

Sky WAA *tch*

The Newsletter of Westchester Amateur Astronomers

June 2019



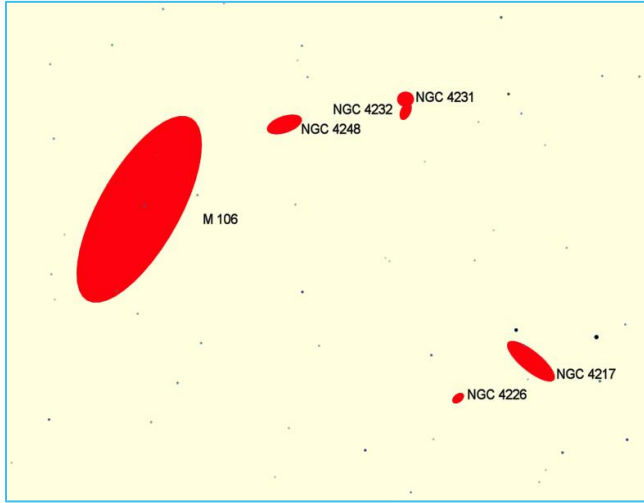
M106 in Canes Venatici by Olivier Prache

See page 2 for a full description.

Cover image: M106 by Olivier Prache

From Olivier's observatory in Chappaqua. Nine hours and 50 minutes total exposure over several nights with a Hyperion 12.5" f/8 astrograph and an FLI ML16803 monochrome camera. Subs were processed with CCDStack and PixInsight.

M106 (also catalogued as NGC 4258) at magnitude 7.38 is one of the best examples of a Seyfert galaxy that is within reach of imaging systems. It's a Seyfert 2 galaxy with a red shift of $z=0.00149$, distance 9.64 megaparsecs.



NGC 4231 and 4232 may be interacting. They and NGC 4226 are much further away than M106 and NGC 4248.

NGC	Visual Magnitude	Distance (Mpc)
4248	12.16	9.46
4231	13.49	106
4232	12.81	100.2
4217	11.20	17
4226	12.05	104

Data from the NASA/IPAC Extragalactic Database (NED) (<http://ned.ipac.caltech.edu>)

In addition to the other NGC galaxies, the faint smudge in the image below M106 is UGC07356 (also catalogued as MCG +08-22-105 and PGC039615), a magnitude 14.75 galaxy much smaller than M106 but somewhat closer to us at 7.06 megaparsecs.

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

May 25 (Make-up date June 1)

June 29 (Make-up date July 6)

WAA Members' Picnic

Saturday, June 8. 12-4 P.M.

Danish Home

1065 Quaker Bridge Rd E,
Croton On Hudson, NY 10520

Food, drink, door prizes, astronomy trivia contest

Rain or shine! A covered pavilion will protect us from the elements if the need arises.

Please RSVP by June 1 to andefam55@gmail.com

New Members

Howard Fink
Howard Finkelstein
Eugene Leeds

New York
Greenwich
Brewster

Renewing Members

Arun Agarwal
Paul Alimena
Jose Castillo
Joseph Depietro
Jon Gumowitz
Kevin Lillis
Arthur Linker
Dante Torrese
Jordan Webber

Chappaqua
Rye Brook
Pelham Manor
Mamaroneck
White Plains
Yorktown Heights
Scarsdale
Ardsley
Rye Brook

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ALMANAC For June 2019

Bob Kelly, WAA VP for Field Events



New
Jun 3



1Q
Jun 10



Full
Jun 17



3Q
Jun 25

The giant planets Jupiter and Saturn make the evening scene. It's about time we had some bright planets before midnight! Jupiter is opposite the Sun as seen from Earth on the 10th. We are closest to Jupiter then, so the only planet that matters¹ is as big and bright as it will get this year. Jupiter and Saturn are so far south on the ecliptic that they don't get more than 27 degrees above the horizon from our location. So, even though Jupiter will rise at sunset this month, it will take a while to get high enough in the sky to make a nice presentation of its cloud belts in a telescope. Saturn follows and maxes out its height in the south by 3am EDT. If you want to see Jupiter overhead, it's time to book that trip to Madagascar, Rio de Janeiro or Australia. Saturn would look pretty good from there, as well.

Jupiter's four largest moons (the Galilean moons) are visible in any telescope when the planet or its shadow doesn't hide them. Three of Jupiter's moons are larger than ours; Ganymede (and Saturn's Titan) are larger than Mercury. Two of Jupiter's moons, Io and Ganymede, throw some shade on the planet just around midnight on the 11th/12th.

Saturn's rings are open 23 degrees toward Earth. How many moons can you see despite the glare of the rings?

Manhattanhenge (attributed to Neil deGrasse Tyson) is when the rising or setting Sun is visible looking down the cross streets of Manhattan. In summer these generally occur in two pairs on each side of the June solstice (depending on the exact position of the Sun and the width of Manhattan streets). They'll be at sunset on May 29th and 30th and again on July 12th and 13th. Just for the record, the summer solstice is at 11:54 A.M. EDT on the 21st. New York's highest Sun

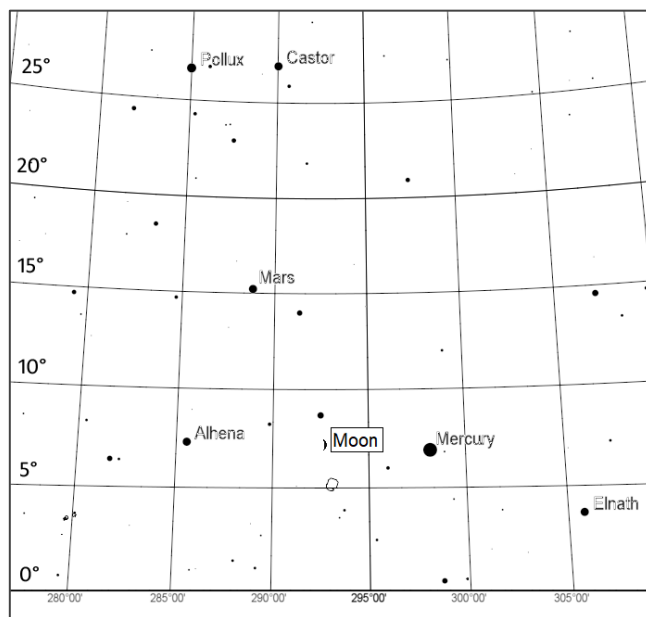
¹ Our solar system can be described as the Sun, Jupiter and debris, with the Sun containing more than 99% of the total mass of the Solar System. Jupiter has more mass than the rest of the objects orbiting the Sun put together. Jupiter is about 318 Earth masses, Saturn and the other six planets 129, the asteroid belt about 0.0005. The entire Kuiper Belt is estimated at less than 0.5, most likely 0.05. Piling up the asteroids and outer belt objects doesn't really change this characterization. In addition, the Sun tops Earth by 333,000 Earth masses.

angle for the year is 72 degrees of elevation, with a complementary 18-degree shadow angle at local noon, 12:57 P.M., on the 21st.

Mercury rises bright but low in the evening west-northwestern sky. It's brightest when it's behind the Sun, as it was back on May 21st. It was then magnitude -2.4, with the disc fully lit, but unfortunately in that orientation it was only 8 minutes of arc from the Sun's limb and essentially impossible to see. Mercury dims rapidly as it gains distance from the Sun. It may be easiest to find in the second week of June, when it passes zero magnitude, even though its greatest elongation from the Sun is on the 23rd.

Mars finally is sinking into the sunset. Gemini is a backdrop for Mars and Mercury until they get head-high with Pollux and Castor, when magnitude +1.8 Mars passes three-times-brighter Mercury on the 18th. Can you find +1.2 and +1.6 magnitude Pollux and Castor looking on from the right?

A 1-day Moon, a real observing challenge, gets low down with Mercury on the 4th. Binoculars will help, and you'll need a clear view of the western horizon.



Western horizon on June 4th one half hour after sunset

Venus and our Moon start the month with another very low conjunction, on the 1st. They rise at 4:30 A.M. EDT, before sunrise at 5:25 A.M., so get out

early and look low in the east, as they are only 12 degrees above the Sun. Which is brighter? Which has the greatest surface brightness? Are they different? Venus is hard to get at this month, but at magnitude -3.8 just before sunrise it will surprise folks with a clear eastern horizon.

Maybe our Moon's pass by the Beehive cluster (M44) won't drown out the bees this time on the evening of the 6th. It might be a nice photo opportunity, with the Beehive four degrees from the earthshine on the "non-illuminated" side of our Moon. On the morning of the 30th, the head of the bull in Taurus appears to butt our Moon low in the east. Can you see the magnitude +4.8 64 Tauri pop out from behind the dark limb of the Moon around 5:41 A.M.? Use binoculars to observe these phenomena.

Get ready for the 50th anniversary of our landing in the Sea of Tranquility in July by observing details on the Moon in June. The same low Sun angle that was present during the Apollo 11 landing occurs on the 11th, after sunrise occurs near Tranquility Base on the 10th. Moon is at perigee on the evening of the 7th, so we'll get a slightly better view than usual.

The International Space Station's avalanche of overflights winds down at the end of May. In June, we have some visible passes in the evening sky through the 6th, then nothing for most of the rest of the month. On June 1st, the ISS and China's Tiangong 2 appear low in opposite parts of the sky about the same time, between 8:50 and 9:00pm EDT. Check Heavens-Above.com for local viewing information.

Hastings Nursery School Pre-K

Bob Kelly



Last election day, the Pre-K class at the Hastings Nursery School voted to choose a subject to focus on for the rest of the school year. Space won.

As part of the project, they asked WAA if we could provide someone to come into their classroom to teach astronomy. I volunteered. I'm good with pre-K kids, but I wasn't prepared for how immersed into space they already were. Posters and photos covered the wall, papier-mâché planets hung from the ceiling and the room was filled with books about space and space travel. I had been warned before the session that going far out and mentioning Ultima Thule would be beyond this class. We talked about space probes visiting planets and I mentioned New Horizons's fly-by of Ultima Thule after Pluto. A sea of hands pointed to a small, blurry photo on the lower right border of the black-

board. Ultima Thule. They were already there! It was hard to stay ahead of them.

For my follow-up trip, they produced a book about the class pet Sneaky the Snail and his visits to the planets and the International Space Station. The class felt they needed to reassure me their mascot Sneaky was only pretend and didn't get hurt by going into space.

I don't think everyone we touch in our talks are going to become rocket engineers or research astronomers, but if more kids were like the ones at the Hastings Nursery School Pre-K, we have hope for a science-literate generation.



There are no lectures in June, July and August. The next club meeting is September 13th: Members' Night.

WAA Members: Contribute to the Newsletter!

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

SkyWAAtch © Westchester Amateur Astronomers, Inc.

Editor: Larry Faltz

Assistant Editor: Scott Levine

Editor Emeritus: Tom Boustead

WAA Member Profile: Peter Rothstein

Home town: Hastings on Hudson

Family: wife, Kate

How did you get interested in astronomy? I'm not really sure. About 10 years ago I bought a 4" Celestron refractor on a GEM that they were almost giving away. It was not computerized. Since then I've upgraded as my interest and experience grew.

Do you recall the first time you looked through a telescope? What did you see? A friend set up a telescope, an SCT, and said, "Look, there is Messier something-or-other." I was not impressed. I had no idea what I was looking at. I didn't know a "Messier" object from a "messy" one.

What's your favorite object(s) to view? Globular and open clusters.

What kind of equipment do you have? TeleVue NP101, Losmandy GM8, TeleVue BinoViewer, TeleVue Gibraltar mount, AstroDevices DCS

What kind of equipment would you like to get that you don't have? The Hubble. Once it is decommissioned, I will put in a bid on eBay. I am very happy with my NP101, and now with the BinoViewer I am even happier.

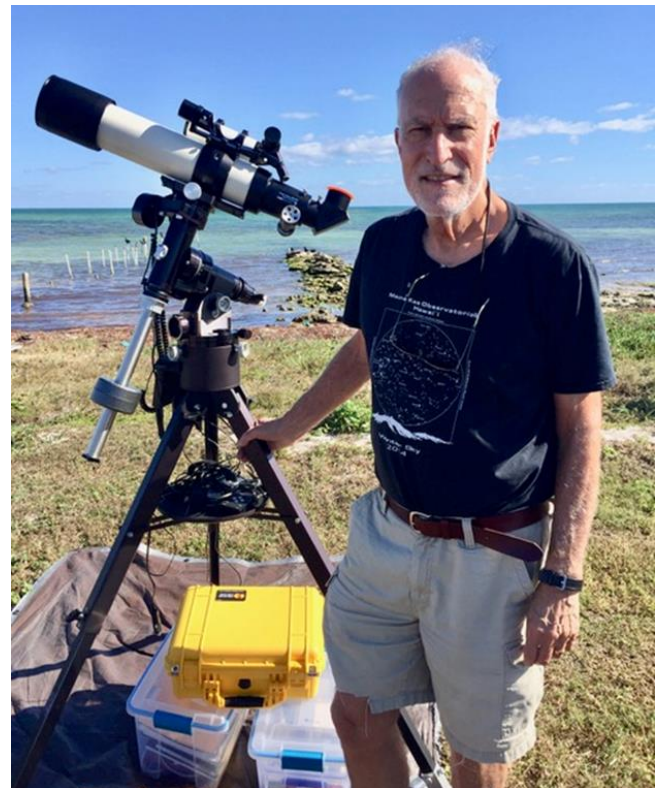
Have you taken any trips or vacations dedicated to astronomy? Earlier this year we were in northern Finland and we watched the aurora borealis for 4 nights. (see the images in last month's SkyWAArch). I have been going to the Winter Star Party in the Florida Keys for a number of years now.

Do you have any favorite personal astronomical experiences you'd like to relate? The time I saw the

supernova in M82 a few years ago. It had blown a couple of days before. I had seen M82 a number of times. Now there was a light bulb in the middle of it!

What do you do (or did you do, if retired) in "real life"? I was a pediatric anesthesiologist, now retired.

How did you get involved in WAA? I met WAA members Eric Baumgartner and Larry Faltz at the Medomak Astronomy Retreat in Maine and Larry convinced me to join, so I paid my dues.



Aristotle on Time and Motion:

How can there be any 'before' and 'after' without the existence of time? Or how can there be any time without the existence of motion? If, then, time is the number of motion or itself a kind of motion, it follows that, if there is always time, motion must also be eternal. But so far as time is concerned we see that all with one exception are in agreement in saying that it is uncreated: in fact, it is just this that enables Democritus to show that all things cannot have had a becoming: for time, he says, is uncreated. Plato alone [in the *Timaeus*, Ed.] asserts the creation of time, saying that it had a becoming together with the universe, the universe according to him having had a becoming. Now since time cannot exist and is unthinkable apart from the moment, and the moment a kind of middle-point, uniting as it does in itself both a beginning and an end, a beginning of future time and an end of past time, it follows that there must always be time: for the extremity of the last period of time that we take must be found in some moment, since time contains no point of contact for us except the moment. Therefore, since the moment is both a beginning and an end, there must always be time on both sides of it. But if this is true of time, it is evident that it must also be true of motion, time being a kind of affection of motion.

Physics, Book 8

On the Motion of 'Oumuamua

Robin Stuart

The discovery of 1I/2017 U1, 'Oumuamua, in October 2017 by Pan-STARRS1 generated a lot of interest and excitement as it was the first, and so far the only, macroscopic interstellar object to be observed passing through the Solar System. Moreover, its light curve was consistent with an object up to one-quarter mile (400 meters) long and highly-elongated, perhaps 10 times as long as it is wide.²



Discovery image of 1I/2017 U1, 'Oumuamua

And then there's its motion. It is sometimes proclaimed that although objects are supposed to slow down as they move away from the Sun, but that 'Oumuamua actually sped up as it exited the solar system! This tidbit of knowledge appears to be widely believed and has been voiced at some recent WAA meetings. It is reinforced by prominent headlines such as "'Oumuamua 'Sped Up' in the Inner Solar System."³ Combined with the other remarkable features of this object, this surely opens the door to some wild speculation (you know what I'm talking about – see Editor's Note). The trouble is that this speed up didn't actually happen.

The sciences use certain words from our language that get assigned very precise and well-defined technical meanings but those meanings do not necessarily correspond to the way the words are understood in ordinary parlance. Velocity, acceleration, boost and impulse are all examples. Without technical precision when using these terms, inexperienced readers of the scientific literature can be prone to misinterpretation.

² "Solar System's First Interstellar Visitor Dazzles Scientists". *Jet Propulsion Laboratory*. 20 November 2017.

<https://www.jpl.nasa.gov/news/news.php?feature=7006>

³ Carlisle, C. M. (2019) 'Oumuamua "Sped Up" in the Inner Solar System. This Might Be Why. *Sky and Telescope*.

<https://www.skyandtelescope.com/astronomy-news/oumuamua-sped-up-as-it-left-the-inner-solar-system-this-might-be-why/>

This seems to have happened in the case of the motion of 'Oumuamua. So what really did happen?

On its passage through the Solar System, a body is subject to the Sun's gravitational attraction, which produces an acceleration that is always directed toward the Sun. Inbound, this acceleration causes it to speed up and outbound to slow down. This is what 'Oumuamua did, just as it should have. Put another way, when a body approaches the Sun its potential energy decreases as its kinetic energy increases, meaning it moves faster, but the total energy, the sum of potential energy and kinetic energy, remains constant. Energy is conserved. If this total energy exceeds a certain level then the body will be able to escape the Solar System and fly off into interstellar space. The potential energy is proportional to an object's distance from the Sun and its kinetic energy depends on its speed. Observing the speed and position immediately reveals this interloper's interstellar origin. The total energy is also imprinted on the body's trajectory. Planets, asteroids, Kuiper belt and other distant objects gravitationally bound to the Sun follow elliptical orbits but bodies like 'Oumuamua with sufficient energy to escape the Solar System, trace out hyperbolas.

In addition to gravity there can be other forces acting on the system. For small bodies, outgassing and light pressure can play a role, but these forces pale in comparison to gravity. To assess and study their magnitude it is natural to subtract the effect of gravity and see what remains. This tiny non-gravitational residual acceleration is the root of the flawed notion that 'Oumuamua "sped up."

So what does the literature actually say? The abstract of an article⁴ in the scientific journal *Nature* entitled "Non-gravitational acceleration in the trajectory of 1I/2017 U1 ('Oumuamua)" states

The motion of all celestial bodies is governed mostly by gravity, but the trajectories of comets can also be affected by non-gravitational forces due to cometary outgassing. Because non-gravitational accelerations are at least three to four orders of magnitude weaker than gravitational acceleration...

and concludes

⁴ Michel, M. et al. (2018) Non-gravitational acceleration in the trajectory of 1I/2017 U1 ('Oumuamua) *Nature* **559** 223–226; <https://www.nature.com/articles/s41586-018-0254-4>

We find comet-like outgassing to be a physically viable explanation, provided that “‘Oumuamua has thermal properties similar to comets.

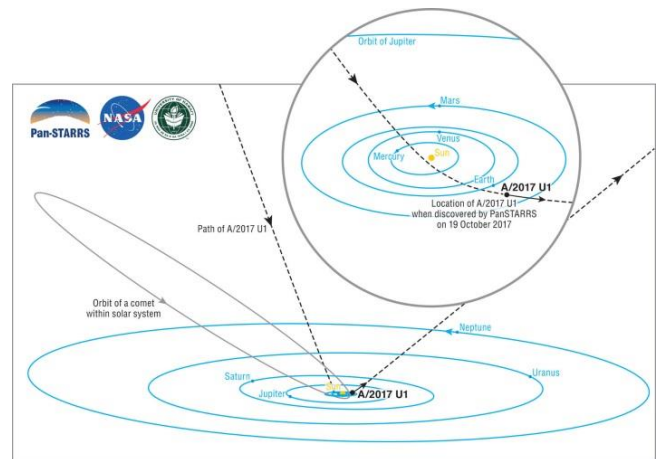
Another article⁵ quotes an anomalous acceleration of $2.5 \times 10^{-6} \text{ m s}^{-2}$ when the object was 1.4 AU from the Sun, the direction of the acceleration away from the Sun. This is what you’d expect from outgassing or light pressure. It is a simple matter to compare this to the acceleration experienced due to the Sun’s gravity which from Newton’s law is $a = GM_{\odot}/r^2$, where $G = 6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ is the universal gravitational constant, $M_{\odot} = 1.99 \times 10^{30} \text{ kg}$ is the mass of the Sun and r is the object’s distance from the Sun’s center. An astronomical unit (AU) is $1.50 \times 10^{11} \text{ m}$, making $r = 2.09 \times 10^{11} \text{ m}$. Plugging in the numbers gives $a = 3.03 \times 10^{-3} \text{ m s}^{-2}$, which is about 1,200 times larger than the anomalous acceleration. This falls within the “three to four orders of magnitude weaker” range stated earlier.

The question might be asked as to whether ‘Oumuamua could have experienced acceleration due to some sort of gravity assist or slingshot effect as it flew by the Sun. The short answer is no, at least not from the point of view of an observer within the Solar System. In a gravity assist manoeuvre a spacecraft undergoes Rutherford scattering in the gravitational field of a planet. Although more familiar in connection with subatomic particles and the Coulomb interaction, Rutherford scattering occurs whenever a small body is deflected by a very much larger one under the influence of an inverse square force. Suppose a spacecraft on an interplanetary mission flies past the Earth. From our perspective, unless accompanied by an engine burn, the spacecraft will swoop in reaching its maximum speed on closest approach and swoop out again. The motion is symmetrical in the sense that at any given distance from Earth, the spacecraft’s speed is the same both on inbound and outbound legs. Only its trajectory is altered. However, since the Earth is in motion about the Sun the spacecraft will have its speed *with respect to the Sun* changed as a small amount of our planet’s orbital momentum is transferred to the spacecraft. From the perspective of the solar system, then, ‘Oumuamua arrived and left at the same speed.

As is normal and healthy in the world of science, not everyone initially agrees with everyone else’s conclu-

⁵ Seligman, D., Laughlin, G., & Batygin, K. (2019) On the Anomalous Acceleration of 1I/2017 U1 ‘Oumuamua <https://arxiv.org/abs/1903.04723>

sions.⁶ Zdenek Sekanina, a comet specialist at JPL, suggests that radiation pressure was responsible.



‘Oumuamua’s trajectory

Editor’s Note

Science fiction aficionados may recall Arthur C. Clarke’s popular 1973 novel *Rendezvous with Rama*, in which a similarly shaped but even larger object flies through the Solar System. It was clearly built by an advanced civilization, but although we board it and meet some robotic drones, we are unable to learn anything about its builders or mission. It flies away leaving us with a mystery, but we know we’re not alone in the universe. The novel won most of the SciFi book awards that year. Plenty of people⁷ recalled *Rendezvous with Rama* when ‘Oumuamua hit the news. Harvard’s respected Chair of Astronomy Abraham Loeb, who seems to have a scholarly fetish about detecting alien technology, published a paper⁸ discussing ‘Oumuamua’s trajectory. He wrote “a more exotic scenario is that ‘Oumuamua may be a fully operational probe sent intentionally to Earth vicinity by an alien civilization.” Loeb concluded, “A survey for lightsails as technosignatures in the Solar System is warranted, irrespective of whether ‘Oumuamua is one of them.” Of course this is the story that the media would most want to report. Aliens sell more soap than outgassing or radiation pressure from the solar wind. -LF

⁶ Sekanina, Z. (2019) Outgassing As Trigger of 1I/‘Oumuamua’s Nongravitational Acceleration: Could This Hypothesis Work at All? <https://arxiv.org/abs/1905.00935v1>

⁷ Sky and Telescope began its first report about ‘Oumuamua with a reference to the novel.

<https://www.skyandtelescope.com/astronomy-news/meet-oumuamua-the-interstellar-cigar/>

⁸ Bialy, S., Loeb, A. (2018) Could Solar Radiation Pressure Explain ‘Oumuamua’s Peculiar Acceleration?, Astrophysical Journal Letters, 868:L1. <https://arxiv.org/pdf/1810.11490.pdf>

The Astronomer at the Opera: The WAA Astronomy Opera Quiz

Larry Faltz

I was tickled by incoming WAA President Paul Alimena's gentle roasting of my interest in classical music, particularly opera, at the January club meeting. Unbeknownst to him, I had for some time thought about preparing an astronomy opera quiz (and now, as SkyWAArch editor, I can publish it!).

My father introduced me to the Metropolitan Opera's live Saturday afternoon broadcasts when I was just a few years old. We often listened in the car, sometimes on our way to visit to the Hayden Planetarium from home in the Bronx. I always enjoyed the opera quiz during the second intermission of the broadcasts, where experts with seemingly inexhaustible recollections of plots, characters, librettos and themes were able to answer all sorts of arcane questions about operas familiar and obscure, or to identify musical excerpts played on the Knabe, the official piano of the Met in those days (we had a small, rather pathetic Knabe at home). Their insights helped me understand what a powerful and universal art form opera can be. I've come up with a series of Met quiz-like questions that relate to specific astronomical bodies or themes in the opera repertoire.

Richard Mantle, the Director of England's Opera North, wrote "the combination of dramatic narrative, stagecraft and music, and especially the range and vulnerability of the human voice, make opera the art form that comes closest to expressing pure emotion." Its very improbability—who walks around singing all day?—makes it that much more profound. If you're not an opera aficionado, and perhaps only a few club members are, I would suggest that you consider spending some time (on a cloudy night perhaps) listening to or even better going to see these peak examples of human creative effort. Although there's nothing like a live opera experience, ticket prices can be daunting, not surprising when you consider that it takes up to 700 people to make an opera production go at the Met. The Met's high-quality digital telecasts in movie theaters are satisfying substitutes and even just listening on the radio can be rewarding. WQXR broadcasts the Met Saturday matinees live (they've been doing it continuously since 1931) from December to May and presents recordings of performances from other opera houses during the rest of the year.

Opera is a comparatively young art form and its history is actually contemporaneous with modern astrono-

my. The first opera is generally credited to Jacopo Peri, who wrote music for a production of the Greek myth of Daphne at the Palazzo Corsi in Florence in 1598. Perhaps Galileo, then 34 and just 11 years away from pointing his telescope at the heavens, would have been in the audience had he not been in Padua teaching mathematics. Galileo grew up in a musical family in Florence: his father Vincenzo Galilei was a well-known musician who was associated with Peri in the Florentine *Camerata*, an organization dedicated to reviving a Greek style of drama with sung text. Vincenzo is credited with inventing monody, a single melodic line with instrumental accompaniment (in contrast to the then-prevalent polyphonic style), without which opera would have been incoherent. His quantitative approach to the study of acoustics helped develop Galileo's interest and skill in mathematics and perhaps physics as well. Galileo's brother Michelangelo was a virtuoso lutenist and played in the courts of Europe. Galileo himself wrote poetry.

There are lots of general references in opera to the sky or the heavens, as in "cielo" or "ciel" or "himmel." Directors frequently use moonlight to illuminate a night scene, and at times the Moon plays a truly critical role in the plot, specified in the composer's score. Sometimes its absence makes for a dark night where intrigue and mistaken identities propel the action, as in the magical last act of Mozart's *Marriage of Figaro*, where in the darkness a would-be philandering husband can't even recognize his own wife. I tried to find specific references to celestial bodies, but I allowed "stars" when they are directly referenced.

These questions come from works that I think are worthy of your attention for their dramatic power, musical inventiveness, humor, humanity, passion or sheer beauty. All of the operas except the last three are generally considered "mainstream" repertoire nowadays, and all have been produced at the Met in the past few years. Some are true staples of the repertoire, receiving productions nearly every season. I didn't include two obscure operas that concern themselves with actual space travel, Karl Birger Bloomdahl's 1959 opera (in Swedish) *Aniara*, which takes place entirely on a space ship, and Jonathan Dove's 2006 opera for Britain's TV Channel 4 *Man on the Moon*, about Buzz Aldrin's life after the Apollo 11 landing.

The answers are given on page 13

The WAA Astronomy Opera Quiz

Name the opera in which...

1. We meet the Queen of the Night.
 2. A doomed hero recalls his love life by singing an aria that begins "And the stars shone...."
 3. The title character sings a "Song to the Moon."
 4. A baritone sings a "Hymn to the Evening Star."
 5. At the end a young Greek god sings to the title character "And may the eternal stars die, rather than you should perish in my arms."
 6. The bad guy is named Il Conte di Luna (Count Moon).
 7. The title character writes a love letter that concludes "And your face will shine upon me like a star in the immensity."
 8. A returning military hero sings to his wife
"A kiss, one more kiss
The burning Pleiades already sink into the sea....
Come, Venus is shining!"
 9. There's a total eclipse of the Sun.
 10. In the last act, a young woman masquerading as the "Fairy Queen" sings
"On the breath of a fragrant breeze
Fly, nimble spirits.
Through the branches appears
The blue gleam of the rising Moon."
 11. The title character gets lured to his death by the sight of a "blood red" Moon.
 12. The title character sings an aria that begins "Now the Great Bear and Pleiades."
 13. The title character, newly married, sings
"Oh, lovely night! What a lot of stars!
Never have I seen them so beautiful!
Every spark twinkles and shines
with the brilliance of an eye.
Oh! What a lot of eyes fixed and staring,
looking at us from all sides!
In the sky, along the shore,
out to sea...the sky is smiling!
Oh, lovely night!
In an ecstasy of love, the sky is smiling!"
 14. A king, the title character's step-father and an actual historical personage, sings "Hide the Moon, hide the stars, something terrible will come." The stage directions call for darkness, and then for a beam of moonlight to fall on the title character, revealing a hideous scene.
 15. Near the end of the last act of the composer's final opera, a countess, mulling over an important choice, is illuminated by moonlight, while the orchestra plays a beautiful interlude called, appropriately, "Moonlight Music."
 16. The title character meets her father and then her lover on a riverbank, with the stage directions specifying "Starry night, Moon shining brightly."
 17. A lover in a garden sings
"Tis there that by night her beauty shines
Arise, o Sun! Turn pale the stars
that, unveiled in the azure, do sparkle in the firmament
Arise! Arise! Appear! Appear
thou pure and enchanting star!"
- These are more obscure operas:
18. In what short opera does a crippled boy sing
"Oh mother! You should go out and see!
There's never been such a sky.
Damp clouds have shined it,
and soft winds have swept it,
as if to make it ready for a king's ball.
All its lanterns are lit,
all its torches are burning,
and its dark floor is shining like crystal.
Hanging over our roof,
there is a star as large as a window;
and the star has a tail, and it moves
across the sky like a chariot on fire."
 19. In what opera, set in Japan, first performed at the Met in 1907 with Caruso in the cast and last performed there in 1915, begins and ends with a "Hymn to the Sun"? The composer is known for a very popular shorter opera.
 20. In what 18th century opera (never performed at the Met but presented in an unusual venue for opera in New York in 2011) does a wealthy man look through a telescope and get convinced that the beings he sees are living on the Moon? The composer is more famous for instrumental music and masses than operas. ■

The Astronomer at the Jeweler: Van Cleef & Arpels

Larry Faltz



In February, we sent an email to WAA members about a display of astronomically-themed timepieces at Van Cleef and Arpels, the high end jeweler at 57th Street and Fifth Avenue. Out of curiosity, Elyse and I dropped by on Saturday, February 16th for a look. You can't just walk around the elegant 2-level shop. After the burly but courteous guard lets you in and sizes you up, a salesperson greets you, offers coffee, tea or champagne and sits you down to present the goods. Audrey, a young Frenchwoman, was excited to show us the Midnight Planetarium watches and a series of Zodiac watches, especially after we made it clear we actually understood something about astronomy.

The biggest and most interesting watch was the men's Midnight Planetarium watch. It's not really a watch, although with rather considerable effort you can read the time. It's primarily an orrery, with the orbits of the pre-Herschel planets, from Mercury to Saturn, on concentric aventurine rings. The planetary orbital periods are correct: Saturn will take 26 years to make one revolution while Mercury takes the requisite 88 days. The Moon circles the earth in 29.5 days. The Earth goes around once in a year. There's a gold star on the crystal that you can set so that the Earth will be under it on a "lucky day" of your choice, say your birthday or maybe your anniversary so you don't forget it again! The large case (the face alone is 44 mm in diameter) is thick gold and the back is transparent so you can see the mechanism in operation. It's self-winding, so as

you move it a large rotor oscillates to power the main-spring. No batteries for the pure horologist! The aventurine face has small inclusions of mica that sparkle, mimicking the starry sky. It's quite beautiful.

The ladies' version only shows Mercury, Venus and the Earth, with the Moon a tiny diamond. It's still a large watch, 38 mm in diameter. The bezel and case are completely encrusted with diamonds.



The Zodiac watches were hardly in the class of the Planetarium timepieces. Each featured a constellation with the main stars, a line diagram and an image. The image on the ladies version was enamel and far more artistic than the mundane line drawing on the men's watches. Pushing small button on the side backlights the stars for a few seconds. These watches have hands so you can actually tell the time.



This kind of over-the-top jewelry design doesn't come cheap. The Zodiacs start at \$115,000. The men's Midnight Planetarium can be yours for just \$237,000 (plus tax) and the ladies version goes for \$285,000, but you don't have to stop there. A diamond-studded band will get the price of the ladies watch up to \$330,000. Or, you could buy fifteen 17-inch Planewave CDK astrographs. ■

The Astronomer at the Museum: Dou's *The Astronomer By Candlelight*

Larry Faltz



Gerrit Dou, *The Astronomer By Candlelight*, oil on panel, around 1655, 32 x 21.2 cm (12 5/8 x 8 3/8 in.).
J. Paul Getty Museum, Los Angeles

I came across this little gem while visiting the Getty Museum in Los Angeles in January. Dou (1613-1675) was 14 when he became a student of the young Rembrandt van Rijn, who was then just 21 but already acknowledged as a master. Dou specialized in small “genre” paintings, scenes of everyday life that were a staple of Flemish art in the 17th century. His works were often shaped for a niche, square on the bottom but round at the top. Even his rectangular paintings frequently contain an architectural element such as an archway, window or drape that frames the subject in a similar manner.

The astronomer, a young man perhaps learning the craft, is intently reading a scholarly book that apparently will help him measure distances on a celestial globe. While I couldn't identify the book, the globe

itself can be recognized as the 34-cm celestial orb made by Jodocus Hondius, Sr. (1563-1612) in 1600. This is the same globe that Johannes Vermeer used in his much larger painting *The Astronomer* (Louvre, Paris)⁹ but Dou shows the globe's opposite side. We can see clearly see Orion with Lepus below him. Since this is a celestial globe, everything is shown in mirror image. There are apparently only 3 of these globes left in the world. There's an astonishing interactive 3-D display of this globe on the National Library of France web site.¹⁰ Check it out.

While a candle was needed to read at night and an hourglass was a common timepiece in the 17th century, these elements might have symbolic intent. In paintings of the time they often represented the transitory nature of life. Perhaps Dou is contrasting this impermanence against the eternity of the cosmos.

The fine detail in this painting reminds us of the patient, focused skill of Dou and his colleagues, who rendered details with a tiny dab of paint on a single strand of horsehair. That kind of meticulousness was at work in the budding field of telescope making elsewhere in the Low Countries in the mid-17th century. Dutchman Christiaan Huygens learned how to make better lenses than anyone else using a lens grinding machine of his own design. He discovered Saturn's moon Titan the same year as Dou's painting. His telescope had a 63 mm (2.5 inch) objective with a focal length of about 132 inches. As an eyepiece he used a lens with a focal length of 3 inches. Magnification was just 43x. The objective is preserved at the University of Utrecht. Huygens scratched *Admovere oculis distantia sidera nostris* (“They brought the distant stars closer to our eyes”) and “Feb. 3, 1655,” the date the lens was finished, along the edge. Like all lenses in those days it had to be stopped down because the figure was not accurate towards the outer edge. The final aperture was just 35 mm (1.4 inches), but it was enough to see the satellite. ■

⁹ See <https://westchesterastronomers.org/wp-content/uploads/2018/06/January2011.pdf>

¹⁰ Load the page below, then click “3D” on the left side. Allow time for it to load. Then click ► or drag your cursor. <https://gallica.bnf.fr/ark:/12148/btv1b550087450/f0.item.r=3D%20Jodocus%20Hondius>

NEAF 2019



Twenty-one WAA members staffed the club's booth at this year's Northeast Astronomy Forum, April 6-7 at Rockland Community College. Thanks go to Paul Alimena, Eva Andersen, Rick Bria, Harry Butcher, Darryl Ciucci, Elyse Faltz, Larry Faltz, Parik Gogte, Cat Hannon, Tim Holden, Josh Knight, Scott Levine, Mike Lomsky, Pat Mahon, Gary Miller, Hans Minnich, Olivier Prache, Karen Seiter, Rich Steeves, Woody Umanoff, and Peter Young

Many other members stopped by, and WAA's two astronomy entrepreneurs, Roman Tytla (Big Bang Prints) and Dan Cummings (Star in a Star), each had their own NEAF booths not far from ours.

Three new members joined at the show.

It was my most frugal NEAF to date: just \$21 on two books! I spent a good part of the meeting chatting with astronomy friends whom I made over the years and get to catch up with at each year's show. I helped a couple of WAA members who were considering new scopes and mounts (it's always nice to help someone work through a complex equipment choice, not to mention helping to spend someone else's money). One of our people invested in a Daystar Quark solar eyepiece, not a bad idea considering the next solar cycle appears to be starting up.

Among the lectures, I was particularly thrilled to hear Alan Stern's talk on New Horizons' findings at Ultima Thule.

Larry Faltz

Photos:

(Left to right)

Top: Woody Umanoff and Gary Miller

Middle: Tim Holden, Rick Bria and Karen Seiter

Bottom: Josh Knight, Rich Steeves and his son Maxwell.

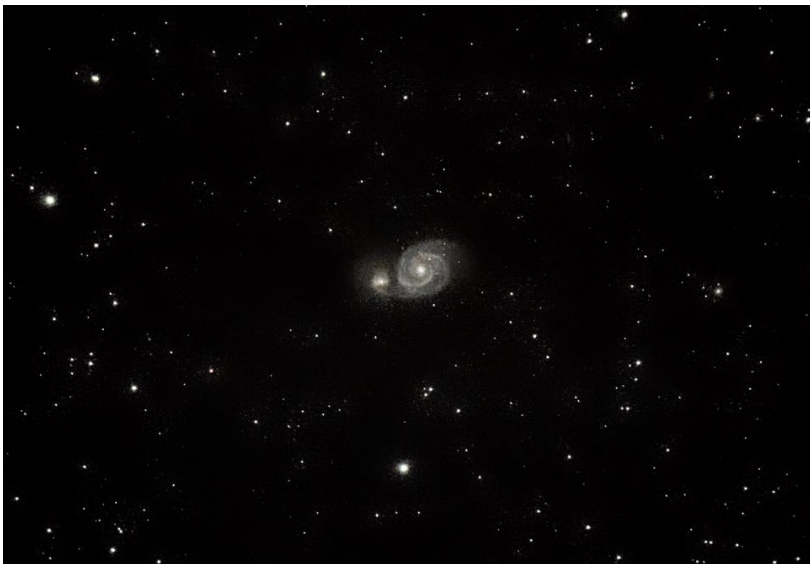
Images by Members



Monument to Copernicus, Philadelphia (Larry Faltz). A plaque reads:

Polish astronomer Mikolaj Kopernik, known to English speakers as Nicolaus Copernicus, was the first to propose that the Earth revolves around the Sun. In the 1500's, when the Earth was thought to be at the center of the universe, this was a revolutionary idea.

The 16-foot outer circle represents the Earth's orbit, and the inner disks symbolize the Sun, sending out its rays of light. The supporting structure suggests instruments that Kopernik used. To celebrate the 500th anniversary of his birth, the local Polish American community commissioned this stainless steel sculpture and donated it to the City of Philadelphia. Soil from his birthplace at Torun, Poland, is placed at the base.



Arnold Rotfeld used a Canon Rebel T6i connected to his Explore Scientific 80mm apochromatic refractor on an Orion Skyview Pro go-to mount to capture this lovely single frame image of M51. ISO 3200 for 30 seconds.

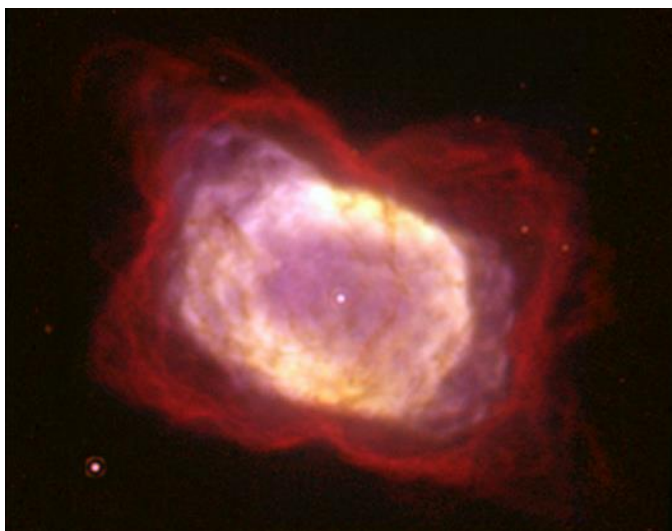
Answers to the WAA Astronomy Opera Quiz

- | | |
|---|--|
| 1. Wolfgang Amadeus Mozart: The Magic Flute | 11. Alban Berg: Wozzeck |
| 2. Giacomo Puccini: Tosca | 12. Benjamin Britten: Peter Grimes |
| 3. Antonin Dvorak: Rusalka | 13. Giacomo Puccini: Madame Butterfly |
| 4. Richard Wagner: Tannhauser | 14. Richard Strauss: Salome |
| 5. Richard Strauss: Ariadne auf Naxos | 15. Richard Strauss: Capriccio |
| 6. Giuseppe Verdi: Il Trovatore | 16. Giuseppe Verdi: Aida |
| 7. Giuseppe Verdi: Falstaff (Act 1, Scene 2) | 17. Charles Gounod: Romeo et Juliette |
| 8. Giuseppe Verdi: Otello | 18. Gian Carlo Menotti: Amahl and the Night Visitors |
| 9. Alexander Borodin: Prince Igor | 19. Pietro Mascagni: Iris |
| 10. Giuseppe Verdi: Falstaff (Act 3, Scene 2) | 20. Franz Joseph Haydn: Il Mondo della Luna (presented at the Hayden Planetarium in 2011). |

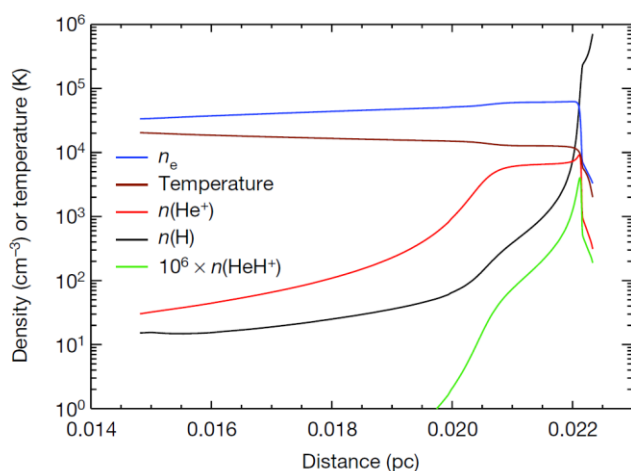
Research Highlight of the Month

Güsten, R, et. al., Astrophysical Detection of the Helium Hydride Ion HeH^+ , *Nature* 2019; 568: 357-359

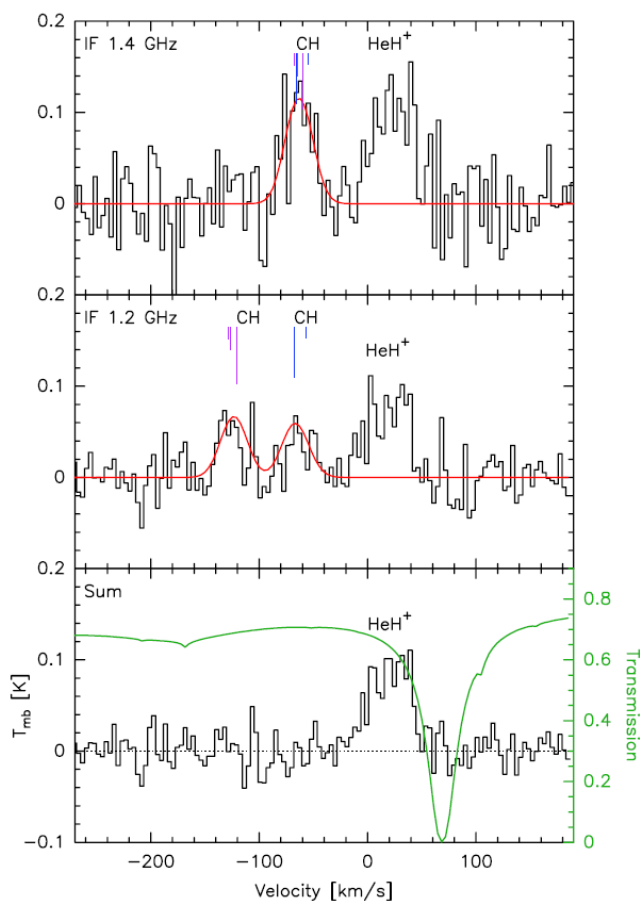
Using NASA's flying Sofia telescope, astronomers captured the spectrum of the (ionized) molecule HeH^+ in the shell of gas surrounding the young planetary nebula NGC 7027 in Cygnus. HeH^+ was the first covalently bonded molecule to form in the universe. Hydrogen and helium nuclei were created in the first 20 minutes after the Big Bang. As the cosmos cooled, helium nuclei (He^{++}) captured electrons, forming the helium ion He^+ and neutral He atoms. Because of helium's higher ionization potential this occurred before electron capture by protons. Helium atoms combined with protons (H^+) to form HeH^+ . The HeH^+ then reacted to form neutral hydrogen molecules (H_2) and release atomic helium. Primordial HeH^+ is all gone, but Güsten et. al. detected its spectrum in the outer shell of a young (just 600 years old) planetary nebula, where in a narrow zone HeH^+ formed in temperature and pressure conditions that apparently mimic those just after the era of recombination. This is the first detection of HeH^+ outside of the laboratory. Although we think of helium and the atoms below it in the periodic table (argon, xenon, krypton, radon) as inert, they are capable of forming molecules under certain energetic conditions.



Planetary Nebula NGC 7027 in Cygnus (Hubble)



Model of the chemical densities and temperature in the shell of NGC 7027 (Fig 2 from Güsten et. al.). HeH^+ molecules form in a very narrow zone (green line).



Extended Data Fig 1 showing the spectrum obtained at two different wavelengths (top 2 panels). The lines of a doublet of the methylidyne radical (CH) close to the HeH^+ line was removed in the bottom figure. The red lines are pattern matches of the CH spectrum. The green line in the bottom panel shows the atmospheric transmission in the area of the microwave spectrum studied; it's primarily due to residual water vapor at the flight altitude of 40-43,000 feet.

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 <u>Hyperstar</u> and wedge). Additional accessories: see August 2018 newsletter for details. Donated to WAA.	\$1000	WAA ads@westchesterastronomers.org
Celestron StarSense auto-align	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
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.	\$120	Eugene Lewis genelew1@gmail.com
Televue Plossl 55mm 2-inch	Very lightly used. Excellent condition. Original box.	\$130	Eugene Lewis genelew1@gmail.com
Astro-Tech AT102ED Doublet, f/6.95	ED glass, dual speed FeatherTouch focuser, retractable dew shield, one tiny scratch on the tube, optics perfect. Original travel case. Tube rings, Orion/Vixen dovetail. AstroTech 2" dielectric diagonal and Astro-Tech red-dot finder included. Rarely used, purchased 2009.	\$625	Susan Lewis sawl6633@gmail.com
Universal Astro-nomics Unistar Heavy Deluxe Alt-Az mount	2" Jaw, UA Medium Aluminum Tripod w/ Fixed Spreader, Adjustable Guide Handle, Heavy Tripod Mounting Post 5/8-11. Very good condition. .	\$275	Susan Lewis sawl6633@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!*