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THE STARGAZER

Newsletter of the Rappahannock Astronomy Club No. 3, Vol. 1 November 2012–January 2013

An Astronomical Journey… From Department Store Telescope to Personal Observatory

by Scott Busby

At first glance, the title of this story implies a space traveler's fantastical journey to strange worlds somewhere out there in the faraway universe. Perhaps it even evokes thoughts of manned space and solar system exploration. Unfortunately, it's none of these. Rather, it's my personal journey discovering the visible universe through a telescope and my personal evolution in the hobby of amateur astronomy. It begins with my introduction to astronomy and my first telescope and ends in the present day using my personal observatory to photograph the planets, galaxies, nebulae, and other interesting objects.

If memory serves, my first interest in amateur astronomy came in 1965 when I was in the sixth grade. My elementary school in San Diego, California, took my class on a weeklong camping trip to Mount Palomar for fun and adventure, which also included a visit to the Palomar Observatory and the world-famous Hale telescope. I didn't know much about the telescope, but at the time, it was the world's largest reflecting telescope, with a mirror diameter of 200 inches. A week before the trip, my teacher diligently introduced us to astronomy, including a documentary film describing the design and construction of the Hale telescope, its optics, and the subsequent movement of the giant 200-inch telescope mirror from its manufacturing location at the Corning Glass Works in New York State to its current position at Mount Palomar in California.

The camping trip itself was a lot of fun. There were plenty of hiking and science-oriented activities for us to do. We stayed in little log cabins, each named for a planet—my cabin was "Mars." About midweek, we boarded a bus and headed up to the great telescope. We drove along the steep mountain road and came out of the woods into a large open area dominated by the giant white observatory dome that housed the Hale telescope. I had never seen anything quite like it, and because it was winter, a few feet of snow covered the ground, which accentuated the dome all the more.

Hale Telescope ***(Source: http://rascvic.zenfolio.com/img/s1/v6/p754799327-3.jpg, 20 Nov 2012)***

We entered the observatory complex through the visitor's gallery. At the center of the huge gallery was a mockup representation of the 200-inch mirror. This really gave a perspective of its tremendous size. On the curved walls of the gallery hung numerous backlit transparency photographs of objects taken by astronomers using the telescope. They were awe-inspiring. I remember quite distinctly an image of M31, the Andromeda Galaxy, that island universe some 2.5 million light years away and the Milky Way's closest neighboring galaxy. *(continued on page 9)*

How to Join RAClub

RAClub is a non-profit organization located in the Fredericksburg, Virginia, area. The club is dedicated to the advancement of public interest in, and knowledge of, the science of astronomy. Members share a common interest in astronomy and related fields as well as a love of observing the night sky.

Membership is open to anyone interested in astronomy, regardless of his/her level of knowledge. Owning a telescope is not a requirement. All you need is a desire to expand your knowledge of astronomy. RAClub members are primarily from the Fredericksburg area, including, but not limited to, the City of Fredericksburg and the counties of Stafford, Spotsylvania, King George, and Orange.

RAClub annual membership is $15 per family. Student membership is $7.50. Click here for a printable PDF application form.

The RAClub offers you a great opportunity to learn more about the stars, get advice on equipment purchases, and participate in community events. We meet once a month and hold regular star parties each month on the Saturday closest to the dark of the Moon. Our website, www.raclub.org is the best source of information on our events.

We also have an active Yahoo group that you can join to communicate with the group as a whole. Just click the link, then the blue Join this Group! button, and follow the instructions to sign up.

The StarGazer
November 2012–January 2013
Published Quarterly by Rappahannock Astronomy Club
Editor: Linda Billard

Website: www.raclub.org
Yahoo Group:
http://tech.groups.yahoo.com/group/rac_group/

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Calendar of Upcoming Events

Club Meeting, Fredericksburg Library	February 13
Star Party, Caledon State Park, King George	February 2
Star Party, Post Oak Middle School, Spotsylvania	February 15
Star Party, Caledon State Park, King George	March 9
Club Meeting, Maury School	March 20
Star Party, England Run Library	March 23
Club Meeting, Maury School*	April 17*
Star Party, Caledon State Park, King George	April 4

Recent Outreach Events Completed

Star Party, Shiloh Historic Schools, Kilmarnock	November 10
Star Party Caledon State Park, King George	November 17
K-6 Outreach Event, Fredericksburg Library	January 11

*Tentative, pending membership vote at March 20 meeting

President's Corner—Observing in Cold Weather

Welcome to New RAClub Members (Nov–Jan)

- Melvin McDaniel

As I write this, it is late in the evening and 23°F outside. The last few days have been bitterly cold; I have seen 8°F on my car's outside temperature indicator when I leave for work at oh-dark-thirty. It's difficult this time of year to get out and observe. It does get warmer during the day, typically in the mid-40s but sometimes only to the mid-30s, so setting up your telescope at 5 or 6 pm in the evening is your best bet. Try to get in some early observing before it gets too late (and cold). In the third week of the month, the Moon and Jupiter are up high in the early evening sky, and I have taken advantage of that to get some really beautiful views (and photos) of them with my 5" refractor.

In frigid conditions, binoculars are probably the best instrument to use because you can get wide views but not be burdened by a larger instrument if you want to stay out for only 10 or 15 minutes at a time and then duck back inside to get warm. With your binoculars, you can spend 1 or 2 hours in the early evening doing a survey of the winter sky, viewing some of the best objects—ones that are only available now. The Orion Nebula is probably the number one object to observe. The Pleiades and the Hyades are also very nice. Use your star charts to identify and locate any new objects that you may not have observed before, using the bright winter stars as your guide. You will be surprised how spending the time in the early evening with binoculars can help you get your observing "fix" during these environmentally challenging times. Be sure to bundle up and drink plenty of water if you are spending more than 30 minutes outside…and be sure to keep your feet warm!

This is the start of a new year, and we have one new club officer. We've planned an interesting group of presentations this year and have two or three new outreach activities planned also. You can also look forward to receiving your quarterly newsletter, *The StarGazer*, this year. In this current issue, In addition to telling us about his road to a home observatory, Scott Busby starts a new feature about "Astronomical Math" that I am sure you will all enjoy. Joe Francis continues our education with a discussion of eyepieces, and I talk about a new instrument I've spent the past few months working on. Linda Billard has again pulled off a very nice piece of work in this issue of *The StarGazer*, the longest one yet at 14 pages. She deserves a lot of credit in keeping the standards high for our club's newsletter.

Keep those astrophotos and observing reports coming, I hope to hear about your binocular observing during these long winter nights. Keep warm and Clear Skies!—*Jerry Hubbell*

Website Review—Apollo Lunar Surface Journal

If you've never visited the Apollo Lunar Surface Journal (http://www.hq.nasa.gov/alsj/frame.html) site, you're missing a treat. It contains all the audio and all the video recorded on Apollo missions 11 through 17—collected, organized, and accompanied by fascinating documents such as flight plans, mission reports, still image libraries, and much more. You could wander this site for days and never be bored. An especially exciting (or scary, depending on your point of view) item is Section 8 of the Mission Report for Apollo 13. Despite its spare language, you have no doubt how serious the problem was and how innovative the solutions were that saved the astronauts' lives. Makes you want to watch the movie again just to see how accurate Hollywood really was!

Outreach at Shiloh Schools, Kilmarnock

By Glenn Holliday with Linda Billard

On November 10, the club took advantage of a unique opportunity to team with another nonprofit organization. Northumberland Preservation Inc. (NPI) wanted to draw the public to its historic Shiloh Schools site through a special astronomy event. The purpose of NPI is "to generate community-wide interest in preservation of sites and structures with special character, providing tangible links to the past, maintaining a public sense of identity." NPI's Jane Towner invited RAClub to hold a star party at the Shiloh Schools site, designated as a Virginia Historic Landmark and listed on the National Register of Historic Places. On the site are two turn-of-the-century one-room schoolhouses.

Glenn prepping for star party at Shiloh Schools (*Source: Linda Billard)*

It turned out be a beautiful night at Shiloh Schools and a busy and active star party with more than 40 attendees. Jane and NPI had done a lot of preparation work. The 1906 schoolhouse served as a warm spot with red lights and hot cider, so everyone could go in and out while maintaining their night vision. This made for a comfortable setup that encouraged people to stay a while.

Jerry Hubbell, Bart and Linda Billard, Melvin McDaniel, and Rob Friedel and his family joined me to support the event. As it turned out, it was fortunate that we had five telescopes, considering the size of the crowd, most of whom stayed for several hours. The site is within shouting distance of the Chesapeake Bay (at one point, we saw lights that we think were on the water), and the evening started out breezy, which made it feel much colder than it was. By 8 or 9, however, the wind was gone, and it felt quite comfortable.

The site has an open, flat horizon in all directions, providing excellent views. The sky, even with some sky glow from towns and cities to the north and south, was quite a bit darker than at Caledon, especially directly overhead. For example, the Milky Way was visible even before the glow from sunset had completely dissipated. Also, even at mid altitudes, more of the Little Dipper was visible than we can see at Caledon, and several of us were able to see the Andromeda galaxy (M31) with the naked eye. Although the old schools are at the intersection of two roads, traffic was light, so car lights did not bother us much.

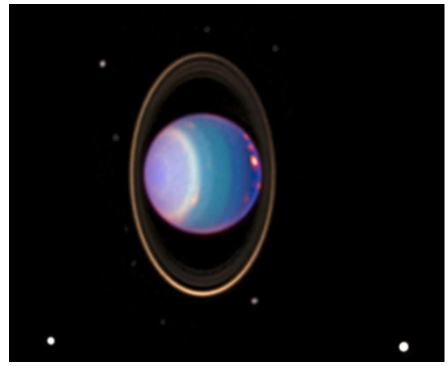
The sky remained partly cloudy, but most of the clouds kept to the north and south, in the sky glow. We had a great eastern horizon, so we had the opportunity to guess the identity of each individual star when it first appeared among the trees, and watch it climb up from its rising until it was visible in the context of its constellation. Jupiter was a popular target, with its bands and four moons quite distinct—it was fun for visitors to see it in all the different telescopes. We watched Ganymede disappear into the shadow of Jupiter. People asked me to return again and again to show the Perseus Double Cluster. Jerry and Bart found Uranus, which is always exciting because it is so faint. They also showed the Ring Nebula (M57). Linda, still very much a novice, took the plunge and ran the club NexStar by herself, finding targets on her own for the first time to show the guests. I think the visitors enjoyed many of the clusters and nebulas we showed, although Orion didn't rise until guests were leaving, so we did not explore the great Orion Nebula.

The event was a great success for all concerned. Jane was so pleased with the turnout that she asked Jerry whether we would be willing to come again next year, perhaps for an event focused on observing the Moon. All of us had great conversations and questions for 3 hours without pause. We were pleased to have so many people come out and really enjoy the sky. Jane's follow-up e-mail said, in part, "The evening with you was uplifting and satisfying. Something like when we were little children, lay on our backs in the grass, and looked at the stars and wondered, puzzled at the mystery. You are all truly amazing people to come so far and to share your talent and knowledge at our simple little rural space with our eager little group."

Uranus—Rings and Moons Aplenty

by Linda Billard

As a follow-up to our successful viewing of Uranus at the Shiloh Schools outreach event, here's some fun facts about this mysterious planet, its rings (yes, it has rings too), and its moons.



Hubble Space Telescope image of Uranus, its 4 major rings, and 10 of its moons (*Source: http://solarsystem.nasa.gov/*)

Like Venus, Uranus rotates east to west. Its rotation axis is tilted almost parallel to its orbital plane, so it appears to be rotating on its side. This situation may be the result of a collision with a planet-sized body early in the planet's history. Because of Uranus' unusual orientation, the planet experiences extreme variations in sunlight during each 20-year-long season.

Uranus was the first planet initially identified with the aid of a telescope. Although it had been seen before, it was always thought to be a star. Even British astronomer James Herschel, who found it in 1781 and is credited with eventually identifying it as a planet, initially thought it was a comet. When asked to name the planet, Herschel chose to call it Georgium Sidus (George's Star) in honor of his patron King George III. The name was not popular outside Britain, but it "took" until 1850 for Uranus to become the official name as suggested by German astronomer Elert Bode. Uranus is the Greek god of the sky.

Uranus is very dim, and its many rings and moons are generally only detectable by spacecraft. However, the initial discovery of the rings illustrates another situation when they can be seen.

In 1977, two teams of scientists, one aboard NASA's Kuiper Airborne Observatory and the other at Perth Observatory in Australia, discovered the inner system of rings. When the two teams of scientists set up to watch Uranus pass in front of star SAO 158687, they expected a rare chance to observe a distant planet. Instead, they made a major discovery. As they watched, the star appeared to blink out briefly several times. Uranus, like Saturn, was encircled with a band of rings! The blinking was caused by the rings blocking the starlight. The Australian team was so surprised, it missed three rings as they tried to figure out why the starlight signal kept disappearing. The Kuiper team had a better vantage point and was first to publish the news that Uranus was encircled by five narrow rings. The Perth team identified six distinct dips in the starlight, which they named rings 1 through 6. After careful analysis and a closer view courtesy of the Voyager 2 spacecraft in 1986, scientists identified 13 known rings around Uranus. In 2005, the Hubble Space Telescope discovered two more. In 2006, observations by Hubble and at Keck Observatory (Mauna Kea, Hawaii) showed that the outer rings are brightly colored.

Uranus has 27 known moons—2 discovered by Herschel and 3 more by other astronomers in the 19th century. The sixth wasn't found until 1948, coincidentally by Kuiper, for whom the Kuiper Airborne Observatory was named. Courtesy of Voyager 2, the number increased to 15, and the current total of 27 is the result of more recent examination by the Hubble Space Telescope and advanced ground-based telescopes. The names of all the moons pay homage to characters in the works of William Shakespeare. Some are very tiny and others have unusual characteristics. Miranda is perhaps the strangest-looking Uranian moon: its complex surface may indicate partial melting of the interior, with icy material drifting to the surface.

Astronomy Math

by Scott Busby

When a visitor asks, "***What's the magnification of this telescope?"—***do you have a quick answer? To calculate the **magnifying power of any telescope and eyepiece combination**, simply divide the focal length (FL) of the telescope's objective lens or mirror by the FL of the eyepiece. Remember to use the same unit of measure—eyepieces are usually sold by FL in *millimeters* while telescopes are often sold by FL in *centimeters or inches*. Don't forget to convert before calculating!

$$\mathbf{Magnification} = \frac{\text{Focal Length of Objective}}{\text{Focal Length of Eyepiece}} \text{ OR } \mathbf{M} = \frac{\text{Objective FL}}{\text{Eyepiece FL}}$$

Keep a "cheat sheet" listing the results for each of your eyepieces when used with your telescope. That way, if you forget, and don't want to do math in your head, you're ready with the right answer.

Ethos Eyepieces—Why They're a Good Investment

by Joe Francis

Sherry and I joined RAClub and the Northern Virginia Astronomy Club in October 2007 based on a life-long interest in astronomy. I've been fascinated with Ethos eyepieces almost from the beginning and would like to share a little story with you about the genesis of my interest.

Each year, in January or February, astronomy club members from all over the world attend the famous Winter Star Party in the Florida Keys. So, because I was semi-retired, Sherry and I attended in February 2008 for the first time. The latitude there, 24:38:25N, enables you to see well below the southern horizon that we experience in Virginia. Additional attractions are the warm sunshine during the day and the clear steady air at night. Good seeing conditions are a product of the surrounding ocean, which provides uniform conditions, so the air is normally steady, not turbulent with altitude, as it glides over the Keys; therefore, telescope users don't experience the wiggly images common at other land-locked locations. Sometimes, seeing is so good that you can effectively use 4,000 power magnification compared with a best of about 400 power at RAClub star party sites. In 2008, these attractions were so strong that amateur astronomers, mostly from the US, Canada, and Europe, attended the weeklong star party. We met one Toronto woman who had been to 18 Winter Star Parties. Although this one was held February 4–10, we were often blessed with 83° weather.

On the first day, I visited the Tele Vue booth and began talking with a nice older gentleman. He was very knowledgeable and patient with my many questions. He let me try out the new NP 101 APO refractor telescope with the acclaimed, new Ethos 13mm eyepiece. The scope was positioned to view a small toy frog of many colors mounted far away as a viewing target. He explained that the name "Ethos" came from Tele Vue's motivation to "do no harm to the image." When I looked through the Ethos eyepiece on the NP 101, I was amazed at the clarity, detail, color purity, and brightness of the image. I could even see a few very fine dust specks on the eye of the frog. I was surprised that I couldn't see all of the field of view (FOV) without moving my eye around the eyepiece, but it was daylight, so my pupil was much smaller than it would be for night vision. The nice older man was generous with his knowledge about eyepiece options for my beginner telescope. I was ready to buy the 13mm Ethos eyepiece for just under $700, but my wife was standing there with somewhat less enthusiasm. So, I didn't buy one—yet.

Later, when I was talking to Sherry about that nice older man, she told me that the name on his badge was Al Nagler. (Al was wearing his badge low, and I am very tall, so I didn't see it.) I was really impressed that such an accomplished man, famous for his telescope and eyepiece designs, would spend so much time with a new amateur. He is truly a wonderful man whom I will never forget. Sherry and I have found such kindness to be common among the accomplished astronomy club members; they are knowledgeable and generous people who go out of their way to help new members.

Al Nagler demonstrates the Tele Vue NP127 with a Bino-viewer (Source: Joe Francis)

After that Winter Star Party, Tele Vue steadily introduced new Ethos eyepieces, and I began buying them at every "good-value" opportunity. In my case, "good-value" means buying a like-new eyepiece from a trusted party who no longer needs it in order to save as much as 20 percent of the cost new. We now have Ethos eyepieces with focal lengths ranging from 3.7mm up to 21mm. We all know that the magnification of a telescope setup is determined by the ratio of the telescope focal length to the eyepiece focal length (see Astronomy Math in this issue—ed.). Because we have an 18" Obsession Ultra-compact telescope with a focal length of 1900mm, the magnification range will be from 90 to 513 with a 100° apparent FOV. But even on our first telescope, a simple Orion Classic 10" Dobsonian, the Ethos eyepieces produce images as good as on very expensive refractor telescopes, in my opinion. I say this based on sharing views of the same subjects with telescopes of much higher quality, but without Ethos eyepieces. I believe we should advise new astronomy members much the same way we advise those planning on a new stereo sound system: Put your money in the output stage! For a stereo system, put half your budget into the speakers. For a telescope system, buy the best possible eyepieces. From that perspective, Ethos eyepieces are relatively inexpensive.

"In September 2007 Tele Vue Optics released 'Ethos,' their newest ultra wide angle eyepiece and an innovative achievement for our astronomy community... none before delivered the combination of:

- a whopping 100° Apparent Field of View,
- a clear and high contrast image that is tack sharp all across that entire 100° field of view,
- compatibility with visual telescopes of all practical focal ratios,
- all of this at a price that is lower than ever before for anything even remotely approaching this performance."

—Company Seven

In conclusion, refer to the evaluation of the first Ethos eyepiece by Company Seven, a highly respected source of independent reviews and astronomy equipment, located in Laurel, MD. It is quoted, in part, in the box to the left.

Adventures in Using a Fiber-Fed Spectrometer for Astronomical Purposes

By Jerry Hubbell

Last year, I began playing with a neat little device called a Spectrum Analyzer 100 (SA100)—a 100 line-per-millimeter (lpm) transmission grating mounted in a 1.25-inch filter holder. You can use the SA100 just as you would any other filter and can screw it into an eyepiece or camera nosepiece. It allows you to observe or record the dispersion of starlight gathered by your telescope. After using this grating for a few months, I was hankering for a higher-resolution spectrometer to learn more about stellar spectra and the science behind spectroscopy.

I joined a few online groups focused on spectroscopy and spectrometers, and one day happened upon a discussion about a fiber-fed spectrometer available on eBay for only a couple hundred dollars. Typically, these devices are big-buck items, ranging in price from $1,000 to several thousand dollars, depending on the features, so I was very interested in this inexpensive model. To make a long story short, I bought one from Science-Surplus. Next, I had to figure out how to make a fiber-head to mount on my astrograph to position the starlight accurately on the end of the fiber optic cable.

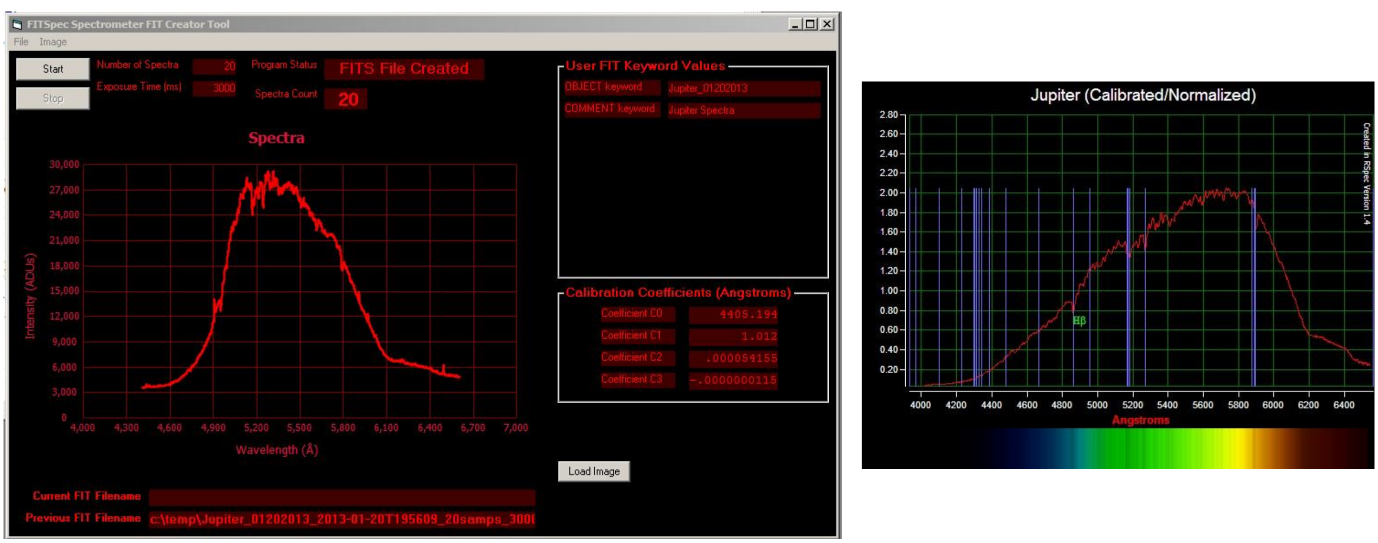
I had read online and in a couple of spectrometry books that amateurs had turned their flip-mirror into a fiber-head by modifying it and replacing the mirror with a beam-splitter. A beam-splitter allows a percentage (typically 50 percent) of the incoming light to pass straight through while reflecting the remainder 90 degrees up into another instrument. In this case, the light that passes through is focused on a CCD camera to accurately position the star. The nice thing about imaging with a CCD is that you can both calculate the position and also use it to guide on the star that you are observing with the spectrometer.

Mounted Spectrometer (Source: Jerry Hubbell)

So I modified my [Orion flip-mirror](), but after talking with Bart Billard, I decided to use a [cold-mirror]() instead of a beam-splitter. A cold mirror is [wavelength sensitive]() in that it reflects wavelengths below 7,000 Angstroms (Å) and allows wavelengths above that to pass through. Because the CCD camera is sensitive to light up into the infrared (IR) range, I would position the star using the IR signal and record the range from 4,000Å–7,000Å with the spectrometer.

Over the past 2 months, I've been able to use the spectrometer and learn all about calibration and CCD response curve normalization. I have also written some software to acquire the data from the spectrometer and display it, and developed a function to save the data using the FITS image format. Data is stored as a two-dimensional array and displayed as an image. This type of image comes in handy to observe any changes in the spectra of a star over time because the y-axis of the image is time and the x-axis of the image is wavelength.

One of the specifications I needed to determine for my system was how sensitive it was. How dim a star would I be able to precisely measure with the required signal-to-noise ratio of 100? Well, it looks like the CCD chip in the spectrometer is not as sensitive as I had hoped. The spectrometer can only acquire data for 60 seconds at a time, so I would need to "stack" spectra if I wanted to image longer to observe dimmer stars. With 20, 1-minute exposures, I have successfully obtained spectra from the star Castor (α Gem) which is a 2nd magnitude star. I need to do further work in this area, mounting the spectrometer on my 8-inch Ritchey-Chrétien astrograph to observe dimmer objects. My scheduled RAClub presentation for the February meeting is entitled "Engineering a Fiber-Fed Spectrometer for Astronomical Use" and will go into much more detail than presented here. I hope to see you there!

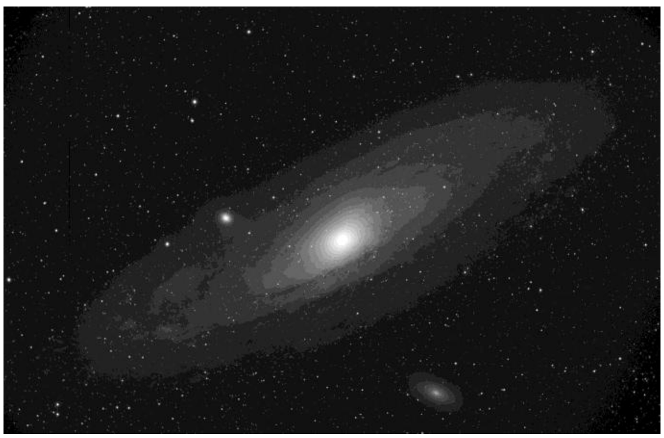


Jupiter: FITS File Display (left) and Calibrated/Normalized Spectrum (right) (Source: Jerry Hubbell)

(An Astronomical Journey…continued from page 1)

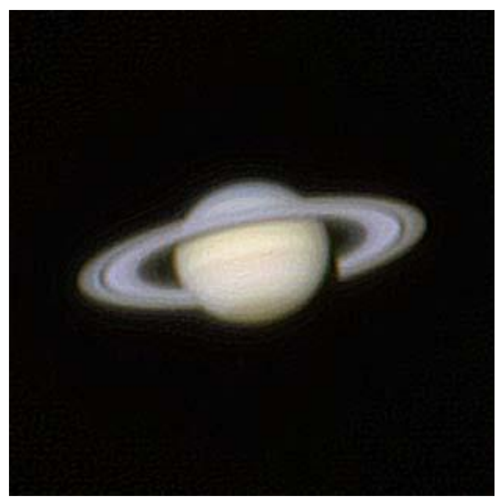
After spending time in the observatory gallery, we were escorted into the telescope viewing gallery at the base of the Hale telescope. My first thought was that it was so huge, so wonderful in its mechanical beauty—simply awesome to behold in person. I remember that the dome rollers that transported the heavy weight of the dome were actually train railcar wheels.

Later, back in camp, we had dinner and then went to the activities lodge to find something interesting to do. There was lots of talk about our trip to the observatory, and I exclaimed that it would be cool if we had a telescope so we could look at the stars. One of the camp counselors overheard my comment and immediately directed me to the corner of the room where a small 40x Bausch and Lomb spotting scope rested atop an old wooden tripod. The counselor said I was welcome to use it. I immediately seized this opportunity and went outside with the little scope and set it up in the snow and freezing cold evening air.


Messier 31, The Andromeda Galaxy, ***(Source: Scott Busby 19 Nov 2012)***

Two bright stars hung low in the western sky. I was immediately drawn to them as my first objects to view using the little scope. I trained it on one of them and recognized it right away as Jupiter, our solar system's largest planet. This was the first time I'd seen it through a telescope. You can imagine my excitement as I noticed the four Galilean moons—Io, Callisto, Ganymede, and Europa. Wow! What a sight. Although the little telescope presented a very small image, it was still a treat to see the four moons and the dark equatorial cloud bands in the planet's atmosphere. Amazingly, the second bright "star" I looked at was Saturn. I was awestruck as I gazed at the ringed planet for the first time.

When I finally returned home, the first thing I asked my parents for was a telescope for Christmas. That Christmas, I received a small 50mm Tasco refractor from the local Sears store. This scope was only slightly better than the one I had used at camp, but it was mine, and I used it on every clear night.


Saturn (*Source: Scott Busby)*

Many Christmases passed, and my interests in astronomy grew ever stronger. I checked out every book on astronomy I could find in the school library and learned a great deal about the cosmic wonders of space. Eventually, the little 50mm scope fell into disrepair, and the desire for an upgrade grew stronger. Once again, I talked my parents into a larger, more capable telescope as a Christmas present.

My second telescope was a Japanese-made 2.4-inch achromat refractor. This scope was heads and tails better than the little 50mm Tasco and came with lots of cool accessories, including a couple of eyepieces, a 2X Barlow, and star diagonal, all on an alt-azimuth tripod complete with slow-motion controls. This scope was my pride and joy for many years into adulthood.

Several years, a marriage, children, and a military career later, I decided to get a little more serious with the hobby of amateur astronomy. Over the years, I lusted after the latest amateur telescopes, looking at catalogs with pictures of "Unitron" refractors and Cave Optical reflectors. These scopes were way beyond what I could afford, and it would be many years before I had the means to buy a modest modern telescope. My other hobby was photography, and I had amassed several thousand dollars' worth of photo equipment over the years. Eventually, as my interest in photography waned, I sold my cameras and equipment, which provided me the wherewithal to buy a better, more capable telescope.

I returned to the hobby on a whim and purchased a new computerized Celestron SLT, 4-inch achromat refractor. This was just a small start to see whether I would stay with the hobby of amateur astronomy. I also joined the Rappahannock Astronomy Club and went to my first star party. In about 3 weeks, I outgrew the SLT and decided to go bigger with the purchase of a used Meade 10-inch Schmidt-Cassegrain reflector. This telescope opened up all kinds of possibilities for me, including astrophotography. Astrophotography required one other expensive accessory, a motorized German Equatorial mount (GEM). The GEM is essential to track objects for long exposure times. Over the course of 3 or 4 years, I added to my inventory—a Meade 4-inch refractor with a reliable GEM; Takahashi apochromatic 2.4-, 3-, 4-, 5-, and 6-inch refractors; a Takahashi Mewlon 250S Cassegrain reflector; and a wonderful Takahashi EM400 GEM. This represented a giant leap in capabilities, optical quality, and of course expense.

Scott's Takahashi Mewlon 250s on an EM400 GEM

Star parties present a wonderful opportunity to travel to dark sites and hob-knob with other amateur astronomers and the interested public. However, owning the latest astronomy hardware also means you have to get it to the dark site—sometimes many miles away—set it up, observe or photograph, and finally tear it all down for transport back home, sometimes in the freezing cold early morning hours. Doing astrophotography at a remote dark site is particularly problematic because you must spend significant time accurately polar-aligning your GEM so that you can at least have presentable astrophotos with nice round stars. The more time setting up equipment, and aligning and tweaking your astro gear, the less time spent actually observing or photographing anything. I often thought that if I could only set it up once and leave it alone, I could focus all my efforts on observing or doing astrophotography. Of course, the solution was simple—own your own personal observatory.

In summer 2011, I bought a used Technical Innovations Pro Dome 10-foot Observatory from a former RAClub member. I purchased the observatory, and at extra expense, built a 24-inch concrete pier base and installed a Pier-Tech 2 electro-mechanical telescoping pier on it. Around this structure, I had a 16-foot custom hexagonal deck built on which would sit the Pro-Dome observatory. I set up my Takahashi EM400 GEM on the pier and then attached an array of telescopes more or less permanently. I now use this setup for casual observing or astrophotography without the hassle of transporting and setting up at a dark site away from home. The Pro Dome Observatory protects the scopes, mount, and accessories from the weather, and I can use the equipment at a moment's notice.

The author's finished Pro Dome Observatory

If ever there were a dream for an amateur astronomer, aside from having a big aperture telescope, it would be his or her own private observatory. The benefits of course should be evident—permanent setup for telescopes, protection from the weather, a shield to protect the observer from wind and external light sources, among other advantages. I was so proud of my new observatory that I gave it a name, “Belmont Observatory” and had a sign made for it.

Scott’s telescopes at Belmont Observatory (left) and the author at Westmoreland State Park(right)

The observatory is a huge convenience. I can use any free time I have to either observe or do astrophotography. Because this is a permanently aligned setup, I can continuously track and photograph over several nights, thus increasing the amount of light exposure for a particular object. Every time I use the observatory, I keep a running log of my activities. I make historical entries for weather conditions at observing time, and list objects observed or photographed and any tweak or modification, including the reason for it. This captures successful and unsuccessful system improvements or modifications.

Some improvements I’ve made over the last few months include installing a de-humidifier, area fan, lighting, and an intercom system. Improvements I intend to make in the next year include adding a weather station and converting to solar power. I might even install a USGS seismometer to monitor earthquakes and a remote connection to the home computer inside the house so I can stay warm and comfortable during the cold Virginia winters.

I am very pleased with my personal observatory. If there is any downside, it might be my reluctance to travel to star parties at any great distance. However, I keep a portable GEM so I can make an occasional trek to a public astronomy outreach event.

Shoot for the Stars—Library Outreach for Kids

By Linda Billard

On January 11, Jerry Hubbell and Linda Billard entertained a group of children (K–6) on the subject of the constellations. The presentation was part of the Central Rappahannock Regional Library’s Fabulous Friday after-school series for kids. A group of 32 parents and children learned about some of the better-known constellations, first in Jerry’s presentation and then through Linda’s use of an iPad and SkySafari to show the participants what constellations they would see if the sky had been dark and clear. The children then split up into groups to create their own “constellations” on paper. The results of the activity are now hanging in the Juvenile Non-Fiction room at Headquarters Library.

Highlights of Recent RAClub Presentations

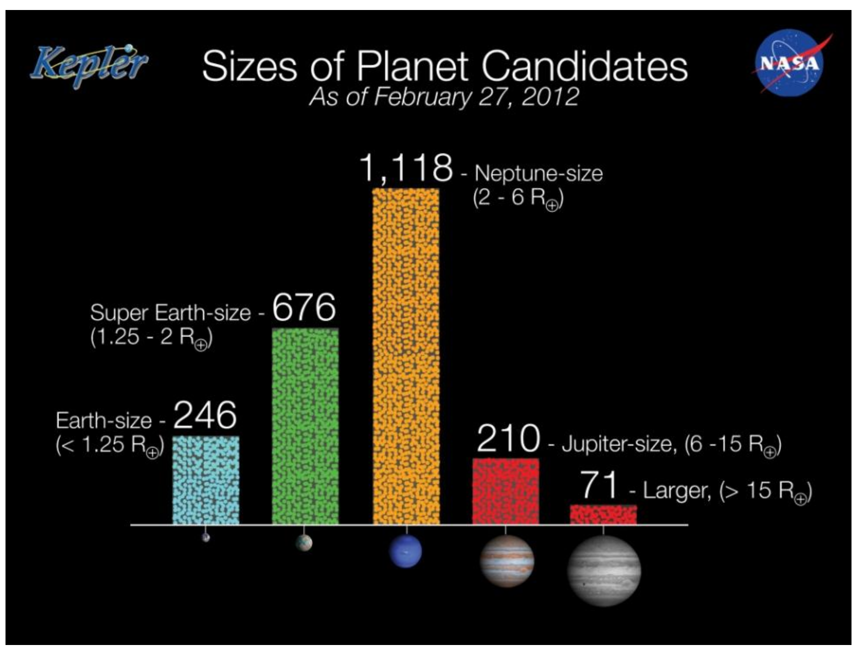
December 2012—NASA Kepler Mission Update

Bart Billard presented an update on the NASA Kepler space telescope mission. The telescope, launched 3-1/2 years ago, had a goal to collect at least 14 quarters of stellar light-curve data on more than 100,000 stars to search for extra-solar planets (exo-planets). The minimum goal was recently achieved, and the mission received approval for a 4-year extension. The telescope is in an Earth-following orbit around the Sun and was 42 million miles from Earth in November. It monitors an area of 105 square degrees between Deneb and Vega, a little above the plane of the Milky Way.

The Kepler telescope uses transit measurements, not radial velocity measurements, to discover exo-planets. In the radial velocity method, the unseen planet's gravitational effect on the host star causes the star to wobble in a small orbit of its own. With a favorable orientation of the planet's orbit, this wobble includes periods of motion toward and away from Earth, and it can be detected by spectroscopic measurements of the Doppler shift. Because larger shifts result from more massive planets orbiting close to host stars, the radial velocity searches completed before Kepler's launch almost exclusively detected planets with masses like Neptune and Jupiter with orbits mostly relatively close to their parent stars in the searches.

The Kepler telescope design, on the other hand, allows it to search for transits—slight dimming of stars for periods of a few hours that result from planets in orbits that pass in front of the host stars from Earth's point of view. To push the capability of finding extra solar planets beyond what was achieved by radial searches, Kepler is sensitive enough to detect these even for a planet of Earth size orbiting a star like the Sun. If these changes reoccur regularly, consistent with a potential planetary orbital period, candidate planets are identified.

Follow-up observations with ground-based telescopes can then be made to confirm whether an apparent transit signal is actually caused by an exoplanet. In some cases, a host star has more than one candidate, and these systems can be confirmed by careful observation of the timing of the transits for evidence of the gravitational influence of the planets on each other. One "false alarm" source that must be ruled out by follow-up observations is variations caused by background eclipsing binary star systems. These can mimic planet transits if they lie behind a star monitored by Kepler. As of early December, Kepler has found 2,321 candidate planets and 2,165 eclipsing binary stars among the 150,000+ stars it is monitoring. While follow-up work has confirmed 105 planets, estimates suggest that as much as 90 percent of the candidates will eventually be confirmed.



Size Distribution of Kepler Candidate Planets (Source: NASA Kepler)

The mission's discoveries to date include the first unquestionably rocky planet (beyond our solar system), the first multiple-transiting planet system, the first small planet in the habitable zone of a star, the first Earth-size planets, Mars-size planets, and confirmation of a new class of double-star planetary systems. Results reported in two recently submitted papers could increase the number of confirmed Kepler planetary systems to 67, with more than half containing more than 1 planet. Nearly half of the candidate planets are Neptune size (2–6 times Earth's size), and nearly 700 are super-Earth size (1.25–2 times Earth's size). There are 246 in the Earth size range, 210 in the Jupiter size range (6–15 times Earth's size), and 71 larger planet candidates. Of 46 candidate planets found in the habitable zone, where liquid water could exist, 10 are Earth sized.

Among systems with unexpectedly small orbits, the first included six candidate planets, all with orbits that would fit inside Venus's. In a recently discovered system with three planets smaller than Earth orbiting a red dwarf 1/6 the size of the Sun, all the orbits take less than 2 days. Kepler-16b is the first planet known to definitively orbit two stars—what's called a circum-binary planet. Kepler has also found circum-binary systems, more than one planet orbiting a double star. The Planet Hunters project has citizen scientists examining Kepler data to see what human pattern recognition capabilities might find that automated data analysis used by the Kepler team might miss. Planet Hunters have found some candidates, and they recently had their first confirmation: a planet orbiting a binary star system that is, in turn, orbited by another distant binary.

January 2013—New Equipment "Show and Tell"

The program for January was an open forum on new astronomy gear and what members have been doing lately. Ranny Heflin led off by showing an ETX 90 Maksutov-Cassegrain telescope. His older son has one, and this one was a present for his younger son. It can be controlled by a computer and equatorially aligned or used in an altitude-azimuth configuration. It has a narrow field of view and could use a better finder, but is suitable for viewing planets in bright skies. It fits his older son's apartment location because it is easy to pack up and go with the optional case. Ranny also showed a new set of filters for his DSLR camera, including hydrogen-alpha, oxygen-III, and sulfur filters.

Meade ETX90 Maksutov-Cassegrain (Source: Google Images)

Rob Friedel bought a new Telrad finder and described an Apple Telrad App. It adds the finder bulls-eye pattern to the view of the sky on the screen. It lets him aim his telescope within a degree or two of his target. He was able to get extra finder base mounts to use on his other two telescopes so that he can easily switch the finder from one scope to another.

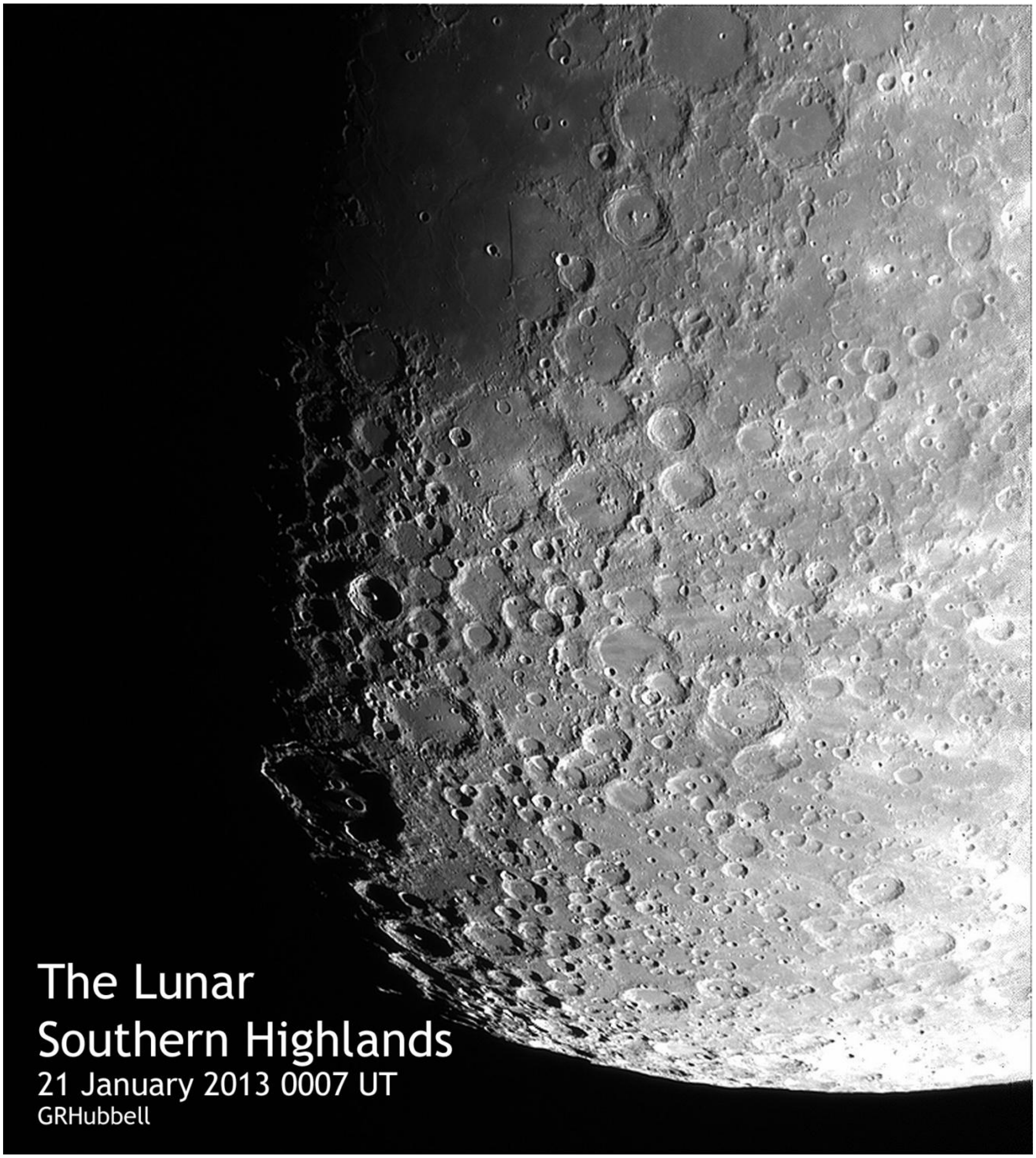
Scott Busby said the astrophotos he sent out recently reflected his main activity of late. He was also working on tweaking his telescopes and autoguiding techniques. However, he found he keeps going back to manual guiding. With his telescoping pier to adjust the height of the eyepiece, he can get very comfortable for manually guiding long exposures. However, he described a drawback he has discovered with the pier in his observatory. It has a large mass of metal that takes a long time to change temperature. When the morning sun reaches the dome, the humidity inside goes up and often condenses moisture on the pier. He found that a dehumidifier only makes it colder, and was considering other options.

Jerry Hubbell bought the Byrch *Great Atlas of the Sky*, which was recently reduced in price. (Some were still available.) It included an overlay for measuring positions, and a clear plastic holder. The large charts, covering 10 by 15 degrees, are removable, and the holder can be used to temporarily mark the chart. The atlas includes more than 2.5 million stars to magnitude 12 and 70,000 deep-sky objects.

Joe Fordham described his new setup with 20x100 binoculars, mount, and chair. He can cover a quarter of the sky at a time in comfort from the chair. He also added Fuji 16x70 binoculars for better image quality views, although not as good for faint galaxies. David Buckwalter did not have new gear, but in part it was because he was busy moving. He said he would be living in a dark sky location not far from Scott Busby. Ben Ashley described a project to build a high-power green laser pointer. Linda Billard had a new sealed 12V lead-acid battery (avoids having to use 8 AAs) for powering the Club NexStar and an iPad to use for accessing SkySafari.

Scott Lansdale had perhaps the most unusual gear to discuss. He built a VLF antenna for observing solar flares and storms. It picks up manmade sources to reveal effects of the Sun on the ionosphere. He said it can also pick up strange things such as earthquakes, if they occur during the day and are located between the antenna and the VLF source to which it is tuned. He said he also picked up what he thinks is a neighbor's invisible dog fence.

Image of the Quarter



Equipment and Comments: I acquired this image on 21 January 2013 0007 UT. This image of the Moon's southern highlands is from a stack of the best 200 out of 1,000 frames acquired with my ATIK 314e TEC CCD camera and my ES ED127 APO 5-inch refractor at a focal length of 952mm and f/7.5. The exposure time for each frame was 0.004 seconds (1/250th second). The total time it took to acquire the 1,000 frames with my deep space camera was approximately 30 minutes. I processed the raw data using Registax6, MaximDL 5.15, and Photoshop 6—*Jerry Hubbell*