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SkyWAAtch

A Trip with the Comet

Comet 21P/Giacobini-Zinner has made a grand tour of our summer sky as it approached the perihelion portion of its orbit. In September, as it passed closest to both Earth and the Sun, it has been "posing" with other deep sky targets. Mauri Rosenthal took advantage of one of our rare clear nights – September 16th – to catch the comet in these colorful tableaux. The green comet – only 1.2 miles in diameter – is approaching the star Eta Gemini, or Propus, which shows reddish orange. To the left (East) the brighter portion of the Jellyfish Nebula (IC3443) glows bright red. To the north and west lies M35, an open cluster with baby blue stars, and its companion smaller cluster NGC 2158 with a distinctive golden glow. For the second image Mauri repositioned his scope, leaving M35 behind but adding the bright red Monkey Head Nebula to the southwest. "The distinctive colors are a bonus of long exposure photography, not a trick or artifact of image processing, and they are associated with specific attributes of these celestial objects: Comets glow green from cyanide and other carbon forms; the red nebulae are principally ionized hydrogen gas, and the blue and gold stars in the clusters speak to the age, type, and velocity of the stars – the blues get a blue Doppler shift because they're moving towards us!" Mauri shot these through a Borg 55FL astrograph with an IDAS LPS-D2 filter on a ZWO ASI1600MC cooled astro cam, tracking with an iOptron CubePro 8200 mount. Four second exposures were used throughout, accumulated into 3-minute stacks via SharpCap, and processed with PixInsight (PI). These images used the Comet Alignment utility in PI to create a "comet only" image freezing the comet's movement, and a background image to combine with the comet.

Events for October

WAA October Lecture

"The AI Revolution and its Applications to Astronomy"
Friday October 5th, 7:30pm
Lienhard Hall, 3rd floor
Pace University, Pleasantville, NY

The recent re-emergence of the field of Artificial Intelligence (AI) from a long period of dormancy (commonly referred to as the AI winter), promises to transform several fields of human endeavor and change our relationship with computing in a profound manner. Using current approaches to AI, which are mostly based in probabilistic and statistical techniques, recent advances have demonstrated that computers can achieve close to a human level recognition of speech as well as images and a better than human level ability to understand language and answer questions, among other things. While these are deeply impressive feats that seem to hint at a future where machines may have better than human levels of intelligence, the reality is far more prosaic. In this talk, Satya Nitta will introduce the field of AI broadly, explore the current state of the art, discuss the limitations of the field and contrast AI capabilities with those displayed by biological intelligence. He will discuss some of the current uses of AI in astronomy today and speculate on some possible new applications in space exploration that might advance our understanding of exoplanets.

WAA member Dr. Satya V. Nitta is currently the founder and CTO of an AI and hardware startup company. Previously, he had an 18 year career at IBM Research where he held several leadership roles in AI and nanoelectronics at IBM's T J Watson Research Center. He holds a Doctorate in Chemical Engineering from the Rensselaer Polytechnic Institute and has over 150 patents and 40 publications to his name. He was named the IEEE ACE Innovator of the Year, one of the 50 makers and shakers of education technology worldwide and has won the IEEE Ace technology of the year award for his work on on-chip airgap interconnects. Free and open to the public. Directions and Map.

Upcoming Lectures

Leinhard Lecture Hall
Pace University, Pleasantville, NY

On November 2nd our speaker will be Jon Morse, CEO of the BoldyGo Institute and former Director of Astrophysics in the Science Mission Directorate at NASA. He will speak on the prospects for lunar-based telescopes.

Starway to Heaven

Saturday October 6h, Dusk.
Ward Pound Ridge Reservation,
Cross River, NY

This is our scheduled Starway to Heaven observing date for October, weather permitting. Free and open to the public. The rain/cloud date is October 13th. **Important Note**: By attending our star parties you are subject to our rules and expectations as described here. Directions and Map.

New Members. . .

Joseph David Rieber - New York
Peter Rothstein - Hastings on Hudson
Parikshit Gogte - Chappaqua

Renewing Members. . .

Tom Boustead - White Plains
Cathleen Walker - Greenwich
William Newell - Mt. Vernon
Daniel Rosenthal - New York
Bill Caspe - Scarsdale
Mark Korsten - Hastings on Hudson
Harry Vanderslice - Mamaroneck
Walter Chadwick - Cold Spring

Courtesy of Scott Nammacher is this picture of the "fireworks" galaxy (NGC 6946) in Cepheus. The image was taken at Scott's Starmere Observatory using a 12.5" Planewave telescope and an SBIG 10XME camera. Shot in LRGB plus Ha, with about 50 minutes in each color and more in luminance.

ALMANAC
For October 2018 by Bob Kelly


Oct 2 Oct 9 Oct 16 Oct 24

Mars is the best and brightest of the easily accessible planets in the evening October sky. Its magnitude drops rapidly through minus 1.0 at mid-month and its size decreases from 16 to 12 arc seconds wide over the month. Jupiter sets just after the end of twilight. Being very low in the southwest makes it hard to get a good view. Compare Jupiter at magnitude minus 1.8 with dimmer, but easier to find, Mars.

Saturn stands modestly halfway between Mars and Jupiter, a pale magnitude plus 0.5 object capping the diving Sagittarius. Its rings appear wider than Jupiter's disk, and are always worth checking out. On the 14th, the thickening crescent Moon is a handy pointer just four Moon-widths away.

Venus starts the month 20 degrees out from the Sun, but is so low off the already low ecliptic that it's hard to find. If you can catch it before or just after sunset; it's a beautiful crescent in a telescope. Venus passes south of the Sun at inferior conjunction on the 26th. Even at 6¼ degrees from the Sun on that day, it's a difficult and dangerous observation. Venus passes BELOW the Sun in our sky. It's harder to block the Sun as you don't want the afternoon Sun to drop into your telescope's view and ruin your eyes. **Use extreme caution** to view the very slim but large (60 arc seconds wide) crescent. Venus is the closest planet to Earth this month, only about .29 AU at mid-month (27 million miles); closer than Mars ever gets.

Venus pass through the 'bottom' of SOHO's C3 LASCO field of view from the 23rd through the 30th, giving a good visual on the apparent distance from the Sun to Venus. Also, you can use the movie loop of the C3 field to see 1Ceres passing at the top of the field during the first half of the month. It'll be faint but moving differently from the background stars in the area.

Mercury tries to get out of the Sun's glare into the evening sky, but it is so far south in our sky, we really don't get an easy look at it even when it is farthest out from the Sun in early November. Jupiter keeps Mercury company during the last week of the month. They'll be only 3 degrees apart and 22 degrees from the Sun. No Moon for Halloween until after midnight.

If this sounds frustrating for bright object lovers, it is. The brighter evening planets are on the bottom of the ecliptic, further south than the Sun on its path through the constellations. The Sun is heading further south as we approach the winter solstice, so any planets out 'in front' of it, from our point of view, are really low and hard to see in northern hemisphere skies.

Of course, you can go deep to the ice giants. Uranus is at opposition on the 23rd at magnitude plus 5.7. The Moon, at its monthly opposition on the 24th, tries to drown it out. Uranus is only 3.7 arc seconds wide, but definitely looks like a planet in the telescope. Compare it with Neptune, smaller and fainter at magnitude plus 7.8. The Moon passes by Neptune's neighborhood on the 20th. Use the finder charts at https://www.skyandtelescope.com/observing/see-all-eight-planets-in-one-night/.

In better news, it's another great month for the Milky Way arcing overhead on moonless nights. True (astronomical) dark arrives by 8pm EDT Oct 1 and 7:30pm even before the clock changes on November 4th. This is also the time of year with the latest sunrise, by the local civil (daylight) time. The Sun will rise after 7am local daylight time by the latter part of the month. It may help you see some Orionid meteors before dawn, peaking at perhaps 10 bright meteors an hour on the 21st. Try any time after Orion-rise near midnight EDT and keep the waxing Moon out of your eyes.

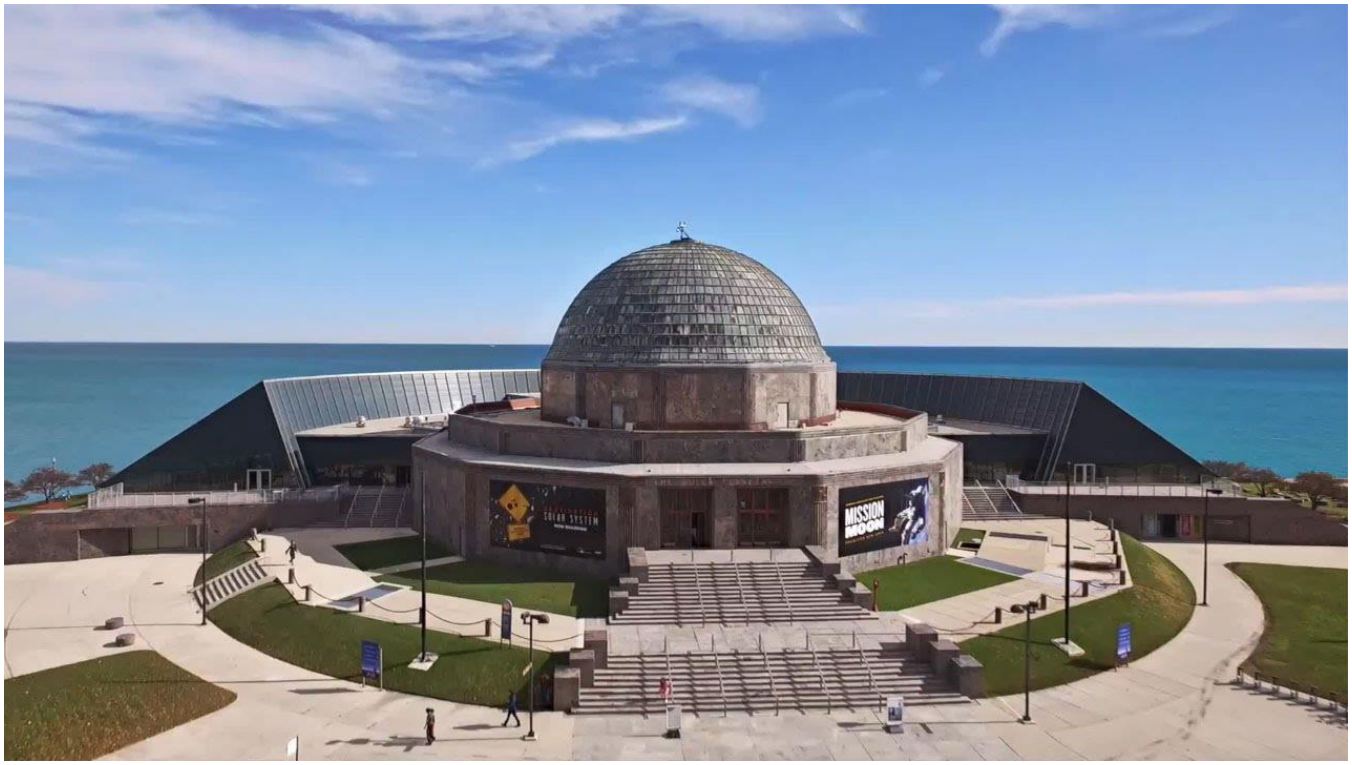
The beautiful Apennine Mountain range on the Moon is illuminated by the setting Sun early and late in the month. The Moon is highest in the sky for the year for this phase. It's a good time to get out in the morning twilight to find the Apollo 15 landing site at Hadley Rille on the 1st and 30th. The moon is near perigee on those dates.

Comet 38P/Stephan-Oterma is batted by Orion's club and takes a wicked hop into the glove of Pollux in Gemini. How bright will it be? Some say only magnitude plus 10. Good luck with good binoculars. But 38P is in a part of the sky with bright stars, so good directions are available.

The International Space Station is visible most evenings through the 14th and in the morning starting on the 25th.

Planetariums: A Visit to the Adler

Larry Faltz



For many of us, interest in astronomy was ignited by a childhood visit to a planetarium, and for New Yorkers like me it was the old Hayden. Whether on a grammar school class trip or a family outing, the experience was always exotic, educational and even perhaps a little spiritual, even for young sceptics-in-training. Mysteries were revealed, beauty shown. Seemingly impossible ideas, distances, and quantities became believable. The grand design of the universe, and our place in it, was revealed as something we might truly understand. For urbanites, there were all those stars!

We know that the sky and its movements have fascinated human beings since the earliest times. Archeosatronomy, the study of how ancient cultures tried to measure and rationally, rather than spiritually, understand the phenomena of the sky, has revealed that early civilizations all over the world were able to compute the regularity of cosmic phenomena, as evidenced by the many sites that were clearly structured for astronomical prediction. The idea that the heavens were a dome over the Earth seems to have escaped the early Egyptians, for whom the stars were part of a flat roof, but the Babylonians, Chinese and other per-Hellenic cultures conceived a hemispherical arrangement of celestial bodies. By the time of the Greeks, with the development of geometry as a body of knowledge, the idea of celestial spheres with the Earth at the center, planets in between and the stars on the outer edge seemed to make sense. This arrangement was first suggested by Anaximander around 575 BCE, a concept that held sway for the next 2000 years. Even the eventual triumph of the Copernicus in displacing the Earth from the center of the universe did not undermine the concept that the stars were far away, arranged on some distant sphere.

Physical representations of the universe as an actual sphere, where one can look at it from the outside (a non-place, of course), were apparently invented by the Greeks. The oldest extant example is considered to be the Farnese Atlas, a 7-foot tall Roman copy of a Greek sculpture showing Atlas holding up a sphere inscribed with the constellations (Greek myth has it that Zeus condemned Atlas, the founder of astronomy, to hold up the heavens, not the Earth, on his shoulders as punishment for siding with the Titans). The statue is in the National Archaeological Museum in Naples, Italy. Celestial globes made by Islamic astronomers survive from the 11th century. As decorative and educational objects they became common in Europe beginning in the late Renaissance. The obvious limitation is that

these models are not a simulation of sky from a realistic perspective. The armillary sphere removed the skin of stars to show the stars, ecliptic and planetary orbits relative to the Earth. The mechanical orrery simulated the motions of the solar system. But an experience of the structure of the heavens was still abstract, having to be extrapolated from an unnatural viewpoint. A modern equivalent is looking at the cosmic microwave background radiation as a sphere, as if we were outside of it, a physical impossibility.

(L) Farnese Atlas (R) Ptolemaic armillary sphere by Gualterus Arsenius, Louvain, 1542 (Adler Planetarium)

King George II's Grand Orrery, London c. 1750, (Enlightenment Room, British Museum)

It would be expected that attempts to put human beings inside of an artificial recreation of the heavens would be made. Perhaps the earliest example we know of was in Mesopotamia. The Sassanid King Khosrow II (reigned 590–628) built a palace in his capital Ctesiphon, near Baghdad in present-day Iraq. In the ceiling of the throne room, his artisans (and presumably scientific advisers) set the moon, stars and planets as well as figures of the zodiac in a ground of lapis lazuli. The dome rotated in concert with the movement of the sky, allowing one to tell the time from it. This dome was, in a true sense, the first planetarium, a device in which the sky and its motions can be experienced from earthly perspective.

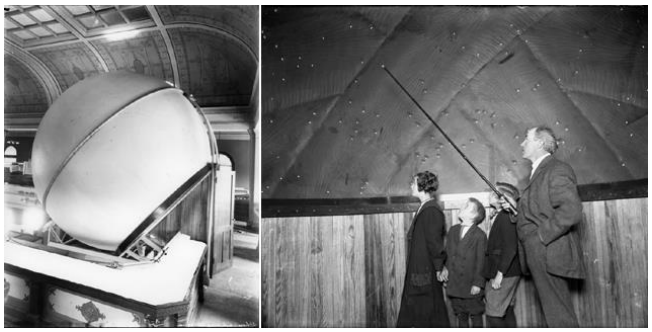
The earliest example of a mechanical ceiling-mounted orrery is the Eisinga Planetarium in Frankener, the Netherlands. It was constructed by an amateur astronomer, Eise Eisinga, in his living room, between 1774 and 1781. It shows the true relative sizes and ellipticity of the planetary orbits (it was finished in the year Herschel discovered Uranus, and in any case the house is not large enough to include that planet's orbit). The house is now an astronomy museum, open to the public. The concept is the same as the famous Copernican Chamber in which the audience assembled for star shows at the old Hayden, but it's far more elegant and informative. Being in Eisinga's house, Mrs. Eisinga apparently had a lot to say about the decorative aspects of the construction.

The ceiling orrery at the Eisinga Planetarium (https://www.planetarium-friesland.nl/en/)

The idea of a celestial globe that could be viewed from the inside was realized in the Gottorf Globe, a 3-meter sphere built for Frederick III, Duke of Holstein-Gottorp, in 1664. The idea was that one (meaning only the Duke and his friends, of course) could sit inside the sphere and view painted figures of the constellations with the stars made from gilt nail heads. Candlelight would make them shine.

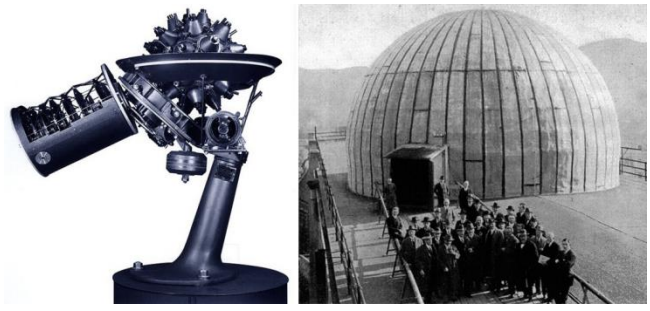
A simpler form of star theater was realized in the Atwood Sphere, 5-meters in diameter, built for the Chicago Academy of Sciences in 1913 and now in the Adler Planetarium. A simple sphere with 692 holes drilled at the positions of the brighter stars. The sphere rotated sidereally on the polar axis. A small number of people

enter with a docent, who would explain the constellations. The sphere now has motorized benches on tracks to move a half-dozen observers into position. The planets, of course, could not be represented in these passive displays.



The Atwood Sphere, Chicago

The planetarium as we think of it today, with a sophisticated projector that could show the sky at any time and from any position and accurately move planets within the celestial background, is less than 100 years old. It was invented in 1924 at the Zeiss factory in the eastern German city of Jena. Oskar von Miller, founder of the Deutsches Museum in Munich, had made a Copernican Room (ceiling orrery) at the museum in 1913, but had grander ideas. He approached Zeiss that same year with idea of something more sophisticated. After the First World War, Zeiss optical engineer Walther Bauersfeld created the first Zeiss star projector, the Mark 1, with multiple optical projectors complexly geared to accurately represent stellar and planetary positions and rotations. Bauersfeld placed the device inside a dome made of aluminum and a thin layer of concrete on the roof of the Zeiss factory. Another was placed in Miller's museum shortly thereafter.



Zeiss Mark 1 (1923) and the Zeiss Planetarium on the roof of the Jena factory.

The Jena planetarium set off an explosion of similar facilities in major cities across Europe and then across the rest of the world, almost all using the Zeiss projector, which rapidly evolved into the barbell configuration that we're familiar with from our childhood. This instrument got increasingly sophisticated, but it was still based on an intricate gear system with multiple overlapping projector fields. Zeiss eventually made 631 projectors, ceasing production in 2011 when new planetariums became all-digital.

The history of planetariums is the subject of a fascinating book, *Star Theater: The Story of the Planetarium* by William Firebrace (London: Reaktion Books, 2017). This well-researched and illustrated work is particular rich in its consideration of planetarium architecture, not surprising since the author is a British architect. He doesn't neglect the other elements of planetariums, among them how they seek to mimic or even augment the experience of viewing the actual night sky, how they impact education, how they have transitioned to the digital age, and how they reflect the societies in which they were constructed. I learned about the book from a review last fall in the British science journal *Nature* written by Marek Kukula, who holds the title of Public Astronomer at the Royal Observatory Greenwich. Kukula commented on the change in structure of the sky show from an interactive program, with presenter-audience exchange and real-time manipulation of the Zeiss projector, to a canned digital production shown to an essentially passive audience. I wrote about this in my review of the Hayden show *Dark Universe* (*SkyWAAtch*, June 2014) and I exchanged emails with Dr. Kukula. We are in agreement that the trend may not be effective in achieving meaningful audience engagement.

The planetarium can be more than just a theater, and even in the era of canned digital sky shows it can create a substantial degree of active attendee participation and present the vast range of information that makes astronomy so interesting, although it may have to do this outside of the domed star theater itself. We observed this in late June when we made our trip to Chicago to visit the Yerkes Observatory (see last month's SkyWAAtch). The following day we spent 6 hours at Chicago's Adler Planetarium, which has the distinction of being the first planetarium in the Western Hemisphere (1930). In 1987 it was made a National Historic Monument.

The first design for a planetarium in the United States was by none other than Frank Lloyd Wright, who designed a kind of spiral ziggurat in 1925 for a proposed resort in Maryland. Like many of Wright's wilder designs, it was never built, although Firebrace suggests that it came to fruition in an inverse way, as Wright's

design for the Guggenheim Museum, constructed in 1959 and perplexing New Yorkers ever since.

Google Earth view of the Adler Planetarium, with the Doane Observatory on its right, next to Lake Michigan.

Max Adler was a German-born Jew who was a concert violinist, but he gave up the instrument to become a successful businessman and was eventually Vice President of Sears Roebuck when that company was in its heyday. In the late 1920's he became a full-time philanthropist. He visited the planetariums in Munich and Jena with his cousin, architect Ernest Grunsfeld. Returning to Chicago, Adler financed the construction of a planetarium to be located on what was then an isolated site beside Lake Michigan. Grunsfeld was interested in Mayan architecture and so he honored that culture by designing a stepped dodecahedral pyramid with a copper-clad dome. Each of the twelve walls has a sculpture of a sign of the zodiac.

At the opening of the planetarium in 1930, Adler said

> The popular conception of the universe is too meagre; the planets and stars are too far removed from general knowledge. In our reflections we dwell too little on the concept that the world and all human endeavors are governed by established order and too infrequently on the truth that under the heavens everything is interrelated, even as each of us to the other.

This defined a spiritual purpose to the planetarium even as it sought to be recognized as a scientific enterprise.

A Zeiss Mark II projector was installed for sky shows in the spacious dome. That same year, Adler acquired a large private collection of astronomical instruments at auction in Amsterdam. He had them displayed around the original building, apparently in no particular order. In its current form the Adler organizes these items and uses them to help explain the history of astronomy and as a lead-in to the more contemporary presentation of space science.

Recognizing that the original building, as elegant as it was, was too small to relate the ever-growing story of astronomy, the Adler Board raised funds for a modern 60,000 square foot extension, the 4-story Sky Pavilion, which opened in 1999. It continues the circular concept of the original building, surrounding the back half of it. Unlike the new Hayden, the historic original structure was not sacrificed.

Only a small number of planetariums function as astronomy museums, and even fewer do it in a comprehensive way. Many smaller planetariums have little in the way of non-sky show material to present. That's not a fatal objection: the root function of the planetarium is achieved in the traditional sky show. But it does limit the degree to which the facility can extend its reach to function as an educational institution for astronomy in anything more than a trivial way. The Adler has developed itself into a full-spectrum astronomy institution: star shows and other productions, a complete museum, education, research, outreach, a terrific web site (https://www.adlerplanetarium.org/) with many on-line resources.

In 1977, the Doane Observatory was opened right on the lake shore to the east of the planetarium. There are two scopes: a 0.5-meter (20-inch) f/8 classical Cassegrain on a fork mount and a Coronado 90mm hydrogen-alpha scope for solar viewing. The solar scope is open daily for 3 hours, weather permitting. The Cassegrain has only a few public viewing nights a year, but is used for research and education projects at other times.

On our visit, we found so much to see that we didn't even bother to go to any of the space shows, which in any case kept getting sold out. The facility was teeming with visitors. As expected for a Saturday, there were many families with children who took advantage of an astonishing range of interactive displays, hands-on activities and astronomy-themed play throughout the Sky Pavilion. A very large area, "Planet Explorers", has a range of interactive displays, mock space ships and other displays that combine fun and education, including activities that could involve children as young as 3 (although probably more for diversion than education). Next door, the large "Curiosity Station" had more hands-on activities. There is nothing at the Rose Center in New York that can provide this level of drop-in activity for the entire age range of youngsters, and I

imagine that as a result there is somewhat of a disincentive for a planetarium visit for a family with younger children. If your eight year old wants to see the universe for a few hours, what do you do with the four year old sibling? The family might walk through the Rose and pause at the Willamette meteorite, but there's little opportunity for engagement.

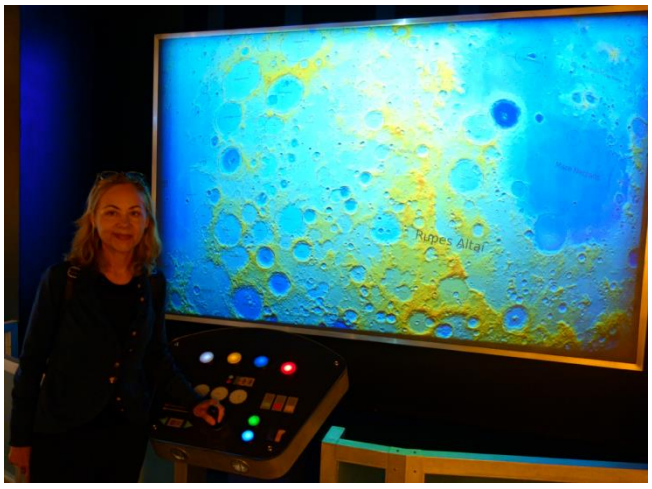
Launching air-pressure rockets (by jumping on the air reservoir). At least the kids aren't on their smart phones.

Elyse and I obviously were more interested in the scientific and historical displays, and it was no problem spending the day among the vast range of material.

From the main lobby, you can walk to the left through a slightly surreal chamber, the Clark Family Welcome Gallery, with organically curved walls and ceiling made of 20,000 yards of fabric, lit by color-changing LED's and upon which are projected a variety of images which are controlled by the viewer's body position. The entrance to the 200-seat Grainger Theater, with its 71-foot diameter dome, is off to the right, while going left takes you into the Sky Pavilion. The circumferential windows in the Sky Pavilion let in lots of light, and next door the large cafeteria had expansive views of the Chicago skyline. On the top floor the sizeable "Our Solar System" area had large panels rich with information about the Sun and each of the planets (including Pluto). The text and images for each body were very informative and detailed. As in many other major planetariums these days, there were true relative-size models of the solar system bodies, the Sun actually being the top of the 55-foot dome of the Definiti Space Theater on the floor below (offering more traditional sky shows). Both of these theaters have state-of-the-art digital systems with 8K resolution.

The Pluto panel in the Our Solar System exhibit

If you enter the planetarium to the right from the main entrance, you enter "Mission Moon", a number of exhibits dedicated to lunar science and exploration. Apollo 13 astronaut James Lovell lives in Chicago and is on the Adler Board of Directors. He donated a huge number of important Apollo mission artefacts to the museum (not just from 13), and so astronaut gear, space suits, commemorative medals, instruments and other memorabilia are on display. There is, of course, a small moon rock encased in acrylic: many planetariums have one. But what no other planetarium has is the actual Gemini 12 command module. A well-informed docent stood next to the exhibit and answered the many questions posed by young and old visitors alike. A wall-sized video display allowed visitors to roam around the moon using a simple control panel. Different lunar image databases from a variety of mapping missions can be loaded to bring out various details. The resolution was impressive.



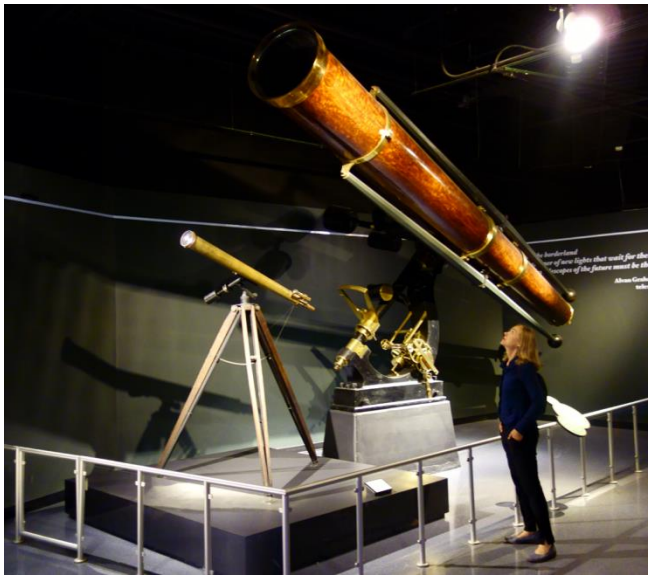
Elyse at the controls of the interactive moon map

The Gemini 12 command module

The section of the Alder devoted to the history of astronomy is vast. It starts in an area called "Astronomy in Culture." Among the more creative elements of this exhibit is a mock-up of a medieval university, with wooden study bays where visitors can pretend to be students reading the astronomy texts of the time. A printed copy of Sacrobosco's *De Sphaera*, dating from around 1500, was on display. This explanation of the Ptolemaic universe was the most popular astronomy textbook from the time of its original, pre-printing-press publication in 1230 until about 1600.

Three 17th century French leather-wrapped pasteboard telescopes (top) and a brass Dollond from the 18th

Early astronomical instruments were present in profusion. There was a room with a couple of dozen astrolabes, large and small, Islamic and European, accompanied by an excellent display of how an astrolabe works. Similarly there were a variety of elegant armillary spheres, orreries, pocket sundials and other small instruments. A large collection of small telescopes from the 17th and 18th century included examples with tubes made of cardboard, leather, brass and ivory. There were several impressive telescopes by the famous English maker Dollond. Occupying a large room was the beautifully restored walnut veneer optical tube and mount from Alvan Clark's 18.6" f/14.9 "Dearborn Telescope," made in 1864 and for a short time the largest refractor in world. The lens is still in use in another instrument at Northwestern University.



A 4⅛-inch Clark and the tube and mount of the Dearborn telescope

And there was more: modern astronomical equipment including a small adaptive optics system, an infrared camera displaying your heat map on a screen and inviting a photograph; rare books, papers, celestial maps, historic photographs, William Morgan's actual first-ever 1951 map of the Milky Way, and many other objects.

There were informative docents and lecturers on hand throughout, complementing the displays and sky shows. In the "Space Visualization Laboratory," a staff member was giving a talk on gravity and the evolution of the Milky Way to half a dozen drop-in attendees, enhanced by computer graphics and images displayed on several screens. The talk was repeated several times during the day. We learned that the Adler's "Far Horizons" program works with high school students to design and launch balloons carrying small experiments and sensors. Far Horizons faculty have developed CubeSats that will track light pollution over Chicago. The plan is to piggy-back them on a commercial orbital launch, such as a SpaceX Falcon-9. The "Community Design Lab" offers younger kids an opportunity to do simple experiments to foster their understanding of science.

Modern astronomy is not neglected. The large "Pritzker Hall of Cosmology," addresses the full range of cosmology and astrophysics, highlighting current issues

such as dark matter and dark energy. And of course there's an excellent shop.

As I mentioned before, my critique of *Dark Universe* was that it was not "heuristic," failing to provoke a deeper interest in astronomy in the otherwise neophyte visitor. One can look beyond the dome, so to speak, at whether the entire planetarium experience has that quality. It's reasonable to contrast the Rose Center for Earth and Space in New York and the Adler Planetarium, in Chicago with that in mind.

The facilities were built in the 1930's (Adler 1930, Hayden 1935) to present the night sky to urban dwellers using the traditional Zeiss-projected sky show. While the Adler boasted a large collection of astronomy artefacts, the Hayden had several very large meteorites, the Copernican Chamber (modeled after the one in the Deutsches Museum in Munich) and those wonderful UV-lit murals (the display was completed in 1953). Both facilities were modernized in the 1990's (since the Hayden was not a National Historic Monument, it could be destroyed). At that time they had the opportunity either to converge or diverge in their approach to presenting astronomy.

The Rose Center, containing the Hayden Planetarium, is a big, impressive space. It's all open and airy, modern, monumental, showing its architectural elements: the spherical planetarium suspended in the air on its tubular structural supports, the spiral Harriet and Robert Heilbrunn Cosmic Pathway descending to the ground. Exhibits engraved on aluminum panels. The focus on planetary science is relatively spare: the models of the planets, suspended in the large space, command attention more than the textual information. At the Adler, the planetary models are proportionally smaller and less commanding, while large panels contain a substantial amount of information and images, demanding some study. Down in the Rose Center's pit, there is information on astrophysics and various aspects of modern space science, with a giant video displaying tidbits of new science cycling over a period of about 10 minutes, and of course everyone wants to see the Willamette meteorite. There are a few pieces of modern astronomy technology, and there's the Black Hole Theater, a side room showing a video about black holes that I think hasn't changed in a very long time. But overall the experience is as much architectural as astronomical. A bit shock and awe, I think.

The Adler divides up its space. You are often in rooms, rooms with things, rooms with information, rooms with activities. It's much more hands-on and it's more complete in its reflection of astronomy as both a body of knowledge and a history.

It also looks to me like the Adler has a much more active public outreach program. It's not that the AMNH doesn't do outreach, but the astronomy programs are just a component of the total AMNH curriculum, while the Adler is on its own and seems to have a broader approach to involving the public and especially students. The intimacy of the Adler is reflected in the way it engages its community. A telescope is one way to make astronomy real (and observing in a group, in the dark, is a kind of intimate event). The Rose doesn't have a telescope. True, both Chicago and New York are terribly light polluted, making night-time viewing of anything other than the moon and the bright planets a problem, but the Adler compensates with an H-alpha scope that's open on any sunny day, and the Rose hasn't taken that route although it easily could have. The Rose's Power of Ten exhibit, displayed circumferentially around the balcony, has no real equivalent at the Adler. Immensity (even the peculiar immensity of the very small) and drama are the driving conceits for the Rose: the grand space, the time-scale arrangement of the Cosmic Pathway, the spherical planetarium floating in the void and the almost incorporeal glass surrounding everything. It's hard to think two facilities ostensibly intending to present the same information could be so vastly different once you get past the sky show, especially the pre-produced ones.

We ought not to expect planetariums to be identical, and we really don't want them to be. If you haven't been to any planetariums other than the Rose/Hayden, put some in your travel plans (and if you're a WAA member, report back to *SkyWAAtch* on your experiences). Include the wonderful Griffith in Los Angeles and above all the Adler in Chicago, America's first and perhaps its best. ■

The Doane Observatory, on the shore of Lake Michigan, houses 90 mm hydrogen-alpha a solar telescope and a 0.5m f/8 classical Cassegrain telescope

Observe the Moon

By Jane Houston Jones and Jessica Stoller-Conrad

This year's International Observe the Moon Night is on Oct. 20. Look for astronomy clubs and science centers in your area inviting you to view the Moon at their star parties that evening!

On Oct. 20, the 11-day-old waxing gibbous Moon will rise in the late afternoon and set before dawn. Sunlight will reveal most of the lunar surface and the Moon will be visible all night long. You can observe the Moon's features whether you're observing with the unaided eye, through binoculars or through a telescope. Here are a few of the Moon's features you might spot on the evening of October 20:

Sinus Iridum—Latin for "Bay of Rainbows"—is the little half circle visible on the western side of the Moon near the lunar terminator—the line between light and dark. Another feature, the Jura Mountains, ring the Moon's western edge. You can see them catch the morning Sun. Just south of the Sinus Iridum you can see a large, flat plain called the Mare Imbrium. This feature is called a mare—Latin for "sea"—because early astronomers mistook it for a sea on Moon's surface. Because the Moon will be approaching full, the large craters Copernicus and Tycho will also take center stage. Copernicus is 58 miles (93 kilometers) across. Although its impact crater rays—seen as lines leading out from the crater—will be much more visible at Full Moon, you will still be able to see them on October 20. Tycho, on the other hand, lies in a field of craters near the southern edge of the visible surface of the Moon. At 53 miles (85 kilometers) across, it's a little smaller than Copernicus. However, its massive ray system spans more than 932 miles (1500 kilometers)!

And if you're very observant on the 20th, you'll be able to check off all six of the Apollo lunar landing site locations, too!

In addition to the Moon, we'll be able to observe two meteor showers this month: the Orionids and the Southern Taurids. Although both will have low rates of meteors, they'll be visible in the same part of the sky.

The Orionids peak on Oct. 21, but they are active from Oct. 16 to Oct. 30. Start looking at about 10 p.m. and you can continue to look until 5 a.m. With the bright moonlight you may see only five to 10 swift and faint Orionids per hour.

If you see a slow, bright meteor, that's from the Taurid meteor shower. The Taurids radiate from the nearby constellation Taurus, the Bull. Taurids are active from Sept. 10 through Nov. 20, so you may see both a slow Taurid and a fast Orionid piercing your sky this month. You'll be lucky to see five Taurids per hour on the peak night of Oct. 10.

You can also still catch the great lineup of bright planets in October, with Jupiter, Saturn and Mars lining up with the Moon again this month. And early birds can even catch Venus just before dawn!

You can find out more about International Observe the Moon Night at https://moon.nasa.gov/observe.

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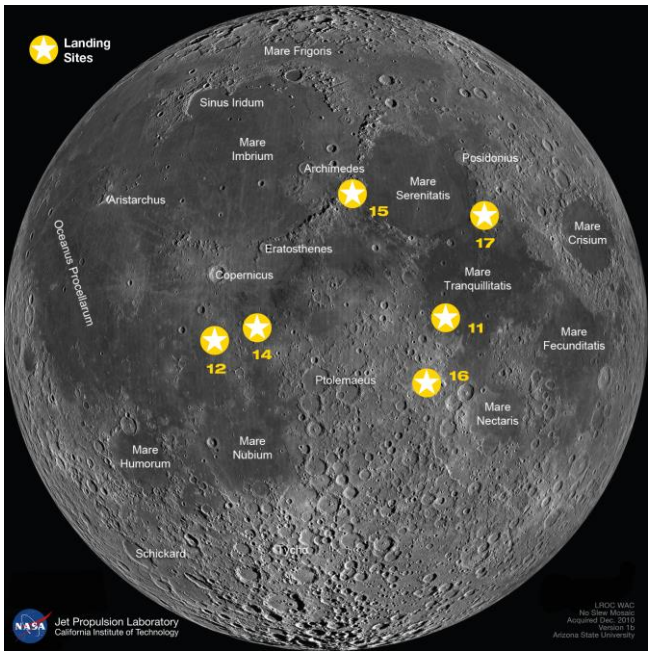


This image shows some of the features you might see if you closely observe the Moon. The stars represent the six Apollo landing sites on the Moon. Credit: NASA/GSFC/Arizona State University (modified by NASA/JPL-Caltech)

WAA is Always Ready to Help

We always try to acknowledge and support outreach programs and inquiries from the public. We want people to rely on our expertise and interest in astronomy, whether it's to give a talk, show the night sky, help someone with a new telescope or rescue an old one. So we were rather tickled to receive the following rather unusual request for assistance via our web site on September 10th:

> I have an odd question - I'm wondering if you have any old image files of the WAA logo from years past. It was similar to the current one (the constellation Cassiopeia), but the connecting lines were dashed and the stars had their corresponding Greek letters next to them. If it would be possible to send me a clear copy of that, it would be great! I am actually getting Cassiopeia as a tattoo, and I always loved the way she was depicted in that particular logo. I can find similar images, but would love to have the one from the WAA logo as the model, as it was the first Amateur Astronomer association I ever joined (I am out in Colorado now, so I am not a current member). Thank you for your help!

So we dug in the files and found a scan of the former WAA logo, which will be familiar to long-standing members. We sent it along to our former member, who will soon be indelibly inscribed with the WAA logo!

A few years ago we had to have the logo remade because we didn't have a digital file of the original. We had been scanning and copying it and the resolution was starting to deteriorate. In doing so, the Board decided to streamline it for ease of reproduction. If you are excited about the WAA and want to tattoo our logo on some part of your body, we'd recommend being up to date by using our new logo!

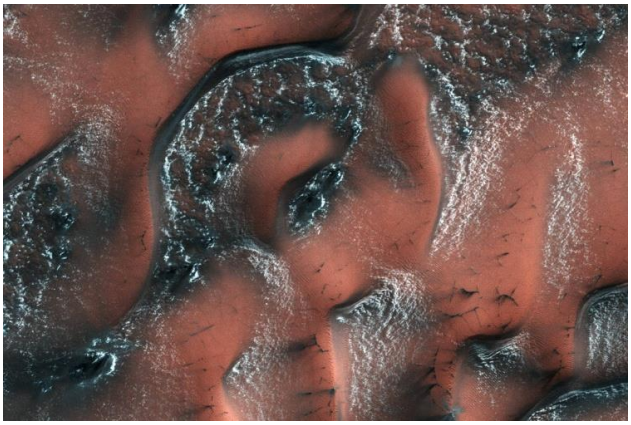
Snowy Worlds Beyond Earth

Linda Hermans-Killiam

There are many places on Earth where it snows, but did you know it snows on other worlds, too? Here are just a few of the places where you might find snow beyond Earth:

Mars

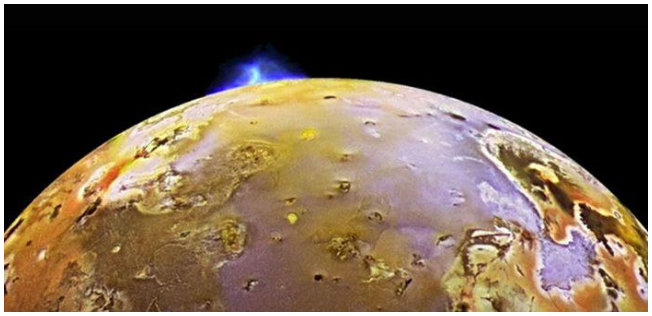
The north pole and south pole of Mars have ice caps that grow and shrink with the seasons. These ice caps are made mainly of water ice—the same kind of ice you'd find on Earth. However, the snow that falls there is made of carbon dioxide—the same ingredient used to make dry ice here on Earth. Carbon dioxide is in the Martian atmosphere and it freezes and falls to the surface of the planet as snow. In 2017, NASA's Mars Reconnaissance Orbiter took photos of the sand dunes around Mars' north pole. The slopes of these dunes were covered with carbon dioxide snow and ice.



NASA's Mars Reconnaissance Orbiter captured this image of carbon dioxide snow covering dunes on Mars. Credit: NASA/JPL/University of Arizona

A Moon of Jupiter: Io

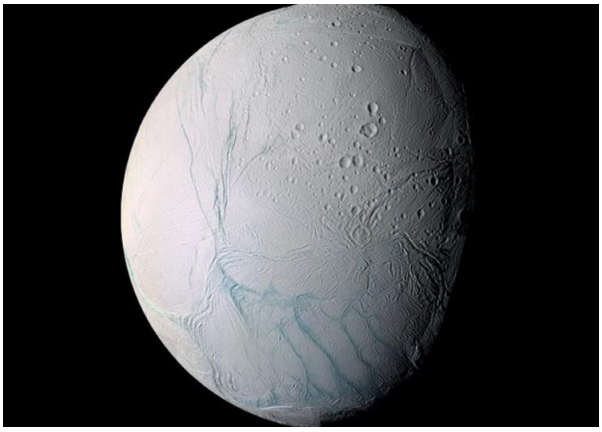
There are dozens of moons that orbit Jupiter and one of them, called Io, has snowflakes made out of sulfur. In 2001, NASA's Galileo spacecraft detected these sulfur snowflakes just above Io's south pole. The sulfur shoots into space from a volcano on Io's surface. In space, the sulfur quickly freezes to form snowflakes that fall back down to the surface.



A volcano shooting molten sulfur out from the surface of Io. Credit: NASA/JPL-Caltech

A Moon of Saturn: Enceladus

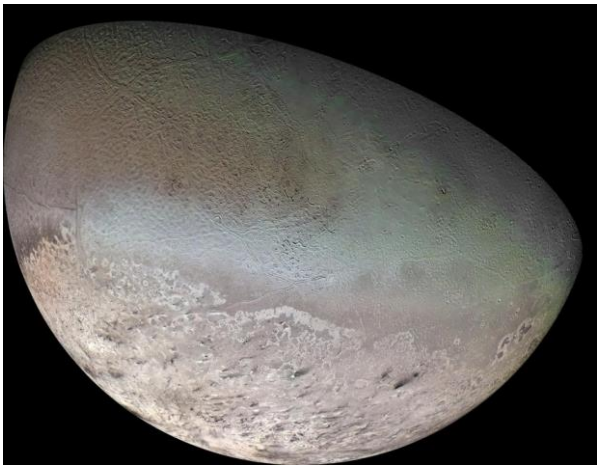
Saturn's moon, Enceladus, has geysers that shoot water vapor out into space. There it freezes and falls back to the surface as snow. Some of the ice also escapes Enceladus to become part of Saturn's rings. The water vapor comes from a heated ocean which lies beneath the moon's icy surface. (Jupiter's moon Europa is also an icy world with a liquid ocean below the frozen surface.) All of this ice and snow make Enceladus one of the brightest objects in our solar system.



Enceladus as viewed from NASA's Cassini spacecraft. Credit: NASA

A Moon of Neptune: Triton

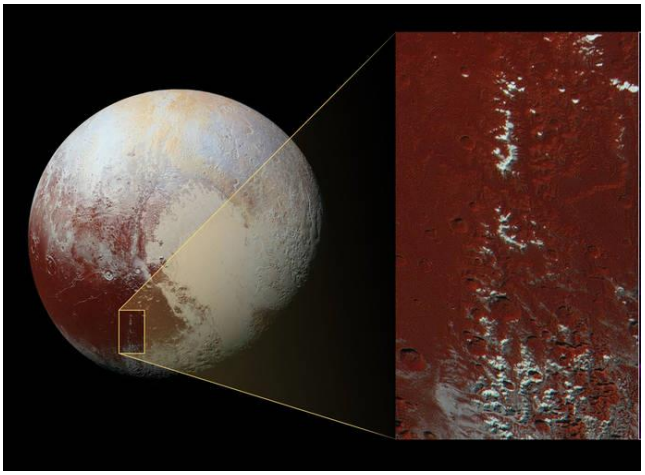
Neptune's largest moon is Triton. It has the coldest surface known in our solar system. Triton's atmosphere is made up mainly of nitrogen. This nitrogen freezes onto its surface covering Triton with ice made of frozen nitrogen. Triton also has geysers like Enceladus, though they are smaller and made of nitrogen rather than water.



The Voyager 2 mission captured this image of Triton. The black streaks are created by nitrogen geysers. Credit: NASA/JPL/USGS

Pluto

Farther out in our solar system lies the dwarf planet Pluto. In 2016, scientists on the New Horizons mission discovered a mountain chain on Pluto where the mountains were capped with methane snow and ice.



The snowy Cthulhu (pronounced kuh-THU-lu) mountain range on Pluto. Credits: NASA/JHUAPL/SwRI

Want to learn more about weather on other planets? Check out NASA Space Place: https://space-place.nasa.gov/planet-weather. This article is distributed by NASA Space Place. With articles, activities and games NASA Space Place encourages everyone to get excited about science and technology. Visit space-place.nasa.gov to explore space and Earth science.

Member & Club Equipment for Sale

October 2018

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.	$1450	Santian Vataj spvataj@hotmail.com
Celestron CPC800 8" SCT (alt-az mount)	Like new condition, perfect optics. Starizona Hyperstar-ready secondary (allows interchangeable conversion to 8" f/2 astrograph if you get a Hyperstar and wedge). Additional accessories: see August newsletter for details. Donated to WAA.	$1300	WAA ads@westchesterastronomers.org
Celestron StarSense autoalign	New condition. Accurate self-alignment. Works with all recent Celestron telescopes (fork mount or GEM). See info on Celestron web site. Complete with hand control, cable, 2 mounts, original packaging, documentation. List $359. Donated to WAA.	$250	WAA ads@westchesterastronomers.org
Celestron Advanced GT Equatorial Mount	Celestron Nexstar+ hand controller, 2" tripod, counterweight bar with 10 lb. weight , cables	$225	Gary Miller garymiller7@optonline.net
Televue Everbrite Diagonal	1.25", brass compression ring	$95	Gary Miller garymiller7@optonline.net
Illuminated Reticle Eyepiece	Meade, 12mm	$30	Gary Miller garymiller7@optonline.net
SuperView 30mm Eyepiece	Generic, 68 degree AFOV, 2" diameter	$35	Gary Miller garymiller7@optonline.net
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
Oberwerk BT-70-45 Binocular Telescope	Excellent condition. Two sets of Oberwerk EPs: 23.9mm (16x) and 8mm (47x). Also include Celestron 13mm (29x) plossls. Metal fitted case. Celestron red dot finder. Phil Harrington says "one of my favorite instruments sold today". Has only been used about 10 times. I like the big bino experience enough that I want to get a 100mm unit. Original cost $1030.	$700	Eugene Lewis genelew1@gmail.com

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to ads@westchesterastronomers.org. Member submissions only. Please only submit serous 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*!