SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

July 2021

Messier 51 by Mauri Rosenthal

Mauri excels at the challenge of obtaining deep-sky images with portable equipment in heavily light-polluted environments. Mauri writes:

"This is my latest project using short exposures. In total 4,725 frames went into this mono/RGB image. I used SharpCap live stacks and brought a reasonable number of six-minute stacks into processing (like having six-minute calibrated sub-frames). A 2X Televue PowerMate brings the focal length of my Borg 71FL refractor up to 800 mm (f/11). Even though the PowerMate is a heavy piece of glass, this optical combo (lens, tube, focuser, camera, PowerMate, filter wheel, plus a guide camera) only weighs 5.4 lbs." Location: Yonkers, NY. SQM 18.4-18.7 (Bortle red zone)

WAA September Meeting

Friday, September 10 at 7:30 pm

Via Zoom

https://zoom.us/j/99588774272?pwd=YXBIUXAySDdEZEZtQUo4TmY3UUtHUT09
Meeting ID: 995 8877 4272, Passcode: 239178

Members' Night

WAA members will 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 socializing with fellow WAA members and guests begins at 7:00 pm!

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

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

Also In This Issue

Westchester Amateur Astronomers

WAA October Meeting

Friday, October 8 at 7:30 pm

Via Zoom

New Horizons and the Solar System's 3rd Zone

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

NASA's New Horizons spacecraft explored the Pluto system in 2015 and in 2019 the small planetesimal Arrokoth. Both are denizens of the distant, frigid, third zone of the solar system, beyond the giant planets. Dr. Grundy will speak about the New Horizons mission and what it has discovered about this region of the solar system.

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

Starway to Heaven

Ward Pound Ridge Reservation, Cross River, NY

Saturday, July 3 (rain/cloud date July 10)

Free and open to the public. Encourage your friends to come.

New Members

Dov Biran	Scarsdale
Aram Fuchs	Irvington
Gerald Jones	Pound Ridge
Michelle Marrinan	Stamford
Victoria Mentz	Valhalla
Kirk Ornstein	Katonah

Renewing Members

Erik & Eva Andersen	Croton-on-Hudson
John Paladini	Mahopac
Deidre Raver	Mahopac
Richard Segal	Chappaqua
Maryellen Sinclair	Cross River
Jordan Solomon	Pleasantville
Alan Young	Tarrytown

ALMANAC For July 2021

Bob Kelly, WAA VP for Field Events


3Q
7/1

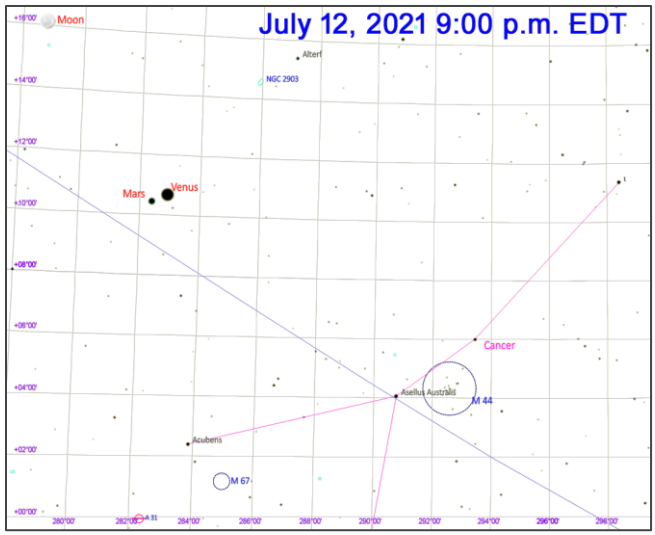

New
7/9


1Q
7/17


Full
7/23

Evening Action

Venus passes Mars on the 12th, trying to shame its perhaps once-Earth-like brother planet into shining a bit brighter. How do they compare in a telescope, with Venus 12 arc seconds wide and Mars 3.7? They will be both in their gibbous phases, looking just a bit out of round. They are both very low in the western sky, so start looking well before twilight ends. Catch this sight in a single binocular field, which will contain them for a few days. On the 11th and 12th, the Moon looks in on Mars and Venus. Mars makes more friends in the evening twilight, moving next to Regulus, the brightest star in Leo the Lion, on July 29th.



Beehive Guest I

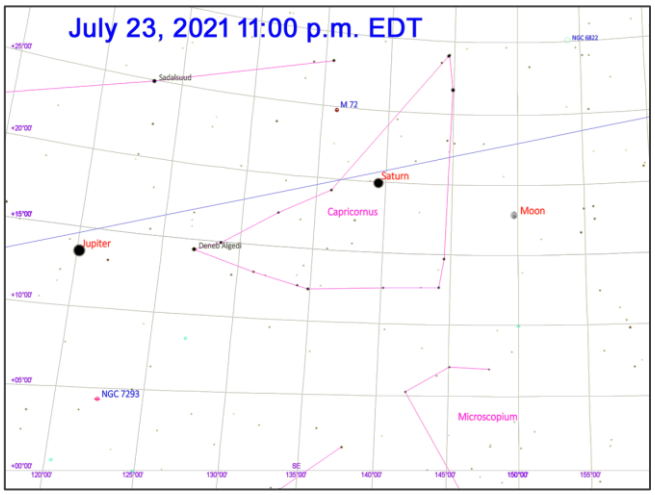
This month's first traveling occupant of the Beehive Cluster (in Cancer) is Venus. Venus passes near the center of M44 on the morning of the 3rd, but our best view is on the evening of the 2nd. Getting the two to show up together in a photo will be harder than last month's Mars/M44 combination because of the magnitude difference. Venus will be no problem to find at magnitude -3.9. Viewing the 6th-magnitude Beehive in twilight will be very hard, but a pair of binoculars might show them. The Bees make a hasty exit from the evening sky, in conjunction with the Sun on the 31st.

Beehive Guest II

Mercury is hardly noticeable as it falls out of the morning sky, after its greatest elongation from the Sun on the 4th, when they will be 22˚ apart. The elusive innermost planet has a conjunction with M44 on the 31st. Mercury is viewable in the Solar & Heliospheric Observatory's C3 camera for several days around then. It's too close to the Sun to see this conjunction any other way.

Outer Planets' Race

Saturn holds its lead on Jupiter, rising in the east almost an hour before the King of the planets. The Moon meets each of them several days apart: Saturn is a fist-width (held at arm's length) left of the Moon on the 23rd and Jupiter is half-a-fist above the Moon on the 26th. By month's end, Jupiter and Saturn have risen by the arrival of the true darkness.



Use the Moon to Find Uranus

Use binoculars and move 5˚ (10 Moon diameters) to the left of the waning crescent Moon in the early morning hours on the 4th to find Uranus.

Use Uranus to Find a Comet

Periodic comet 15P/Finlay, which will be around 10th magnitude, will pass 5˚ south of Uranus in the morning sky between the 1st and 3rd. It might be visible in big binoculars and a dark sky. The 'P' stands for "pe-

riodic." Comet Finlay was discovered in 1886. It takes six years to orbit the Sun.

International Space Station

From the evening of July 10 through the 18th, the ISS will be visible four or more times a night. Before the 10th, the ISS will be a morning object. It will be making evening appearances after the 18th.

Meteors

The summer meteor drought continues until some early members of the August Perseids arrive in increasing numbers in the latter third of July.

Milky Way

The cloud-like band of stars of our galaxy gets well up above the horizon by the time the sky has darkened. The end of astronomical twilight starts around 10:30 p.m. EDT at the beginning of the month, and moves half-an-hour earlier by the end of the month.

I'm a Little Teapot

Sagittarius, which looks more suited for serving tea than shooting arrows, follows the truncated Scorpion into the evening sky low in the southeast at the end of twilight. The Scorpion had to give up its front claws to allow Libra to join the zodiac. That makes twelve zodiacal constellations to go with the twelve months of the year. The Romans thought Libra looked so much like a set of scales it just had to be called that. These southern constellations can be hard to pick out. You can start higher up in the east with Cygnus the Swan, also known as the Northern Cross. Fly down the Milky Way to the center of our Galaxy in Sagittarius.

Social Distancing

We on Earth are farthest from the Sun on the 5th. The Moon is at apogee that day, as well. Was it something we said? ■

Prolific astrophotographer Steve Bellavia made this wide-angle image of the Milky Way on June 15 from Orient Point in eastern Long Island. You are looking towards the center of our galaxy, 25,896.82 light years distant.

Member Profile: Daniel Cummings

Home town: Croton-On-Hudson, NY

Family: Married, 3 kids, 1 Dog

How did you get interested in astronomy? My dad first introduced me to astronomy. He was a flight navigator on a B52 bomber in the 1960s. After he retired from the Air Force and started a family, he used to take the kids out at night and point out navigation stars and constellations. Before smartphones and GPS, airmen used these to find their way while flying from their Air Force base in Bangor, Maine across the North Pole towards Russia.

I grew up in Westchester and I remember seeing the Milky Way a lot. Back then, there were fewer lights around everywhere and cities were smaller so we could see many more stars.

As I got older I stayed in touch with the movements of the Sun and the stars and the planets and the Moon and the Earth. When I studied astronomy in college I discovered that there was a long history of sky knowledge going back thousands of years. Then I had kids of my own, and they started asking questions about the sky that I couldn't answer. So, I wanted to learn even more about the sky and teach these incredible scientific ideas in a way that would be easy to understand.

Do you recall the first time you looked through a telescope? What did you see? It was at a college astronomy class at the first observing session and I saw Saturn.

What's your favorite object(s) to view? I love following the constellations through the seasons and experiencing the Earth's orbit by observing how they move westward in the sky each night. The ISS is a favorite for me too! I have an alert set to tell me when it does a flyover. It is thrilling to me to see that speck of light - it has 11 humans on it right now!

What kind of equipment do you have? I have The Moon Hat, a smartphone, and pair of binoculars!

What kind of equipment would you like to get that you don't have? I would like to have a device that could shut off all the lights around. Something like the "Deluminator" that Dumbledore has in the Harry Potter series.

Have you taken any trips or vacations dedicated to astronomy? Tell us about them. My family went to Folly Beach near Charleston, South Carolina to be under the August 2017 eclipse.

Are there areas of current astronomical research that particularly interest you? Dark matter and dark energy are topics that I have tried to follow closely. It's so incredible to me that everything we think of as "real" makes up only 5% of the estimated mass of the universe.

Do you have any favorite personal astronomical experiences you'd like to relate? My voice has traveled to the Moon and back! In 1996 I attended a "Moon Bounce" performance at Cal State Hayward during a lunar eclipse where the composer Pauline Oliveros invited the participants to bounce their voice off the Moon using a telephone, ham radio and the Stanford radio dish to send and receive the signals.

What do you do (or did you do, if retired) in "real life"? I run a start-up company that invents, manufactures, and sells astronomy education products. Forbes magazine called The Moon Hat the "Best Science Gift" of 2018 and 2019. It's a fleece beanie that I sell through my own website,

https://themoonhat.com, Amazon, and 30 science museums and distributors around the US and Europe. A baseball cap is also available. I also do contract web development.

Have you read any books about astronomy that you'd like to recommend? I read all of Guy Ottewell's work at https://universalworkshop.com . He also has an incredibly detailed and engrossing poster called the "Zodiac Wavy Charts" that is like a Moon Calendar but for the entire Solar System! I highly recommend it. I've even written a user's guide for it that's on my astronomy website.

How did you get involved in WAA? I joined when I started my astronomy education company, *Star In A Star* (https://starinastar.com) and began volunteering by helping build the WAA website.

What WAA activities do you participate in? I attend meetings and I read the amazing WAA Newsletter. I also love the Member's Night each September because I am always tinkering with some new way to teach astronomy concepts and the WAA Member's Night meeting is a great audience!

If you have or have had a position in WAA, what is it, what are/were your responsibilities and what do you want the club to accomplish? I support the website, as web development is my other line of work in addition to astronomy education.

Besides your interest in astronomy, what other avocations do you have? I love to trail run and play games with my kids.

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

I love writing "Astronomy Koans" - short, memorable sayings that contain a gem of astronomy insight. Here are a few of mine. Please read and dwell on their meaning - there are layers of insight compacted to the smallest phrase I could find:

The Earth makes the stars move and the Sun makes the planets move.

Sunset on a mountain means your shadow is out in space.

Raindrops don't fall in a parallel; they fall toward the center of the Earth.

The Moon moves toward the dawn.

Same Sun all night. Dusk to the left, dawn to the right.

Orion reaches to the ecliptic.

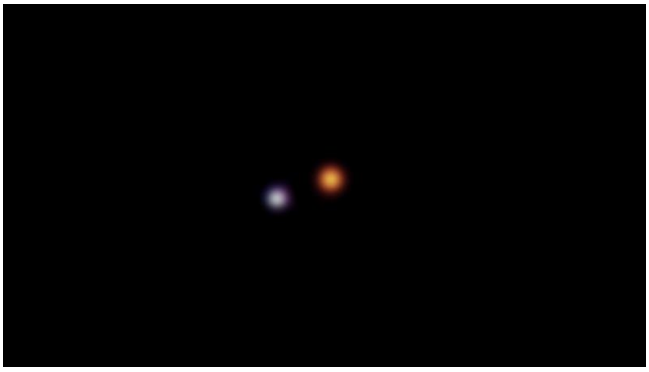
Moon noon.

Another Movie Telescope

The 1946 "film noir" *Nobody Lives Forever* starred John Garfield, Geraldine Fitzgerald and Walter Brennan. Playing a petty con-man, Brennan is selling peeks through what looks to be a 6-inch f/15 refractor for 10 cents while picking the observer's pocket. We're familiar with Brennan from a million westerns, playing alongside John Wayne, but he had a long and varied career, winning three Academy Awards. Submitted by Howard Fink.

Deep Sky Object of the Month: Alpha Herculis

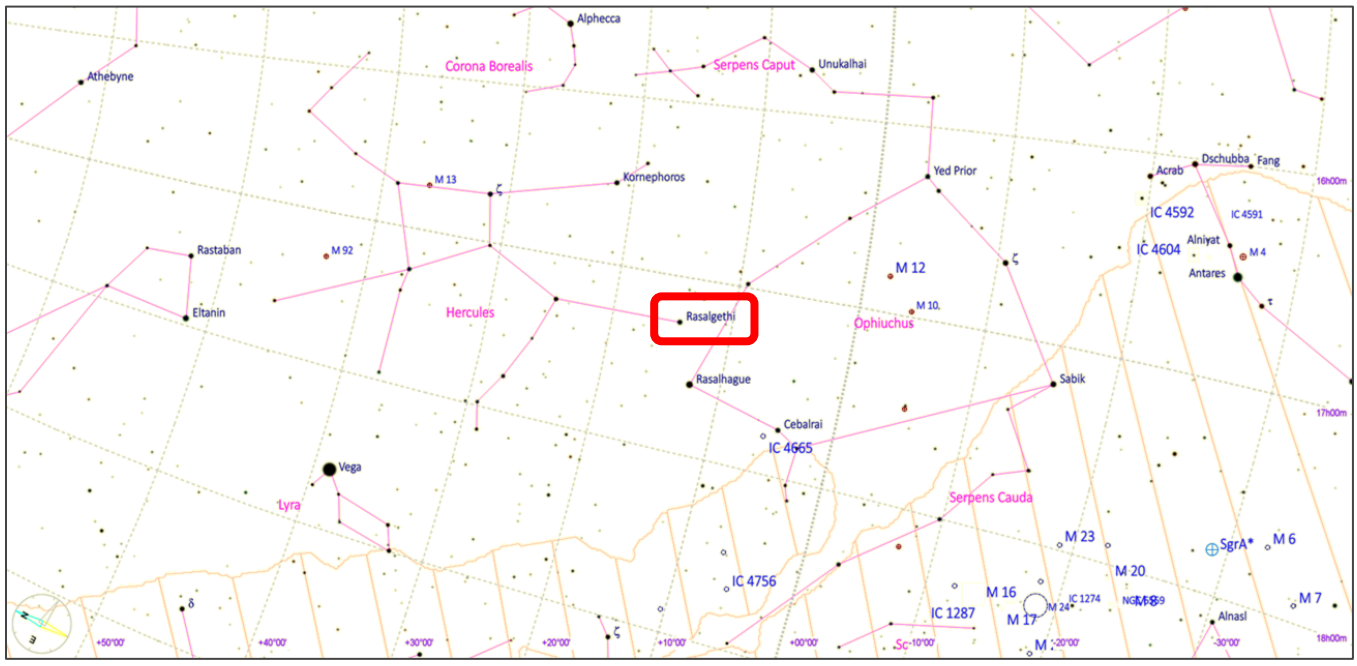
Alpha Herculis	
Constellation	Hercules
Object type	Double star
Right Ascension J2000	17h 14m 38.827s
Declination J2000	+14° 23’ 26.33”
Magnitude	2.78 (A=3, B=5.5)
Size	Separation 4.9”
Distance	359.6 LY
Other designation	BD+14°3207 AAVSO 1710+14 WDS J17146+1423
Common Name	Rasalgethi



Visibility of Alpha Herculis			
11:00 pm EDT	7/1/21	7/15/21	7/31/21
Altitude	164° 57’	194° 05’	222° 28’
Azimuth	62° 24’	62° 30’	56° 48’

While you are looking at M13 in Hercules or any of the many open and globular clusters in Ophiuchus, take a look at the brightest star in the constellation. It’s not in the famous “Keystone,” but farther south. Rasalgethi, literally “the kneeler’s head” in Arabic, is a very pretty double star, with the reddish A component separated by 4.9 arc-seconds from the slightly fainter yellow-green B component, itself a spectroscopic binary of two hotter stars, classes G8 and A9. Alpha Herculis A is an asymptotic red giant branch star that has both hydrogen and helium shells around a degenerate carbon-oxygen core. Its mass is between 2.1 and 3.5 solar masses. Each component of B is 2-2.5 $M_{\odot}$.

The A component was imaged in the 1920’s by Francis Pease with an interferometer on the 100-inch telescope at Mt. Wilson. Its diameter was estimated to be 0.03 arc-seconds. The radius is now measured at about 1.87 astronomical units, larger than the orbit of Mars. The A component is variable (as expected for old AGB stars), with a complex cadence of maxima and minima due to a high degree of stellar mass loss. A sparse, gaseous envelope extending outward at least 930 AU and growing by 10 km/sec was detected in 1956 by Caltech astronomer Armin Deutsch using the Mt. Wilson and Palomar telescopes.



Notes from the Junkyard Astronomer — John Paladini

A Telescope in Tudor Times?

The Digges-Bourne Telescope—The Telescope that Never Was?

Several years back, I was drifting between being awake and asleep while watching a History Channel show that detailed the adventures of settlers on Roanoke Island in what is now North Carolina. Settled between 1585 and 1588 under the sponsorship of Sir Walter Raleigh, the colony disappeared by 1590, and is now known as the "lost colony" of Roanoke.

The program mentioned a telescope where the user looked through the side of the tube into a mirror. Well. my ears perked up like a puppy dog being called for dinner. I had to find out more about this because those events happened before 1608, the date history assigns for the debut of the telescope.

After doing some internet searches I came up with the following important information from the modern era.

1) In 1991 Colin Ronan, FRAS, a widely-published historian of astronomy and a collaborator of Sir Patrick Moore, delivered the Presidential address at the British Astronomical Association. He claimed that Leonard Digges invented a reflecting telescope before Lippershey and more than 100 years before Newton.[1]

2) In 2014, Tad Gallion posted a video pitch to *National Geographic* on YouTube.[2] His intent was to get research money to further investigate how the Digges-Bourne scope, as it is now known, was made. He also made the claim that the "007" symbol (yes, Bond, James Bond) is actually based on this scope!

3) In 2017 "WholeLotofBoehm" (real name unknown) started a blog called "Backwards Though a Tudor Telescope." Among his many posts are several describing the Digges-Bourne telescope and its history. The blog is quite informative and much of my work is based on this source.[3] He notes

> In 1591 the book *Pantometria* by Leonard Digges was published posthumously, with an introduction written by his son Thomas Digges. In the introduction mention is made of a proportional glass which can be used to view distant objects, but without giving much detail. Fortunately a description is given in *Inventions or Devises* by William Bourne, published in 1578. In the book's 110th entry a device is described consisting of a large curved mirror into which one peers, and a lens. Bourne commented that the device worked but had a small field of view. As Leonard Digges died in 1559 we can be certain that he invented his proportional glass before then, possibly as early as 1540.

4) All indications that the Digges-Bourne telescope actually existed are based solely on documents, logs and letters. There are no original Digges-Bourne scopes in existence.[4]

[1] http://adsabs.harvard.edu/pdf/1991jbaa..101..335r.
[2] http://www.007telescope.com/
[3] https://tudortelescope.blogspot.com/
[4] Ronan suggests the possibility of finding a D-B scope in shipwrecks. See the *International Journal of Nautical*

I checked against what I consider to be the Bible of telescope history, Henry King's *The History of the Telescope* (1955).[5] Sure enough, pages 27 through 30 describe the Digges-Bourne telescope in detail.

This whole story reads like the script for a stage play, with descriptions of the sets and a slew of actors.

A few definitions

Perspective glass: the old term for an objective lens.

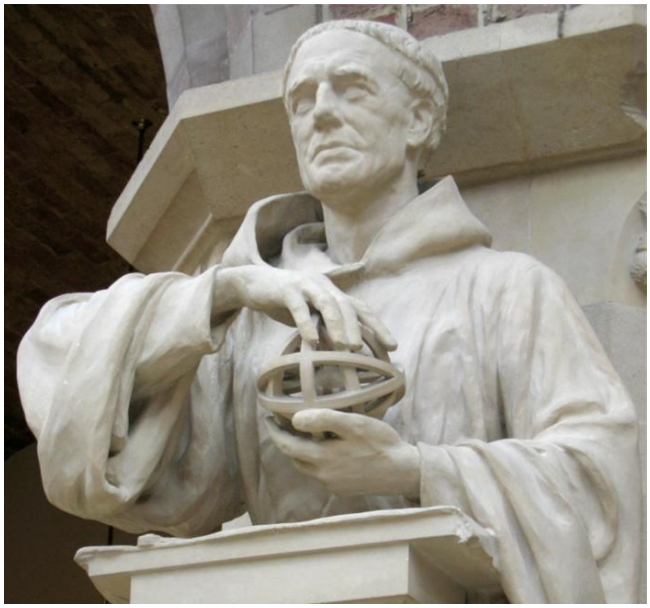
Proportional glass: a perspective glass with an eyepiece (in other words, a telescope).

Dutch Trunke: an English term of the day for a refracting telescope, such as Galileo's telescope.

Hypermetropia (or hypertropia): far sightedness. This is where the focus of the eye's lens is behind the retina. About 10 percent of the population is affected by this condition (as am I).

Focal length of a concave mirror: 1/2 the radius of curvature of a glass globe. If you want a mirror with 100-mm focal length you need a globe with a radius of 200 mm (8 inches). The focal length of a plano-convex lens (assuming crown glass) is 2 times the radius, so in this case it is 16 inches.

Dramatis Personae



Statue of Roger Bacon in the Oxford University Museum

Roger Bacon (1210-1294). The famous medieval scholar known as *Doctor Mirabilis*, he is from pre-Tudor times but his work forms the basis of the Digges-Bourne scope. His 1267 work *Opus Majus* describes, among its many subjects, the magnifying properties of a convex lens. Considered a "wizard," Bacon introduced gunpowder to England and commented on the possibility of heavier-than-air flight.

Leonard Digges (1515-1559). A scientist and writer, Digges made use of a "proportional glass" to view distant objects and people. He is credited with the first mention of a telescope although many still doubt this claim.

Thomas Digges (1546-1595). The son of Leonard Digges, he was a mathematician and astronomer. He was the first man to postulate the "dark night sky paradox," more than 250 years before Olbers. He published *Pantometria*, which describes his father's work with proportional glasses.

John Dee (1527-1608/9). Tutor to Thomas Digges, Dee was an Anglo-Welsh mathematician, and an advisor to and possibly a spy for Queen Elizabeth I. Some historians claim he was the original 007 because he signed letters to the Queen "007."

William Bourne (1535-1582). A mathematician. As Tad Gallion noted, Bourne's 1578 book *Inventions or Devises*, describes Digges's telescope. The user peered into a large curved mirror that reflected an image produced by a large lens. All modern recreations are based on Bourne's description, and for this reason the telescope is called the "Digges-Bourne" telescope. Hereafter we will call it the "D-B scope."

Queen Elizabeth I (1533-1603). Daughter of Henry VIII and Anne Boleyn (who was beheaded two years after Elizabeth's birth), she was the last of the Tudor monarchs. She had her chief advisor, Lord Burghley, press William Bourne to investigate the D-B scope for military use. Its narrow field of view made it impractical for that purpose, although there is at least one claim that it was used to spot the Spanish Armada in 1588.

Thomas Harriot (1560–1621). A mathematician and astronomer, he introduced the symbols < for "less than" and > for "greater than." Harriot may have used a D-B scope, later switching to a Dutch Trunke. Many historians of science believe that he used a re-

Archaeology in 1994 (https://is.gd/ronan_db). Ronan passed away in 1995 at the age of 75.

[5] Available on line at https://is.gd/king_tel

fracting telescope to view the Moon prior to Galileo's observations in the fall of 1609.

The place and time: Tudor England. The Tudor period began in 1485 with Henry VII's victory at the Battle of Bosworth Field (concluding the War of the Roses), and ended with the death of Elizabeth I, the so-called "Virgin Queen," in 1603. Historian John Guy argues that "England was economically healthier, more expansive, and more optimistic under the Tudors than at any time in a hundred years."

Act One

Roger Bacon's *Opus Majus* describes the magnification of distant objects with a single convex lens.

> And thus from an incredible distance we may read the smallest letters and may number the smallest particles of dust and sand by reason of the greatness of the angle under which we see them.... The Sun, Moon and stars may be made to descend hither in appearance and to be visible over the heads of our enemies... which persons unacquainted with such things would refuse to believe.

I purchased a plastic 200-mm diameter convex lens with a 750-mm focal length. This lens, by today's standards, is pretty bad. It has a zonal ring about two thirds out from center plus other "hills and valleys," but its defects are exactly what I need since it mimics the level of optical quality of pre-1700 glasses.

The zonal ring is evident in this projection through the plastic lens.

By sheer luck (and in this case, verified by my optometrist) I happened to be far-sighted. Convex lenses correct for this condition. This is important because if you have 20/20 vision or are near-sighted this experiment will fail.

I placed the lens slightly less then arm's-length from one eye (using two eyes will result in a double image). I beheld a thing of wonder: objects did appear closer. My estimate is about two to three times. I was quite taken back about this. I retested with an eye test chart and sure enough I got same result. If I had stopped here this would have been enough to make me happy. I have been able to pick out M35 and M13, as small patches of light using just this lens. It helps when looking at the Milky Way. If you are one of those people who are far-sighted, I recommend you give it a try. If you see me holding a big magnifying glass like Sherlock Holmes but looking skywards you'll know why. I recently ordered a better quality glass convex lens (152 mm dimeter, 650 mm focal length) for this purpose. Lenses with short focal lengths don't work.

A modern alternative is the 2.1 x 42 wide-field binocular. This niche product does pretty much same thing. Companies like Orion, Omegon and SVBONY make them. You don't need to be far-sighted, and using two eyes is even better. The June 2021 issue of *Sky & Telescope* has a review of the Omegon product.

Conclusion: So far, so good.

Act Two

Leonard Digges reads Bacon's papers and does his optical experiments. He writes some papers but dies before they are published. His son Thomas picks up the torch and has his father's papers published in *Pantometria* in 1571.

In the preface, Thomas writes

> My father by his continual paynfull practises ... hath, by proportional glasses duely situate in convenient angles, not only discovered things farre off, read letters, numbered peeces of money ...."

The reference to Digges using telescope "glasses" is plural. Does it mean he used a combination of lenses or just tried two separate lenses like Bacon did? This is not clear.

But later, Thomas says,

> By concave and convex mirrores of circular and parabolic forms or by pairs of them placed at due angles and using the aid of transparent glasses which may break or unite the images produced by the reflection of the mirrors".

This is the first time a possible telescope is described. The description is vague. I tried several combinations of convex and concave mirrors plus a lens. I was able to enlarge close objects but not those in the distance. It could be I wasn't using proper focal lengths in one or more of the optics. More investigation would have to be done. Without Bourne's later description there

is simply not enough to go on. Conclusion: Inconclusive.

Act Three

John Dee makes a passing reference to lenses in the preface of his book *Euclid* (1575). He also refers to their possible use by a "commander of the armies".

William Bourne creates the best account[6] of the effects of convex lenses when in 1585 he writes about optics at the request of Lord Burghley. Bourne describes creating a convex lens up to 12 inches in diameter, "grinding the lens so as to be thick in middle and thinning out towards the edge."

He creates a mirror by placing foil on the curved side of what appeared to be a plano-convex lens, most likely using lead foil (35-40 percent reflective when freshly polished) covered with wax to hold it in place and to keep air out. These are back-coated mirrors, considered useless for astronomy in modern era.[7]

All modern recreations of Digges's design are based on this layout: lens in front (objective), concave mirror (back coated) as the eyepiece, with the observer looking into the mirror from an off-axis position.

Build experiment #1: A convex plastic lens 200 mm in diameter and focal length of about 750 mm, concave mirror 2 inches wide, focal length 200 mm. This has an effective power of 3.7X. This is similar to Tad Gallion's "007" scope or the "Big Henry" scope from the Tudor scope blog.

The lens and mirror are mounted on a stick, hanging by threads. This is truly the most junkyard scope I ever made! It works, but it's an embarrassment. I decided to name it "Double Naught Seven" as a tribute to Jethro from the show "Beverly Hillbillies" who wishes to be a "double naught spy" because "they do all the fightin' and luvin'."

Experiment #1

So how does it work? It works if you keep powers low. The errors are not overwhelming and image is usable. After taking some pictures to prove that it worked, I decided to retire Double Naught Seven.

Build experiment #2: The modern version of the Digges-Bourne scope. A 50-mm plano-convex lens of 1,000 mm focal length and a 50-mm concave mirror with 100 mm focal length in a PVC tube, with a cutout so the mirror can be seen off-axis, yielding 10X. This is basically a copy of the scope in the Tudor telescope blog. I used a front surface mirror, so this is beyond what Bourne ever did. This scope is good enough to show craters on the moon. I decided to keep this scope as a demonstration scope for others.

Experiment #2

[6] https://is.gd/Bourne_lens

[7] More on mirrors at https://www.furniturelibrary.com/mirror-glass-darkly/ and mirror coatings at https://is.gd/mir_coat.

The Dénoument

D-B scopes work but are limited because the mirror tilt introduces distortion. This scope is pretty much limited to terrestrial use. There is absolutely no record of it being used for astronomical observing. Keep in mind that it's hard to enough to point a scope at an object in the sky while you are looking in the same direction, and now imagine trying to spot a celestial object while looking at your feet! It reminds me of the famous Annie Oakley mirror shot, and that took her a lot of practice.

Annie Oakley's mirror shot, from a publicity photograph

Thomas Harriot probably used both D-B scopes and Dutch Trunke scopes. I find it interesting that his Moon drawings are made using a Dutch Trunke scope. My gut feeling is that once he realized how much the Dutch scopes were superior to the D-B type, he dumped the D-B scope. Maybe today he'd put it on Astromart.

Some other thoughts

Some people state that such scopes were never actually made. One argument is that mirrors were simply not good enough or that you MUST have front surface mirrors. However:

1) Testing shows back-coated mirror will work at low power, just not very well.

2) Back-foiled mirrors existed since the 3rd century. They are not the best and are pretty dark, but for sunny terrestrial use they are functional. What I find strange is that better amalgam mirrors using tin/silver and mercury existed since 1400s. Perhaps they were too expensive for common use. They show up in famous paintings, such as Jan van Eyck's *Arnolfini Portrait* from 1434 (National Gallery, London). Speculum-metal mirrors also existed at that time. But perhaps Bourne did not have the skills to make and grind them. Foiled mirrors were the easiest ones to make.

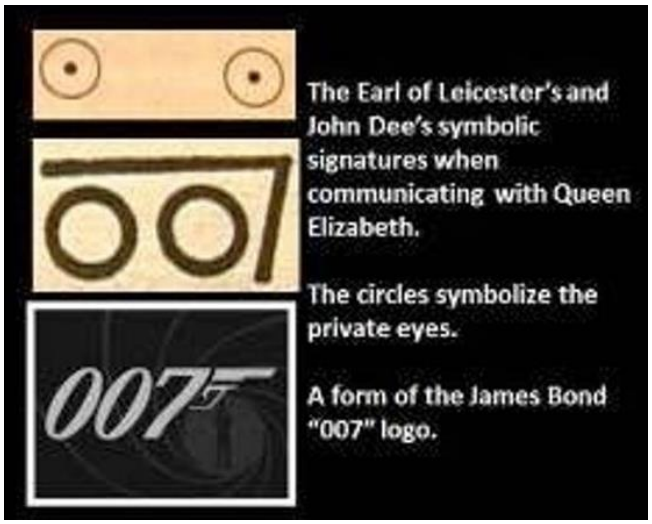
3) Why would documents attesting to the D-B scope be all lies? What's the point?

4) Lord Burghley wouldn't have had Bourne research optics if there was nothing there.

5) I think once the Dutch Trunke came around it just replaced previous D-B technology. There is a modern parallel: the mechanical television. From 1925 to the early 1930s there were mechanical TV's that used a spinning wheel to make the image. It worked, but not very well. Once the video tube was invented mechanical TV quickly disappeared.

The Digges-Bourne telescope was a dead-end branch of the telescope tree. I can't prove it existed since there are no surviving examples, but the evidence is strong that it could have existed and most likely did.

A note on the 007 symbol: Tad Gallion suggests that the D-B scope is the inspiration of the 007 (for eyes only) symbol used by Dees since it looks like two optics hanging on a supporting rod. I think this a step too far. We must keep in mind that science, religion, mysticism and the like were all wrapped together the 16th century mind. John Dee was well-educated in many of these subjects. A more viable explanation is that the two zeros are eyes and the "7" is for good luck. This number is all about abundance, success and achievement. That is a more plausible explanation.



All in all, this was a fun project.[8] ■

[8] Additional references:
Chronicling the Golden Age of Astronomy by Neil English (https://is.gd/eng_tel)
The Long Route to the Invention of the Telescope by Rolf Willach. *Transactions of the American Philosophical Society* .2008, Vol 98 (5), p. 122
The Invention of the Telescope, Albert Van Helden , *Transactions of the American Philosophical Society*, 1977, 67, (4) 1-67

From the Editor: Space Food? Larry Faltz

With the successful test in May of SpaceX's Starship rocket, the goal of sending astronauts to the red planet is just a little bit closer to reality. Much has been written on-line and in magazines, books and screenplays about what a mission to Mars would entail (see my review of *The Martian* in the December 2015 SkyWAAtch) and how travelers might deal with both obvious and hidden risks, not to mention relics of dead Martian civilizations or live aliens. In spite of Elon Musk's enthusiasm and the quarter of a million people who signed up in 2013 as possible crew members for the Mars One project (which seems to be somewhat dormant right now), there are still vast technical, logistical and even biological hurdles to be overcome. But a news story came across my screen in late April that jiggled my interest. The headline read, "Experts are Split on Whether Mars Astronauts Should Eat Dead Crew Members."

My immediate response was not what you would think, and it even surprised me. It wasn't whether I opted for "yes" or "no." Instead, I thought, "How does one become an expert in cannibalism?"

It's easy to debate the philosophical and ethical issues regarding eating your fellow human beings when you are well-fed. But *expertise*? That's gained by practice, Malcolm Gladwell's 10,000 hours and all that. Who is really an "expert" in cannibalism?

Alas, we can't consult Jeffrey Dahmer, who one thinks would be the mostly likely person to be considered an "expert" in the field of human edibility. Convicted of murdering, dismembering and devouring 16 people, Dahmer was sentenced in 1992 to 16 life terms and fulfilled his commitment to justice when he was beaten to death by another inmate just two years into his imprisonment.

The Colorado wilderness guide Alferd Griner Packer confessed to eating the deceased members of a party of five explorers who tried to hike through the rugged San Juan Mountains in southwestern Colorado in the winter of 1874. There used to be a restaurant in Vail, the ski town, called "Alfie Packer's." The burgers were good there, but I suppose you had to wonder.

Presumably some expertise can be gained by observation, although it can't possibly be sufficient. It's more like a priest offering marriage counseling, isn't it? Can you become a surgeon by watching surgery, or a pianist by listening to a lot of piano music, or an artist by going to museums?

The neuroscientist Carleton Gadjusek received his MD from Harvard. He went on to investigate a peculiar neurologic disease endemic in a primitive New Guinea tribe, the Fore. The disease, called kuru, was more prevalent in women and children. It turned out that the Fore would honor their deceased relatives by eating them. The men, being first at the table, would devour the muscles, but the women and children would get what's left, primarily the brain, which harbored a peculiar infectious agent that was neither bacteria nor virus. This pathogen was the first example of what we now call a prion, a self-replicating protein. It's the agent of Creutzfeldt-Jacob disease in humans, bovine spongiform encephalopathy in cows (Mad Cow Disease) and scrapie in sheep, and has been suggested as the possible agent of Alzheimer's disease. Gadjusek won the 1976 Nobel Prize for this work. He did not participate in the kitchen, nor at table, so he was not an actual expert by the Gladwell/Dahmer/Packer criteria.

Carelton Gadjusek (left) in New Guinea with the Fore, accompanied by a colonial official and two guards

I saw an ad for *The Cannibal's Cookbook: Recipes and Remedies for Human Sacrifice,* published in 1996, but the description suggests there are no actual recipes, so the author's expertise has to be questioned.[1] Dahmer left no recipes either, by the way. Another

[1] The blurb is "This is a book everybody concerned about their own well-being and the future of their world will want to read and give to their best friends. It is a light and humorous--albeit critical and insightful--account of how culture shapes our perceptions of reality and gets us to do what we don't intend to do." Speaking of light and humorous, two cannibals were having dinner, and one said to the other, "Having a good time?" and the response was, "Sure, I'm having a ball."

book, *To Eat or Be Eaten – A Guide to Cannibalism* by Antonio Cascos Chamizo, is the thesis for a master's degree at the Oslo National Academy of the Arts. It's described as "the what-if question, the construct or the fictional scenario, which starts with assemblage of data, info and facts that justify cannibalism ethically and show its potential to be the answer of some global issues as overpopulation and lack of resources." But Johnathan Swift did that famously in the satirical *A Modest Proposal* in 1729, solving the problem of famine in Ireland. So none of these writers can claim to be "experts." Anyway, these books use cannibalism only in a symbolic sense, and thus offer nothing to someone trying to be completely prepared for space travel.

How delicious would an astronaut be? NASA says that weightless astronauts can lose up to 20% of their muscle mass during missions of only 5 to 11 days, primarily the "anti-gravity muscles," including calf muscles, the quadriceps and the muscles of the back and neck. In other words, all the muscles that might make for a hearty *ragoût à la Dahmer*. Exercise helps minimize atrophy, and ISS astronauts exercise for 2½ hours a day. Scott Kelly, who spent 340 days on the ISS, lost 15 pounds, probably all of it muscle, since there was evidence that early skeletal bone loss reversed as the mission went on. Of course, astronauts who are starving will lose even more as their ability to exercise wanes and they breakdown skeletal muscle to provide nutrients for critical cellular functions in vital organs. Their stringy, atrophied muscles wouldn't make palatable or satisfying spaceburgers for their surviving crew members.

The provision of nourishment for a long exploratory journey has a well-documented history. The holds of sailing ships were packed with preserved meat and grain, but voyagers could also live off the catch of the sea if provisions ran out. The main nutritional problem was scurvy, from lack of vitamin C, a problem rectified by providing limes to British seamen (which why Brits are referred to as "Limeys"). Land expeditions into the unknown, or across deserts or mountains, needed to carry all their own food, as will space missions. The Antarctic expeditions of Robert Falcon Scott and Ernest Shackleton assumed caloric requirements as high as 8,000 calories a day when man-sledging, and met them with pemmican, a high-calorie, compacted mixture of fat, meat and berries invented by native North Americans. It was generally served as a stew. I own a copy of the first edition of Shackleton's *The Heart of the Antarctic*, the story of his 1907-09 attempt on the South Pole. The text describes the planning for the expedition in meticulous detail, including the recipe for pemmican and calculations to determine just how much of it needed to be carried on the sledges. There was little room for error, because every additional pound dragged across the ice on the 2,000-mile round-trip route (including a 10,000 foot elevation change) increases the amount of work required and slows progress, time being of the essence since the Antarctic summer is so short. Shackleton's team of four was 97 miles short of the pole when his daily calculations showed that there weren't enough calories left to reach it and return to base alive. Shackleton turned around, later commenting "a live donkey is better than a dead lion." Scott, in 1911-12, was a poorer planner. His team also man-hauled all the way, reaching the pole but arriving a month after the Norwegian Roald Amundsen, whose party used dog sleds, which reduced their own caloric needs. They carried less food, some sledge dogs being sacrificed to become nourishment for the remaining dogs (sledge dogs apparently lack ethical concerns about this practice) and, towards the end of the trip, the explorers. Although British tradition makes Scott into some sort of hero, he and his companions ran out of energy and unheroically froze to death.[2]

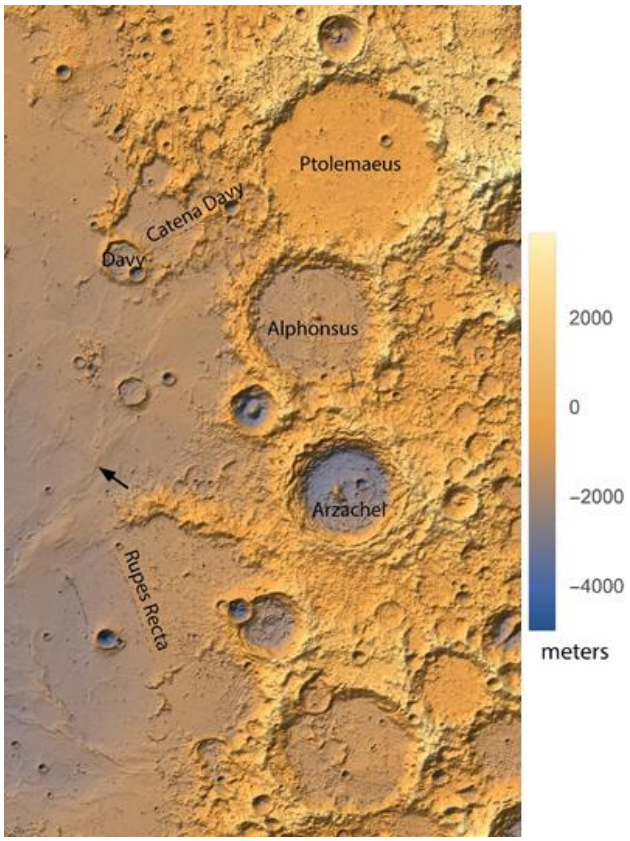
Like the Antarctic explorers, who provisioned supply depots with food and fuel at intervals on their route, Martian expeditions will have supplies accurately landed on the surface in advance of any human footsteps. The target ellipse for the Perseverance rover was just 4.5 miles in diameter, and once it was down NASA knew its *exact* location. The real risks to space travelers is technical failure in transit, either intrinsic (like the Apollo 13 malfunction) or extrinsic, like a meteor hitting the spacecraft. In either case, absent a brilliant technical correction like Apollo 13 that saves the day, stranded astronauts are likely to run out of oxygen or water before they starve. Those substances need to be carried into space and their utilization can be precisely calculated. No recipes are needed, and once you're out, you're out. ■

[2] A really great book about Antarctic exploration is Roland Huntford's *The Last Place on Earth: Scott and Amundsen's Race to the South Pole* (2nd ed., 1999).

Exploring Lunar Terrain in 3D

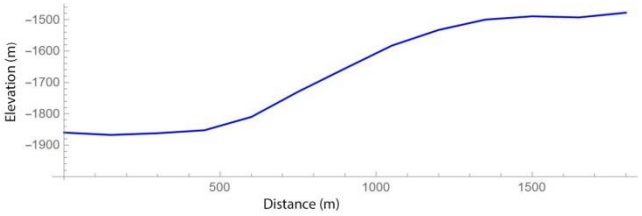
Robin Stuart

Lying just west of the Moon's central meridian, Straight Wall (Rupes Recta) and its surrounding region are best viewed just after first quarter. In that phase the Moon conveniently culminates in the early evening.



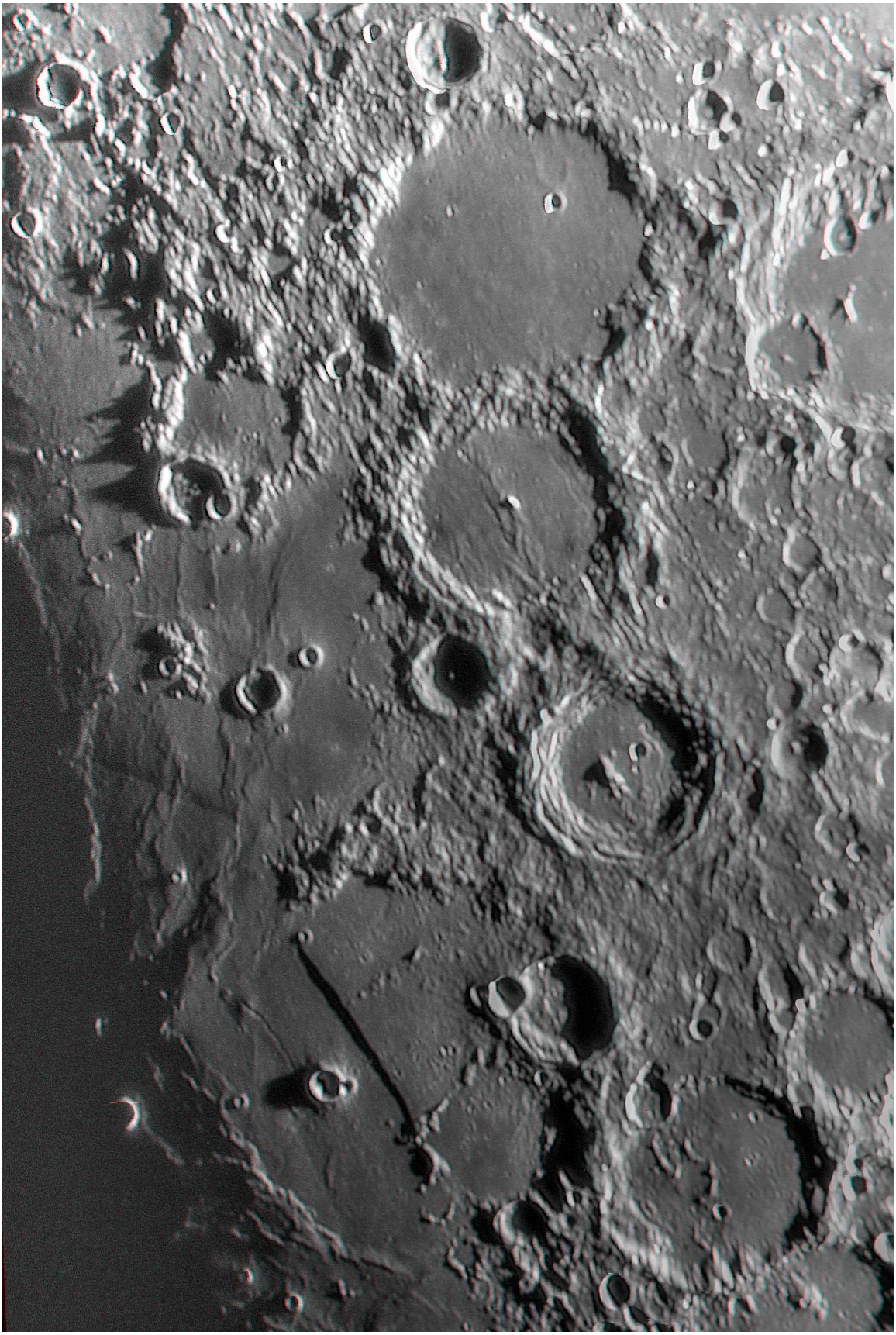
The release of *Mathematica 12* introduced new features that give easy access to elevation data for the Earth, Moon, Mercury, Mars and Pluto. In the case of the Moon, the data is available down to a resolution of 167 meters. The relief map above shows the region around Straight Wall generated by using native Mathematica functionality. Elevations are in meters relative to a standard *reference ellipsoid*, which is a sphere of radius 1737.4 km located at the Moon's center of mass. Labels were added manually. A noteworthy feature is Catena Davy, a chain of small craters believed to have been formed by the impact of fragments from a tidally disrupted parent body, reminiscent of the *string of pearls* of Comet Shoemaker-Levy 9 as it impacted Jupiter in 1994.

The elevation data allows the lunar surface to be explored and understood in intricate detail. For example, taking a transect across Straight Wall reveals its true nature. The graph below is a plot of elevation and is shown to scale. Often taken by observers to be a cliff, it is in fact an escarpment rising around 350 m (1150 ft) over a horizontal distance of 900 m (0.56 miles) with a maximum gradient of about 1 in 2.

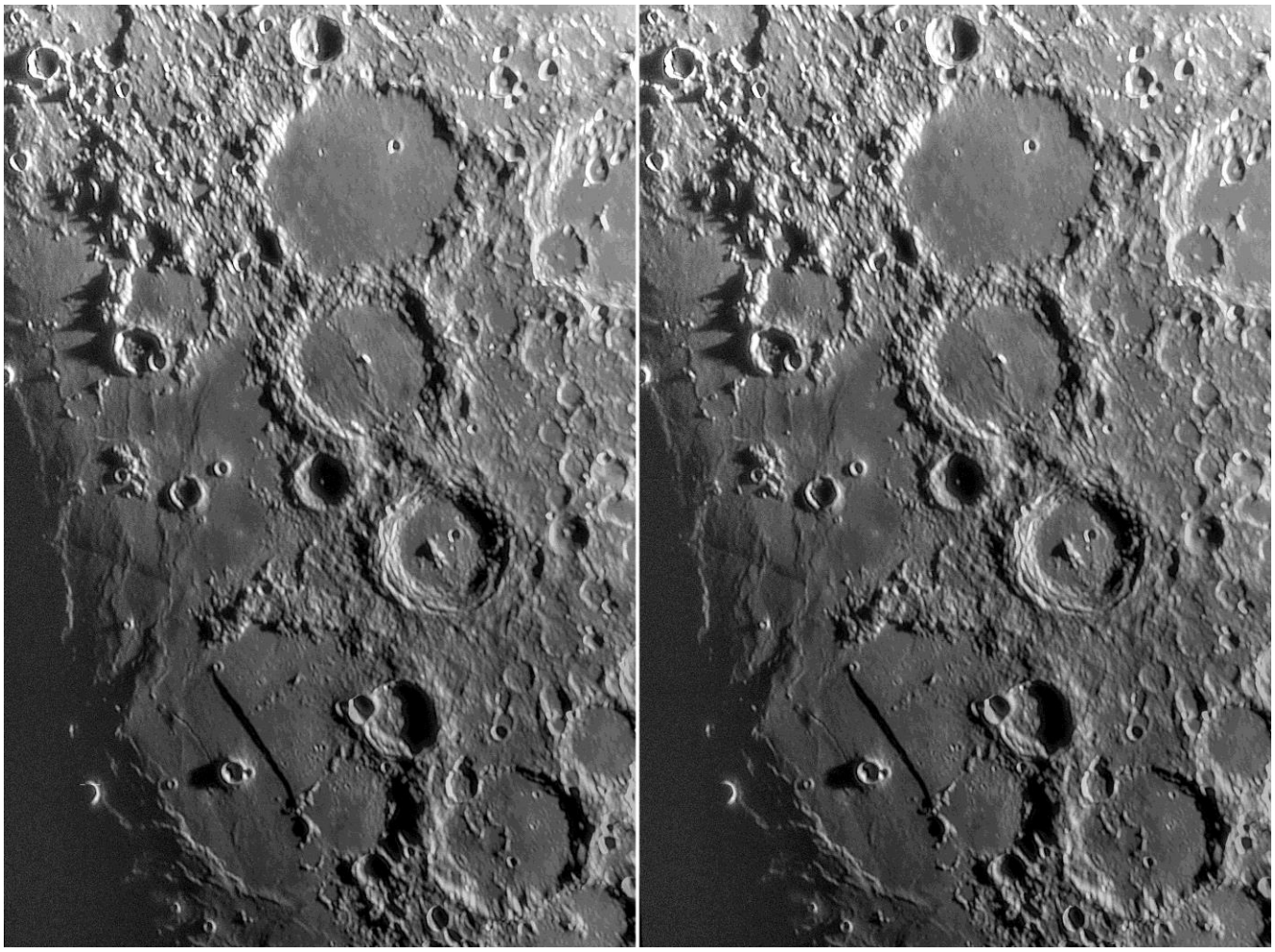


The availability of lunar elevation data coupled with Mathematica's versatile image processing capabilities opens the possibility transforming telescopic images in a way that displays the 3D character of the lunar terrain (see SkyWAAtch October 2019, p. 8). The image on page 16 shows the result of some initial efforts in this direction. Although it may look like a poorly registered color image of the Moon's surface, when viewed through a pair of red-cyan stereo glasses, the 3rd dimension rises out of the page. It shows the view an observer would have looking directly down on the scene. The original image was made through a Televue NP127 refractor equipped with a 5× Powermate, using a Meade LPI-G monochrome video camera. It was taken on the evening of March 21, 2021 from Valhalla, NY at about the same time as the 3rd image in the sequence shown in the June 2021 SkyWAAtch, p. 21, when the region was very close to the terminator.

The wall of Davy crater and nearby outcrops cast long shadows on the lunar surface that give the impression of soaring spires. Three of the largest craters in Catena Davy are resolved. The floors of the craters Ptolemaeus, Alphonsus and Arzachel are seen to lie at progressively greater depths, indicative of their decreasing ages. In addition to Straight Wall, at this low Sun-angle another linear surface feature (arrowed in the relief map) can be seen at the center left of the image. By taking a transect in the same way as was done for Straight Wall it is found that it represents a sudden change in the gradient of the lunar surface but is a very gentle slope of only about 1 in 90.

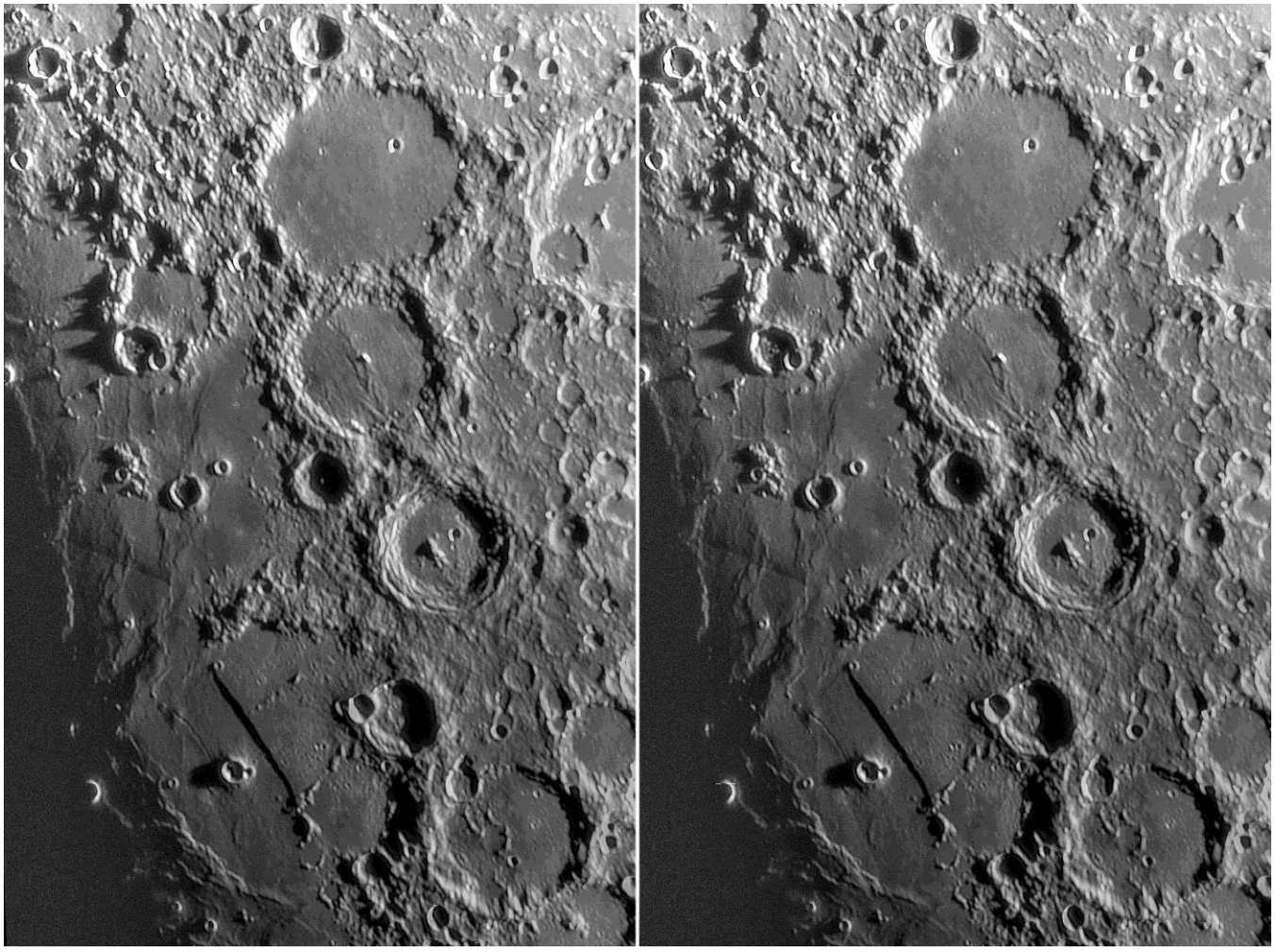


Use red/cyan anaglyph glasses for this image



Use “free fusion”

You may need to adjust the size of the page on your monitor to view the stereo images on this page and the next page successfully. Placing the center of each pair of images about 55 mm apart on the monitor is a good starting point.



Use “cross-eyed fusion”

The original image used here was constructed from the best 25% of a total of 264 frames selected and stacked with Autostakkert!3. Light wavelet sharpening at the finest scale was applied with RegiStax6. The combination of a Televue 127, 5X Powermate and Meade LPI-G gives a measured image scale of 0.16 arc-seconds per pixel which falls well inside the Dawes limit of 0.9 arc seconds for this 5 inch instrument. Increasing the magnification would only reduce the field of view without improving resolution. The crater Davy C, lying at the western end of Catena Davy, is clearly seen. It has a diameter of 3 km and at the Moon’s distance at the time of 390,000km subtends 1.6 arc-seconds. Images taken close to the terminator have a very steep brightness gradient and the Lommel-Seeliger disk function adjustment technique, discussed in my “Moonlight” article (April 2021 SkyWAAtch, p. 14), performs poorly there. *Ad hoc* adjustments are needed, as was done for the quartet of lunar disk images (June 2021 SkyWAAtch, p. 21). Photomatix Pro HDR software was used to compress the dynamic range prior to producing the 3D image in this article.■

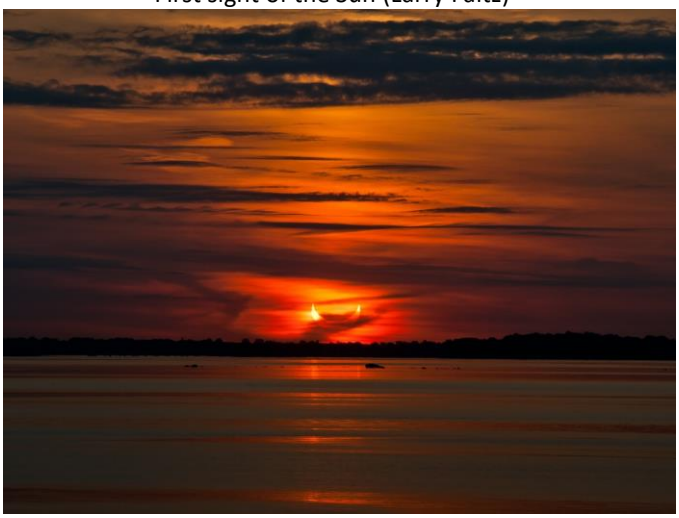
Partial Solar Eclipse June 10th

About 20 WAA members observed at the Westchester Country Club's Beach Club on Manursing Island in Rye, arriving at 4:45 a.m. Thanks to WCCBC manager Tom Nevin and WCC member Peter Rubinstein for arranging our access to the club.

About 5:05 a.m.

First sight of the Sun (Larry Faltz)

Bob Kelly



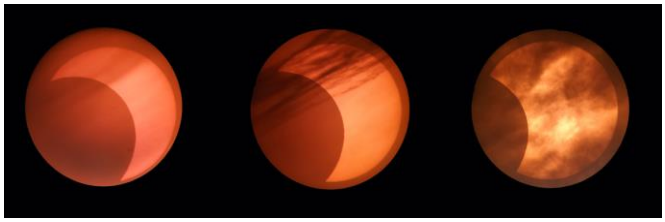
Manos Makrakis

Marcy Cohen

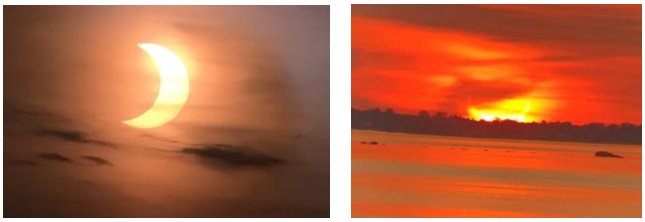
Elyse Faltz, Peter Rubinstein, Marcy Cohen (LF)

Clockwise from upper left: Alex Mold, Frank Jones, Hans Minnich, Paul Alimena, Mike Lomsky, Jordan Webber (LF)

Larry Faltz



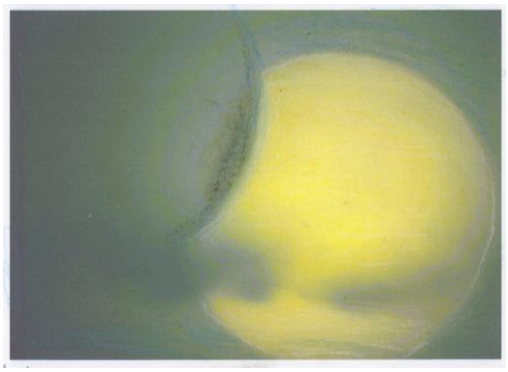
Alex Mold, via cellphone and 5” Mak



Peter Rothstein via cellphone camera & binoculars

Member images from other locations

Mauri Rosenthal, from Scarsdale



John Paladini, drawing, from Mahopac

Steve Bellavia, from Orient Point, NY

Robin Stuart, from Nahant, MA

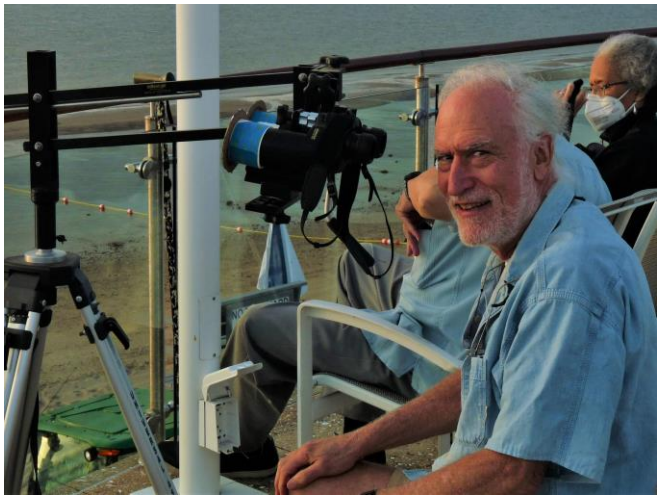
Photos by Frank Antinorella

Judy Alimena, Paul Alimena, Lydia Maria Petrosino

Elyse & Larry Faltz, Peter Rubinstein, Wayne Turk, Marcie Cohen

About 6:00 a.m.

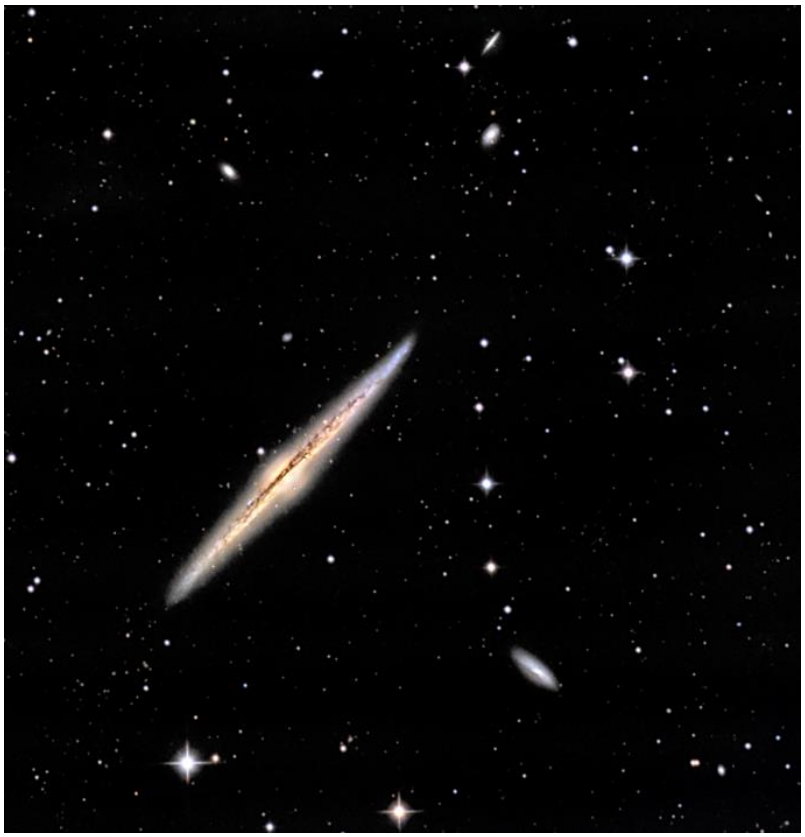
Bob Kelly

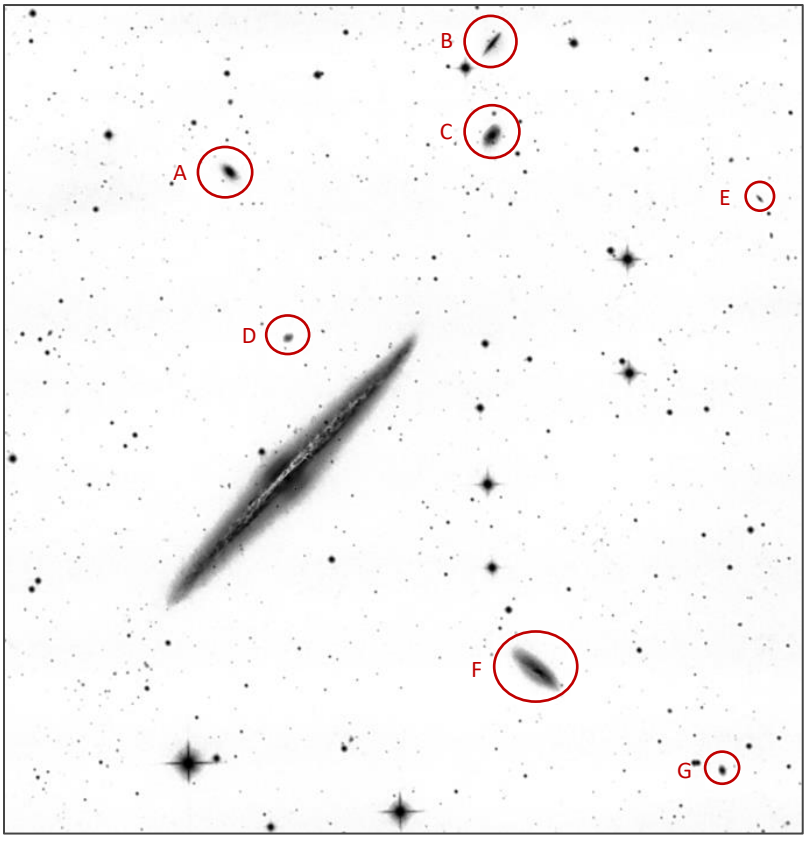


Peter Rothstein

Marcie Cohen

Images by Members





NGC 4565, the Needle Galaxy, by Rick Bria

NGC 4565 is located towards the north galactic pole of our Milky Way galaxy. Looking in that direction, away from the plane of the Milky Way, we see a multitude of distant galaxies.

NGC 4565 is a very large spiral galaxy seen almost edge-on from our vantage point. During the summer, from a very dark location you may notice a band of light overhead. That's our galaxy, made of billions of unresolved stars. Research suggests NGC 4565 looks very similar to our galaxy. We see the Needle Galaxy edge on from 42 million light years away. We see the Milky Way galaxy edge-on from inside it.

There are seven other galaxies in the picture, with a range of sizes and distances. They are identified in the inverted image. PGC 3791769, in the upper right of the picture, is probably the same size as the Needle Galaxy, but appears tiny because it is 1.3 billion light years away. Once again we are reminded that the sky has depth.

This picture covers an area of sky about the size of a dime held at arm's length. In that small area we find eight galaxies, each containing billions and billions of stars. This is just a small sample of the countless galaxies in the direction of the north galactic pole.

--Rick Bria

Galaxy	Name	Distance (LY)
A	IC 3582	330 million
B	IC 3543	310 million
C	IC 3546	305 million
D	PGC 2793674	64 million
E	PGC 3791769	1,300 million
F	NGC 4562	36 million
G	IC 3533	430 million

Mary Aloysia Hardey Observatory, April 7, 2021. PlaneWave 14 CDK, STX 16803.

Owl and Surfboard by Steve Bellavia

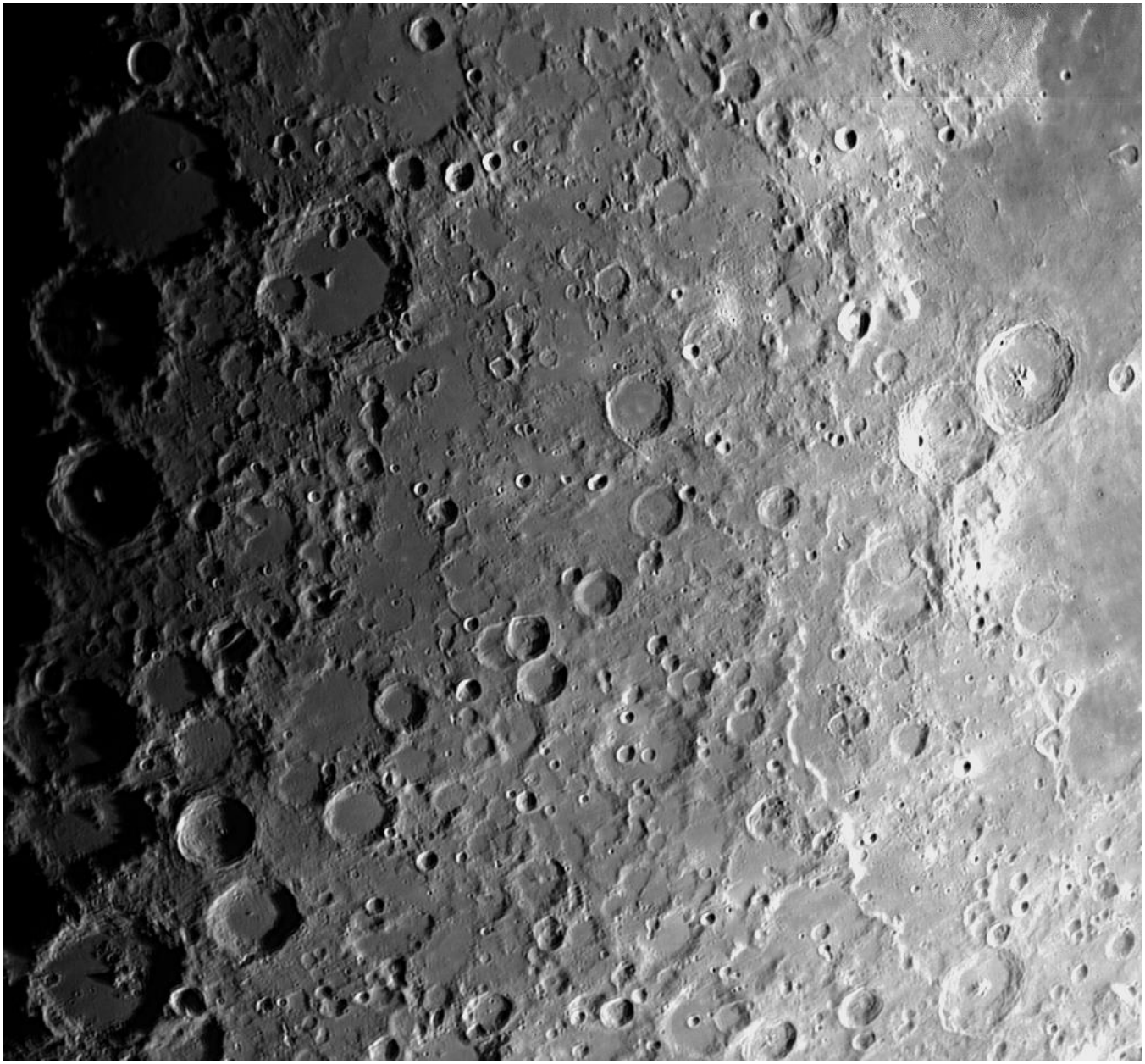
Messier 97, the Owl Nebula, is a large planetary nebula with a distinctive internal structure. It is 1,630 light-years from us, age 8.00 years. Although listed as magnitude 11.8, it's not hard to see with a reasonable-sized scope, especially with a filter that passes the OIII and Hα spectral lines, as most aggressive light-pollution reduction (LPR) filters are designed to do. A specific OIII filter in a 12-inch or larger scope will do the trick nicely due to the large amount of doubly-ionized oxygen in this object, which gives it its distinctive blue color in images and in larger telescopes. The wavelength of OIII is 500.7 nm, close to the human eye's optimal scotopic vision (night vision) sensitivity of 507 nm. In dark skies, an 8-inch scope will easily show it, and Stephen James O'Meara, in *The Messier Objects* (Deep Sky Companion series) says it's "one of the finer examples of a planetary nebula for a 4-inch telescope." Maybe in rural Hawaii, where he lives, but it would be a serious challenge in our area to see it with that aperture due to light pollution. It's about 2.8 arc-minutes in diameter. The central star is magniftude 14. For more on planetary nebulas, see the October 2015 SkyWAAtch.

Messier 108 is a very small spiral galaxy, perhaps one-twentieth the mass of the Andromeda Galaxy, M31. Although its core looks depleted, there is active star formation in its arms. It's 8.7 x 2.2 arc-minutes in extent, mag. 10.7, distance 46 million light-years (MLY).

Along the top edge of the image, on the right, is NGC 3594, mag 15.2, distance 94.8 MLY. Between it an M97 is MCG+09-19-018, a "LINER" galaxy, mag 15.3, distance 467 MLY Left of center near the bottom of the image is 16.0-magnitude spiral galaxy UGC 6211, distance 257 MLY. Use the paired colored markers on the edges to find these three small galaxies. There are many smaller, fainter galaxies on the image.

Steve made this image on March 13, 2021, when the bowl of Ursa Major was nearly at the zenith. Technical details and more background information at https://www.astrobin.com/e9di6w/.

First-Quarter Moon Lunar Highlands by Larry Faltz



This image of the northern part of the lunar highlands between the eastern edge of the Mare Nubium on the left and the western edge of the Mare Nectaris on the right spans about 25% of the Moon's full diameter. It's the area just to the east of Robin Stuart's images on pages 16-18. Along the terminator on the left, dawn illuminates the tops of the central peaks of Alphonsus and Arzachel while their floors are still in shadow. On the right the brilliant mid-morning Sun begins to wash out contrast on the lunar surface. The serpentine Rupes Altai snakes towards the bottom right of the image, ending at the crater Piccolomini. This cliff is 3,000 feet high and extends for 290 miles. The crater Theophilus, 61 miles in diameter, is at the upper right. It is clearly a later impact than the similar-sized crater Cyrillus at its 8 o'clock position.

April 19, 2021, Larchmont, NY. Moon elevation 67°, age 7d 22h. Orion 127 Mak, iOptron Minitower alt-az mount, Skyris 445M camera, 25A red filter, FireCapture, Autostakkaert!3, Registax 6.1. Best 10% of 1800 frames.

Research Highlight of the Month

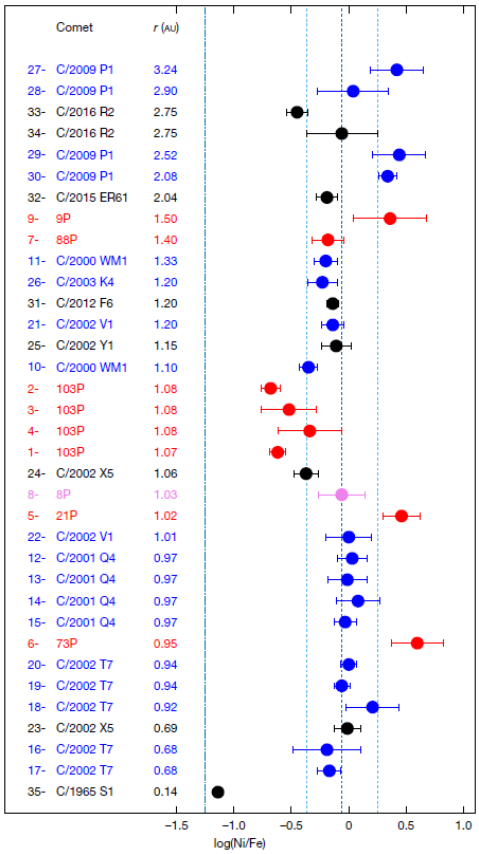
Manfroid, J, Hutsemeker, D, Johin, E, Iron and nickel atoms in cometary atmospheres even far from the Sun, *Nature* 2021; 593: 372-4

ABSTRACT: In comets, iron and nickel are found in refractory dust particles or in metallic and sulfide grains. So far, no iron- or nickel-bearing molecules have been observed in the gaseous coma of comets. Iron and a few other heavy atoms, such as copper and cobalt, have been observed only in two exceptional objects: the Great Comet of 1882 and, almost a century later, C/1965 S1 (Ikeya–Seki). These sun-grazing comets approached the Sun so closely that refractory materials sublimated, and their relative abundance of nickel to iron was similar to that of the Sun and meteorites. More recently, the presence of iron vapor was inferred from the properties of a faint tail in comet C/2006 P1 (McNaught) at perihelion, but neither iron nor nickel was reported in the gaseous coma of comet 67P/Churyumov–Gerasimenko by the in situ Rosetta mission. Here we report that neutral Fe I and Ni I emission lines are ubiquitous in cometary atmospheres, even far from the Sun, as revealed by high-resolution ultraviolet–optical spectra of a large sample of comets of various compositions and dynamical origins. The abundances of both species appear to be of the same order of magnitude, contrasting the typical Solar System abundance ratio.

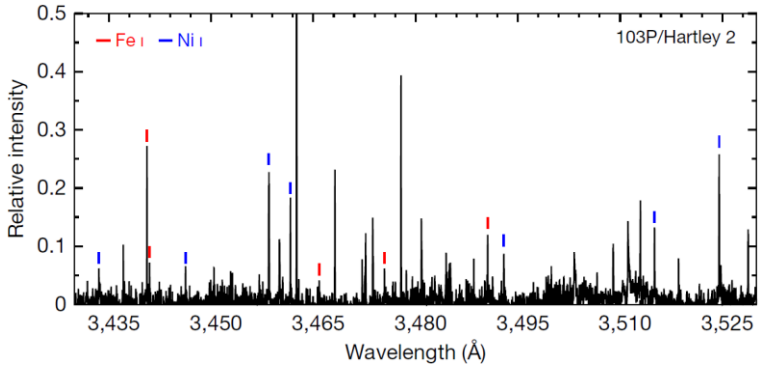
Comet spectra show emission lines from fragments of molecules, such as hydroxyl (OH), cyanide (CN) and dicarbon (C_2), but emission lines from metals have not been previously detected in all but the two comets mentioned. One reason is that their spectral lines are hidden amidst those of the more numerous small molecules. Metal atoms have been found in comet samples from the Stardust mission (Comet Wild 2) and in spectra of comets close to the Sun, when temperatures are much, much higher than they are in most comet trajectories.

Data was collected starting in 2002 with a spectroscope on the Very Large Telescope in Chile. The metallic emission lines were able to be teased out of the spectra and were present regardless of a comet's distance from the Sun. The authors developed a model to predict the production rates of nickel and iron. They calculated that the comets release about 1 gram of metal per second, about a millionth of the rate of water release. The amount of nickel produced in one second is about the same as in a US nickel coin.

The authors propose that the Ni and Fe are in organometallic complexes that are broken up when irradiated by sunlight, rather than simply being in inorganic minerals that are heated.



Above: Data for the comets analyzed. The Ni/Fe ratio of the Sun is the blue line to the right of the distance data. The dotted lines are the group average (center) ± 1 SD. Different colors are used according to the dynamical class: Jupiter-family (in red) and Halley-family comets (in pink) correspond to ecliptic comets with short periods (<200 years), external comets (in blue) have a semi-major axis of a < 10,000 au, and new comets (in black) come directly from the Oort cloud (a > 10,000 au).



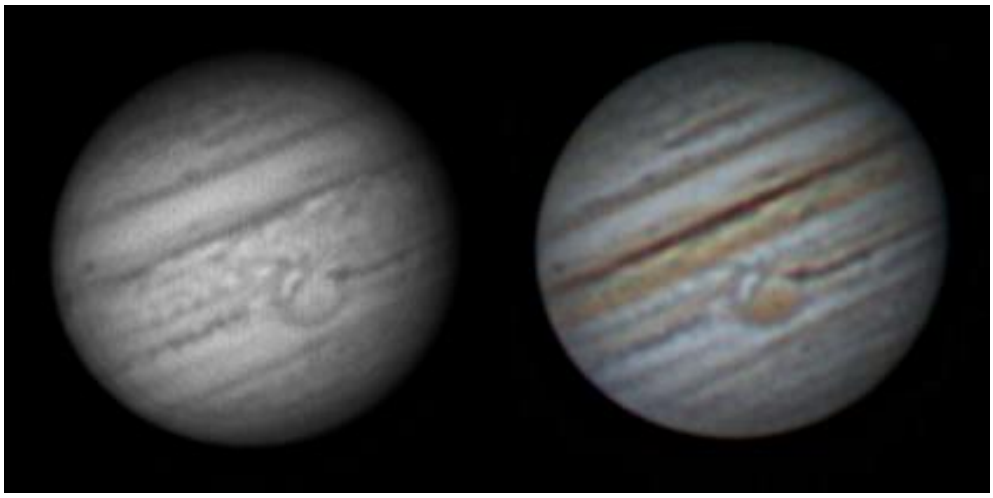
Near-UV region spectrum for 103P/Hartley

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
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
ADM R100 Tube Rings	Pair of 100 mm adjustable rings with large Delrin-tipped thumb screws. Fits tubes 70-90 mm. You supply the dovetail. Like new condition, no scratches. See them on the ADS site at https://tinyurl.com/ADM-R100. List $80.	$50	Larry Faltz lfaltzmd@gmail.com
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.

Buying or 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 for the 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!*



Jupiter
by John Paladini

John imaged through a venerable Criterion RV-6 reflector (6" f/8) with color and monochrome ASI120 cameras. The monochrome image utilized a red filter in front of the sensor.

June 29, 2021