The Observer

The Official Publication of the Lehigh Valley Amateur Astronomical Society

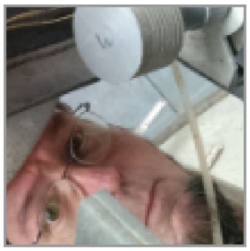
http://www.lvaas.org

610-797-3476

http://www.facebook.com/lvaas.astro

November 2016

Volume 56 Issue 11



ad astra

One of the best things about being a member of LVAAS are our monthly membership meetings, with great programs by great speakers about fascinating topics related to Astronomy. But there is a lot more to LVAAS, enough to justify making LVAAS itself a topic of a monthly program, presented by an LVAAS member. Our October program by Sandy Mesics on the history of the Schlegel Observatory and our 40-inch telescope project was a good example of this. Sandy is so passionate about digging out and pulling together treasures from the history of LVAAS that she has become an LVAAS treasure herself.

We plan to have another presentation about the Schlegel and the 40-inch project in 2017, focusing on the challenges of finishing it and getting to "first light," and our plans to address them. We will fit this in around the schedules of outside speakers, so stay tuned for further details in the coming months.

Membership and Member Services

I am pleased to announce that outgoing Treasurer Scott Fowler has agreed to serve as our new Director of Membership! His transition into this role will take place over the next month or so. Many thanks to Scott for his excellent stewardship of our finances and for volunteering to stay on the Board.

Speaking of membership, it's renewal season again! Please download the updated renewal form from the link on the full-page ad in this issue, and either renew by mail or at the Christmas party or another meeting.

This is the final month in Chuck and Donna Bradbury's tenure as LVAAS Member Services co-directors, and operators of The Red Shift. They have done a terrific job for us; let's all remember to thank them! We are still looking for a replacement. If you are interested in having this position, please contact me.

As a result of this transition, we are going to "punt the ball" on one service that has been provided in recent years. The Royal Astronomical Society of Canada 2017 Observer's Handbook is now available for ordering. This year, if you would like to have one, you are on your own. Please visit this link to order a copy: https://goo.gl/Al1okL.

Volunteers Needed

We have two activities coming up for which we need some volunteers. On **November 16th, between 10 and 1,** we will give a planetarium show for special needs students from Salisbury High School. Carol Kiely will do the show, but we could use one or two assistants to help with the event. Then on **November 17th, at 11:00,** we'll do a planetarium show for Community Options. Fred Bomberger will be the presenter, but we would like some volunteers to help out and to provide tours of the observatories. If you are interested in volunteering for either of these activities, please contact me.

Waves of Freedom

Have you ever played the part of a molecule in a giant physics simulation with a few thousand other participants? If you have been to a football game since the early eighties, you probably have. First, you saw the surge of energy starting to approach you from around the curve of the stadium, and then as the fan next to you rose from his or her seat, you stood up alongside, throwing your arms up in exuberance rather than exasperation — you became a part of the medium, transmitting the pulse of fanatic energy around the bleachers. You did The Wave.

I found out that it is called the "Mexican Wave" in places such as the U.K. and Australia. To take part, you only had to be aware of which direction it was coming from, and then follow the motion of the person on that side of you. So you programmed yourself to follow a fairly simple rule, and since almost everyone in the bleachers was following the same rule, a phenomenon emerged in that transmission medium of enthusiastic fans, imitating a similar phenomenon in physical media.

Wave Videos!

The First "Wave:"
https://www.youtube.com/watch?v=_sqGxQoORYE

Water Wave Physics:
https://www.youtube.com/watch?v=7yPTa8qi5X8

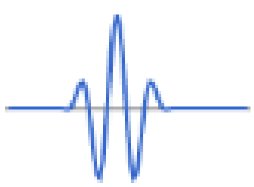
I've been thinking about physical waves recently, of the various forms we have observed since we added gravitational ones to the list in this past year, and of the physical media in which they form and the laws that make them propagate. Of course, the original form of wave has been known to us since time immemorial, and it is still what non-scientists are likely to associate with the word. A wave is a moving bump of water that you try to jump over at the beach.

But as scientists, we know that waves take many other forms, and are hugely important in physics. Quantum Mechanics tells us that we cannot correctly describe the behavior of matter without taking into account its wave characteristics. This may surprise you, but if you dive further into Quantum Field Theory, there is room for doubt about whether we even need the particle aspect. It is possible that eventually the famous Wave-Particle Duality could go away, leaving us with Just Waves.

But what is a wave? The dictionary says that it is an oscillation that moves in space, transporting energy. One important characteristic is that the wave is moving through the medium, elements of which by and large return to their original positions after conveying the wave's energy. At the beach, the waves flow up onto the shore, but the water stays in the ocean. Sound waves can hammer into your ear canal all day, but your head does not fill up with air. The energy is transported but the medium is not.

It occurred to me that using a fairly simple, almost intuitive thought process, we can draw some important conclusions about what it takes for a wave to exist. Obviously you need space of at least one dimension, and time, otherwise you could have no movement. And you need a medium which has at least one degree of freedom, i.e. some characteristic than can change from point to point and from time to time to manifest the wave and carry the energy that it transports. But is that enough?

In describing a physical system, we want to define a concept we refer to as the state of the system — at any particular instant of time, the condition that everything is in, the values of every independent degree of freedom of everything that we care about. For example, in a Newtonian gravitational model, such as the original description of how the planets in our solar system stay in orbit around the Sun, the state of the system at any instant of time consists of the positions of all of the bodies in space, and their velocities. There are other important quantities at play, such as the masses of the individual bodies and their accelerations. But in our orbital model of the solar system, the mass of each planet is assumed to be constant, so it is not a degree of freedom. Acceleration is not a degree of freedom either, because even though it varies, it can be calculated at any time from the gravitational force between the bodies, which depends on their masses and positions.



Waves are phenomena of field theories, and fields are like mathematical functions in spacetime — that is, a field is something that has one or more degrees of freedom for each point in space at each instant of time, and it varies smoothly in all four directions. Suppose there was only one such value in our system: a single, real-valued (as opposed to complex) scalar function, as shown in the figure at left. Sure, it looks like a wave of some sort. You can tell there is energy there, and you can assume it is moving through space. But in which direction?

This is a clue to a simple truth: with only one degree of freedom, you can't have waves. Field theories are built with the property of locality, such that each tiny point along the space-time continuum "knows what to do next" by how it relates to the points adjacent to it, an infinitesimal distance away. Mathematically, they are described by differential equations which allow you to calculate the rate of change over time of the field at each point, depending on the value of the fields in the system, and sometimes their rates of change over distance. In the figure, the only thing that can tell the graph how to evolve at each point are its height, its slope, and its curvature at that point. Under this constraint, the overall shape of the curve doesn't matter, and it should be obvious that the figure could represent a wave moving from left-to-right as easily as right-to-left. But real waves only go in one direction at a time.

The point I am trying to make is that in order for the wave to move, it has to know which direction it is going; and in order for the wave to know which direction it is going, there has to be at least two different degrees of freedom in the system, with some interaction between them. Fields that have only one degree of freedom can generally only evolve by diffusion — the energy just spreading out uniformly to equalize the system, such as a concentration of heat in a solid material.

When you were part of a football stadium wave, it may have seemed that there was only one DOF at play, which was how high you lifted from your seat and threw up your arms. But in this system, the principle of locality was violated, in that you could see which direction the wave was coming from, and only responded to the movement of your neighbor on that side.

So, let's think about a real physical wave a little more and see if can see what's going on. Ocean waves are a little too complicated for this process, but ordinary sound waves are fairly easy to think about. Imagine that the air in a quiet room is divided up into tiny, imaginary cubes, and you are one of them. You and all of the other atmospheric building blocks are all stacked on each other and packed into the room in an orderly fashion, still and quiet, all exerting the same pressure on each other and on the walls of the room, everything in equilibrium and nothing moving around to any significant degree. But then a sound passes through.

When the sound wave reaches you, the first thing you feel is an increase in pressure in the direction it's coming from. Now the pressure on you is not balanced, and it exerts a net force on you, causing you to start to move away from the area of higher pressure. In doing so, you apply increased pressure on the next portion of air in the direction you are moving. This pressure is the first degree of freedom.

As you move further, the pressure behind you levels off and the pressure in front builds up, and soon this increased pressure is again in balance at your location — the guy down the line is pushing back just as hard as the upstream guy - and you stop accelerating. Now you are a body in motion, but there is no net force acting on you, so you stay in motion, as dictated by Newton's First Law. You have momentum, the second degree of freedom in this system, which causes you to continue to move and increase the downstream pressure, even as the upstream pressure starts to decrease.

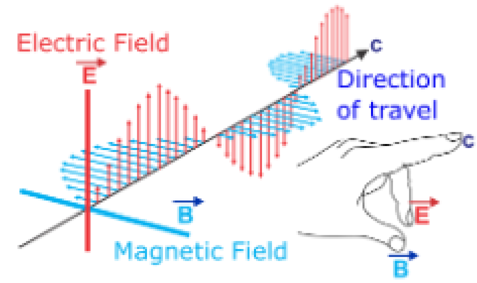
Soon the pressure imbalance reverses, and the force acting on you is now in the opposite direction. It starts to slow you down, decreasing that momentum, until you come to a stop. But the momentum has carried you too far, and the reversed pressure imbalance still needs to be corrected. You start accelerating in the reverse direction.

In a normal sound wave, this cycle repeats many times — forward pressure imbalance, forward momentum, reversed pressure imbalance, reversed momentum — as you and all your little cubical elements of the room air vibrate back and forth, carrying a signal that could be anything from a baby's first cry to a clap of thunder. In the process you receive energy from the air closer to the source of the sound and transmit it further along, experiencing oscillations in movement and pressure, but never really going anywhere. Just as in the football stadium, the wave moves on but you return to your original position.

Anyway, I suppose you are tired of hearing about sound waves. (I know that was bad, but I had to try.) Ocean waves are conceptually similar to sound waves, but there is up-and-down motion as well as longitudinal, and the height of the water surface interplays with the velocity, so it is more difficult to visualize.

The astronomer's favorite wave has to be the electromagnetic, since all of astronomy up until late last year was based on detecting and receiving electromagnetic waves. The two degrees of freedom in an electromagnetic wave are referred to in its name: the electric and magnetic fields. Both of these fields were phenomena known since prehistoric times. The electric field was observed in the mysterious force that caused "static cling" of charged-up dry, lightweight materials. The magnetic field was seen in the interaction of lodestone with the earth's field as well as with iron.

A bevy of modern scientists, including Faraday, Gauss, and Maxwell, applied the disciplines of science and mathematics to these observations, as well as findings from other experiments, and succeeded in showing that electricity and magnetism are aspects of the same thing, i.e. a phenomenon that can be unified under a coherent set of laws that provide an explanation for light itself. In electromagnetic radiation, the two fields operate at right angles to each other, and establish the direction that the wave travels by means of a "left-hand rule" (or "right-hand rule" depending on which element of the system you assign to which finger).



A "left-hand rule" for the propagation of electromagnetic waves.

Another type of wave is the one defined by the Quantum Mechanical field equation that describes the motion of electrons and other particles in the Fermion family. In the Schrödinger equation, physics seems to cheat a little bit - the field needs to have two degrees of freedom, but there are not two components of it that can be distinguished. So it is represented by a two-part complex number, instead of a real number, a method for providing the required degrees of freedom that makes the mathematics convenient, in addition to getting the physics to work.

To a certain extent, the same thing is true of gravitational waves, though the situation is complicated and I had to do a lot of research and thinking to boil it down this way. Modern gravitational physics starts of with the General Theory of Relativity, which uses the Einstein Field Equation to describe the bending and stretching of spacetime itself. Einstein defined a "tensor," or 4x4 matrix of real numbers, to describe the curvature of spacetime, which is not unsurprisingly known as the Einstein tensor. The basic concept was invented by Cauchy in the 19th Century in order to analyze stress in physical materials, and applied to spacetime itself by Einstein. And although the Einstein tensor has 16 numbers, there are a few constraints on their allowed values that reduce the total degrees of freedom to six -- two for each spatial direction, just enough to get a wave going.

But what exactly are they? Coming up with a satisfactory identification of two distinct degrees of freedom in a gravitational wave which is moving in a particular direction is not easy. It is not quite as mysterious as in the Schrödinger equation, but the extremely weak coupling of gravitational waves to ordinary matter means that these are phenomena with which we have no everyday experience, except for the gravitational attraction we have to the Earth, and that celestial bodies have to each other.

The properties of the gravitational field — inverse square law and so forth — are similar to the properties of the electromagnetic field, and this is an entry point into a discipline that probably gives us the best answer we will get: a treatment of General Relativity called "gravitoelectromagnetism."

To get started on this, one must first linearize the Einstein Field Equation. What does this mean? Well, think about a gravitational wave traveling through space. It is carrying energy, and energy is equivalent to mass. That means that the gravitational wave acts as a massive object, and generates gravity of its own. But, unless you are trying to accurately calculate the waves generated in the immediate vicinity of colliding black holes (something that was done to interpret the results if the LIGO gravitational wave detection), this effect is negligible. You can describe a gravitational wave accurately enough without accounting for its self-gravity.

Having done this, you end up with the equation shown at right, which is deceptively simple for what it represents. This is because there is a lot of magic in that square box, which is the symbol for the “d'Alembert operator.” It basically carries the whole mechanism for a wave equation in one tidy square package. The thing is, once this equation is written, to a physicist it looks very familiar.

$$\Box \bar{h}^{\alpha\beta} = 0$$

The linearized Einstein Field Equation with no matter present.

The reason is that it also shows up in electromagnetism, as well as many other systems that support wave action. When physicists want to work with electromagnetic fields within the theory of General Relativity, they find it convenient to rewrite Maxwell’s Equations in another form that looks very much like the linearized Einstein Field Equations. This correspondence allows us to redefine the Einstein tensor in terms of a “gravitomagnetic field” and a “gravitoelectric field.”

$$\Box A^{\mu} = 0$$

The relativistic electromagnetic field equation, with no charges present.

The gravitomagnetic field is really hard to observe. The detection of gravitational waves can be considered a confirmation of the existence of gravitomagnetism; another confirmation is the detection of “frame dragging” by the Gravity Probe B satellite, in which the precession of a gyroscope orbiting the Earth was very slightly affected by the Earth’s rotation. But, other than sensitive experiments such as these, it is outside our experience. The gravitoelectric field, on the other hand, is what is holding you in your chair right now — the standard force of gravity with which we are all very familiar.

In summary, for a physical field theory to support wave mechanics, it must have at least two degrees of freedom. The two DOFs of a gravitational wave, then, are the ordinary gravitational field and the mysterious gravitomagnetism. For a Fermionic wave, they are the real and imaginary parts of the complex value of the wave function. For sound waves, pressure and momentum. And for starlight and other electromagnetic waves, the electric and magnetic fields. Ad Astra!

— *Rich Hogg*

General Meeting at South Mountain
Sunday, November 13th, at 2 p.m.

The Mysterious Case of Boyajian's Star (nee Tabby's Star)

Featuring Joshua Pepper, Professor of Physics, Lehigh University

The NASA Kepler satellite has made thousands of major new discoveries in the science of variable stars, exoplanets, and other fields, but maybe none of them is more mysterious, intriguing, or tantalizing than the single object called Boyajian's Star (nee Tabby's Star). This is an otherwise typical star, slightly hotter and larger than the Sun, but which shows unprecedented changes in its brightness, over many different timescales.

Dozens of explanations have been proposed for this phenomenon, ranging from pedestrian to exotic. I will describe the behavior of this star, explain why it is so unusual, and review the various explanations that have been proposed. I will use this case to explain how the scientific community grapples with unexpected and unusual discoveries.

2017

Will Be Here Before You Know It!

It's time to break out the checkbook, update your information, and renew your LVAAS membership.

Please download the renewal form from this link:

http://lvaas.org/filemgmt_data/files/LVAAS2017MembershipRenewalForm.pdf

And send it, with your check, to:

LVAAS

ATTN: Membership

620 B East Rock Road

Allentown, PA 18103-7525

Minutes for the LVAAS General Meeting of 9 October 2016

The October General Meeting was held at our South Mountain headquarters in Allentown, PA. The meeting started at 7:02 p.m. Director Rich Hogg announced that there would be a very brief business meeting for the election of officers, to be followed by the speaker, and then the usual information session.

Rich called the business meeting to order and turned the meeting over to Bill Dahlenburg of the Nominating Committee. Bill reminded the membership that nominations for offices had closed last month and that only one person had agreed to run for each of the four elected positions. On a motion by Chuck Bradbury, seconded by Tom Ledoux, the members unanimously passed a motion for the secretary to cast a unanimous ballot for the slate of officers. The elected officers for 2017 are Rich Hogg as Director, Sandy Mesics as Assistant Director, Ron Kunkel as Secretary, and Gwyn Fowler as Treasurer. They will officially assume office duties on December 1, 2016. A motion at 7:07 p.m.to close the business meeting passed on a motion by Mike Clark with a second by Tom Duff.

Following the close of the business meeting, Rich called on Programs Director Sandy Mesics, who presented an interesting program on the history of our 40” telescope project, titled “The Long and Winding Road: A Brief History of the Schlegel Observatory.” In 2017 LVAAS will celebrate its 60th anniversary, and for 30 of those years has been working on this ambitious project, the 40” Cassegrain telescope. The building was erected in 1990 and the dome installed in 1992. Simultaneously the mirror was being worked on, but cleanliness and testing problems cropped up during the polishing operations. Completion of the mirror is still ongoing as is a total rehab of the building itself. The program was well received by the membership as it was very well researched, prepared, and presented by Sandy.

The program completed at 8:35 p.m. and after 10 minute break Rich began the usual information session. As acting Membership Director, Rich conducted new member readings. Shawn Matthews was recognized for his second reading. Additionally, Rich announced that the LVAAS Board of Governors had granted Mike and Tara Leonard second reading status based on their participation at some 40” workdays. They and Shawn are now welcomed as full members of LVAAS. A first reading was held for Charles Christman.

Rich next called on Treasurer, Scott Fowler for a report. Scott simply announced that fiscal 2016 did close with a net surplus budget. The original budget called for a net deficit but higher than expected income and lower expenses resulted in the budget surplus. The 2017 budget, approved by the membership last month, similarly projects a slight budget deficit.

Lastly a few announcements were mentioned. The 12” Newtonian at Pulpit Rock is down with a broken drive key. Thursday, October 13th will be the next meeting of the Astro-imaging Group, and the next General Meeting will be held on November 13th at 2:00 PM at our South Mountain site. The speaker will be Dr. Josh Pepper from Lehigh University speaking on “Tabby’s Star”.

The meeting adjourned at 9:55 p.m.

Minutes prepared and submitted by Ron Kunkel, Secretary.

HELP WANTED: No Experience Necessary. Operate/manage small retail establishment. Manage inventory and purchasing of beverages, snacks, hot dogs, custom-branded apparel and SWAG, and astronomy-related curiosities and media. Staff retail counter at Star Parties and General Meetings, or coordinate volunteers to do same. Procure and distribute beverages at Christmas Party, same plus additional staples at annual Picnic. Account for revenue, expenses, and profits, and report to owning organization. * * * The Red Shift needs a new proprietor!!! * * * Position opening in December. Apply in person or by e-mail to director@lvaas.org *

*As a footnote to above, my wife and I will turn over the cashbox, keys and paperwork regarding the Red Shift to the BOG on November 27, 2016. **If a replacement has not been found prior to that date the Red Shift will remain closed at the Star Party on December 3**. I am willing to train and provide a set of instructions to anyone who applies for this position, through November.

Thanks, Chuck and Donna Bradbury, Red Shift Proprietors

LOOK GOOD WHILE LOOKING!

Your Red Shift Store at South Mountain is now fully stocked with clothing merchandise that you just must have for yourself or others.

What better to way to show off the organization that you belong to than by wearing apparel with one of the LVAAS Logos?

Ball Caps (one size fits all) in Navy Blue or Natural/Royal Blue
T-Shirts from size small to 2x large in Athletic Heather, Navy Blue or Black
Polo Shirts from size medium to 2x large in Black or Celadon Blue

And for the not-so-adults:
T-shirts from size small to large in California Blue, Pink, Neon Green, Island Yellow

And for those cooler months soon to come:
Fleece Jacket (real great windbreaker) from size medium to 4xxx large in Blue Glacier
Beanie (alright, call it a stocking cap) in Navy Blue
Sweatshirt from size small to 2x large in Navy Blue or Ash
Denim Shirt from size medium to 2x large in Light Blue

All this clothing merchandise is available now at the Red Shift store on Star Party nights and General Meeting nights.

Stop by, and we thank you for visiting the Lehigh Valley Amateur Astronomical Society's (LVAAS) Red Shift store. LVAAS is a 59-year-old 501(c)3 non-profit educational institution. Your purchase will help us carry out our mission of bringing astronomy to the public. Thank you for shopping, and for your support!

Contributed by Chuck and Donna Bradbury, Member Services

LVAAS Astrophotography Calendar 2017

Submissions for the 2017 LVAAS Astrophotography Calendar closed as of October 28, 2016. Submissions were open to the membership and the general public. The weather was an issue again this year as usual, but beginner and seasoned amateur photographers still managed to capture some stunning images.

The talent, enthusiasm and dedication they devote to their passion make the LVAAS Calendar a fine example of amateur astronomy imaging at its best. We expect to have the calendar available for sale at the November 13th general membership meeting. Please visit the LVAAS website for more information about purchasing the calendar. Proceeds benefit the LVAAS Greater Lehigh Valley educational outreach program.

Thanks to everyone who helped make this calendar happen again this year! - Sandra Repash, Calendar Editor.

Calendar Cover Photo Credit: Gary A. Becker

Hello Everyone,
I've given talks at your astronomy clubs regarding my experiences visiting large observatories in Chile through the ***Astronomy in Chile Educator Ambassadors Program (ACEAP)****. This exciting opportunity is now officially open for new applicants. Please share the following with your membership. I'd be happy to answer any questions you have or you can contact Tim Spuck, who is the coordinator for the program. This is an amazing experience to work with wonderful people, visit incredible facilities, and learn and share how modern astronomy is done today.*
Best wishes and good luck to all the applicants!
Peter (Detterline)

Dear Potential ACEAP Applicant,

The Astronomy in Chile Educator Ambassadors Program (ACEAP) has been an incredible success these past 2 years. To date 18 astronomy educators (formal and informal) from across the US and its territories have traveled to Chile for this amazing experience, and these individuals have paved the road for what we all hope will be an enduring program for years to come.

We are in the process of seeking the necessary funds to continue ACEAP, however to date funding has not yet been secured for ACEAP 2017, and it is unlikely we will have confirmation of funding until February 2017 or later. Please know that the ACEAP Leadership Team is committed to exploring avenues to keep the program going, and we believe the success of ACEAP 2015/2016 significantly increase the likelihood of continued funding from NSF, but there are no guarantees. Depending on funding, ACEAP 2017 may not take place at all, or may be altered significantly from ACEAP 2016/15.

With this understanding, we are opening the application process for ACEAP 2017. Although there is a level of uncertainty, it is necessary to move forward with the application process if we are to adequately plan for the selection of a 2017 Cohort and a 2017 Expedition. All applications must be submitted online at https://www.surveymonkey.com/r/ACEAP2017 by 11:59 PM (your local time) on Sunday, January 22, 2017. Again, please keep the uncertainties about ACEAP's future in mind as you consider applying for ACEAP 2017. As soon as we have any news on future funding, we will share it with you and the rest of the community.

To learn more about ACEAP or to apply to ACEAP 2017 please visits our website at https://public.nrao.edu/look-deeper/aceap or visit us on Facebook at https://www.facebook.com/AstronomyAmbassadorsProgram/.

Thank you so very much for your time and consideration, and your understanding and patience as we work to secure future funding for ACEAP 2017 and beyond. If you have any questions, please direct them to Mary Mayo (ACEAP Program Administrator) at mmayo@nrao.edu, Tim Spuck (ACEAP PI) at tspuck@aui.edu, or Charles Blue (ACEAP Co-PI) at cblue@nrao.edu.

Sincerely,

Tim and the ACEAP Leadership Team

The Eagle Nebula

By Mike Tapper

This image was taken from Pulpit Rock in July of ’09 with an Atik 16C OSC camera. The exact exposure time and number of sub-exposures is not remembered, but most likely consists of 15-20, 5min exposures. The telescope used was a William Optics 90mm Megrez APO mounted on a Losmandy GM8 mount. Nebulosity was used for capture and calibration. Final processing was done in Photoshop CS2.

Ron's Ramblings

Ron's Ramblings is a monthly series of articles describing some recent or otherwise important event in astronomy. The ramblings will attempt to describe both the astronomical event and its significance. Obviously, the description will be that of a rambling amateur astronomer.

The Milky Way's Missing Dwarf Galaxies

The standard model of cosmology suggests that dark energy and cold dark matter govern the universe's evolution and the formation of galaxies. It predicts many more dwarf galaxies near the Milky Way than what have been observed. Large surveys such as the Sloan Digital Sky Survey and the Dark Energy Survey have closed in on theory and observers have begun to identify some of these hard-to-find dwarf galaxies. Dozens of dwarfs have been spotted over the last 15 years, but theory suggests perhaps even hundreds more have yet to be discovered. Now, the list of known dwarfs has just added one of its largest members, the Crater 2 Dwarf Galaxy. Crater 2 is the fourth largest dwarf galaxy of the Milky Way, surpassed only by the Large Magellanic Cloud, Small Magellanic Cloud, and the Sagittarius Dwarf.

Gabriel Torrealba (University of Cambridge, UK) led a team that discovered the Crater 2 dwarf galaxy in survey data collected at the Very Large Telescope in Chile. You'd think large dwarfs would be easy to find, but this one's stars are spread out and easily entangled with the stars of the Milky Way. It took a sensitive survey to pick out the small galaxy hidden behind the galaxy's stars. The team used specialized software to spot an over-crowding among stars, searching for dim stellar clumps. But identifying a clump isn't enough. Only Crater 2 contained red giant stars and horizontal branch stars — both old, evolved stars that mark an ancient stellar population separate from the youthful Milky Way disk.

Torrealba and colleagues estimate that Crater 2 lies 391,000 light-years from Earth. That makes it one of the most distant dwarf galaxies known. It's also one of the largest: at 6,500 light-years across, it comes in fourth among our galaxy's neighbors, after the Large and Small Magellanic Clouds, and the torn-apart Sagittarius Dwarf. Moreover, it's incredibly diffuse, its stars spread out over several square degrees. So despite its size, Crater 2 is much fainter than those Milky Way companions, nearly 100 times fainter than the Sagittarius Dwarf and almost 10,000 times fainter than the Large Magellanic Cloud.

As sky surveys continue to enable discoveries of dwarf galaxies such as Crater 2, the gap between theory and observations continues to narrow, clarifying our understanding of the Milky Way's evolution.

The future is bright for the study of these dim galaxies, thanks to surveys such as the Large Synoptic Sky Survey (LSST) on the horizon. LSST will push to even fainter magnitudes and may finally resolve the discrepancy between theory and observation as regards the missing dwarf galaxies.

References:

The feeble giant. Discovery of a large and diffuse Milky Way dwarf galaxy in the constellation of Crater. (2016, October 26). Retrieved from https://arxiv.org/pdf/1601.07178v4.pdf

The end of my ramblings until next month. Ron Kunkel

StarWatch

by Gary A. Becker

Carhenge: Only in America

Virtually everyone has heard about Stonehenge near the town of Salisbury, England. When completed about 2600 BCE, it consisted of a circle, a henge of 30 upright sarsens capped with rectangular lintels. Interior to that was a horseshoe-shaped configuration of five free standing trilithons, each capped with a lintel facing towards the NE, in the direction of the Heel Stone, 254 feet distant. The Heel Stone marked the direction of sunrise on the summer solstice, the longest day of the year.

If you stand near the center of Stonehenge as I have done, and imagine it complete and in operation 4600 years ago, most of the horizon was blocked from view except for key slots which also allowed the observer to view the winter solstice (shortest day) sunrise and sunset, as well as the summer solstice sunset. Stonehenge could be described as a religious temple or as a calendar, but one fact is certain; it was part of a much larger complex of circles, avenues, and burial mounds where the nobility of that time wished to be interred.

There are many recreations of Stonehenge around the world, but in typical American fashion, there is one near Alliance, Nebraska which is so weird that I just had to see it on a trip this past summer. It is called Carhenge, and you may have already guessed it. The monument is composed of entirely American automobiles. The total solar eclipse of August 21, 2017 passes right across Carhenge, so it will probably be a gathering place for the Flower Power generation of which I am a member. I approached Carhenge as a lark, but as I walked around the gray spray painted cars, the sarsens and lintels of the structure, it became evident to me that there were similar alignments imbued into Carhenge, comparable to the sarsens at Stonehenge. Alignments for sunrise and sunset on the two solstice dates were easily visible, but whether they lined up precisely with the rising and setting positions of the sun, I do not know. Carhenge's brochure intimated that they do, but I'd have to witness that to believe it is true.

Carhenge Overview: With no giant slabs of stone present in the Alliance, Nebraska area, designer Jim Reinders, a petroleum engineer, decided on a new medium for his sculpture—cars. They were essentially the same shape as the sarsens at the real Stonehenge, and with wheels, they were truly easy to move around. The original 25 cars were erected during a family reunion in six days and dedicated on the summer solstice of 1987. Image by Gary A. Becker.

Carhenge, Looking towards the Heel Stone: Although the construction in this direction looks a little sloppy to me, the summer solstice sun at the real Stonehenge rises over a sarsen called the Heel Stone. This is represented by the distant upright automobile. Along this same corridor, exactly opposite to the summer solstice sunrise, the winter solstice sun sets. Image by Gary A. Becker.

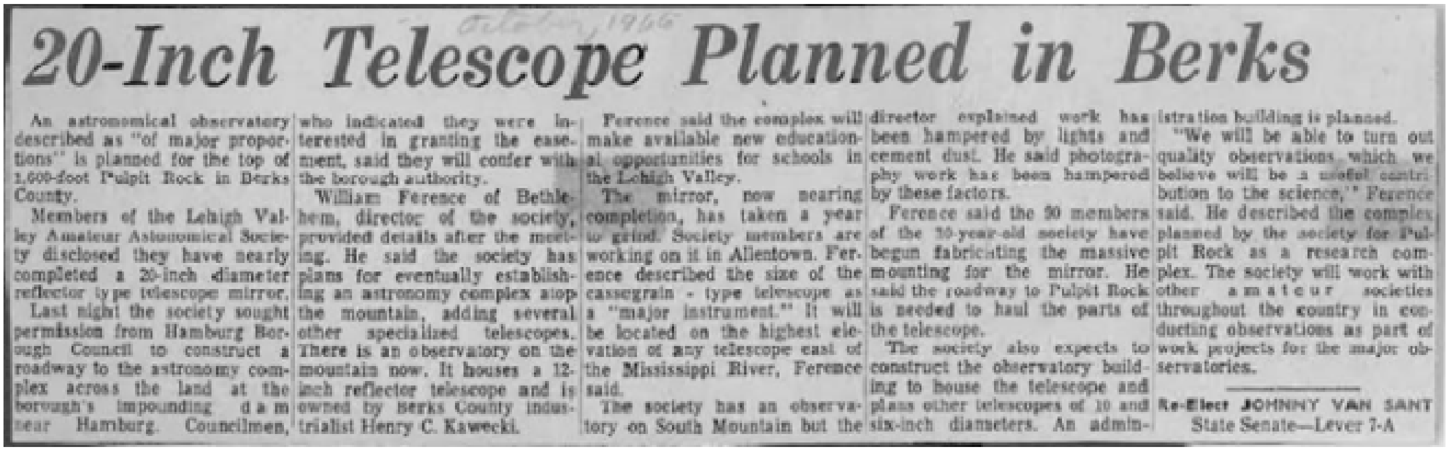
Carhenge, Looking towards Winter Solstice Sunrise: I was surprised to be able to view through the outer sarsen circle and through two free-standing trilithons to gain a clear access to the winter solstice sunrise position. Opposite lies the direction of summer solstice sunset which also would be visible from the center of Carhenge pending a correct orientation of the monument. Image by Gary A. Becker.

From the LVAAS Archives:

The Schlegel-McHugh Observatory

By Sandy Mesics

In November 1966, the road to Pulpit Rock was under construction, and the first major LVAAS observatory project was underway: the Schlegel-McHugh Observatory, which was to house a 20-inch telescope. The story of how the mirror came to be was very interesting.



October, 1966

20-Inch Telescope Planned in Berks

An astronomical observatory described as "of major proportions" is planned for the top of 1,600-foot Pulpit Rock in Berks County.

Members of the Lehigh Valley Amateur Astronomical Society disclosed they have nearly completed a 20-inch diameter reflector type telescope mirror.

Last night the society sought permission from Hamburg Borough Council to construct a roadway to the astronomy complex across the land at the borough's impounding dam near Hamburg. Councilmen, who indicated they were interested in granting the easement, said they will confer with the borough authority.

William Ference of Bethlehem, director of the society, provided details after the meeting. He said the society has plans for eventually establishing an astronomy complex atop the mountain, adding several other specialized telescopes. There is an observatory on the mountain now. It houses a 12-inch reflector telescope and is owned by Berks County industrialist Henry C. Kawecki.

Ference said the complex will make available new educational opportunities for schools in the Lehigh Valley.

The mirror, now nearing completion, has taken a year to grind. Society members are working on it in Allentown. Ference described the size of the cassegrain - type telescope as a "major instrument." It will be located on the highest elevation of any telescope east of the Mississippi River, Ference said.

The society has an observatory on South Mountain but the director explained work has been hampered by lights and cement dust. He said photography work has been hampered by these factors.

Ference said the 90 members of the 30-year-old society have begun fabricating the massive mounting for the mirror. He said the roadway to Pulpit Rock is needed to haul the parts of the telescope.

The society also expects to construct the observatory building to house the telescope and plans other telescopes of 10 and six-inch diameters. An administration building is planned.

"We will be able to turn out quality observations which we believe will be a useful contribution to the science," Ference said. He described the complex planned by the society for Pulpit Rock as a research complex. The society will work with other amateur societies throughout the country in conducting observations as part of work projects for the major observatories.

There was a group called "The New York Telescope Makers" and around 1937 they acquired a 20 inch mirror blank, which, according to Gary Becker, was a very early Pyrex casting, probably occurring sometime in the mid-thirties when the 200-inch Palomar blank was poured. The New York Telescope Makers became part of the optical Division of the AAA (Amateur Astronomers Association) which was formed just then.

There are a couple of references to the blank in “The Sky” Magazine: in September 1937, page 17, there is a picture of Clyde Fisher looking at the blank and it states that work was to begin on it (although the headline erroneously stated "Complete 21-inch disk."). Again in June 1939, page 24, there is an article on grandiose plans for an "Optical Division 20 inch Observatory." There is a sketch of a proposed mounting for the 20". It states also "at present Jim A. Grant is constructing a machine for final finishing of the mirror." A couple of months later, in September 1939, page 20, a notice states that the AAA and neighbor societies had an astronomy exhibit at the Museum (NY Museum of Natural History). One of the exhibits was "Jim Grant, O.D., grinding machine for 21" mirror".

Rough grinding commenced but was interrupted by World War II. Subsequently the blank was on display in the Hayden Planetarium for a while and then ended up in the museum’s Optical Department. Presumably it sat there for quite a while.

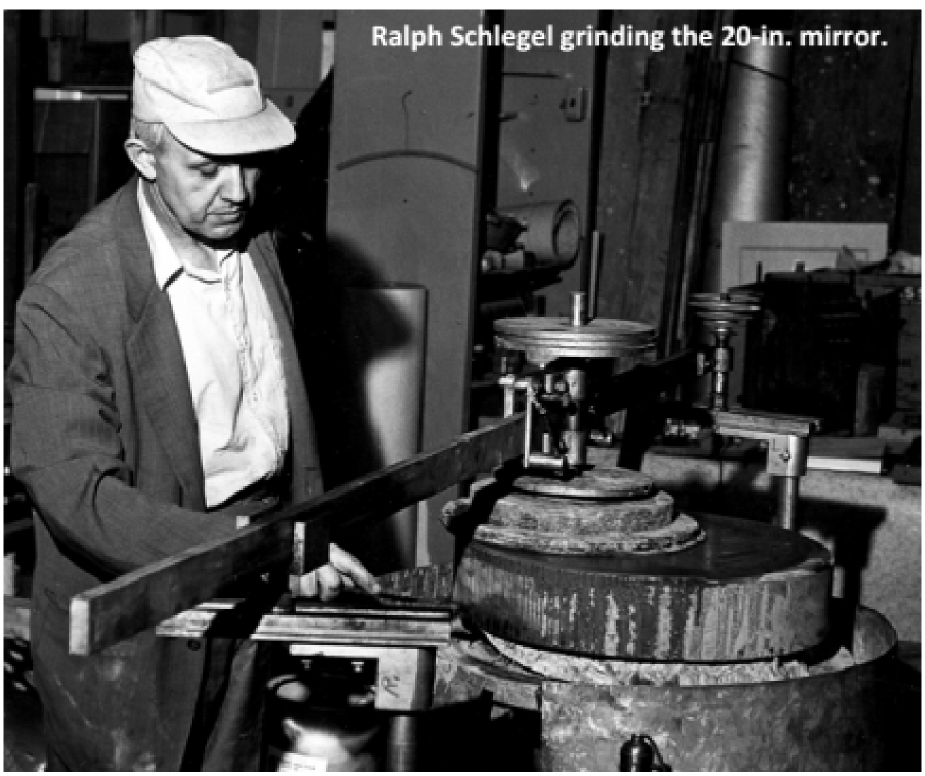
Then, LVAAS came along. More specifically, Ralph Schlegel and Bill McHugh.

Bill McHugh (left) and Ralph Schlegel (right). Photo by Gary Becker.

According to the March, 1965 Observer, “The society has acquired a 20” Pyrex mirror blank from the Optical Division of the New York AAA for the price of $100. The blank is 4 inches thick and has been partially ground to about f:2.5. Included with the blank were a huge mirror grinding machine and some accessories. There are no plans to begin work on a 20-inch telescope in the near future; we have too many other projects going at the moment. The society merely acted on an opportunity which presented itself.” The society also received a small number of 6” Pyrex mirror blanks as part of the transaction, which were offered to sale to the members.

Arrangements were made to move the blank, accessories, and grinding machine to Allentown. “But, in the meantime, a big jewel robbery occurred at the Museum of Natural History where these items were stored. Security was tightened, and in effect, Ralph Schlegel and Bill McHugh had to start all over again to arrange for transportation of the equipment. They went to New York City on a cold, late winter, Sunday afternoon, backing Bill's truck into the Hayden Planetarium entrance of the Museum of Natural History. With the grinding machine standing upright, there was just enough room to squeeze a person into the service elevator. No one knows what people in the museum were thinking as this equipment was dragged across the lobby floor and stowed into McHugh's truck. A very daring daylight escapade.” (Observer, October 1974)

The mirror blank was already ground and partially polished to a focal ratio of f/2.5. This had been accomplished over many years of laborious effort, using several 12-inch sub-diameter grinding tools. At the time of receipt, the surface contained several bad scratches and a rather severely turned-down edge. But before work could begin on the front surface, six months’ worth of effort were needed to grind the back of the disk flat.

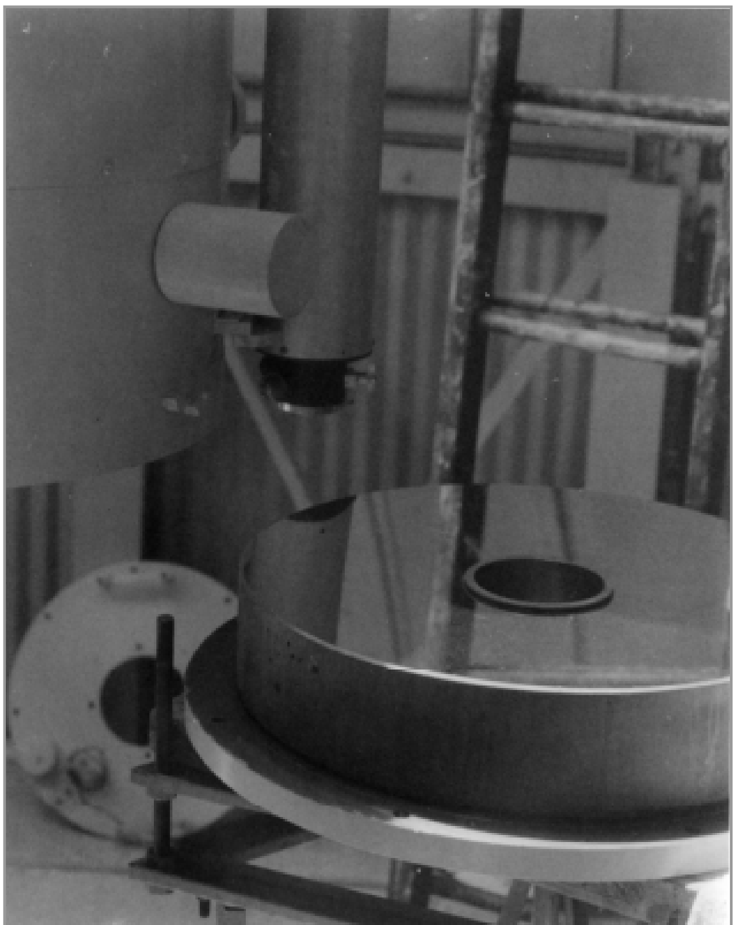

Ralph Schlegel grinding the 20-in. mirror.

Thereafter, each Friday night for almost six years, Ralph and Bill got together at South Mountain to continue the polishing and testing of the mirror, while also starting to work on the mechanical parts of the scope. Often these sessions would deal with testing the workability of equipment which had been made during the week at home in their small machine shops, or setting up for a big job which would take months to complete. There was virtually no finished piece of equipment bought commercially during the whole project, and only a few instances where outside help was required in machining parts; i.e., the main drive gear and the rolling of the tube. The efforts to do as much of the construction and assembly as possible was evident with the building of the fork, that portion of the mount which holds the telescope. All of the original steel was flat plate, cut, bent, bored, tapped, and welded into an aesthetic but rigid structure.

Coincidentally, in September, 1965, Paul Robinson of the Flemington Astronomical Society presented the society with a 20” optical blank that “will fit in perfectly with our plans for a 20” telescope, now in its preliminary stages.” As reported in the October 1965 Observer.

The optical design for the telescope was to be a compound system, utilizing two mirrors and a corrector plate, commonly referred to as a Schmidt-Cassegrain reflector. The instrument would have three focal ratio systems: an f/15 all-mirror system for photoelectric photometry; an f/12.6 visual system; and an f/6 photographic system. The last two designs will utilize corrector plates to help alleviate off-axis aberrations.

Originally, the mirror was to be coated using the vacuum tank at Mike Spacek's machine shop in Pottstown, Pa. Spacek was an LVAAS member and owner of Spacek Instruments, and had built the Kawecki Observatory. However, due to leaks in the vacuum system, L.V.A.A.S. had the mirror aluminized at the Dentin Vacuum Company in Cherry Hill, New Jersey, for only $50.00. Just in time too, because the primary was installed only a few days prior to the dedication event at Pulpit Rock.

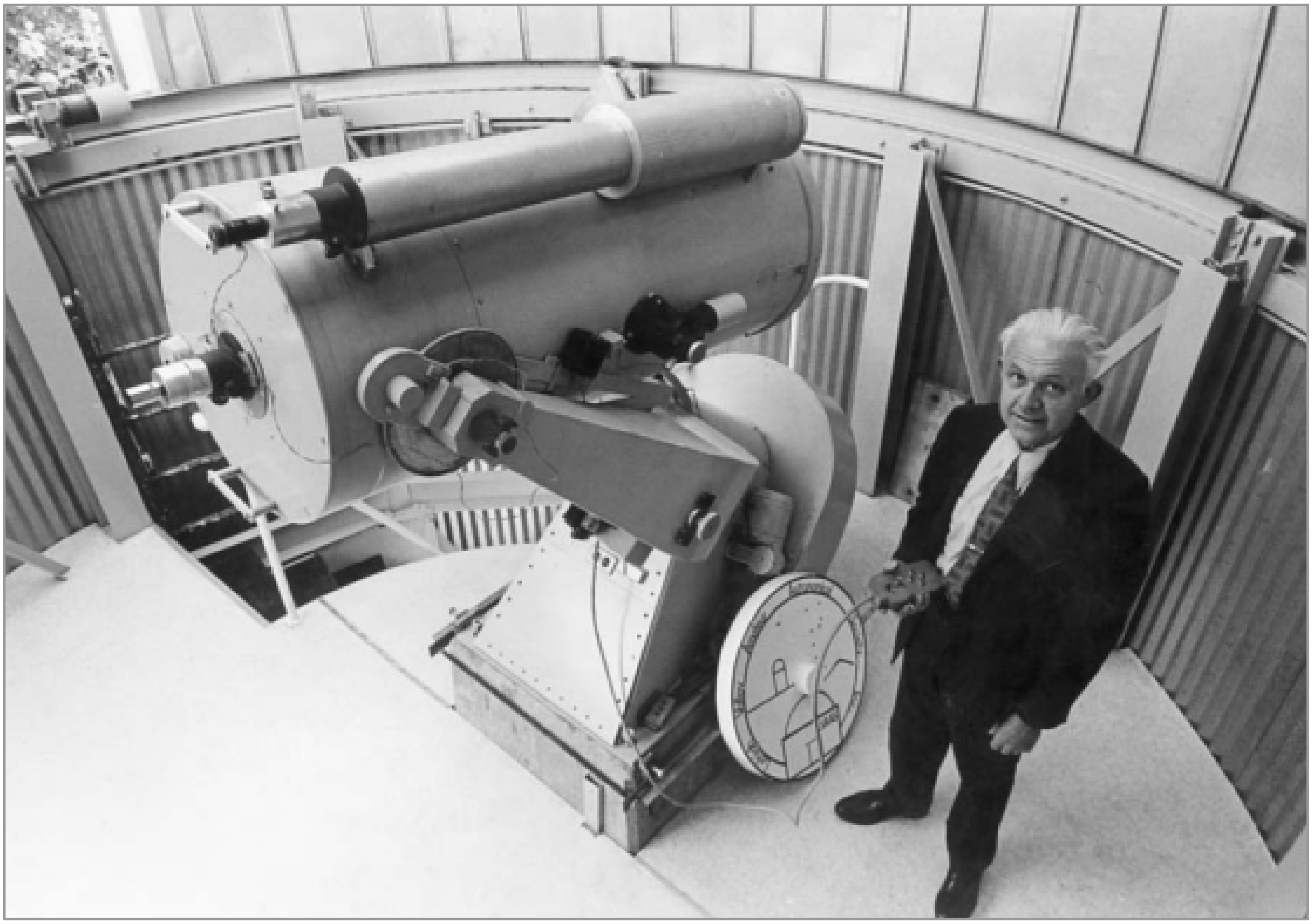

The 20-inch mirror being installed.

The Schlegel-McHugh Observatory was dedicated on October 5, 1974, and the instrument saw first light. The Villanova University Astronomy Department installed a photoelectric photometer and recording apparatus on the scope and brightness measurements of variable stars were made by LVAAS members and Villanova students. Data were reduced at Villanova, and the results were published jointly.”

Observations made in part by the telescope involved photometry of HR 5110, (BH Canum Venaticorum, HD 118216) which established it as a variable star: in fact it is a close binary system with an orbital period of 2.61 days. LVAAS members Pete Brooks, Ralph Schlegel, and Rick Wasatonic were co-authors of the publication announcing this.

However, even though the instrument went into use, work continued on the sub-par optical system. While the scope was meant to be a Schmidt-Cassegrain, figuring the corrector plate proved to be problematic, so the optical set was instead finished as a variation of a Cassegrain, with a spherical primary mirror and an ellipsoidal secondary mirror. According to Bob Mohr, “My understanding was they had spent so long making the primary, building and mount, that they were burned out, and decided to do a temporary secondary just to make it usable.”

The Observer reported in January 1975, that “Ralph Schlegel and Bill McHugh are spending Friday nights grinding the corrector plate for the 20-inch, and Ralph is working on a Schmidt Camera to be mounted on the 20 inch.” Six months later, the Observer reported, “Bill McHugh and Ralph Schlegel are continuing to figure the secondary mirror at Pulpit Rock. They have reduced the disc size of stars from about 5 seconds of arc to 2 seconds of arc. Their goal is about one second of arc.”



Ralph Schlegel and the 20 inch telescope: Photo by Gary Becker.

However, despite a less-than-ideal mirror, in February 1976, the Observer reported that the 20” scope was in use virtually every clear night of the year, and that members would have to reserve time on the instrument if they wanted to use it. There aren’t too many LVAAS members still around who actually looked through this instrument, but most agree that there was a fair amount of coma.

Again, Bob Mohr recalls, “One of the problems with collimation was that there was a movable secondary. A little motor drive would move it in and out to allow focus over a longer range. The issue was that whenever you used this to move it, you then needed to collimate the scope again. I think this was the main reason that most people thought the scope was not usable for visual observing, as most of the time it was out of collimation. Whenever Charlie (Palulis) and I went up to use it we expected to spend a half hour collimating before we even began to observe. A couple times we discussed disconnecting the motor, but I don't believe that was ever done. It would have been much better to set it up with an extended drawtube on the focuser that could have been adjusted.

“Quite a few members also used it as a photography platform. It was fantastic for the long guided astrophotos we took back then. It had a Schmidt Camera mounted on it, as well as a Nikon 1000 MM telephoto, which was set up with a T mount so it could be used for most any camera. Plus you could hang any camera and lens you had on it, it didn't affect the balance. Don Schwarzkopf was up there one night doing a long guided photo, and during the photo tried to shift his body around a bit. Wacked his head so hard on one of the counterweights that stuck out the back of the scope that he almost knocked himself out. The photo that was in process at the time was unaffected by this, and showed nice pinpoint stars.”

By 1985, LVAAS was looking to upgrade the optics. In the March 1985 Observer, Ralph Schlegel wrote, “As some of you are probably aware, we are in the process of making a corrector plate for the 20-inch telescope at Pulpit Rock in order to complete what is intended to be a Schmidt Cassegrain system. The present arrangement, with a spherical primary and an ellipsoidal secondary is satisfactory for photometry and some visual uses but has too much coma for more critical viewing.”

LVAAS member Bob Mohr recalls, “As to the corrector, several people had worked on it for a couple years; I know I had a couple hundred hours of time logged in polishing it. We got it to the point of having both sides polished, and started discovering that we were polishing astigmatism into both faces of it, because the backer we were using was not precise enough to properly support the glass. We tried doing little rotations of the corrector on the tool, but it didn't seem to be getting better, and that's when the project ground to a halt. (bad pun intended). When grinding and polishing, we were using a setup where just the edge of the glass was supported. Then we had a little tank that we could pump a partial vacuum under the glass, which pulled the glass down into a shape that we could polish spherical. When the vacuum was released the resulting figure would be the 4th order curve that is required of a Schmidt Cass. ... I believe the glass used was a water white plate glass; I don't believe it was really an optical grade glass. As with many things, we tended to use whatever was available.” Despite the coma problem, more than a few LVAAS members viewed Halley’s Comet with the scope on October 27, 1985.

A few months later, in July 1985, the 40-inch project was announced. Although the details are lost in the archives, it appears that work on the 20-inch virtually ceased, while efforts went into the new telescope-observatory project. The trail resurfaces in January 1994, when LVAAS member and optician Paul Shenkle reported that the aluminum coating on the primary mirror was bad, but would not be corrected until the optical work on the conversion to a true Schmidt-Cassegrain was complete. Bob Mohr states, “To make a Classical Cass, the primary would need to be parabolized, which is what Paul was going to do to it.” Paul thought this could be done by August 1994. But when August rolled around, Shenkle reported that work was still underway, and “there is a 50% chance of completion of the project by the end of the year [1994].”

The 20-inch tube (left) and mount (right) in storage at Pulpit Rock.

Ralph Schlegel died in July, 1995 with the work on the 40-inch and the 20-inch refurbishment uncompleted. It was reported in June 1995 that Paul Shenkle was still working on the corrector plate. A couple of months later, in the August 1995 Observer, the report was that the "20-inch is not operational."

The scope remained dormant until May 2013, when it was removed from the Schlegel-McHugh Observatory and replaced with a Tinsley 18-inch Cassegrain donated by Kutztown University. The 20-inch telescope and mirror have been placed in storage. A LVAAS crew retrieved the unfinished optical set from Paul Shenkle before he died in January 2014.

Will the 20-inch ever see star light again? It's possible. Newer techniques can use an all-spherical optical configuration with a corrector lens in the optical path just in front of the eyepiece. LVAAS has the right to replace any observatory at Pulpit Rock, as well as the right to construct one more. So it is possible that some future LVAASers might take up the refurbishment and bring the Schlegel-McHugh scope back to life. I'm pretty sure Ralph and Bill would like that...

References

Becker, Gary. The Schlegel-McHugh Observatory of the LVAAS, The Reflector, May 1975.

HR 5110: a New Variable Star. Hall, D. S.; Henry, G. W.; Vaucher, Ch. A.; Louth, H.; Lovell, L. P.; Landis, H. J.; Brooks, P.; Schlegel, R.; Wasatonic, R. Information Bulletin on Variable Stars, No. 1459, #1.

Thanks to Bob Mohr, Bill Dahlenburg, and Ron Kunkel, who helped me with this article.

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"The 40" building at PR today (Oct. 25, 2016) with a little fall color under the clouds."
Contributed by Carol and David Moll.

Highlights of the November Sky

by

Carol Kiely

Early in October, Chris and I toured the Welsh coast. We visited some fabulous beaches and the weather gods were really kind to us. Here is a picture of me "plodging" at Three Cliffs Bay on the Gower Peninsula. On this beach, you have to have your wits about you because the tide comes in pretty quickly. Of course, I couldn't help reminding myself that the moon was playing a big role in all of this.

Well, on Monday, November 14th, the Moon will be the closest it has been to Earth for 68 years. It will also be a full moon which means that the press will be calling it a "super moon". This time, however, it deserves the title as the moon will not come as close to Earth for another 18 years.

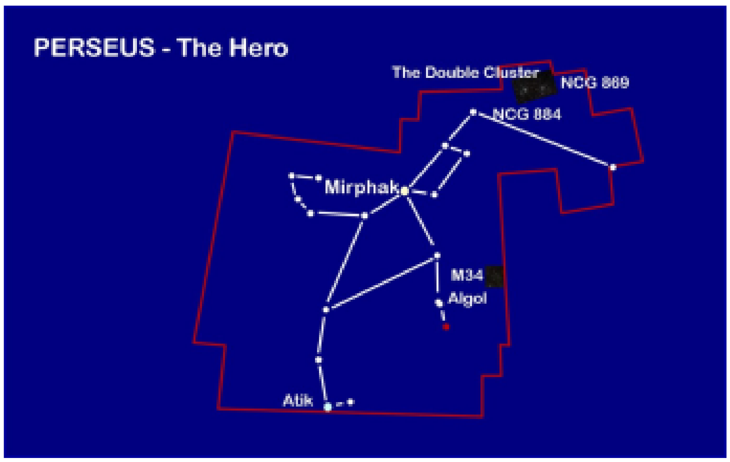
Image Credit and data: ***NASA/Goddard Space Flight Center Scientific Visualization Studio***

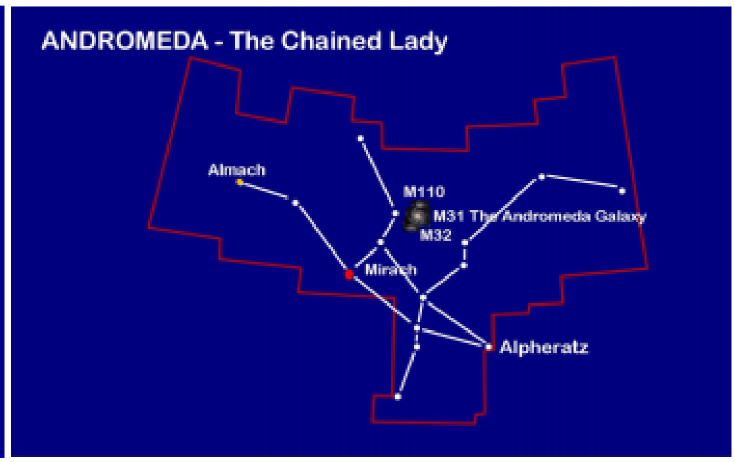
So, if the sky is clear then we can all bask in moonlight for a few nights which is good in some respects but really annoying for meteor shower observers - the likelihood of seeing any of the Leonids on November 17th/18th will be extremely small. However, you may see some slower moving meteors or, if you are lucky, a fireball in the first week of November, just after the new moon. These are known as the Taurids and are a result of the Earth passing through the debris left behind by Comet Encke that completes an orbit around the Sun every 3.3 years. This comet was "discovered" in 1786 by the French astronomer, Pierre Méchain.

Also at the beginning of the month, three planets can be seen with the naked eye just after sunset. Venus, "the Evening Star" will be low in the southwestern sky but will climb upwards as the month progresses.

Saturn, however, will only be visible at the beginning of the month and will soon dip below the horizon. Mars will be making its way from Sagittarius to Capricornus. As the evenings become cooler and there is less humidity, it is a great time to look at the red planet through a telescope. For early risers, Jupiter can be seen in Leo in the southeastern sky before dawn.

In September, I told you about Algol - the demon star in Perseus - an eclipsing binary whose brightness drops by a third when the dimmer star passes in front of its brighter companion. You can test this out for yourself by comparing its brightness to surrounding stars during the Lunatics and Stargazer's Evening on Friday (Nov. 4th), when Algol will be at its brightest, with its appearance on the following evening at the Star Party (Saturday, Nov. 5th) when its brightness will be at a minimum, weather permitting, of course.





There is a also beautiful visual double consisting of a bright yellow and a blue-green star separated by 9.7 arcseconds in Andromeda. Its name is Almach (or ɣ-Andromeda). These stars are much closer together than those of its more famous counterpart, Albireo in Cygnus, but you should be able to resolve them with a high magnification eyepiece. Almach is actually a multi-star system: the dimmer blue-green star is itself a double star.

Below the Great Square of Pegasus and Andromeda, you should be able to find two circlets of stars that represent the head of the two fish in Pisces. East of Pisces is the small constellation Triangulum. As its name suggests, it contains only 3 bright stars, but it also houses the third largest member of the local group of galaxies, M33 - the Pinwheel Galaxy. This spiral galaxy has an apparent magnitude of 5.72 so it is not possible to see it with the naked eye but, using a low magnification eyepiece, you should be able to locate it with your telescope. It lies in between α-Triangulum and Mirach (β -And).

As the evening progresses, the Pleiades will make their entrance. I never get tired of looking at this beautiful star cluster through binoculars. Their appearance is a reminder to dress up warm t he next time you go stargazing - winter is on its way.

Happy Stargazing!

Is Proxima Centauri's 'Earth-like' planet actually like Earth at all?

by Ethan Siegel

Just 25 years ago, scientists didn't know if any stars—other than our own sun, of course—had planets orbiting around them. Yet they knew with certainty that gravity from massive planets caused the sun to move around our solar system's center of mass. Therefore, they reasoned that other stars would have periodic changes to their motions if they, too, had planets.

This change in motion first led to the detection of planets around pulsars in 1991, thanks to the change in pulsar timing it caused. Then, finally, in 1995 the first exoplanet around a normal star, 51 Pegasi b, was discovered via the "stellar wobble" of its parent star. Since that time, over 3000 exoplanets have been confirmed, most of which were first discovered by NASA's Kepler mission using the transit method. These transits only work if a solar system is fortuitously aligned to our perspective; nevertheless, we now know that planets—even rocky planets at the right distance for liquid water on their surface— are quite common in the Milky Way.

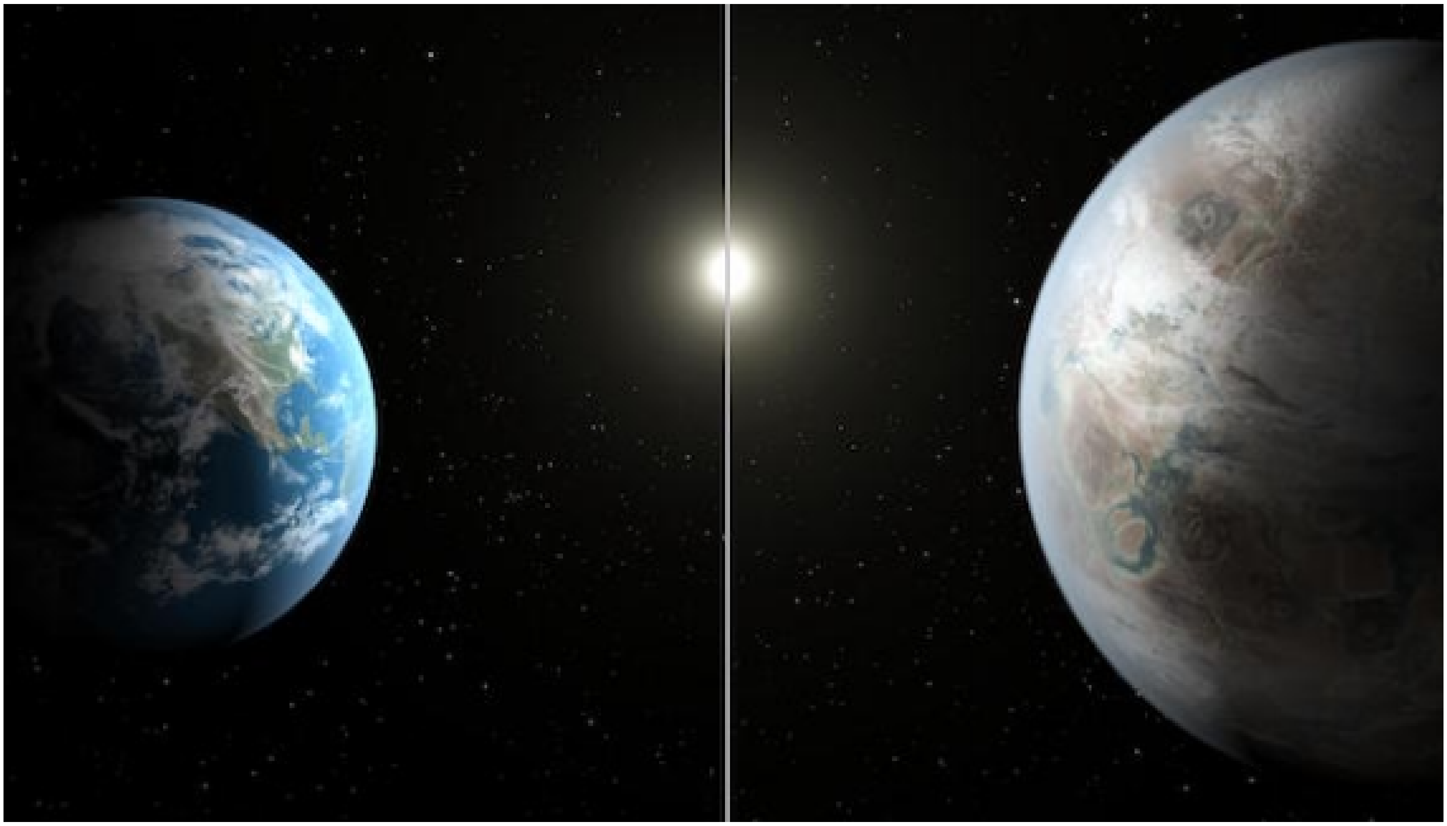
On August 24, 2016, scientists announced that the stellar wobble of Proxima Centauri, the closest star to our sun, indicated the existence of an exoplanet. At just 4.24 light years away, this planet orbits its red dwarf star in just 11 days, with a lower limit to its mass of just 1.3 Earths. If verified, this would bring the number of Earth-like planets found in their star's habitable zones up to 22, with 'Proxima b' being the closest one. Just based on what we've seen so far, if this planet is real and has 130 percent the mass of Earth, we can already infer the following:

- It receives 70 percent of the sunlight incident on Earth, giving it the right temperature for liquid water on its surface, assuming an Earth-like atmosphere.
- It should have a radius approximately 10 percent larger than our own planet's, assuming it is made of similar elements.
- It is plausible that the planet would be tidally locked to its star, implying a permanent 'light side' and a permanent 'dark side'.
- And if so, then seasons on this world are determined by the orbit's ellipticity, not by axial tilt.

Yet the unknowns are tremendous. Proxima Centauri emits considerably less ultraviolet light than a star like the sun; can life begin without that? Solar flares and winds are much greater around this world; have they stripped away the atmosphere entirely? Is the far side permanently frozen, or do winds allow possible life there? Is the near side baked and barren, leaving only the 'ring' at the edge potentially habitable?

Proxima b is a vastly different world from Earth, and could range anywhere from actually inhabited to completely unsuitable for any form of life. As 30m-class telescopes and the next generation of space observatories come online, we just may find out!

Looking to teach kids about exoplanet discovery? NASA Space Place explains stellar wobble and how this phenomenon can help scientists find exoplanets: http://spaceplace.nasa.gov/barycenter/en/



An artist's conception of the exoplanet Kepler-452b (R), a possible candidate for Earth 2.0, as compared with Earth (L). Image credit: NASA/Ames/JPL-Caltech/T. Pyle.

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

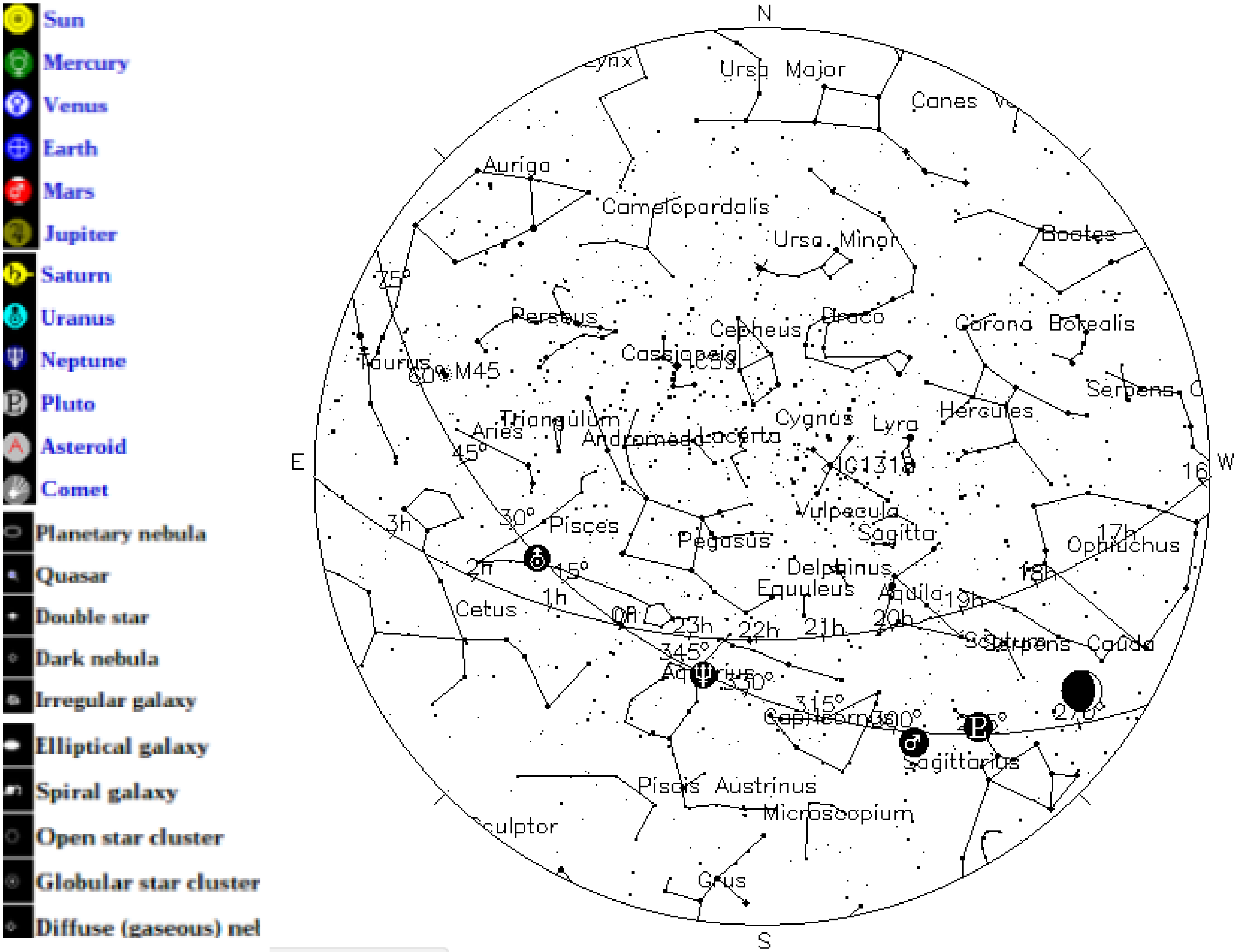
Oh, Snap!

Video ©JAXA/NHK

Lapis lakes
Pillow clouds
Billow winds
Mountain shrouds
We don't deserve
This beautiful place
Greed-obsessed
We fell from grace
Will we soon end
Of our own device
No one to mourn
Our sad demise
Or will mankind rise
And flourish healed
With wiser souls
To till the fields

Oh, Snap! is a monthly feature of LVAAS members' astronomy and celestial works which have been generously shared for the enjoyment of our readers. Kindly submit your original photos, videos or other material to editorlvaas@gmail.com

Sky above 40°33'58"N 75°26'5"W at Fri 2016 Nov 4 0:00 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.

ppmtogif.c - read a portable pixmap and produce a GIF file

Based on GIFENCOD by David Rowley [mgardi@watdscu.waterloo.edu].

Lempel-Zim compression based on "compress".

Modified by Marcel Wijkstra [wijkstra@fwi.uva.nl]

*Check out additional features of **Your Sky** at :* http://www.fourmilab.ch/yoursky/

Please visit lvaas.org for up-to-the-minute calendar information

NOVEMBER 2016

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		01	02 LVAAS Scout Group	03	04 Astronomy Merit Badge - Pulpit Rock Lunatics and Star gazers Night	05 Astronomy Merit Badge - Pulpit Rock Star Party
06 Astronomy Merit Badge - Pulpit Rock	07 First Quarter Moon	08	09	10	11	12
13 General Meeting - 2:00 PM South Mountain	14 Full Moon	15	16 Star Party fora group from Salisbury High School	17 Astro Imaging	18	19
20	21 Last Quarter Moon	22	23	24	25	26
27 LVAAS Board of Governors Meeting	28	29 New Moon	30			

DECEMBER 2016

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				01	02	03 Star Party
04	05	06	07 First Quarter Moon	08	09	10 General Meeting/Holiday Party 2:00 PM
11	12	13 Full Moon	14	15 Astro Imaging	16	17
18 LVAAS Board of Governors Meeting	19	20 Last Quarter Moon	21	22	23	24
25	26	27	28	29 New Moon	30	31

2016 LVAAS Event Calendar

2016 LVAAS Event Calendar

	Sundays			Thursday	Saturdays		Mondays	Multi-Day Weekends	Moon Phase			
	General Meeting	Board meeting		Astro-Imaging		Star Parties	Scouts at S. Mountain	Scouts at Pulpit R.	New	First	Full	Last
January	2:00 PM 10-m	31		21		no mtg		no camping	9	16	23	2 31
February	2:00 PM 14-m	28		25		13		no camping	8	15	22	
March	13	20		24		19		no camping	8	15	23	1 31
April	10	24		21		16		22-24	7	14	22	29
May	15	22		19		14		20-22	6	13	21	29
June	12	26		no mtg		11		24-26	4	12	20	27
July	05:00 PM 9-s	31		no mtg		16		15-17	4	11	19	26
August	13-sp	28		no mtg		6		19-21	2	10	18	24
September	11	25		15		10		16-18	1 30	9	16	23
October	9	30		13		8		14-16	30	9	16	22
November	2:00 PM 13	27		17		5		11-13	29	7	14	21
December	2:00 PM 10-sc	18		15		3		no camping	29	7	13	20

(-s) = Saturday meetings - Rain date on Sunday
(-m) = Muhlenburg College
(-sp) = Saturday meeting at Pulpit Rock
(-sc) = Saturday Holiday Party at Grace Community Church
All meetings 7:00 PM unless noted otherwise

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 astro-images), with an online tool such as http://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 (LVAAS) Inc., 620-B East Rock Road, Allentown, PA, 18103 and as of June 2016, is available for public viewing. Frances A. Kopy, editorlvaas@gmail.com

Members please use above email address for submissions.

Society members who would like to submit an article or photo for publication should kindly do so by the Sunday before the monthly meeting of the BOG (please see calendar on website) for the article to appear in the upcoming month's issue. PDF format is preferred. Early submission are greatly appreciated. Articles may be edited for publication. Your comments and suggestions are invited.

Every effort is made to properly credit the sources of the material used in this publication. If additional credit is required, please notify editorlvaas@gmail.com with the required information for a timely correction.

To update LVAAS information or to make member contact changes or corrections, please email LVAAS Director Rich Hogg, theotherplanb@gmail.com or Assistant Director Sandy Mesics astrosandy@gmail.com.