The Observer

The Official Publication of the Lehigh Valley Amateur Astronomical Society
https://lvaas.org/
https://www.facebook.com/lvaas.astro
October, 2019
Volume 59 Issue 10

Sky above the tent at the Black Forest Star Party, September 27, 2019. Imager: Frank Lyter.

Cover image: **The North American Nebula NGC 7000 in Cygnus, by Frank Lyter. Imaged from Pulpit Rock Astronomical Park during LVAAS's annual MegaMeet 2019 with assistance from imager Dave Moll, using Deep Sky Stacker, Nebulosity and Paint Shop.**

ad astra**

Some people might say that there hasn't been a good science fiction movie since *2001*, which came out in 1968. Or maybe they would say since 1968, which is when *2001* came out? Either way, the future was an awful long time ago.

Most of my friends would probably say April, when *Avengers: Infinity War* was released. I guess superhero movies are technically science fiction, but they don't quite fit my definition. Since at our September meeting we were privileged to host one of my favorite authors, SF writer Michael Flynn, I'm going to go off on a tangent about written science fiction in the form of novels.

My dad read SF (*not "Sci-Fi"!*) when I was a kid. At some point I started reading his paperbacks, and I was hooked. I cannot remember the first one I read; it might have been one by Isaac Asimov, Arthur C. Clarke, or Robert Heinlein, all of whose names were mentioned at the meeting. I really think it might have been *A Trace of Memory* by Keith Laumer. Its eerie imagery is still vivid to me with a feel that seems like it was formative.

Or maybe it was *They Shall Have Stars* by James Blish. I have a memory of my Dad, sitting in his rocking chair, telling me that he was reading a book about men building a bridge out of ice on Jupiter. The steadily escalating scale of this series of books took my breath away. *A Life for the Stars*, the second in the series, begins with the entire city of Scranton, where I was born and grew up and learned to love SF, preparing to wrench itself from the Pennsylvania soil and go off roaming around the galaxy, as usual in search of a fix for its desperate economy. The series goes on for two more books and the stage just keeps getting bigger and bigger.

In the *Cities in Flight* series, with the right engine you could go faster than the speed of light, and the bigger your vessel the faster you could go. Like any genre of fiction, SF has its rules, and each sub-genre has more specific rules. These were an example of "hard" SF, in which some extension or modification of the known laws of physics might be postulated, but they would still be laws of physics, imposing an algebra of capabilities and limitations on the characters and their gadgets. Everybody knows that even if you can go faster than light, you still can't exceed roughly Warp Factor 9, and that it takes a pretty special "bucket of bolts" to make the Kessel run in 12 parsecs.

Going faster than light, so you could hop in your ship and swing by Remulak and still make it home in time for Christmas, is almost certainly the most popular natural-law fiddle in SF. Interstellar travel is such a hallmark that it gets thrown into stories that don't depend on it, just for color, like "attack ships on fire off the shoulder of Orion." There are lots of other options, but for me, there have to be rules to make it work. Such as, you can't read someone's mind without squinting real hard while holding their head like it was a bowling ball; or maybe you can do it from a few feet away, but it gives you a massive headache. Or it gives them a massive headache. You can go back in time but only if you were really always already there. Stuff like that. (To me, it kind of defeats the literary purpose that you need to make Bruce Banner genuinely angry in order for him to create several hundred kilograms of well-toned bone, muscle, and sinew our of — what, the vacuum energy? Complete disregard for fundamental physics, but then throwing in some psychic padlock that needs to be picked, just seems lazy to me.)

In hard sf, the laws of nature are taken seriously, even if they are modified a little bit. There are some really wonderful stories in which even minor tinkering is ruled out, in favor of generous extrapolations in technology. Most of the tech advances imagined in SF will be, or have been, surpassed by real life sooner than we imagine

I'm thinking of 23rd-century Mr. Scott scoffing at the Macintosh computer, that could not respond to his spoken commands even when he yelled them directly into the mouse. Maybe all he had to do was to say "Alexa!"

One good example of this "really hard" sub-genre is *Incandescence* by "Greg Egan." ("Greg Egan" is a name associated with one of the most amazing minds in the universe, but nobody knows what "Greg Egan" looks like, or even the preferred pronoun of "Greg Egan." I think there is room for another sub-genre of stories about the true nature of "Greg Egan." Whatever; I am down to read anything with that name on it.) In *Incandescence*, nothing goes faster than light, and people don't live much longer than we do, at least not all at once. They do have some amazing technology that lets them put the living part of their lives on hold for a while, and other stuff that makes it possible for them to travel the galaxy, all without violating any of the laws of physics that we understand today.

I have read a ton of great SF since discovering Dad's paperbacks, as well as some that was fair to mediocre. The really good stuff helped ignite a passion for science and technology that led to many of the best things in my life. I'll finish up by mentioning a few more good books.

In a recent conversation with some friends, we agreed on two of the best books to recommend to new readers. One that most people have heard of is *Dune*, by Frank Herbert, the source matter for a weird David Lynch feature adaptation, as well as a Sci-Fi Channel miniseries that was pretty good, and another two-part movie reboot which is expected to debut about a year from now. The spice movies must flow! You should just read the book, really. Herbert milked the franchise for five sequels, the merits of each of which at first seemed less than the last; but on finishing the final one I decided that the whole was greater than the sum of the parts after all.

The other is *The Mote in God's Eye* by Larry Niven and Jerry Pournelle. It's a brilliant and colorful tale of humans, expanding throughout the galaxy, and suddenly discovering that they are not as alone as they thought; and of the unique dilemma presented by the fascinating aliens that they encounter.

Niven and Pournelle were already two of my favorite writers when they collaborated on *Fallen Angels* with Michael Flynn, our September speaker. My most recent read was Flynn's *Eifelheim*. This is an example of another sub-genre, which uses the devices of SF to let us see ourselves in a new way; in this case, a wonderful village of 14th-century feudal Germans through the multi-faceted eyes of some stranded extraterrestrial grasshoppers. That Mr. Flynn is a consummate scholar of the Middle Ages, as well as astronomy and space exploration, is as obvious from this novel as it was from his LVAAS talk. I loved *Eifelheim* for bringing the period to life even more than for its traditional SF content.

If you enjoy books but are one to scoff at science fiction, I think you should give it a chance; there is a huge spectrum of SF, with great stuff to satisfy almost any taste rooted in general fiction. If you don't like books, but love science and technology, it's possible that some good SF will change your mind. And if you have never read anything but SF, in that case you ought to branch out a little, once in a while! But just be aware that the universe of science fiction is vast. I really believe that there are more good science fiction books already published than any of us could read in a lifetime, and more are coming out every month.

Ad Astra!

— *Rich Hogg*

LVAAS General Meeting: Public Welcome!

Sunday, October 13, 7:00 p.m.

South Mountain Headquarters, 620B East Rock Road, Allentown PA

Program: "The History of Celestial Cartography - The Evolution of Art and Science in Early Printed Star Charts and Atlases"

Presented by **Ray Harris**

Ray Harris is a former LVAAS Director and an LVAAS member since 1985. Ray has been studying and collecting antique star charts and atlases for 30 years. he will take us on a tour of the art and science depicted by the craft, explaining the evolution of celestial cartography from the earliest days of printing to the present.

Minutes for the LVAAS General Meeting - September 8, 2019

The September 2019 LVAAS General Meeting was held on September 8th at the LVAAS facility at South Mountain in Lower Saucon Twp. Attendance was approximately 50 people. Director Rich Hogg opened the meeting at 7:07 p.m. The speaker was Michael Flynn, a prolific science fiction author who has written more than 70 stories and articles, as well as 15 novels and story collections. He received the Robert A. Heinlein Award for his body of work, and the Sturgeon prize for the short story House of Dreams. His most recent work is the collection Captive Dreams, six interlinked stories dealing with issues of morality and technology. Michael lives in Easton, PA with his wife, Margie.

His presentation was entitled "The Great Ptolemaic Smackdown and Down-n-Dirty Mud-Wrassle," concerning the transition from the geocentric to the heliocentric model of the solar system. He covered this topic in a nine part(!) series on his blog, but pared it down to an hour for us. The transition required new math, new data, more new math for the new data, new kinds of data, new physics, and proof. What seems obvious to us now, was not obvious 500 years ago. Back then, obviously, the Earth didn't move, since we did not fall over, the Moon did not fly off into space, and everything else can be seen to move. Early proponents of the heliocentric model liked it for the wrong reasons: Fire is a nobler element, the center is a nobler position, so the Sun should be in the center! How to prove it? Prior to the invention of the telescope, the only tools available were theodolytes, quadrants, globes, etc. The instruments of the time were not sensitive enough to measure any of the motions one might select, e.g., rotation of the Earth under objects shot up into the air, parallax of astronomic objects, or corriollis effect on objects dropped from high towers.

In the 11th and 12th centuries, geometric optics were discovered (mostly for spectacles, but eventually led to telescopes), along with concepts of relativity (if the Earth was moving, it would affect our ability to measure the movements of other objects) and impetus (the force moving a body stays with that body until acted upon by friction, paving the way for Newton).

Initially, astronomy was studied primarily to set calendars for religious observances (like Easter or the Hadj,) and horoscopes (astrology, and as an aid to navigation - important once Europeans began to leave the near shore and Mediterranean waters.) Ptolemy's geocentric model used circular orbits with equants and epicycles (which, unbeknownst to him, approximated the elliptical orbits we now know the planets follow,) allowing him to predict the motion of the planets, eclipses, etc.

With the Renaissance came a polymath: Copernicus. His heliocentric model still used epicycles, which however still insisted on circular orbits. Some people liked this model because it elevated the Earth to the third level of Heaven. Copernicus made very few observations of his own, instead relying on the Alfonsine Tables, a collection of data that wasn't so precise to begin with, but had been hand-copied so many times that many errors had crept in. Enter Tycho Brahe, a Danish astronomer who set up an observatory and built instruments that allowed him to make measurements with errors as small as the width of a quarter a football field's distance away!

Brahe favored a hybrid model: the Sun revolved around the Earth and everything else revolved around the Sun. The next big step was when Brahe hired Johannes Kepler and assigned him the job of sorting out the problems with Mars' orbit. Of the 6 planets known at that time, Mars had the most eccentric orbit. He tried several models and corresponded with Fabricius, speculating on an "oval" (elliptical) orbit. Kepler also suggested that the planets might appear to speed up and slow down because they actually do! (Everyone had previously assumed uniform speed for all celestial bodies.)

Eventually, he tossed out circular orbits, epicycles, equants, and uniform motion in favor of elliptical orbits with the Sun at one focus. He also concluded that all the planets had a single cause for their motion, paving the way for Newton and gravity, but empirical proof was still needed, and the discovery of the telescope provided the means to obtain that proof. Mountains and craters became visible on the Moon, moons were observed orbiting Jupiter (objects that orbited something other than the Sun or the Earth,) sunspots (imperfections on the Sun,) the phases of Venus (only possible with a heliocentric model.)

For many people, the nature of the model was unimportant, so long as it predicted correctly. A model that contradicted religious expectations could simply be called a mathematical convenience, not a representation of the "real world." Kepler's data predicted transits of Mercury and Venus across the face of the Sun, and Galileo and Kepler linked the ocean's tides to the orbit of the Moon. The new physics that was required was eventually developed: objects fall at the same rate, independent of their weight, and acceleration due to gravity was first estimated. Both sides of the debate were still able to refute the others claims, with the exception of the inability to detect any parallax in the stars. In 1678, Newton published his Universal Law of Gravitation, and everyone was using Kepler's easy to use data tables. Finally, in 1806, parallax was observed for Vega. In 1820, Settele published "Elements of Optics and Astronomy" and met the church's criterion for proof of the heliocentric model, the acceptance of which also resulted in the lifting of the ban on Galileo's work.

The talk was very well received with a Q&A followed by a break from 8:28 p.m. to 8:52 p.m.

Rich called the meeting to order and Gwyn Fowler proceeded with the introduction of new members.

First readings:

- Bret Begovich: Lives near the South Mountain HQ, graduated from DeSales with a degree in Chemistry and works at B Braun. Recently engaged and has lots of young cousins.
- Marrissa Burns: originally from Pottsville, 2010 graduate of PSU, also works at B Braun Medical Devices in Post Marketing Safety Surveillance. Involved in Davinci Science Center's Women in Science & Engineering (WISE) program. An admitted "super novice" at astronomy.
- Greg Wirtz: retired, has had many jobs (Geophysics, software). BA in astronomy. Looking to dust off his skills and is curious about our facilities.

Second reading: Jennifer Craig. She is now a full member of LVAAS, entitled, among other things, to obtain keys to the facilities and be trained on and use club equipment.

The business meeting was officially opened at 9:04 p.m. in order to discuss and vote on the **2020 proposed budget**. The budget had been distributed to the membership via email before the meeting. There was no further discussion. Ron Kunkel made a motion to approve the 2020 budget, which was seconded by Fred Bomberger, and unanimously approved by the members present.

Nominations: Bill Dahlenburg presented the current slate and asked for any additional nominations (there were none.) A motion was made by Tom Duff to close the nominations, seconded by Terry Roszhart, and unanimously approved. **The finalized slate is: Director - Rich Hogg, Asst. Director - Tom Duff, Treasurer - Scott Fowler, Secretary - Dennis Decker (assisted by Kelly Craig.)**
A motion was made by Ron Kunkel to close the business meeting, which was seconded by Priscilla Jacobsen, and unanimously approved.

Library - Dave Raker reported there are more books/videos for sale. He also asked for suggestions for more materials to purchase.

Astroimaging - Tom Duff reported the first meeting of the season will be on Sept. 12th at 7:00 p.m.

Star Party - Carol Kiely reported that there was a Star Party the previous evening, Sept 7th, and that the turnout was good. No one showed up for the 6:00 p.m. show, which was fortuitous, since the bulb had to be changed in the planetarium projector. The talk at 7:00 p.m. and the 8:00 p.m. planetarium show were packed. 45 cars were counted in the parking lot! There will be a meeting of all interested parties on Monday, Sept 9th, to discuss/troubleshoot any **issues with the projector**. The next star party will be the 1st week of October, **International Observe the Moon Night.**

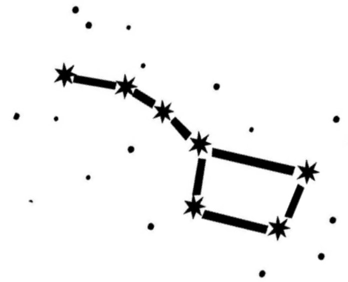
UACNJ rep Earl Pursell noted that they have a talk and star party every Saturday, so if anyone wants to do some observing or see their facilities at Jenny Jump State Park, they can go up there the three other weekends of the month.

The **Black Forest Star Party at Cherry Springs State Park** is the weekend of the 28th. Registration is full.

New member Jennifer Craig asked for suggestions regarding eyepieces she can use on club equipment. Bill Dahlenburg answered her questions.

The meeting ended at 9:19 p.m.

Submitted by Earl Pursell, Secretary



UACNJ provides free public programs at our Observatory in Jenny Jump State Forest from April through October on Saturday evenings. An astronomy presentation begins at 8 PM in the lecture hall regardless of the weather and is followed by stargazing on the observatory's telescopes until 10:30 PM, weather permitting.

UACNJ Weekly Talks for 2019

April 6	- What's Up in the April Sky?	- Lonny Buinis
April 13	- Size Scales of the Solar System and Beyond	- Jason Kendall
April 20	- Journey to the Stars	- Karl Hricko
April 27	- What Happened to Pluto?	- Ron Kunkel
May 4	- What's Up in the May Sky?	- Lonny Buinis
May 11	- Making Isaac Newton Proud: Modern Newtonian Telescopes	- Rob Teeter
May 18	- Astronomy for Beginners	- Ken Taylor
May 25	- Night Vision and Astronomy	- Earl Pursell
June 1	- What's Up in the June Sky?	- Lonny Buinis
June 8	- How the Stars Got Their Names	- Bill Murray
June 15	- The Life and Death of Stars	- Walt Windish
June 22	- Mars Through the Dust Storm	- Clif Ashcraft
June 29	- Eclipses, Occultations, and Transits	- Gregg Waldron
July 6	- What's Up in the July Sky?	- Lonny Buinis
July 13	- Fly Me to the Moon	- Sean Post
July 20	- New Rides to the Moon	- Dale Skran
July 27	- Let's Go to the Moon	- Karl Hricko
Aug 3	- What's Up in the August Sky?	- Lonny Buinis
Aug 10	- Astronomy for Beginners	- Ken Taylor
Aug 17	- New Horizons Visits Ultima Thule	- Michael Dean Lewis
Aug 24	- You Bought a Telescope, Now What?	- Paul Fischer
Aug 31	- The Milky Way Galaxy - Structure & Evolution	- Ron Kunkel
Sept 7	- What's Up in the September Sky	- Lonny Buinis
Sept 14	- Photographing Night Sky Landscapes	- Stan Honda
Sept 21	- Traveling in Space and Time	- Gary DeLeo
Sept 28	- Northern Lights	- Gregg Waldron
Oct 5	- What's Up in the October Sky?	- Lonny Buinis
Oct 12	- Introduction to Video Astronomy	- Bill Murray
Oct 19	- The Cosmic Distance Ladder	- Jason Kendall
Oct 26	- The Beauty and Power of the Universe	- Walt Windish

Street Address:
333 State Park Road
Great Meadows, NJ

More information and alternate directions can be found through our website

NATIONAL GEOGRAPHIC MapGuide Destination

www.uacnj.org

LVAAS SKY SURVEY

It's Sky Survey time! Now that it's getting darker earlier in the evening, we would like to collect some data on just how bright the lights of the Lehigh Valley are, and what affect they are having on our hobby. Beginning on the evening of our next General Meeting, October 13, 2019, and continuing for two months until December 13, we are asking that members and friends of LVAAS help the club gather sky brightness measurements in the area. The process will be totally on your schedule. There are no fixed times for measurement, but we'd like to have readings include times from just after dark (stars visible) to just before dawn breaking, for every night possible during the two-month survey period. So, if you decide you would like to help out, you can take as many readings as you would like, on as many or as few nights as you would like. We will compile the data and use it to bolster our arguments for lighting ordinances and light trespass controls across the region. For the purposes of this project we are defining the "region" as the local news coverage area of WLVT-TV, Channel 69.

So, you will need an iPhone or an iPad in order to participate. Unfortunately, Android phones will not work for this purpose because the cameras in Android phones are not standardized as those in an iPhone are, so there are no sky brightness metering apps available for Android devices. We apologize profusely to those with Android devices, but the circumstances are beyond our control. We are not happy about this, either, because it will very much limit the final size of our dataset.

You will need to purchase and install the Dark Sky Meter app by DDQ from the App Store. Unfortunately, the Dark Sky Meter app is not free, but it is only $1.99. Consider it a small donation to LVAAS! Once installed on your device you will use this app to take readings of the brightness of the night sky.

The process is very simple:

1. Using a microfiber cloth or lens tissue, wipe off the protective glass of your device's camera
2. Start the Dark Sky Meter app
3. Cover the camera and take a dark frame (press button 1)
4. Point the camera straight up at the sky (zenith) and press button #2 to take a reading
5. Enter the sky conditions
6. Either take a screen shot or write down the resulting SQM number
7. When the results are displayed, enter the sky conditions.
8. DO NOT PRESS the SUBMIT button
9. Repeat the process four more times, at an altitude angle of 45°, to the N, S, E, & W
10. Send your results to darksky@lvaas.org (DO NOT submit through the app), and include:
    a. Your location coordinates from the GPS in your phone
    b. The time you started each five-shot sequence
    c. The sky conditions you chose from the app drop-down menu
    d. The SQM number and the pointing direction for each shot.

You can take as many or as few readings as you like during the two-month survey period. And please, if you are a true "night owl", those late-late night readings will be very useful, because a number of "bright-light" sources (car dealers, athletic fields, and the like) are dimmed or out after 11pm or so. And readings don't have to be from your home. If you are out and about, and can take the time to get a set of readings, that would be very helpful, as long as you are located in our survey region.

We hope all of you iPhone users will decide to participate. Thank you in advance for helping us out!

------ SEND ALL RESULTS TO DARKSKY@LVAAS.ORG ------

Step 4 is to be done via email, NOT through the app. If you send your results through the app they will not be tabulated in this survey.

------ SEND ALL RESULTS TO DARKSKY@LVAAS.ORG ------

From the LVAAS Archives:

The Great 1939 Open House

by Sandy Mesics

The precursor to LVAAS, the Lehigh Valley Astronomical Society (LVAS) held an annual open house event in the late 1930s until interrupted by World War II. These events were a combination of a star party and a Mega Meet. Hundreds of people would show up at the West Allentown home of L.H. Cutten to view the skies using club members' telescopes.

The August 1939 open house was particularly memorable, according to LVAS Secretary Eugene Carl Jr., who wrote at the time: "On Monday evening, August 21, 1939 at 8 p.m. the Lehigh Valley Astronomical Society held it's yearly 'open house' meeting. Previous to this meeting there were four such events held. Two were held in 1937, one in 1936, one in 1938.

"This meeting, as usual, was held entirely out-of-doors at the home of our advisor, Mr. L.H. Cutten. Ten telescopes were erected on the lawn by society members. Mr. Ralph Schlegel also contributed his orrery for the event. This 'open house' event was undoubtedly the biggest and best our Society ever held. The evening was remarkably clear and the following objects of interest were viewed by the public: the Moon in first quarter, Mars, at its closest approach to Earth, Jupiter and his satellites, Saturn and its rings, and also several double stars and clusters. To add to the beauty of the night a clear display of aurora borealis was noted.

ALLENTOWN MORNING CALL, TUESDAY, AUGUST 30, 1938

Peeping at the Stars Through Huge Telescope

Locar star gazers were given an opportunity last night of getting a close-up of Venus, Jupiter, Saturn and the first quarter of the moon through the courtesy of the Lehigh Valley Astronomical society. The above photo shows a group of gazers gathered at the home of L. H. Cutten, 2815 Washington St., who was host at the open meeting. Mr. Cutten, wearing white cap, is explaining the working of the huge telescope to one of the gazers. Standing in back of Mr. Cutten is Eugene Carl Jr., president of the society.

Figure 1. Newspaper coverage of the 1938 Open House Event

“There were a total of three hundred and fifty seven (357) persons who registered for the event, but there were undoubtedly some persons who did not register which would have probably brought the figure to over four hundred. We were fortunate in having visitors from such surrounding cities and states as Philadelphia, New York City, Decker, Indiana, Akron, Ohio, and Hartford, Connecticut.
“We also had the pleasure of entertaining Mayor and Mrs. Malcolm W. Gross of our own city.

LVAS Open Houses

- October 20, 1936: 21 attendees
- June 15, 1937: 35 attendees
- September 9, 1937: 93 attendees (> 100?)
- August 29, 1938: > 200 attendees
- August 21, 1939: 357 attendees (> 400?)
- September 9, 1940: 74 attendees (cloudy)
- October 28, 1941: No record of attendees
- May 6, 1946: 129 attendees (> 150?)
- May 26, 1947: 50 attendees (> 100?)
- June 14, 1948: ≈ 100 attendees
- After 1948?????

People who were interested in getting a look at the stars began to use the telescopes at about 8:00 and from that time until about 11:30 p.m. people came and left the meeting. ... It was felt sure that all who attended had been satisfied with what we were able to show them of a splendid astronomical evening.”

It is likely that this was the largest open house in LVAS history, though there is no record of the number of individuals who attended the 1941 event.

References

The LVAS Bulletin, September, 1939.
LVAS meeting minutes, Meeting No. 40; August 21, 1939 “Open House”

Schlegel Observatory Report

by Rich Hogg – October 2019

This month: a major milestone, a revised plan, some engineering progress, and an epiphany.

Optics! **-** A few days before Labor Day we heard from our optician, Lockwood Custom Optics, that the figuring of our secondary mirror was complete. It would be shipped out for coating, and we should make arrangements to come and pick up our primary.

Those arrangements came together within about a day. On the morning of Thursday, August 29, our Assistant Director Tom Duff got in his pickup truck and picked up Secretary Earl Pursell and Pulpit Rock Maintenance Director Ron Kunkel, and they began the drive from Ron's house to the optics shop, over 700 miles away.

I guess Ron, Tom, and Earl (left to right, in photo) felt they really had to step on it in order to get the mirror loaded and make it back home on Friday! I spoke with them while they were on the road, stuck in a traffic jam on Interstate 70. We decided I would line up a crew to help unload the mirror on Saturday morning.

The response was good, but not quite good enough to make me fully comfortable that they would have enough help. My brother Blair was in Scranton with me, and I talked him into getting up early and hitting the road Saturday morning, so that we could lend our hands to the effort.

We arrived just in time for Blair to crawl into the back of the truck to help loop a strap around the crate. Ron was setting up his ramps. Something was said about carefully allowing the crate to slide slowly down the ramps. About a second later, everybody was checking to make sure that no toes got caught under the expensive, precision optical component, which once on the slippery ramps, had rapidly indulged its gravitational attraction to the thankfully soft ground. (From left: Bill Thomas, Blair Hogg, Tom Duff partially obscured by Ron Kunkel's back, and Earl Pursell.)

Next, Bill T., Tom, Ron, Earl, and Bill Dahlenburg prepared to tip the crate up on its side, so that it could enter the side door into the observatory building.

Here, we see Tom, Blair, Bill T., Earl, and Bill D. holding the mirror carefully to make sure that it doesn't spontaneously shoot into the building, or up into the sky. In another minute they rolled it over to the doorstep (on wooden rollers), and then tipped it up onto the observatory's first floor, and continued rolling it into its chosen storage corner.

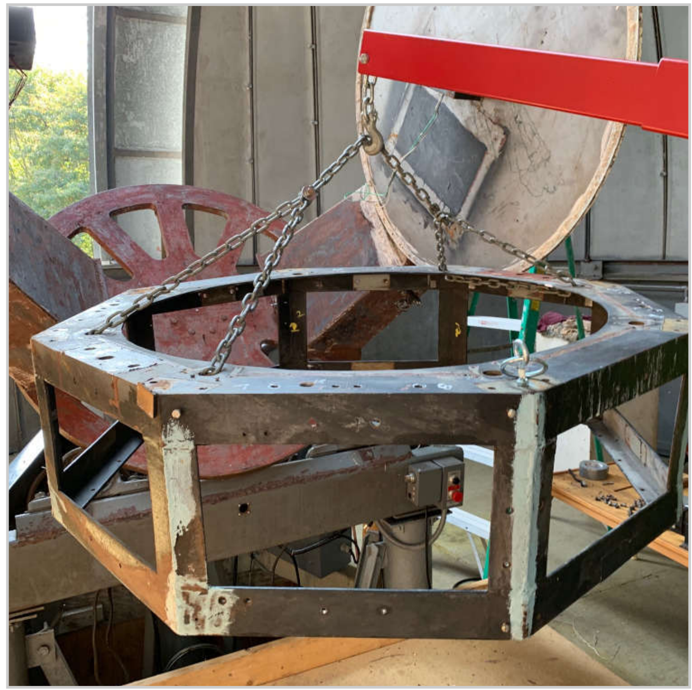
Photos by the author, except for the first photo, which was by Mike Lockwood. For the next step, tipping the crate back down to the horizontal position, the camera went into my pocket and I actually helped a little bit.

We had instructions to open the crate and remove a cover made of acid-free paper so that it was not resting against the aluminized surface. It was a blessing to have a good reason to open it up and gaze upon the finished product, because the appetite to have a look and take a picture was palpable. This massive piece of glass has traveled thousands of miles and suffered a long and complicated "chain of custody" since this project was begun in the mid-1980's. Now, it is finally a finished product, safely at rest in its intended home, and waiting for the rest of the instrument to be completed so that it can taste a view of the sky.

Andy Heilman, Bill Dahlenburg, Earl Pursell, Tom Duff, Peter Detterline and Blair Hogg are seen reflected in the finished 40" primary mirror in the Schlegel Observatory, now awaiting completion of the telescope. Photo by Rich Hogg.

Mike Lockwood made arrangements to have our secondary mirror coated. He now has an arrangement with Zambuto Optical Company, who manufacture fine mirrors for Newtonian reflectors up to 20", and have begun doing their own coating. The mirror is at Zambuto's and I already have a FedEx tracking number which will be activated when the mirror begins its journey back to us. (I will take delivery of it, and then open it and inspect it in the presence of at least one other LVAAS member.)

Slight change of plan - I had previously reported that we were done disassembling the telescope, and would begin rebuilding it once painting was complete. Well, since I wrote that, Pulpit Rock Observatory Director Frank Lyter informed me that we would remove the lower octagonal frame of the main mirror cell from the fork. Without doing this, we would find it difficult to paint everything, since the mirror cell and the fork fit closely and it cannot easily be rotated to expose all of the surfaces.



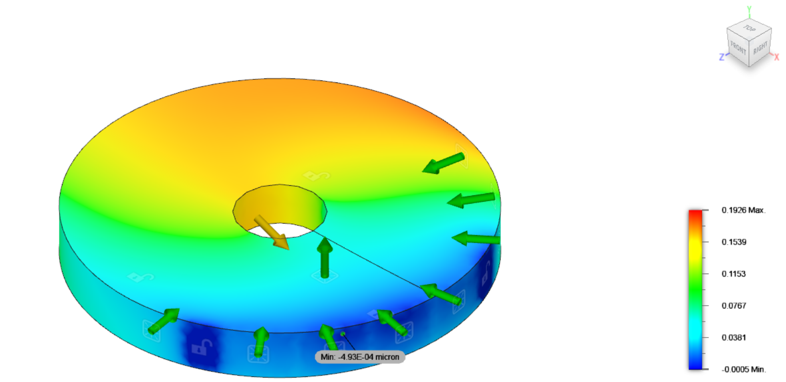
An examination of the design convinced us that it would be fairly easy, and I built a quick 3D model of the frame in Fusion 360 and allowed it to calculate the weight. The answer it came up with was almost exactly 150 pounds. Frank and Ron met at Pulpit Rock while I was home, writing the first part of this column, and completed this disassembly step in about half an hour.

Andy Heilman has been continuing his efforts at stripping the old paint, some of which you can see more clearly in the above photo. Thanks again, Andy, for your dedication to this job! Now he has easier access to some parts that he was not able to get to before.

Mirror support engineering - last month I mentioned that I was looking at some alternatives for supporting the mirror in the radial (or side-to-side) direction. The existing axial support, the airbag that lies under the flat side of the mirror, continues to look like a good solution. I still have not converged on a recommendation for the radial support, but I'm getting closer.

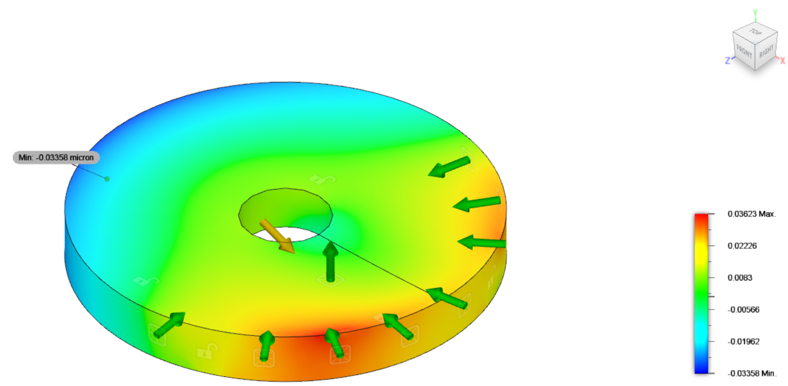
I built a fairly realistic 3D model of an edge support system using 16 airbags, along with 4 hard supports. The model only has half of the system, which is all that are used at any one time. Two hard supports are needed to precisely locate the mirror, and the airbags are needed to take some of the weight off the hard pads and "even out" the support. (I am hoping we could get by with 12 airbags, but for this experiment I wanted to try a superior configuration.)

The next figure shows the deformation of the mirror with the gravity vector (the orange arrow) rotated 70 degrees, simulating the telescope being pointed 20 degrees above the horizon. The pressure (represented by green arrows) in the main axial airbag is reduced to 0.18 psi, and 6 of the edge bags have 2.2 psi. (The ones at either end don't really do anything to support the mirror in this orientation; if filled, they would just squeeze it from either side). The shading on the mirror indicates the calculated deformation in the X direction, which is towards the edge that is on the downward side.

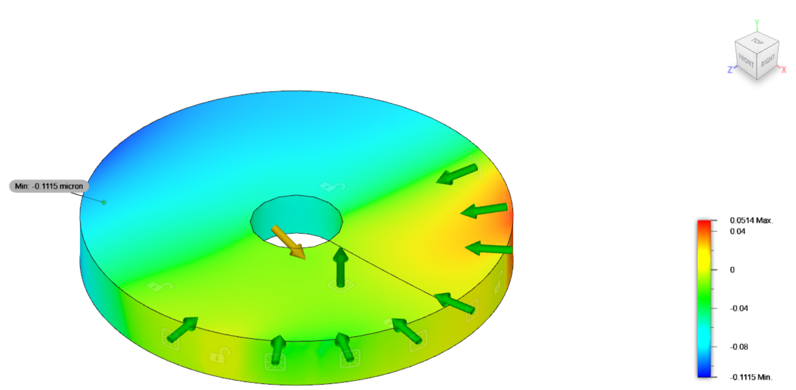


The maximum deformation is at the top edge of the mirror; it is compressing towards the bottom by about 200 nm. This isn't terrible because its effect on the wavefront is reduced by the slope of the mirror's figure. It's a bit asymmetrical because I have chosen to model an orientation in which the hard pads are not symmetric with the direction of tilt. (The hard pads are at the locations with wider spaces between the green arrows.)

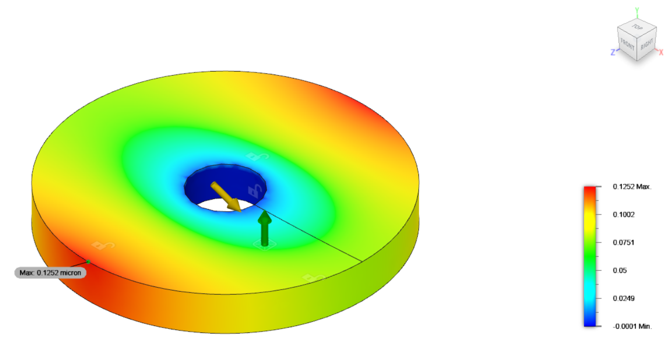
In the same simulation, we can view the deformation in the Y direction, which is axial. This deformation directly impacts the wavefront, since it is perpendicular to the direction in which the light is traveling. But there is only about a 70 nm peak-to-peak difference in the deviation.



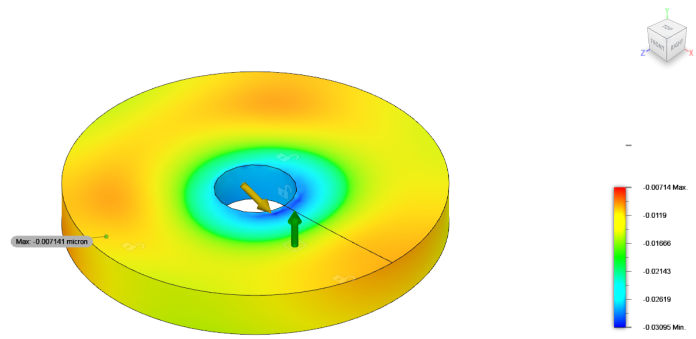
For completeness, here is the Z deformation, or horizontally across the face of the mirror. Mostly, we see the lower right side of the mirror being squeezed in a little, again causing only a very small amount of wavefront error. These results could probably be improved a bit with some tweaking of the pressures, but I think they already show that the airbag edge support system would perform well enough.



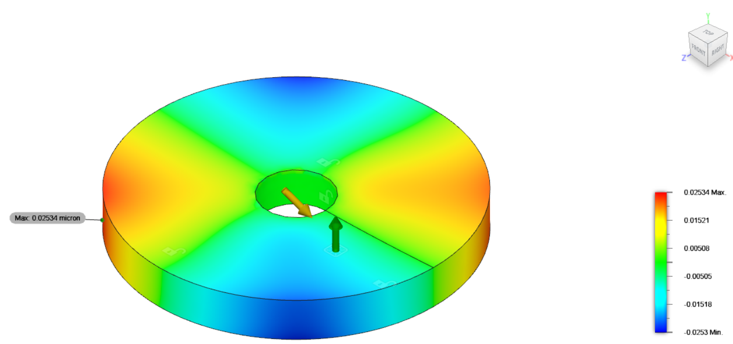
I mentioned in last month's column that I was looking at another option. Here I will show the results of a somewhat idealized model of a central hub support for the mirror. Where the edge support is like carefully cradling a doughnut, standing on edge in the curved palm of your hand, this is like just hanging it through the central hole on your thumb. But, it seems as if it might actually perform better.



As shown in the figure, the Y-direction deformation is a maximum of about 125nm, on either side of the hub. This is significantly less than what we saw with the edge support. In addition, it is mostly perpendicular to the slope of the mirror's figure, so its effect on the wavefront is even less. (Where the Y deformation in the edge support case was reduced like the effect of distance on altitude while walking up a shallow slope -- you might walk 10 feet horizontally but only change your elevation by 1 foot, which is what counts -- in this case, in the location of the worst of the already reduced deformation, we are walking across the face of the slope and the effect is even less.)



I also think the amount of deformation is lower simply because the maximum distance of the unsupported glass from the support is lower. The Y and Z deformations look very good also, although the Y looks like it would be even better with a tiny bit more pressure in the axial airbag; the imprint of the three axial hard pads are showing through a little bit.



In addition to performing better, the hub support is easier to build and a lot more compact, freeing up a lot of room in the mirror cell, around the edge of the primary. But assuming we decide to go this way, my plan will be for us to try to hedge our bets by leaving that space uncommitted. Just in case we have made some mistake in our analysis, it would be nice to have room to add an edge support if we find we need it down the road.

This is an idealized model of a hub support, and it will probably not look quite as good when I replace it with a realistic model. There is a reason I haven't done that yet. Figuring out exactly how to build that structure has not been trivial, because I am concerned about thermal stress. The Schott Duran glass that the mirror is made of should expand 3 parts per million for each Centigrade degree of temperature increase. On the other hand, the various types of steel that we might use to fabricate the support hub expand by anywhere from 12 to 17 ppm, and aluminum is even worse. Fusion 360 has the capability to analyze thermal stress, and I set up one quick simulation in which I placed a close-fitting tube with a 1/4" steel wall into the central aperture of the glass at -18°C, and evaluated it at 50°C. The contact pressure between the steel and the glass was around 800 psi! I fear if we did something like that, we might open up the scope after a warm day and find our expensive mirror split into at least two pieces by the expanding steel hub. Obviously we will go to great lengths to avoid that.

I was thinking about one easy fix, which is to include a layer of some compressible material, like rubber, between the steel and the glass. As the steel expanded, the rubber would readily compress, resulting in a much lower increase in pressure on the glass. The problem is that the rubber would also compress from the weight of the mirror, allowing it to move slightly as we tilt the telescope, affecting the critical alignment between the primary and the secondary. We've already determined that we would like to hold the misalignment to around 20 thousandths, ideally, or 50 thousandths worst case, and our truss, even with the improvements we've made, is likely to use up a good fraction of that 0.02". I thought, if we have to add that to the shifting of the mirror on the hub due to compression of its cushion, we might exceed our misalignment budget...

And Then! A Revelation Occurred.

I stopped in my tracks as I realized something really cool. These two problems do not add, they subtract! The truss mostly deforms under gravity load like a big parallelogram, allowing the secondary to shift linearly towards the downward side of the telescope. At the same time, the cushion I am proposing would allow the primary to shift linearly towards the downward side of the telescope. Theoretically, we may be able to get these two problems to cancel out!

There is a precedent for this, which is a concept first invented in 1935 for the Palomar 200-inch telescope: the Serrurier Truss. The idea was to have two truss sections extending in opposite directions from a central support, such that their deflections under gravity would cancel each other out. In our case, we are considering a small ring of compliant material instead of one of the truss sections, although we ought to (and will) also consider the deformation of the "mirror cell" structure as part of the equation.

This idea just came to me a few days ago, and I am excited to get working on it. We don't have the manpower or the experience that the Palomar team had, but the software tools we have are far superior to their methods; so I am optimistic that we can get a great result. Stay tuned!

StarWatch

by Gary A. Becker

© Gary A. Becker – beckerg@moravian.edu or garyabecker@gmail.com
Moravian College Astronomy - astronomy.org
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Ad Astra: Atypical of Space Adventures

If you are expecting the flash and bang of a Star Wars movie or conquering the difficulties of a new world as witnessed in The Martian, then ***Ad Astra*** isn't for you. Not to say it doesn't provide for some tense moments and action sequences, but they are few and far between. Mostly it gives the audience a more realistic view of the perils of space travel that includes other dangers besides aliens and predators.

It is about Major Roy McBride's (Brad Pitt's) epiphany to understand the key ingredient that makes humanity human. Set in the near future, the Earth is in peril, being blasted by an unknown source of gamma ray bursts called "the Surge" which is destroying the solar system's commutations infrastructure. Military assets have determined that the signals are coming from Neptune, possibly from the considered destroyed Lima Project sent to the outermost planet to search for extraterrestrial life. The entire crew thought to be dead was commanded by Clifford McBride, Roy's father, (Tommy Lee Jones), who in his zeal to be successful at any cost abandoned his family 32 years earlier for the mission. After decades of unsuccessful results, McBride's rebellious crew wants to go home, but they are killed by a captain gone mad who will stop at nothing to be victorious. Roy McBride, equally driven and unable to connect with humanity because of his father's abandonment, is first sent to contact Clifford from Mars where the last functioning communications station exists, then steals passage on the ship deployed to destroy the project.

Everything goes horribly wrong right from the blastoff. The three-man crew is killed by Roy McBride, and he finds himself alone voyaging to Neptune to confront his father and to end the Lima Project. Throughout the movie Roy is wrestling with his own inner monsters—the loneliness of space, abandonment, the inability to connect with anyone in a meaningful fashion, and the intense physical isolation from everyone on Earth. On the outside Roy McBride is the most successful astronaut in the space program. He appears serene, normal and functioning, but on the inside, he gives the viewer a glimpse into the dark "landscape of his mind" through voiceover monologues which get horribly realistic. The feature film asks us deep questions about our choices, our careers, our concepts of success, and our innermost fears.

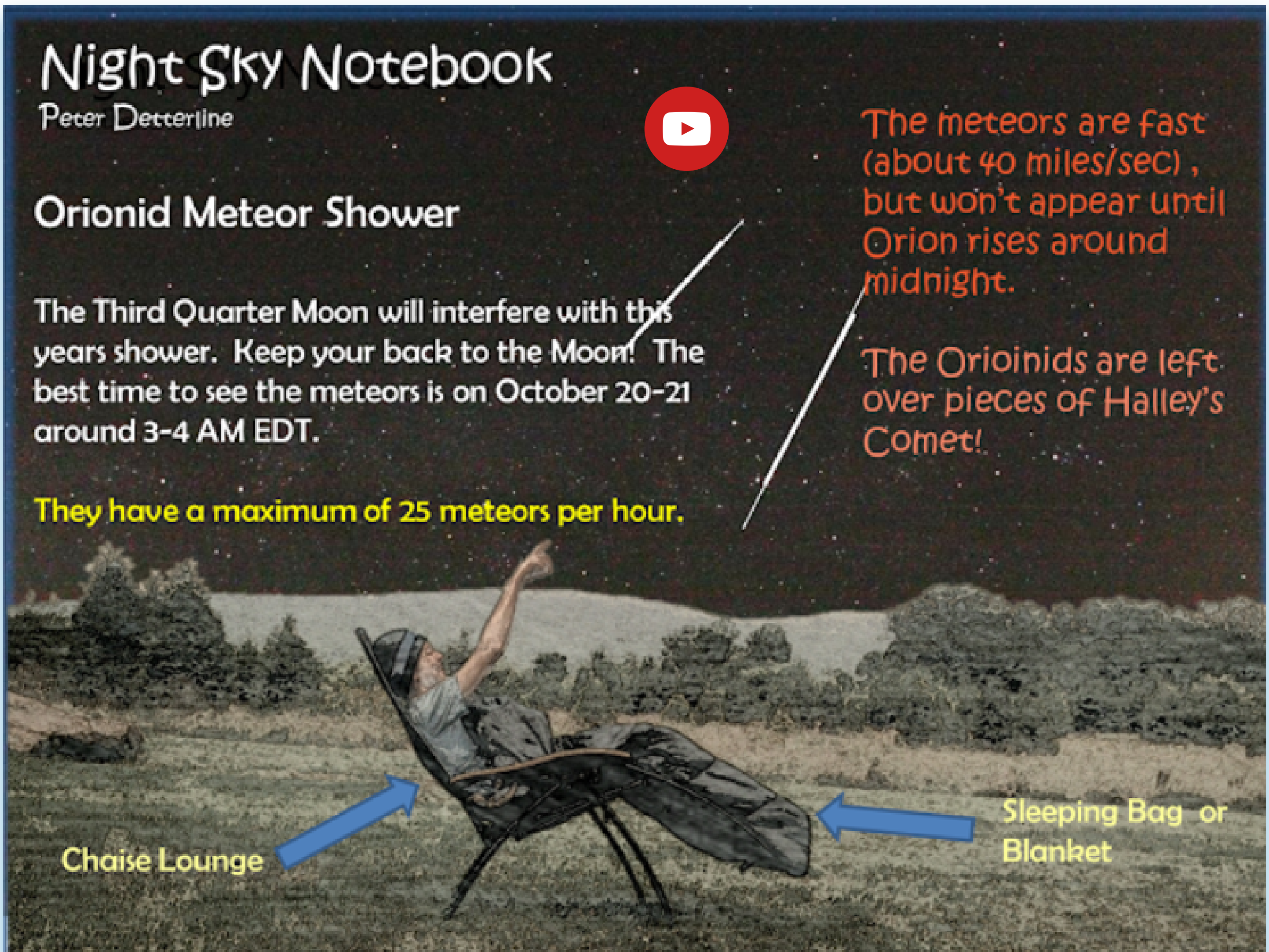
In the end McBride meets his father, then leaves him go physically and spiritually before destroying the project and returning back to Earth. Human beings are complicated and fragile and aren't composed of just a corporeal essence. There is a rich spiritual dimension that, if ignored, no amount of productivity can compensate or balance. On the long voyage home McBride begins to understand how his life must be shaped if he is not meant to embrace the fate of his father. There is hope, but it is muted against the vast and lonely landscape of space.

Ad Astra challenges us to be more thoughtful in a world where shades of grey cloud the easy black and white decisions that most of us seek.

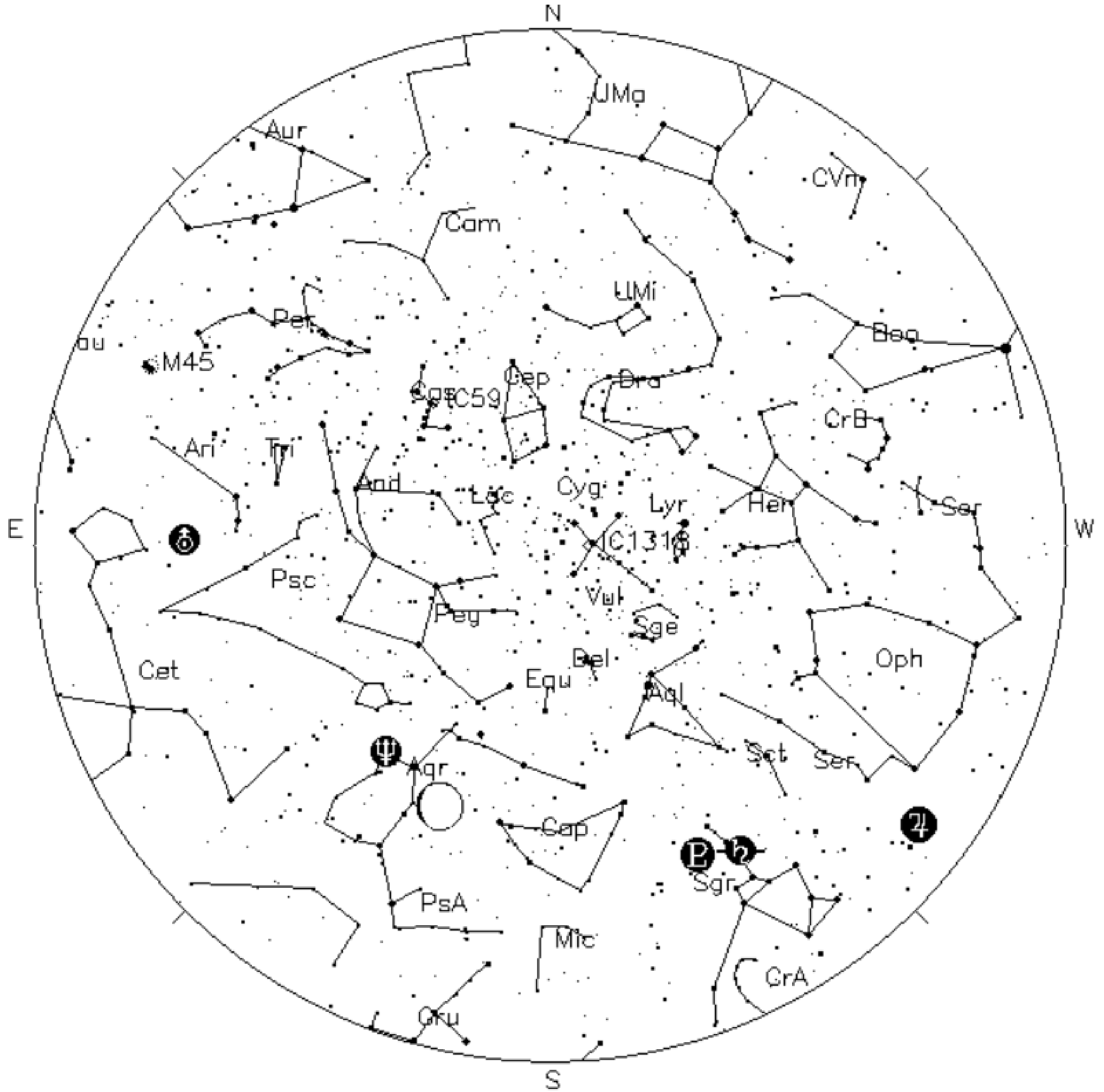
Night Sky Notebook for October

by

Pete Detterline



Sky above 40°33'58"N 75°26'5"W Thursday 2019 Oct 10 1:00:00 UTC



Your Sky was implemented by John Walker in January and February of 1998. The calculation and display software was adapted from Home Planet for Windows.

The GIF output file generation is based upon the ppmtogif module of Jef Poskanzer's pbmplus toolkit, of which many other components were used in creating the images you see here.

Customize Your Sky -> *at* : http://www.fourmilab.ch/yoursky/

OCTOBER 2019

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		01	02	03	04	05 First Quarter Moon Star Party
06	07	08	09	10	11 Scouts at Pulpit Rock Palmer Elementary Field Trip	12 Scouts at Pulpit Rock
13 Full Moon Scouts at Pulpit Rock General Meeting - 7:00 PM	14 Columbus Day	15	16 LVAAS Scout Group	17 Astro Imaging - 7:00 PM	18	19
20 Deadline for submissions to the Observer	21 Last Quarter Moon	22	23	24	25	26
27 New Moon LVAAS Board of Governors Meeting	28	29	30	31		

NOVEMBER 2019

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					01	02 Star Party
03	04 First Quarter Moon	05	06	07	08	09
10 General Meeting - 7:00 PM	11 Veterans Day	12 Full Moon	13	14 Astro Imaging - 7:00 PM	15	16
17 Deadline for submissions to the Observer	18	19 Last Quarter Moon	20	21	22	23
24 LVAAS Board of Governors Meeting	25	26 New Moon	27	28 Thanksgiving	29	30

2019 LVAAS Event Calendar

2019 LVAAS Event Calendar												
	Sundays				Thursday	Saturday	Mondays	Multi-Day Weekends	Moon Phase			
	General Meeting time	Date/location	Board meeting	Observer submission deadline	Astro Imaging	Star Parties	Scouts at S. Mountain	Scouts at Pulpit R.	New	First	Full	Last
January	2:00 PM	13 Muhlenberg	27	20	24	no mtg		no camping	5	14	21	27
February	2:00 PM	10 Muhlenberg	24	17	21	no mtg		no camping	4	12	19	26
March	2:00 PM	10 Muhlenberg	31	24	21	16		22-23-24	6	14	20	28
April	7:00 PM	14 S.M.	28	21	18	13		no camping	5	12	19	26
May	7:00 PM	5 S.M.	19	19	16	11		17-18-19	4	11	18	26
June	7:00 PM	9 S.M.	30	23	no mtg	8		14-15-16	3	10	17	25
July	5:00 PM	13 S.M.	28	21	no mtg	6		19-20-21	2 31	9	16	24
August	7:00 PM	10 Pulpit	25	18	no mtg	3		16-17-18	30	7	15	23
September	7:00 PM	8 S.M.	29	22	12	7		13-14-15	28	5	14	21
October	7:00 PM	13 S.M.	27	20	17	5		11-12-13	27	5	13	21
November	7:00 PM	10 S.M.	24	17	14	2		no camping	26	4	12	19
December	2:00 PM	15	29	22	12	no mtg		no camping	26	4	12	18

July, Aug & Dec are Saturday meetings with rain date on Sunday
Jan, Feb & March meetings are at Muhlenberg College
August meeting is at Pulpit Rock
December meeting / Holiday Party is at

NEAF	April 6 – 7
Cherry Springs S.P.	May 30-June 2
Stellafane	Aug 1 – 4
Black Forest S.P.	Sept 27 – 29
Mega Meet	*see website*

Contributed by Bill Dahlenburg

Publishing images is a balancing act!

When preparing your images for publication in The Observer, please consider the following guidelines:

Put the quality in:

- Considering the "print" size of the image, make sure you have at least 150 pixels/inch.
- Use a reasonably good quality for the JPEG compression ratio.

But watch the "waistline"!

- Don't go too much above 200 pixels/inch max.
- Use the lowest JPEG quality that still looks good!
- Shoot for <300KB for a 1/2 page image or <600KB for a full page.

Tip: If you're not Photoshop-savvy, you can re-size and compress undemanding images ("human interest" not astroimages), with an online tool such as: https://www.ivertech.com/freeOnlineImageResizer/freeOnlineImageResizer.aspx. It will also tell you the pixel size and file size of your original, even if you don't download the processed copy.

The Observer is the official monthly publication of the Lehigh Valley Amateur Astronomical Society, Inc. (LVAAS), 620-B East Rock Road, Allentown, PA, 18103, and as of June 2016 is available for public viewing. Society members who would like to submit articles, images or videos for publication should kindly do so by emailing The Observer editor, Frances Kopy at editorlvaas@gmail.com. Articles submitted prior to the Sunday before the monthly meeting of the board of governors (please see calendar on website) will usually appear in the upcoming month's issue. **PDF format is preferred**. **JPEG images** emailed directly to the editor following above guidelines are preferred. Early submissions are greatly appreciated. Articles may be edited for publication. Comments and suggestions are welcome.

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