



FOCUS

DELAWARE ASTRONOMICAL SOCIETY

Vol. 62, No. 1, January, 2020

Next Meeting

Tuesday, January 21
Mount Cuba Astronomical Observatory

Board Meeting: 7PM
General Meeting: 8PM

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Happy New Year!



FOCUS editor:
Richard G. Spencer
Publications Chair, DAS



It's a New Year! It's a New Decade!

*Will history designate this
“The Decade of the DAS”?*

The Board kicked it off by going for broke with NYE ad space for 1,000,000,000 viewers *worldwide* at Times Square (photo, pg 1)—and well-wishes from around the globe continue to pour in.

Do you have astronomy-related New Year's Resolutions? I'll put them in the next FOCUS (with or without your name, as you prefer) if I get a few.

Sample: “I will read the FOCUS more carefully”.

*Wishing you the best year ever for
astronomical pursuits!*

RGS

Jan. 21 Agenda

Orbits! Part II
By Rick Spencer

★ How high is a geosynchronous orbit on Jupiter?

★ What is escape velocity—*and why it doesn't matter*

★ Black hole radius—*did Einstein miss this one?*

What's Up in the Sky?
By

Greg
Lee



Astrophoto Showcase
By Bill Hanagan



From the President

Rob Lancaster

January 2020 President's Column

Dear DAS Members,

Welcome back from the holidays! This winter has been fairly warm so far, I hope you have been able to get outside and enjoy it! Unfortunately, due to travelling to visit family over the holidays and less frequent clear skies, I didn't get to enjoy the night sky as much as I like, but I hope you did. Despite the two-week break that the DAS took from activities, we were especially active in the past month or so. The

December DAS Equipment Sale went extremely well. Every item on the list except the EQ6 tripod sold to a DAS member. The equipment we sold was not quite appropriate for use as loaner telescopes, but was still good equipment. So, it is good to see that equipment in the hands of our club members getting used instead of sitting in the storeroom collecting dust. Also, in December, the DAS accepted the donation of a new Meade LX200GPS. We have started testing it out, and hope to get it ready to use in the near future. In January, we have already held the first two Astronomy Workshops of this year. At last week's workshop, we completed a major project. Thanks to the idea of Rick Spencer, the donations of Mike Cimorosi, the persistence of Jeff Lawrence, and the hard work of everyone who came to the Astronomy Workshop last Tuesday, we successfully put up new whiteboards in the Mount Cuba Classroom. A big thank you to everyone involved!

At January's monthly meeting we will have several DAS member talks. From the beginner friendly "What's up" by Greg Lee, to the beautiful astrophotography of Bill Hanagan, to the mathematical wizardry of Rick Spencer, we should have some really great presentations. We might even have the Sawin Observatory open depending on the weather. As usual, the meeting will start at 8 pm, but you can come to the board meeting before that if you like, which starts at 7 pm. Remember that due to the new gate policy, you should not arrive before 6:45 pm.

If you did not get the news, in preparation for the new upgrades to equipment at Mount Cuba, they have gotten a new gate system activated by a key code entry. You should have received an email about a month ago explaining our new procedures for DAS events held at Mount Cuba to make sure that nobody ends up stuck at the gate without being able to get in. If you did not receive the email, please let me know. Also, Mount Cuba has re-instituted policies for Educational and Technical Associates along with new application forms that must be filled out if you want keys to the building. The building was rekeyed last week, so if you previously had a key to Mt. Cuba, it will no longer work. If you didn't get the forms, or are interested in becoming an Educational Associate, please see Kim Green for details.

Please note our upcoming, exciting astronomy events! Remember that there are Astronomy Workshops every Tuesday that is not a monthly meeting date. The next Astrophotography group meeting is the weekend of January 24th/25th. The next book club meeting is on January 28th. Keep your eyes out for emails to the DAS Groups.io group, since we may have one or more observing runs to dark sites depending on the weather.

Thank you,
Rob Lancaster
DAS President





1/21/20 DAS Board Meeting Agenda

1. Review of Minutes from Last Meeting—Bill McKibben
2. Treasurer's Report—Bob Trebilcock
3. Project Status Reports:
 - New Whiteboards
 - New Telescope Donation
 - Equipment Sale
4. New Fence at the Sawin Observatory
5. DAS Intro to Amateur Astronomy Course



Mike Cimorosi

Let's all give a big thanks to Mike Cimorosi for the very generous donation of whiteboards for the Mt Cuba lecture room! That is a great upgrade for our meeting space.

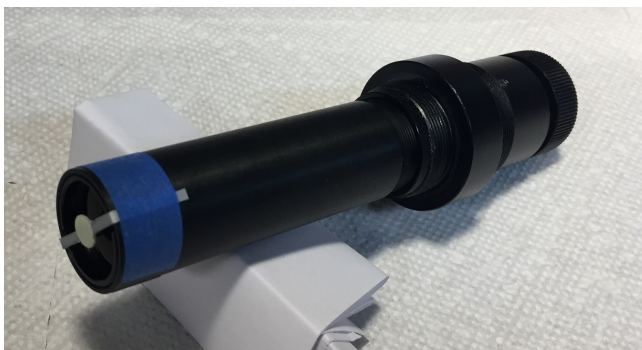
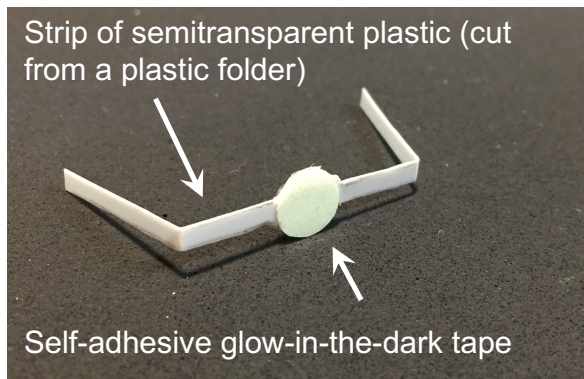
Jeff Lawrence on behalf of the DAS "Board"



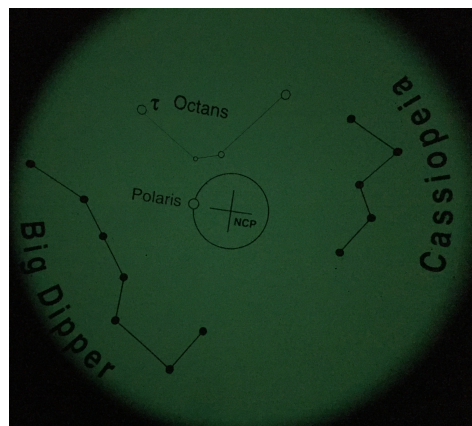
DIY polar scope illuminator

Igor Peshenko (BMAA, CAS, SJAC)

If your telescope uses an equatorial mount, you will have to align the mount with the north celestial pole for the telescope to track properly. Most of equatorial mounts are equipped with so called "polar alignment scope" usually mounted inside RA axis. Polar alignment requires sighting Polaris through the polar scope and aligning it with engraved markings inside the polar scope eyepiece. The problem is that when it is dark, the markings cannot be seen so they have to be artificially illuminated. Unfortunately, some mounts and polar scopes, including my Celestron AVX mount, do not have built in illuminator. All factory made and DIY polar scope illuminators that I saw on the web relied on a small LED bulb as a source of light and required batteries to operate. My first DIY illuminator also featured a flashlight. Recently, I came with the idea of placing a small dot of glow-in-the-dark tape in front of the polar scope objective lens. Being greatly not in focus the image of the glowing dot spreads all over the field of view thus creating the effect of "light pollution" making engraved markings readily visible.



The polar scope illuminator is taped in front of the polar scope objective lens. Alternatively, the self-adhesive glow-in-the-dark dot can be permanently attached directly to the surface of objective lens but I did not have courage to do that because it would be very difficult to remove the dot should I change my mind. Anyway, even the plastic strip design is still very simple.



The illuminator is "charged" by briefly flashing white light either through the opening in the front of the mount or through the polar scope eyepiece. After that it creates evenly illuminated background just bright enough to see the markings and Polaris at the same time.

Astronomer in the News

Vera Rubin

July 23, 1928 - December 25, 2016

Nobel prize citation would have read something like:
 “For seminal observations helping to establish the existence of dark matter”
 ...but she never received the Nobel Prize



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ROTATION OF THE ANDROMEDA NEBULA FROM A SPECTROSCOPIC SURVEY OF EMISSION REGIONS*

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 Department of Terrestrial Magnetism, Carnegie Institution of Washington and
 Lowell Observatory, and Kitt Peak National Observatory‡
 Received 1969 July 7; revised 1969 August 21

ABSTRACT

Spectra of sixty-seven H II regions from 3 to 24 kpc from the nucleus of M31 have been obtained with the DTM image-tube spectrograph at a dispersion of 135 \AA mm^{-1} . Radial velocities, principally from H α , have been determined with an accuracy of $\pm 10 \text{ km sec}^{-1}$ for most regions. Rotational velocities have been calculated under the assumption of circular motions only.

For the region interior to 3 kpc where no emission regions have been identified, a narrow [N II] $\lambda 6583$ emission line is observed. Velocities from this line indicate a rapid rotation in the nucleus, rising to a maximum circular velocity of $V = 225 \text{ km sec}^{-1}$ at $R = 400 \text{ pc}$, and falling to a deep minimum near $R = 2 \text{ kpc}$.

From the rotation curve for $R \leq 24 \text{ kpc}$, the following disk model of M31 results. There is a dense, rapidly rotating nucleus of mass $M = (6 \pm 1) \times 10^9 M_{\odot}$. Near $R = 2 \text{ kpc}$, the density is very low and the rotational motions are very small. In the region from 500 to 1.4 kpc (most notably on the southeast minor axis), gas is observed leaving the nucleus. Beyond $R = 4 \text{ kpc}$ the total mass of the galaxy increases approximately linearly to $R = 14 \text{ kpc}$, and more slowly thereafter. The total mass to $R = 24 \text{ kpc}$ is $M = (1.85 \pm 0.1) \times 10^{11} M_{\odot}$; one-half of it is located in the disk interior to $R = 9 \text{ kpc}$. In many respects this model resembles the model of the disk of our Galaxy. Outside the nuclear region, there is no evidence for noncircular motions.

The optical velocities, $R > 3 \text{ kpc}$, agree with the 21-cm observations, although the maximum rotational velocity, $V = 270 \pm 10 \text{ km sec}^{-1}$, is slightly higher than that obtained from 21-cm observations.

I. INTRODUCTION

The Andromeda Nebula offers a unique opportunity for the study of the dynamics of a galaxy. Because of its large angular extent on the sky, it is possible to observe individual emission regions spectroscopically and, in principle, to map the velocity field of a galaxy which resembles our Galaxy. In practice, however, the extreme faintness of the regions makes detailed optical studies very time-consuming, if not impossible. The very early observations of M31 were restricted to the bright central regions. In 1914, from observations made with the Lowell Observatory 24-inch refractor, V. M. Slipher (1914) reported inclined absorption lines across the nucleus of M31. From absorption lines, Pease (1918) measured the rotation out to 150 seconds of arc from the nucleus on a single plate of 79 hours' exposure, taken in 1917 during the months of August, September, and October. The Mount Wilson 60-inch reflector was used, the dispersion¹ was 192 \AA mm^{-1} , and the resulting values are of sufficiently high accuracy to warrant serious scientific consideration today.

The first large-scale study of motions in M31 was made by Babcock (1939) with the 36-inch Crossley telescope at Lick Observatory. His observations included spectra of the unresolved central nucleus (exposure times 25 minutes to 22 hours) and a few spectra of

* Contributions from the Kitt Peak National Observatory, No. 492.

† Visiting Astronomer 1966, 1967, 1968, Lowell Observatory; and Visiting Astronomer 1967, 1968, Kitt Peak National Observatory.

‡ Operated by the Association of Universities for Research in Astronomy, Inc., under contract with the National Science Foundation.

¹ Drs. N. U. Mayall and R. Minkowski have pointed out that there is a misprint in Pease's paper, and the observed wavelength range is actually 3930–4950 \AA , not 4930–4950 \AA as published.



Vera Rubin is *In The News*: the NSF just announced that its Large Synoptic Survey Telescope project, under construction in Chile, will be known as the Vera Rubin Observatory. First light is expected in 2022.

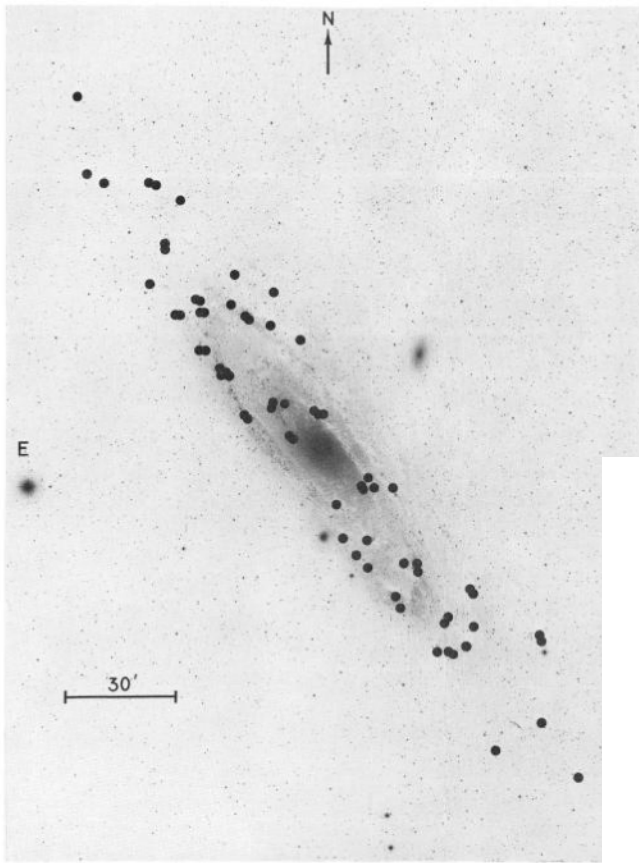


FIG. 1.—Identification chart for emission regions in M31 for which velocities have been obtained from Palomar 48-inch Schmidt ultraviolet photograph, 103aO plate + UG 1 filter, courtesy of Dr. S. van Bergh.
RUBIN AND FORD (see page 380)

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Rubin studied the rotation curve of the Andromeda galaxy—the speed of rotation as a function of distance from the galactic center—and found that its pattern couldn't be explained by the pattern of luminosity (i.e., visible mass)! This indicated the existence of gravitating matter that does not absorb or radiate light.

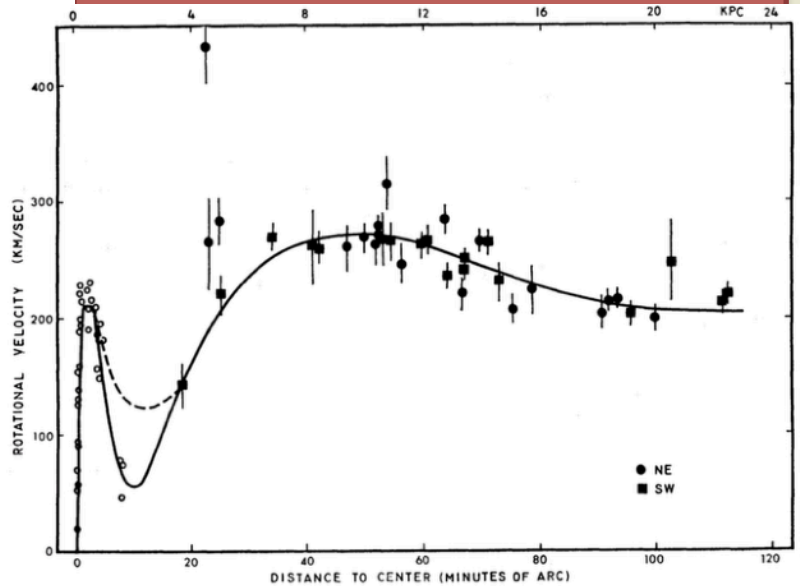


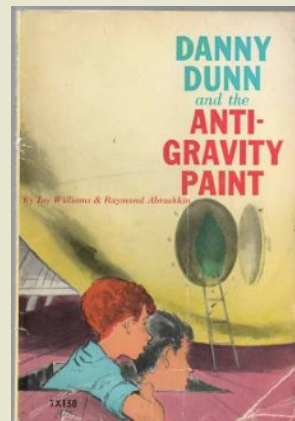
FIG. 9.—Rotational velocities for OB associations in M31, as a function of distance from the center. Solid curve, adopted rotation curve based on the velocities shown in Fig. 4. For $R \leq 12'$, curve is fifth-order polynomial; for $R > 12'$, curve is fourth-order polynomial required to remain approximately flat near $R = 120'$. Dashed curve near $R = 10'$ is a second rotation curve with higher inner minimum.

Fun Fact!

Do you remember the difference between “Dark Matter” and “Dark Energy”?

Dark matter generates an attractive force—it's gravitating matter, but doesn't interact with light

Dark energy generates a repulsive (anti-gravity) force—and accelerates the expansion of the universe



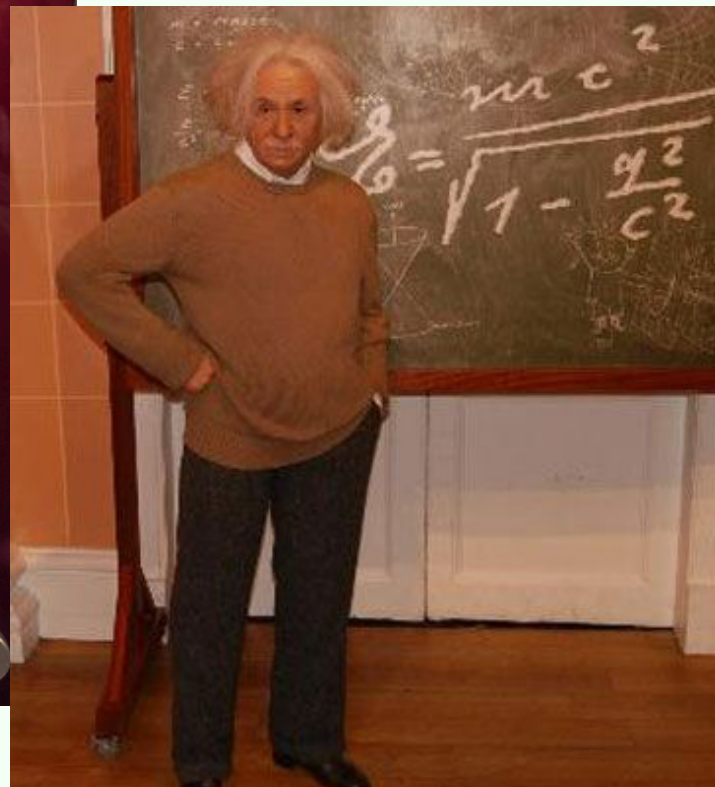
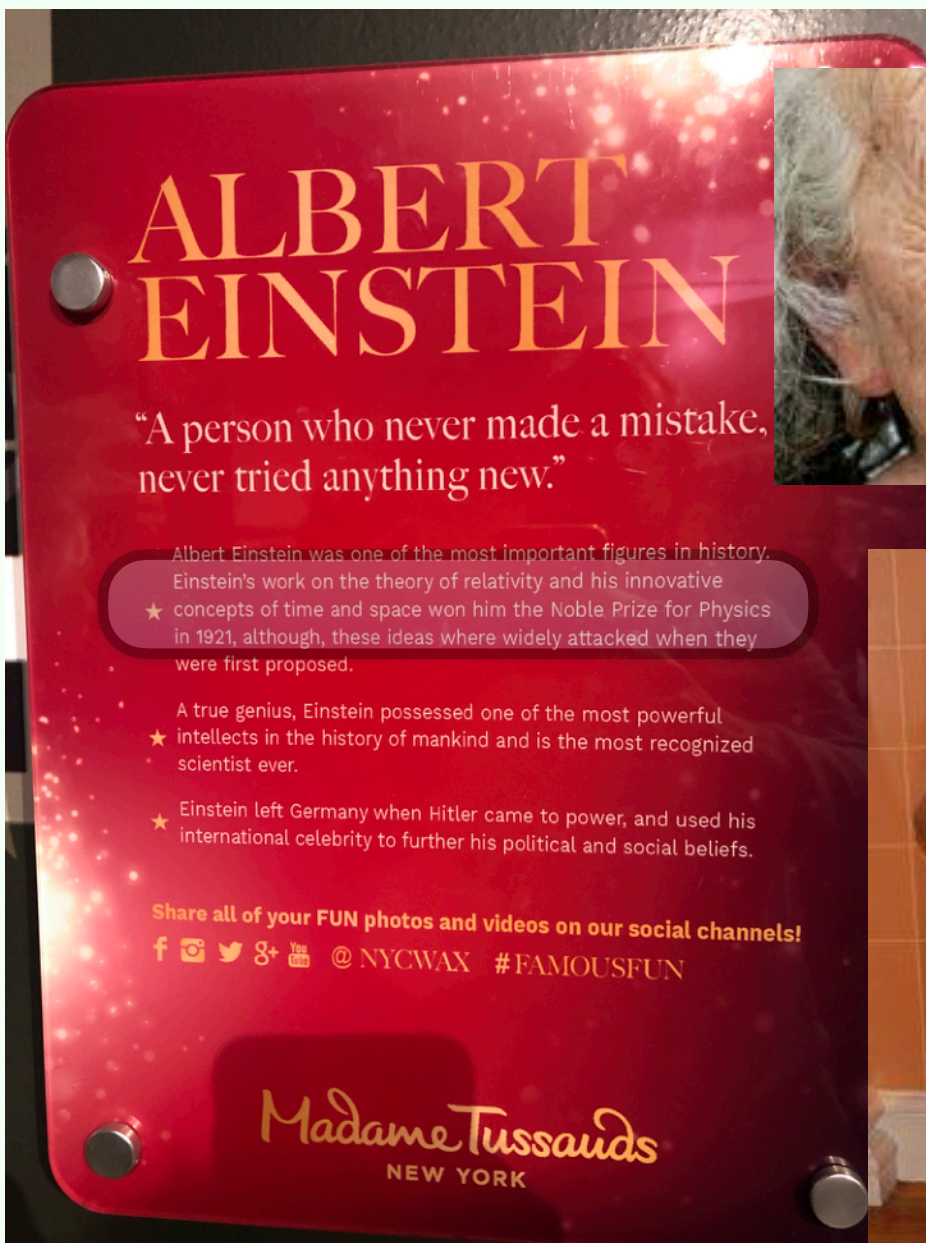
Early theoretical work on *Dark Energy* appeared in the 1950's

The physics of galactic rotation curves will be discussed at an upcoming DAS meeting meeting.

Chaos and Confusion at Madame Tussaud's

As part of a fact-finding trip to NYC, my wife and I visited Madame Tussaud's wax museum. *We found a critical error in the Albert Einstein plaque.* As all DAS members know from one of my lectures, Einstein's Nobel Prize was awarded for the theoretical explanation of the photoelectric effect, NOT for the special and general theories of relativity!!!

We immediately notified the Staff and were assured that appropriate measures would be taken.



Astrophotos by AP-SIG & DAS Members

Narrow-Band Images of the Pelican Nebula using the SHO Color Mapping (aka the “Hubble Palette”) as well as a More Natural HSO Mapping

by Bill Hanagan

The following 2 images of the Pelican Nebula (IC5070) were produced from data acquired jointly with Rick Spencer. This is the “First Light” Image from Rick’s new observatory and it was made from data acquired just 32 days after ground-breaking.

In narrow-band imaging, image data is acquired using several filters which reject most of the visible spectrum and pass the strongest emission line(s) of one or more gaseous elements commonly detected in emission nebulae. H-alpha (656.28 nm, red), SII (671.6 nm, red), and OIII (500.7 nm, blue-green) data is commonly obtained, since these emissions are often significant in many types of emission nebulae and their distribution across the nebula can vary substantially.

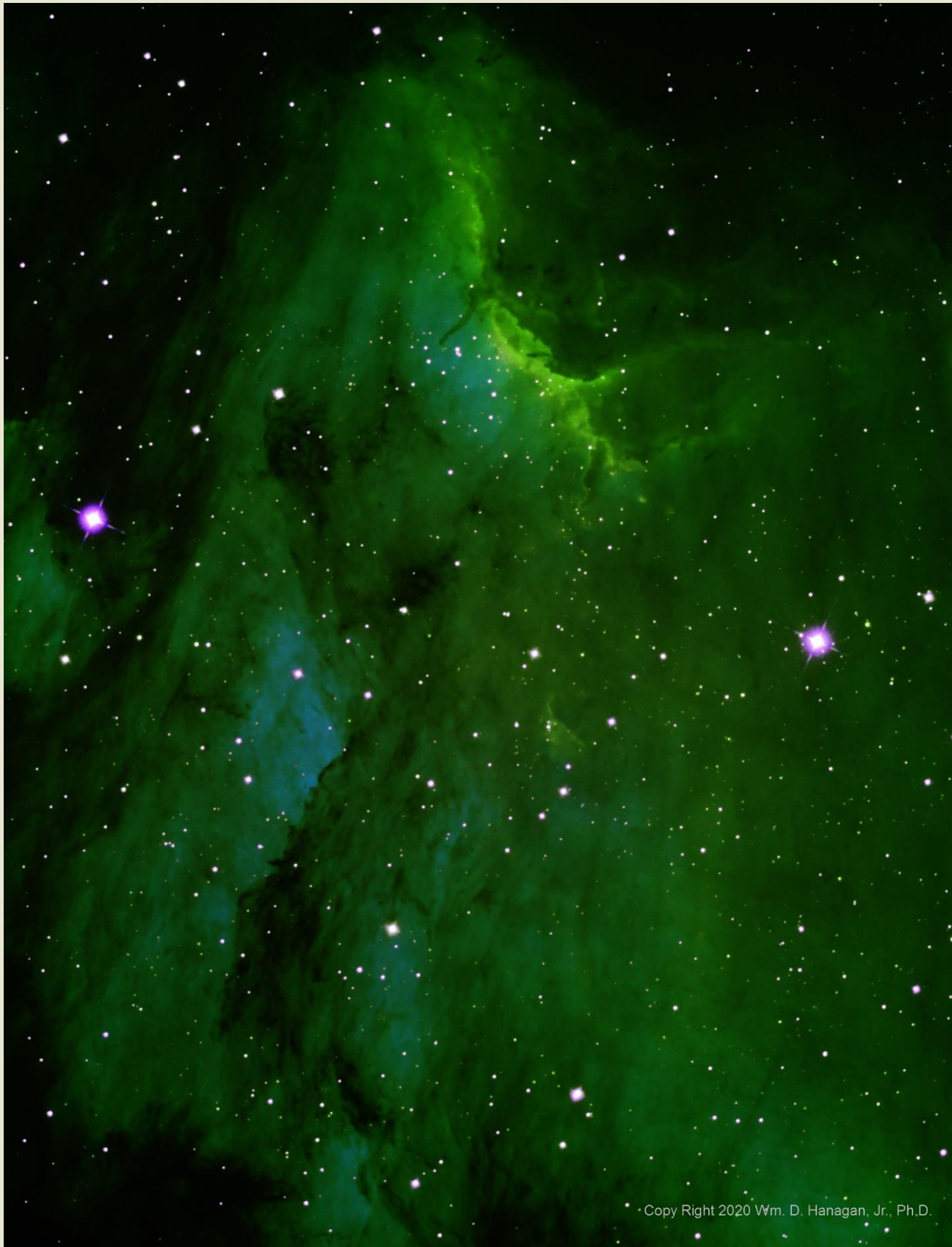
In processing narrow-band image data, you need to decide how to map the data into the red, green, and blue channels of the color image you are producing so that the viewer can recognize the parts of the object where each element has its peak emission. If possible, which it isn’t always, it’s nice for the end result to have a somewhat natural look. When only H-alpha and OIII data are obtained, a natural look can be obtained using the HOO = RGB mapping, since H-alpha data goes into the red channel, which is color appropriate, and OIII data goes into both the blue and green channels, which is also color appropriate because OIII emission is blue-green in color. You’ve seen this on my East Veil and Western Veil images from earlier in the year.

However, when you bring SII or NII emission data into the mix, you’ve got a problem: both of these wavelengths are slightly deeper red than H-alpha. If you combine the data from all red emission lines into the red channel, there will be no color differentiation between the different emission sources, which is something you want to see. That’s why NASA scientists came up with the so-called “Hubble Palette” where SHO = RGB. That is, SII is assigned to red, H-alpha is assigned to green, and OIII is assigned to blue. This is all

about “color shifting” to make what’s going on easier to see, as explained by Joe DePasquale from the STScI at the June DAS meeting. Achieving truly accurate color hues when you’re only sampling 3% of the visible spectrum is not really in the cards no matter how you map the emission data.

The Pelican Nebula image on the right was processed

using the Hubble Palette / SHO color mapping.



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The areas that appear blue show where OIII emission is at its maximum, while the yellow-green areas at the back of the Pelican’s neck and near the center show where SII emission is at its maximum. The peak SII areas are not bright red because the H-alpha

signal is very strong in the same areas and the blended colors have yielded a yellow-green color.

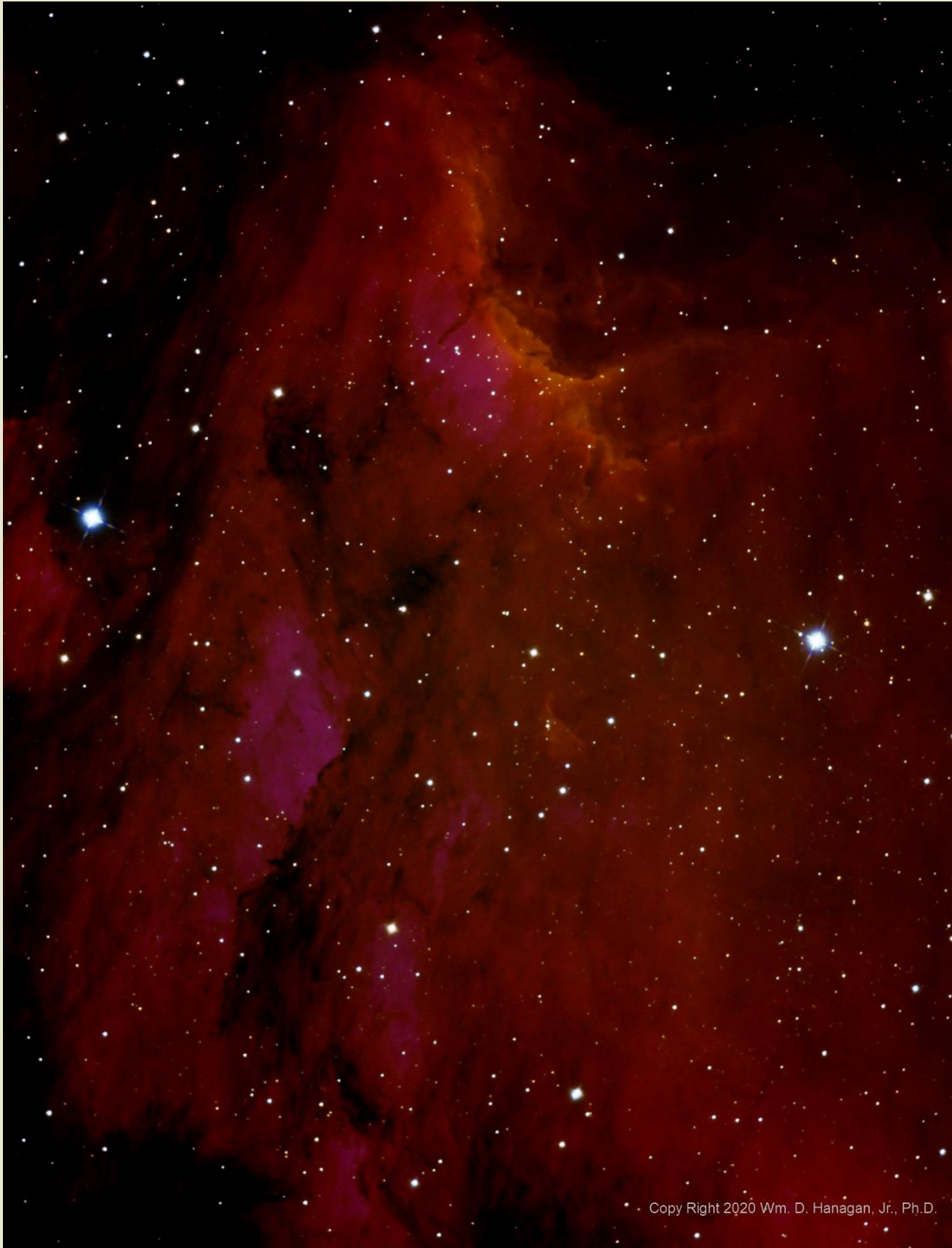
The image to the right, is the “HSO” mapped version of the same image.

Mapping H-alpha to red yields a more natural overall appearance for the vast majority of the nebula.

The yellow-orange areas show where SII emission is at its highest, while the purple areas show where OIII emission is at its highest.

The SII and OIII channels in

both of these images were more aggressively stretched than H-alpha to make their peak emission areas visible.



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How the Pelican Nebula Image Was Produced

The filters used to produce the component images of the Pelican nebula all had 3 nm band-passes which cover about 1% of the visible spectrum, which runs from 400-700 nm. By using filters that tightly restrict the range of wavelengths from which image data is acquired, the emission from the target nebula can be captured with a transmittance over 90% while nearly all of the harmful sky background from moonlight and light pollution is rejected. This allows narrow-band image data to be acquired with great success on nights when the moon would otherwise work against the photography of faint deep-sky objects. Using narrow-band filters also eliminates light pollution as a serious detriment when imaging emission nebulae.

Narrow-band imaging is described in greater detail at the link below.

<https://starizona.com/tutorial/narrowband-imaging/>

It should be noted that the data for this image was obtained on nights when the moon was 50%-72% illuminated! This image is another demonstration of the fact that, with narrowband imaging, you don't have to wait for a moonless night to do astrophotography!

Data Acquisition Details for the Pelican Nebula

- Total exposure time: 4 hours (1 hour each for H-alpha and SII, and 2 hours for OIII)
- Sub-exposures: 10 minutes each, dithered and guided
- Date and Site: 11/24/19, Rick Spencer's Observatory
- Sky conditions: clear, with occasional thin clouds and 72% lunar illumination
- Optics: 10" Takahashi CCA-250 with an 0.72 focal reducer, operating at 890 mm and f/3.6 (f/4.4 based on the amount of light blocked by the central obstruction)
- Telescope mount: Astro-Physics AP1100GTO with CP4
- Imaging Camera: QSI-683wsg8, with off-axis guider (OAG), operated at -10C
- Guiding camera: Starlight Xpress Ultrastar, mounted in the OAG
- Software: Windows 10, ASCOM, Astro-Physics Command Center (APCC), Cartes du Ciel (SkyChart), Nebulosity4, and PHD2

Image Processing Details for the Pelican Nebula

I did all of the image processing in PixInsight 1.8. The most important processing steps are described sequentially below. Combined words like “ImageCalibration” and “StarAlignment” are not typos—they denote specific PixInsight Processes and Scripts that were used to transform the raw data into the intermediate “master” images and eventually into the final image.

- All sub-exposures were calibrated against a single master dark frame made using 24 x 10 minute dark frames.
- Blink was used to inspect the individual frames. Some of the OIII frames were dropped due to horizon limits being reached.
- StarAlignment and ImageIntegration were employed as usual to produce separate Ha, OIII, and SII master light frames.
- The maximum shift of any image for each of the 4 edges was determined using Blink. DynamicCrop was used to remove the affected pixels from both master light frames.
- DynamicBackgroundExtraction was used separately on the H-alpha, OIII, and SII masters.
- The MureDenoise script was used on the linear master frames to reduce noise. Thanks go out to Mark Mitchell for calling this script to my attention!
- LinearFit was applied to the H-alpha, OII, and SII masters to balance the relative brightness of all three.
- The H-alpha, OIII, and SII masters were given a preliminary stretch with HistogramTransformation before being mapped into the RGB image.
- The H-alpha, OIII, and SII masters were combined using PixelMath according the SHO and HSO mapping schemes to produce the two different RBG images.
- A final stretch was performed using CurvesTransformation.
- MultiscaleLinearTransform was applied to the final images to further reduce background noise.

--Bill Hanagan

From Ryan Gilbert—Australia Starscapes, #1, #2, & #3



Australia Starscape-1
The Pinnacles Desert in Western Australia was a great stargazing spot. Although the cloud cover was 50%, a long exposure revealed a full starscape. Instead of continuous arcs like typical long exposures of the night sky, I got a sky full of dashed lines as clouds came and went. I'd prefer continuous arcs, but I was only in this location for a single, partly cloudy night. I used flashlights behind the camera to the left and right to provide low-level continuous lighting of the foreground pinnacles. This photo

is mostly unedited except for the image stacking. Camera: Nikon D610. Lens: Rokinon 14mm @ f/4. Stack of ten 4.5-minute exposures.

Australia Starscape-2

You can tell I was in the southern hemisphere for this one. The Large and Small Magellanic Clouds are bright overhead. Each is a nearby galaxy to the Milky Way, distorted from gravitational effects. The third galaxy in this photograph is the "back side" of the Milky Way itself, streaming diagonally across the sky. The core is well below the horizon, but even this side had enough detail to catch my attention. The skies were partly cloudy, but this stack of 14 images helped ensure that each part of the sky was visible at some point during the exposures. I lit the foreground with low level continuous lighting from a flashlight. Processing was done in Lightroom and stacking/blending was done in Starry



Landscape Stacker. Camera: Nikon D610. Lens: Rokinon 14mm @ f/2.8. Stack of fourteen 30-second exposures.



Ryan Gilbert, cont'd

Australia Starscape-3

Orion is high and bright above the Pinnacles Desert, albeit upside down. The brightest star in the image is Sirius, and the Pleiades are on the left edge. I light painted this scene with a single headlamp, running behind rocks and shining the light around from different locations. The skies were partly cloudy, but shooting and stacking multiple images back-to-back ensured that the majority of the sky was clear for at least one of my fourteen exposures. Preprocessing was done in Lightroom, stacking/blending was done in Starry Landscape Stacker, and editing of the light-painted foreground was done in Affinity Photo. Camera: Nikon D610. Lens: Rokinon 14mm @ f/2.8. Stack of fourteen 30-second exposures.

From Ron Worden

Flaming Star Nebula (IC405, SH 2-229, Caldwell 31), an emission and reflection nebula in the constellation Auriga.

Date: 1/01/2020

Location: W75° 40' 43.04" N39° 34' 39.7"

Telescope: ED102CF Refractor + .8x Focal Reducer F/5.6 , FL 571mm, Guide Scope 60mm Prime Luci Labs
Mount: Losmandy G11 Guided with Dithering

Cameras: SBIG ST2000XM + ZWO174 autoguider(+/- 1 arcsec)

Temperature: 37°F cooled to -10°C

Filters: L,Ha,Oiii,Hb

Exposure: 21LF-300sec .sub frames (1.75hrs.)(6L,5Ha,6 Oiii,4Hb) 6L in L



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NGC 7380 - The Wizard Nebula in Cepheus— Jarrod Bieber



Imaging Telescope: Sky-Watcher Pro 80ED APO Refractor
Imaging Camera: ZWO ASI 1600MM Pro
Filters: Astrodon 1.25" 5nm HA, 3nm OIII filters
Mount: Celestron AVX
Guide Camera: Orion SSAG
Image Acquisition Software: Sequence Generator Pro, SharpCap Pro
Post Processing: PixInsight
Exposures: 110 3-minute subs in HA, 92 4-minute subs in OIII (11.6 hours of total integration)
Dates: Nov. 2, 2019, Nov. 25, 2019, Dec. 21, 2019
Captured from my front yard in Middletown, DE

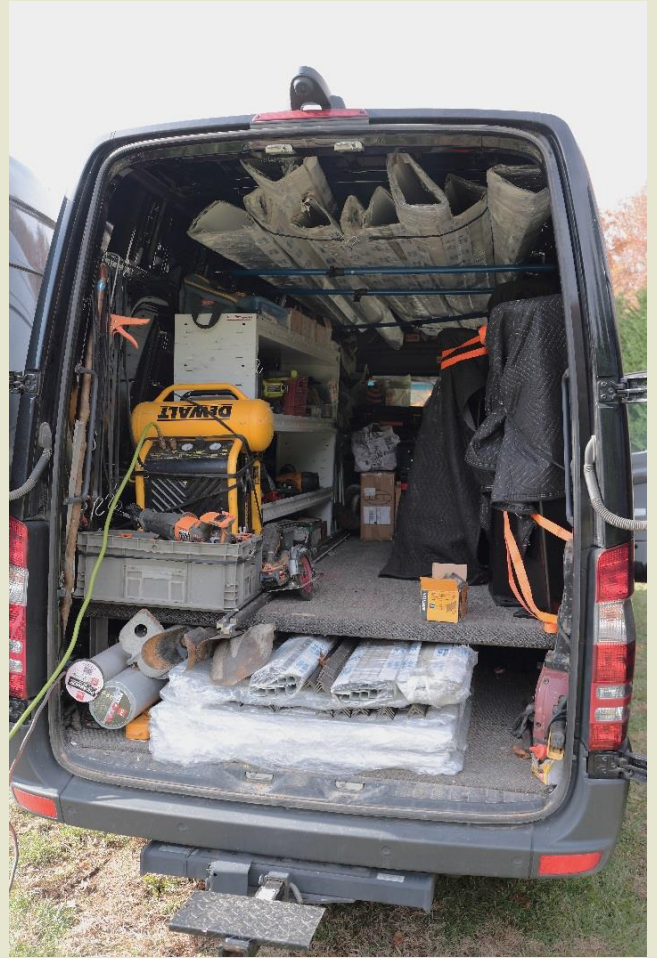
The Construction of Rick Spencer's Observatory

by Bill Hanagan 1/16/2020

Ground breaking for Rick's Observatory took place on October 23, 2019 when the concrete work got underway. I described some of the key aspects of the concrete work in the November 2019 AP-SIG meeting report. For anyone who is interested in the process of building an observatory, I thought I would continue that discussion here with photos and comments on the second phase of the construction, the building of the observatory structure itself.

I helped Rick with planning the construction of his 15'6" x 15'6" observatory and created multiple CAD drawings for the concrete and conduit work as well as the floor plan.

On November 9, 2019, Scott and Diane Horstman of Backyard Observatories (BYO) rolled into Rick's driveway ready to build their 296th Astronomical Observatory. They brought all of the special hardware and tools for building the observatory in their van (right). Lumber, doors, and windows were delivered to the site by a local building supply company, who left everything at the top of the driveway rather than at the construction site 200' away in Rick's back yard. So, Scott and Diane began by hauling most of the lumber down to the construction site. Rick and I also pitched in to help them for a few hours, since this extra effort was not anticipated. The photo below shows most of the lumber which was used, including the sheathing. Siding and roofing were brought down later.



The photo to the right shows the east wall under construction. It was clear from the start that Scott and Diane knew exactly what they were doing and the order in which it needed to be done.



The original slope of the land would have had about 16" of concrete exposed at the closest corner in this photo, though that would not have been a problem because the monolithic concrete pour runs > 36" below grade on all sides. To further improve drainage, the soil level was built up around the edges of the observatory using the dirt removed during excavation.

The walls are set square and most of the sheathing is attached before raising the walls. Temporary "A" frames are used on each free-standing wall to hold it plumb.



Several gray PVC conduits for AC power and control cables terminate inside the footprint of the walls. 1.5" conduit was used to run data / control cables from the walls to the telescope piers and 1" conduit was used to route AC power to the observatory walls and from the observatory walls to the piers.

From the breaker box to the observatory, the AC power conduit had to be buried 20" below grade to satisfy local code. Within the observatory, the AC power lines running under the concrete also had to be kept at least 3" below the top surface of the concrete. For maximum protection, the conduits running below the concrete were all embedded in the gravel layer below the 6" concrete pad. To minimize the noise induced on control cables, the AC conduits and control conduits were separated by several inches and shielded control cables were used.

Notches were cut and knocked out of the treated lumber sill plate for the conduits that needed to start or end in the wall cavities, as seen in the photo to the right.



The 1" conduit proved to be more than large enough for the AC power lines both in terms of code requirements and the ease of running the wires. The 1.5" conduit for the control lines proved to be a good compromise in terms of size versus the ability of the concrete workers to place larger conduits inside the wall footprint, but an even larger conduit for control cables would have been nice.

Each of the two telescope pier bases is 16" in diameter, runs 36" below grade, and is isolated from the concrete floor by a 3/4" gap.



In the photo above, the AC power conduit for the telescope pier comes up at the center of the pier base. The larger conduit for the control cables comes up just outside of the pier base on the north side where it won't be in the way. Originally, we hoped to have the control cable conduits come up just inside the perimeter of the concrete pier base, but there was too little free space available for that. Also, only one end of the control cable conduits leading to the pier bases could be positioned precisely and it was more important to get the end coming up into the wall in exactly the right spot. A 1/2" variation in where the control cable conduit comes out of the floor is not critical in this situation.

A conduit for Ethernet or fiber optic data cables entering the building was placed in the north wall of the observatory to make a hard-wire connection to the Internet possible. Rick's home Wi-Fi network seems to be making a reliable connection despite the considerable distance from his home, probably because nearby homes are even farther away and there are no intervening structures to block the signal, just shrubbery.

The west wall can be seen in the photo below, with the J-bolts for the two telescope piers visible through the double-door opening in the center. The door was placed to allow a future warm room to be built inside, just to the left of the doorway. No window was placed in the wall section to the right of the door to keep the sun's heat from warming the area around the second telescope pier in the late afternoon and evening.



In the next photo, the north wall of the observatory waits to be sheathed, erected, and tied into the east and west walls. The tree line visible to the south blocks the sky from about 14 to 20 degrees above the southern horizon.



At right, Diane Horstman can be seen finishing the construction of the gantry onto which the roof is rolled to open the observatory. All of the exposed structural wood is treated lumber. The exposed wood trim on the observatory is cedar.



The photo on the right shows the “Smartside” pre-primed siding being nailed into place. The siding will eventually be painted a light color to minimize heat penetration into the building. The siding and exposed wood won’t be painted until late spring to allow all of the wood to dry out.



The photo below is a view of the observatory from the east. Rick’s back yard is a very pastoral setting and his observatory was placed behind the swimming pool and behind an evergreen hedge so as to be nearly invisible from his house.



The photo on the right shows the construction of the roof. Just above the walls in the dark horizontal space you can see the grooved wheels at the base of the roof. The wheels are mounted in two inverted u-shaped wood channels that act as the base of the roof. The roof was kept



attached to the walls by the temporary diagonal brace in the center of the photo until it was complete.

Note that this roof design uses only two trusses, one at each gable end. The weight of the roof is carried to those trusses by over-sized purlins or joists running the entire width of the roof. This roof design maximizes headroom below the roof. Note also that the roof is fully decked with OSB to make it rigid enough that the roof can be moved when force is applied to only one side of the roof.

The photo to the right shows the roof rolled partially off. The hinges for the fold down sections of the south wall are visible on the right and one of BYO's Omega-1 telescope piers can be seen bolted to one of the two concrete pier bases.



This photo shows the lap joint where the gantry beam is tied into the corner studs of the observatory walls. The bolt on the right secures the axle of the first grooved wheel on which the roof rolls. An inverted rail made of angle iron sits below the grooved wheels and is screwed down along the top of the east and west walls and extends over the gantry beams.



The roof is opened and closed using the geared-down AC motor seen below, which uses a rack and pinion arrangement. Note the silver grooved roller partially visible just to the right of the motor. Limit switches stop the motor when the roof reaches each end of its travel.



At right, you can see the outside of the south wall of the observatory with the roof closed.

The metal roofing used was “Polar White” made by North Star Metals. A very light colored metal roof like this helps to minimize heating of the observatory, which helps to preserve the seeing.



The two framed rectangles at the top of the south wall are mounted on interior hinges and designed to flip in and down inside the observatory, as seen in the photo below of the interior south wall. This “fold down south wall” allows telescopes in the observatory a lower southern horizon.



There are two pieces which fold down separately. When in the up or closed position, simple latches at the center and sides keep the fold down sections locked in place.



Above, the nearly complete observatory can be seen with only minor interior work remaining. We'll have to get a better shot after the grass grows back.

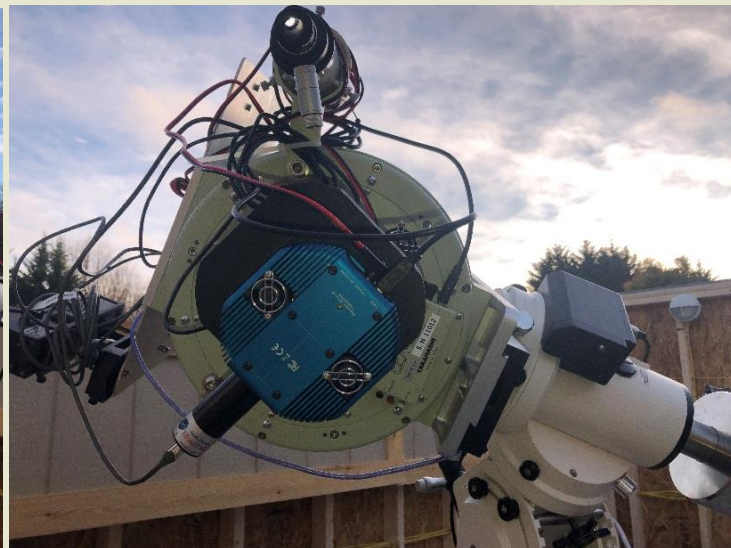
At right, Rick, Diane, and Scott pose for a group shot in front of Rick's completed observatory on November 12, 2019.

Rick and I moved his Astro-Physics 1100GTO and Takahashi CCA-250 into the observatory on November 16 and acquired the first data from the observatory on November 24.

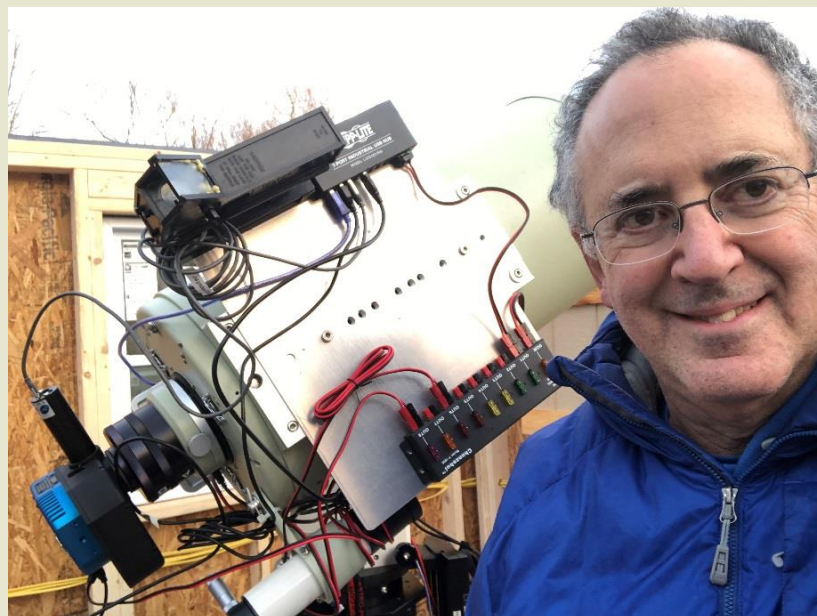
In all, it was only 32 days from ground breaking to the first night of image acquisition, 8 days of which was waiting for good weather. Of course, it took some preliminary groundwork to make the project proceed as quickly as it did.



Here are some photos taken by Rick from behind the scope to show the horizons, with the scope pointed southeast, south, west, and north, respectively. The distance from the scope to the walls along with the height of the scope were carefully planned to keep the walls from degrading the horizons.



And, finally, here's a selfie from Rick to wrap things up.



Beginners Astronomy Class!

Have you always wanted to be “in the know”?

Are you confused about which end of the telescope to put a lens cap on?*

Then this is for you—and the cognoscenti will learn as well!

Organized by Todd Beckley

Hi All,

I've volunteered to organize a beginners astronomy class for new members or current members looking to learn more. At the moment it will be just for members but, depending on attendance, we may open it up to the public. We were thinking about doing this in the spring. The general idea would be 1 night a week for 4 weeks at Mt Cuba.

At this time I'm looking to see who would be interested in attending as a student and what they would like to learn from the class. I'm also looking for those who would be interested in teaching and what information they can offer.

Please email me directly if interested and include any comments or questions you may have.

Thank you,
Todd Beckley

*both

Did you know?...*another way to contribute to the DAS*

The Delaware Astronomical Society is a registered charity under AmazonSmile. Amazon donates 0.5% of the price of eligible smile.amazon.com purchases to the charities selected by customers. If you are making Amazon purchases and want to see a portion of your purchase price donated to DAS please use the link below

Delaware Astronomical Society's unique AmazonSmile charity link: <https://smile.amazon.com/ch/23-7281900>

Do you believe 0.5% couldn't matter?
Think again!

From: Mary Poppins;
extolling the virtues of small
investments



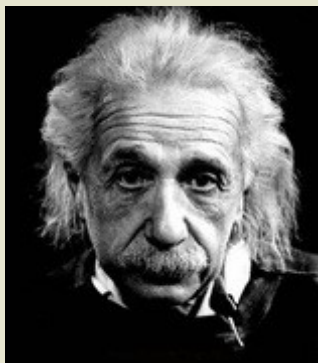
Fidelity Fiduciary Bank

If you invest your tuppence
Wisely in the bank
Safe and sound
Soon that tuppence safely invested in the bank
Will compound
And you'll achieve that sense of conquest
As your affluence expands
In the hands
Of the directors
Who invest as propriety demands

You see, Michael, you'll be part of...
Railways through Africa
Dams across the Nile
Fleets of ocean greyhounds
Majestic self-amortizing canals
Plantations of ripening tea

All from
Tuppence prudently, thriftily, frugally
Invested in the...
To be specific
In the Dawes, Tomes, Mousley, Grubbs
Fidelity Fiduciary Bank

DAS Loaner Equipment



“Be a loner. That gives you time to wonder, to search for the truth. Have holy curiosity. Make your life worth living.”

The DAS has several telescopes that are designated for loan to members. Our advice to new members is to take any of these telescopes out on loan so you can learn the advantages and disadvantages of the various designs.

- 80mm Celestron Refractor with a NexStar GOTO mount. (On loan from Bill McKibben)
- Meade ETX 90mm Special Edition
- Bushnell Voyager 4” tabletop scope (AstroScan clone)
- Three Dobsonian scopes: two with 6” aperture, one with 8” aperture. This style scope is very easy for beginners.
- Meade 8” LX-10 Telescope: This 8” Meade LX-10 Schmidt Cassegrain Telescope (SCT) is a good loaner if you have any thoughts about buying an SCT telescope on a GoTo fork mount.

Procedure for DAS Members to Sign Out Loaner Equipment

1. **Inform:** Please inform DAS Observatory Chair via e-mail -- this is currently how all loaner equipment is being logged/tracked. (email below)

2. Borrower email to include:

- a. Your name and contact information (cell #, email, home number, etc.)
- b. Date equipment borrowed
- c. Description of all equipment being borrowed
- d. Estimated return date for each component borrowed
- e. List any damaged/missing components (if applicable)

3. **Damage:** If the equipment is damaged while you are borrowing the equipment, please notify the DAS Observatory Chair in a timely manner.

4. **A sign out log** will be posted in the near term to compliment the email notification. **NOTE:** Currently DAS Loaner equipment is **only available for loan to current DAS members.** (Which is a great excuse to join DAS)

Thank you,
Chris Horrocks
DAS Observatory Chair

DAS AMATEUR TELESCOPE MAKING SPECIAL INTEREST GROUP

Bill Hanagan

The DAS Amateur Telescope Making (ATM) Special Interest Group (SIG) is made up of DAS members who get together to work on their own as well as club related telescope making projects. We get together at times and locations appropriate for whatever projects are currently underway.



The general range of activities of the ATM SIG includes all manner of telescope making including Newtonian mirror making, the testing of complete telescopes as well as individual optics, and the making of telescope accessories. In the past, we have made several Newtonian telescope mirrors from scratch and completed some mirrors that members brought in as works in progress, including one that was started in the mid-1960's! We've also made new telescope tubes, made secondary mirror holders, tested numerous telescope objectives, made wire spiders for Newtonian secondaries, and made many solar filters for telescopes and binoculars. We also completed the refiguring of the DAS 17.5" Newtonian mirror used in the Big Dob currently housed in the Sawin Observatory.

If you're interested in telescope making, feel free to email me and let me know what you're interested in doing at hanaganw@verizon.net and include your name, address, and phone number. I'm always glad to provide some guidance and information to other telescope makers.



Images taken before and after adjustment of the Hubble Space Telescope *using methods fully endorsed by the ATM SIG.*

From the Desk of: Robert Trebilcock, DAS Treasurer

It is time to renew Delaware Astronomical Society 2020 Annual Membership Dues

November 1 is past--time to renew DAS Dues!

Delaware Astronomical Society 2020 annual membership dues were due November 1.

Dues remain \$30 for the 2020 calendar year.

Dues remain \$30 for the 2020 calendar year.

There are several payment options:

1) You can bring cash, check or money order for \$30 made out to DAS to the Tuesday meeting November 19. I will be available at the meeting to collect any payments.

2) You can use your PayPal account to send payment to DASmtcuba@gmail.com

3) You can pay with PayPal using the link below; you don't need to have an account with PayPal, just a credit card.

https://www.paypal.com/cgi-bin/webscr?cmd=_s-xclick&hosted_button_id=NDGKG4CWCX8GU

4) You can mail payment to:

Robert Trebilcock
DAS Treasurer
3823 Rotherfield Lane
Chadds Ford, PA 19317

If you know that you don't want to rejoin, let me know, and I will stop sending reminders, but we *really, really* want you to continue with DAS!

If finances are a barrier to rejoining, let me know confidentially, and we will find a solution.

If you believe that you have already paid your 2020 dues, send me an email at trebilcock@aol.com and we will try to figure out what happened.

Think of the many benefits of being a member of the Delaware Astronomical Society!

We have telescopes including eyepieces and collimating equipment for your use. You will have access to an array of telescopes for loan or for use in the Sawin Observatory at Mt. Cuba. The most recent purchases are a solar scope, and the Orion HDX110, which can be used for observing or for astrophotography, depending on your interests. If you know nothing about astrophotography, no problem, we have people eager to teach you how to do it. There is a special interest group in astrophotography that meets monthly.

If you want to build a telescope of your own, we have members who are expert and who are willing to show you how to do it. We have books in our library that explain the concepts.

If you are a beginner, you will have help in Greg Lee's "What's Up in the Sky", so that you will know where to look for interesting objects that month and we have added mini talks to the monthly meetings on basic astronomy concepts geared to beginner astronomers.

If you want help with finding objects in the sky, come to our star parties, formal and informal, to get some help with using your telescope. You can also borrow a club loaner scope or just come and enjoy the sharing of views through several scopes.

If you have a problem with your equipment, we meet informally every Tuesday night to share discoveries of new equipment, solve problems, chat and observe. Come out on Tuesday nights to find members who can help you problem solve. Let us know in advance what you would like to work on or which problems need solved, or what interesting things you would like to try.

If you want to be more involved, let one of the Board Members know!
We need people with diverse interests!

There is something for everyone in the DAS, so be sure to send in \$30 for dues soon to help improve the amenities of the club even more.



Medieval astronomers favored clubs—you should too!

How to Join the DAS Groups.io Group

DAS FORUM / E-MAIL SITE ON GROUPS.IO

This is an e-mail service, online forum, and information sharing service for use by DAS members and our astronomy enthusiast friends. To Subscribe to the service, just send an email to: DAS+subscribe <at> groups.io. Then we will compare your name/ email to our lists to make sure that we know you, and if so, we will approve your subscription. If you are not currently a member of the DAS, we strongly encourage you to join.

That is all that you need to do to get into the system. You don't even need to setup an account. But if you want to have more control over how you receive messages from the group or if you want to use the more advanced features, then head over to the website <https://groups.io/login> after you are approved for the DAS Group and you can log in to make any changes you like.

For more information about our group click this link:

<https://groups.io/g/DAS>



**Io, the highly volcanic innermost moon of Jupiter, after which the .io groups were named (I presume)
—RGS**

New Members Form

Please make checks payable to DAS, print out the following form and mail to:

Robert Trebilcock, DAS Treasurer, 3823 Rotherfield Lane, Chadds Ford, PA 19317

DAS Membership costs \$30 per year, which renews November 1st. We pro-rate membership based on when you join, as follows:

Month Joined	Cost	Renewal Due
Jan-Feb	\$30	This November
March-May	\$20	This November
June-Aug	\$10	This November
Sept-Dec.	\$30	Next November

NEW MEMBERSHIP FORM

Item	Cost	Sub-total
Membership	\$30/20/1	
Astronomy Magazine	\$34	
	total:	



Name _____
Email Address _____
Street Address _____
Phone Number _____
City _____ State _____
Zip _____
How did you hear about
DAS? _____

For questions, contact Robert Trebilcock, DAS Treasurer at (610) 558-1637 (leave message) or by email New Members

Please see the [How to Join page](#) on our website for methods to become a dues-paying member. If you have any questions call any of the member representatives listed.

If you're just joining us for the first time, THANK YOU VERY MUCH, and WELCOME to the DAS! It's GREAT to have you with us!—Rob L.

to Trebilcock@aol.com

DAS Contacts

Please call or email us with any questions or for more information!

Officers:

President: Rob Lancaster, rlancaste AT gmail DOT com

Vice-President: Jeff Lawrence, (302) 668-8277, jef.law76 AT gmail.com

Secretary: Bill McKibben, billmck21921 AT gmail DOT com

Treasurer: Bob Trebilcock, trebilcock AT aol DOT com

Board Members at Large:

Bill Hanagan, (302) 239-0949, hanaganw AT verizon DOT net

Tom Harding, hardintw AT aol DOT com

Dave Groski, groski AT udel DOT edu

Standing Committee Chairs:

Observatory: Chris Horrocks

Education: Vacant--*are you interested?*

Library: Maria Lavallo and Sue Bebon

Observing: Greg Lee, (302)252-7806, greglee288 AT gmail DOT com

Publications: Rick Spencer, rgspencer AT ymail DOT com

Other Positions:

Amateur Telescope Making Special Interest Group: Bill Hanagan, hanaganw AT verizon DOT net

Astronomical League Coordinator: K Lynn King, klynking AT verizon DOT net

Astro-Photography Special Interest Group (AP-SIG): Bill Hanagan, hanaganw AT verizon DOT net

Awards Chair: Amy Hornberger, aehornberger AT gmail DOT com

DAS Book Club Leader: Amy Hornberger, aehornberger AT gmail DOT com

Elections Chair: Sidney Ocampo, gegocampo AT yahoo DOT com

Programs Chair: Jeff Lawrence, jef.law76 AT gmail.com

Webmaster: Rob Lancaster, rlancaste AT gmail DOT com

