SkyWAAtch

The Newsletter-Journal of Westchester Amateur Astronomers

August 2021

Messier 106 by Rick Bria

A Type-2 Seyfert galaxy in Canes Venatici, magnitude 8.4, distance 23.7±1.5 million light years. April 6, 2021, 14-inch PlaneWave CDK, STX 16803 camera. Mary Aloysia Hardey Observatory, Sacred Heart School, Greenwich.

WAA September Meeting

Friday, September 10 at 7:30 pm

On-line via Zoom

Members' Night

WAA members present brief talks on topics of interest. Trips, observations, imaging, new equipment, or anything else of interest to fellow WAA'ers. It's one of our most popular events.

Members interested in making a presentation should contact Pat Mahon at waa-programs@westchesterastronomers.org.

Pre-lecture on-line socializing with fellow WAA members and guests begins at 7:15 pm!

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

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Editor: Larry Faltz
Assistant Editor: Scott Levine
Almanac Editor: Bob Kelly
Editor Emeritus: Tom Boustead

Also In This Issue

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

WAA October Meeting

Friday, October 8at 7:30 pm

On-line via Zoom

New Horizons and the Solar System's 3rd Zone

Will Grundy, PhD
Planetary Scientist, Lowell Observatory
Co-Investigator, New Horizons mission

Starway to Heaven

Ward Pound Ridge Reservation, Cross River, NY

August 7 (Rain/cloud date August 14)

Free & open to the public. Bring your own telescope or view through members' instruments.

New Members

Monica Carmen	Ossining
Ayumi Noda	Elmsford
Tracy Ostroff	Ardsley
Steve Schwartz	Patterson
Trudy Swan	Yorktown Heights
Anna Tkachenko	Chappaqua

Renewing Members

Eric and Katherine Baumgartner	Redding
Leandro Bento	Mohegan Lake
Brian Blaufeux	Larchmont
Anthony Bonaviso	New Rochelle
Michael & Ann Cefola	Scarsdale
Walter Chadwick	Cold Spring
Federico Duay	Briarcliff Manor
Dugan Family	Sleepy Hollow
Thomas Durkin	White Plains
Ireneo Fante	White Plains
Barry Feinberg	Croton on Hudson
Mitchell Feller	Cortlandt Manor
Howard Finkelstein	Greenwich
Charlie Gibson	Scarsdale
Patricia Mahon	Yonkers
Alexander Mold	Tarrytown
Anthony Monaco	Bronx
Charles Pevsner	Riverside
Steven Reed	New York
Red Scully	Cortlandt Manor
Pierre-Yves Sonke	Tarrytown

ALMANAC For August 2021

Bob Kelly, WAA VP for Field Events


New
Aug 8

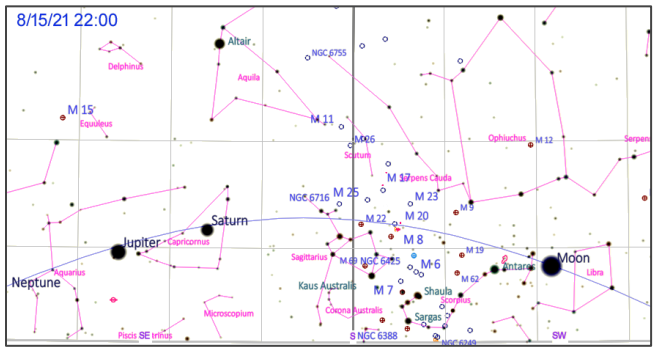

1Q
Aug 15


Full
Aug 22


3Q
Aug 30

Gas Giants Oppose Us

Jupiter and Saturn are at their largest for the year this month as they reach opposition, with Earth between them and the Sun. Objects at opposition rise at sunset. That's wonderful, but sunset is still late, moving from 8:10 p.m. on the 1st to 7:28 p.m. on the 31st. So, viewing the gas giants when they get well above the horizon is a stay-up-late event. We are closest to Saturn on 2nd and Jupiter on the 20th, but they will be larger than average for the whole month or so. Here's a map for mid-month at 10 p.m, looking due south.



Satellite Shadows Haunt Our Nights

Jupiter's four brightest satellites align in fascinating formations. Near opposition a good pair of binoculars will show their changing line-ups, but a larger telescope will make them easier to see. On the 8th/9th for an hour around midnight Ganymede passes in front of slightly brighter Europa, making a dimming that should be noticeable.

Sometimes the Galilean moons cast their shadows on Jupiter. On the 15th, there will be two double shadow transits: first Ganymede and Callisto and later Europa and Io, but both pairs will occur during our daytime, when Jupiter will be only visible from the other side of the world. Check web sites like Sky & Telescope[1] to find other times when shadows dance on the "surface"of Jupiter. There are also some good apps that show the moons of Jupiter and Saturn and their interactions.

[1] https://skyandtelescope.org/wp-content/plugins/observing-tools/jupiter_moons/jupiter.html

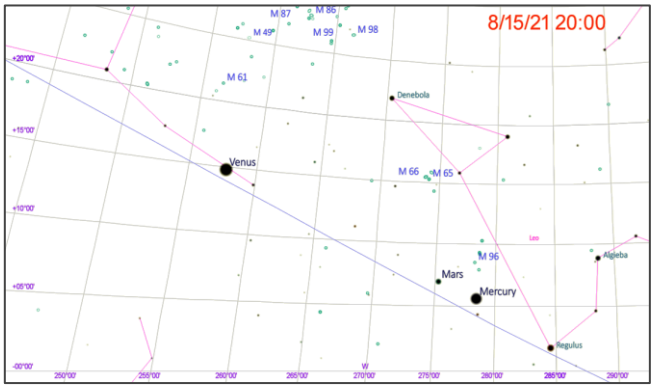
Beautiful Days in Saturn's Neighborhood

Saturn's rings are tilted 18 degrees towards Earth. Quite a sight! Titan, the ringed planet's +9 magnitude moon, is north of the planet around the 2nd and 18th and south of it on the 10th and 26th. At the end of the month, Iapetus is near Saturn's disk, to the south. One peculiar feature of Saturn at this time is how the rings look noticeably brighter in the days around opposition. It's just like when dew in the grass forms a halo around your head's shadow.

Venus Struggles

Venus' elongation from the Sun continues to increase, but the Sun is so high in the sky and the ecliptic so relatively close to the horizon that Venus doesn't get very high in our Northern Hemisphere's evening sky. Venus is looking larger from Earth, getting a bit brighter (ending the month at magnitude -4.0), and its phase is down to three-quarters-lit.

Mars is still two months from conjunction with the Sun, but it shares Venus' lack of altitude. If you have a clear view of the western horizon, look for Leo trampling on Venus and Mars. Regulus, the alpha star of Leo, sets by 9 pm. on the 1st and around 8 p.m. towards the end of the month, so you don't have much time to see these objects.



Mars and Mercury, A Passing Acquaintance

Good luck viewing Mars' slide past Mercury on the 18th. They may be spotted in a high-power telescope,

well-shielded from the Sun, during the day on the 18th or 19th. On these days, the planets follow the Sun, 16 degrees to its east.

If you do that daytime astronomy session, look for Venus, 20˚ east of Mars and Mercury. Looking for Venus first might be good preparation for finding her rocky brethren further in the Sun's glare. (Like many families, the family resemblance is not very clear.)

Be very careful not to look directly at the Sun, especially with unfiltered magnification. You will permanently damage your eyes. Try blocking the Sun with a building or another immovable, opaque object while you look for the planets. (See the Editor's suggestions, to the right).

Mercury's greatest elongation from the Sun is coming up on September 13th. Mercury starts out August in conjunction with the Sun. Watch Mercury slide out from the Sun and Regulus beat a path across the Solar and Heliospheric Observatory's (SOHO) C3 camera's field of view this month.

Drops of Swift-Tuttle in Our Hair

The Perseid meteors are easier to see this year, with the Moon so thin and setting so early that it won't hinder the view. The peak is on the afternoon of the 12th, but you might see 20 to 50 pieces of Comet 109P/Swift-Tuttle per hour after dark. The numbers will increase as the radiant in Perseus rises higher during the night and Earth rotates into the meteor swarm.

Ahoy, International Space Station!

The ISS is visible to the unaided eye evenings through the 3rd and mornings starting on the 23rd. Wave to the seven souls aboard this month, sustaining 20 years with a continuously crewed outpost in space.

The Largest Comet Ever?

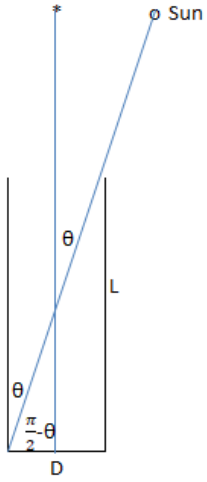
Did you see any of the latest batch of 10th magnitude slushies last month? So far, nothing brighter than that this month. C/2014 UN271 (Bernardinelli-Bernstein) may be the largest comet ever, but you probably won't get to see it. B-B's orbit tells us it's a visitor from 0.6 light years away in the Oort Cloud. It's very bright for an object now 20 astronomical units from the Sun (an AU is the Earth/Sun distance, or 93 million miles; 20 AU is about the distance Uranus is from the Sun), but it won't get closer than 11 AU. It's not likely to be brighter than magnitude +16, and that'll be at perihelion - a decade from now. That's a comet with a large orbit! ■

Safely Observing Planets Near the Sun

You are always risking eye damage when observing near the Sun. We take no responsibility for any injuries you may sustain! *Cave, videntium!*

To minimize risk, I always use a go-to drive. I place a Baader solar filter on the finder and double-check that the telescope tube is completely and securely covered. You don't want sunlight getting into the tube even if you are not sighting with it: the heat can damage optics. After doing a "solar system align" on the Sun, I slew the telescope to the desired object, and only then do I remove to telescope's cover.

You should also shield the front optics from any stray sunlight with a sunshield of required length, so that it casts a shadow over your entire objective (or corrector plate).



Determine θ (theta), the elongation of the planet from the Sun, from a planetarium program. Add 0.25° to correct for the Sun's diameter (0.5°), since the offset in your astronomical table is from the Sun's center . To find L, the length of the sun shield, calculate the tangent. Junior high school trigonometry!

The formula is

$$L = \tan\left(90° - (\theta + 0.25°)\right) \times D$$

You can easily program a spreadsheet to do this calculation for various elongations. Excel prefers radians (90°= π/2 radians), so the Excel function is

=TAN((PI()/2)-RADIANS(Angle+0.25))*Diam

where the cell containing the elongation angle θ in degrees is named "Angle" and the cell containing the optic's diameter is named "Diam". This is a minimum length! Make it a little longer to be safe.

I made a sunshield out of several sheets of "oak-tag," purchased inexpensively at a local Staples. I taped the sheets together with duct tape, and added enough length so it slides solidly onto the telescope tube. I tape it to the tube for extra security. --*The Editor*

Mutual Events of Jupiter's the Galilean Satellites — Robin Stuart

Twice during Jupiter's 12-year orbit, the Sun aligns with the orbital plane of its Galilean satellites. At such times the shadow of one satellite can fall on the face of another, producing an eclipse. In addition, since from Jupiter's perspective the Earth is tucked in fairly close to the Sun we can also observe occultations of one satellite by another. These are known collectively as *mutual phenomena* or *mutual events* of Jupiter's satellites. The current season began in January of this year and ends in August. For most of the year Jupiter has been poorly placed to observe them but as it reaches opposition this month the situation improves.

Predictions can be found at Institute of Celestial Mechanics and Ephemeris Computing (IMCCE) website http://nsdb.imcce.fr/multisat/nsszph517he.htm. In order to obtain the local circumstances of the events, an observatory code needs to be entered from the IAU Minor Planets Center list at https://minorplanetcenter.net/iau/lists/ObsCodesF.html. The observatory in the list nearest to the WAA's observing site in Ward Pound Ridge Reservation is 796 Stamford. The table below gives all entries within a 50 mile radius along with their distances.

Code	Name	Latitude (°)	Longitude (°)	Distance (miles)
796	Stamford	41.0905	-73.5500	11.9
932	John J. McCarthy Obs., New Milford	41.5257	-73.4261	20.4
W72	Trumbull Observatory, Trumbull	41.2431	-73.1789	21.7
928	Moonedge Observatory, Northport	40.9052	-73.3239	28.3
794	Vassar College Observatory, Poughkeepsie	41.6882	-73.8900	33.3
798	Yale Observatory, Bethany	41.4267	-72.9846	33.7
797	Yale Observatory, New Haven	41.3163	-72.9249	35.0
865	Emmy Observatory, New Paltz	41.7094	-74.1208	41.3
795	Rutherford	40.7311	-73.9877	41.8
H95	NJIT Observatory, Newark	40.7418	-74.1788	46.9
H98	Dark Rosanne Obs., Middlefield	41.5169	-72.7345	48.0

The type of a mutual event is denoted by the shorthand mEn for eclipses or mOn for occultations where m and n are numbers assigned to the Galilean satellites according to their distance from Jupiter; Io 1, Europa 2, Ganymede 3 and Callisto 4. The table below was constructed from output generated for Stamford. In the first two events Ganymede eclipses and then occults Europa causing their combined magnitude to drop (Δm) by 0.465 and 0.157 magnitudes respectively. The last column on the right is the altitude of Jupiter at the start of the event.

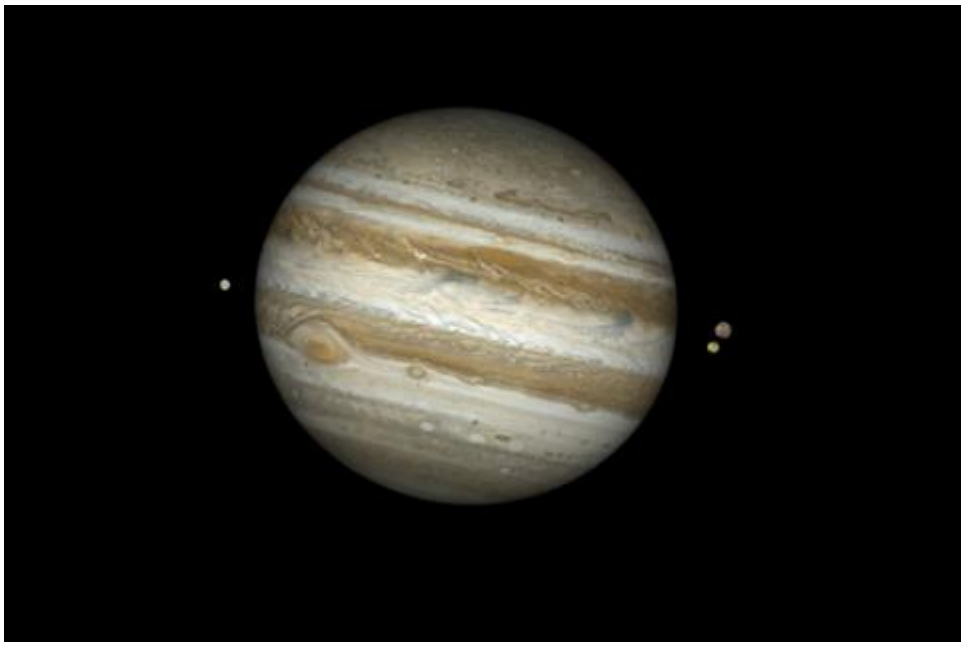
Day Aug.	Begin (EDT)	End (EDT)	Type	Duration (minutes)	Δm	Altitude (°)
8	23:37:08	00:44:41	3E2	67.5	0.465	28
9	02:17:33	02:46:42	3O2	29.1	0.157	36
12	01:58:42	02:20:43	1E3	22	0.128	36
19	00:15:07	00:34:14	1E3	19.1	0.112	34

The free program WinJUPOS (http://jupos.privat.t-online.de/index.htm) can simulate close up views of the mutual events.

Ganymede eclipses Europa.
Mid-event UT 00:10:54UT 9 August 2021

Ganymede occults Europa.
Mid-event UT 04:32:07UT 9 August 2021

The last two events in the 2021 mutual event season will be hardly, if at all, noticeable, with Io's shadow barely nicking Ganymede's limb and causing a dip in brightness of just over 1/10 of a magnitude each time. The event in the early hours of 19 August may nevertheless be quite photogenic, with Europa, Ganymede, Io and the Great Red Spot all grouped closely together as this simulated image shows.



There will be a few shadow transits visible during the month as well. These are more frequent and make for interesting photographs. Use a program such as Sky & Telescope's JupiterMoons phone app or the S&T website https://skyandtelescope.org/wp-content/plugins/observing-tools/jupiter_moons/jupiter.html to make plans. There are several multiple-shadow transits in August, but all occur during daylight in our area.

Jupiter is low in the southern sky this year, culminating at 36 degrees at the beginning of the month and just a degree or so less at the end. It's a lot of atmosphere to image through from our area, but worth a try for these events. ■

Member Profile: Byron Collie

Home town: Croton-On-Hudson NY. Originally from Grafton, New South Wales, Australia

Family: Married to New Yorker. Family in Australia

How did you get interested in astronomy? My father was the person who encouraged my interest. As a child (3½ years old) I watched the Apollo 11 landing with him. My parents took me to the Port Macquarie Observatory (https://www.portastronomy.com.au/) on holidays when I was slightly older. I had a small, cheap department store telescope at when I was about 10.

Do you recall the first time you looked through a telescope? What did you see? Not an exact recollection, but as a child, I probably saw the Moon in my cheap telescope, and some planets and stars on holiday at Port Macquarie.

What's your favorite object(s) to view? M42 (Orion Nebula) and M101 (Pinwheel Galaxy). I also like planetary observing of Jupiter and Saturn.

What kind of equipment do you have? Here's a list.

Scopes

Meade ETX90RA 90mm F/13.8 MakCas (2003)
Hardin Optical DSH-10 10" F/5 Newt Dob (2003)
Meade 114NT/500 F/8.8 Newt (2007)
Explore Scientific AR152 F/6.5 Achromatic Refractor (2020)
Astro Tech AT80ED F/7 Widefield Refractor (2021)

Mounts/Tracking

Sky-Watcher Star Adventurer Pro (2020) for ETX90 and DSLR
Sky-Watcher EQ6R Pro (2020)
Sky-Watcher EQM35 (2020)
Orion StarSeeker IV GoTo Altazimuth (2021)

Eyepieces

Bresser 70° 2" 25mm, 30mm and 35mm
Bresser 70° 1.25" 10mm, 15mm, 20mm
SVBONY 1.25" SV135 Zoom 7 to 21mm
GSO 2" 2x ED Barlow Lens
GSO 1.25" 2x "Shorty" Achromatic Barlow Lens
GSO 1.25" Plossls - 40mm, 32mm, 25mm

Filters

GSO 1.25" Neutral Densit /Moon Filter ND96-0.6 25% Transmission
GSO 1.25" Neutral Density/Moon Filter ND96-0.9 13% Transmission
Orion 1.25" UltraBlock NarrowBand Filter
Neewer 1.25" Filter Set (Moon, CPL, Red, Orange, Yellow, Green, Blue),
Baader Planetarium 2" Fringe Killer Filter
Orion 2" UltraBlock NarrowBand Filter

Cameras

Nikon D3300 (2015)
Imaging Source DFK 21AU04.AS Color Camera (2020)
ASI120 Mini Camera & 30 mm Guide Scope (2020)
ZWO ASI 294 MC Pro Color Camera (2020)
QHY PoleMaster Polar Scope (2020)

Miscellaneous

ZWO ASIAIR Pro WiFi Camera Controller (2020)

What kind of equipment would you like to get that you don't have?

GSO 8" Carbon Fiber Ritchey Chretien
Explorer Scientific 152mm David H. Levy Comet Hunter Mak Newt
Skywatcher Starlux 190mm Mak Newt
Good ZWO mono camera and filters once I get good enough.
Dedicated remote observatory at a western/upstate NY dark site. 😊 [Don't we all. Ed.]

Have you taken any trips or vacations dedicated to astronomy? Tell us about them. None yet.

Are there areas of current astronomical research that particularly interest you? All-sky camera monitoring. I'm currently working on developing a solution with four Raspberry Pi HQ cameras with 120° lenses for weather, meteor tracking and sky monitoring.

What do you do (or did you do, if retired) in "real life"? I'm a retired Australian Federal Agent and Air Force Officer, currently Technology Risk Management executive at a bank.

Have you read any books about astronomy that you'd like to recommend? Greg Redfern's *Astrophotography is Easy!: Basics for Beginners* (one of the Patrick Moore Practical Astronomy Series).

How did you get involved in WAA? I was researching local astronomy clubs and found WAA. I've been a passive member for years but 2020 drove me to becoming active.

What WAA activities do you participate in? Only just becoming active despite years of financial membership.

Besides your interest in astronomy, what other avocations do you have?

Radio Control Aircraft (long standing active member of Miniature Aircraft Association of Westchester)

Amateur Rocketry (Member of Tripoli, NAR and active member of Metra Rocket Club)

Amateur Radio (Software Defined Radio, Signals Monitoring and Analysis)

Amateur Radio Astronomy. I'm really interested in building a small, portable radio telescope based on software-defined radio programs using an equatorial mount, folding antenna and Peltier-cooled receiver

I support many wildlife conservation activities, national parks and environmental causes.

I also support many humanitarian causes including Red Cross, Salvation Army, Feeding America and local organizations.

Provide any other information you think would be interesting to your fellow club members, and don't be bashful!

Science and tech, sci-fi, etc. Watching YouTube videos on cool things has been a Covid pastime. ■

Bill Newell on the History of WAA

[After Bill provided information on WAA's involvement with the rescue of the 6-inch Alvan Clark refractor, now at the Hastings Historical Society (SkyWAAtch, January 2021, p. 16), I invited him to tell us more about the club's origin. Ed.]

In May of 1984 I was thinking about updating or expanding a hand-plotted chart of the stars that I'd made. Why? I don't know, as star positions hadn't changed much in a couple of years. I was doing astronomy in isolation at the time and not getting magazines or anything. I was looking for an updated ephemeris and nautical almanac and ended up calling the Hudson River Museum. I had taken a course on astronomy there with my dad in 1964 when I got my first telescope, so I knew they had the planetarium.

I spoke with the planetarium director, whose name escapes me, and he indicated that there was a small "observers' group," called the Andrus Planetarium Observers' Group, that met there the first Thursday of each month. This was on a Tuesday, two days before the meeting. I indicated I'd like to attend and he said he'd look forward to meeting me.

I arrived at the HRM on Thursday evening and asked the first person I met if I could see director so-and-so. I was told, "He got fired yesterday." This person I spoke to was Jon Elvert. This particular Thursday was his first day on the job and he was supposed to be working with the now defunct planetarium director – I don't think Jon even got to meet him. Jon was now the planetarium director.

So to say there was some confusion is an understatement. Jon Elvert was there. The two planetarium techs (Marty Hoffman and John Radzilowitz –I never be sure of the spelling of his name) were there. Then there was myself and Ed Orevac, whose love was variable star observing. We stood around staring at each other wondering what to do. Eventually Jon asked if we wanted to keep the observers' group going or just call it quits since attendance was obviously not great. We unanimously answered that we should keep it going and that was the real start of today's WAA – May 3. 1984. Sam Storch may have helped instigate that earlier observers' group. I don't know, and none of us ever knew about that. We just knew that what we started was from that particular evening. Marty and John were in college and when they graduated

they moved on. Ed thought we weren't taking the group in the right direction as he wanted it small and serious but Jon and I were working to build greater awareness and interest in astronomy among the public, so Ed left after a couple of years. Jon was director of the Andrus Planetarium until he got an offer in Oregon and went there in 1989. Charlie Gibson, WAA's current Senior Vice President, and I are both still in touch with Jon. I first met Charlie in 1987 when he came to a meeting. Thirty-four years ago. Wow!

Bill Newell (L) and Mike Cefola with an 8-inch Dobsonian made by WAA members. Note the finder made from a Pringle's can. April 2014 outreach event at the Quaker Ridge School in Scarsdale.

Of course, we did also get the 6-inch Clark refractor, probably in 1988, and did the work on that when Jon was still here. The club also had a Celestron 8 that we got somehow.

We had some fantastic events. Early on, we had a meteor shower event in the courtyard of the HRM. It being Yonkers, there were no meteors to be seen, but about 1,000 people showed up. That really impressed the artsy types on the HRM board. We also had several Halley's Comet events that were attended by hundreds of people – including at one of the office buildings on Executive Blvd at about 2:30 a.m. I remember it was the coldest I've ever been in my life. Star parties started on the roof of an old 1820s-era mansion in Hastings where Jon Elvert and his wife Regina had an apartment. This flat roof overlooked the Hudson, the river towns and down to Manhattan. It was a great location. The building belonged to a Carlson family. Then we held star parties at Bear Mountain. That was a big move up. There were just mailed meeting announcements and word-of-mouth when we started, and no dues. Newsletters and all came much later.

We did an event on a lunar eclipse night at the Science Hall in the old World's Fair building in Flushing Meadow Park in Queens that was resurrected as a science museum (it's now the New York Hall of Science). It was raining out but lots of people were there. Their staff was in confusion and utterly lost. The observers' group essentially took over for them, did impromptu lectures, held Q&A sessions, showed people how our scopes worked, wandered around talking with people, etc. We were out there because it was supposed to earn the club $500. We never got paid.

We struggled with meetings at the Planetarium after John Elvert left for Oregon. The person running planetarium and the club at that time seemed to take little interest in the details. There were a number of meeting cancelations with no notification, so people showed up for meetings that didn't happen, etc. I had it out with the director at the end of a meeting and the answers weren't satisfactory so I just dropped going to meetings for a while. One of the problems was that the club's funds were controlled by the Hudson River Museum and the planetarium director wasn't responsive to the members. Fortunately, Bob Davidson started to take on responsibility and things began to work better. About 1991 the club was able to completely free itself from the HRM's control, although meetings were still held there until about 2009, when we moved our meetings to Pace University. Once we were organizationally free of HRM, things had much more the feel of the original club and a lot of progress was quickly made under Bob and Mario Palmieri. ■

Westchester Amateur Astronomers

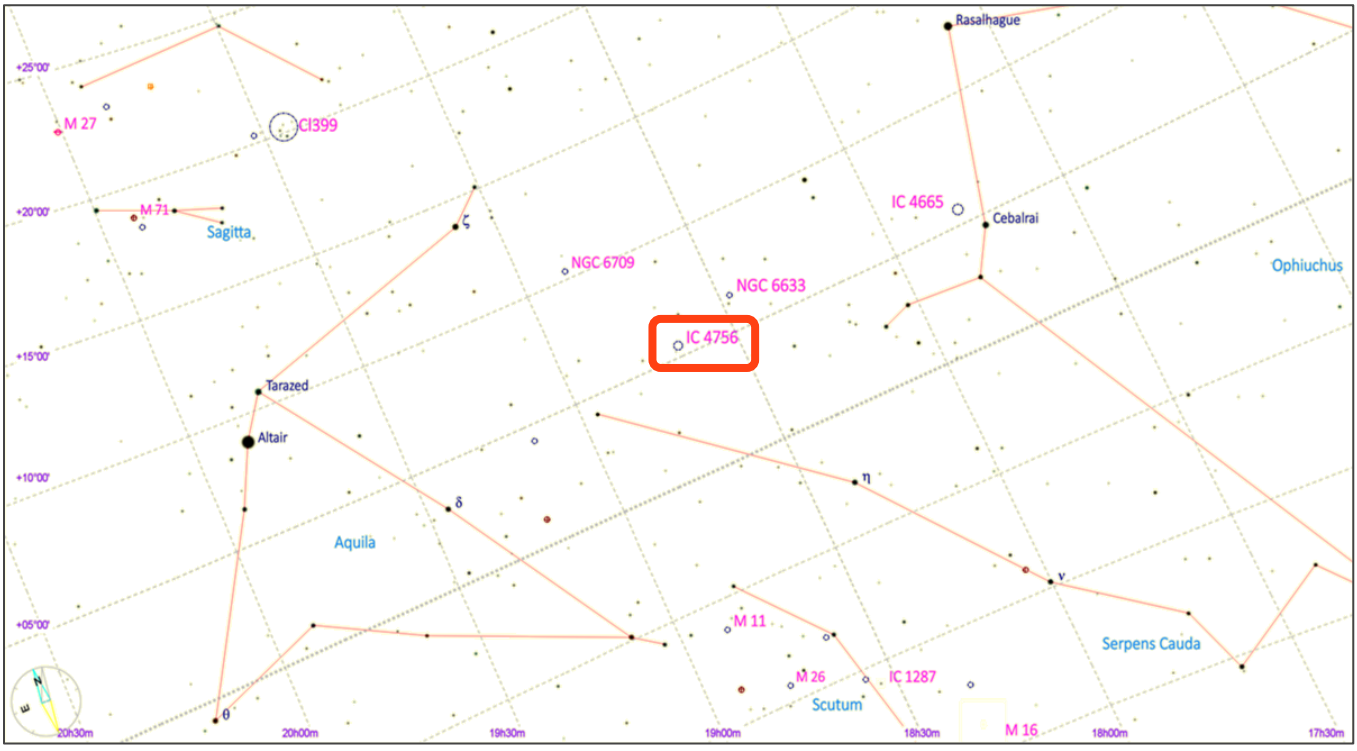
Deep Sky Object of the Month: IC 4756

IC 4756	
Constellation	Serpens
Object type	Open Cluster
Right Ascension J2000	18h 38m 51.5 s
Declination J2000	05d 28m 58s
Magnitude	4.6
Size	40’ diamater
Distance	1,300 LY
Other designations	Cr 386, Mel 210 Graff’s Custer

Situated at the edge of the Milky Way, this cluster is a naked-eye object in dark skies, and is just 3° from another naked-eye open cluster, NGC 6633. Stephen James O’Meara, in *HiddenTreasures*, refers to them as the “Tweedledee” and “Tweedledum” clusters, after the twins in Lewis Carroll’s *Through the Looking Glass*. Although first glimpsed by Jean Philippe Loys de Chéseaux in 1745, he did not publish a catalog. It was not seen by the Herschels, and wasn’t formally identified until Solon Bailey saw it in 1908 on photographic plates made at Harvard’s Arequipa Station in Peru. It is also sometimes called Graff’s Cluster, after Kasimir Romuald Graff, who listed it in a catalogue of OC’s in 1922, apparently unaware of the IC listing.

Visibility for IC4756			
10:00 pm EDT	8/1/21	8/15/21	8/31/21
Altitude	158° 58	181° 54	207° 27
Azimuth	52° 29	54° 13	51° 11

To see the cluster well in a telescope, use low power, lest its stars be lost among countless others along the edge of the Milky Way.



From the Editor: ET Phone the DNI — Larry Faltz

On June 25, the Office of the Director of National Intelligence (DBI) released the *Preliminary Assessment: Unidentified Aerial Phenomena* (UAP),[2] following several weeks of anticipatory publicity and media hype, accompanied by grainy in-flight videos of black or white blotches.

E.T., a bug on the camera lens, or maybe the Bat-signal?

The report is as dry as a potato chip, as it should be. It's extremely general but at the same time precise in its assertions, telling us only what is known, which is very little, and not indulging our imaginations. Truth is often unexciting, ignoring our wish to be constantly titillated. It's the government's responsibility to tell the truth to its citizens. (Really, it is.)

The nine-page report is a general summary of what pilots have seen and what has appeared on sensors. "Most of the UAP reported probably do represent physical objects given that a majority of UAP were registered across multiple sensors, to include radar, infrared, electro-optical, weapon seekers, and visual observation." This is not to say that each UAP was detected by all those modalities at the same time. It just means that each modality had some unexplained detections. For those UAPs that exhibited "unusual flight characteristics" (that is, accelerations that seemed to violate the laws of aerodynamics) "these observations could be the result of sensor errors, spoofing, or observer misperception."

The report goes on to note that "Our analysis of the data supports the construct that if and when individual UAP incidents are resolved they will fall into one of five potential explanatory categories: airborne clutter, natural atmosphere phenomena, USG [US government] or U.S. industry developmental program, foreign adversary systems, and a catchall 'other' bin." It's the "other" bin that's intriguing.

The *Wall Street Journal* headlined their story "UFO Report Says 'Unidentified Aerial Phenomena' Defy Worldly Explanation." The DNI's "we don't know" is not the same as what the WSJ headline intimates: that we know everything we could know and still can't explain it, which might justify the word "defy." While our technological sophistication isn't perfect, it's pretty darned advanced.

In spite of thousands of claims of UFO sightings, visitations and abductions, there is not one shred of verifiable evidence of alien spacecraft. Think of what our technology has been able to do in the three-quarters of a century since the "Roswell Incident": land men on the Moon; land robotic laboratories on Mars and drive them around; land on Titan; ride along with a comet; fly the New Horizons spacecraft to within 60 miles of the target window after a flight of 4 billion miles over nine years; detect tiny near-Earth asteroids that would be far smaller than an alien craft; visualize individual atoms with scanning tunneling electron microscopes; detect gravitational waves by observing two mirrors changing their spacing by 1/1000th of the diameter of a proton; detect and measure over the entire sky the temperature of the 13.8-billion year-old cosmic microwave background to within 0.00001 Kelvin; kick the Higgs boson out of its quantum field and detect it; measure the magnetic moment of the muon. We can even lay claim to detecting the invisible: dark energy and dark matter. It's laughable to think that our technology is not already up to the task of catching alien craft if they exist. Is all technology perfect? Of course not. Will we ever explain 100% of the "other" group? No. But proof of aliens will have to come from meeting them, not

[2] https://is.gd/UFODNI

from outrageous claims or seeing an indistinct blur that could still be something else and is ripe for over-interpretation or even falsification and exploitation. Every time I see a fuzzy image purporting to be a UFO, I think of Antonioni's movie *Blow-Up*.

An overriding claim in the UFO community is that alien craft have indeed been detected (and even alien bodies recovered) and the proof is withheld from us because of a deep, ongoing government conspiracy. To which I present this cartoon by Alan Dunn, published in the *New Yorker* issue of June 4, 1966:

"I assure you, Madam, if any such creatures as you describe really existed, we would be the first to know about it."

Conspiracy theories are replacing logical thought throughout our society. Nothing is real, nothing is as it seems. Government is not to be trusted; whatever it says has an ulterior motive. But a conspiracy that lasted 75 years would be a miracle. How should we approach miracles?

We would do well to utilize "Hume's maxim", from Chapter 10, "On Miracles," in *An Enquiry Concerning Human Understanding* by the Scottish philosopher David Hume (1711-1776):

> The plain consequence is (and it is a general maxim worthy of our attention), that no testimony is sufficient to establish a miracle, unless the testimony be of such a kind, that its falsehood would be more miraculous, than the fact, which it endeavors to establish…. When anyone tells me, that he saw a dead man restored to life, I immediately consider with myself, whether it be more probable, that this person should either deceive or be deceived, or that the fact, which he relates, should really have happened. I weigh the one miracle against the other; and according to the superiority, which I discover, I pronounce my decision, and always reject the greater miracle. If the falsehood of his testimony would be more miraculous, than the event which he relates; then, and not till then, can he pretend to command my belief or opinion.

By Hume's criterion, UFO conspiracies are dismissible. It's too grand a plan, requiring too many things to be foreseen and accounted for, too many people sworn to unshakeable denial.

Anyway, why would aliens spend the last 75 years flying around in our atmosphere and, from time to time, interacting with humans but in such a way as to only marginally shield their existence, neither revealing their presence nor hiding it totally? Isn't the opposite, that these ideations are tricks of the easily and frequently tricked human mind, far more likely?

Anyway, why would aliens waste their time doing what they are purportedly doing? We could suppose that they have a bizarre psychological compulsion to get pleasure by taunting us while not completely violating their version of the Prime Directive. Or maybe it's just an alien college fraternity stunt. It's hardly dignifying, but maybe they don't care, or can't help themselves. Perhaps this cartoon from the New Yorker, drawn by Henry Martin and published in the July 16, 1966 issue, suggests a more rational answer:

"I say if they keep tossing hardware up here, we keep buzzing their swamps!"

On Bill Maher's TV show in June, Neil DeGrasse Tyson made the argument that a species intelligent enough to conquer the problems of interstellar travel simply wouldn't behave like that. We presume they would treat us as we imagine treating a species that we encounter were we to travel to a planet with intelligent life. We'd want to show them our moral, intellectual and ethical best. We would invoke the Golden Rule. They would do the same when they came here, right? Well, maybe not. They could treat us rationally, like Klaatu, exploitatively, like the Kanamit in the *Twilight*

Zone episode "To Serve Man," or cruelly, like the aliens in *Independence Day*. There are parallels in human history, and sadly very, very few of the first kind.

Most astronomers will acknowledge that there is a very high probability that alien life exists. Some of it might have evolved consciousness and intelligence. Some intelligent alien species may wish to explore the cosmos and, managing the race between constructive and destructive technologies, may have avoided the political, religious or ecological stupidity that will likely destroy our planet and its civilizations before we become space-faring. While Arthur C. Clarke's dictum that "Any sufficiently advanced technology is indistinguishable from magic" may be true, advanced technology can't violate the laws of physics. Magic of the kind we see at a Penn and Teller show or during the cocktail hour at your cousin's kid's bar mitzvah, is always explainable. You just can't see and aren't told the explanation, which is what makes it entertaining. Magicians, even Clarke's, always obey the laws of physics.

Getting from there to here might be physically possible but has technological and perhaps biologic impediments. A spacecraft that accelerates at a pleasant one G could go halfway to its target and then decelerate at one G to arrive at a velocity that allows orbit. The Alpha Centaurians could arrive here in nine years that way. But that depends on a propulsion system that can carry enough fuel for constant acceleration. Accelerating at one G, you reach relativistic velocity in about one year. That means that the inertial mass of the spacecraft is now much, much greater, and so the amount of energy needed to continue the one-G acceleration is vastly increased, which means even more fuel, more speed, more inertial mass, and so on *ad infinitum*. There's no power source capable of doing that. One analysis I saw on the Internet suggested the entire ship would have to be made out of antimatter. As soon as you start building it, it explodes.

At a constant acceleration of 0.1 G, the trip from Alpha Centauri would take 28½ years, but there would still be a prolonged period of relativistic velocity and its attendant energy needs. How about going at a constant velocity, say one million km per hour (twenty times the speed of New Horizons)? It would take over 4,500 years to get here from Alpha Centauri. It's hard to believe that sentient organisms would choose to take that voyage. Perhaps if their metabolism was incredibly slow they could tolerate it. But then when they got here they would be indistinguishable from rocks. A space vessel that would house a large population in an entire ecological environment operating over multiple generations makes for good science fiction but seems utterly unrealistic and destined for failure. Frankly, I don't see interstellar travel, although I'm a *Star Trek* fan, have read plenty of science fiction and love the movie *Paul*.

What if aliens created space-faring automata with artificial intelligence and the ability to repair, reproduce and even evolve? They would presumably be resistant to senescence. Even if they managed to function properly, what would be the point of sending them if they were not going to interact with us directly? Did they evolve away from their primary mission, develop a sense of humor, and decide to goof on Navy pilots and anally probe the credulous?

I think belief in aliens is an exercise in fantasy. Now, fantasy is a unique characteristic of the human mind,[3] a necessary element of learning and psychic development[4] and a marker of cultural identity. Its enjoyments persist into adulthood, although adults are supposed to separate fantasy from reality even as we enjoy it. Failure to do that is psychosis. We can fantasize about aliens and UFOs, but we ought not to believe in them until we see them, and I mean <u>really</u> see them, not an unresolved blotch or testimony of a hyper-excited and perhaps transiently hypoxic pilot.

I don't think aliens can get here, and so the UAPs can't be alien spacecraft. I'd love to be wrong, but I'm certain I'm not. I would like there to be smart, generous, optimistic aliens who can solve our problems for us. But my bet is that if they exist, they can't reach us physically. We should search for life in the solar system with spacecraft and landers, on exoplanets via spectroscopy, and with SETI using radio waves and perhaps laser detections. Sadly, human beings have not been visited, probed, impregnated or blessed by aliens, even if some think they have. As Captain Jean-Luc Picard once said on the bridge of the Enterprise, "Wishing for something does not make it so." ■

[3] Cats dream, but does your cat dream of space cats?
[4] For a psychoanalytic approach to fairy tales, read Bruno Bettleheim's *The Uses of Enchantment: The Meaning and Importance of Fairy Tales* (1976).

Chasing Space Stations

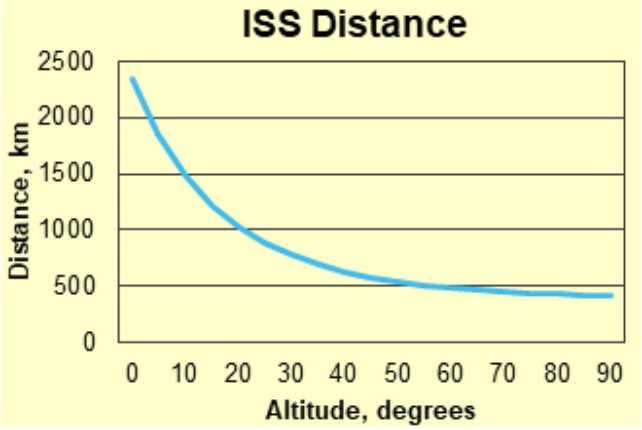
Robin Stuart

My efforts to photograph orbiting space stations date as far back as 1973. It was predicted in the local press that soon after its launch Skylab would make a visible pass in the early morning hours over our home in Dunedin, New Zealand. I set up my father's 4-inch focal-length fold-out camera loaded with 100 ASA Kodak 620 film. Bright Skylab appeared on cue and I was able to capture a satisfactory trail. As I was packing up, another bright object following the same path appeared and then another and another, all of which were successfully captured. It was apparent that there was quite a bit of rocket debris following Skylab in orbit.

Recently I have tried my hand at obtaining high resolution images of the International Space Station (ISS). Frequently seen gliding serenely across the night sky, sometimes with a supply vehicle on its heels, it can be an impressive sight to behold. Pass predictions and sky charts can be found at https://heavens-above.com/, which is also available as a phone app.

Solar and Lunar Transits

Technically, one of the easiest ways to photograph the ISS is to shoot video as it transits across of the face of the Sun or Moon, as was done for the image on the following page. In this sequence the ISS is moving from bottom left to top right. Transits can also be observed visually through a suitably filtered telescope but last only around half a second. Blink and you'll miss it!



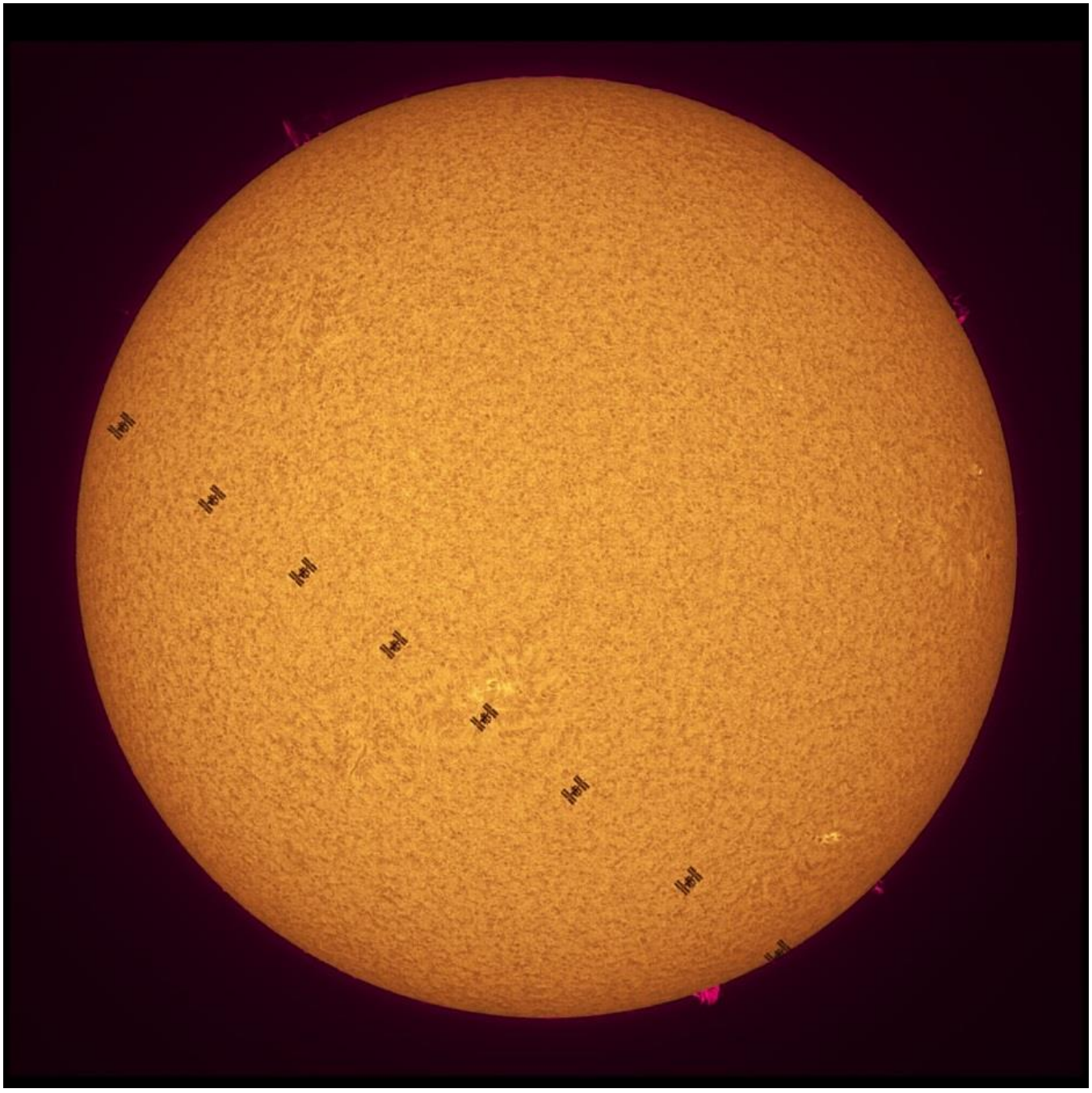
The ISS follows a very nearly circular orbit at a height of about 420 km (260 miles) above the Earth's surface. As it rises higher in altitude above a viewer's horizon it gets closer to the observer. Using simple trigonometry, the distance as a function of altitude can be calculated and is plotted in the graph. It is clear that once the ISS rises above about 45° it doesn't get much closer to the observer. However, the higher its altitude, the broader the cross-section it presents to the observer and the more clearly the individual modules can be discerned.

Left to its own devices the ISS would orbit the Earth keeping a fixed orientation in space. Relative to the ground it would appear to turn through 360° once per revolution. By means of reaction wheels (gyroscopes), which do not require expending any propellant, and sometimes assisted by thrusters, the ISS is made to rotate on its axis so that the observation cupola and overall plane of the structure faces the Earth's surface.

Travelling at 7660 m/s (17,100 mph) the ISS completes an orbit of the Earth every 93 minutes. The overall length of the support truss is 109 m and the solar panels are 75 m wide. The ISS therefore traverses its own length in roughly 1/100 second, which limits the exposure time that be used to capture a transit. At its closest possible distance of 420 km, the ISS subtends just 65 arc-seconds measured corner to corner. For reference, at the Moon's average distance the crater Copernicus is 50 arc-seconds across.

ISS transit predictions for the Sun and the Moon can be found at https://transit-finder.com/, with potentially observable events within a 50 mile radius occurring every every few days. I happened to notice a few days beforehand that a particularly favorable solar transit would occur two seconds before 1 p.m. on Sunday, June 6. The path along which it would be visible was 4.2 km wide. I set up my Televue Pronto refractor in a grassy area next to the parking lot of the West Point Foundry Preserve in Cold Spring, NY, equipping it with a 60-mm Coronado Hα filter and Meade LPI-G monochrome video camera. From that location the maximum possible altitude of the Sun at any time of the year is 72°; for this event it would be at 71.3°, so they don't come much better! The weather was hot, still and clear. I started recording a video 45 seconds before the predicted time and soon witnessed a bat-like silhouette race across the face of the Sun. The transit lasted just 0.55 seconds.

The image shown here is a colorized composite with the prominences being captured separately immediately after the event. For the ISS the camera exposure time was set to 0.5 ms. The solar panels and major modules are clearly visible and can be identified using the NASA schematic at https://is.gd/issexploded.



Direct Imaging

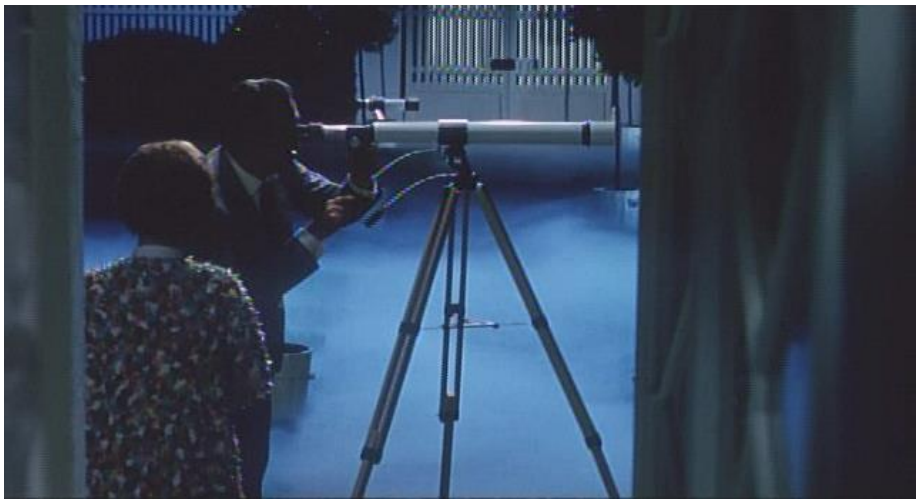
Capturing the ISS directly in the night sky is a much more challenging endeavor. Some observers have been successful with manual tracking and imaging through Dobsonian telescopes. Alternatively, some high-end mounts and their associated software are capable of tracking the ISS along its predicted path. I have used TheSkyX software and a Paramount MyT German equatorial mount for my initial forays into this field. The length of the path that a German equatorial can follow is limited by the meridian flip.

The software computes the predicted position of the ISS or other satellites from NORAD 2-line elements (TLE) available from many sources online. These are essentially the geocentric Keplerian osculating orbital elements as described in the October 2020 issue of SkyWAAtch, p. 7. For computer processing they are presented as two lines of text in a standard format. Although updated frequently they can become stale or the ISS may have had its orbit boosted in the interim, meaning that the predictions would be off. To allow for this T*heSkyX* permits manual track offsets to be applied on the fly.

The image below is the product of one of my attempts at direct imaging of the ISS. It was taken with a Canon 60Da through a Televue NP127 equipped with a 5× Powermate. The mount was accurately polar-aligned. Piggybacked on top, to use as a finder order to monitor and estimate the offset required to track the computed path, was a Televue Pronto with a 0.8× focal reducer to maximize the field of view, and a Meade LPI-G video camera. There is a definite knack and skill required to successfully follow the target, and opportunities to practice are brief and infrequent. I am still very low on the learning curve.

The image was taken on May 14 right after Andy Poniros's engrossing WAA meeting lecture, "The Space Race in Review." Having set up the equipment before the meeting, I signed off of Zoom at 9:20 p.m. and prepared to capture the passage starting six minutes later. The maximum altitude was to be 42° at which time the ISS would be 605 km (376 miles) away and appear 45 arc-seconds across from corner to corner. The image was taken at 1/500 second, ISO 1600. Notice that at this altitude the ISS is viewed obliquely, compared to the transit image, when it was more nearly overhead. ■

More Telescopes in the Movies



In *Juliet of the Spirits*, a 1965 film directed by Federico Fellini, Giulietta Masina, plays a subservient wife who eventually gains the strength to leave her philandering husband. It's typical Fellini, where at times you aren't sure of what is real and what is fantasy. In this scene they are spying on the neighbors, but there's no erecting prism, so the view would be upside down! Masina and Fellini were married for 50 years.

Burt Lancaster as Don Fabrizio Corbera, Prince of Salina, in the 1963 film *The Leopard*, directed by Luchino Visconti. Besides being an aristocrat, Don Fabrizio is also a serious amateur astronomer. The film is set in Sicily at the time of the unification of Italy by Garibaldi (1860).

A telescopic mistake! This is a frame from the 1953 film *Young Bess*, starring Jean Simmons and Stewart Granger (then husband and wife), directed by George Sydney. We are on a ship carrying King Henry VIII (played by Charles Laughton) and his entourage. King Henry died in 1547, some 60 years before the telescope was invented, so the lookout could not have been using this instrument.

Images by Members

The North American Nebula by Tony Bonaviso

First light for Tony's new William Optics Redcat 51. ZWO ASI294 MC Pro cooled color camera with an Optolong L-Extreme filter. 15x300 sec @ -10° C lights; 25x300 sec darks, 21 flats and bias frames.

The tiny Redcat shows that big things can come in small packages. Compare this with Tony's previous image of NGC 7000, on the cover of our March 2021 issue. This image used 15 five-minute subs, while the March cover image used 25 five-minute subs.

This large emission nebula in Cygnus was first sighted by William Herschel on October 26, 1786. It was first photographed in 1890 by Max Wolf, who saw its obvious resemblance to our continent, with Central America and Mexico well-defined but the rest of the continent requiring a little creativity to envision. While the nebula is invisible in small-to-medium sized telescopes in Westchester, it can be easily seen in dark locations at higher altitudes with just 7x50 binoculars. It's been glimpsed in an image-intensifier eyepiece and the BiPH device from Ward Pound Ridge, especially if a hydrogen-alpha filter is used in front of the optics.

Catalogued as NGC 7000 and listed by Sir Patrick Moore as Caldwell 20, the nebula is an HII region, hydrogen ionized by the ultraviolet energy from one or more hot young stars. Originally, Deneb was thought to be the energizing star, but then even hotter O6 star HD 199579 was implicated. Over the past 40 years, other stars in the area have been suggested as providing the necessary irradiation.

The North American Nebula by Steve Bellavia

First light for Steve's Hyperstar-outfitted Celestron 6-inch SCT Is a completely different take on the nebula from Tony Bonaviso's image on the previous page. To get the widest field of view (although not quite as wide as Tony's Redcat), Steve converted his 6-inch f/10 Celestron SCT to an f/2 astrograph with a Starizona Hyperstar v.4. This device replaces the scope's secondary (it's easy to switch back to the regular secondary). The camera is placed at the focus. It looks like it obscures the light path, but there's enough aperture and with a focal ratio of f/2, the field is enormous and a lot of light reaches the sensor.

This narrowband image was made from 120 30-second frames through a 6-nm hydrogen alpha filter and a similar number of frames through a 6-nm oxygen III filter, the camera gain identical for both.

The fundamental difference between Steve and Tony's images comes from the fact that Tony uses a color camera and Steve a monochrome camera. Different tools give different results. A Beethoven piano sonata sounds different when played on a Steinway than it does on a Bösendorfer, but it's still glorious Beethoven. In addition, Steve has somewhat darker skies on the North Fork of eastern Long Island (Mattituck) while Tony's image was made at Ward Pound Reservation, closer to larger concentrations of night-time illumination.

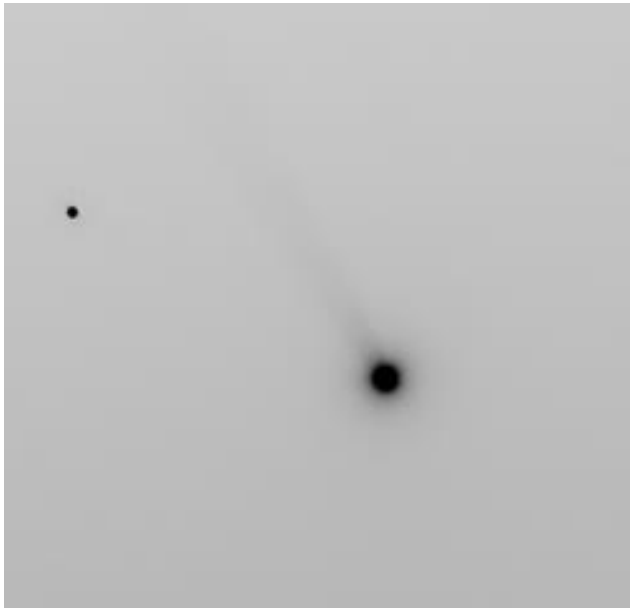
De gustibus non disputandem est.

Mercury's Tail by Steve Bellavia

Mercury was favorably placed in the western sky after sunset in May, making conjunctions with the Moon and then Venus. It's rare enough just to get a look at the innermost planet, but Steve did something clever.

Employing a narrowband filter centered on the bright yellow sodium line at 589 nm, Steve captured the ephemeral plume of gas ejected from Mercury's thin exosphere by the impact of charged particles in the Sun's stellar wind. This is the mechanism that forms a comet's ion tail. The tail extends as far as 24 million miles from the planet.

Borg 90FL with 0.72X super reducer, ASI 183MM camera. SkyWatcher EQ6-R Pro Mount. Edmund Optics 21.3-mm diameter sodium (589 nm) narrow-band filter (10-nm bandpass). Twenty 60-second subs.



Here's a slightly enlarged inverse of the image to show the tail with greater clarity.

Mercury's exosphere is composed primarily of sodium, magnesium, and calcium ejected from the planet's surface. Traces of hydrogen, helium, and potassium can also be detected. Mariner 10 had reported a lot of oxygen, but very little was found by Messenger. Messenger also detected water molecules. At the surface, the concentration of atoms is 10^5 particles per cubic centimeter, a pressure of less than 10^{-14} bar. For comparison, the Earth's surface has about $2.5x10^{21}$ molecules per cc, and of course a surface pressure of 1 bar.

Messenger was launched by NASA in 2004. It orbited Mercury from 2011 until 2015, when it ran out of propellant and was crashed into Mercury's surface. Messenger made over 200,000 images of the planet.

The sodium D line is a doublet at 588.9950 and 589.5924 nanometers, in the yellow. You can demonstrate this line, at your own considerable risk, by preparing an "electric pickle." See https://is.gd/epckle for more info and warnings. We take no responsibility if you try it. Maybe, you should just watch the videos.

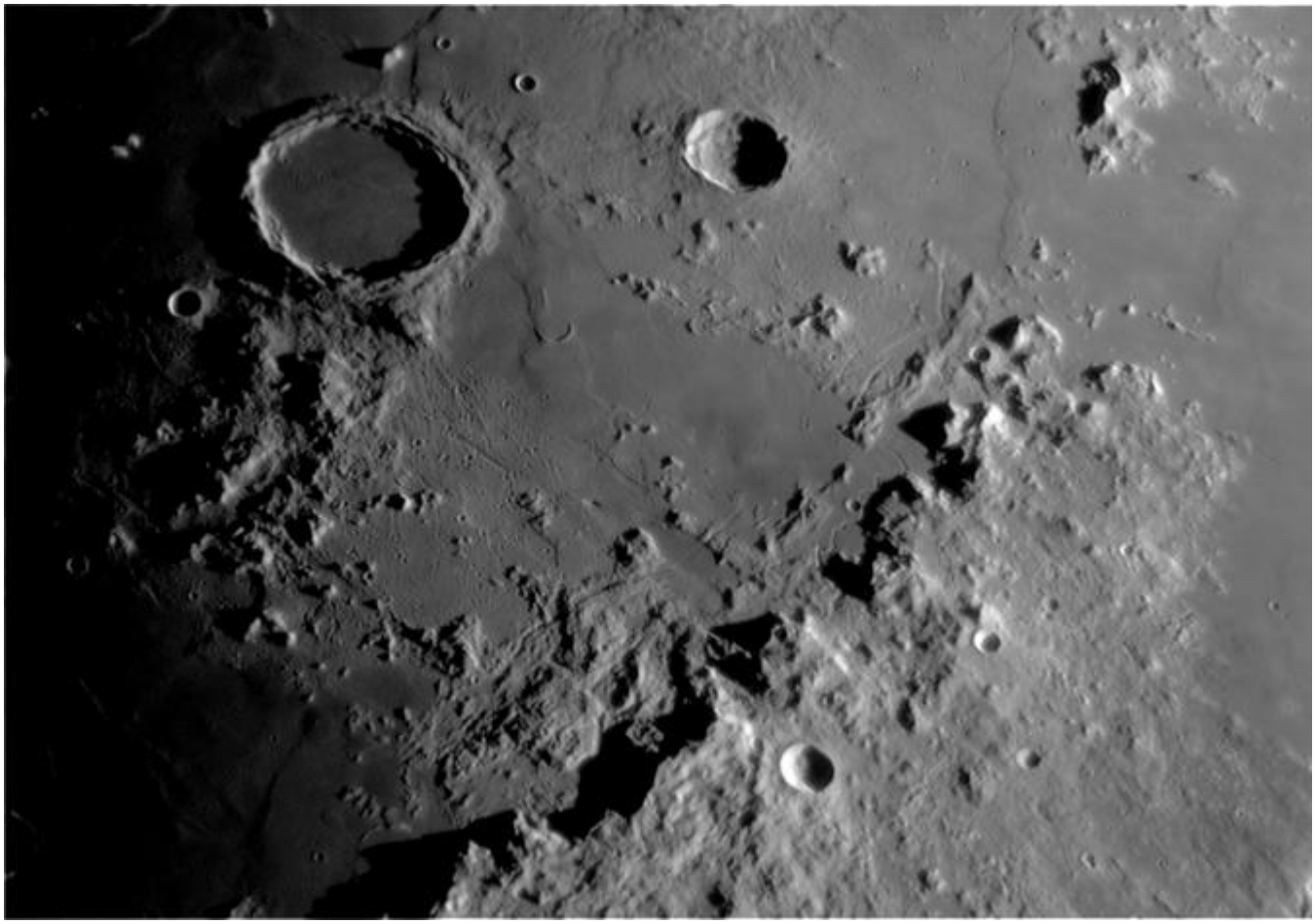
The Moon on April 26, 2021 by Greg Borrelly

The full Moon on April 26, 2021, taken around 11:30 p.m. Greg used an ES 127 triplet refractor and Canon T6i mounted on a Twilight II. ISO 400, 1/1600 second. The Moon's diameter was 33' 45". It was 33° 10' 23" above the horizon, with an airmass of 1.6 dimming its -12.7 magnitude by perhaps 0.25 magnitudes. Still pretty bright! At a distance of 357,378 km, the Moon was almost as close to Earth as it gets. On November 26, 2034, it will be 356,452 km away, the closest between 2013 and 2100.

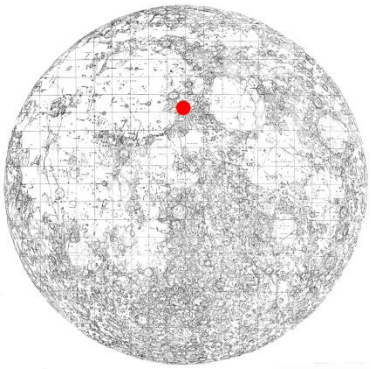
The term "supermoon" was coined in 1979 by astrologer Richard Nolle, referring to a full Moon close to perigee. These get a lot of play in the popular press, along with the usual silly Farmer's Almanac appellations that taint every full Moon (this one was the Pink Moon, the Sprouting Grass Moon, the Egg Moon, the Fish Moon and some other dumb names). The hype infects the innocent, who think there is something particularly remarkable about the phenomenon. Back in 2015 your editor was asked by a reporter for the *Journal News* where one could go to see a supermoon, expecting me to reveal some secret location. My response was, "Go outside and look up."

Lunar Imaging — Larry Faltz

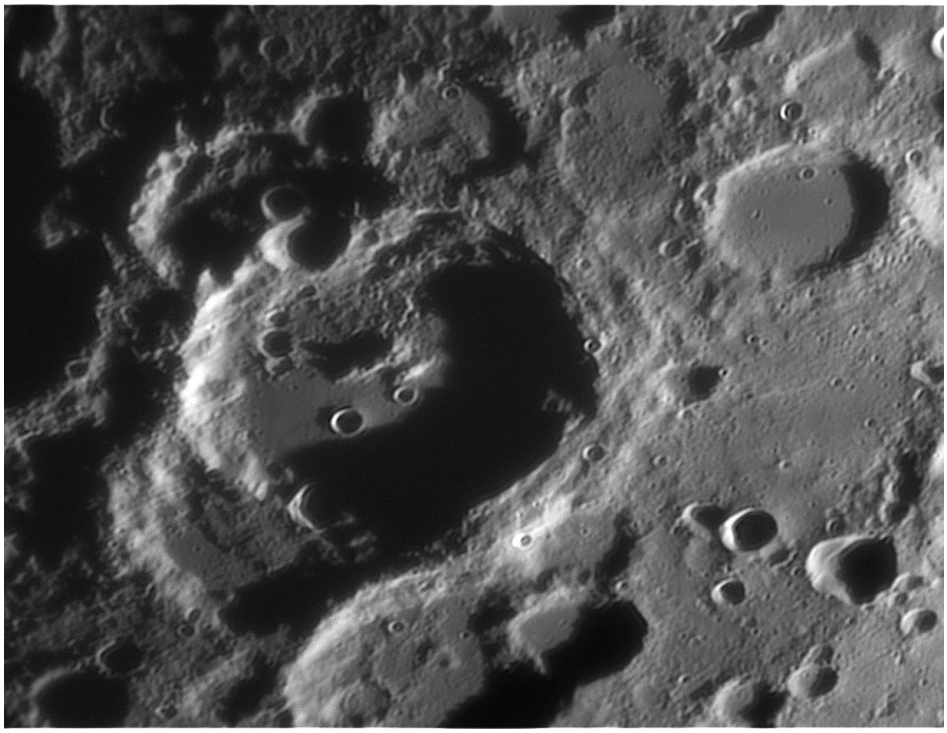
This spring I upgraded from a 1.2-megapixel Celestron Skyris 445 monochrome CCD camera to a more sensitive 2.1-megapixel ZWO ASI290MM CMOS camera for solar and lunar imaging, where color isn't important. I wanted shorter exposures and higher frame capture rates. The Skyris 445 claims 30 FPS but I never achieved that rate. The ASI290 captures images at 82 FPS at its full 1936x1096 resolution; with a smaller "region of interest" speeds are even higher. It helps to have a fast computer: I complemented the new camera with a new lightweight 14-inch Acer i7 2.8 GHz laptop with 16 GB of RAM and 512 GB SSD storage. The image below was a 1280x720 capture at 125 FPS, so its 4,126 frames, each 2.1 milliseconds in duration, were acquired in just 33 seconds.

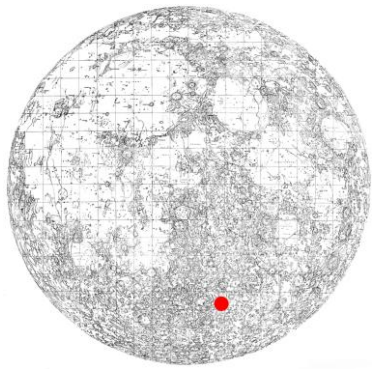


The Sun is rising on the crater Archimedes and the eastern Apennine Mountains. Archimedes is 50 miles in diameter; its floor has filled in with lava. The smaller crater to the east is Autolycus, 24 miles in diameter. Between these craters and the Apennine Mountains to the south is the flat Palus Putredinis, the "Marsh of Decay". The largest mountain in the Apennines is Mons Huygens, the massif at the bottom edge of the image. It rises to a height of 16,400 feet. Mons Hadley, its peak reflecting the morning sunlight, is near the northeastern end of the chain. It is 14,500 feet high and overlooks the one mile wide Hadley Rille, landing site of Apollo 15 (see Robin Stuart's article in the June 2020 SkyWAAtch, p. 15).

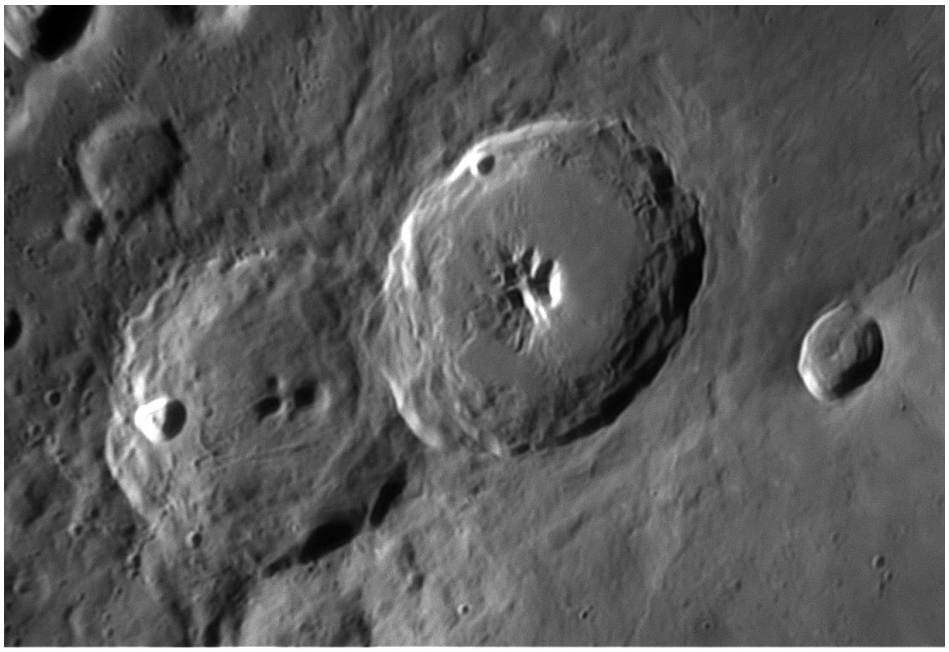


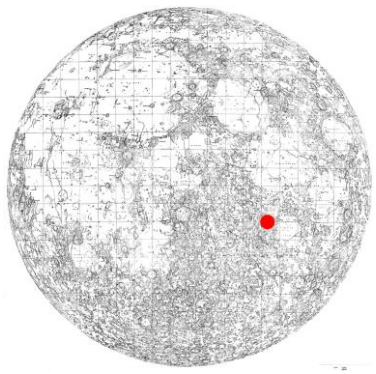
5/20/21 Moon age 9d 6h.



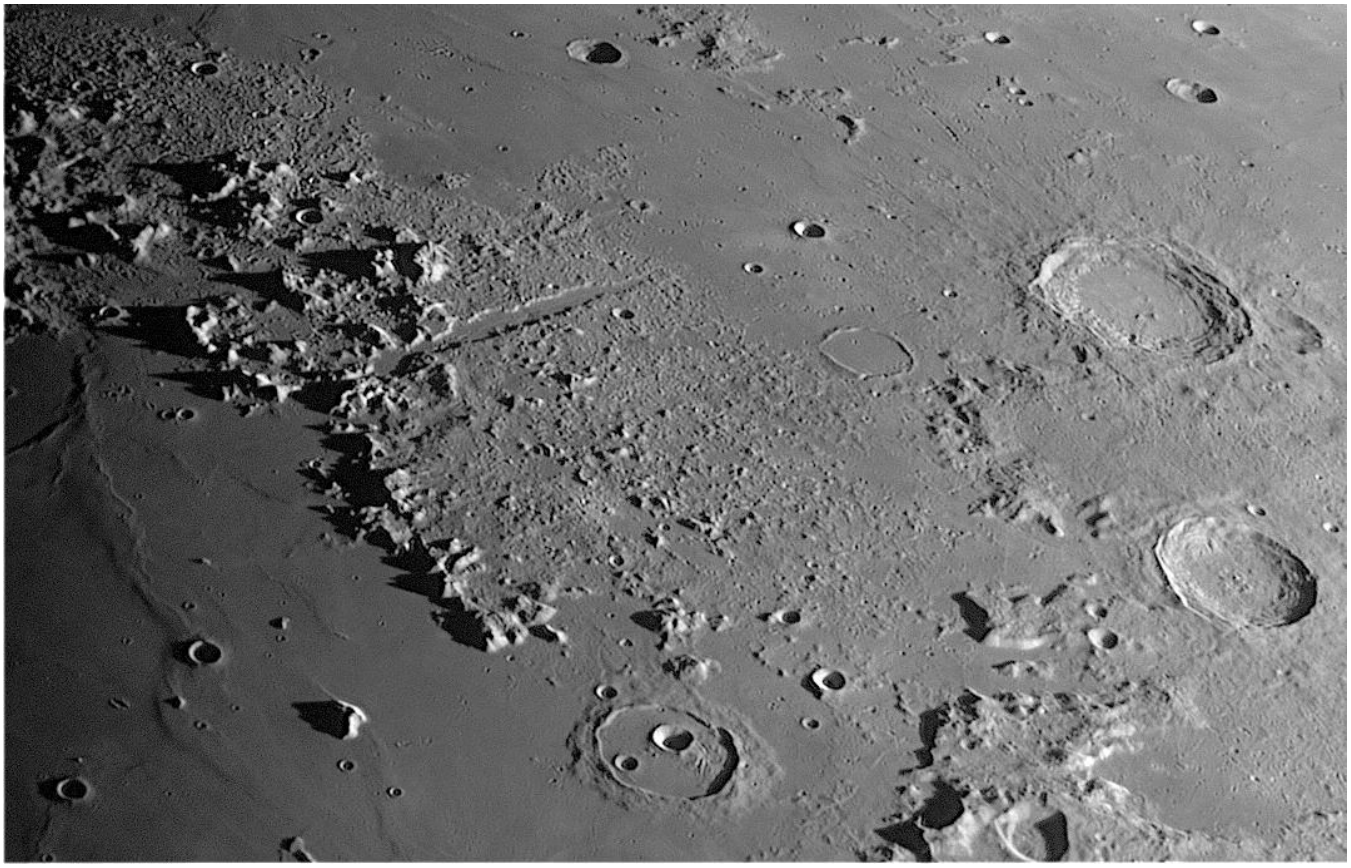


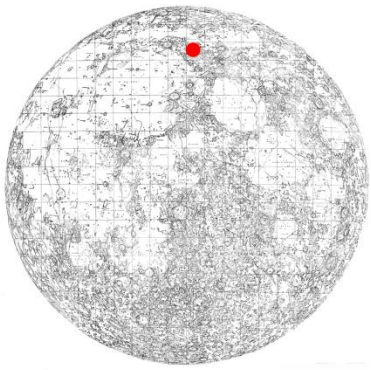
Maurolyticus, 114-km in diameter, is in the heavily-cratered southern highlands. The rising Sun is reflected off of the crater's western wall, while the eastern half of the crater remains in darkness. The crater below, cut off by the lower edge of the image, is Baroclus. To the upper right is the flat, lava-filled Buch, with a few small, more recent impacts. 6/16/21, Moon age 6d 14h. 2X Barlow.





Theophilus (R) and Cyrillus (L) are at the western edge of the Mare Nectaris. Theophilus is a much more recent impact than Cyrillus, as might be deduced from the latter's more disrupted floor and walls. Both are around 100 km in diameter. The small crater Mädler lies to the east. 6/16/21, Moon age 6d 14h. 2X Barlow.



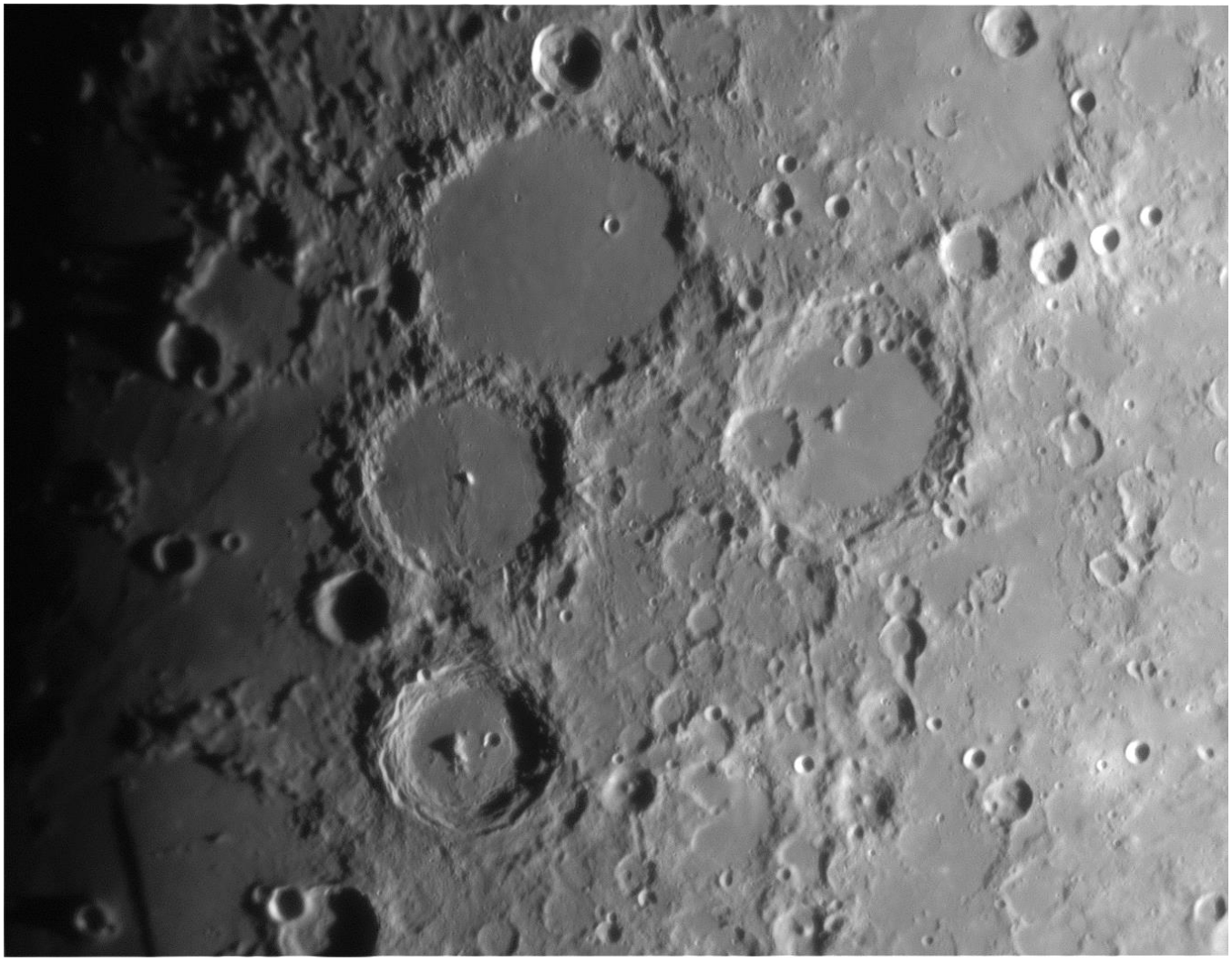


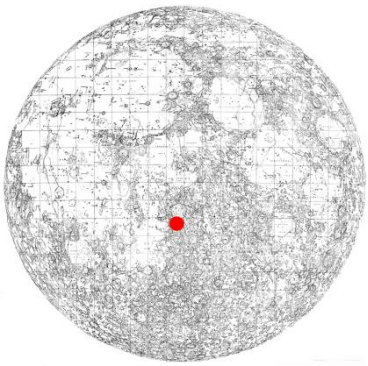
The Montes Alpes separates the Mare Imbrium from the Mare Frigoris. The Alpine Valley (Vallis Alpes) is a 180-km cleft in the mountains, easily seen in a small telescope. To the right is the 87-km wide crater Aristoteles, and below it Eudoxus, 67 km in diameter. It's appropriate that the two craters are close together: Eudoxus and Aristotle were both students of Plato, and Eudoxus' schema of planetary circular motion with epicycles was thoroughly described by Aristotle in *On the Heavens*. No original work of Eudoxus survives.

The thin-walled crater Cassini, in the center-bottom of the image, is filled with lava and punctuated by two smaller, more recent craters, Cassini A and B. To Cassini's left (west) is the isolated Mons Piton, 2,250 meters high, and further west the small isolated crater is Piazzi Smyth, named after the British astronomer Charles Piazzi Smyth (not to be confused with Giuseppe Piazzi, who discovered Ceres in 1801). Piazzi Smyth was the Astronomer Royal of Scotland in the late 19th century. A productive astronomer, he was also peculiarly interested in Khufu's Pyramid (the Great Pyramid) in Egypt and hatched a variety of fantastical theories and claims about its origin. He even proposed a mystical numerology based its dimensions.

The tiny crater just below the eastern (right) terminus of the Alpine Valley is 9-km diameter Trouvelot, named for Étienne Trouvelot, a French astronomer and accomplished artist who made over 700 beautiful astronomical pastels and lithographs, some of which you've probably seen, since they are frequently reproduced. He accompanied William Harkness of the US Naval Observatory to Creston, Wyoming to view and draw the 1878 total solar eclipse, in a party that included telescope maker Alvan Clark. Trouvelot was also an amateur entomologist and schemed to develop a silkworm industry in the US, but in 1869, while living in Medford, MA, he unintentionally released gypsy moth caterpillars into the environment, creating a plague that is still with us.

5/20/21 Moon age 9d 7h.

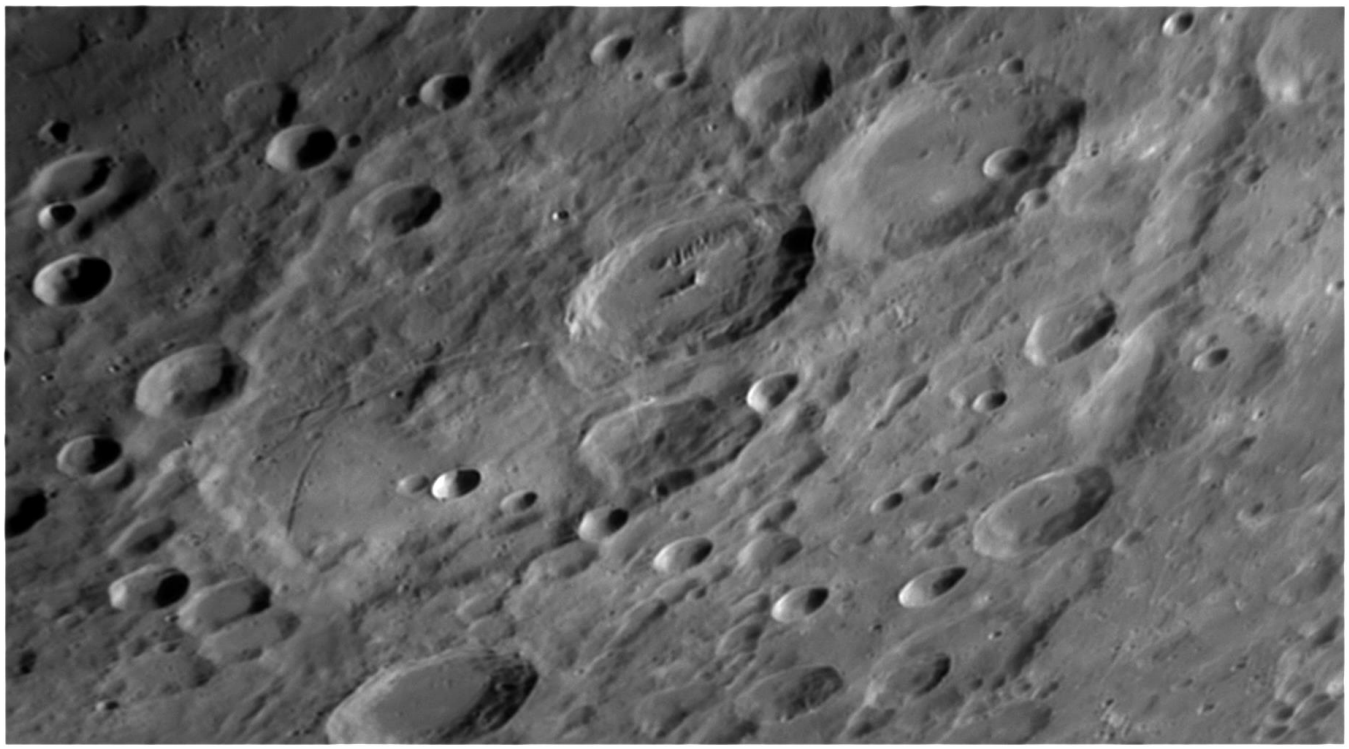


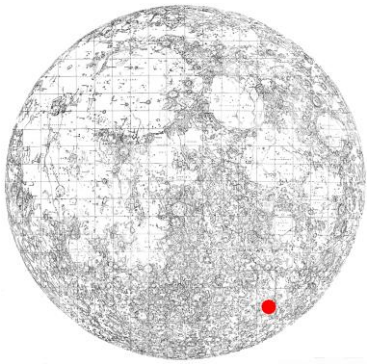


The craters Ptolemaeus, Alphonsus and Arzachel form a line from north to south just east of the terminator. Ptolemaeus, 153 km across, is formally called a walled plain but undoubedly originated as a crater. Its lava-filled floor filled hosts the young 9-km crater Ammonius. To the east (right), the central peak of the large crater Albagensus rises above its lava-filled floor. Its western edge is disrupted by the crater Klein (44 km diameter). South of Ptelemaeus, crater Alphonsus is named for the 13th century Spanish King Alfonso X, known as "El Sabio" (the Wise). He sponsored the Alfonsine Tables of star and planetary positions. The tables were used for 300 years (Copernicus bought a copy) until they were replaced by the Prutenic Tables in 1551 and in 1627 Kepler's Rudolphine Tables, which used Tycho Brahe's accurate positions. The scalloped walls of Azrachel remind us of the crater Copernicus, probably the most photographed site on the Moon.

At the lower left corner of the image, at the terminator, the barely visible shadow of the Rupes Recta (Straight Wall) is a bit thicker than we usually see it because of the extremely acute angle of the rising Sun. The Rupes Recta is was long believed to be very steep, but its gradient is only about 1:9, at most an intermediate ski slope. To its west, just the top of the western wall of the crater Birt sees the morning light. Further west, it's still night on the Moon.

5/20/21 Moon age 9d 6h.

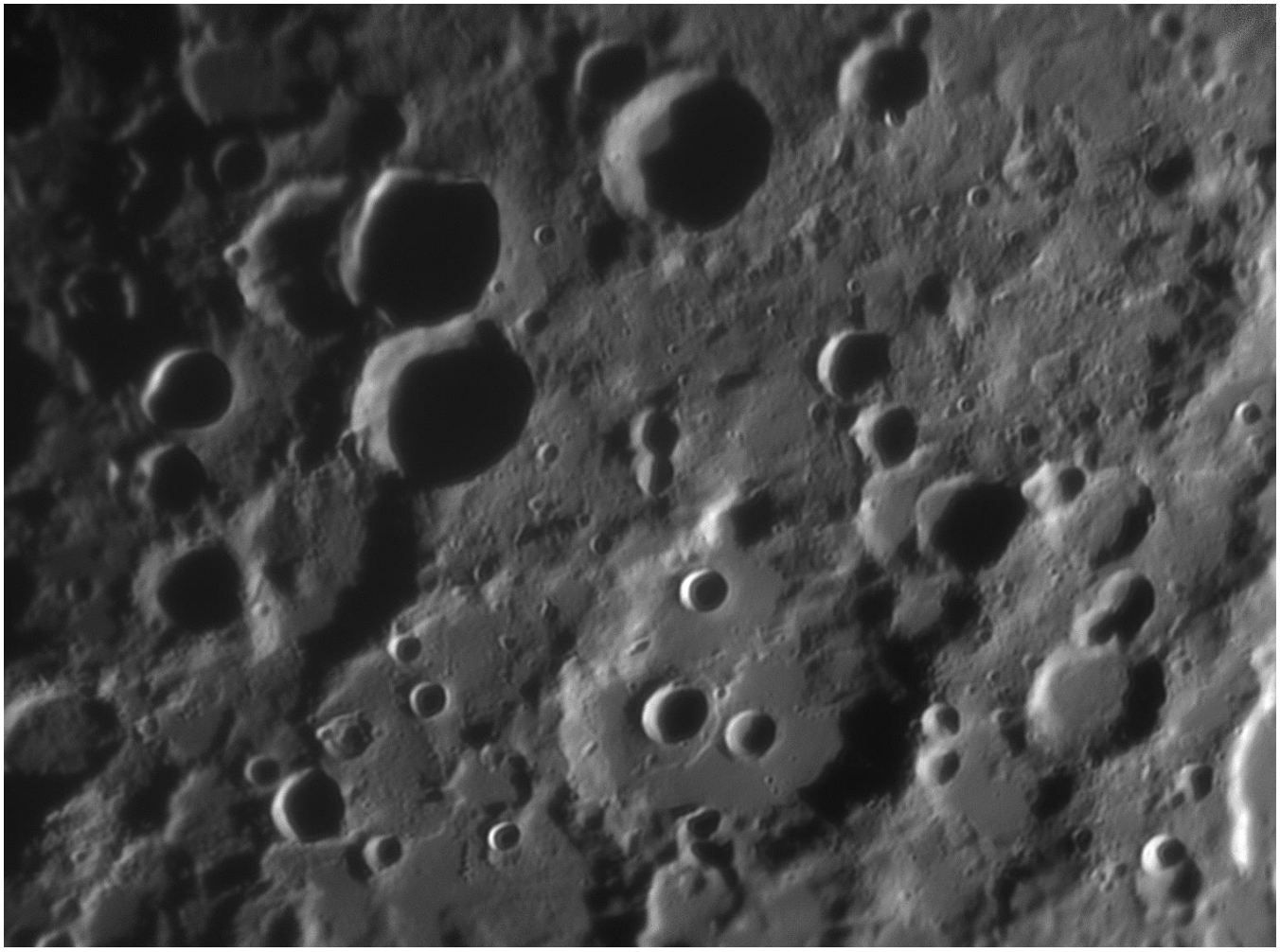


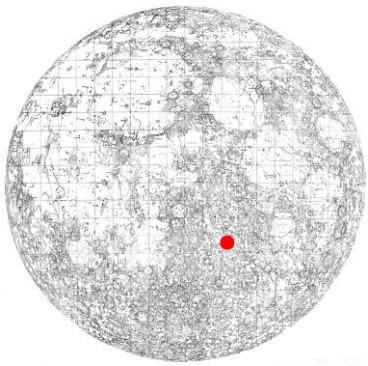


The open flat plain Janssen has several rilles on its western side, known collectively as the Rimae Janssen. The most prominent of these is a curved fault extending from the crater's flat floor to the hilly area in its northern section. The rille points to the younger crater Fabricius, diameter 78 km, and further to the northeast is the 88-km crater Metius. To the east (right), we can see a gouge that is part of the Vallis Rheita. This is the longest valley on the near-side of the Moon, extending about 500 km south from its origin in the Mare Nectaris.

Prominent lunar features were named by the Jesuit astronomer Giovanni Batista Riccioli, whose 1651 map (see https://is.gd/riccmap) was more popular than the 1647 map that Johannes Hevelius published in his *Selenographia* (see https://is.gd/hevseleno). Hevelius' nomenclature was used more by English astronomers until about 1800, when Johann Schröter published *Selenotopographische Fragmente zur genauern Kenntniss der Mondfläche*, using Riccioli's nomenclature. It became the standard lunar reference. Riccioli named craters for astronomers, mathematicians and philosophers from antiquity to his time. Schröter retained Hevelius' names for only a few mountain ranges. A Jesuit, Riccioli rejected the Copernican theory of the solar system, but named craters for Copernicus and other prominent advocates of heliocentrism, including Galileo and Kepler. Was he perhaps a secret Copernican?

With an abundance of namable craters, the face of the Moon reflects the history of astronomy. Janssen is named for Pierre J.C. Janssen, who was the director of the Paris Observatory at Meudon in the last quarter of the 19th century. On the western edge of Janssen is the 34-km wide crater Lockyer, named for Norman Lockyer, who in 1859 discovered the previously unknown element helium in the Sun's spectrum. Lockyer viewed the 1878 total solar eclipse from Rawling, Wyoming accompanied by Westchester's own Henry Draper and his wife Anna, Thomas Alva Edison, and the University of Michigan astronomer, asteroid hunter and believer in planet Vulcan James Craig Watson (see the December 2019 SkyWAAtch, p. 12). Just as for constellations, cartographers chose their own names for newly-drawn lunar features until the International Astronomical Union took over in 1935. It now controls all lunar nomenclature (in fact, all astronomical nomenclature). 6/16/21, Moon age 6d 14h. 2X Barlow.

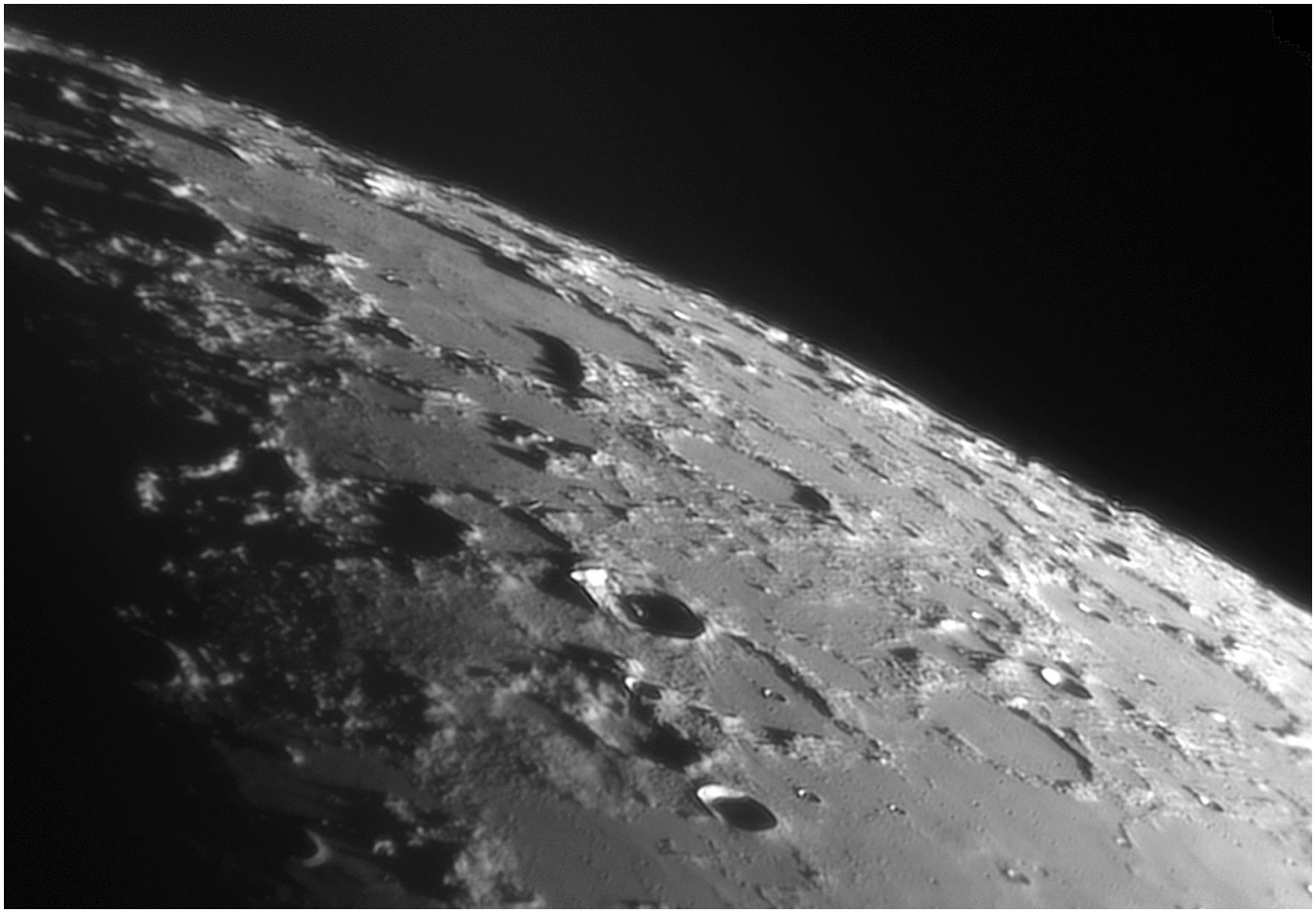


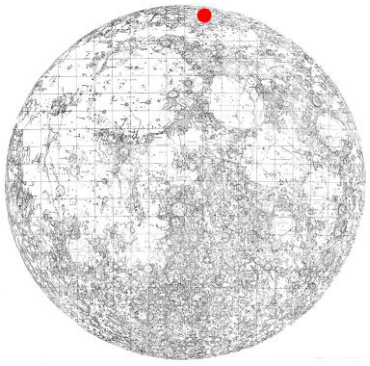


The southern highlands have a mixture of old and new craters, as shown in this image. Azophi, Abenezra and Geber are the three shaarp craters near the top of the image. The large crater Sacrobosco, in the lower middle, contains three more recent craters, appropriately named Sacrobosco A, B and C. The largest, A, is 17.7 km in diameter. At the lower right edge of the image is the sunlit western wall of a small section of the Rupes Altai, which was shown and described in last month's SkyWAAtch, p. 24. In between Sacrobosco and the Rupes Altai is the small crater Fermat (whose "last theorem," proposed in 1637, was finally proven in 1994). The crater name was assigned by Mädler in the famous map that he and Wilhelm Beer published in 1837. Perhaps if the theorem had been proven sooner, and had not been so challenging and perplexing to mathematicians in the intervening two centuries, Fermat would have gotten a smaller crater.

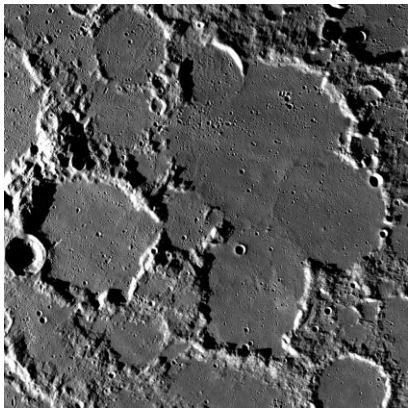
The Beer-Mädler map quickly became the definitive lunar atlas for the remainder of the 19th century. You can look at a fine copy at https://is.gd/beermad.

Johannes Sacrobosco, or John Holywood as he is known in English, was a monk who lived in the first half of the 13th century and taught at the University of Paris. He was the author of a number of important texts. His *Tractatus de Sphaera* (1230) was the most important astronomy textbook of the late medieval period. Printed editions appeared not long after the invention of printing in the 1450's. It drew on Ptolemy's *Almagest* as well as the work of later Arabic astronomers. 6/16/21. Moon age 6d 13h. 2X Barlow.



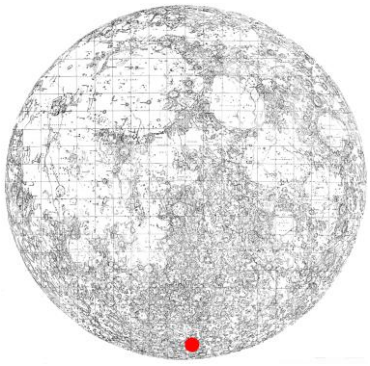


Sighting along the Moon's limb challenges our imagination to reconstruct the face-on appearance of its features. Fortunately, the images from 1960s Lunar Orbiters, Apollo and subsequent missions such as Clementine and Lunar Reconnaissance Orbiter, are freely available.The large flat plain on the upper left is Meton, 123 km in diameter and described as "clover-shaped," although that's a little hard to see from the image. A round crater filled with lava just to its lower right is Neison. The more distinct crater with the bright feature just below the middle of the image is C Mayer. These names show the variable provenance of lunar nomenclature. Meton was named by Riccioli, while C Mayer was delineated by Schröter in the *Selenotopographische Fragmente*. Neison, named for the British astronomer Edmund Neison, was only assigned that name in 1956 by cartographer Felix Chemla Lamèch and then agreed to by the IAU.



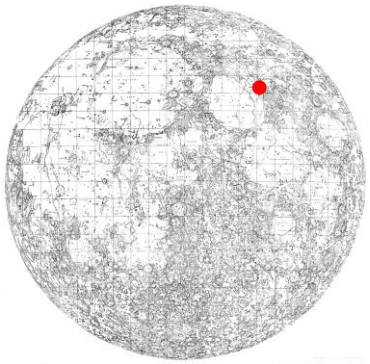
The face-on image, left, from the Lunar Reconaissance Orbiter Camera, shows the irregular borders of Meton, with the crater Barrow on its left. It would appear that Meton began as at least three, perhaps four, separate impacts, later being filled in by lava, many details erased. A vague hint of the outline of one of the crater walls can be seen in the image.

On the lower right of my image we see the edge of the Mare Frigoris, the Sea of Cold, an appropriate name for the most northern of the Moon's maria. 6/16/21, Moon age 6d 14h.



Towards the Moon's southern pole, where there are a vast number of overlapping criaters, are formations named for individuals whose astronomical fame is dimmer than those whose craters lie in more prominent lunar areas. The distinct flat-bottomed crater on the upper right is Manzinus, named for the 17th century Italian astronomer Carlo Manzini. His 1660 work *L'occhiale all'occhio, dioptrica practica* is one of the oldest accounts of techniques for manufacturing lenses through grinding and polishing. The crater is about 98 km across. To its south is Boguslawsky, named for Palon H. Ludwig von Boguslawsky, a German astronomer who discovered the comet of 1835 and was immortalized with this crater just two years later in Mädler's moon map. The sharp Boguslawsky D, just 24 miles across, sits on its southeast wall.

Closer to the terminator, the distinct crater in the left corner, most of it in shadow except for its western wall, is Schomberger, named by Riccioli for a 17th century Austrian mathematician and astronomer. North of Schomberger, mostly in shadow, is Simpelius.We can see sunlight on the outside of its eastern wall and along the top of its western wall. Hugh Simpell was a Scottish mathematician of the early 17th century. The round crater above it, just a little larger than Schomberger, is Simpelius A, and scattered around are other craters given letter names tying them to their "parent" crater. At the bottom edge of the image, in the center, is an oblong-appearing crater, Demonax, named for a 2nd century CE philosopher who may have actually been an invention of the Assyrian satirist Lucian, who claimed he was his teacher. There are no original writings by Demonax and he was not mentioned by other contemporary writers. One wonders who among the fictional literary or cinematic figures of our time might be taken for historical figures in the future. Sherlock Holmes? James Bond? Stanley Kowalski? Yossarian? 6/16/21 Moon age 6d 14h. 2X Barlow.



The peculiar crater Posidonius lies at the northeast edge of the Mare Serenitatis (Sea of Serenity). There are remnants of internal walls, as well as several rimae coursing through the interior. The more recent crater Posidonius A is nearly in its center, while Posidonius B lies on its northeast edge, with Posidonius J to its north. To the southeast lies the crater Chacornac, whoses walls appear disintegrated. In the upper right corner is the crater Maury, named for Antonia Maury, the pioneering woman astronomer who classified stellar spectra. She was Henry Draper's neice and in her later years she lived at the Draper residence in Hastings-on-Hudson. Between Maury and Posidonius is the Lacus Somniorum, the Lake of Dreams. 6/16/21, Moon age 6d 15h, 2X Barlow

The biggest technical hurdle in lunar astrophotography is seeing. Even during short duration (millisecond) images, the Earth's atmosphere plays havoc with the wavefronts. Sometimes the clearest nights have the worst seeing. In our suburban area, heat rising from rooftops, even from a distance, adds to the optical confusion. Stacking software can do a lot, but it can't make details where the details don't exist. A red filter, or even a hydrogen alpha filter, can help a little by reducing some of the atmospheric dispersion, since the wavefront disruption varies according to the wavelength, a form of chromatic aberration as well as simple blurring. I didn't use a filter for these images, but I'm planning to do so for my next batch. There's a learning curve for everything in astronomy, one of the reasons it's such an involving hobby.

All images were made in Larchmont with a Celestron CPC800 (8-inch f/10 SCT, with 2X Barlow as noted in some images, ASI290MM camera, stacked with Autostakkaert!3 and wavelets were applied with Registax 6.1. ■

Research Highlight of the Month

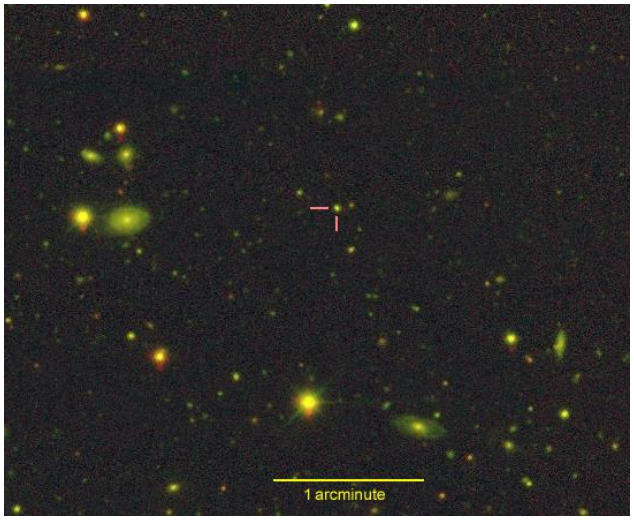
Tsukui, T, Iguchi, S, Spiral morphology in an intensely star-forming disk galaxy more than 12 billion years ago. *Science* 2021; 372: 1201-1205 (June 11, 2021)

Abstract: Spiral galaxies have distinct internal structures, including a stellar bulge, a disk, and spiral arms. It is unknown when in cosmic history these structures formed. In this study, we analyzed observations of BRI 1335–0417 an intensely star-forming galaxy in the distant Universe, at a redshift of 4.41. The [C II] gas kinematics shows a steep velocity rise near the galaxy center and has a two-armed spiral morphology, which extends from about 2 to 5 kiloparsecs in radius. We interpret these features as due to a central compact structure such as a bulge, a rotating gas disk, and either spiral arms or tidal tails. These features had formed within 1.4 billion years after the Big Bang, long before the peak of cosmic star formation.

How galaxies form and evolve in the early universe is still unknown. Many of the oldest (most redshifted) galaxies are small and irregular. Since the universe was smaller, it is likely that there were many mergers, which would have disrupted the formation of spiral arms. (In the local universe, galaxy mergers inevitably form elliptical galaxies). Spiral galaxies have been found as far back as *z*=2.67. A small number of galaxies at z=4-5 have shown a compact central structure, but not distinct arms. Using data from the Atacama Large Millimeter-Submillimeter Array (ALMA), Tsuki and Iguchi examined velocity curves in the galaxy BRI 1335-0447 (also known as QSO J1338-0432), a hyper-luminous infrared galaxy at redshift *z*=4.4074, corresponding to 1.4 billion years after the Big Bang. It has the luminosity of 31 trillion Suns and has a very high star formation rate of 5,000 $M_\odot$ (solar masses) per year (the current star formation rate in the Milky Way is 1- 2 $M_\odot$ yr^{-1}). Star formation was thought to have peaked in the universe somewhat later in cosmic time, at *z*=1.5 to 3.0.

By analyzing the [CII] emission line of ironized carbon, which is generated in interstellar dust heated by young stars and/or an active galactic nucleus, the authors were able to make velocity maps of the galaxy. They found a central compact structure and what appear to be two spiral arms rotating at 179^{+25}_{-18} km s^{-1}. There is a central compact structure (a core) with a radius of less than 1.3 kpc and a mass of between $5.2x10^9$ and $3.0x10^{10}$ $M_\odot$. Much of this mass is contained in a supermassive black hole.

The authors note that "because this galaxy has a rotating disk and a compact structure at its center, sufficient time for their formation is likely to have passed after any major merger event." As a "dusty starburst galaxy," BRI 1335-0447 is likely to evolve into an elliptical galaxy.



BRI 1335-0447 as seen on an image from the Dark Energy Survey (Victor Blanco 4-meter telescope, Cerro Tololo, Chile)

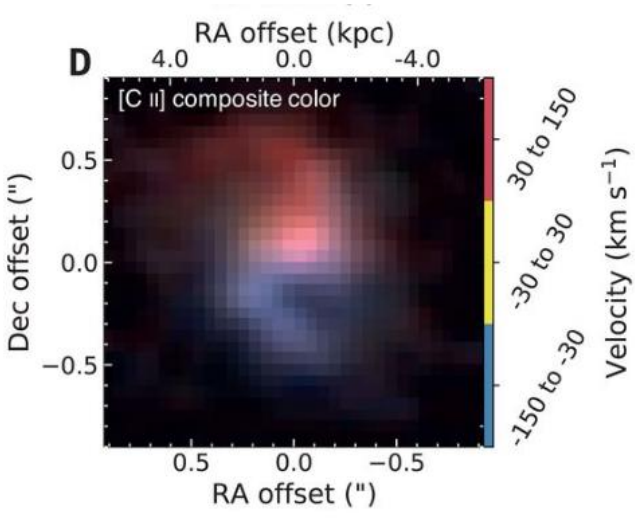


Fig.1D. Composite color image showing gas emission velocities. This clearly shows the evidence of rotation.

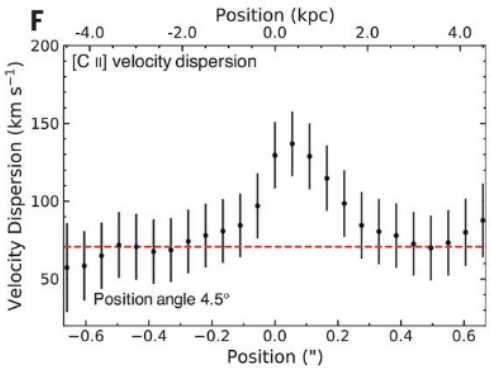


Fig. 1F showing the velocity dispersions

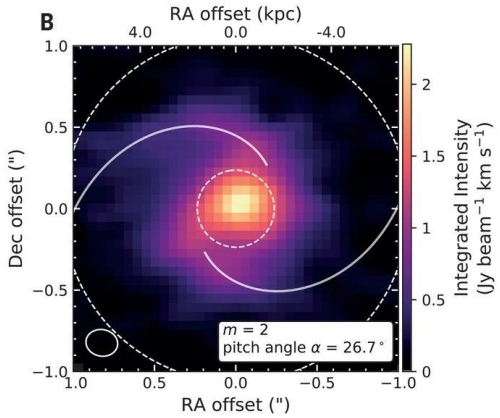


Fig. 3B showing the CII line intensity image overlaid with the best-fitting two-armed logarithmic spiral

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
NEW LISTING Nexus DSC Digital Setting Circles	Connects to encoders on your mount (you provide) for accurate push-to object finding. Contains many astronomical catalogues. See https://www.astrodevices.com/Products/NexusDSC/index.html.	$100	Peter Rothstein peterrothstein01@gmail.com
Bausch & Lomb 5-inch f/8 objective lens	Large-format/aerial camera lens in cell. Cleaned and reconditioned by John Paladini. Diaphragm removed. Weight 10 lbs. Mounted on a wooden board, can be removed. See images at https://is.gd/WAABL. Use in a telescope or camera project. Donated to WAA.	$25	WAA ads@westchesterastronomers.org
ExploreScientific 127-mm refractor	Air-spaced ED APO f/7.5 triplet OTA with tube rings, 2” diagonal, Orion focus extender. Like new condition; rarely used. See https://is.gd/es127gb for more information.	$1000	Greg Borrelly gregborrelly@gmail.com
Denkmeier 60-mm Spectrum 60 upgrade (OTA) for PST	Unscrew the 40-mm PST tube and screw in the upgrade, and now your PST is a 60-mm solar scope. It does work with newer PST's. Original price $599.	$200	John Paladini jpaladin01@verizon.net
ExploreScientific 40-mm eyepiece	68° field of view. Argon-purged, waterproof, 2" eyepiece. New in original packaging, only used once. Lists for $389.	$340	Greg Borrelly gregborrelly@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 offer only serious and useful astronomy equipment. WAA reserves the right not to list items we think are not of value to members.

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