions began with Ed Wiley's

Continued on Page 8



The view NORTHWARD at 9 p.m. in mid-December. As is shown by this chart, familiar objects and constellations appear "upside-down" from their traditional map orientations when viewed in this direction. (Cassiopeia is 65° above the horizon, and the center of the map is looking nearly straight up.)

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

December Skies

Continued from Page 1

The planet will reappear around 11:13 a.m., emerging from the Moon's darkened northwestern limb at about the "2:30" position from Denver's point of view. It's a good idea to observe early, both to see the Moon gain on the planet before the occultation, *and because the timings can vary by a minute or more from within the larger Metro Denver area*.

Mars, at magnitude 1.5 and brightening, spends December in Virgo, with a week near Spica after the 20th. The duo will be close enough together to share a binocular field.

Jupiter remains in southeastern Leo, about 5° from Beta (β) Virginis. The planet rises about 12:30 a.m. in early December and around 10:30 p.m. by month's end—it's clearly on its way to becoming an evening object.

There are a number of minor meteor showers this month, but the **Geminids** are a shower worth seeing. Their peak should be **visible all night from the evening of the 13th to the morning of the 14th**, with the moon setting early enough to not be a bother. According to Ottewell's, peak rates are typically in the range of of 50 to 130 meteoroids per hour. (As you might expect from their name, the radiant is near Castor.)

Deep Sky

In order of the difficulty to find them, this month's roster includes a beautiful, if less well-known binary, a *very* well-known set of clusters for the newbies, and a fascinating edge-on galaxy for our more advanced observers.

First off, then, is our binary, **Achird,** or **Eta (η) Cassiopeiae**, at **0h 50m, +57° 54'**. Visually, this 3rd-magnitude pair has a lovely color contrast, "cream and garnet" to my eyes. In a 6-inch scope, the pair splits easily with moderate magnification, but it's noticeably dimmer than Almach (which we saw last month) or Albireo. In larger scopes, the extra light allows the subtle colors to shine through.

Unlike Almach, though, which is a giant, dying star pouring out tons of light across a great distance (with bright companions, to boot), Achird is pretty down-to-earth: Its primary is very similar to the Sun, with roughly the same mass and diameter. Achird is also only about 20% brighter—a fraction of a magnitude—*so looking at Achird is about the same as looking at our own Sun at the same distance*. (If you were wondering, its companion is a dim orange dwarf, with about 1/30th of the Sun's brightness.)

To get some quick perspective, have a look at Achird (which is about 19 light-years from us) and then at Almach. Almach's primary appears well over a magnitude brighter to our eyes than Achird's does, even though Almach is *some twenty times farther away!* Remember that if they were instead of the same "absolute" or intrinsic brightness, like two matching flashlights, then Almach would appear 400 times dimmer than Achird because of the distance—to get the view that we see, Almach must be powerful indeed. In comparison, Achird (and, by extension, our Sun) are fairly nondescript!

To find Achird, just look for Cassiopeia's W-shaped outline—Achird shares a Telrad or finderscope view with Shedar, the "bottom-right" star of the W (*as it appears on maps*). Because Cass is so high in declination (i.e., so far to the north), *turn your toes and nose northward*—around 9 p.m. on December evenings,

Continued on Page 7

December Skies

Continued from Page 6

the constellation lies about 30° above Polaris (the North Star), and somewhat to the left. When you do this, the W will look more like an "M" ("upside-down" compared to maps) and Shedar will be at the *top-left* vertex, with Achird visible (in suburban skies or darker) about 2° to the right. (If you're not familiar with Cassiopeia, check out this month's "Getting Your Bearings.")

The Double Cluster, NGCs 869 & 884, in Perseus. ***Image © Darrell Dodge***

Cassiopeia has quite a number of fascinating objects—clusters, nebulae, and binary stars—that are worth investigating on your own, but for now, we'll make a short hop to our next target, the well-known **Double Cluster in Perseus, NGCs 869 and 884.** (The former, NGC 869, is at **2h 20m, 57° 11'**.) Either cluster taken on its own is a beauty—but viewing these open-cluster "cousins" together (a 1° field will do it) is really something! In a 6-inch scope, the clusters' stars glow like twin sprays of diamonds on a velvet sky; in a 12-inch under just the right conditions, these stars are joined by a dense and comparatively reddish background of field stars. (Though they're rather dimmer, these anonymous companions, denizens of the Milky Way's Perseus arm, are unforgettable for their sheer numbers.)

These clusters must both be quite young, because they contain large numbers of hot blue stars. (Such stars burn through their hydrogen supplies very quickly, so they're bright and *short-lived*—if most of them haven't used up their fuel yet, then their parent clusters can't be very old.) As for how bright these blue behemoths are, well, consider that they're roughly *7500 light-years away*, in a different arm of the galaxy. If our Sun or Achird were at that distance, neither would be visible in a 10-inch scope.

To find the Double Cluster, look north again at Cassiopeia. As before, the traditional "W" is an "M" on December evenings. Find the M's central and *top-right* corner stars (Navi and Ruchbah) to use as a pointer. Starting at Navi, head to Ruchbah and then keep going in the same direction: In dark skies, you'll see a very definite glowing patch about twice as far beyond Ruchbah as Ruchbah is from Navi. Center your Telrad or finderscope on that glow, and you're in!

Last up, a holiday present for "our observers who've seen everything," **NGC 891, at 2h 24m, +42° 25'**, on Andromeda's eastern edge. This galaxy looks like the little brother of NGC 4565 in Coma Berenices—we see it edge-on, its thin "flying saucer" cross-section bisected by a dark lane. (Astrophotographers will note a reddish tinge near the dark lane; it's due to light scattering from the dust in that area.)

In a 6-inch scope, you might discern a dim "wedge" shape, but an 8-inch is more likely to show you the overall outline. A 12-inch scope should get you the dust lane, though observer reports suggest a 10-inch can do it on a good night. (Try using about 10X per inch of aperture to start, and move the magnification up or down from there.)

NGC 891 is about 3½° from Almach, at an angle of 88°—*almost directly eastward*. All you *equatorial-mount folks* can just center Almach and drag east those few degrees until you hit the galaxy. (A Telrad can quickly take you most of the way, and you can use the slow-motion controls to sweep the remainder while looking through the scope.)

For the Dobsonian folks, well…. First off, we usually talk about our targets "around 9 p.m. mid-month," but at that time, NGC 891 will be near enough to the zenith to make aiming a pain. Throw in a search for an unfamiliar object, and you've got trouble. So the first trick is looking either before or after that time by at least an hour.

Our target lies about halfway between Almach and the cluster M34, so finding that cluster is our next step: Look midway between Almach and Algol—M34 *might* be visible to your naked eye. If not, aim your telescope there and use the finderscope to pick up the cluster and center it. Your Telrad will now point to M34's position. (M34 is a nice cluster, too—don't forget to check it out while you're there!)

Once your Telrad is marking out M34, imagine the point halfway from there back to Almach, and point the Telrad there. In theory, if you can set up your scope for a 1° field (as for the Double Cluster), then NGC 891 should appear near the edge of the view. If your widest field is narrower than that, nudge your scope slightly southward (the direction is perpendicular to the line between M34 and Almach), then sweep the M34-Almach line if necessary.

Finding NGC 891 could be a bit much for the newbies, so don't think it's "only you" if you can't locate it. On the "up" side, though, a polite request to a more advanced DAS member at the Dark Sky Site may get you a look at it—that's a good way to learn, and you might make a friend.

—Since we're all into astronomy here, I can wish you a "Merry Winter Solstice" (extra-long nights for observing…) and still be politically correct! *See you next year.*

Okie-Tex Report

Continued from Page 5

discussion of his pro-am adventure doing real science with a 6-day (night) run on the 2.1-meter telescope at Kitt Peak. He was making speckle autocorrelation observations of very close double stars with the 2.1-meter reflector, showing excellent results, and also showing a great relation with the professional community. Ed's measurements of double stars, made with his own equipment, a C-11 SCT and 8-inch Dall-Kirkham, compare very favorably with many other professional results. (Yes, amateurs can do cutting edge research!)

This was followed by Howard Edin talking about building a Sky Quality Meter (SQM) with readily available electronics. Then it was Andrew Planck with his book *What's Hot on the Moon Tonight,* a discussion of Lunar Observing with a logbook for recording one's observations. Thinking this would be another promotion, I only caught parts of his talk. What I did see, though, was very informative, and the book promo part was less than a minute! The after-dinner talk was from Tim Hunter: his life and times as an amateur astronomer, quite entertaining!

Saturday afternoon opened with the swap meet, Part II. First talk following the swap meet was by Wes Atchison and his radio for observing meteor ion trails. This, followed by Howard Edin again, with his radio observations of meteor trails for fun and science. After dinner was the grand—and I do mean *grand*—finale, David Levy's address discussing his life as an astronomer, lecturer, educator, discoverer of some 53 asteroids, and comet discoverer. Not the least of which was Shoemaker-Levy 9 that Eugene and Caroline Shoemaker and David photographed using the Palomar 18-inch Schmidt Camera in 1993. As we remember, this was truly an unusual object; further investigation showed it had had a close encounter (of the worst kind?) with Jupiter a year earlier, getting ripped apart. Later, the comet had an even worse encounter, slamming into Jupiter in July, 1994. (See *https://en.wikipedia.org/wiki/Comet_Shoemaker%E2%80%93Levy_9*.) David gave many kudos to the Denver Astronomical Society, had us all stand and get recognition, and recalled his fond memories of his earlier years with the organization that helped him get his start in astronomy. (See *https://en.wikipedia.org/wiki/David_H._Levy*.)

The DAS had 22 folks on the registration list (a total of 40 from Colorado); Oklahoma City, the ones who put on the Okie-Tex, had 25. We're catching up to them!

All told, a terrific time was had by all. Every one of the first-timers I talked with said they're definitely coming back!

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