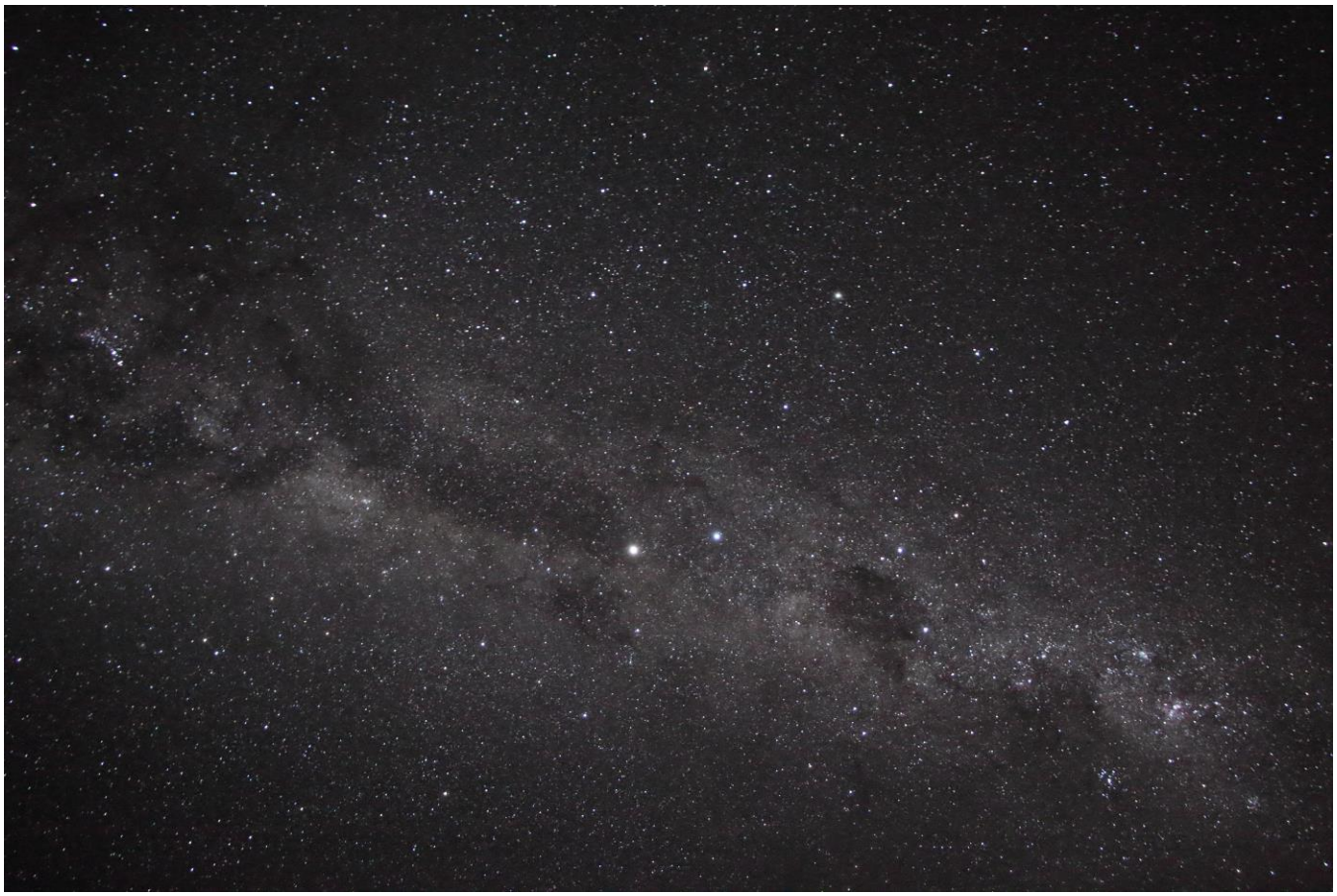
SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

September 2019



The Milky Way in Centaurus and Carina

Alpha and Beta Centauri are the two bright stars in the center of this image, made on Rapa Nui (Easter Island) on July 3rd by Larry Faltz. An orientation diagram can be found on page 14. Rapa Nui is the most remote continuously inhabited place on Earth. The skies are very dark, although in the austral winter there's a good bit of cloudiness typical of a small subtropical volcanic island. Fortunately, this particular evening was clear for several hours. The image was made at 27° 08' 26.69" South, 109° 21' 25.15" West at 10:18 pm local time. Canon T3i, ISO 6400, 18-135 zoom at 18 mm (35 mm equivalent 28.8 mm), f3.5, fixed tripod. The field is about 45° across.

WAA September Meeting

Friday, September 13th, 7:30 pm

Lienhard Hall, 3rd floor
Pace University, Pleasantville, NY

Members' Night

Presentations by WAA members

Each fall we begin our lecture series with short presentations by WAA members on astronomical topics of their choosing: recent astronomy-themed trips, observations, new equipment, imaging techniques, even original research.

The only qualifications are membership, enthusiasm and a desire to share.

It's "show and tell" for adults!

If you are interested in presenting, please send an email to Pat Mahon, VP for Programs, at patmahon@optonline.net.

Pre-lecture socializing with fellow WAA members and guests begins at 7:00 pm!

Also In This Issue

WAA October Meeting

Friday, October 4th at 7:30 pm

Lienhard Hall, 3rd floor
Pace University, Pleasantville, NY

CCD and CMOS Sensors for Astronomy: An Introduction and Comparison

Jules Insler, Senior Principal for Systems Engineering, BAE Systems

The world of imaging is undergoing constant change and improvement. CMOS sensors are replacing CCDs, the miracle that replaced film. Jules Insler is an expert in imaging devices. He is best known as the inventor of the laser printer.

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

Starway to Heaven

Ward Pound Ridge Reservation, Cross River, NY

Saturday, September 21st (rain/cloud date September 28th)

New Members

Dominic Albanese	Rye
Joan Indusi	Ossining
Daniel Intrilligator	Peekskill
Manish Jadhav	Ossining
Steven Kasarda	White Plains

Renewing Members

Andrea Anthony	Yorktown Heights
Leandro Bento	Mohegan Lake
Walter Chadwick	Cold Spring
Dugan Family	Sleepy Hollow
Joe Geller	Hartsdale
Jimmy Gondek & Jennifer Jukich	Jefferson Valley
John Lasche	Hastings-on-Hudson
Anthony Monaco	Bronx
Kristina Newland	White Plains
Deidre Raver	Mahopac
Peter Rothstein	Hastings on Hudson
Ihor Szkolar	White Plains
Alan Young	Tarrytown

WAA Members: Contribute to the Newsletter!
Send articles, photos, reviews or observations to waa-newsletter@westchesterastronomers.org

ALMANAC For September 2019

Bob Kelly, WAA VP for Field Events


1Q
Sep 8


Full
Sep 14

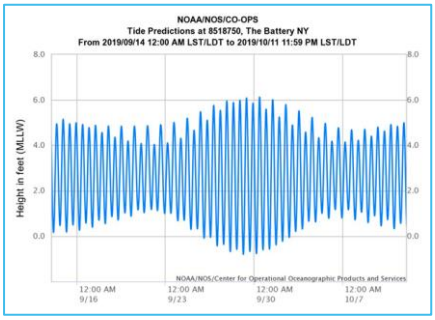

3Q
Sep 21


New
Sep 28

Venus, Mercury and Mars will be in the house of the Sun this month. Venus and Mercury will exit by mid-month and Mars will depart before the close of the month. Catch them in the SOHO C3 camera while you can. Mars is in conjunction with Sun on the 2nd, with Mercury passing conjunction from the other direction on the 3rd. These two planets appear closest to each other on the 3rd. Mars is twice as far as Mercury is from us. Spacecraft orbiting the red planet will get some relief from Earth flight controllers' constant jabbering. Solar conjunction makes communications problematic. Commands sent during this time have an increased chance of errors induced by solar static that could result in spacecraft doing unexpected and possibly damaging things.

Venus and Mercury appear very close together on the 13th, only 8 degrees from the Sun, but following the Sun in our skies. They will fit in the same telescope field for experienced daytime observers who do well at hiding the Sun.

Our Moon is at perigee on the 27th, 16 hours before new moon on the 28th. Call it a super new moon – even though you can't see a super new moon, you'll know it's there from the larger range of tides for several days around the 28th.



On the evening of the 29th can you pick out the Moon and Venus just after sunset? Venus will be only 13 degrees out from the Sun. The low angle of the path of the inner planets in our evening sky will make them even hard to find for a couple of months.

Another note about Mars: It's near its aphelion. If you could see it, Mars is so far away it appears only 3½ arc seconds wide, about the same apparent size as Uranus. Mars' distance from the Sun varies by 26 million miles from perihelion to aphelion. It has the most eccentric planetary orbit other than Mercury, but not the largest variation in miles. The outer planets are less eccentric but are so far from the Sun that they have a larger change in absolute distance. The Earth's distance from the Sun varies by only 3 million miles.

Darkness is coming earlier, with sunset occurring before 7 pm Daylight Time starting on the 18th. While we have more time to see the sky, at dusk Jupiter is already ambling down toward the southwestern horizon. Saturn is sitting pretty, due south at its highest point at the start of the night. See if you can make out Saturn's shadow on the rings. Iapetus is west of Saturn this month and near its brightest at magnitude 10.4, after passing south of Saturn on the 11th. It is further out but is not as bright as magnitude 8.4 Titan. Iapetus and magnitude 14 Hyperion travel together around the 11th, but you'll have to see that paring in your mind, in a simulation or in an expert image. Uranus joins the evening shift, already staffed by Neptune all-night as the 8th planet reaches opposition on the 10th.

Magnitude 0 Vega starts our night overhead. Imagine yourself 12,000 years in the future. The stars will be rotating around Vega, four degrees from that era's celestial North Pole. Vega's own North Pole now points five degrees from our Sun in its sky. The Sun would appear as a rather dim magnitude +5 star. Sirius is almost exactly opposite to Vega's direction as seen from Earth, so the Dog Star might be close enough to Vega's celestial North Pole to be more useful as the Vegans' pole star. Sirius is much brighter than our Sun, even though it's further from Vega. So, the Sun is likely to be outshined by Sirius. That's another story I'll have to change for star parties.

The equinox arrives 3:51am EDT on the 23rd.

If the International Space Station was a person; it would be old enough to be starting its freshman year in college. You can see it in the pre-dawn hours through the 16th. It makes passes in the evening sky for the rest of the month. The Planetary Society has been solar sailing for the past month with LightSail 2, 450 miles above the earth. According to heavens-above.com, it's not particularly bright despite its 38 square yards of reflective Mylar. It averages magnitude +7. Its low-inclination orbit means we only see it on occasion, very low in the southern sky. It may produce brighter flashes if the sail is angled just the right way to our line of sight. ■

Member Profile: Jordan Webber

Home town: Rye Brook, NY

Family: I'm married for 10 years to my wonderful wife, Nicole, and I have two children Spencer (5) and Piper (2).

How did you get interested in astronomy? I've always had a fascination with the night sky, but the first time I considered getting into astronomy as a proper hobby was when I was around 15 and looked at the Moon through a friend's telescope after dinner at his house. The scope was a simple 70mm refractor, but the view of the Moon was breathtaking. I knew right then that I needed to have a scope of my own, so I saved up and bought a 90mm Orion Astroview refractor. I got my first views of Saturn and Jupiter through that scope, and I delighted in sharing the views with my family. During college I became interested in photography, so I brought the scope out again one night to try my hand at some photos of the Moon. I realized the limitations of the scope, but had fun capturing images here and there, along with some shaky images of Saturn and Jupiter as well. After finishing college and getting a job that allowed me to afford it, I picked up my current scope, an 8" Orion SkyView Pro Newtonian, and began to take an even more serious interest in the hobby as I set up the scope night after night in the back yard to hunt for Messier objects. My yard being a far from ideal place for this, I started researching to find a better place to observe, which is when I learned about WAA.

What's your favorite object(s) to view? Saturn and the Ring Nebula are two of my favorites. I also love M13 (especially when I get to view it through larger aperture scopes).

What kind of equipment do you have? My primary scope is the Orion 8" Newtonian Reflector on an Orion SkyView Pro EQ GoTo mount. For eyepieces, I most commonly use an Orion Q70 38mm for wide views or a Q70 26mm with a 2x Barlow for more magnification. I have shorter focal length 1.25" eyepieces, but I like the eye relief the 2" eyepieces provide. I use a Telrad reflex sight for aiming the scope, and I use a Canon 6D DSLR for photos. I also still have the 90mm refractor I mentioned above that I sometimes pull out for quick lunar or planetary observing in the driveway.

What kind of equipment would you like to get that you don't have? I'm torn on my next purchase – I'd really like one of those 82-degree TeleVue eyepieces because the views with those are amazing, but I'd also like to try autoguiding, which would probably be easier with a more robust mount. I'd also love to get a large Dobsonian scope (12" or greater) at some point.

Have you taken any trips or vacations dedicated to astronomy? I took road a trip with a friend to South Carolina in 2017 for the Solar Eclipse. We had to scramble around a bit at the last minute due to some menacing clouds, but in the end we got to see the entirety of totality from a clear spot on the side of the road, and it was easily one of the most amazing things I've ever seen – it absolutely lived up to all of the hype and was worth the long drive.

Are there areas of current astronomical research that particularly interest you? I'm always interested in learning the latest regarding putting a human on Mars.

Do you have any favorite personal astronomical experiences you'd like to relate? Helping my son look at the Moon through the telescope for the first time was magical. He just turned 5, so I'm looking forward to getting him outside with the scope more often.

What do you do in "real life"? I work in business analysis for a large financial services company.

Have you read any books about astronomy that you'd like to recommend? I haven't read any adult astronomy books in a while, but I've actually really

been enjoying reading the "for babies" science books by Chris Ferrie to my kids. My daughter particularly loves *Quantum Physics for Babies*, and my son likes *ABCs of Space*. I recommend them to anyone with young kids.

How did you get involved in WAA? I was trying to find a park or open space somewhere in Westchester where I could go to use my new scope, and WAA came up in the search results. Attending outreach events has been a great way to get to know other members.

What WAA activities do you participate in? I try to get to as many star parties as I can, and I love doing outreach. The annual Camp Ramah outreach event is a particular favorite. I also try to make it to the lectures when there's a topic I'm particularly interested in – I'd go to all of them if I could, but it's not always easy me for to make it.

If you have a position in WAA, what is it, what are your responsibilities and what do you want the club to accomplish? I don't have an official position, but I do record the outgoing messages for the club's hotline now!

Provide any other information you think would be interesting to your fellow club members, and don't be bashful! I try to participate in club outreach events as often as possible, which is something I highly recommend. I especially love the events with the camps and the schools – I had considered becoming an elementary teacher at one point in my college career, so I consider it a real privilege to be able to contribute to science education in this way. ■

November Transit of Mercury

Make your plans now to observe the transit of Mercury on Monday, November 11th. It will be the last transit until 2032. The entire event is visible from Westchester, weather permitting. The planet will start crossing the Sun's disc at 7:36 am with the Sun at 9 degrees elevation, so you will need good eastern exposure. Maximum transit is at 10:20 am and the transit ends at 1:04 pm. Mercury will be 9.9" in diameter, just 1/196 the diameter of the Sun, making naked-eye observation pointless. Proper filtration is mandatory, so get a glass or Mylar solar filter for your telescope or binoculars. Of course a hydrogen-alpha telescope will give a fine view.

George Ellery Hale at Caltech

While visiting Pasadena in January, the Editor came upon this bust of George Ellery Hale prominently displayed on the Caltech campus. Hale founded the University of Chicago's Yerkes Observatory in Wisconsin in 1897 but shortly thereafter moved to the clearer skies of southern California to establish Mt. Wilson Observatory. He set up a solar observatory and built the famous 60- and 100-inch telescopes in 1908 and 1917 respectively. The 60 was used by Harlow Shapley to measure the size of the Milky Way. Edwin Hubble subsequently used the 100 inch to elucidate the nature, distance and expansion rate of galaxies. In 1907 Hale joined the Board of Trustees of Throop College of Technology, a small engineering school in Pasadena. He recruited MIT chemist Alfred Noyes and University of Chicago physicist Robert Millikan to the Board and expanded the scientific mission of the institution. In 1920, Throop changed its name to the California Institute of Technology. Noyes resigned from MIT to become director of chemical research at Caltech, and Millikan became its first Chairman of the Executive Council, equivalent to President.

Hale went on to develop the 200-inch telescope at Mount Palomar, to this day a Caltech-managed facility. He founded the journal *Science* and the International Astronomical Union. To learn more about Hale's contributions, particularly the amazing story of the building of the 200-inch telescope, read Ronald Florence's superb book *The Perfect Machine* (1993).

Caltech and MIT vie for the title of the country's top science and engineering university. Although it is undoubtedly impossible to determine which institution is "better," for sure the weather is usually more pleasant in Pasadena than Cambridge. ■

Balancing a German Equatorial Mount

Robin Stuart

An article in the June 2019 edition of *Sky & Telescope* (p.64) describes how to balance a German equatorial mount. I was a bit surprised at what was being suggested. It's not the procedure that I follow and it didn't look like a particularly safe way of going about things. A scan of the web shows that the method described in S&T has been widely disseminated whereas what I typically do seems little known. I cannot necessarily claim this method is new and unknown but present it here in the hope that others will see its advantages and find it useful.

In order to better appreciate what is going on it is worthwhile reviewing some results that derive from the science of *Statics*. On a German equatorial mount the counterweight, shafts, telescope and other equipment represent weights at various distances from the polar axis. The average position of all these weights is the *center of mass* (CM). If a system of weights is free to pivot about an axis it will naturally adopt a position in which the CM is as low as possible. In this state the gravitational potential energy of the system is at a minimum which in practice means that the CM hangs directly below the axis.

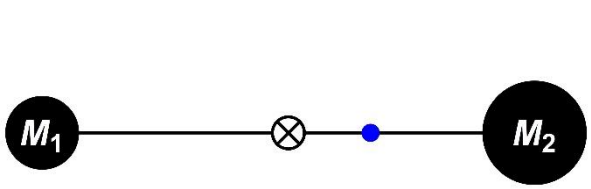


Figure 1a: Weights connected by a light beam free to pivot about the crossed circle. The blue dot indicates the center of mass of the system. M_2 is twice the weight of M_1.

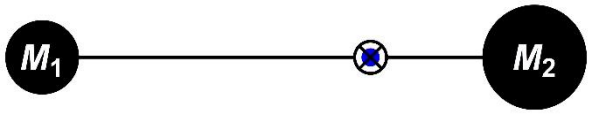


Figure 1c: Weights in Fig.1a when the pivot is adjusted to be coincident with the center of mass. This equilibrium is unstable with respect to small displacements to the pivot point.

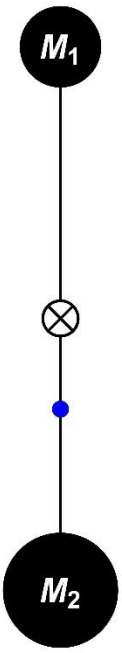


Figure 1b: Position adopted by the weights in Fig.1a when released.

Some stylized configurations of weights are shown in **Figures 1–3**. In all three figures the weight of M_2 is twice the weight of M_1 and the beam that connects them is assumed to be negligibly light. The circle with an "x" in it is the pivot point and the location of the CM for the system as a whole is indicated by the blue dot.

When the system shown in **Figure 1a** is released, it will move to adopt the orientation shown in **Figure 1b** in which, as noted above, the CM hangs directly below the pivot point. The system may be brought into balance by adjusting the position of the pivot on the connecting beam to coincide with the CM. In principle the beam can then be set at any angle and will not move. However this equilibrium is unstable in the sense that a small displacement of the CM from the pivot point will cause the system to again adopt the orientation like **Figure 1b**.

Figure 2a (next page) shows a configuration in which the pivot point is offset from the beam connecting the two weights. When released it adopts the position shown in **Figure 2b** again with the CM directly below the pivot. This is a stable equilibrium in the sense that a small change made to the weights or their position on the connecting beam will produce only a small change to the angle at which the system hangs. This angle off the vertical will increase as the weight, M_2, increases (or M_1 decreases) and will be zero when the two weights are equal. This arrangement can be and is used as a set of scales. The angle can also set to zero by sliding the pivot point along the connecting beam as shown in **Figure 2c.**

How can this understanding be used to balance a mount? The widely disseminated method to balance a German equatorial calls for balancing the declination axis by first setting it to be horizontal. To achieve this, the polar axis

needs to be firmly locked to resist the initial imbalance. This is all very intuitive and natural but this places the equipment in a position that is analogous to **Figure 1a** and is unstable. Indeed the operator is cautioned to hold on to the equipment to guard against sudden rotation the consequences of which might be dire if your expensive camera finds itself careening downward at high speed.

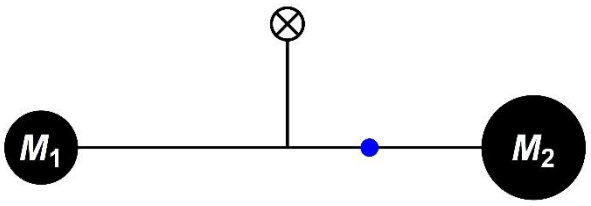


Figure 2a: Weights connected by a light beam with an offset pivot point

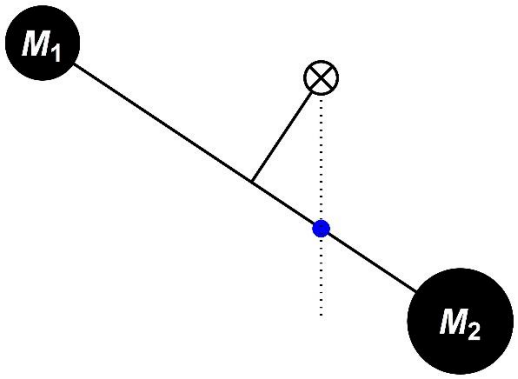


Figure 2b: Position that the weights in Fig.2a will adopt when released. The center of mass lies directly below the pivot point.

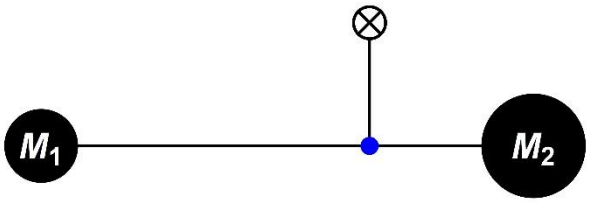


Figure 2c: Weights in Fig.2a with the pivot point moved to sit directly above the center of mass. Small displacements in the pivot point produce only small changes in the angle of tilt.

Armed with a basic understanding of statics, however, it is possible to devise a method to bring a German equatorial mount into perfect balance without ever putting it in an unstable configuration and without needing to strain the axis locks counteracting the initial imbalance.

Instead of making the declination axis horizontal, first ensure the counterweight is well out on the shaft and let it hang loose in its natural position. Turn the telescope so that it is pointing at right angles to the polar axis as shown in **Figure 4a**. If the mount is at least roughly polar aligned then the telescope will be looking toward the celestial equator or 0° declination. Depending on the degree of imbalance this means that the telescope will be pointing roughly east-west and its tube will be more or less horizontal. This arrangement is represented stylistically in **Figure 3** (next page). M_1 represents the counterweight and M_2 is the center of mass of the telescope and other equipment. The position of M_2 can be adjusted left and right along the horizontal beam in **Figure 3a**. In the case of a real telescope this adjustment corresponds to sliding the telescope fore or aft in the dovetail saddle (see the yellow arrow in **Figure 4a**). The pivot point in the diagrams is the mount's polar axis. When released the stylized system adopts the position shown in **Figure 3b** but, with the counterweight positioned well out on the shaft, the resulting tilt will be fairly small. The aim is to adjust the telescope's position so that the CM is in line with the declination axis as shown in **Figure 3c**. The direction that the telescope needs to be moved is indicated by the direction of the tilt. When the counterweight has been made to hang straight down it's safe to move the counterweight further in toward the polar axis. However care should be taken not to go too far and move it beyond the balance point. Moving the counterweight closer to the polar axis increases the system's sensitivity to any residual imbalance and permits finer adjustments to be made. The process is repeated until the counterweight reaches a point that is close to being balanced about the polar axis or adjustments to the telescope's position that cause it to tilt to one side or the other are deemed to be so small as to be insignificant. Finally turn declination axis to horizontal and make any necessary refinements to the position of the counterweight to achieve perfect balance in the polar axis. The mount is now balanced. This ideal condition is quick and easy to achieve and is approached through a sequence of increasingly sensitive but stable configurations.

In this description it has been assumed that it is only necessary to adjust the telescope's position in a direction that is parallel to the tube but this may not always be the case such as, for example, when two telescopes are mounted side by side on a single mount. In that situation the process should also be performed with telescope(s) pointed at the pole rather than the equator.

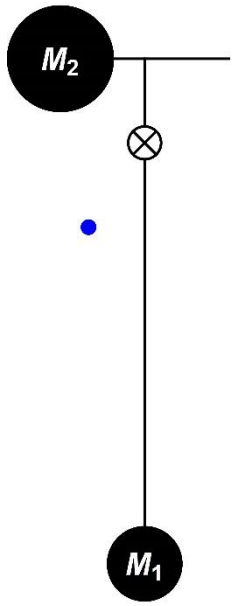


Figure 3a: Stylized German equatorial mount. M_1 is the counterweight and M_2 represents the combined center of mass of the telescope and other equipment. The vertical beam is the shaft of the declination axis. The blue dot indicates the position of the center of mass for the combined system as a whole.

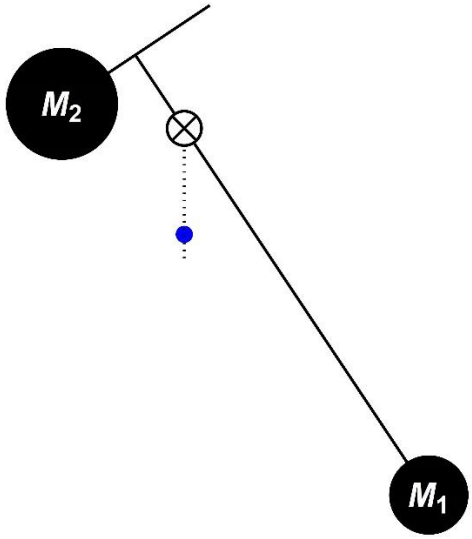


Figure 3b: Position adopted by system shown in Figure 3a when released. The center of mass for system as a whole the lies directly below the pivot point.

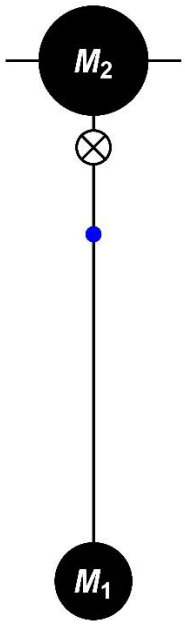


Figure 3c: Position adopted by the system shown in Figure 3a after the equipment has been adjusted so that its center of mass is aligned with the declination axis.

To summarize the process for balancing a German equatorial mount:

1. Remove lens caps and move cameras or eyepieces to their focused position.
2. Move the counterweight well out on its shaft which should be hanging nearly downward.
3. Turn the declination axis so that the telescope is pointing at right angles to the polar axis (Figure.4a). For a polar aligned mount this means that the telescope will be pointing at celestial equator or indicate a declination of 0°.
4. Slide the telescope in the dovetail saddle to a position where the counterweight hangs directly downward.
5. Move the counterweight further in toward the polar axis (but not beyond the balance point for the polar axis).
6. Repeat steps 4 and 5 until the size of the adjustment that causes the declination axis to tilt to one side or the other is negligibly small or the counterweight is approaching the polar axis balance point.
7. Make the declination axis horizontal and make any final refinements to the position of the counterweight to balance the polar axis.

Figure 4a shows the initial stages of balancing a German equatorial mount. Note that the counterweight has been set all the way out at the end of the declination shaft. **Figure 4b** shows the mount after balancing. The counterweight is now closer to the polar axis and the declination axis hangs directly downward. Displacements left or

right in the telescopes position in the dovetail saddle of as little as the order of a millimeter or two induce an appreciable tilt in the angle of the declination axis.

Having obtained perfect balance it may, in some cases, be desirable to undo it by applying an offset that puts a constant pressure on the gears in the mount's drive train and ensures that their teeth remain in contact without any "chatter." ■

Figure 4a: Initial stage of balancing a German Equatorial Mount. The counterweight is at the end of the declination shaft. The telescope tilts to the left indicating that the dovetail plate needs to be slid to the right as shown by the yellow arrow. The state of the mount shown here corresponds to Figure 3b.

Figure 4b: The mount after having been balanced in declination. The counterweight is now further up the declination shaft as can be seen by comparing the lengths of the red arrows in the two pictures. Even very small displacements of the telescope to the left and right now produce a noticeable tilt.

Curiosity Rover isn't the only thing crawling around Mars

At the July 26th WAA star party at Ward Pound Ridge Reservation, WA VP for Events Bob Kelly brought along a 25x25-foot NASA topographic map of Mars, lent by outreach maven Jupiter Joe.

Summer 2019 WAA Outreach Events

Bob Kelly at Greenburgh Library, July 17th

Bob Kelly enlightened an enthusiastic group of adults and young people with a presentation about the travails of the Apollo program. Entitled "Failure *IS* an Option: How the Apollo Program Almost Never Landed on the Moon," the talk provided a vast trove of details about each of the Apollo missions and explained the many near-misses that threatened success. Almost all of them have fallen out of public consciousness except for the tragedy of Apollo 1, the fuel situation and computer alerts during the landing of Apollo 11, and the fuel tank explosion on Apollo 13, but every mission had a story and Bob was in command of all of them (your Editor was there!). He presented so much information with so much enthusiasm that one attendee asked him to slow down! In addition to his talk, Bob brought a wealth of background material, newspapers from July 1969, books and pamphlets for attendees to peruse, as well as a mock spacesuit that people could don and have their picture taken with the astronauts, the LEM and the Lunar Rover.

Bob Kelly at Somers Library. July 27th

On a brilliant, sunny Saturday, Bob curated an interactive museum of lunar exploration at the Somers Library. Families came by asking lots of probing questions about how humans traveled to the Moon. The young folks followed Apollo-style checklists as they perused 3-D photos of the lunar surface, took their own photos in front of a lunar landscape, made star maps, read books about the Moon and viewed videos that answered questions about landing and launching from the Moon.

Camp Ramah, July 25th

David Butler has been coordinating an annual outreach event at Camp Ramah in Wingdale, NY for the past few years. David writes: "The weather was very good this year and the turnout was highest yet for the event, with over 400 kids [!!!-Ed.] from the 5th through 12th grades. The kids came early: Jupiter was visible and Saturn was sighted shortly thereafter. Art Linker, Woody Umanoff, Mike Lomsky, Josh Knight, Jordan Webber and I had our telescopes ready to meet the viewers. I was the last to get setup because my viewfinder broke off! With a 2000 mm focal length (8" SCT) and no viewfinder I was limited to Saturn and Jupiter. One of the kids noted the red spot on Jupiter. Another asked me the distance of Saturn in light years. It took me a while to come up with 90 minutes.

"I was happy that Mike and Jordan helped to lead the final route into Camp Ramah and back to Route 22. It's off the beaten path. Mitch Mernick from the camp was very helpful. He got me water, a box for the shorter people to stand on, cupcakes etc. and did a great job of organizing the event and trying to handle everyone's requests. It was a great evening."

Lewisboro Outreach July 26th

The Lewisboro Children's Library asked WAA to hold an outreach at Onoatru Farm Park, the town's sports center about 4 miles east of our regular star party site at Ward Pound Ridge Reservation. WAA members Chris Plourde, Cat Hannon, Josh Knight, Dave Butler, Kevin & Claudia Parrington and Larry Faltz brought telescopes. In the dark, clear skies, Saturn and Jupiter evoked squeals of delight from several dozen children and their parents, none of whom had apparently looked through a telescope before. Later in the evening the group got to see some of the brighter summertime deep sky objects.

Outreach in Croton-on-Hudson, August 12th

The Croton Free Library held a Moon Viewing Party to commemorate the 50th Anniversary of Apollo 11. Fifty attendees had a nearly perfect evening for observing, though they had to patiently wait for the moon to clear the trees. Librarians Thao Nguyen and Tony Gordon kept everyone interested and entertained with a wonderful outdoor event that included plenty of astronomy books for all reading levels, tables with materials to make your own rocket ship and lots of refreshments including the ever popular half-moon cookie. WAA members Erik and Eva Andersen brought their telescopes as well as Eva's life-sized cutout of Neil Armstrong, which though difficult for her to part with has found its new permanent home in the Croton Free Library. Tony also works at the Andrus Planetarium at the Hudson River Museum in Yonkers NY and brought her hand-crafted wearable phases of the moon display that was both fun and informative. A great time was had by all!

Chloe Costello gets a close look at a waxing crescent moon with Librarian Tony Gordon while 2 astronauts in training pose with Apollo 11 Commander Armstrong

Outreach in Harrison, August 15th

Rebecca Fitzgerald, the Children's Librarian at the Harrison Library, organized a group reading of the famous children's book *Goodnight Moon*, by Margaret Wise Brown, illustrated by Clement Hurd. It was an attempt to set some kind of *Goodnight Moon* group reading record, appropriate in this 50th anniversary summer. WAA was asked to bring a couple of telescopes. Eva and Erik Andersen arrived with Televue 85 and Televue NP-101 refractors and I brought an Orion Apex 127 Maksutov on an iOptron Minitower alt-az go-to. About 50 parents and children (and the three WAA'ers) were handed copies of *Goodnight Moon*, which was first published on September 3, 1947, making it about a month older than me, in other words, ancient literature! I don't recall having it read to me as a child. We were a Little Golden Books family.

Goodnght Moon tells the story of a bunny, tucked into bed by its mother, saying "goodnight" to everything around him (or her). Although it is true that the bunny's feelings are not quite as intense as, say, Ahab's "Towards thee I roll, thou all-destroying but unconquering whale; to the last I grapple with thee; from hell's heart I stab at thee; for hate's sake I spit my last breath at thee," it's rather a better choice as a bed-time story for young children than *Moby Dick*. Writer Ellen Handler Spitz said it teaches "young children that life can be trusted, that life has stability, reliability, and durability." Would life be so forever, in which case we wouldn't need to read *Moby Dick*! Over 48 million copies of *Goodnight Moon* have been sold since it was first published, probably outdistancing the sales of all of Melville's literary output.

The reading started about 15 minutes after sunset. We were all given glow sticks, a fun touch. The participants spread out on a large tarp on the lawn next to the Harrison Library, which is just across the street from the Metro North station. We all chanted the text in unison, which took exactly 2 minutes and 25 seconds (last year it took me all summer to re-read the lengthy and complex *Moby Dick*). Following the reading, which apparently did set some kind of record, children and parents lined up at the three telescopes for fine views of Jupiter and Saturn. The Moon didn't rise high enough to be visible until 9:30 pm. A few inquisitive adults stayed to look at it with us. And then we all said, "Goodnight, Moon."

WAA has done 5 or 6 viewings and lecture events with the Harrison Children's Library in the past few years. They've been well-organized and attended by a diverse, inquisitive and enthusiastic audience. A lot of the parents mentioned how excited their kids were about astronomy, and many said they had adorned their children's bedrooms with astronomy-themed decorations. We look forward to more events with this excellent facility. -- LLF

Flight into Totality, July 2nd

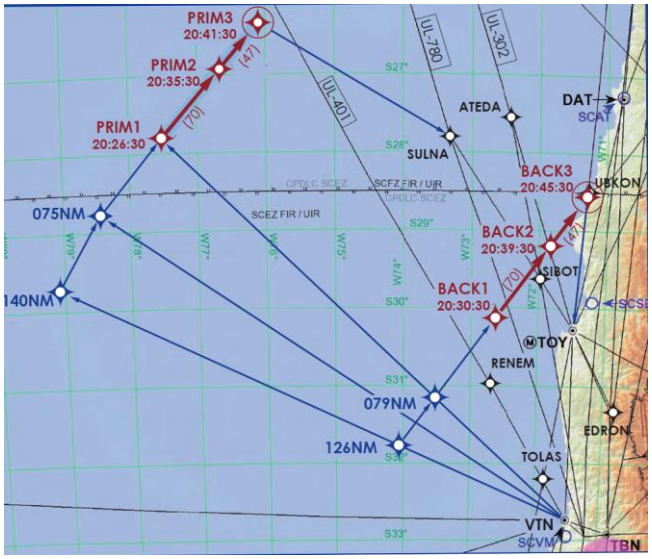
Larry Faltz

Photo by Ricardo Arancibia Figueroa, courtesy of *S&T*

Not chancing the possibility of low winter clouds that might obscure the July 2nd total solar eclipse, Elyse and I opted for the *Sky & Telescope* "Flight into Totality" aboard a LATAM Airlines Airbus 320-NEO out of Comodoro Arturo Merino Benítez International Airport in Santiago, Chile. Totality would be guaranteed, with a duration of over 3 minutes, compared with 2 minutes 18 seconds on the ground in the La Serena-El Molle area.

After arriving in Santiago on Saturday, June 29th, we met with S&T Senior Editor Kelly Beatty, who did most of the pre-planning, S&T Science Editor Camille Carlisle, who was leading the flight, and photographer Ricardo Arancibia Figueroa, whom Kelly had engaged to document the experience so we could concentrate on viewing. There were many more details to arrange than I had considered. For an eclipse flight, you don't just get on a plane. LATAM had to develop a flight plan that ensured interception of the eclipse path at exactly the right time, with some flexibility built in. LATAM guaranteed several back-up planes in case of mechanical difficulties. The flight controllers had to facilitate take off within a very narrow window, which meant no delays leaving the gate or on the taxiway. The windows had to be cleaned and defogged. All of this had to be cleared in advance and locked in place. Although the flight was in a sense a private charter, it still had to have a flight number, and so LATAM Flight 1242 was scheduled for a 14:20 departure.

Camille adeptly took care of all the final details since Kelly had left on Monday morning to lead the S&T ground tour in La Serena. On Tuesday morning, July 2nd, 38 eager eclipse chasers convened at the Holiday Inn across the street from the airport's main terminal for introductions and instructions from Camille about the flight. Besides Elyse and me, WAA was represented by Mark Hefter of Dobbs Ferry. Most of the folks had seen the 2017 eclipse; just a couple had seen three or more but for six it was their first experience of totality. The group had lunch and then walked over to the terminal. We quickly went through security in the first-class area. At the gate, a bus took us about 100 yards to the aircraft, where we posed for a group photo. There were three pilots on the flight and the head of the cabin crew was one of the senior LATAM managers, so I imagine there was some rank-pulling for this assignment. Although Camille distributed S&T-branded solar glasses to everyone, LATAM had thoughtfully prepared their own.



Flight 1242 flight plan, courtesy of LATAM and Camille Carlisle.

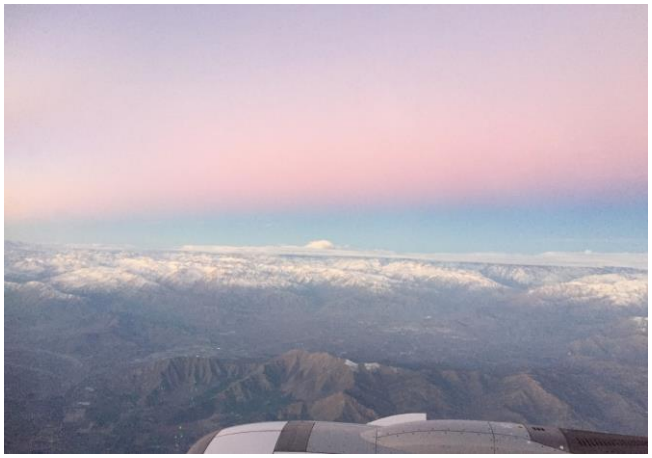
To balance the aircraft for take-off we all sat in the middle 7 rows (over the wings) of the 150 passenger plane. Once the seatbelt sign went off, we moved around to our (pre-booked) seats and started fiddling with our equipment, which ranged from cell phones to pre-programmed computer-linked DSLRs.

We headed northwest and climbed to 37,000 feet. The mood on the plane was jolly. Crew and passengers interacted cordially and the door to the cockpit remained open so the pilots could show us what they do. Their windows, being larger and panoramic, gave a wonderful view. We began to see the partial phase ahead on the right side of the aircraft. At the proper

time, about 250 miles west of the coast, the plane turned to the northeast to intercept the umbra. We had a condensed period for the partial phase. Finally the moment arrived. Elyse and I had to do some gymnastics so both of us could see out the window. The spectacular diamond ring was made more brilliant by the lack of atmosphere, as was the corona. Venus was radiant below and to the left of the Sun. The umbral shadow was shaped like a flattened parabola, too wide for the focal length of either of my cameras. Totality was its usual indescribable marvel. As always, it was shorter than one either expects or wishes. Another diamond ring flashed and then it was over.

I found making images to be very difficult. There was no way to set up a tripod, and the smallish window meant I would have had to displace Elyse to focus on the Sun if I wanted to get a longer series of exposures, an act too obnoxious to contemplate. There was also a tiny bit of turbulence that impacted the image detail, considering the slower shutter speeds needed to capture the corona. And my wide-angle shots were overexposed in spite of my planning. But so what? We saw it and it was grand.

We returned to Santiago, and on the way I got a nice view of the city of La Serena and behind it the barren mountains of Coquimbo. The observatories on Cerro Tololo and Cerro Pachon (Gemini South, SOAR and Large Synoptic Survey Telescope, under construction) were visible as tiny white structures on two of the seemingly innumerable mountaintops (see image on page 15). A brilliant Belt of Venus arced across the eastern horizon at dusk (see the November 2016 SkyWAAtch for more about this phenomenon). We celebrated back at the hotel with cocktails and dinner, and then off to bed before our next adventure, 5 days on Easter Island.

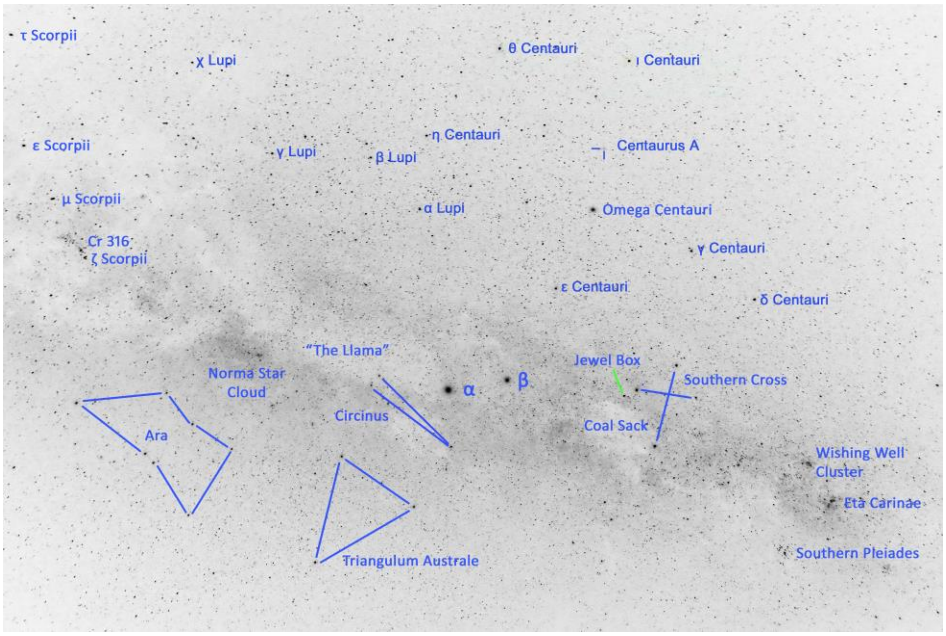


The Belt of Venus, seen over the Andes east of Santiago.

Seeing the eclipse from an airplane is a rare and unique experience. It's very different from seeing the event from the ground. You don't get the adagio tempo of the partial phase, or the subtle changes in light, temperature and behavior that one gets on *terra firma*, with nothing between you and the Moon's shadow. It's hard to set up photographic equipment on the plane. In 2017 we arranged our cameras hours in advance and simply let the eclipse flow over us. On the other hand, there's no anxiety whatever about visibility, nor is there the inevitable stress and worry about whether your travel investment is going to disappear in the clouds (my 1991 experience). Eclipse flights are only feasible if the Sun at totality is relatively close to the horizon (it was 20 degrees up during our pass), which means early morning or late afternoon local time. In 2020 and 2024 the eclipses will probably be at too high an altitude at any point within a reasonable flight time from a major airport, so there may not be any flights offered. I definitely wouldn't recommend a flight for first-time eclipse viewing, but if you've seen a few, it's an intriguing way to do it.

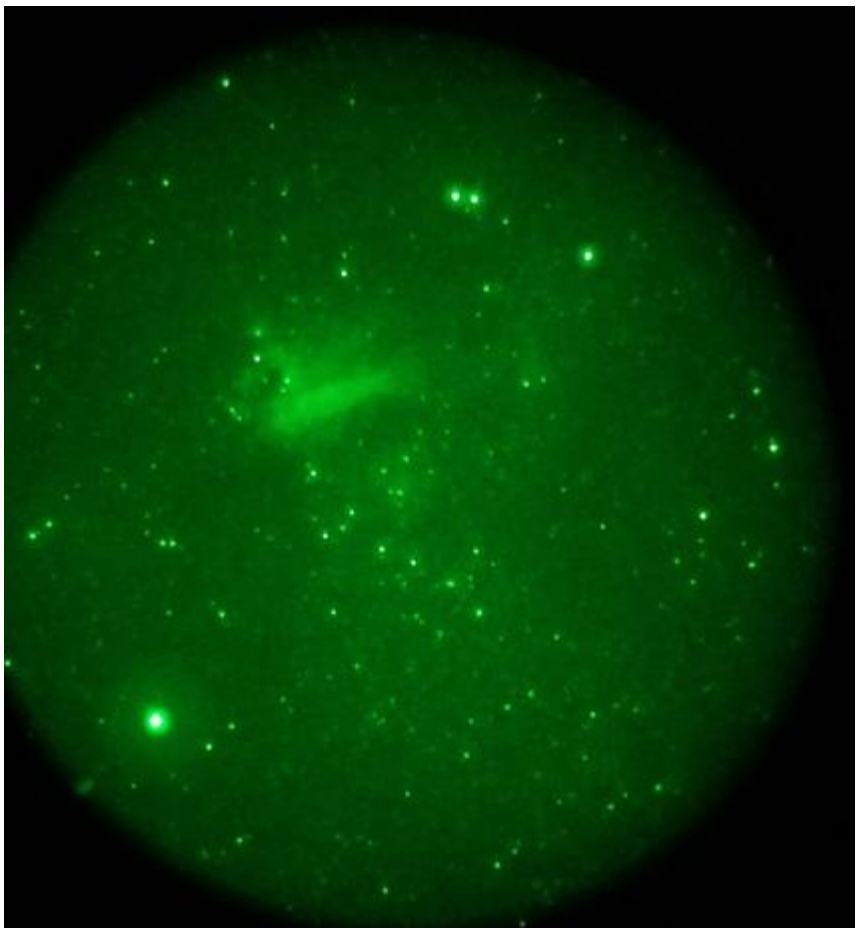
Photos of the trip by Ricardo and some of the other passengers are on the Shutterfly website at https://chileflighttse2019.shutterfly.com/. S&T's Sean Walker posted a beautiful (ground) image at https://www.skyandtelescope.com/astronomy-news/2019-totality-report/. ■

Images



Legend for front page image

The Milky Way in Centaurus and Carina is rich in famous asterisms, open clusters, dark nebulae and even the notable radio galaxy Centaurus A (NGC 5128). The Incas made their constellations out of voids rather than stars. They called the extensive dark nebula (light in this reverse image) stretching from Scorpius on the left to Alpha Centauri "The Llama". Similarly, they imagined a "Turtle" rather than the Coal Sack.



Messier 17 via image intensifier

The ever-inventive John Paladini captured M17, also called the Swan or Omega nebula, with a home-made image intensifier eyepiece mounted on a Meade 10-inch f/4.5 reflector. He used an Orion wideband filter and captured the image with a hand-held cell phone. The device uses a Photonis p22 intensifier.

The nebula is an HII region (ionized hydrogen, in other words energetic protons) in Sagittarius, about 5-6,000 light years from Earth. The brightest star, near the lower left edge of the field, is HD168415 a K3 star 517.7 LY distant, magnitude 5.39. The three brightest stars above and slightly to the right of the nebula are, moving clockwise, HD168607 (B01, 1812.0 LY mag 8.08), HD 168825 (B61, 1304.6 LY mag. 8.36) and HD168701 (K1, 2329.7 LY, mag 7.64.

Observatories in Chile. Looking east out the window of LATAM flight 1242 on July 2, 2019 Larry Faltz spotted the two major observatory complexes in the mountains of the Coquimbo region of Chile, about 215 miles north of Santiago. Near the left edge about a third of the way up from the bottom is the observatory complex of Cerro Tololo Inter-American Observatory. The largest dome houses the 4-meter Victor Blanco telescope, which currently carries the Dark Energy Survey camera. On the right about halfway down from the top are the three telescopes on Cerro Pachon: from left to right the 4.2-meter Southern Astrophysical Research Telescope (SOAR), the 8.1-meter Gemini South telescope and the 8.4-meter Large Synoptic Survey Telescope, which is currently under construction and slated to see first light possibly in 2020. The two complexes are about 6.4 miles apart as the crow flies.

WAA on the Science Channel

Our star party on May 24th was the backdrop for a segment of the "The Truth Behind the Moon Landing," a program that systematically debunked conspiracy theories about Apollo 11. A drone filmed us as we set up telescopes before dark. WAA was only on screen for a total of 3 seconds (!), but the club was referenced during the program. Here's a frame to show what our star party looks like during pre-sunset set-up. See the July SkyWAAtch, page 23, for more photos.

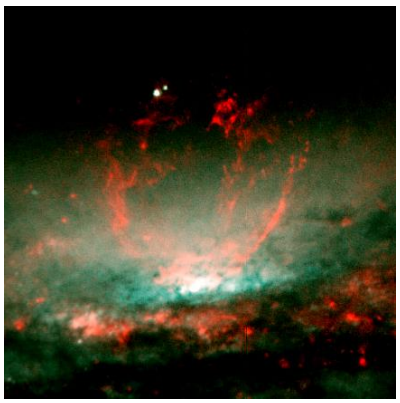
Research Highlight of the Month

Sebastian, B, Kharb, P, O'Dea, CP, Colbert, EJM, Baum, SA, The Filamentary Radio Lobes of the Seyfert-Starburst Composite Galaxy NGC 3079, https://arxiv.org/pdf/1907.12765.pdf

I'm a fan of NGC 3079, an 11.5-magnitude barred spiral Seyfert galaxy in Ursa Major. Fan of a galaxy? Why? It's the signpost to find QSO 0957+561 A/B, the gravitationally split Twin Quasar, a 17th magnitude object that I can just make out (but not split) in my 8" SCT with Mallincam video camera. NGC 3079 features an unusual bubble of hot gas near its center, possibly due to high-speed particles emanating from star formation, but its exact mechanism has not been elucidated. An international consortium of astronomers from India, Canada and the United States recently used the Jansky Very Large Array to study polarized radio signals from the galaxy.

The paper's abstract reads, in part, "Our sensitive radio observations reveal a plethora of radio "filaments" comprising the radio lobes in this galaxy. We analyze the origin of these radio filaments in the context of existing Chandra X-ray and HST emission-line data. We do not find a one-to-one correlation of the radio filaments with the emission line filaments…The magnetic fields are aligned with the linear extents of the optically-thin filaments, as observed in our, as well as other observations in the literature…. Our data best fit a model where the cosmic rays follow the magnetic field lines generated as a result of the dynamo mechanism.…We speculate that the peculiar radio lobe morphology is a result of an interplay between both the superwinds and the AGN jet that are present in the galaxy. The jet, in fact, might be playing a major role in providing the relativistic electron population that is present in the radio lobes."

NGC 3079



Top: SDSS image
Bottom: Hubble image of the central bubble.

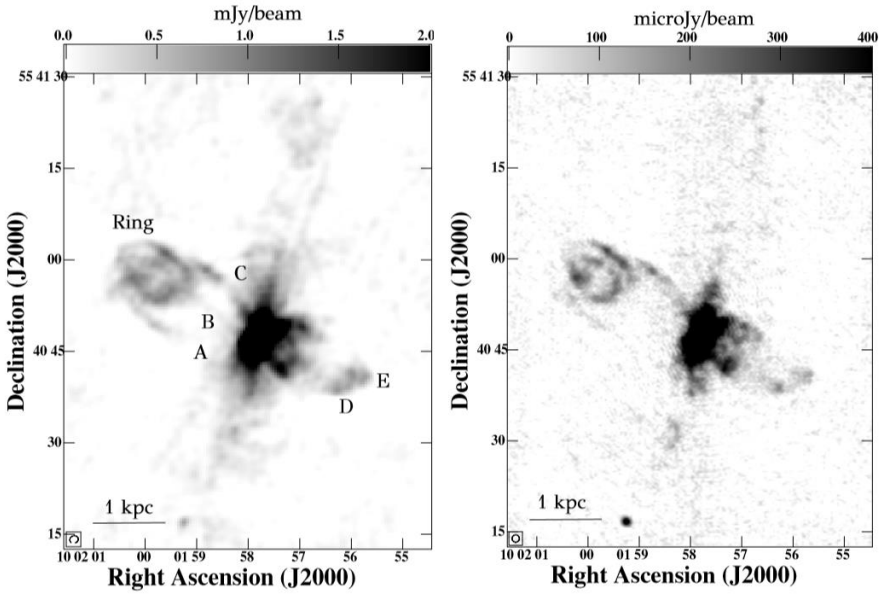


Figure 1. Grey scale images of total intensity showing the filamentary radio structures observed in NGC 3079 with the (left) VLA A-array at 1.4 GHz with a beam size $1.45'' \times 1.19''$ and P.A., $-80.2°$ and (right) VLA B-array at 5 GHz with a beam size, $0.58'' \times 0.43''$ and P.A., $85.8°$.

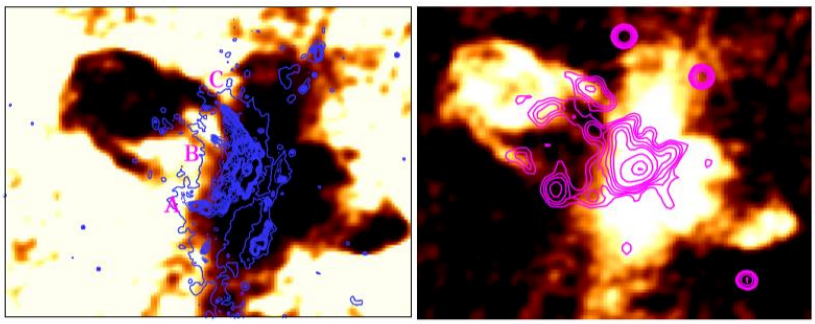


Figure 9. (Left) Overlay of the contours representing the *HST* WFPC2 $H\alpha+[NII]$ line emission in blue and (right) Chandra ACIS-S X-ray emission in pink, over the total intensity image in colour of NGC 3079 with the VLA A-array at 1.4 GHz.

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Celestron 8" SCT on Advanced VX mount	Purchased in 2016. Equatorial mount, portable power supply, polar scope, AC adaptor, manual, new condition.	$1200	Santian Vataj spvataj@hotmail.com
Celestron CPC800 8" SCT (alt-az mount)	Like new condition, perfect optics. Starizona Hyperstar-ready secondary (allows interchangeable conversion to 8" f/2 astrograph if you get a Hyperstar and wedge). Additional accessories: see August 2018 newsletter for details. Donated to WAA.	$1000	WAA ads@westchesterastronomers.org
Explore Scientific Twilight I Mount	Manual Alt/Az, capacity 18 lb. Steel tripod. Excellent condition. Used fewer than 10 times. Great for grab-and-go viewing. Owner upgrading to an EQ mount.	$110	Eugene Lewis genelew1@gmail.com
Meade 395 90 mm achromatic refractor	Long-tube refractor, f/11 (focal length 1000 mm). Straight-through finder. Rings but no dovetail. 1.25" rack-and-pinion focuser. No eyepiece. Excellent condition. A "planet killer." Donated to WAA.	$100	WAA ads@westchesterastronomers.org
Televue Plossl 55mm 2-inch	Very lightly used. Excellent condition. Original box.	$110	Eugene Lewis genelew1@gmail.com

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to ads@westchesterastronomers.org. Member submissions only. Please submit only serious and useful astronomy equipment. WAA reserves the right not to list items we think are not of value to members.

Buying and selling items is at your own risk. WAA is not responsible for the satisfaction of the buyer or seller. Commercial listings are not accepted. Items must be the property of the member or WAA. WAA takes no responsibility for the condition or value of the item or accuracy of any description. We expect, but cannot guarantee, that descriptions are accurate. Items are subject to prior sale. WAA is not a party to any sale unless the equipment belongs to WAA (and will be so identified). Sales of WAA equipment are final. Caveat emptor!

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Send articles, photos, or observations to
waa-newsletter@westchesterastronomers.org

Editor: Larry Faltz
Assistant Editor: Scott Levine
Editor Emeritus: Tom Boustead

Left: Mike Lomsky explains the workings of his 14" motorized Dobsonian at a club star party.