http://www.raclub.org/

The StarGazer

Newsletter of the Rappahannock Astronomy Club No. 1, Vol. 3 May 2014–July 2014

Astronomy Night on the National Mall—June 6, 2014

By Ron Henke with Linda Billard

This is the second year RAClub has participated in Astronomy Night on the National Mall and the first time for me personally. The event is sponsored by Hofstra University, and 2014 was the fifth year the event has taken place. A number of scientific and astronomy organizations (including NASA and the National Science Foundation) participated, providing quite a range of expertise for those who attended. I only wish I had had the time to take advantage of what they had to offer…but more about that later. The event was held on the lawn between the Washington Monument and Constitution Avenue, which I have to say, despite being light polluted, is a great spot to look at the planets.

Moon over the Washington Monument
Source: Ron Henke

Astronomy Night on the Mall had been discussed for several months at club meetings. Being new to amateur astronomy, I thought this would be a great way to share my excitement about this hobby with others. Six of us (Bart and Linda BIllard, Jerry Hubbell, his daughter Rachel and granddaughter Charlie, and me) all met at the North Stafford Market Place parking lot before setting off in a caravan of cars for the National Mall.

Despite the inevitable heavy traffic and an accident on I95, we arrived at the Mall just after 5 p.m. and unloaded our equipment. Hofstra University had volunteers to help us move our equipment to a staging area near where we would set up. At this point, Jerry mentioned (warned?!) that as soon as we set up, people would line up to look in the telescope. After not paying much attention to what he said, we went and parked our cars. We returned to the staging area, got our equipment, and began setting up. I did take a few minutes to eat a third of a sandwich and drink half a Coke that I had brought…it's a good thing I did because that was the last time I had a moment to myself.

The Moon was out, even at 5:45 in the evening, so I did what any astronomer would do, I pointed my telescope at it. This is where the evening got interesting. I was hoping to be able to talk with some other amateur astronomers there, but that didn't work out. While eating my sandwich, I saw some people looking at my telescope. So I went over and took the lens cover off and put the Moon in the field of view. I never left the scope for the next 5 hours! Jerry was right! During the time the Moon was out, there were always at least five or six people in line to take a look. What I wasn't ready for was what happened when it got dark, and I moved the telescope to focus on Saturn. The line went from 5 or 6 people to 30 to 40 people. From what I could see, Linda, Bart, and Jerry were having a similar experience. We estimated that with our four telescopes, we provided at least 1,000 views! *(continued here)*

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.

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

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Jerry Hubbell Astrophotography

Calendar of Upcoming Events

Picnic/Star Party, Belmont Observatory*	August 23
Club Meeting, Maury School	September 17
Star Party, Caledon	September 27
Club Meeting, Maury School	October 15
Star Party, Caledon	October 25

*members only

Recent Outreach Events Completed

Star Party, Caledon	May 3
Star Party, Burgess, VA (Girl Scout Camp)	May 3
Virginia Renaissance Faire	May 27
Star Party, Caledon	May 31
Astronomy Night on the Mall	June 6
Star Party, Caledon	June 28

President's Corner

Welcome to New RAClub Members (May–July)

- Lauren Nicholson
- Lisa Manion

In reviewing this quarter's newsletter, I was struck by how we have provided articles that link up very well with some of our presentations. As Linda remarked to me, this is a mere coincidence, but it is interesting nonetheless. I think that you will enjoy the links between Bart Billard's article on occultations and the presentation he did at a past meeting. Also, Myron Wasiuta's talk about star testing and my review of the star testing bible, *Star Testing Astronomical Telescope*, is included this quarter. Certainly, we have all come to appreciate Scott Busby's Astronomy Math, and he has given us an interesting topic this quarter on star distances. Ron Henke has provided a new member's view of the club's annual trip to the Astronomy Festival on the Mall. Terry Barker has showed us how to get what you normally would pay for, for free. And finally, both Scott Lansdale and I have provided articles on conferences we recently attended.

Overall, this is another excellent newsletter, and to date Linda has done a uniformly excellent job in putting these together. Without all the wonderful contributions of our members, this newsletter would not be the excellent resource that it has become over the past 2 years. I look forward to seeing many more issues. And don't forget, please let Linda or I know if you have any ideas for articles. At the club annual picnic in August, we will be having an activity to brainstorm ideas for future articles.

Thanks again for your support of the RAClub, and I look forward to seeing you soon!

Well, that's it for now…until next time, Clear Skies!—*Jerry Hubbell*

Astronomy Math by Scott Busby

The bright star in Orion called Betelgeuse is 650 light years from Earth. What is this distance in kilometers?
(We'll write the answer using words such as thousand or trillion, where appropriate, and round the answer to the nearest 1,000 trillion.)

If 1 light year is 9.3 trillion kilometers (km), multiply this by 650 to get the distance to Betelgeuse

650 x 9.3 = 6045 trillion km

which we can rewrite as 6,000 trillion km. The actual name for 1,000 trillion is one quadrillion, so we might also write Betelgeuse's distance as 6 quadrillion km.

Betelgeuse is expected to blow up as a supernova sometime in the next 1 million years. Suppose this happened in the year 3,000 AD. In what year would someone on Earth see this explosion?

Betelgeuse is 650 light years from Earth, so it takes 650 years to reach us. If the explosion happened in the year 3,000 AD, then we would see the light arrive in the year 3,650 AD, 650 years *after* the event occurred.

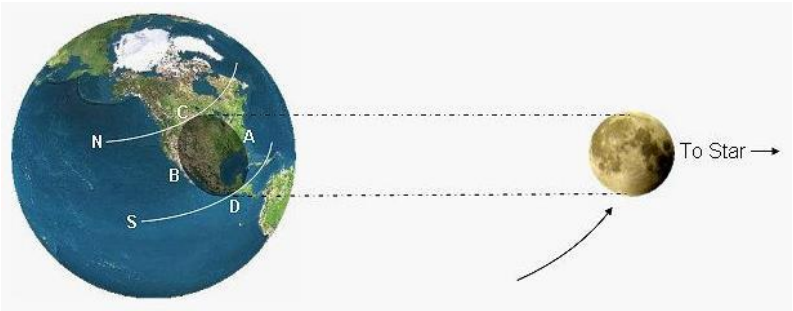
Okay, So What's an Occultation?

By Bart Billard

Linda and I attended to our first Northeast Astro-Imaging Conference (NEIAC) and the Northeast Astronomy Forum (NEAF) in New York last April. On the last day (Friday) of NEIAC, we had taken a brief break to rest and so arrived late for a presentation that proved to be very interesting.

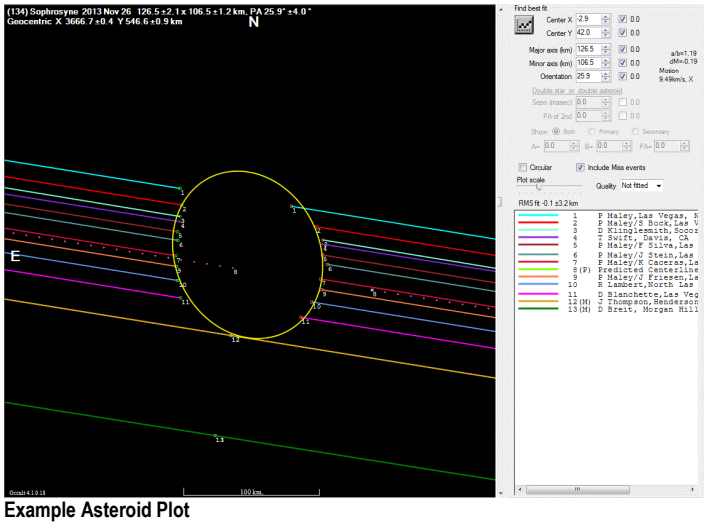
Ted Blank of the International Occultation Timing Association (IOTA) talked about the science of timing occultations of stars by asteroids. I was intrigued by his description of setting up remote "mini-observatories" aimed in advance at the right part of the sky to record video of a star disappearing for a while and reappearing as it drifted through the FOV of the telescope. The trick he described is to find a star at the same declination as the target star you want to see, and point to it at the appropriate time in advance (calculated from the difference in right ascension). This made sense to me, and I have since confirmed I understood how to do it. Missing most of Ted's presentation didn't turn out to be much of a handicap because IOTA had a booth at NEAF where we could learn more. On Saturday, Ted also held a workshop talking about the basics of occultation timing. This was a new topic for me, and I hope this article offers a good introduction and some helpful links for further exploration. So let's find out: what *is* an occultation, what sort of scientific information can timing them provide, and how are they timed?

What's an Occultation? IOTA's website has a tutorial page explaining occultations ("What is an Occultation?"). Briefly, an occultation occurs when a solar system object blocks some or all of the light of a more distant object. IOTA's timing efforts usually involve occultations of stars by the Moon or asteroids. These target stars are so distant that at any moment, the phenomenon is only visible from an area the size of the Moon or an asteroid. In the diagram above, a shadow cast on the ground moves across a swath of the Earth's surface. Starlight is not bright enough for us to make out the shadow on the ground, but an observer in the path, looking at the star, would see it disappear for a while and then reappear. (Note that if the limb of the Moon is sunlit where one of these events occurs, the disappearance or reappearance wouldn't be visible except for a very bright star.) If observers at different locations time the interval between the disappearance and reappearance, observers nearer the edge of the path will get a shorter time than those nearer the middle. An observer at the edge of the path (at "C" in the diagram, for example) would see a "graze." Because of mountains and valleys on the limb of the Moon, a graze observer could see more than one disappearance and reappearance. Timing these events can allow a team of observers arrayed near the edge of the shadow path to measure the topography of a portion of the Moon's limb.



Moon Occulting a Star
Source: http://netstevepr.com/iota/wp-content/uploads/2013/12/im1-1.jpg

Asteroid occultation timing is similar, although it is rarer to have good enough predictions to allow several observers to measure a graze. However, a picture of the shape of the asteroid can be plotted from the results of the timing by a team of observers. In the plot, parallel trails represent where the star was visible to each observer, and gaps in the trails represent where the star was not visible to the corresponding observer.



Example Asteroid Plot
Source: http://www.asteroidoccultation.com/observations/Results/Data2013/20131126_SophrosyneProfile.gif

Adjustments must be made for differences in the positions of observers along the path of the shadow, making the plot appear as though all the observers were in a single line perpendicular to the path of the shadow. Then the blank areas of all the trails line up to indicate the shape of the asteroid's shadow (see example to the left). An outline is added around this blank area in the shape of an ellipse. The shape of the blank area represents one cross section of the asteroid, and additional measurements of other occultation events would be needed to develop a three-dimensional picture. The elliptical outline can be a starting point for modeling the shape when information about the asteroid is limited. Many asteroids too faint to be seen in small telescopes can still reveal themselves to amateur observers using these occultation exercises.

Why Do Occultation Measurements? In addition to contributions to knowledge of the shape of asteroids and lunar limb topography, amateur asteroid occultation timing observations can lead to double star discoveries (they disappear in steps), discoveries of orbiting companion asteroids, improved knowledge of asteroids' orbits, and more. Recently, as a result of occultation data on a 19th magnitude star, an asteroid was discovered to have a ring system although the star that was used is rather faint for amateur telescopes. Lunar occultation timing can contribute to similar information about stars. In addition, lunar grazing occultations that repeat for the same star over the 18-year lunar cycle can be timed to improve proper motion information for the star. Also, grazes on lunar limb terrain with a shallow slope can resolve the angular diameter of some stars. Instead of meeting the star head-on at the apparent angular speed of the Moon's motion across the sky, the feature gradually rises up across the star nearly perpendicular to the Moon's motion. This phenomenon is best timed with two or more observers closely spaced so their relative timing measures the slope of the feature.

The starting point for timing an occultation is getting a prediction. The IOTA website has download links for prediction software (http://occultations.org/observing/software) and links to other resources. For example, Steve Preston maintains a prediction website (http://www.asteroidoccultation.com/) with detailed lists covering 3 months and links to his picks for the best events in the current and coming year. More observation opportunities are possible if you can travel some distance and/or observe fainter stars.

Equipment. Minimal equipment for timing an occultation would include a recorder for your voice and as a timing source, a shortwave radio tuned to a time signal such as WWV, and binoculars or a telescope capable of showing the star. This setup allows visual timing, which is limited in precision by your reaction time, but I found it was a useful learning experience to try it. Video recording has become the preferred method and can be done by adding a video camera adapted to the telescope and a camcorder. Low-light surveillance cameras are good video camera options. A focal reducer is helpful for getting a brighter star image and making the field of view wider to simplify pointing. Video allows timing precision of about 33 milliseconds. Accurate timing can be obtained by recording the radio timing signal on the audio track, or you can get a GPS video timing insertion device that annotates each frame of the recording with universal time information along the bottom. Steve Preston's prediction website provides a details page for each event, with maps of the predicted shadow path and links to finder charts and other details (see the example for "(232) Russia" at http://www.asteroidoccultation.com/2014_08/0820_232_33579.htm). With a tracking telescope, you can find the target ahead of time and track until it is time to start recording. The trick Ted

Blank described works for a telescope that doesn't have tracking capability. Choose a reference star west of the target that has the same declination and is easy to find. The difference in right ascension of the target star and the reference star is the amount of time between when the telescope is pointed at the chosen star and locked in place until the target star rotates into the same position in the FOV.

This is just a taste of what's available on the IOTA website. There's a downloadable manual, *Chasing Shadows,* and a variety of tutorials on different techniques. It's become another new subject to add to my "continuous learning" goals.

Telescope Automation at the US Naval Observatory

by Jerry Hubbell

Over the past few years, I have been fortunate to meet a variety of people in the astronomy industry, both amateur and professional, who are leaders in their fields. Recently, I met Russ Genet, a pioneer in the use of microprocessors for controlling telescopes. His book, *Microcomputer Control of Telescopes*, written with Mark Trueblood and published by Willman-Bell in 1985, made a strong impression on me back in the mid-1980s. His more recent book, *Telescope Control*, published in 1997, expands on the original material and updates the technology discussed.

US Naval Observatory
Source: Jerry Hubbell

After some good conversations with Russ about telescope and observatory automation, he invited me to attend a conference at the US Naval Observatory called Workshop on Automation and Robotic Operation of Moderate-Sized Telescopes for Speckle Interferometry. That's certainly a mouthful! Anyway, the conference was held June 2–3 with a meet-and-greet the previous evening. The meet-and-greet was held at the USNO James P. Gilliss Library, which contains the world's largest collection of astronomy books, periodicals, etc. It also includes a good selection of antique documents, including Bayer's 1603 edition of *Uranometria*. At this event, I met Russ (in person for the first time), the observatory director, and the USNO public relations officer, Geoff Chester.

US Naval Observatory 26-inch Refractor

The first day of the conference began with coffee and Danish first thing in the morning—after a 2-hour drive from home, it was a good respite. The papers presented during the day included talks about observing programs for high-cadence long-focus instruments, current speckle observing programs, and high-end cameras and camera systems. As you can tell from the descriptions, this was only professional level stuff. Russ told me to expect that, but that I and the another amateur astronomer who attended were invited to provide our input during the discussion because the professionals valued our knowledge of the more practical side of doing astronomy from home. That afternoon, after the day's presentations, we toured the grounds of the observatory and the time standards housed there. Geoff Chester gave us a good description of the history of the time standard and how the observatory continues that work to this day.

That evening, we were invited to visit the USNO 26-inch Clark Refractor and hear a talk about the speckle instrument installed on it. This telescope is a twin of the one at the University of Virginia's Leander McCormick Observatory.

The agenda on the following day covered topics such as automating and adding speckle instruments to existing telescopes and also the design of a dedicated speckle instrument. The day finished with a discussion about software and standards dealing with high volumes of data.

Overall, I had a great time at the observatory and welcome the opportunity to visit there again in the near future. If you have a chance to go, take advantage of it, it is well worth the aggravation of driving into DC. It was very cool being included in the discussions on what the professionals are planning for future automation projects and the work that is done at the US Naval Observatory. I was thrilled to be invited to provide a copy of my book to add to the USNO library collection for use by the library patrons. It's certainly an honor to have it included in the largest astronomy library in the world.

Magazines for Free—and Yes, *Astronomy* Is One of Them

By Terry Barker

I'm sure you've been solicited for magazine subscriptions before. And you can get some pretty good deals. But, I've got an offer that's even better. Free. Not for "a limited time," but forever. And there's never a late fee. What do you have to do?

Do you belong to the Central Rappahannock Regional Library (CRRL)? Then you're eligible to check out dozens of magazines, for free. Digitally, of course. And, as an added bonus, one of those subscriptions is to *Astronomy Magazine*. I've been doing it for several months now, and it works perfectly.

I now have free subscriptions to *Astronomy*, *Discover*, *Popular Science*, and several more. I can read them either on my PC or on my Nexus 7 tablet. Here's how to do it:

Rbdigital is the service that offers this program to libraries, but you have to start at the CRRL site. Sign on and look for the ebook links on the right side of the page.

That will take you to the page below, where you're able to select the reader software that you're going to use to actually read the magazine.

I use Zinio, which is the first icon on the left. It works on Windows and most mobile devices, so I can recommend it without reservation. Zinio is the king of emagazines. It has literally hundreds of selections. Many more than are offered with Rbdigital, and you have to pay for them, of course. But, the ones you can select through Rbdigital are free.

Once you click on the icon, you'll see options to download the software. Once you've done that, come back to this site, and you'll be able to select the magazines you want.This should get you started—let me know at the next RAC meeting if you've tried it.

Astronomy Night on the National Mall—June 6, 2014 (continued from page 1)

I have to say, it was exhausting and exhilarating all at the same time. Nearly everybody that came through the line said “Oh wow” or “That’s amazing.” Nearly everybody also said “Thank you.” For many of them, this was the first time they had looked through a telescope. I had one couple come through the line four times, once to see the Moon and three times to see Saturn.

In the 6 or 7 months I’ve had a telescope, Astronomy on the Mall has been my best experience. I did learn a couple of things I’d like to pass on. First, take time for yourself. This includes a restroom break and taking enough time to have something to eat. Once the lens cap comes off, you are done doing anything but astronomy for the rest of the evening. Second, if you have a go-to scope, take the time to align it once there are enough objects visible in the sky. This does two things—you won’t have to put the object back in the field of view every third or fourth person in line, and it will allow you to use a higher magnification. I was using only 77x to keep Saturn in the field of view longer, whereas if the scope had been aligned properly, I could have easily used 200x for a better experience for those looking. I encourage all of you to participate next year. It was a blast!

Society of Amateur Radio Astronomers (SARA) Conference 2014

By Scott Lansdale

The annual conference was held June 29–July 2 at the National Radio Astronomy Observatory (NRAO) in Greenbank, WV. In addition, this year, there was a follow-on meeting held by the Radio Jove group July 2–4; their focus was detecting and analyzing radio emissions from Jupiter. The group attending this year was the largest in the organization's history and with more than 420 members—SARA is reaching out to more people than ever before.

NRAO's 40-foot telescope, the cornerstone of Green Bank's educational initiatives. Source: https://public.nrao.edu/news/tip-sheets/june-2014-tip-sheet

The papers ranged over a wide variety of topics from Software Defined Radio, to Raspberry Pi, various antenna designs/uses, and even SETI. The keynote speaker this year was Dr. Joe Taylor, who participated in the discovery of pulsars, including the first binary system in 1974. These binary systems were found to lose energy based on Einstein's General Theory of Relativity due to gravitational radiation. Hulse and Taylor shared the Nobel Prize for this discovery.

There were several projects on display outside the residence hall in the evenings. These included Radio Jove antennas and receivers, spectrometers, Sudden Ionospheric Disturbance (SID) systems, and even a lonely albeit popular, optical telescope. Groups gathered to learn more about the setup and use of the systems, and where they could be set up and operated.

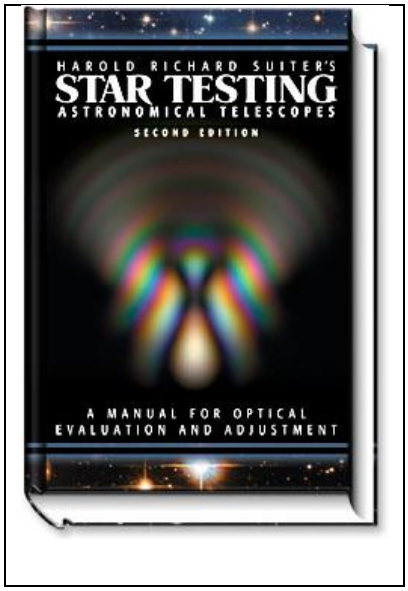
Each year, a "High Tech Tour" is given of the NRAO facility; however, because the group was so large this year, they brought the tour to us. In the conference room, they remotely operated the Green Bank Telescope (GBT) and showed how antenna operations are performed. Observation was limited to a brief drift scan but it showed the extreme sensitivity of the telescope—we were able to detect hydroxyl (OH), without pointing the telescope in any particular direction. Hydroxyl is one atom of oxygen and one of hydrogen—combine with more neutral hydrogen and you get water (H_2O). Between the hydrogen and the hydroxyl spectral lines lies the "water hole" a popular band for radio astronomers.

Following the SARA conference was the special-for-this-year Radio Jove conference. In the brief 2 days, many topics were covered focusing on Jupiter-Io interactions and the radio emissions generated. In short, Io, one of Jupiter's Galilean moons is the most volcanically active body in the solar system. Many particles are ejected into space and mostly confined to a torus or "donut" around Io's orbit. Jupiter's large magnetic field draws these particles in and as they travel along the magnetic field lines, several types of radio emissions are generated. Some of these emissions are referred to as S or L bursts and are relatively easy to detect with modest antennas here on Earth. At 20 MHz, these are on the low end of the radio frequencies that make it through the Earth's atmosphere.

The Jove group described the ways these emissions are generated, how to detect them, and what they might mean in terms of what is actually going on between Jupiter and Io. They also discussed the history of the Radio Jove group, hardware and software used for detection, spectrograph hardware and software, and various Jupiter satellite missions and their contributions. Overall, this year's conferences were packed full of great demonstrations and presentations. The SARA organization's goals are to raise awareness of radio astronomy, encourage research, and promote educational and outreach programs. The conference certainly furthered those goals.

Book Review: Star Testing Astronomical Telescopes

by Jerry Hubbell



One of the first things you learn when you start practicing the art of astrophotography is that excellent optical alignment or collimation of your telescope is very, very, important for obtaining the highest quality images. To ensure that your telescope has been accurately collimated, several tools are available to visibly measure your scope's optical alignment. One of the most useful is star testing. Star testing is a method where you use the out-of-focus star image in your eyepiece to gauge the accuracy of your scope's optical alignment. Typically, reflecting telescopes need to be collimated fairly often, and checked at every session. Refractors are much more robust in their construction leading to a much more stable collimation. You very rarely have to collimate a refractor and only the more expensive examples even provide a way for the user to collimate their refractor.

So that you can learn how to collimate your telescope through the star testing techniques and/or investigate the full range of performance of your telescope, the book *Star Testing Astronomical Telescopes: A Manual for Optical Evaluation and Adjustment*, Second Edition by Harold Richard Suiter is available from Willman-Bell. The second edition, first published in 2009 has become the bible for learning how to measure the performance of your telescope's optical system. At the asking price of $34.95, this book is a bargain for the amount of material included.

This book does an excellent job explaining the theory behind telescopes and how the different errors in optical surfaces and alignment can affect the view through your telescope. A simple browse through the table of contents will immediately show you how comprehensive the material truly is. If you want to get the highest performance from your telescope, studying the different errors and aberrations that can affect the performance of your optical system is key. Using the different images in the book to compare with your own view through your telescope can quickly enable you to identify and, with a little skill and know-how, fix any problem you scope may have. Star testing with help of this book is very easy to do and should become a habit once the techniques are mastered. The book does a great job explaining all the different problems that can afflict your telescope and their root causes.

Overall, whether you simply want to learn an effective and quick way to collimate your reflecting telescope, or you want to learn the minutia of telescope optical performance, this is the book you need to have on your library shelf. At 428 pages, it contains a wealth of knowledge that you can spend years learning and practicing until you are a master at measuring the performance of your telescopes. To me, this is one of the few fundamental skills that the astronomer should have—on par with being able to find objects in the night sky, and observing and describing those precious objects we so much enjoy.

Highlights of Recent RAClub Presentations

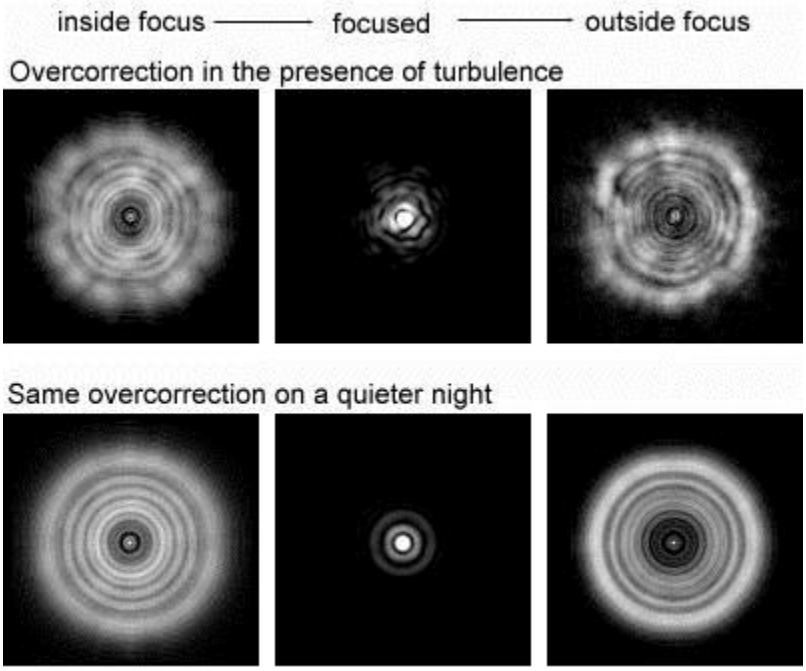
Abstracted from Bart Billard's Meeting Minutes

May 2014—Star Testing

Myron Wasiuta presented a program on star testing. He said his interest in astronomy started by age 10, when he witnessed a bolide in the sky over Pennsylvania. Before looking up to see the trail in the sky, he saw a shadow play on the ground as the shadows cast by trees moved about. Later, when he was in high school, he saw mention of this event in an astronomy magazine story on meteors.

Myron's first serious telescope was an RV-6 Dynascope. After using it for about a year, finding all the Messier objects and moving on to objects from the New General Catalog (NGC objects), he started becoming aware of optical limitations. Things got blurry at higher powers. Myron said he then began developing an interest in the optics of telescopes and reading up on the subject. He eventually learned about the subtle details of getting quality images that still require a human touch. Myron recommended learning to recognize quality optics by comparing telescopes at star parties or by learning to judge your own telescope.

The first step is to learn to judge seeing—the turbulence of the atmosphere that degrades images regardless of the telescope quality. Myron cautioned that we should also become aware of local seeing effects that we can avoid or control to get better images. These include effects of viewing out a window (or through one), as well as over rooftops or asphalt retaining the heat of the day. Any nearby source of temperature contrasts can cause problems. Even a telescope that has not had time (at least 20 minutes) to come to temperature equilibrium with the air can degrade images. Seeing effects of the rest of the atmosphere are generally beyond our control, but he said summer is generally better than winter, especially about 2 days after a storm.



Source: ***Star Testing Astronomical Telescopes, A Manual for Optical Evaluation and Adjustment*****, Second Edition by Harold Richard Suiter (Willman-Bell, Inc. 2009)**

The next thing to learn is how to make sure your telescope is collimated. Myron said collimation is usually not necessary with refractors, although some of the best have provision for adjusting collimation. Reflectors regularly require collimation, and Cassegrains often require it, too. The latter can be tricky to learn which adjustment works which way. Star testing is a good way to check whether collimation is needed.

Myron described the basics of star testing. He said to use a relatively high power, about 150 to 200, and to choose a bright star high in the sky to minimize seeing effects. You look at the star out of focus in both directions (focusing in toward the telescope and out away from it). You look for a disk with a dark hole in the center (no hole for refractors: it is the shadow of the secondary for reflectors and Cassegrains). It should have concentric interference rings. Astigmatism appears as an oval shape, longer in one direction inside focus and in the perpendicular direction out of focus. He said you need to see what is causing the astigmatism: if it is your eyes, you see the direction change when you rotate your head; if it is the eyepiece, you see it change direction when you rotate the eyepiece.

Myron described features to look for. The out-of-focus images should be round. The outermost ring should show the same brightness both inside focus and outside focus. It should also show the same sharpness. The rings inside the outermost ring should show uniform brightness, both inside and outside of focus. The in-focus image should not show a trefoil pattern, which indicates pinched optics. He said this issue is the result of tightening the mirror cell too much after collimating, which is a no-no. It should be just barely tightened. An ideal in-focus image for a refractor (or other system without a central obstruction), the Airy pattern, should look like a central disk with a single faint diffraction ring around it. A brighter ring, or more than one ring, visible indicates aberrations are causing less than the ideal 83 percent of the starlight to be included in the central spot and is a sign that sharpness and contrast of images will be poorer.

Myron showed us examples of star test images for various problems with optics, including a "turned edge" and spherical aberration. During the talk, someone asked whether Myron had ever used an artificial star for star testing. He said he had not done it himself, but the book he based his talk on, Harold Richard Suiter's *Star Testing Astronomical Telescopes*, (see Jerry Hubbell's review of this book) discusses how to do it. It is important to have the source far enough away, as explained in the book. Myron recommended the book highly. He used figures from it in his presentation. Myron offered one more bit of advice—don't make a snap judgment based on one night of testing. Practice testing for several nights before drawing conclusions.

June 2014—Dragon Eats Saturn and Orion

The first SpaceX Dragon capsule pauses near the International Space Station on May 31, 2012, so the ISS' robotic arm can grapple and berth it.
Source: http://earthsky.org/space/spacex-dragon-spacecraft-scheduled-for-splashdown-in-pacific-today

Terry Barker began by explaining that the title of his presentation referred to the Dragon robotic spacecraft made by SpaceX, and Saturn and Orion referred to the NASA Moon rocket and the proposed next NASA vehicle project that is now shelved. Dragon is an example of a privately developed space/engineering capability inspired by a prize competition such as the Ansari X Prize. Terry's presentation theme was the potential of such competitions to spur new developments in science and technology. He had an interesting presentation arrangement using the PowerPoint alternative, Prezi (http://prezi.com/), in which everything was on one slide: an image of the Dragon capsule in orbit. Each new topic was revealed as a small marking somewhere on the capsule: the slide would pan and zoom in on the spot and reveal a slide within the slide.

Terry used a series of trivia questions and passed out a Milky Way (bar) to reward each right answer. The first question revealed that Al Gore first proposed a satellite that would orbit between Earth and the Sun and was designed to monitor both. Terry said the project was started but subsequently scrubbed, but that it has been revived recently with a launch scheduled for 2016. He had four more questions with a common answer. Elon Musk, one of the founders of PayPal, is now the head of both Tesla and SpaceX, and was an X Prize board member. Currently, only Russia and the United States can get to the International Space Station (ISS), and Russia is the only country with a capability to transport humans. The United States is only capable of reaching ISS via SpaceX Dragon, a commercial cargo vehicle. SpaceX just announced Dragon version 2 is scheduled to fly in 2016. SpaceX is also building another rocket called Falcon Heavy, which is to be the most powerful rocket ever built. The current rocket is Falcon, which can be recycled.

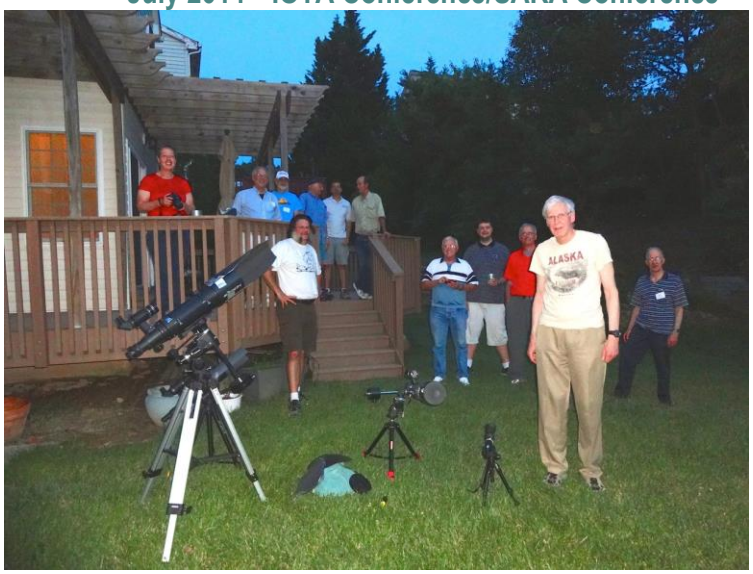
Terry also went online to show some interesting pictures and websites he has found recently. He included a slide show from the recent Science Expo at the DC Convention Center. He and Don Clarke were there and were amazed by the size of the exposition. They were able to see an actual Enigma machine. Terry showed us a website (Super Planet Crash) where you can play a game with simulated planetary systems by adding your choice of planet types at different orbital distances. You can then see whether the configuration is unstable, causing a collision or a planet to be thrown out of orbit.

Ishai Zimerman and Ronen Atzili, 2014 Technobrain first prize winners for their device that successfully climbed up a steep cable at a high speed powered by an electric screwdriver. They received a 10,000 NIS cash prize (about $2,900 US). Source: http://www.technion.ac.il/en/2014/06/technobrain-2014-screwdriver-power/

Another web page Terry showed us was a news item about a technical competition held in Israel on the date of the club meeting. Technion was holding a "space elevator" competition, with Yuri Artsutanov as guest of honor and serving as one of the judges. Contestants were challenged to build a device capable of climbing 25 meters up a steep cable. Artsutanov is noted for proposing a method of making a space elevator by lowering a cable from geosynchronous orbit while extending a counterweight outward to maintain the center of mass at the geosynchronous platform. Technion later reported the winners based their vehicle on the workings of an electric screwdriver.

July 2014—IOTA Conference/SARA Conference

Bart Billard presented a program on his first International Occultation Association (IOTA) annual meeting. The meeting took place at the University of Maryland Observatory in College Park, the weekend before our club meeting. Bart said the program was packed with presentations, and he would try to give an idea of the flavor of the meeting in case others might be interested in future IOTA meetings. An example of the "flavor" was the barbeque on Saturday evening, pictured on the IOTA meeting webpage, which was hosted by Joan and Dave Dunham. They also provided food and snacks for attendees during the meeting, and Bart's only expenses were the drive up Saturday and back home Sunday, along with overnight lodging. (There was no charge to attend the meeting.)

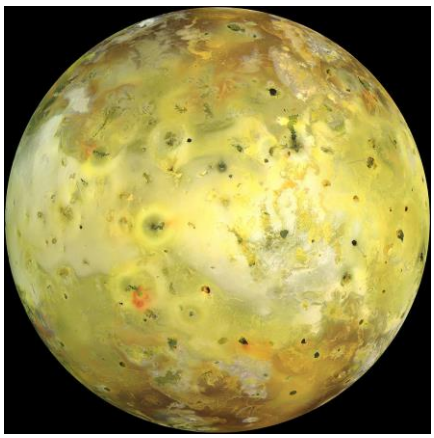


IOTA Meeting BBQ (Dave Dunham and Bart Billard are the right) Source: http://occultations.org/wp/wp-content/uploads/2014/04/IOTA_Group_2014_C.jpg

Bart showed the IOTA webpage explaining occultations (see "What is an Occultation") before describing a few talks at the meeting. For a more detailed discussion of occultations, see the article earlier in this issue of the newsletter.

Bart briefly touched on other topics covered at the conference and showed slides from a presentation by Ted Blank on making a video camera adaptor to use an Orion Go-Scope 80 as a mobile occultation timing station. He also talked a little about a March attempt at timing an occultation of Regulus by Erigone and showed some slides from a talk about the next predicted occultation of Regulus by (1669) Dagmar in May of next year. The March attempt was spoiled by clouds, and next year's will be a daytime event with Regulus low in the sky for the Washington, DC, area. IOTA's presentations page provides downloads for most of the talks, as well as links to videos of the presentations on YouTube. The meeting was streamed on the web for those who could not attend in person.

Scott Lansdale also briefly talked about the 2014 meeting of the Society of Amateur Radio Astronomers (SARA), during the week of June 30 at the National Radio Astronomy Observatory in Green Bank, WV.(See article earlier in this issue of the newsletter for details.) There were talks about the Search for Extraterrestrial Intelligence, receiver development, and porting Sudden Ionospheric Disturbance monitoring to Raspberry Pi, a credit-card-sized single-board computer based on Linux. It reportedly would be a better solution for continuous operation than the current equipment based on a PC with a sound card.



Jupiter's Moon Io
Source:
http://photojournal.jpl.nasa.gov/catalog/PIA02308

Scott said there was an associated conference focused on radio observation of Jupiter. He was interested in radio outbursts or storms of synchrotron radiation resulting from the volcanically active satellite, Io, which spreads ionized particles into the strong magnetic field around Jupiter. Scott said he was purchasing an antenna pair designed to observe these storms at 20 MHz. The antennas are designed to run east–west and are phased to direct the beam toward Jupiter. He hopes to use the antennas in his attic to avoid objections from his homeowners' association, although it may not be the ideal distance from the ground. The projects are packaged for middle and high school students. SARA dues are inexpensive, and mostly support 6,000 such educational projects. Scott plans to report on his experimentation efforts in his talk scheduled for the December RAClub meeting.

Image of the Quarter

Mars taken by Scott Busby at Belmont Observatory May 31st.