

Sky WAA tch

The Newsletter of Westchester Amateur Astronomers

March 2019

Lunar Eclipse - 1/21/2019UT - Mary Aloysia Hardey Observatory - TV85mm - Canon 60Da



5:42UT
2 second exposure

Total Lunar Eclipse, January 20-21, 2019 by Rick Bria

This year's only total lunar eclipse occurred on January 20-21st and brought many WAA members out into the clear, frigid night to observe and image the spectacle. The temperature in our area at mid-totality was about 9 degrees above zero with blustery and gusting winds lowering the wind chill to below minus 6. In spite of that, a few hardy members set up their cameras and telescopes. Rick Bria used an 85mm refractor and tracked the Moon to record this faithful, high resolution image from the Mary Aloysia Hardey Observatory in Greenwich, CT.

See page 7 for more on the eclipse.

WAA March Lecture

Friday, March 1st, 7:30 pm

Lienhard Hall, 3rd floor

Pace University, Pleasantville, NY

Catching Comets (and the Instruments that Catch Them)

Steve Bellavia, Brookhaven National Labs



This is a talk on the more notable comets in the last several years, how they were discovered, and the technology required to discover them. It also briefly discusses the Large Synoptic Survey Telescope, the LSST, that once up and running,

will undoubtedly be the comet-catching observatory for the world. It finishes up with a discussion of 'Oumuamua and the intriguing questions it has left behind as it leaves our solar system.

Steven Bellavia is an amateur astronomer and telescope maker. He is an aerospace engineer who worked for Grumman Aerospace with the Thermodynamics Group of the Space Division. He had a key role in developing a nuclear rocket engine and performed the analysis, design and fabrication of the micro-gravity liquid droplet radiator that flew on Space Shuttle mission STS-029.

Steve has been at Brookhaven National Laboratory since 1992 and is the principal mechanical engineer on the camera sub-system for the Large Synoptic Survey Telescope. Prior to that, he was doing research and engineering for the Relativistic Heavy Ion Collider and the NASA Space Radiation Laboratory. Steve is also adjunct faculty at Suffolk County Community College for Physics, Engineering and Astronomy, and the Astronomy Education and Outreach Coordinator at the Custer Institute and Observatory in Southold, New York.

Steve received the Master Outreach Award of the Astronomical League, and twice won Stellafane for innovations in optics for astronomy. His articles and photographs have been published on Gizmodo, Earth-Sky, and Astronomy magazine.

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

WAA Lecture April 2019

Friday, April 5, 7:30 pm

Lienhard Hall, Pace University

Astronomy and the Ancients: A Classical Journey through the Stars

Matthew McGowan

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the [WAA website](http://www.waa-ny.org).

Starway to Heaven Star Party

Ward Pound Ridge Reservation Cross River, NY

Weather permitting!

Saturday, March 2nd. Sunset is at 5:47 pm.

[Saturday, March 9th is the make-up date]

Renewing Members

Harry S. Butcher, Jr.

Mahopac

David Butler

Mohegan Lake

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WAA Members: Contribute to SkyWAArch!

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

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Editor: Larry Faltz

Assistant Editor: Scott Levine

Editor Emeritus: Tom Boustead

Northeast Astronomy Forum

Rockland Community College, April 6-7

<http://www.rocklandastronomy.com/neaf.html>

Help staff the WAA booth. Contact Charlie Gibson,
waa-vicepresident@westchesterastronomers.org

ALMANAC For March 2019

Bob Kelly, WAA VP for Field Events



Mar 6



Mar 14



Mar 20



Mar 28

The early morning still shows Jupiter and Saturn fleeing from the solar glare, low, but well into the dark sky. Venus still blows the rest of the planets away with its brightness, but it's getting so, so low down among the streetlights. Around mid-month, the three are equally spaced across the southeastern and southern skies.

What does Jupiter look like to you? Get your telescope, any size, and aim low to find the banded planet. What do its bands look like this month? Typically, Jupiter has two darker bands, one above and one below its oblate equator. One year, bright ammonium sulfate clouds formed over one of the bands, so it looked like Jupiter only had one stripe. Early reports say the equatorial region has darkened. What do you see? Let us know!

During one of your mornings with Jupiter, you might see one or two of Jupiter's moons making shadows on the planet. The moon itself may appear to be out to the side of the planet at that time because we get a bit sideways with Jupiter while it is at quadrature this month. The Canadian Almanac says two shadow transits at once will occur in the early mornings of March 18th and 25th. You often need three inches or more of telescope aperture to see these satellites' shadows.

Mars leads the passage of the bright winter stars across the evening sky. Going to daylight savings time makes Orion and the other constellations seem to take a step backwards. In the fall, the switch back makes the stars seem to rush for the exits sooner.

Guy Ottewell points out our Moon, Saturn and Pluto will appear to be within a tight circle on the 2nd. If you are spending a spring break in Cancun later in the month, you can point out where Pluto is on the 29th, when Pluto is passing near or just behind our Moon around 12:00 UTC. Earlier that day, Saturn will be occulted by our Moon for folks in southern Africa.

Speaking of unobservable events, the Moon approaches various clusters each month. For its pass by the Beehive on the 17th, the waxing gibbous Moon will make the bees hard to see without optical aid. However, it is fun to make the bees appear in a telescope when our Moon is so close by.

The pass of solar system objects by our Sun in our skies should be a classic unobservable event, but people who read this Almanac know our secret for actually viewing these events, using NASA's SOHO at <https://sohowww.nascom.nasa.gov/data/realtime-images.html>. Mercury, Neptune and the minor planet Vesta pass through the SOHO LASCO C3 frame this month. The United States' Naval Research Laboratory has a finder chart for these passes can be found at https://sungrazer.nrl.navy.mil/index.php?p=transits/transits_2019. [You can ignore the Certificate Error if you receive it; the site is safe per US NRL.] Or, see <https://bkellysky.wordpress.com/2019/02/15/using-soho-to-see-the-impossible-scene/>.

The International Space Station is visible in the dawn sky through the 18th and for the rest of the month in the evening. Have you seen the United States Air Force space plane OTV-5? It's visible to the unaided eye, but it's not very bright. See it to get astronomical and spy tech bragging rights. Based on long-range projections, mid-month will be the best time for evening sky viewing. Changes in solar 'wind' strength and its effects on our Earth's tenuous but tenacious upper atmosphere can change satellites orbits with time. Check <https://heavens-above.com/> or your favorite satellite spotting app for updates. The Air Force launched the OTV-5 in September 2017, and the Air Force changes OTV's orbit from time to time and could bring it back with a gliding landing at any time.

This month's full Moon is on the 20th, just 25 hours after lunar perigee. It's not a very close perigee, 1,500 miles farther away than February's closest approach for the year and March's full Moon is 3,400 miles farther away than last month's full Moon.

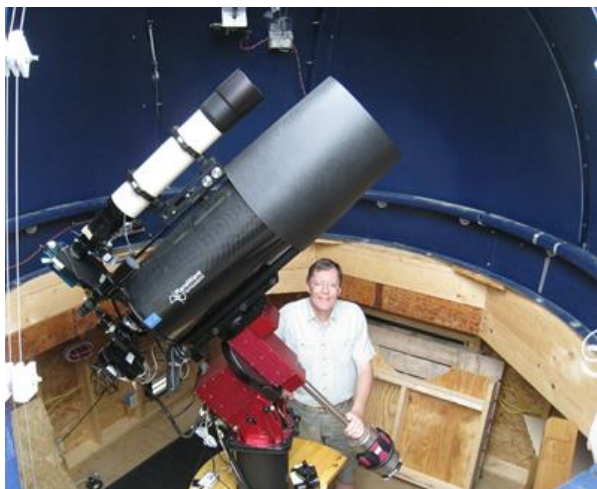
Daylight time begins Sunday morning, March 10th. It moves the sunrise forward an hour by the clock, making our morning planet-viewing time more accessible to everyone. Look out for some clear mornings after the time shift! Then look for some long-range forecasts of when a big high-pressure system may settle over us, or, even better (but typically briefer), when a tropical warm front brings stable but perhaps hazy air our way. Our evening star shows start at a later hour, making it harder to schedule star parties in prime time, especially for our youngest astronomers. ■

Treasures of the Night Skies Astrophotos of Scott Nammacher Larchmont Public Library

March 2nd through March 28th, 2019

Deep space and northern lights photographer Scott Nammacher, a Westchester-based amateur astrophotographer and member of Westchester Amateur Astronomers, will be exhibiting his images at the Orsman Gallery at the Larchmont Public Library. “Treasures of the Night Skies” opens March 2nd and will be on view until March 28th.

There will be an artist’s reception on March 2nd between 2 and 4 pm. WAA members are encouraged to attend.



Scott Nammacher’s photographs are taken at his up-state observatory (Starmere) and two remotely operated observatories, one in Australia and the other in New Mexico. He has been photographing nebulae, galaxies, along with cloud and gas regions, and more local solar system targets since the early 2000s. He became more seriously involved after he designed and built his own fully automated observatory near Catskill, NY in late 2008.

He recently photographed the spectacular aurora borealis (northern lights) from Churchill, Manitoba, just south of the Arctic Circle. The best of these images will be on exhibit at the show.

Scott’s images are printed on an emulsion layered on thin aluminum, which enhances the color and vibrancy of the photos.

On Sunday, March 3rd at 2 pm, Scott will give a talk at the Library about his photography and the techniques and equipment he uses to obtain the images. Weather permitting, a solar telescope will be set up for detailed views of the sun.

Larchmont Library information:

121 Larchmont Avenue, Larchmont, NY

Phone: 914-834-2281; Website: www.Larchmontlibrary.org

Artist Information:

Website: Starmere.smugmug.com; Email: snammacher@msn.com



Member Profile: Karen Seiter

Home town:

Larchmont

Family:

George Carteris

How did you get interested in astronomy?

I remember being interested in astronomy when I was young. My father loved everything “space” and he must have influenced me. My grandfather worked on the LEM module at Grumman in the 60s and that is why my family relocated to Bethpage, Long Island. Space is in my blood. However as a teenager and young adult I was busy with school and with starting a career in medicine so I drifted away from astronomy. However about 20 years ago I took a night course in astronomy at Westchester Community College and this rekindled my interest. It was there that I first learned about the Westchester Amateur Astronomers.

Do you recall the first time you looked through a telescope? What did you see? As a child. I think I saw an upside down bird in my back yard.

What’s your favorite object(s) to view? Anything deep sky. It helps me keep life in perspective.

What kind of equipment do you have? Meade LX-90.

What kind of equipment would you like to get that you don’t have? Nothing in particular

Have you taken any trips or vacations dedicated to astronomy? We took a driving tour of the southwest. We visited the National Solar Observatory, the Jansky Very Large Array, the Lowell Observatory and Meteor Crater. We also took a trip to Iceland on an aurora borealis tour. We saw the 2012 partial solar eclipse from New Mexico and the 2017 total solar eclipse from Jackson Hole.

Are there areas of current astronomical research that particularly interest you? I most enjoy high energy astrophysics and black hole astronomy.



What do you do (or did you do, if retired) in “real life”? I am a hematologist/oncologist who specializes in the treatment of adult patients with leukemia. I perform clinical trials of new drugs on my own patients and I am a member of the National Cancer Institute IRB for national clinical trials.

I am currently the Secretary of the Board of Directors of the Cradle of Aviation Museum in Garden City, New York. This museum celebrates the history of aviation on Long Island, including Lindbergh’s historic transatlantic flight and Grumman’s role in World War II and the space program. The museum is highlighting the 50th anniversary of the Apollo 11 mission this year with multiple events and speakers.

I am also involved in space exploration advocacy. I visit Capitol Hill yearly to push for more funding for space research. I have visited on behalf of the American Society of Gravitational and Space Research, the American Institute of Aeronautics and Astronautics, and the National Space Society.

Have you read any books about astronomy that you’d like to recommend? I have a very busy schedule so I enjoy concise books. I am currently reading *All of Physics in 15 Equations*.

How did you get involved in WAA? I learned about the club when I took an astronomy course at Westchester Community College.

What WAA activities do you participate in? I try to participate in everything however I travel and work a fair amount and am not always around. In the past I was the events coordinator for the club and then the club secretary. ■



In the Naked Eye Sky

March 2019: The Low End of the Big Dog

Scott Levine

Most of the stars we see any given night are fairly close by, within a couple hundred light years. For instance, all winter we've had the sublime pleasure of watching unmistakable **Sirius** (α CMa), be the last to join all the Winter Circle's stars, acting like a period on an enormous, looping and swirling sentence. It's one of the closest stars to us, only about eight and a half light years away.

As March comes roaring in, the southern end of Canis Major is finally high enough early in the evening that from my favorite south-facing spot I can see that there's more to the Big Dog than just Sirius.

What looks like a lazy and unassuming triangle from our thawing lawns is actually a stunning group of enormous and powerful stars, some of the most incredible in the sky. They give us a chance to look deeper into the galaxy, far beyond our familiar neighbors.

Wezen (δ CMa), at the top of the triangle, culminates – that is, it's due south and at its highest above the horizon for the night – right around 8:30 PM on March 1 and again, thanks to the whims of Daylight Saving Time, on March 15. Wezen is a young, giant star about 1600 light years away. It would swallow the entire inner solar system if it were dropped in place of the Sun. As far away as it is, it still looks to us like a steady second magnitude star.

Lower and to the west – to Wezen's right – is **Adhara** (ϵ CMa), a double star about 450 light years away. Toward the brighter end of second-magnitude, it looks blueish, as if it were **Rigel's** (β Ori) dimmer cousin.

The left-hand corner of the triangle brings us to **Aludra** (η CMa), a bright supergiant over almost 2000 light years away.

Wezen and Aludra are among the farthest stars we can see with the naked eye. If we add in the blue giant **Alnilam** (ϵ Ori), just across the street in the middle of Orion's belt and also about 2000 light years away, we can use that end of the sky to test the limits of how far we can see. It's always interesting to try to imagine how much light stars like these must be pumping out for us to see them so well from so far. In fact, Wezen

is about 80,000 times and Aludra over 100,000 times more luminous than the Sun. Alnilam is thought to be 500,000 times more luminous than the Sun! What would the sky would look like if these stars were as close as Sirius?

It's too dim to see with the naked eye, but off the eastern limb (the Wezen-Aludra side) of the triangle is VY Canis Majoris, the largest known star. Its diameter is 1500 times larger than the Sun.

If you can, try to imagine what all of this looks like in three dimensions. Rather than flattened by the enormous distances, we'd see Sirius up close up. Far behind it, the stars of the triangle would look tilted, angling away from us, pushing deeper and deeper into the galaxy.

While most of us are gawking at the bright sights high overhead, there are some amazing stars hiding a bit lower down. I hope you'll take a look.



Scott Levine's astronomy blog, *Scott's Skywatch*, can be found at <https://scottastronomy.wordpress.com/>

The January 20-21 Total Lunar Eclipse

Larry Faltz



A sequence of images of the partial and total phases of the eclipse by the author. Stellarvue SVR-105 triplet apo refractor (f/7), Canon T3i, no tracking. Larchmont, NY

Lunar eclipses don't have the panache of their solar counterparts. There's little long-term planning for observers, no need to compete for viewing sites, no trekking, no monomaniacal commitment on the part of some observers to see the next one, and the next, and the next. Totality comes on not with a bang, but a whimper. In fact, it's hard to be exactly sure when totality actually begins and ends, since the illumination of the fully eclipsed lunar disc exhibits a gradient, with the side closest to the umbra's edge being brighter than the rest of the disc. The shading could never be homogeneous unless the Moon is at the exact syzygy point in mid-eclipse, which happens in a minority of eclipses. The center of the Moon passes in most eclipses north or south of the exact umbral midpoint, sometimes missing it altogether as did the January 20-21 eclipse, since the size of the umbra is about 2.6 times the diameter of the moon.

In addition, the face of the moon with its maria and craters has an inconstant local albedo, adding to the variability. The human nervous system reacts to the color and intensity changes gently, almost autonomically, unlike the passionate coronal outburst we experience at solar totality. Our expectations are muted; we substitute elegance for drama. Lunar eclipses are a steady adagio. There's no stirring cadence, no crash of cymbals. They have a stately beauty.

Lunar eclipses do not have much presence in our cultural history, although there are a few that seem to have had an impact on certain historical events, perhaps with the most direct impact during a raid undertaken by Lawrence of Arabia on July 4, 1917 in the lead up to Lawrence's famous capture of Aqaba after

a trek through the Nefud desert.¹ In literature, solar eclipses have occasionally been used as a *deus ex machina* to rescue the protagonist, most notably in Mark Twain's *A Connecticut Yankee in King Arthur's Court* and H. Rider Haggard's *King Solomon's Mines*. The narrow path and exact timing of a solar eclipse makes such dramatic escapes completely unlikely in reality, but a total lunar eclipse did save Christopher Columbus's hide on March 1, 1504 as described delightfully by Joe Rao in a 2008 article on Space.com.² On October 27, 2004, a total lunar eclipse accompanied the sweep of the St. Louis Cardinals by the Boston Red Sox in the World Series, breaking the "Curse of the Bambino," the hex that presumably barred Boston from post-season glory for 86 years because they had traded Babe Ruth to the New York Yankees in January 1920. It was a fine coincidence. Or was it?

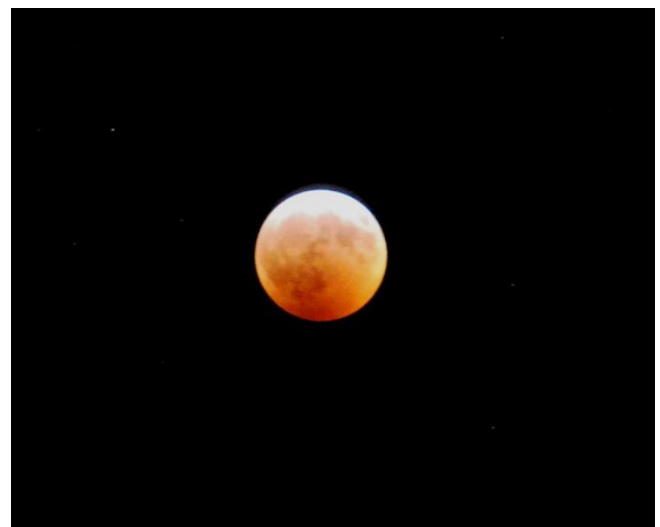
There was quite a bit of publicity in the lay media for this year's only total lunar eclipse. Non-cognoscenti enjoyed calling it a "Super Wolf Blood Moon" so they could explain the meaning of these folksy appellations, none of which are particularly appealing to me. Giving the full Moon a name in each month is attributed to Native American cultures and seems to have recently been perpetuated by the Farmer's Almanac. I hadn't heard it much before last year. I imagine that different tribes may have given the Moon different names in each month, or none at all. Some writer or editor decided not that long ago to fix the appellations and I am afraid now we are stuck with them, amplified by the Internet and social media. The "Harvest Moon" is the only one that was regularly named in the past. It made some sense, since the angle of the ecliptic around the time of the autumn equinox means that the moon rises at nearly the same time each night for a few days before and after, providing illumination that increases the time available for harvesting crops. And of course we had the old ditty "Shine on, Harvest

Moon," a song premiered in the 1908 Ziegfield Follies and one of the earliest hit recordings of the nascent gramophone era.

As for a "blood moon," there's just something creepy about calling it that, and not just for its evocation of werewolves. Fundamentalist Christian preachers John Hagee and Mark Biltz claimed that the April 2014 lunar eclipse, the first of a series of 4 that happened to occur on Jewish holidays, was the beginning of the "end times" as described in the Bible in the Book of Joel, Acts 2:20, and Revelation 6:12. Hagee wrote a best-selling book, *Four Blood Moons*. The Rapture was coming! Only it didn't, and of course it won't. The Jewish calendar has a lunar basis and it is to be expected that eclipses will fall on holidays on a fairly regular basis (and there are a lot of Jewish holidays.) The religious connotation of "blood moon" puts off a rationalist like me, and I disdain the term completely.

We hear a lot about "Super Moons," denoting a full Moon that occurs near perigee. From the point of view of the amateur astronomer, a full Moon is just a full Moon. It's nice when it's close to perigee and therefore appears a bit larger than usual, but the difference is not particularly perceptible to the eye and it makes little difference to imagers.

The attractiveness of a lunar eclipse is in the slow march of the Earth's umbral shadow across the lunar face and then the red glow of the completely eclipsed orb.



Mike Cefola used a Nikon DSLR on a non-tracking tripod

Making an accurate image of what one perceives visually seems to be nearly impossible. There is a tendency to overexpose the disc in an effort to capture surface detail and produce a pleasant picture. I found

¹ "The nearer post...commanded the valley—a strong place which it might be costly to take. We assigned the honor, in irony, to ibn Jad and his unwearied men, advising him to try it after dark. He shrank, made difficulties, pleaded the full moon: but we cut hardly into this excuse, promising that tonight for a while there should be no moon. By my diary, there was an eclipse. Duly it came, and the Arabs forced the post without loss, while the superstitious [Turkish] soldiers were firing rifles and clanging copper pots to rescue the threatened satellite." T.E. Lawrence, *Seven Pillars of Wisdom*, Chapter 54.

² <https://www.space.com/2729-lunar-eclipse-saved-columbus.html>

this eclipse to be fairly dark, with the southern limb almost imperceptible from my vantage point (and with my aging eyes), and I chose to keep my totality image fairly faint, the lunar south pole almost invisible. Perhaps I was not quite dark adapted, what with peering at the camera's video screen throughout the event. Rick Bria's image of late totality (on the front page of this issue) shows more homogeneous lighting, while John Paladini's shot earlier in totality (below) is even brighter. Our eyes are better than CMOS or CCD sensors for brighter objects. For the partial phases, one has to choose between detail and lighting, overexposing or underexposing some part of the lunar disc out of necessity. *De gustibus non disputandum est.*

John Paladini (Mahopac) sent in a few photos along with his usual parsimonious description: "well these were mine for what its worth. it was real great in bino viewer."



John Paladini, 80 mm APO refractor

Joe Rao sent this wonderful, scholarly report from Putnam Valley:

Because of the extremely cold conditions (~14 F) and forecast of blustery/frigid winds (and fear of frostbite), my original intentions were to observe this eclipse running in-and-out of my house with nothing more than my 7 x 35 "wide angle" (11 degree field) binoculars. However, at around 9:30 p.m. upon stepping outside I was surprised at the fact that the wind was much lighter than I had expected. Rather than drag my 10.1-inch Dobsonian telescope out of the garage, I set up a card table just a few feet away from the front door of my house and set up my son's Edmund Astroscan 2000 telescope. This provided fine views of the eclipse and even allowed my daughter to take a few pictures through the eyepiece using nothing more than her smartphone (see image below).

Skies were exceptionally clear at my location in the wake of a potent winter storm that hit us the night before. Aside from some occasional fast-moving cloud patches, it was a very clear and transparent (albeit frigid) night.

After catching the end of the AFC Championship game between the Patriots and the Chiefs, which had gone into overtime, I stepped outside at 10:20 p.m. and immediately could discern a faint shading on the Moon's lower left portion indicating the presence of the penumbral shadow. Just prior to the Moon's first contact with the Earth's umbral shadow, the penumbra appeared grayish to the unaided eye, but in binoculars and the Astroscan it resembled a brown or tan color.

As the Moon moved into the penumbra, its inner part could be seen as a dusky band bordering the outer edge of the umbra. This was especially evident with the unaided eye; I estimated the apparent width as equal to roughly one-third of the Moon's diameter or about 11 arc minutes.

As the Moon began its plunge into the umbra, I was amazed at how bright it was. Only 15 minutes after first contact, I could readily see lunar features inside of the umbra, including craters such as Grimaldi. And by 11:00 p.m. EST, 27 minutes after first contact with the umbra, I could readily detect a faint reddish coloration within the umbra. When about 90% of the Moon was inside the umbra, a distinct deep red-orange coloration was visible. The coloration was less prominent when I used optical aid: in my 7 x 35's the hues were coppery-red, but these colors were less evident in the Astroscan.

A few minutes before totality, the naked-eye view of the Moon suggested a closeup view of Mars with its north polar cap visible. During the opening minutes of totality a bright rim in the region of Mare Crisium displayed shades of robin's-egg blue, which gradually faded as the Moon pushed deeper into the umbra. In fact, at mid-totality (12:12 a.m. EST) the blue had pretty much disappeared and was now a dull gray-white. Visually the eclipse was quite bright. Maria were visible as "spots" to the unaided eye and were readily visible with the 7 x 35 binoculars. It appeared that the second half of totality was noticeably brighter than the first half.

On the 5-point Danjon color scale, estimating with just my eyes alone, I came up with $L = 2.9$ at the start of totality, $L = 2.6$ at mid-totality, and $L = 3.3$ at the end of totality.

To estimate the Moon's actual brightness, I used the 7 x 35 binoculars held backwards to obtain reduced images of the Moon so I could compare it with the stars of the mid-winter sky. At the start of totality I estimated a magnitude of -3.0 , at mid-totality, a trifle brighter than Sirius at -1.5 , and at the end of totality -3.3 .

So at mid-eclipse, the Moon faded 11.2 magnitudes or a ratio of 30,200 times dimmer compared to just prior to the onset of the eclipse!

Finally, the overall view of the sky at mid-totality was quite striking. Pollux and Castor served as "pointer stars" aimed almost directly at the darkened Moon. I could also make out the Beehive star cluster in Cancer, sitting just 7 degrees to the east of the Moon; in my wide-field binoculars, I could fit both the Moon and star cluster in the same field of view, a beautiful sight!

Several minutes after the Moon began to edge out of the umbra (creating the beautiful "Japanese Lantern Effect") I decided that I had enough of the arctic conditions. I brought the Astroscan back into the house, folded up the card table and called it a night. This was my 19th total eclipse and could also be traced back -- through three Saros cycles -- to my very first total lunar eclipse in December 1964.

Joe mentioned the Danjon scale, an attempt to objectify the brightness of a lunar eclipse. It's one of the many attempts to classify and regularize otherwise subjective observations in astronomy, such as seeing and transparency (These remind me of the send-up of philosophy in Woody Allen's *Love and Death* that starts "Subjectivity is objective....") The scale was

developed by French astronomer André-Louis Danjon in the 1920's.

L	Description
0	Very dark eclipse. Moon almost invisible, especially at greatest eclipse.
1	Dark Eclipse, grey or brownish in coloration. Details distinguishable only with difficulty.
2	Deep red or rust-colored eclipse. Very dark central shadow, while outer edge of umbra is relatively bright.
3	Brick-red eclipse. Umbral shadow usually has a bright or yellow rim.
4	Very bright copper-red or orange eclipse. Umbral shadow has a bluish, very bright rim.

Atmospheric phenomena: humidity, clouds, pollution and volcanic ash can have major impacts on an eclipse's brightness and color, and observers standing next to each other often disagree.



Moon emerging from total eclipse. Taken by Maria Rao holding her smartphone up to the eyepiece of an Edmund Astroscan 2000 at 12:45 a.m. EST on 21 January 2019.

Susan and George Lewis (Mamaroneck) reported an experience that I suspect was common, until they threw in a variation: "To avoid the freezing temperatures as much as possible, we used our binoculars to watch the partial eclipse phase from our living room window. At about 11:15pm, we bundled up, got in our car and drove over to a good viewing spot in Mamaroneck. We were about to get out of the car and stand nearby when inspiration struck! We stayed in our car and opened up the—*ahem*—Moon Roof and watched the rest of it from inside our car. What a glorious sight on a crystal clear night, perhaps the best Lunar Eclipse we've seen."

Arthur Rotfeld (White Plains) wrote "You can likely recall the challenges of observing the lunar eclipse last month. It was extremely cold, windy, and (worst of

all) clouds obscured the moon for most of the totality—at least here in White Plains. I didn't have the patience to set up a tracking mount, so this shot was taken on my simple grab-and-go tripod. I used an 80mm APO refractor with a 1 sec exposure at 1600 ISO, certainly working at the very limit of such a set-up." Arthur's experience is a reminder that in addition to the miserable cold temperatures, the dreadful weather earlier in the day had not completely cleared, with patches of thin clouds moving quickly across the field and occasionally blotting out the dim lunar disk.



Arthur Rotfeld, 80mm refractor

Eva, Erik, Bjorn and Callie Andersen (a lunar Labrador retriever) "viewed the lunar eclipse on the evening of Sunday January 20, 2019 from the convenience of ten feet from our front door in Croton-on-Hudson. Even though we were protected from the wind, the low temperature was somewhat limiting in how long we stayed outdoors at any given time. We viewed the various stages of the eclipse via naked eye, binoculars and Eva's Televue NP 101 with a 26mm Nagler type 5 eyepiece and were treated to a beautiful winter eclipse. The photo was taken with Eva's cell phone via the 26mm lens. A lovely time was had by all."



Eva Andersen's fine cell phone photo through a Televue NP-101

I had made all sorts of plans for imaging, mostly involving setting up scopes and cameras on my iOptron MiniTower alt-az tracking mount but it was so cold that the extra fiddling with alignment and power was out of the question. Discretion being the better part of valor, I took Arthur's approach and used an old Giro-II alt-az mount out and attached my 105mm f/7 Stellarvue triplet refractor with a Canon DSLR, setting up on the sidewalk in front of my house in Larchmont. Fortunately the two LED streetlights were to the north and far from the field of view. I didn't even bother with eyepieces. I dressed in ski clothes and down coat, but since I had to take my gloves off to fiddle with the camera my fingers got pretty numb by the time totality was over in spite of the occasional quick warming sessions in the house. Not tracking, I was limited to a maximum of 0.4 second exposures based on the useful formula for avoiding star trails with a fixed mount: 500 divided by the lens focal length. The T3i's smaller APS-C sensor requires a 1.6x magnification factor, so I was photographing at 1,176 mm. I had to shoot at higher ISO's at totality and the images were perhaps a little noisier than I might have liked. Fortunately that doesn't show much at the size used here.

When it was over and the equipment put away (actually left to thaw out, as all the metal parts of the telescope and mount were covered with a layer of frost and the lens fogged over as soon as it hit the warm air in my basement) I was too wired to sleep. I took advantage of Monday's holiday I stayed up and downloaded the images from the camera, processed one of them and sent it to few of the WAA imaging contingent. Then my thoughts turned again to the issue of lunar coloration.



Kevin Lillis, Yorktown Heights

If we looked back at the Earth from the surface of the Moon during a total lunar eclipse, we would see a black orb with a thin reddish rim. The Moon is illuminated by red light for the same reason that the daytime sky is blue: Rayleigh scattering. Small gas molecules in the Earth's atmosphere scatter shorter wavelength

blue light more efficiently than longer-wavelength red light. The less-scattered red light passes through the atmosphere and illuminates the Moon. Now, the week of the eclipse I happened to be reading *Space Oddities: Our Strange Attempts to Explain the Universe* by S.D. Tucker, a rather entertaining book about many of the peculiar ideas otherwise (presumably) intelligent people have had about the cosmos. Tucker devotes part of a chapter to the Flat Earthers, and it occurred to me to look at the Flat Earth Society's web site³ to see what they thought about lunar eclipses. It's weirder than you could imagine!

Flat Earthers believe there is a "Shadow Object" that passes between the sun and the moon, but that shadow object is NOT the Earth.

It is estimated that the Shadow Object is around five to ten miles in diameter. Since it is somewhat close to the sun the manifestation of its penumbra upon the moon appears as a magnified projection. This is similar to how during a shadow puppet show your hand's shadow can make a large magnified projection upon your bedroom wall as you move it closer to the flashlight....

There is also a possibility that the Shadow Object is a known celestial body which orbits the sun; but more study would be needed to track the positions of Mercury, Venus and the sun's asteroid satellites and correlate them with the equations for the lunar eclipse before any conclusion could be drawn.

More study to track the planets? We have positions of these bodies going back to the Babylonians! Newtonian physics rules, except for Mercury where the corrections of General Relativity are needed to plot its orbit. But let's just dismiss all of that, shall we?

As to the red color of the totally eclipsed moon, they have this explanation:

The Lunar Eclipse is red because the light of the sun is shining through the edges of the Shadow Object which passes between the sun and moon during a Lunar Eclipse. The red tint occurs because the outer layers of the Shadow Object are not sufficiently dense. The Sun's light is powerful enough to shine through the outer layers of the Shadow Object, just as a flashlight is powerful enough to shine through your hand when you put it right up against your palm.

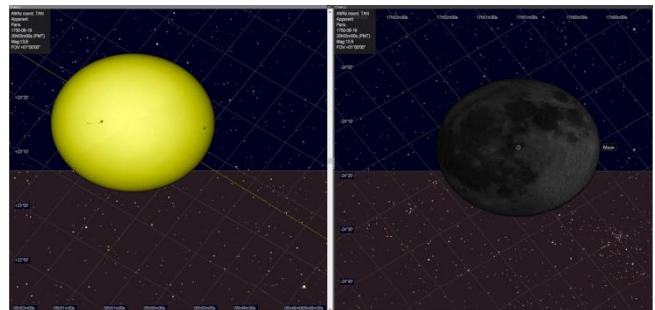
Now, if that seems bizarre, here is an attempt at an explanation based on recorded observation:

³ <https://theflatearthsociety.org/home/>

We must conclude as William Carpenter did in *One Hundred Proofs That The Earth Is Not A Globe*. [a book written in 1885] "The Newtonian hypotheses involves the necessity of the Sun, in the case of a lunar eclipse, being on the opposite side of a globular earth, to cast its shadow on the Moon: but, since eclipses of the Moon have taken place with both the Sun and the Moon above the horizon, it follows that it cannot be the shadow of the Earth that eclipses the Moon; that the theory is a blund (*sic*); and that it is nothing less than a proof that the Earth is not a globe."

The author of this particular piece, one John Davis, says "One [eclipse with both the Sun and the Moon in the sky] occurred in Paris, 19th of July, 1750 as reported to Rowbotham⁴ through Astronomy and Astronomical Instruments by George G Carey. Again on 20th April, 1837 and the 20th of September 1717 reported through McCullochs Geography."

The lunar eclipse of 19 June 1750 was in progress at sunset in Paris, and a part of each body was above the horizon, easily shown in this screen shot from Cartes du Ciel (the moon is dark because CdC accurately positions it in the Earth's umbra).



CdC plots of the setting sun and rising eclipsed moon from Paris, June 19, 1750, 20:03:30 local time.

That doesn't negate the fact that the two bodies were indeed on opposite sides of the Earth, 12 hours apart in right ascension (the difference in RA is just 7 seconds of arc). Their simultaneous appearance opposite each other in the sky is easily explained by the fact that the Earth's umbra is larger than the moon, as mentioned earlier. The same phenomenon occurred in the other eclipses mentioned but as no locations were given I couldn't make CdC plots. The phenomenon occurs at the edge of the geographic zone where the Moon is in the umbra at sunrise or sunset, as it must

⁴ Samuel Rowbotham (1816-1884), the author of *Zetetic Astronomy: Earth Not a Globe*, is generally viewed as the prophet of flat earth beliefs. Mr. Rowbotham dropped out of school at the age of 9.

appear somewhere on the Earth in every total lunar eclipse. To see it, you need to be able to observe each horizon with less than about 0.25 degrees of obstruction from a location in that zone. It would be an interesting sight!

The Flat Earth Society web site takes a stab at rebutting the scientific explanation for the red coloration:

The red color supposedly comes from Rayleigh scattering. So often the positivist attempts to shove the round hole into the square block! So often he does so with refraction! From here he takes his assumption of the round earth and calculates what the variables would need to be to allow for a red moon. Then against all reason he declares it true - without a second thought. This may suit him well, if only the light from the earth was a deep bright red! Go out and observe it dear reader. Do you truly believe this is light that was Rayleigh scattered through the atmosphere?

Of course not. This is evidenced by the fact that the sky night is not red, but black! Should this light be bending this way and that to travel around the earth, we would see some of this light scattered within our atmosphere giving us a red night sky. Of what fun it is to watch the mental gymnastics of the round earther determined to keep hold of his faith.

The night sky is black because there's no sunlight falling on it, of course, and scattering is not the same as refraction. Many of the Flat Earth arguments against science take the form of insults and sarcasm rather than investigation. Frequently, the writings of 19th century flat-earth prophets (Rowbotham and Carpenter) are simply cited as "proof." Conspiracy theories abound. Of the one hundred proofs that Carpenter offers (a scan of the book is available on line) not one makes any sense unless you are already a true believer or credulous beyond all hope.⁵

I have to admit that I am both fascinated and repelled by the Flat Earthers. Reading their stuff is like watching a train wreck, but it's a wreck of the human mind. Such beliefs are not going to change the motions of celestial bodies or the flightpaths of airplanes, but they

⁵ Example: "33. If the Earth were a globe, people—except those on the top—would, certainly, have to be "fastened" to its surface by some means or other, whether by the 'attraction' of astronomers or by some other undiscovered and undiscoverable process! But, as we know that we simply walk on its surface without any other aid than that which is necessary for locomotion on a plane, it follows that we have, herein, a conclusive proof that Earth is not a globe."

carry with them disbelief in other scientific facts that society does need to understand, like climate change and the safety and efficacy of vaccinations. Belief in a flat earth is actually growing. Here's a survey of 8,215 Americans conducted by YouGov in 2018.

1. Do you believe that the world is round or flat?

	%	TOTAL	18-24	25-34	35-44	45-54	55+
I have always believed the world is round	84	66	76	82	85	94	
I always thought the world is round, but more recently I am skeptical/have doubts	5	9	7	6	3	1	
I always thought the world is flat, but more recently I am skeptical/have doubts	2	5	4	3	2	1	
I have always believed the world is flat	2	4	3	1	2	2	
Other/Not sure	7	16	10	8	8	2	

Perhaps some of the younger respondents were goofing on the surveyor, but alas the trend is clear: ignorance is growing. It's almost as if it's being celebrated. The failure of science teaching in most schools and even in higher education is partially to blame (and must account for 16% of the 18-24 year old group simply not being sure of anything in the above poll). According to a 2015 Pew Research Center poll, only 73% of Americans could distinguish between astronomy and astrology. A January 2019 Pew poll showed major differences between public beliefs and those of members of the American Association for the Advancement of Science (I'm one). While some of the questions involve opinions (it's hard for anyone to be sure how to calculate that the space station is a "good investment"), it's terrifying that only 50% of Americans believe in human evolution (vs. 98% of AAAS members), only 37% think genetically modified foods are safe to eat (vs. 88%) and only 50% think climate change is caused mainly by human activity (vs. 87%).

It's another reason that WAA needs to provide and support outreach astronomy programs as an entry into scientific reasoning and the rational understanding of the universe.

The next total lunar eclipse visible from our area won't be until May 16, 2022. On July 5, 2020 we're in a good position to experience a partial penumbral eclipse, with just the Moon's northern half getting slightly, perhaps imperceptibly, shaded. On November 19, 2021, we'll be able to see a near-total eclipse, with just a small chord of the Moon's south pole failing to enter the umbra. ■

Images by WAA Members



The Belt of Venus by Rick Bria

Most people will notice a sunset. Not many look in the opposite direction and so they miss the “Belt of Venus.” A short time after the Sun dips below the western horizon, the Belt of Venus appears in the east.

The Belt of Venus is a pink glowing band above the horizon. It is caused by sunlight passing through the earth's atmosphere at a very low angle and the longer wavelength red rays being refracted back to the observer. The effect has nothing to do with Venus the planet, but it relates to a wondrous sash that the Greek goddess Venus wore. See the [November 2016 SkyWAArch](#) for more on this often overlooked but very beautiful phenomenon, including more about the goddess' sash.

Below the pink band is the blue/gray shadow of the earth projected onto the Earth's atmosphere. There are two instances when we can see the Earth's shadow. The Earth's shadow on the Moon during a lunar eclipse is, of course, the one almost everybody knows, and this is the other. In fact, if you observe the Belt of Venus and below it the Earth's shadow across the entire horizon, say from the top of a mountain, you will see that it is arc shaped just like the umbral shadow during a lunar eclipse.

Both the Belt of Venus and the Earth's shadow only last a few minutes. As the Sun sets further below the horizon the effect dissipates. It occurs almost every clear sunset. To see it you must have an unobstructed eastern horizon and you must look in the opposite direction of the setting sun. The Belt of Venus and the Earth's shadow can also be seen just before sunrise. Naturally all directions will be reversed.

Rick took this photo with his cell phone. ■

Images by WAA Members

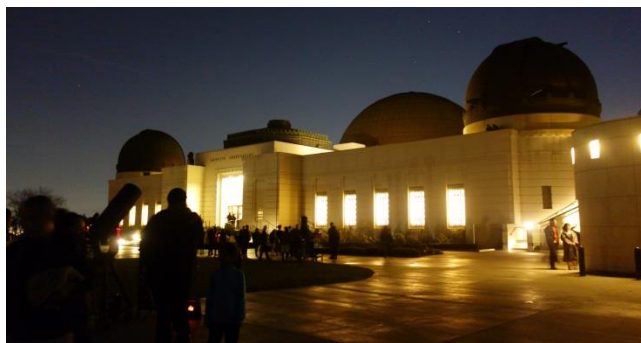


Stars over Griffith Observatory by Larry Faltz

Griffith Observatory in Los Angeles is open every day until 10 pm. Entry is always free. Larry and Elyse were among a substantial throng of visitors to this iconic, educational and frequently filmed facility on a 65° F Sunday evening in late January. Although the Observatory's 12-inch refractor was not open, there were three 11-inch Celestron telescopes on the grounds for outreach. This is a ½ second exposure, f/1.8, ISO 1600, taken with a Sony DSC-DX100 camera. Although there were some cirrus clouds and lots of light pollution from the city of Los Angeles, the bright stars of Orion (as well as M42), Sirius, Procyon and even 2nd magnitude Gamma Geminorum (Alhena), to the left of Betelgeuse, were easily visible.



Griffith is just 5 miles from the center of downtown LA

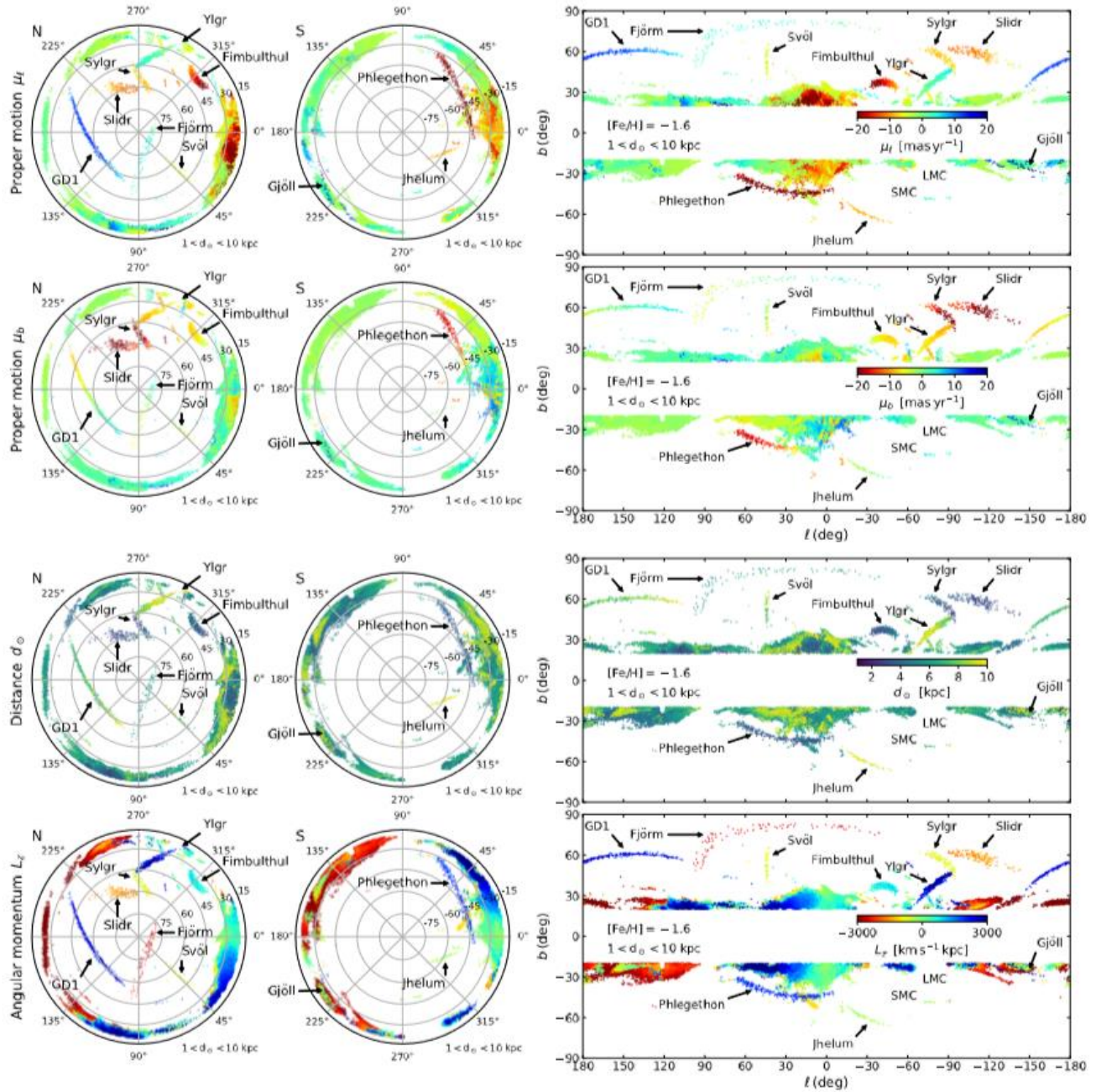


Celestrons set up for outreach

More information about Griffith is in the June 2015 newsletter (<https://westchesterastronomers.org/wp-content/uploads/2018/06/June2015.pdf>).

Research Highlight of the Month

Inner Galactic Stellar Streams



Using a new algorithm to process data from the vast Gaia DR2 catalog (released in April 2018) of over a billion Milky Way stars, researchers from the University of Strasbourg, Stockholm University and the Max Planck Institute discovered a number of stellar streams between 1 and 10 kiloparsecs from the Sun. The stars appear to have low metallicity and are therefore quite old. The team thinks that they represent the debris of gravitationally disrupted inner halo globular clusters. They gave the streams Norse names such as Sylgrm, Ylgr and Fimbulthul. This is Fig. 7 from the paper Ibata, RA, Malha, K, Martin, NF, The streams of the gaping abyss: A population of entangled stellar streams surrounding the inner galaxy, arXiv 1901.07566v1, accepted by the *Astrophysical Journal*.

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Celestron 8" SCT on Advanced VX mount	Purchased in 2016. Equatorial mount, 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 <u>Hyperstar</u> and wedge). Additional accessories: see August newsletter for details. Donated to WAA.	\$1100	WAA ads@westchesterastronomers.org
Meade Research Grade 12½" f/6 Newtonian telescope.	Ex Bowman Observatory, Greenwich. New in 1985, normal wear but it is complete and everything works. 8" Beyer drive, 80mm f/15 guide scope. 50mm finder. Moonlite focuser. Drive control. Updated mirror mount. Mirrors refinished 2013 Metal pier.	Free!	Rick Bria rickbria22@gmail.com
Celestron StarSense autoalign	New condition. Accurate auto-alignment. Works with all recent Celestron telescopes (fork mount or GEM). See info on <u>Celestron web site</u> . Complete with hand control, cable, 2 mounts, original packaging, documentation. List \$359. Donated to WAA.	\$225	WAA ads@westchesterastronomers.org
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.	\$150	Eugene Lewis genelew1@gmail.com
Celestron 114mm f/8 reflector	Equivalent to Powerseeker 114, this older model has a beefier EQ2 GEM mount and a strong wooden tripod, unlike current aluminum tripods. Slow motions on both axes. Setting circles. No motor drive, not go-to. One 10mm wide-field eyepiece. Finder. Optics in good shape. Very good condition. Donated to WAA.	\$50	WAA ads@westchesterastronomers.org

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 only submit 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!*