SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

June 2020

M81 by Rick Bria

Although it looks gigantic in images, M81 is only about half the size of the Milky Way. Distance 12 million light years. It’s easy to spot the nucleus in binoculars on a clear night. Note the “>” in the lower right. See page 2.

Due to the COVID-19 pandemic, WAA group events are canceled until we are given notification by public health authorities that such group activities are safe.

As of this writing, Ward Pound Ridge Reservation is open. Updated accessibility information can be found at https://parks.westchestergov.com/covid19-updates. WAA members may observe at Ward Pound Ridge with proper identification by notifying the park 24 hours in advance. Call the number on the back of your ID card, which was sent with your membership or renewal, and bring the card. Remember that social distancing and masks are appropriate on the observing field. It is reasonable for each instrument to be used by a single individual or family to prevent possible contamination.

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

Note on the cover image of M81

As we noted in the May 2000 SkyWAAtch, when Rick Bria examined this beautiful image, he thought that the faint background galaxy in the lower right-hand corner marked with a ">" was the farthest object ever imaged with the 14-inch Corrected Dall-Kirkham telescope at Mary Aloysia Hardey Observatory at Sacred Heart University in Greenwich. From its size, he estimated its distance at 408 million light years, not a bad guess. The galaxy is formally named SDSS J095353.89+685253.5. It appears to be a spiral galaxy with a magnitude of 18.29 and a redshift 0.05925, which puts it approximately 800 million light years away from us. Distances derived from red shifts are calculated after inputting reasonable values for the Hubble constant (H_0), the fraction of the total mass-energy of the universe that is dark matter and the fraction that is dark energy. There are several on-line calculators that make this easy (see for example https://ned.ipac.caltech.edu/help/cosmology_calc.html). But that object is just one-tenth of the distance to the Twin Quasar in Ursa Major, QSO 0957+561 A/B, which Rick imaged a few nights later and which we presented last month.

New Members

Richard Austin	Milford
Stephannie Ducksworth	Portchester
Giulio Ricciardi	Stamford

Renewing Members

Jose E. Castillo	Pelham Manor
Byron Collie	Croton on Hudson
John & Maryann Fusco	Yonkers
Jeffrey Jacobs	Rye
Frank Jones	New Rochelle
Arthur Linker	Scarsdale
Jeremy Pantlitz	Port Chester
Lydia Maria Petrosino	Bronxville
Daniel Rosenthal	New York
Red Scully	Cortlandt Manor
Karen Seiter	Larchmont
Dante Torrese	Ardsley
Jordan Webber	Rye Brook

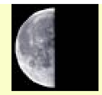
Also In This Issue

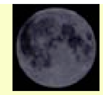
The WAA Hot Line
Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

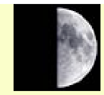
ALMANAC For June 2020

Bob Kelly, WAA VP for Field Events


Full 6/5


3Q 6/13


New 6/21


1Q 6/28

To make the most of our short summer nights, you'll have to shift most of your planet-viewing into the morning hours. Jupiter and Saturn approach their July oppositions. They're low in the south. The gas giants start out the month rising just before midnight, but they'll rise around 9:30 p.m. by June's end. Even then, they don't even reach 30 degrees above our southern horizon when they culminate in the wee hours. Mars will be found higher in the southeastern sky before dawn, about the time Jupiter and Saturn are setting in the southwest. Venus flits to the morning sky. Mercury keeps its hold on the early evening sky, low, but findable below Castor and Pollux in the west-northwest. The Milky Way transits just before dawn. In the evening the starry band may look more like a hazy band in the east sky, if your sky is dark enough.

Jupiter and Saturn are increasing in size, which makes for a more comfortable view in the telescope. The Moon joins them on the 8th and 9th, first just to their west, then just to their east.

Jupiter's four Galilean moons should be visible in binoculars. They occasionally transit the striped planet in pairs this month. Saturn and its rings are tilted 24 degrees toward us with the planet's north pole visible. Titan is visible at 9th magnitude in small telescopes. Iapetus is at its brightest early in the month, west of Saturn, temporarily joining Dione, Tethys and Rhea near 10th magnitude. Iapetus passes north of Saturn on the 20th, dimming as it moves eastward. Scopes of six-inches or greater aperture will be able to see these satellites.

Use Mars to help find Neptune, two degrees above it. They are closest on the 13th. Mars is at a right angle to the Earth-Sun line–*quadrature*–on the 6th/7th. This view makes Mars look gibbous from Earth. Mars brightens to negative magnitude this month. As its size passes 10 arc seconds this month, you might start to see various shadings on its surface if you use a large enough telescope. But try even with smaller instruments to see how out of round it is at 85 percent illuminated. [Editor's note: An orange filter often helps bring out surface markings on Mars.]

Venus passes through inferior conjunction on the 3rd at 1:38 p.m. EDT, just missing a transit of the Sun by a quarter of a degree. Venus squirts out into the morning sky at mid-month, surprisingly visible, even though it will be just 10 degrees above the horizon at sunrise. By the end of the month, it's still 10 degrees above the east-northeastern horizon in mid-twilight (about 4:30 a.m. EDT). It's hard to believe that Venus rises almost two hours before the Sun but is still so close to the horizon. Venus and the Moon rise a Moon-width apart on the 19th. Can you spot the Pleiades ten degrees above Venus during the second half of the month? Then try for the Hyades just below Venus. Use binoculars.

Mercury is farthest out from the Sun in the evening sky on the 3rd/4th. If you can spot Castor and Pollux in the west-northwestern sky, scan downward with binoculars to find Mercury. It'll be getting fainter and sets by 10 p.m. daylight time. High power will show a waning crescent. Mercury passes through inferior conjunction, four degrees from the Sun, on the 30th. Our Moon is closest to Mercury on the 22nd, only 13 degrees from the Sun. It takes all month for Mercury to reach inferior conjunction, finally aligning with the Sun on the 30th.

How about Uranus? It's a morning planet too, rising after Mars. The Moon passes half-a-fist-held-at-arm's-length south of the ice giant just past last quarter on the 14th.

Our Moon has a perigee 2½ days before June 5th's full Moon, as the monthly date of closest approach to the Earth drifts away from the time of full Moon. The Moon will be 90 percent full then, with its rugged south polar region tipped five degrees toward Earth. There is a bonus lunar perigee for the month on the 30th, about 3,000 miles farther than the perigee on the 2nd.

Summer Solstice occurs on the 20th at 5:45 p.m. EDT. This year's earliest sunrise is June 14th. By the end of June, it'll be noticeably darker later in the morning.

The International Space Station has only a few overflights this month: early in June evenings and mornings in late June.

Department of Things Unseeable: There is a penumbral lunar eclipse not visible from the USA on the 5th.

An annular solar eclipse happens on the 21st, visible from parts of Africa and Asia. We'll get a faint penumbral lunar eclipse on July 4/5.

From the Editor

Explore Scientific Discovers New Class of Celestial Objects

Much recent progress in astronomy has come from examining objects with truly gargantuan energy output, such as supernovas, pulsars, quasars, black hole accretion discs, merging neutron stars and black holes, and a cosmic ray with the punch of a baseball thrown at 100 miles per hour. However, in an obscure but important announcement in *Sky & Telescope*, the world's leading amateur astronomy magazine, telescope manufacturing company Explore Scientific has revealed that it has amassed a catalog of objects with profoundly Lilliputian energies.

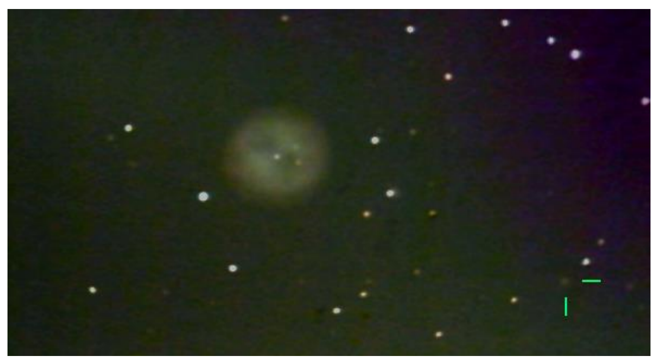
On page 71 of the June 2020 issue of *Sky & Telescope*, Explore Scientific describes the new FirstLight 203 mm Newtonian with EXOS2GT GoTo mount. "The StarTracker hand paddle includes 1-, 2-, and 3-star alignment routines and an internal database of more than 270,000 objects powered by eight D batteries." This quote is exactly as printed.

Astronomical science has hitherto not described any cosmic objects that are powered by eight D batteries, or any number of D batteries, or any batteries at all.

A D battery can output about 0.1 watts, so eight D cells will provide 0.8 watts. If all 270,000 objects are powered by the same 8 batteries, it would mean that on the average each object would be emitting just 2.96×10^{-5} watts. The Sun has a luminosity of about 3.828×10^{26} watts and would shine at magnitude +4.8 if it was located at a distance of 10 parsecs (32.6 light-years) from Earth. At that distance an object with 31 orders of magnitude less luminosity would shine at approximately magnitude +79 by our calculations (assuming a similar spectrum over all wavelengths), and would be much fainter than that if farther away, as many of these objects must be. That Explore Scientific was able to detect and catalog these amazingly faint objects is truly remarkable and a testament to their technology. Even if each object was powered by 8 D cells, the achievement would hardly be less astonishing.

We are awaiting the usual slew of arXiv papers explaining the nature of these objects and their relationship to various quantum gravity theories, as well as at least one paper co-authored by Harvard's Abraham Loeb proposing that they might be evidence of intelligent extraterrestrial life. ☺

On a more serious but happy note, we had some very fine, clear weekday evenings in May and quite a few club members took advantage of our special use permit arrangement with Ward Pound Ridge to do some observing and imaging. On May 21st at least 14 telescopes were set up. It had the feeling of a real star party, *sans* the public and with proper pandemic courtesies bring observed. I looked at deep sky objects with *Locutis*, my Mallincam/8" SCT set-up.



This image of the Owl Nebula, M97 in Ursa Major is a 28-second exposure. The video output of the Mallincan has a rough time getting into the computer: the composite video-USB frame grabber washes out the image, and only some of it can be brought back with processing to resemble the on-screen view. Amp glow from the camera's electronics imparts a color cast to one corner of the image. But it's illustrative of the benefits "video-assisted astronomy" can provide. The blue center and red fringe of M97 are visible. The central white dwarf of the nebula is 14th magnitude, the two other stars "inside" of it are both mag 16.5, and you can even make out 17.1 magnitude galaxy PGC 2483306 (tick marks). ■

Member Profile: Cliff Wattley

Home town: Danbury CT

Family: Wife of 45 years; 3 children, daughter and son-in-law and 3 grandkids

How did you get interested in astronomy? A number of things. I saw Sputnik fly overhead when I was 7. My Dad worked on jet engines and Apollo fuel cells. It was the dawn of the space age with rocketry and the Mercury program. You could see the Milky Way from suburban Hartford, pre light pollution. My neighbors gave me the Golden Children's book on the Moon. A close friend had a scope. Not sure how to get the future generations hooked.

Do you recall the first time you looked through a telescope? What did you see? In 1961, I was 11 and received a great Edmund Scientific 3 inch starter scope for a Christmas present (they were $29.95) I lugged it outside on the first clear, cold January night with snow around, shadows from the full Moon and eerie black tree fingers reaching the sky. I saw amazing caves and nooks on the Moon. It was so close, frankly I figured some animal was going to come crawling out. Scared at what I might see, I went back in the house. Afterwards realized the diagonal hung off a screw and was loose and I was probably magnifying the inside of the cardboard tube.

What's your favorite object(s) to view? Saturn on public observing nights. I love the wows and the people who come back and ask for another look. Also, the Moon, Jupiter and the Orion nebula. I really enjoy looking at objects with my astronomy buddies and exclaiming over faint fuzzy patches of any sort.

What kind of equipment do you have? I observe at New Pond Farm Observatory in West Redding, the former site of Western Connecticut University's observatory. They built a roll off building with a Criterion 6 and 8 inch Newtonian, a platform to stand on and a small, heated classroom building. With grants we now have Celestron 14 and 9.25 inch SCT's on equatorials. WesConn built 2 newer observatories in Danbury, one with a 20 inch RC. I have a refurbished Meade 8 inch LX 90 I am looking forward to using with the grandkids and their friends.

What kind of equipment would you like to get that you don't have? I need to figure out what I want to do long term. Astrophotography? Home observatory? I love wandering the fieldhouse at NEAF. Perhaps large aperture DOB such as a Teeter (although he has suspended manufacturing)? Someone in NH has reversed engineered the Porter garden telescope. He picked me out in a parking lot in Maine because of my car's Stellafane bumper sticker, opened up his trunk and showed me one. He likely knew by the make and age of my car, I was not a customer but I enjoyed seeing it.

Have you taken any trips or vacations dedicated to astronomy? Tell us about them. Nothing too exotic other than multiple Stellafane trips. I really enjoy their Thursday Hartness House seminars and walking the fields. I once drove up to Mt. Wilson while on business trip to Los Angeles.

November 2019 Mercury transit at New Pond Farm

Are there areas of current astronomical research that particularly interest you? I am on the Astronomy Department Council for Columbia, so whatever research the department wants us to hear about is great. I was fascinated by the LIGO detection of the collision of the two neutron stars and the heavy elements created. I think the Sky and Telescope articles may have taken a decided uptick since AAS ownership, and that is about the level I am okay with.

Do you have any favorite personal astronomical experiences you'd like to relate? I was in college in Richmond, Indiana in March 1970 and was going to run the college's observatory, which had a 6 inch Clark refractor, for the town for a partial solar eclipse. Then I found out late Friday there was a student with a car who was willing to take it to Virginia Beach to watch the total solar eclipse, mid day Saturday. I found someone to run the observatory, ran to the library to look at an atlas, and found 4 others wanting to make the trip. The less than two minutes of totality made the whole 32 hour trip, mostly me driving, so very worthwhile.

What do you do (or did you do, if retired) in "real life"? I am a project manager in the Alternative Investment department of UBS in Manhattan. I manage feeder funds which invest in private equity funds such as Blackstone and Carlyle. One of the underlying investments, Saint-Gobain in France, cast the blanks for the 60- and 100-inch telescopes at Mt. Wilson

Have you read any books about astronomy that you'd like to recommend? *Telescope in the Ice* by Mark Bowen and *Einstein's War* by Michael Stanley were very well written and absorbing books. Both writers did a great job, understood the technology and are great story tellers. *Telescope in the Ice* is about drilling in the ice of Antarctica to set up the IceCube neutrino detector, and it describes the technology trials, the development of neutrino astronomy, and all the personalities involved. *Einstein's War* is about the steps he went through developing relativity and his struggle, as a German and a Jew, to get it accepted during and after World War I. Arthur Eddington plays a big part, much more than just the famous eclipse photographs in 1919. Part of the story is a good recounting on Einstein's trials and tribulations in developing the theory itself.

How did you get involved in WAA? I have been a card carrying member for so long, I don't recall.

What WAA activities do you participate in? I have attended Friday night programs and enjoy the newsletter.

Provide any other information you think would be interesting to your fellow club members, and don't be bashful! I was a college intern in the Grumman structural test department for the F-14, which was in development in the summer of 1971, and watched a LM take off from the Moon. My supervisor said "There goes my heat shield! It met 300% of test!" I didn't think to ask, "Is that because it was overweight or you did a great design within the weight objectives?" A local friend was a college classmate of Carl Sagan's and he told me as an undergraduate, Carl was having difficulty buying into the idea that the seasons were a function of the Earth's tilt. After a couple of weeks Carl apparently said, "I get it."

August 2019 with granddaughter Libby in S. Dartmouth MA ■

Filler from the Editor

A 28-second Mallincam capture of magnitude 10.1 galaxy M108 in Ursa Major, on May 21st. The good astrophotos start on page 13.

Astronomy 101 Scott Levine

The other night, I sat staring at the sky at my favorite north-facing spot. There, reliably as always, were the bright stars of the Big Dipper. Cassiopeia's "W" peeked out from behind the houses up the street.

These stars are amazing for lots of reasons, but maybe the best is they're always there. They're not seasonal like Orion or Aquila, which come and go throughout the year. Instead, night after night, month after month, year after year, we get to watch them dance around each other like lovers on a ballroom floor.

These stars belong to a group that we can describe with the word circumpolar. *Circum* comes from the same root as "circle;" for example circumference is the distance around a circle. *Polar* means relating to the Earth's poles. So, the circumpolar region is where things appear to circle the poles. There's a northern circumpolar region and a southern one. Today, we'll just talk about the north, but things are similar in the south.

Do you remember "culmination," from the April 2020 issue? That's one of the two times each day when things cross the meridian, the imaginary line that runs all the way around the entire sky from north to south and back, cutting the sky into eastern and western halves. The upper culmination is an object's highest point for the day. In the northern hemisphere, this is actually when it will be at its most southern point on the celestial sphere.

You might not realize it, but everything in our sky circles the north celestial pole. Most things are far enough south that this illusion widens until it's lost, object appear to travel from east to west across the sky, rising, upper-culminating, then setting and lower-culminating below the ground each day. Circumpolar things live differently.

They circle the pole far enough north that they never get low enough to set. Their lower culmination happens above the ground. They circle the sky over and over, and never reach the horizon. If you could snap your fingers and turn off the Sun (please don't),* you'd see these stars in the sky the whole time, just appearing to revolve around Polaris.

This creates a really neat effect. The next time you head out, look for the Big Dipper. It's high overhead, pouring soup onto your neighbor's roof. Come November at about the same time at night, it'll be at the bottom of the sky, catching the soup it poured this spring (things move slowly in astronomical time). With the Sun off, we'd be able to see this soup pouring happen every 12 hours.

In Westchester, the Dipper and Cassiopeia are both circumpolar, but that's not true everywhere. The farther north you go, the higher Polaris is in the sky, which brings the circumpolar zone with it. At the North Pole Polaris is very close to exactly overhead. There, you'll see the entire northern sky, and all the stars you can see clear out to the horizons in all directions are circumpolar. None of them will ever set. Conversely, the farther south you go, the less of the sky is circumpolar, until you reach the equator, where nothing is. What's circumpolar for you in Oslo might not be circumpolar for me in Marrakesh.

We're treated to having these stars there for us, helping us finding our way, reliable and steady, every night of the year, if your skies are clear. Have a look tonight.

Scott Levine's astronomy blog, *Scott's Skywatch*, can be found at https://scottastronomy.wordpress.com/ or email him at astroscott@yahoo.com

* The editor refers the curious reader to the H.G. Wells short story "The Man Who Could Work Miracles" to examine the consequences of having that kind of power.

My First Views of Jupiter and Saturn

Greg Borrelly

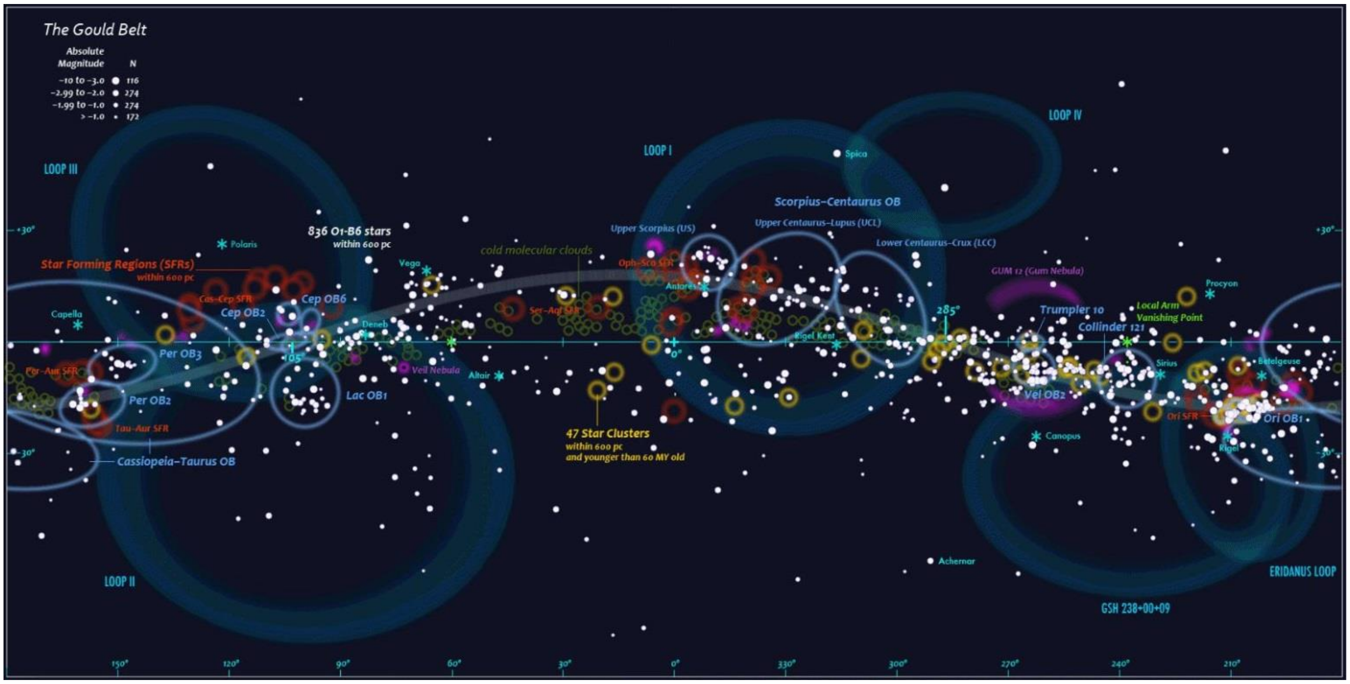
April 22nd was the first time I observed Jupiter and Saturn. I wrote something to commemorate the moment, before the feeling escapes my grasp. It was three o'clock when I woke up. I can't remember what woke me up. It could have been the wind or a bad dream, but the romantic in me wanted to think it was destiny. Regardless of the cause, I'm eternally grateful to it because of what happened next. As soon as I woke up, one thought came to my mind "The Planets!" I knew Jupiter, Saturn and Mars were coming into the morning sky, and I had been trying to wake up early for a couple of months. Being a "night owl" this is a tremendous challenge for me. Now that I was awake, there remained but one issue. Three o'clock was too early so I needed to wait an hour and a half before the planets would be visible from my roof. I made a deal with myself. If I could remain in bed and stay awake for that long, I would go up. An hour passed. I got out of bed and told my wife "I'll be right back. I'm about to go see the planets." She looked back, bewildered and half-asleep, and mumbled "OK." I put on my coat, shoes, and my favorite hat with the chess federation logo on it. I grabbed the key to the roof and opened the door to my apartment. Walking quietly up to the roof so I wouldn't wake up any of my neighbors, I opened the roof door and looked roughly East to South. At the edge of a tree branch, I saw a very bright light. At first I thought it looked like Venus. Trying to conceal my excitement, I gasped "It's Jupiter!"

I don't remember walking down the steps from the roof. I got back in the apartment with 30 minutes to set up my telescope. I grabbed my Orion 120ST and Twilight mount. I removed the lens cap. To save time, I decided to go with a Celestron zoom eyepiece. That way I don't have to carry multiple eyepieces to the roof. I'm almost at the door when the number 600 pops into my head. Right, the focal length on my 120ST is 600 mm. With the eyepiece at its lowest focal length of 8 mm, that would only be 75x, not enough magnification. So I left the telescope by the door and ran back to grab a 2x Barlow. With the Barlow on my coat pocket, I made my way back up the stairs. My steps were now like steps you hear when you walk into church. I knew I was about to see something that will change me forever. I stopped at the top of the stairs. My heart was racing, yet I knew the importance of this moment and wanted to savor the seconds before I opened that door. When I did, Jupiter had cleared the tree and Saturn followed in its wake. Perfect. I set the telescope down and observed both Jupiter and Saturn as for long as I could. I don't have the words to properly describe what I saw, except to say that they were beautiful, full of detail, just out of this world. I will remember this morning for the rest of my life. Mars did not get to clear the trees before the sun started rising, but it didn't dim the quality of the experience. ■

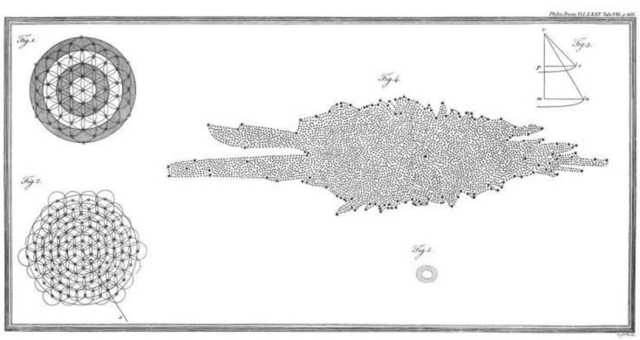
Jupiter (mag -2.3) and Saturn (0.6) are the brightest objects in the cell phone shot that Greg took at 4:56 am on April 22nd. To the right of Jupiter is Pi Sagittarius (Albaldah, 2.8), Sigma Sag (Nunki, 2.05) and Zeta Sag (Ascella, 2.6). Above and left of Saturn is Beta Capricornus (Dabih, 3.0) and near the top center is Alpha Aquilae (Altair, 0.7). Enlarge the page to see all the stars.

Unbuckling Gould's Belt

Larry Faltz



It wasn't until the end of the 18th century that the Sun's place within the Milky Way was a subject of astronomical research. William Herschel counted stars and in 1785 proposed that the Sun was at the center of the galaxy (although the concept of a "galaxy" was certainly not yet clear).



William Herschel's map of the Milky Way

The shape of the Milky Way and the Sun's position within it would not be the subject of rigorous astronomical measurement until the early 20th century, when Kapteyn and then Shapley took up the problem. But after Herschel, improvements in astronomical equipment and techniques made accurate mapping of the local stellar environment much more feasible. By the end of the century, the distances to about 60 stars had been determined by parallax, the exact positions and brightness of many more had been logged. Stellar spectroscopy, due primarily to the work of the Harvard "computers" Annie Jump Cannon and Antonia Maury, led to the Henry Draper Catalog of 1890 and elucidation of the relationship between star color and temperature. The New General Catalog, containing 7,840 deep sky objects, added a trove of information when it was published in 1888.

In 1879, prior to the advent of the stellar classification system, American astronomer Benjamin Apthorp Gould published a catalog of 7,756 southern hemisphere stars within 100 degrees of the South Pole, whose positions he himself had measured at the Observatorio Nacional Argentino in Cordoba. The stars are in 66 constellations, all or part of which are south of +10 degrees declination. Gould noticed that many of the brightest stars appeared to mark out a band in the southern sky that was tilted about 20° from the plane of the Milky Way, highest in the direction of what we now know to be the galactic center.[1] Further analysis suggested that the brightest and bluest stars throughout the celestial globe could be arranged as a band surrounding the Sun. This structure was named Gould's Belt in his honor.

[1] Apparently William Herschel's son John, observing from South Africa in the early 1830's, had an inkling of this distribution.

Benjamin Apthorp Gould
(1824-1896)

Gould was one of the most important American astronomers of the 19th century. A Bostonian, he attended Boston Latin, the first public school in the United States and still one of the premiere high schools in the country (his father was the principal) and went on to Harvard. He studied mathematics, physics and astronomy at the University of Gottingen under the famous Johann Carl Friedrich Gauss, and was the first American to receive a Ph.D. in astronomy. To encourage and advance American astronomy, he founded the *Astronomical Journal* in 1849, modeling it on the prestigious *Astronomische Nachrichten*, the oldest (1821) publication solely dedicated to astronomy. After directing Albany's Dudley Observatory, he was put in charge of the longitude department of the U.S. Coast Guard from 1852 to 1867. In 1868 he went to Argentina to set up their national observatory. A pioneer of astrophotography, he accumulated over 1400 negatives of southern stars and clusters.

The prominent band of bright stars of Gould's Belt can most easily be seen in the southern hemisphere when the Milky Way is overhead, and it's what captured Gould's attention from his vantage point in Cordoba at 31° south latitude.

Bright stars in (left to right) Scorpius, Lupus and Centaurus. The two brightest stars in the lower center are α and β Centauri. To their right are the Coal Sack, the Southern Cross and the red Eta Carina nebula.

From outside our galaxy, the Belt might look like NGC 206, the bright knot of blue stars in the Andromeda Galaxy prominent enough to warrant its own catalog entry.

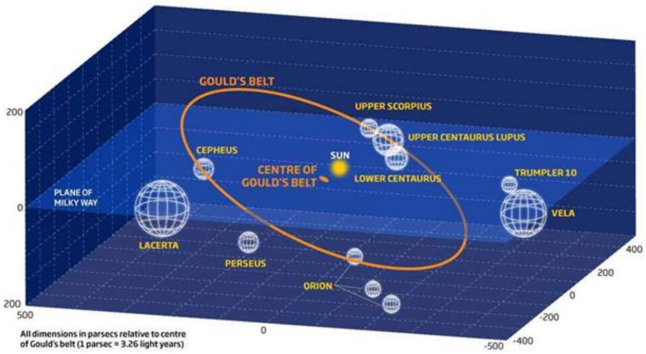
NGC 206 in the Andromeda Galaxy (M31)

The largest but loosest organizational structure reflecting linked astrophysical processes is the "stellar association." Associations are far larger than open clusters but much smaller than the arms of the Milky Way, which are created by gravitational forces rather than by astrophysics. There are three types of associations, OB, R and T. OB associations are groups of very hot, young, massive stars from 10 to 50 solar masses and with absolute luminosities that can be 100,000 times that of the Sun. Open clusters and molecular gas are distributed among these associations. The stars in the associations are thought to have common genesis, as do stars in the open clusters, but are more geographically spread out. The stars in R associations are less massive (3-10 solar masses) and are often surrounded by dust, creating reflection nebulae. An example is the Monoceros R2 Association, containing NGC 2170.[2] T associations are groups of even cooler, redder stars and often contain systems still in formation such as T Tauri.

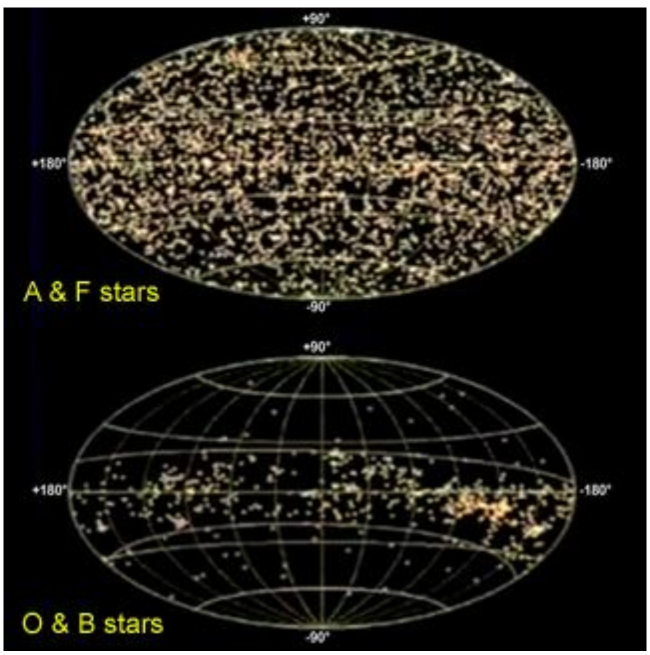
Gould's Belt is essentially a collective of OB associations, in which sit hot, young O and B stars, open clusters and gas, as portrayed in the graphic at the beginning of this article. Because of all the active star formation, intense stellar winds further roil the molecular clouds. Within the Belt are runaway stars such as ζ (zeta) Oph, supernova remnants (the Vela supernova remnant, the Orion-Eridanus superbubble), obscuring dust clouds, famous open clusters, and well-known stars that we wouldn't think of as being related to

[2] For an excellent description and image of this object, see http://www.robgendlerastropics.com/NGC2170text.html.

each other: Alkaid (η [eta] Uma), δ (delta) Cep (the prototype Cepheid variable), and the stars of Orion's Belt, among many others.



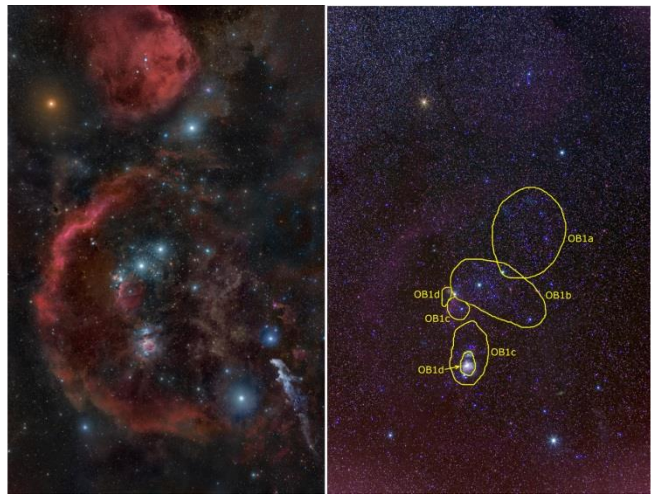
Model of Gould's Belt based on Perrot, CA, Grenier, IA, 3D dynamical evolution of the interstellar gas in the Gould Belt, *Astronomy & Astrophysics* 2003; 404, 519-531



The Hipparcos satellite, which measured stellar spectra and distances with unprecedented accuracy from 1989 to 1993, provides evidence for the Belt. The top image above shows all the A and F stars within 1500 LY from the Sun, while the bottom image shows the hotter, younger O and B stars in that range.

For an excellent description of the geography of Gould's Belt, see the article by Glenn LeDrew in the January 2000 issue of the newsletter of the Royal Astronomical Association of Canada.[3]

The Sun is inside, but not at the center, of Gould's Belt. We are approximately 40 light-years (12 parsecs) north of the Belt's equatorial plane and about 325 light-years (100 parsecs) from its center. Its diameter is about 3,000 light years (920 parsecs). The mystery of Gould's Belt is that it is quite young, with its oldest members only about 30 to 50 million years old. Many of its youngest members are just a few millions years old. Yet the Sun is almost 5 billion years old. How did our relatively senior star end up in the middle of a stellar nursery?



(L) Orion Giant Molecular Cloud Complex, (R) the location of the components of the Orion OB1 association

A number of mechanisms have been proposed to account for Gould's Belt. Thirty million years ago, something must have triggered a burst of star formation, most likely starting in the region of the Perseus OB3 association. It might have been a powerful density wave in the spiral arm of the galaxy, or a high-velocity gas cloud falling back onto the galactic plane, or a hypernova, or something else that would have compressed local molecular clouds enough to initiate new star formation. Star formation can beget more star formation as shocks from supernovas and stellar winds from young stars further mix and compress the gas clouds. A remnant of this early period may be the Melotte 20 cluster that surrounds Mirfak (α Per). In addition, since movement of stars and gas along the rotational plane of the galaxy is sinusoidal, deformations might account for the 20° tilt.

An interesting suggestion was made by Kenji Bekki from the University of New South Wales in Australia in 2009.[4] He proposed that the Gould Belt was formed when a dark matter clump of some 10^7 solar

[3] http://ottawa.rasc.ca/ottawa.rasc.ca/files/publications/Ottawa-2000-01.pdf

[4] https://arxiv.org/pdf/0906.5117.pdf

masses collided obliquely 30 million years ago with a gas cloud of about 10^6 solar masses. This was based on simulations, but the resulting models fairly accurately reproduced the dynamical behavior of the cloud and its stars, including star formation rates, rates of expansion and stellar radial velocities.

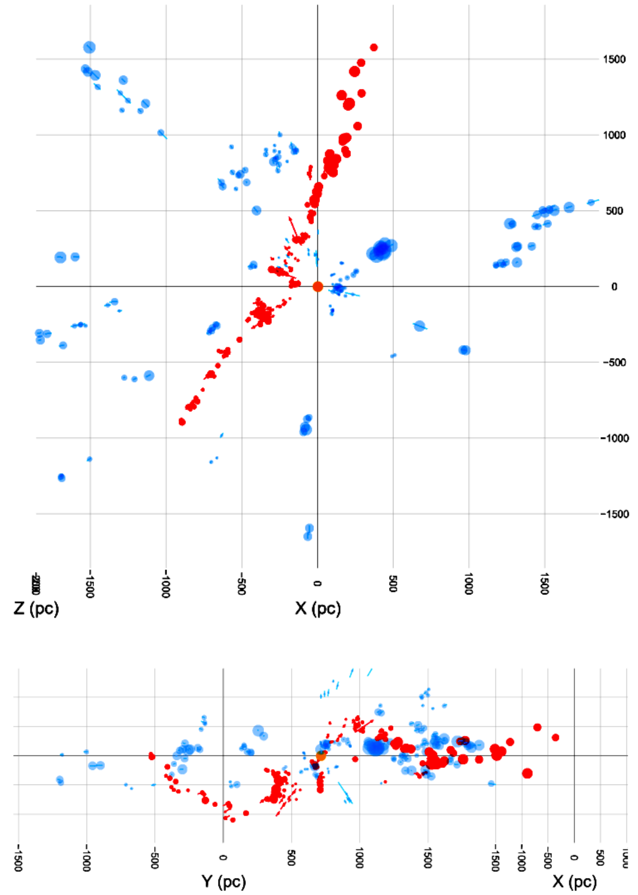
More recently, a group based at Harvard determined the distances to all local molecular cloud complexes to reveal their three-dimensional structure.[5] Rather than a ring, they find a "narrow and coherent 2.7-kiloparsec (8,800 light-years) structure of dense gas in the solar neighborhood that contains many of the clouds thought to be associated with the Gould Belt." They named this structure the Radcliffe Wave, "in honor of early 20th century women astronomers Radcliffe College and the Radcliffe Institute, which contributed to this discovery."

It's a wave because it appears to be undulating on the galactic plane, perhaps shaped by the sine-wave motion of stars and gas above and below the plane as they rotate with the galaxy. The authors go on to suggest that the entire structure is moving tangentially with about the same speed as the local galactic disk. The mass of the structure is at least 3 x 10^6 solar masses. There is a second, smaller linear structure about 1 kiloparsec long containing the Scorpius-Centaurus, Aquila and Serpens clouds. The authors call it the "split."

The authors go on to state that "with the improved distances, [the Gould Belt] is a poor fit to the data…. This fact alone challenges [its] existence, as two points can always define a ring. Because four out of five of the Gould Belt clouds (Orion, Perseus, Taurus Cepheus) are part of the much larger Radcliffe Wave, whereas one of the five (Ophiuchus) is part of the split, we propose that the Gould Belt is a projection effect of two linear cloud complexes against the sky. Our results provide an alternative explanation for the 20° inclination of the Gould Belt: it is simply the orientation of the Radcliffe Wave from trough (Orion) to crest (Cepheus)…. [T]he X-Y distribution of local B-stars in these regions from the 30-year old Hipparcos satellite resembles the two elongated linear structures more closely than a ring, bolstering previous suspicions that the Gould Belt is a projection effect."

[5] Alves, J. et. al., A Galactic-scale gas wave in the solar neighborhood, *Nature* 2020; 578:237-239

However, the authors are unable explain the origin of the Radcliffe Wave.



Top: Linear distribution of Radcliffe Wave as seen from above the galactic plane; Bottom view from plane of galaxy. Red dot at center is the Sun.

It should not be of any concern to amateur observers that the Gould Belt may very well have been "unbuckled" by this new work and that it may not be an actual cosmic structure. The constellations themselves are not coherent structures in space (only Orion, Crux, Lupus, Centaurus and northern Scorpius even come close). They're all just projections. We've made them up, but we're happy to use them to know where we are in the sky. So even if Gould's Belt turns out not to be an astrophysically integrated ring structure responding as a unit to galactic rotational forces and expanding after a discrete cosmic event not far from us thirty thousand millennia ago, it's a useful construct to help us perceive our corner of the Milky Way galaxy. And other than an indistinct crater in the Mare Nubium, we seem to have no other way of remembering a very important American astronomer. ■

Images

NGC 4565 by Gary Miller

Number 38 in Patrick Moore's *Caldwell Catalog* extension of Messier's listing of deep sky objects, edge-on spiral galaxy NGC 4565 in Coma Berenices was discovered in 1785 by William Herschel. At magnitude 9.6 but with excellent surface brightness, the galaxy is visible in medium-sized telescopes. It is about half as wide across as the full Moon. The nucleus can appear star-like, just offset from the equatorial dust band.

The Caldwell Catalog was created by famed British astronomer and writer Sir Patrick Moore. It was first published in 1995 in Sky & Telescope. It contains 109 objects (the same number as the Messier catalog—even though there's an M110 there are still just 109 objects since Moore claims M102 is a duplicate of M101). Moore selected objects as far south as 47 Tucanae in the Small Magellanic Cloud, but the bulk of the objects are visible from mid-northern latitudes. They were selected for their appeal to amateur observers, and included brighter objects that Messier overlooked, such as the Double Cluster in Perseus

We've posted a listing of the Caldwell objects organized by constellation, complete with NGC numbers and images, on the WAA website. Download it at https://westchesterastronomers.org/wp-content/uploads/2020/03/Caldwell-catalogue.pdf.

For more information on the Caldwell objects, we highly recommend Stephen James O'Meara's *The Caldwell Objects*, part of his Deep-Sky Companions series, published by Cambridge University Press (2002).

Narrow and Wide from Steve Bellavia

M78

Reflection nebula in Orion.

M78 is a member of the Orion Molecular Cloud complex, 1350 light-years distant, and as such is associated with Gould's Belt.

Saturn, Mars and Jupiter, March 26, 2020, 5 AM

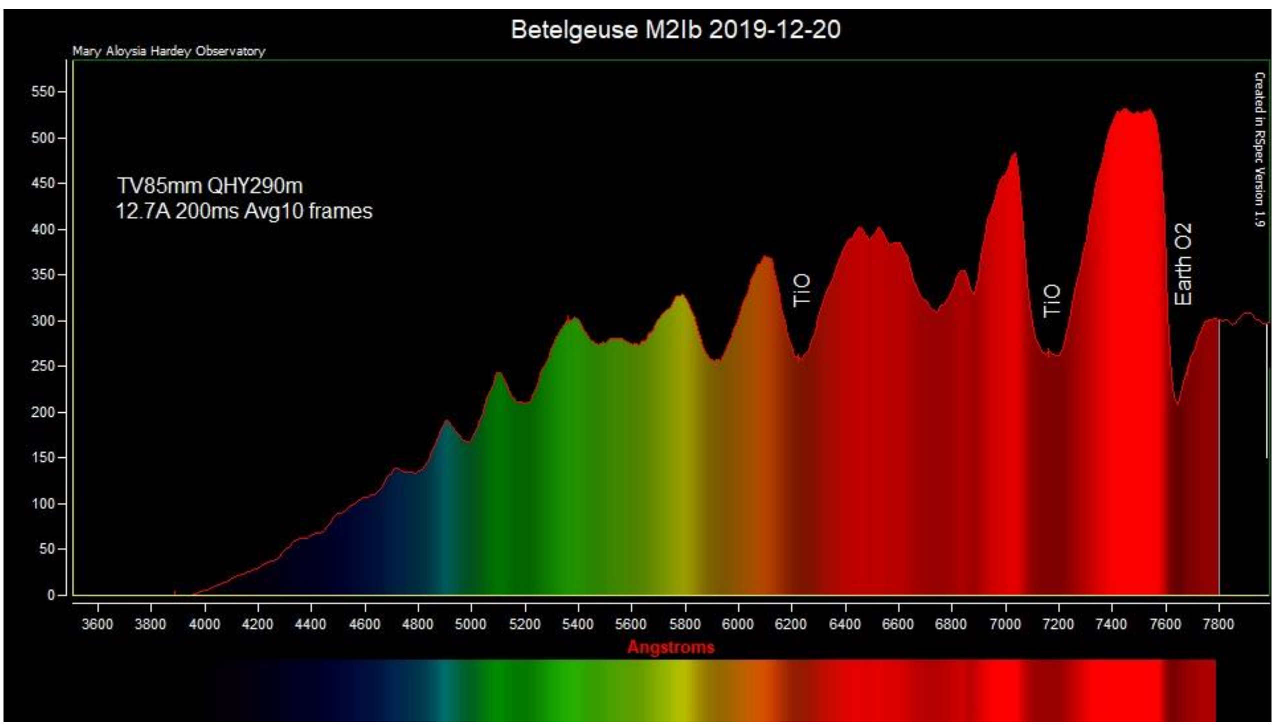
Steve images from eastern Long Island.

M78 image: Telescope: 4.5-inch f/4, semi-homemade Newtonian reflector. ZWO ASI 183MM Pro and ZWO ASI 183MC Pro, cooled monochrome and color astronomy cameras. Various filters. SkyWatcher EQ6-R Pro equatorial mount. Guide telescope: Vintage Tele-Lentar 300mm camera lens, guide camera: ZWO ASI224MC. Total time=6 hours.

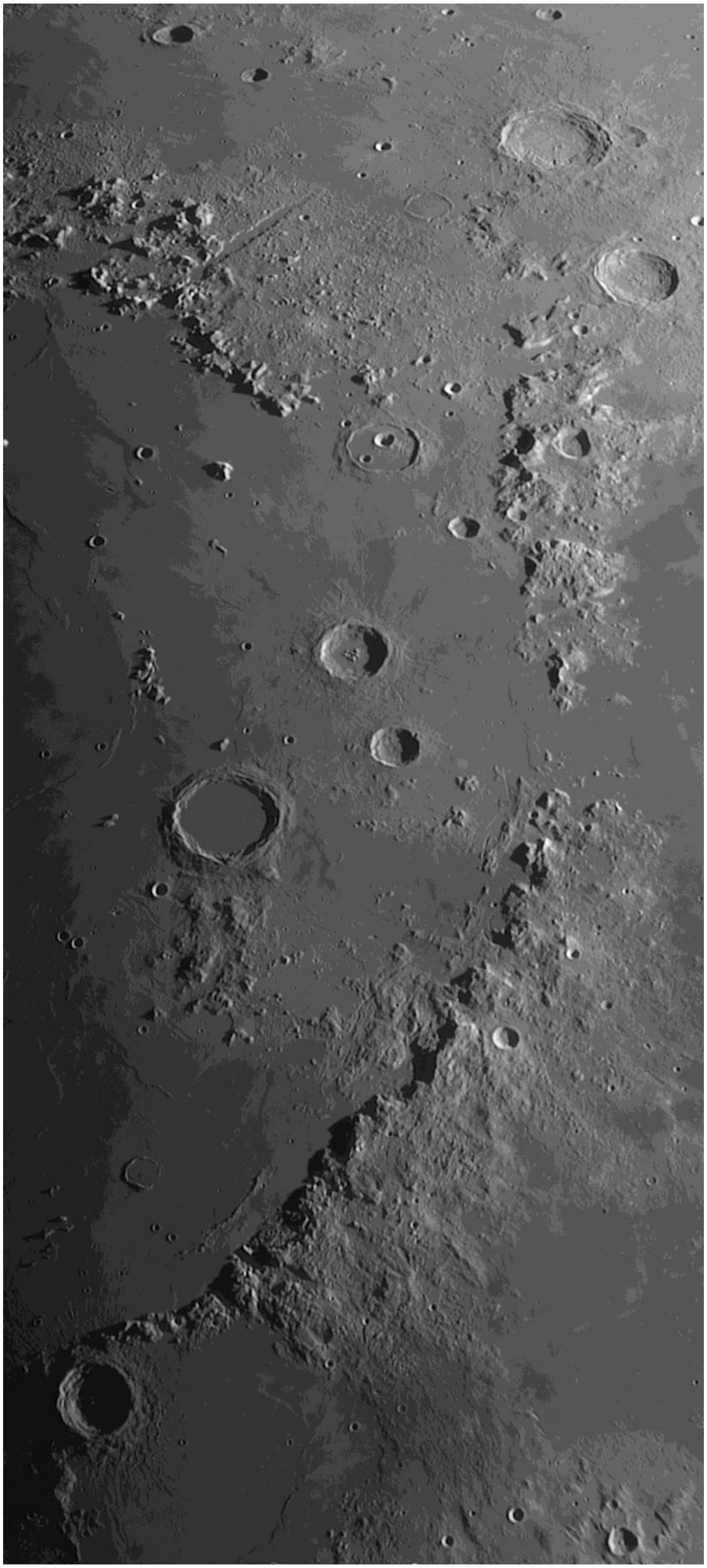
Wide field image: Canon EOS SL1, Canon 100mm f/2 lens, stopped down to f/4.1 using 1.25-inch UV-IR cut-filter, which has approximately 24.5 mm open diameter. Five 4-second subs, ISO 1600 plus 25 dark frames at the same ISO and exposure.

Greg Borrelly's fine shot of the first quarter Moon on the night of April 1st. Lots of detail and contrast along the terminator, from Plato in the north, past Eratosthenes down to Tycho and Clavius in the south.

Robin Stuart's narrower field image from the same night is on the next page.



Rick Bria imaged the spectrum of Betelgeuse in December, when it had already dropped 1.3 magnitudes from its maximum, most likely due to a dust cloud obscuring its southern hemisphere. Red Giant atmospheres are rich in titanium oxide, which has absorption bands at the red end of the visible light spectrum. Betelgeuse reached its nadir around February 7th, magnitude +1.614, only 22% as bright as when it is at its maximum magnitude of 0.0. By the end of April, Betelgeuse had recovered its former brightness.

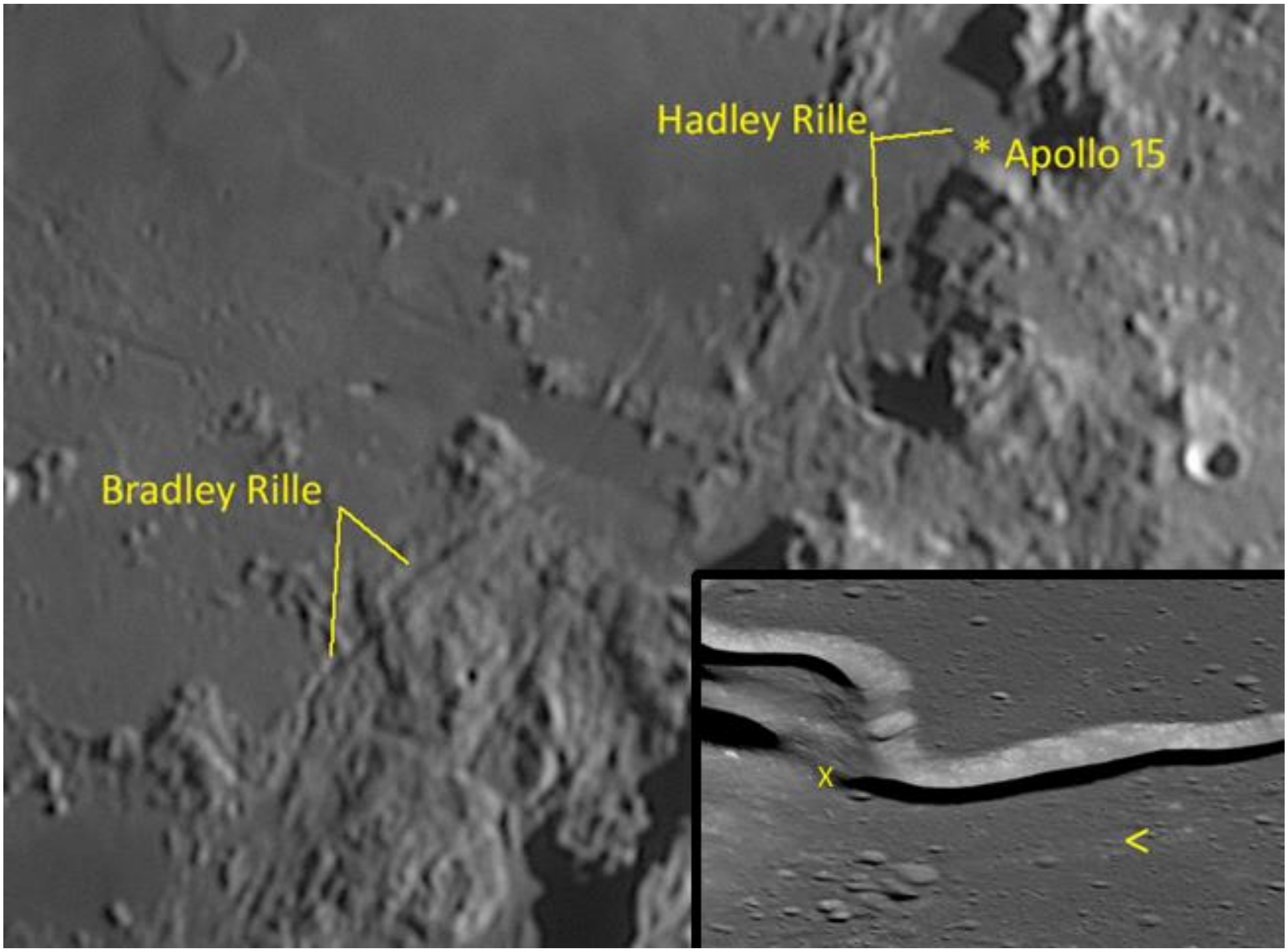


The Apennines and the Apollo 15 Landing Site by Robin Stuart

The sweeping arc of the Apennine Mountains meets the Caucasus Mountains in the upper right part of this image (left). On the upper left the Alpine Valley slashes through the lunar Alps. The large flat-bottomed crater at center-left is Archimedes and above it are the Spitzbergen Mountains, an archipelago in the Sea of Rains (Mare Imbrium). Further to the north the solidary Mount Pico catches the dawn sunlight. At bottom left the crater Eratosthenes emerges from the shadows. This crater is painted with ejecta from the younger crater Copernicus that lies some 300 km to the south west, as shown in the image on page 17 of the May 2020 SkyWAAtch. Eratosthenes becomes practically invisible at full Moon, but it's a deep and beautiful crater when it emerges from the terminator at local dawn.

Bradley Rille runs parallel and to the north of the lower Apennines. Zooming in further reveals Hadley Rille (next page), the landing site for Apollo 15. This mission, in July 1971, was the first to carry the Lunar Rovering Vehicle (LRV). Hadley Rille averages just 1.2 km across and is also shown in "Street View" along with astronaut Commander David Scott and the LRV on the next page.

Taken on April 1st, this is a 2 image mosaic, each a stack of around 35 images taken with a Meade LPI-G monochrome video camera through a Tele Vue-NP127 using a 5× Powermate. On that day the first quarter Moon culminated at 72° altitude from my location and was ideally placed for early evening viewing, with the zone east of the terminator perfectly illuminated for imaging.



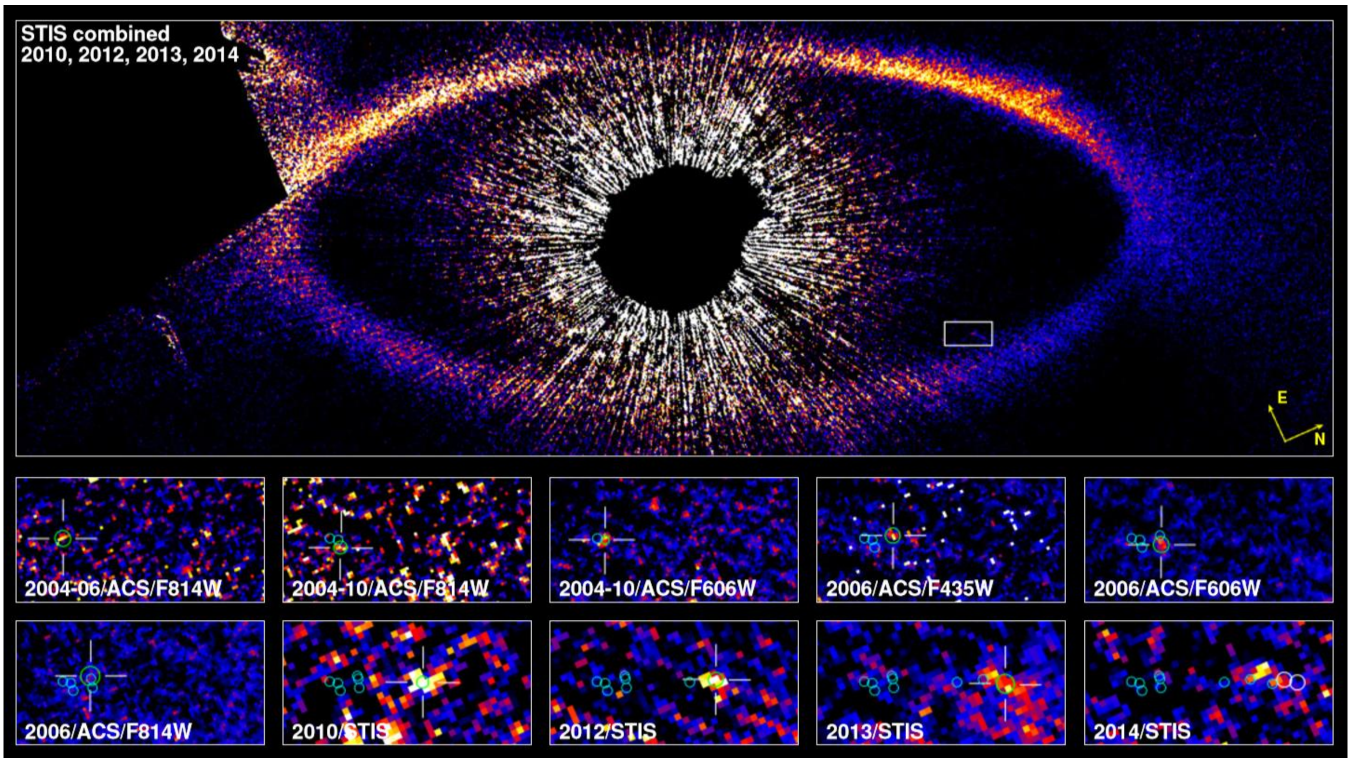
Annotated enlargement of a section of Robin Stuart's image showing the locations of Bradley and Hadley rilles and the Apollo 15 landing site. Inset: Lunar Reconnaissance Orbiter Camera view looking west over the Apennines. The Apollo 15 lunar module site is at the point of the **<** symbol (LM not visible on the image). On their first EVA, which lasted 6½ hours and covered 10.3 km, the astronauts travelled to the edge of Hadley Rille at its bend left of center, and to the base of St. George crater, the large depression cut by the left edge of the inset.

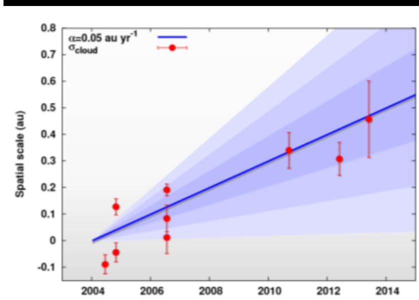
David Scott with the LRV, Hadley Rille in the background. Robin Stuart made this never-before-seen panoramic with Microsoft ICE, merging several Apollo 15 images taken by James Irwin, whose shadow is at the lower left corner. The images were taken at the point marked "X" in the inset, above.

Research Highlight of the Month

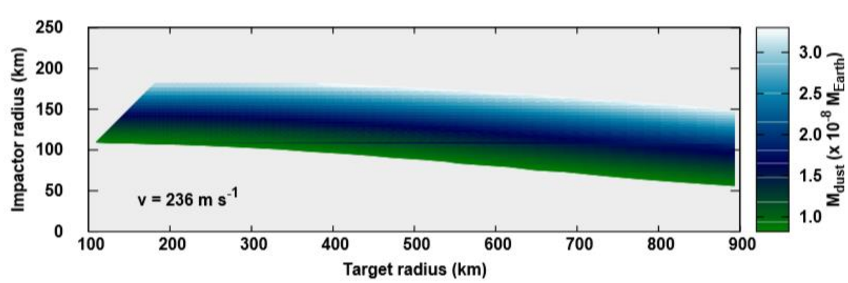
András Gáspára and George H. Rieke (Steward Observatory, Tucson), New HST data and modeling reveal a massive planetesimal collision around Fomalhaut

Summary: The planetary nature of Fomalhaut b has been a mystery ever since its detection over a decade ago. In this paper, we present previously unpublished measurements of this object, and also re-reduce all archival data to present a coherent analysis that shows its behavior over a decade. We find that the source has grown in extent since its discovery. We use updated astrometry and orbital solutions, finding its motion is consistent with radial (escaping) motion. To explain these new observations, we model Fomalhaut b as an expanding dust cloud, containing copious amounts of dust produced in a massive planetesimal collision. Our model produces a light curve, angular extent, and orbital motion consistent with the observations spanning a decade. While Fomalhaut b is not likely to be a directly imaged exoplanet, it is probably the first super catastrophic planetesimal collision observed in an exoplanetary system! Production of this amount of dust through planetesimal collisions in dynamically quiescent systems should be very rare. The rate of such events would be increased substantially if hypothetical planets around Fomalhaut are undergoing orbital migration, resulting in a dynamically active population of planetesimals. (https://arxiv.org/pdf/2004.08736.pdf)





Spatial Evolution of the dust cloud



The amount of dust produced up to radii of 1 mm as a function of the radii of the postulated target and impactor planetesimals, assuming a collisional velocity of 236 m s^{-1}

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Meade 395 90 mm achromatic refractor	Long-tube refractor, f/11 (focal length 1000 mm). Straight-through finder. Rings but no dovetail. 1.25" rack-and-pinion focuser. No eyepiece. Excellent condition. A "planet killer." Donated to WAA.	$100	WAA ads@westchesterastronomers.org
Meade LX-70 Equatorial Mount	Dual Axis Drive and Polar Scope - Brand New. Bought during the closeout sale of these mounts. Owner thought he might like to have a light GEM, but decided to stick with alt-az mounts. Set up once in the garage to be sure it all works, and it does, but never saw first light in the field. Price paid: $365.	$195	Eugene Lewis genelew1@gmail.com
Sky-Watcher 10" f/5 reflector OTA	Brand new in box. Newtonian optical tube, 2" focuser, tube rings. No eyepieces, finder or dovetail. Would make a great Dobsonian or use on a decent sized GEM. These listed at over $500 when new. Donated to WAA.	$225	WAA ads@westchesterastronomers.org
Celestron 6-inch f/5 reflector OTA	Same tube as the Orion 6" StarBlast. 1¼" rack-and-pinion focuser, Celestron 25 mm EP, tube rings, dovetail plate. 5x30 straight through finder. Dark canvas carrying case with compartments, room for accessories. Excellent condition, unblemished optics. This size OTA is hard to find without a mount. An Orion StarBlast 6 with 1¼" focuser and table-top Dobsonian mount lists for $379. Meade's 6" f/5 OTA, admittedly with a 2" Crayford focuser but no case, lists for $339. Donated to WAA.	$175	WAA ads@westchesterastronomers.org
Celestron Orange Tube C8 **NEW LISTING**	A classic gem from the 1970's! WAA has had this scope in storage for a long time. Serial #25778-6, labeled "Celestron Pacific," so it was made before 1978, when the company became "Celestron International." Perfect condition, unblemished optics, comes with 110 volt power cable, finder and wedge, lacks only the tripod. Includes several eyepieces and other paraphernalia. You could also de-fork it and use the optical tube on a go-to GEM, which actually makes the most sense, although you might feel bad about getting rid of the iconic Celestron fork mount. Current Celestron 8" SCT optical tubes list for $679-$800.	$300	WAA ads@westchesterastronomers.org

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to ads@westchesterastronomers.org. Member submissions only. Please submit only serious and useful astronomy equipment. WAA reserves the right not to list items we think are not of value to members.

Buying and selling items is at your own risk. WAA is not responsible for the satisfaction of the buyer or seller. Commercial listings are not accepted. Items must be the property of the member or WAA. WAA takes no responsibility for the condition or value of the item, or 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!*