SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

January 2020

Moonrise over Mount Vesuvius

Your editor took this shot of the near-full Moon (98.8% illuminated) rising over Mount Vesuvius on October 12, 2019 from the Castel Sant'Elmo in Naples, Italy. The castle, in the Vomero neighborhood, is reached by funicular from the central part of the sprawling city, which is below and off the left side of the image. The busy harbor is flanked by industrial areas and suburbs that extend to the base of the still-active volcano (last eruption in 1944). Sony DSC-RX100, ISO 800, 1/80 sec f/4.9, 35 mm equivalent focal length 98 mm. Original RAW image 5472 x 3648 pixels processed in Sony Image Data Converter version 5, converted to jpg file.

WAA January Meeting

Friday, January 10th at 7:30 pm

Lienhard Hall, 3rd floor
Pace University, Pleasantville, NY

Why Go Back to the Moon?

Andy Poniros
NASA Solar System Ambassador

Andy has been a NASA volunteer since 1997 and a NASA/JPL Solar System Ambassador since 2004. He has a degree in Electrical Engineering and has worked as a Medical Imaging Engineer for 45 years. He is certified by NASA to handle Lunar samples, is a science correspondent for radio station WPKN in Connecticut where he produces astronomy and space mission radio shows and podcasts. He's also an amateur astronomer and telescope maker.

Pre-lecture socializing with fellow WAA members and guests begins at 7:00 pm!

New Members

Brian Carroll	Ossining

Renewing Members

Castellano Family	Hawthorne
Byron Collie	Croton on Hudson
Kevin Doherty	White Plains
Sharon and Steve Gould	White Plains
Daniel R. Poccia	Cortlandt Manor
Richard Segal	Yorktown Heights
Cliff Wattley	Danbury
Roger Woolcott	Brewster

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

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Editor: Larry Faltz
Assistant Editor: Scott Levine
Editor Emeritus: Tom Boustead

WAA February Meeting

Friday, February 7th at 7:30 pm

Lienhard Hall, 3rd floor
Pace University, Pleasantville, NY

Methane on Mars

Br. Robert Novak, PhD, SJ
Iona College

February is Mars month at WAA. Brother Novak is a member of the team at the NASA Goddard Space Flight Center's Solar System Exploration Division, studying the Martian atmosphere using large terrestrial telescopes in Hawaii. He will bring us up to date on exciting recent findings from his group and from the Mars Curiosity rover that may suggest a biologic origin to atmospheric methane on the Red Planet.

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 Star Party

Ward Pound Ridge Reservation,
Cross River, NY

The next star party will take place in March. We will ring in the vernal equinox with a star party on March 21st, with a rain/cloud date of March 28th.

Also In This Issue

ALMANAC For January 2020

Bob Kelly, WAA VP for Field Events


1Q
Jan 2

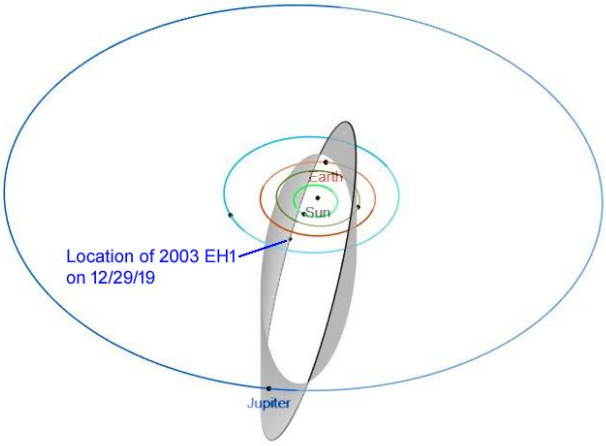

Full
Jan 10


3Q
Jan 17


New
Jan 24

The bone-chilling event of the month is the Quadrantids meteor shower. These pieces of asteroid 2003 EH_1 can produce a meteor a minute at their peak. The bad news is the peak only lasts a few hours. The good news is the peak occurs at 3:20 AM, peak meteor shower time, and without a bright Moon. An investment of couple of hours in the bleak mid-winter night will give you a wealth of tiny streaks in the sky. Bob King provides a comprehensive report on how to prepare to view a winter sky show in January's *Sky and Telescope*. I like being in a sleeping bag on a lay-out lawn chair with my house blocking any bright lights. WAA members can view at the Ward Pound Ridge Reservation provided they notify the park 24 hours in advance and bring their ID cards.

2003 EH_1 is a chunk of rock, not a comet, so it's an unlikely source for a meteor shower. Maybe the pieces are left over from a really bad breakup that 2003 EH_1 hasn't gotten over yet.



Orbital diagram of 2003EH1 (from NASA/JPL Small-Body Database Browser, https://ssd.jpl.nasa.gov/sbdb.cgi)

Mars starts the month alone in the morning sky. At magnitude +1.5, it's a pale pinkish dot low in the southeast just above the claws of the Scorpion. Compare color and brightness with "anti-Mars" Antares five degrees below Mars at mid-month. By then, Jupiter pops up to keep Mars company in the morning sky, low to the left. Saturn follows at the end of the month, even farther to the lower left.

Before that, Jupiter and Mercury pass through the Solar and Helispherical Observatory's C3 camera.* Saturn and Mercury make their closest approach, which should be visible in the C3 field, on the 11th.

There are still no sunspots for us white-light solar observers as we are in an extended solar minimum in the 11-year cycle of solar activity.

Venus outshines all the other bright points in the evening sky. Otherwise, Uranus would lay claim to the brightest of the wanderers in our evening sky. Neptune precedes Uranus to the western horizon. We have another chance to watch Venus sliding underneath the crescent Moon on the 27th, in case you missed the closer pass that made a cosmic semicolon in December. That evening, magnitude +7.9 Neptune is hiding less than a Moon-width to the lower right of magnitude -4.0 Venus.

Mercury strays into the evening sky late in January, hugging the horizon to the left of the setting Sun as it moves toward maximum elongation in early February.

Have an overhead skylight and want a romantic weeknight at home? Do some indoor stargazing. Turn out the lights and frame the sublime Seven Sisters overhead in the window. The Pleiades are closest to overhead about 9 PM local time in early January, 7 PM by the end of the month.

The International Space Station overflights are visible in the morning sky through the 12th and in the evenings starting on the 18th.

We have our closest moment each year with the Sun on the 4th, only 1.7 percent closer than the astronomical unit, our average distance from the Sun. The Parker Solar Probe comes to its perihelion, 12 percent of one astronomical unit, on the 29th.

The Moon has a faint penumbral eclipse on the evening of the 10th. It happens before moonrise here. Some folks in northeastern Maine and points north and east might notice it, but it won't be visible in our area. [It's not a dramatic enough event to warrant a trip to northern Maine, and anyway, do you know what the weather is like there in January? Brrr!– Editor]■

* https://sohowww.nascom.nasa.gov/

A Note from the Editor: New Typeface for SkyWAAtch

The note in Calibri 10.5:

I expect that very few of you, if any, print the newsletter. Reading it on screen is easier, consumes no paper or ink, and the images always look better on a monitor. For most text, SkyWAAtch has been using Times New Roman, a typeface based on Times Roman, which was commissioned by the *Times* of *London* in 1931. It's a serif font, one that has little extensions on the letters that facilitate the flow of the eye across the page. Generally, the object in utilizing typefaces is to slow the eye for titles by using sans-serif fonts (those without any extensions on the letters) and speed it for blocks of text with a serif font.

The problem is that sans-serif fonts seem to work better for text on computer screens. Although Times New Roman was modified from the original Times Roman for balanced legibility on screen and on the printed page, it's not really optimal for either usage. On screen, the small extensions on serif fonts are sometimes smaller than a pixel.

Even major scientific publications recognize that their readership accesses the information on-line. The prestigious British scientific journal *Nature* recently acknowledged this fact. In order to provide "clearer research communication in the digital age" they commissioned a new typeface that optimized screen readability. The new typeface is called "Harding" after Anita Harding, an inspirational professor at London's Institute of Neurology who made important contributions to neurogenetics before her death at the age of 42. The font made its debut in the November 4th issue of the journal. It's a smart and attractive font and seems to serve the intended purpose, but it has not been made available for general use.

After some discussion among our editorial board (me, Scott Levine and Tom Boustead) we agreed to try out a sans-serif font for text. Among the choices available for Microsoft Word, we chose Calibri. We've already been using it for the classified ads on the last page of the newsletter, and we thought we'd try it out for the rest of the publication, generally in font size 10.5 point.

We welcome your feedback. Is the newsletter more readable in Calibri 10.5 than Times New Roman 11?

The note in Times New Roman 11:

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Please send your comments to waa-newsletter@westchesterastronomers.org

Astronomical Events in 2020 — Bob Kelly

Six eclipses worldwide in 2020:

- **January 10**: Penumbral lunar eclipse. Might be faintly visible at moonset in Maine and points north and east.
- **June 5**: Penumbral lunar eclipse: Not visible from the USA
- **June 21**: Annular solar eclipse Not visible from the USA. Visible in Africa and southern Asia
- **July 4/5**: Penumbral lunar eclipse: Near midnight. Visible here, but very faint.
- **November 30**: Penumbral lunar eclipse. Early morning. Visible here, faint; darkest about 5:45 AM EST.
- **December 14**: Total solar eclipse. Visible in Chile and Argentina. Not visible in the USA.

When do we get our turn?

- See partial phases of a total lunar eclipse **May 26, 2021.** The next total lunar eclipse visible in Westchester is **May 15/16, 2022**.
- Next partial solar eclipse is **June 10, 2021.** Peak coverage about 60% just after sunrise.
- Next total solar eclipse is on **April 8 2024.** Totality passes through western New York State.

Perigee Full Moons

- **March 9**: Full Moon occurs 12 hours before lunar perigee.
- **April 7**: Nearest lunar perigee for 2020, 9 hours before full Moon.

Best times to see bright objects

For those of us who prefer evening observing (as opposed to oh-so-early in the morning observing), the best time this year will be after we make our closest approach to the giant crowd pleasers Jupiter and Saturn in mid-July. They will still be fairly low in the sky but still excellent especially for outreach events. The rest of the summer and into autumn, sneaky Mars approaches Saturn in apparent size and eventually surpasses both Jupiter and Saturn in brightness in early October. Mars won't be as close to Earth as it was at the 2018 apparition, but will be 30 degrees higher in our skies and so we'll have a better view of the tiny red planet. Venus has the evening sky stage pretty much to herself for the first four months of the year, and in the morning from late summer through the end of the year. For the first half of the year, the other planets will give preview performances in the morning sky.

The best appearances of Mercury will be In the evening during the first half of February. In June, Mercury's evening appearance will be even better. The planet will will get as high as 19 degrees above the setting Sun. The best morning appearance will be in mid-November.

Jupiter and Saturn will be close enough to almost merge as seen by the unaided eye on the evening of December 21, low in the western sky at Sunset.

Interesting events in our area, by date

- **January 4**: The Quadrantids meteors peak about 4 AM without interference from the Moon, which sets about 1 AM. The peak doesn't last long, but we might see a meteor a minute on average.
- **January 12**: Mercury and Saturn are 2 degrees apart. View them via the Solar and Heliospheric Observatory (SOHO) as they spend the week approaching each other from opposite sides of the Sun. Pluto and Ceres are in the scene, but too faint to be seen.
- **January 27**: Venus and Neptune are less than a quarter degree apart in the evening sky.
- **February 18**: The Moon goes in front of Mars just after sunrise. This might be a good chance to see Mars in the daytime, although the thin Moon will also be hard to find. Telescope or binoculars will be needed.
- **March 8**: Daylight time begins for much of the United States at 2 AM.
- **March 18**: The Moon, Mars, and Jupiter are very close together in the morning sky. Mars spends the next two weeks sailing between Jupiter and Saturn.
- **March 24**: The Moon is at farthest distance from Earth for 2020.
- **April 4**: Venus is in the Pleiades.
- **May 1**: Uranus is just 0.3 degrees northeast of Mercury, but at 4 degrees from the Sun, it's only visible in SOHO's cameras.
- **May 22**: Mercury is very close to Venus in the evening sky, only 19 degrees from the Sun. The Moon joins them on the 23rd and 24th.
- **July 20**: Saturn is at opposition; largest apparent diameter for the year (18.5").
- **August 11/12**: Perseid meteors peak 8 AM on the 12th. The last quarter Moon is rising at midnight and will reduce the number of meteors seen, but the Perseid showers usually have many bright meteors.
- **September 4**: Winter solstice on Mars's northern hemisphere.

- **September 11**: Neptune at opposition; magnitude 7.8, diameter 2.5".
- **October 2**: Venus is 0.1 degree from Regulus; 40 degrees from the Sun in the morning sky.
- **October 13**: Mars is at opposition; magnitude -2.6, disk diameter 22.3". It's 8% farther away than it was at the 2018 close approach, but will be 30 degrees higher in the sky and that may allow us to see more detail on Mars than we did in 2018.
- **October 16**: An unobservable new Moon just four hours before perigee.
- **October 31**: Uranus is at opposition; magnitude 5.7, disc diameter 3.6".
- **November 1**: Daylight time ends Sunday at 2 AM
- **November 14**: The new Moon occurs 17 hours after perigee. Another invisible "supermoon."
- **November 16/17**: Leonid meteors peak in a dark sky (moonset before end of twilight).
- **December 13/14**: Geminid meteors peak 8 PM on the 13th, increasing the chance of seeing meteors in the evening sky. Nearly new Moon is not a problem.
- **December 21**: Jupiter and Saturn will be only 0.1 degree apart, 30° from the Sun in the evening sky. It will be a spectacular conjunction but in our area the planets will set by 6:30 pm. This will be a major observing and imaging opportunity. You will need clear western exposure down to the horizon. At sunset (4:29 PM) the two planets will be just 19 degrees 30 minutes above the horizon at azimuth 216 degrees (southwest). If you want a better view, you'll have to head south, preferably to South America. Go to the eclipse in Argentina or Chile and extend your trip, or have that Australian or South African adventure that you've always wanted.

Mitch Feller at WAA Star Party, May 2019

WAA Meetings and Lectures 2020

Fridays, 7:30 pm

3rd floor lecture hall, Leinhard Hall, Pace University, Pleasantville, NY

January 10
February 7
March 13
April 3
May 1
September 11 (Members' Night)
October 2
November 6
December 4 (Annual Meeting)

WAA Starway to Heaven Star Parties 2020

Saturdays at dusk. Weather permitting.

The make-up date will be one week later if the regular star party if cancelled.

Meadow Picnic Area Parking Lot, Ward Pound Ridge Reservation, Cross River, NY

Regular Date	Rain/Cloud Makeup Date
Mar 21	Mar 28
Apr 18	Apr 25
May 16	May 23
Jun 13	Jun 20
Jul 18	Jul 25
Aug 15	Aug 22
Sep 12	Sep 19
Oct 10	Oct 17
Nov 7	Nov 14

Other important dates:

Northeast Astronomy Forum April 4-5
Rockland Community College, Suffern, NY

WAA Member & Family Picnic
Saturday , June 13, 12 noon-4 PM
Danish Home, Croton-on-Hudson
Courtesy of Erik and Eva Andersen

Member Profile: Rick Bria

Home town: Greenwich

Family: Mary Ann (Wife), Amanda & Gina (Daughters)

How did you get interested in astronomy? When I was in in grade school, people were landing on the Moon. Like everyone in my class, I wanted to be an astronaut. I became an amateur astronomer instead.

Do you recall the first time you looked through a telescope? What did you see? Yes, I saw Jupiter and its four moons through a 3-inch Unitron refractor telescope in my junior high astronomy club. I was hooked.

What's your favorite object(s) to view? What I like about astronomy is the fact that it is multifaceted. I bounce around the sky, interested in many types of objects. While certain objects may occupy my attention for a time, I don't really have a favorite. Indeed, sometimes just looking at the Moon still blows my mind!

What kind of equipment do you have? I'm lucky to have access to a few observatories with research class 14" and 16" telescopes. That is what I use regularly. I do have my own 8" reflector and 10" SCT, but haven't used them in decades.

What kind of equipment would you like to get that you don't have? I would like to have a high resolution spectrograph to record red shifts in galaxies and to do spectroscopy I can't do with my low resolution Star Analyzer.

Have you taken any trips or vacations dedicated to astronomy? Tell us about them. Yes! Saw solar eclipses in Hawaii, Aruba and Idaho. Oddly, I liked the Idaho eclipse the best. It had the best corona in my opinion. I've been to the Connecticut star party several times, Stellafane countless times, and had incredible views of the Milky Way and southern sky objects at the Texas Star Party. Other than getting married and the birth of my children, they were times in my life with the greatest impact.

Are there areas of current astronomical research that particularly interest you? Exoplanets are hot now and interest me very much. When I was a kid exoplanets were just an unproven theory. I am fascinated by the fact that now many thousands of confirmed exoplanets exist. In 2017 I recorded exoplanet WASP 39b using off-the-shelf equipment. If you told me I would be able to do that 5 years ago, I would have said you need medication.

Do you have any favorite personal astronomical experiences you'd like to relate? Either 2000 or 2001, I'm not sure, I saw the Leonid meteor shower from Pound Ridge. I remember reading about the 1966 and 1933 Leonid storms in *Sky and Telescope* magazine at my junior high school library. I promised myself I would see the event. Although not a storm, that Leonid shower was fantastic with many fireballs and trails.

What do you do (or did you do, if retired) in "real life"? I'm the shop foreman at a Subaru dealership.

Have you read any books about astronomy that you'd like to recommend? I loved Stephen Hawking's *A Briefer History of Time*.

How did you get involved in WAA? I heard the WAA a group that got out under the stars as much as I did. They were crazy too!

What WAA activities do you participate in? Sadly, my observatory endeavors keep me from the star parties and being more involved in WAA. But I like to help with the WAA NEAF Booth and present on Members Night.

If you have a position in WAA, what is it? I help out with maintain and upgrading the club's 20-inch Obsession telescope.

Provide any other information you think would be interesting to your fellow club members, and don't be bashful! The great thing about being part of a group is being inspired and learning from different members. I have been inspired and learned from many WAA and ASG (Astronomical Society of Greenwich) members. For that I'm truly grateful.

What Moves the Planets? Larry Faltz

Elyse and I were in Los Angeles last January for a combination family visit and vacation. Trying to decide on a museum for an outing, we came across a listing for "The Museum of Jurassic Technology" on Venice Boulevard in Culver City. What could "Jurassic Technology" possibly be? The mystery only deepened when we looked at their web site, http://mjt.org/. We took a chance and dropped in to the small gallery on a Saturday. Without giving anything away, let me assure you that this is one of the truly not-to-be-missed small museums in the entire world! It's a museum about the concept of museums, the nature of truth, and the richness of the mind. Some things in it are real, some are not, and it's not so easy to tell which. There are a number of exhibits that relate to astronomy, but in peculiar and intriguing ways. If you are in LA, don't miss it!

Among the installations was a room dedicated to the 17th century Jesuit intellectual and polymath Athanasius Kircher (1602-1680). He was the author of over 40 scholarly books on a vast range of topics. One of his biographers referred to him as "the last man who knew everything." The MJT's affinity for Kircher is understandable not only for his eclecticism but to honor his creation of one of the world's first museums, the *Museum Kircherianum* at the Roman College, an expansion on the theme of the *Wunderkabinett* (Cabinet of Curiosities) constructed by educated and wealthy connoisseurs beginning in the late 16th century. Kircher studied medicine, Egyptology, Sinology, mathematics and microbiology among many other fields. He had himself lowered into the caldera of Mt. Vesuvius to investigate its geology. He researched acoustics, wrote music and invented instruments, perhaps foremost among them the *Katzenklavier* ("cat piano"). This was a jig in which a number of the felines would be restrained. A keyboard was linked to hammers that would drive spikes into the cats' tails, eliciting yowls at specific pitches. It is not known whether this instrument was ever built, but the concept is, well, intriguing, and the sounds would have been fantastic.

Among Kircher's many inventions was a magnetic clock. He wrote about magnetism in a large 1641 work *Magnes sive de Arte Magnetica Opus Tripartitum* (Magnets, or the Magnetic Art, a work in three parts). Kircher's book is both scholarly and frivolous and veers off into some strange areas including a discussion of tarantulas. Sadly it's not been translated into English, so I couldn't read it. I did get an information-rich, illustrated coffee-table book about Kircher, Joscelyn Godwin's *Athanasius Kircher's Theater of the World: The Life and Work of the Last Man to Search for Universal Knowledge* (2009). The ever-interested Kircher seems to me to have embodied the old saying (used by internists such as myself to rib surgeons) "Often wrong, but never in doubt." Kircher's magnetic opinions will come back to our story near the end.

Shortly after my California trip I was in Albany for a medical meeting. Afterwards, Elyse and I drove up to Saratoga Springs to visit the Tang Museum on the Skidmore campus. On our way back through town we stopped in the Lyrical Ballad Bookstore, an improbable labyrinth of used books of every description and condition. Heading over to the Astronomy section, I came across a mint paperback copy of Thomas Kuhn's *The Copernican Revolution*. Kuhn is most famous for the enormously influential *The Structure of Scientific Revolutions* (1962), the work that put the (now overused) phrase "paradigm shift" into our language.

In *The Copernican Revolution* (1957) Kuhn meticulously explains how planetary motions were modeled by the Greeks. He traces the development of planetary astronomy through Ptolemy, the medieval scholastics, Copernicus, Kepler and Galileo. He exhaustively analyzes Copernicus's *De revolutionibus orbium coelestium* chapter by chapter. Kuhn also pays a great deal of attention to Tycho's hybrid model that kept the Earth at the center but had Mercury and Venus orbiting a planetary Sun. He reminds us that planetary astronomy did not exist in limbo, but influenced and was influenced by contemporary social and religious beliefs. The inclusion of diagrams and geometrical examples explaining how the various solar system models accounted for astronomical phenomena is a highlight of Kuhn's book.

Until Kepler, it was a given that all motions in the cosmos beyond the Earth were circular. Why did this principle hold for over 2,000 years? How was it supposed to work? Newtonian gravitation as the impelling force of the cosmos is so ingrained in our modern brains that we

forget that it's a comparatively young concept. What was the "force" that moved the planets before Newton? And so, with thoughts of orbits, magnets and planets in my head I decided to investigate by starting at the beginning. I got a hold of Plato's *Timaeus* and Aristotle's *On the Heavens* and *Metaphysics*.

I sometimes joke that the purpose of an education at my alma mater, Columbia, seemed to be to force the student to decide whether Plato was right or Aristotle was right. Columbia's core curriculum was founded a hundred years ago on reverence for Greek and Roman civilization as the basis for all subsequent Western culture, which of course it is. You can see that in the names on the frieze of Butler Library on the Columbia campus: Homer, Herodotus, Sophocles, Plato, Aristotle, Demosthenes, Cicero, Virgil. I had to read works by all of them before I finished my freshman year. The readings were distributed in two courses: Contemporary Civilization (CC) and Literature Humanities. Both featured classes of a dozen or so students with senior professors from among a variety of humanities departments. The Socratic method of reading, questioning and discussing, was used.

CC started with Plato's *Republic* and Aristotle's *Nichomachean Ethics*. Pimply 18-year old freshmen (all men at Columbia College from its founding in 1754 until 1987) were confronted with the Platonic-Aristotelian dichotomy: Are all things in the universe—real objects, social organization and even moral and ethical behavior—an imperfect reflection of some ideal form that exists outside of reality itself, although we can glimpse the ideals through reason (Plato)? Or, is reality all that there is, and we can know everything there is to know about the world, including behavior and social organization, simply from observation (Aristotle)?

Plato's Realm of Forms, most famously illustrated in the Cave, where the prisoners only see the shadows on the wall, posits that there are truths that cannot be revealed merely by observing the material world. We only see appearances, which can't be genuine knowledge. We can reason to discover the ideal truth, but we can't just observe it. Aristotle, on the other hand, envisioned a logical process that would show that everything *was* present in the real world. His writings are intensely analytical, often using the dialectic: he chooses among exclusive alternatives to figure out what makes sense. By asking which alternative is confirmed by observation he gave birth to science, even though the actual scientific revolution had to wait until the 16th century. Plato's impact on the history of Western thought was more immediate, because the nascent Catholic Church adopted the 3rd century CE doctrine of Neoplatonism, Plotinus's riff on Plato. Christianity was happy to conform itself to a philosophy that made room for the immaterial. The Neoplatonist Augustine of Hippo's *City of God* (426 CE), another book in my CC curriculum, was arguably the founding document of Catholic philosophy. Aristotle's ideas might have shaped western civilization sooner than Plato's had not Alexander the Great, whom Aristotle tutored, died at such a young age, his empire broken up and later replaced by Rome. The tenets of the Catholic Church could have been quite different had Alexander lived to a ripe old age.

Ultimately, though, it was Aristotle, not Plato, who was referred to as "*The* Philosopher" starting in the late Middle Ages. Unlike Plato, Aristotle was essentially unknown in Europe until translations from Arabic started arriving in the middle of the 12th century. Fresh and attractive, they exploded into the consciousness of scholars at those newly created institutions of knowledge, universities (the first one, the University of Bologna, was founded in 1088). Aristotelian philosophy was a substantial driver of the Renaissance; it complemented but did not replace Plato. The dual importance of Plato and Aristotle to the Renaissance is reflected in Raphael's great fresco at the Vatican, *The School of Athens,* where the Plato and Aristotle are the focus at the center of the image.

Rafaello Sanzio, *The School of Athens*, 1509-1511, fresco 300 x 200 inches (big!!), Apostolic Palace, Vatican City, Rome

As it happens, Elyse and I visited the Vatican Museum in October. Looking at the *School of Athens* from up close I was struck by the poses that Raphael chose for the two philosophers' right hands. Plato is pointing up, undoubtedly referencing his ideal, heavenly world, while Aristotle has his hand outstretched, as if he were saying "No, *this* world is where everything is."

We can trace Greek cosmology back to the Pythagoreans, two centuries before Plato. They are known for their reverence of mathematics, but their philosophy was much more comprehensive and often quite mystical. Anaximander, Pythagoras's teacher, lived early in the 6th century BCE. He broke with the mythic Greek tradition that had the Gods physically moving celestial bodies (Helios carrying the Sun on his chariot, for example). He seemed to be the first to suggest that the stars and planets, including the Sun and Moon, moved circularly on wheels surrounding the Earth, which floated in the center of the universe (he thought the Earth was shaped like a cylinder). Pythagoras (c. 570 – c. 495 BCE) and his contemporary Parmenides vie for the credit of suggesting that the Earth itself was spherical, which was accepted by Plato, Aristotle and apparently by just about everyone else in the classical world, but only proven by Eratosthenes around 240 BCE. Kuhn talks about the "two sphere model" -- an Earthly sphere and a heavenly sphere -- that worked perfectly well for navigation and the calendar, which, with astrology, were the main uses of astronomy at that time.

Philolaus (470-385 BCE), a follower of Pythagoras, seems to have been the first Copernican. He suggested that there was a "central fire" around which the Earth, the Sun and all the other planets and stars rotated. This idea is credited to Pythagoras by some scholars but as there are no surviving texts by him, we're not certain, so Philolaus gets the honor. In Philolaus's solar system, the central fire was not visible, at least from Greece. Earth was balanced by a "counter Earth" or *antichthon* on the exact opposite side of the central fire, so we can't see it either. Motive forces are not seemingly considered in these cosmologies. Perhaps they were in the original manuscripts, but we only have reports of reports (and sometimes only reports of those).

Plato (c. 425 – c. 348 BCE) was the most famous student of the Athenian philosopher Socrates. He founded the Athenian Academy and taught Aristotle. Many of Plato's works are in the form of dialogues between Socrates and other Athenian intellectuals. The *Timaeus* (c. 350 BCE) is the dialogue that espouses Plato's view of the creation of the universe and its evolution as far as the development of man. Its importance is reflected in the fact that in Raphael's *School of Athens* the book that Plato is carrying is labelled "Timeo," Italian for *Timaeus*. In this dialogue, Socrates has a conversation with a group of students, bemoaning that the prior day's colloquy about politics was not "entertaining." So to provide a diversion, one Critias relates the story of Atlantis and its destruction at the hands of ancient Athenians. The discussion then turns to a lengthy discourse by the "astronomer" Timaeus on the origin and evolution of the universe (Timaeus of Locris was said to be a Pythagorean philosopher, although whether he actually existed is unclear).

Timaeus explains that the Universe came into being by the action of a God (a *Demiurge*) who modeled it after the eternal Forms but created a real universe that had a beginning. The Demiurge created order out of disorder. Timaeus follows the Pythagorean idea that the universe has consciousness, and he describes the world as an "animal," but one of a peculiar shape.

> … He made the world [the entire universe] in the form of a globe, round as from a lathe, having its extremes in every direction equidistant from the center, the most perfect and the most like itself of all figures.

Later on, Timaeus reviews the four elements, air, fire, water and earth, first proposed by the 5th century BCE philosopher Anaximenes. He assigns to each a geometric shape: tetrahedron (fire), octahedron (air), icosahedron (water), and cube (earth). The fifth geometric solid, the dodecaheadron, is assigned to "the most translucent kind (of air) which is called by the name of aether." Some writers equate the aether with the substance of the (non-terrestrial) universe as a whole, but I don't find this in the *Timaeus*. It seems only later that Aristotle made something structural from this material, differentiating it from the element air.

The Timaeus reads like a long sermon. Although there's some geometry and arithmetic in it to help describe the universe and its contents, Plato doesn't employ formal logic the way Aristotle does.

To Aristotle, there is only what actually exists. Truth comes from contrasting parts reality with each other. In *On the Heavens*, for example, he compares straight and circular, weight and weightless, infinite and finite, hot and cold. After considering how these qualities are man-

ifest in the real world, he comes to his conclusions about the structure and motion of the universe. It's a bit difficult for modern readers to follow the arguments. Living in contemporary times as we do we have to remember our biases: early in our education we learn how things really are and by the time we're reading Aristotle we already know the answers that he was seeking. Until the 17th century, arguments for cosmology had no observational backing other than the crudely measured motions of the planets and the stars. Even the most educated knew nothing beyond what they saw. The Aristotelian reasoning process was invigorating for readers in that kind of epistemological environment. I can't say I was that invigorated when I read Aristotle in college. He can be a bit of a slog, although I was sold by the main argument of the *Nichomachean Ethics*: The goal of life *is* happiness and you achieve it through virtuous action.

Both Plato and Aristotle assume that planetary motion is circular. But as was known even then, the movement of the planets is not constant and they regularly undergo retrograde motion against the stars. About 800 years after Plato, the Greek philosopher Simplicius wrote that Plato had challenged astronomers to figure out how to account for the observed movements of the planets using constant circular motion. No specific text stating this challenge is found in Plato's works, which compared to the texts of many Greek philosophers were well preserved. Perhaps in response to this challenge the mathematician Eudoxus, a student of Plato's just a few years older than Aristotle, developed the first detailed system of cycles and epicycles, all uniformly spherical. Eudoxus's texts were lost and we only have the information as reported by others. Aristotle, who frequently cites his philosophical antecedents, presents them in the *Metaphysics*. He writes

> Eudoxus supposed that the motion of the Sun or of the Moon involves, in either case, three spheres, of which the first is the sphere of the fixed stars, and the second moves in the circle which runs along the middle of the zodiac, and the third in the circle which is inclined across the breadth of the zodiac; but the circle in which the Moon moves is inclined at a greater angle than that in which the Sun moves. And the motion of the planets involves, in each case, four spheres, and of these also the first and second are the same as the first two mentioned above (for the sphere of the fixed stars is that which moves all the other spheres, and that which is placed beneath this and has its movement in the circle which bisects the zodiac is common to all), but the poles of the third sphere of each planet are in the circle which bisects the zodiac, and the motion of the fourth sphere is in the circle which is inclined at an angle to the equator of the third sphere; and the poles of the third sphere are different for each of the other planets, but those of Venus and Mercury are the same.

Aristotle does his own calculation of the number of spheres and comes up with 47. As to how they move, he writes in the *Metaphysics*

> But if there can be no spatial movement which does not conduce to the moving of a star, and if further every being and every substance which is immune from change and in virtue of itself has attained to the best must be considered an end, there can be no other being apart from these we have named, but this must be the number of the substances. For if there are others, they will cause change as being a final cause of movement; but there cannot he other movements besides those mentioned. And it is reasonable to infer this from a consideration of the bodies that are moved; for if everything that moves is for the sake of that which is moved, and every movement belongs to something that is moved, no movement can be for the sake of itself or of another movement, but all the movements must be for the sake of the stars. For if there is to be a movement for the sake of a movement, this latter also will have to be for the sake of something else; so that since there cannot be an infinite regress, the end of every movement will be one of the divine bodies which move through the heaven.

You can see why this can be hard to follow!

In *On the Heavens* Aristotle exhaustively discusses the qualities of the four elements. Each has its own "natural" motion. Air and fire go up, water and earth go down. Heaviness and lightness are due to those motions (not the other way around, as we now know). Aristotle adds another element to the traditional four, but he calls it the "first element" and says that its natural motion is circular, as compared to linear motion of the others. This element makes up the crystalline spheres that hold the planets and is never present in the sublunary (earthly) sphere. It has none of the properties of matter. It was set in motion by a "Prime Mover" outside of the sphere of the stars and needed no further impulse to continue. It's clearly related to Plato's *aether*, but more fully described and functional.

Aristotle also argues that logic requires that the universe had no beginning, unlike Plato, whose World of Forms may be eternal, but whose "real" world was created by the Demiurge, time beginning at that moment. Aristotle's universe may be eternal but it is not limitless:

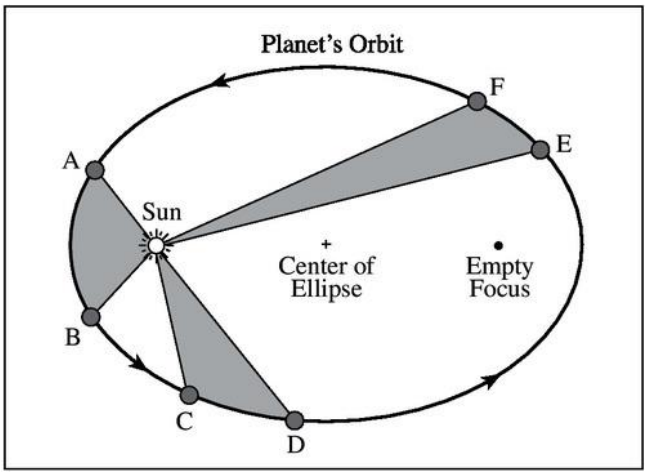
there is an outer boundary, outside of which is nothing. The outermost sphere moves circularly and transmits movement to the planetary (and lunar and solar) spheres interior to it. But, as for Plato, the movements are all circular and once set in motion, no additional impetus is required. It is in the nature of the substance from which the spheres are made that they move, after the initial kick by the Prime Mover.

As more observations of the positions of the planets were made, crude as they may have been, calculations showed that Eudoxus's system wasn't accurate enough. The Alexandrian Greek astronomer Ptolemy added epicycles (for a total of 55), equants and deferents, publishing the *Almagest* in 150 CE. Ptolemy's Rube Goldberg system worked reasonably well and was accepted for nearly 1500 years in spite of the fact that it was so complex and fussy, requiring so many arbitrary elements to work in tandem.

There were stabs at a heliocentric universe in the late Renaissance, but it was left to Copernicus' *De Revolutionibus* in 1543 to commence the transformation of our understanding of the universe.

Kuhn points out that Copernicus's model of the universe still employed circular orbits and epicycles. We honor Copernicus for placing the Sun at the center of the solar system but we forget that he was still in thrall to the ancient belief in circular motion. It wasn't until Kepler showed that the orbit of Mars was an ellipse and that the speed of the planet varied along its orbit that it became clear that an eternal circular motion wasn't tenable. Something had to speed the planet up when it was closer to the Sun and slow it down when it was further away.

Kepler was an enthusiastic Copernican, stating that the Sun "alone appears, by virtue of his dignity and power, suited [to move the planets in their orbits]." In his early work he thought the Sun emitted rays of a moving force, the *anima matrix*. The rays would be restricted to the ecliptic. The number of rays that a planet would encounter would be greater when it was closer to the Sun and fewer when further away, somehow regulating the motive force proportional to the distance. Further calculations showed that the planetary orbital velocities were not simply related to their solar distance by 1/*r*. Once Kepler realized that the orbits were elliptical, he was able to formulate his Second Law: "A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time." Kepler published this in 1609 in the *Astronomia Nova* (New Astronomy). But what was the force? It could not be the *anima matrix*.



Kepler's Second Law. The areas Sun-A-B, Sun-C-D and Sun-E-F are equal.

Magnetism had been known since the ancients discovered lodestones. The compass was invented in China during the Han Dynasty (~200 BCE) and had been in use for navigation since medieval times, although no one knew how it worked. The first scientific investigation of magnetism *De Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure* (On the Magnet and Magnetic Bodies, and on the Great Magnet the Earth), by William Gilbert, was published in 1600.

Gilbert's work is one of the first examples of experimental science. He built a small model Earth, called a *terrella*, on which to test his theories. He correctly determined that the Earth was a gigantic magnet and that lodestones were attracted by the Earth itself, not Polaris or a magnetic island at the North Pole. He enthusiastically but incorrectly ascribed a number of astronomical phenomena to magnetism. He believed that the Sun and the planets exchanged magnetic influences to account for their movements, that magnetism held the Moon in its orbit, and that the ecliptic and precession of the equinoxes were due to magnetism.

When Kepler realized the *anima matrix* didn't work he endorsed magnetism as the force that drove the heavenly bodies and the planets' elliptical orbits, including this perspective in *Astronomia Nova*. In his later *Epitome Astronomiae Copernicanae* (Summary of Copernican Astronomy) of 1617-21, Kepler described the interiors of the Sun and planets as being similar to lodestones. Even Galileo included an appeal to magnetism to account for certain phenomena, and in the *Dialogo sopra i due massimi sistemi del mondo* (Dialogue Concerning

the Two Chief World Systems) of 1632 he cites magnetism as being responsible for the Earth's polar tilt.

Galileo's telescopic observations provided objective evidence of heliocentricity. Late in 1610, after the publication of the *Sidereus Nuncius*, he observed the phases of Venus and correctly ascribed them to the planet orbiting the Sun interior to the Earth. Galileo showed the heavens through his telescope to Jesuit astronomers in Florence. In Rome, the Jesuit Christopher Clavius and his associates, initially doubters, viewed the cosmos through an instrument provided by Venetian Antonio Santini. They found it difficult to use, so in March 1611, Galileo went to the Eternal City with a letter of introduction from Cosimo de Medici. He was able to demonstrate all of his findings to the curious Jesuits. This success was reported to the official Papal theologian, Cardinal Bellarmine, who then invited Galileo to the Roman College, the center of the Jesuit order. Galileo appeared there on May 18, 1611, as J. L. Heilbron says in his definitive biography *Galileo* (Oxford University Press, 2010), "to be celebrated before all its students and professors, and also princes, prelates, and cardinals." Galileo wisely did not say anything about heliocentrism at that time, and he had not yet published his Venus or sunspot observations (1613). It had been enough to wow the crowd with the wonders of the heavens.

In 1613 Galileo publicly proclaimed his belief in a Sun-centered universe. It was, unfortunately for him, too much to ask religious conservatives to accept heliocentrism in spite of the irrefutable evidence. There were too many places in the Bible that were interpreted as confirmation of the geocentric model and in any case there had been 2,000 years of ingrained belief in the Aristotelian/Ptolemaic paradigm. Several influential conservatives pressed the Inquisition to declare in 1616 that heliocentrism was "formally heretical." Galileo, who was personally liked by many important church figures, was not convicted of heresy but told to abandon the belief that the Earth moved and never to teach it. Ultimately, he fell off the wagon, so to speak.

Galileo was convicted in 1633 of being "suspected of heresy," a consequence of the publication of the *Dialogo* with its logical arguments for heliocentrism and ridicule of an Earth-centric cosmos. By that time the Church must have noted how many astronomers, especially in Protestant countries, vociferously advocated heliocentrism. The Jesuits turned on Galileo and employed their considerable intellectual powers in an attempt to refute the evidence for heliocentrism. Among their arguments was an attack on the possibility that magnetism was an effective force for moving the planets. It was perhaps more a "protective reaction strike" (to use Nixon's justification of the bombing of North Vietnam in 1970) than an affirmation of holy doctrine, which had nothing to say about magnets.

Athanasius Kircher arrived in Rome in 1633, a month after the trial. He had been appointed Professor of Mathematics at the Roman College. He continued his various researches and inventions and began the *Museum Kircherianum*, displaying Roman, Etruscan and Egyptian artifacts, perpetual-motion machines, optical tricks, a mermaid's tail, the bones of a giant and many other natural, artistic and confabulated marvels.[1]

Frontispiece of Kircher's Magnes

In 1641, Kircher published *Magnes*. He argued that magnetism kept the Earth fixed in the center of the universe because the Earth's poles had a magnetic attraction that aligned it with the celestial poles, which had their own magnetic force. Kircher also tried to refute

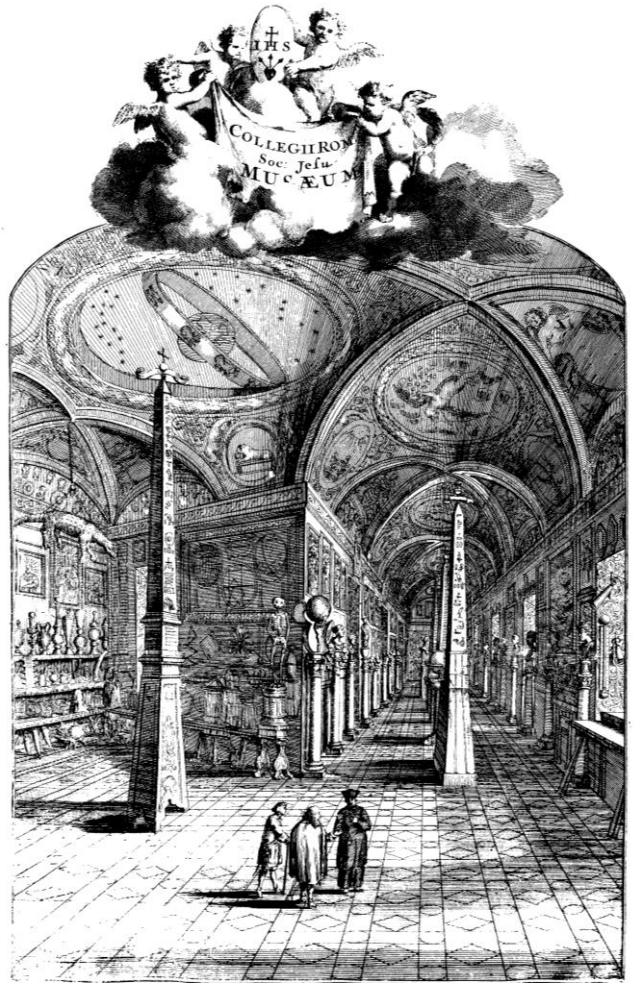
[1] A scan of the National Museum of Florence's copy of the 1709 catalog of the *Museum Kircherianum* is online at https://archive.org/details/bub_gb_ZXzTtvVZ2JMC. Sadly, there's no *Katzenklavier* listed.

some of Gilbert's conclusions, most notably that the Earth itself was a big magnet. He claimed that only its poles had magnetic activity. He calculated that if the entire Earth were a magnet and the Moon was ferrous (which it would have to be if magnetism was responsible for holding it in orbit), the Earth would pull the Moon into a catastrophic collision. He also argued that if the Earth were a magnet men could not use iron tools. Kircher wrote that Gilbert's conclusions were "*absurda, indigna et intolerabilis*." You don't have to speak Latin to grasp his meaning. In *Magnes* Kircher also provides arguments against Kepler's employment of magnetism as the force that moved the planets.

A number of other Jesuits weighed in against Copernicanism in general and magnetism as the motive orbital force in particular. These included Jacques Grandami (1588-1672), Niccolo Zucchi (1586-1670) and Gasper Schott (1608-1666), all of whom wrote treatises on magnetism and other scientific phenomena. The arguments always concluded that if magnetism did anything, it held the Earth at the center of the universe. The geocentric arguments were generally not scientific, appealing not only to scripture but to metaphysical concepts and anthropomorphism. Grandami wrote in his *Nova demonstratio immobilitatis terrae petita ex virtue magnetica* (A new demonstration of Earth's immobility by virtue of magnetism) of 1645 that

> The goal of magnetic virtue is the good and quiet of the Earth, the conservation of the Earth in its immobile place in the middle of the elements and at an equal distance from all parts of the ends of the sky in order that it may receive light and necessary influences which were established by divine wisdom and give goodness for the health of men.

Interest in magnetism as a cosmological force waned in the second half of the 17th century, probably because there was no additional evidence that could prove that it was responsible for planetary motion. Advances in astronomy and the declining authority of the Church made geocentrism increasingly untenable. The Catholic Church removed its opposition in 1820 with the statement "His Holiness has decreed that no obstacles exist for those who sustain Copernicus' affirmation regarding the Earth's movement in the manner in which it is affirmed today, even by Catholic authors." The *Dialogo* was formally removed from the *Index Librorum Prohibitorum* in 1835, but it wasn't until 1992 that Galileo was pardoned by the Pope and declared to have been correct all along.



The Museum Kircherianum from a 17th century etching

René Descartes proposed in 1644 that space was filled with matter, perhaps the aether, in the form of vortices (with circular motion) that drove the planets around the Sun. Christiaan Huygens, the discoverer of Titan, amplified this theory, but it did not ultimately fit with the observed paths of the planets and their satellites. In 1687, Newton published the *Principia* and in it established that gravity was the force responsible for planetary motion. Although no one knew how gravity worked (and actually we still don't) the Newtonian paradigm lasted until 1915 when Einstein's General Theory of Relativity was published, although it took a few years for it to be fully accepted. For everyday use, Newton's formulation gives correct answers. All of Eudoxus, Aristotle and Ptolemy's epicycles, deferents and equants were reduced to the simple $F=Gm_1m_2/r^2$. As Einstein said, "Any intelligent fool can make things bigger and more complex… It takes a touch of genius – and a lot of courage – to move in the opposite direction." ■

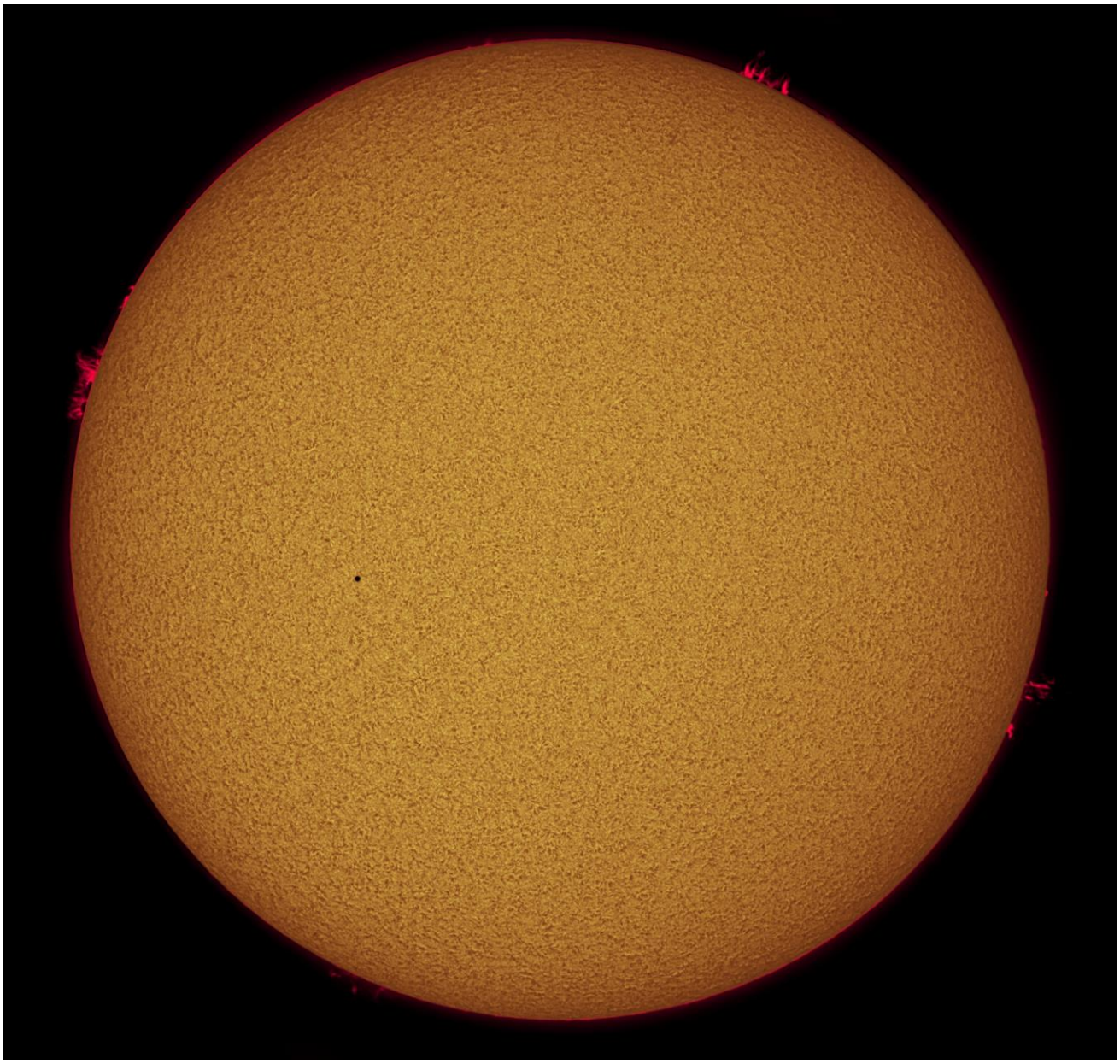
Images by Members

Gary Miller obtained this image of IC342, also catalogued as Caldwell 5, in September. It's a 9.1-magnitude spiral galaxy in Camelopardus. Distance 3.3 mega parsecs. Twenty-seven 3-minute DSLR exposures with 127 mm ED refractor on Losmandy GM811G. Processed in Pixinsight.

Bob Kelly's view of the 3rd quarter Moon in the early morning hours of September 21st .

Canon XS with 50-250 mm zoom lens at 250 mm, on tripod 1/125 second at f/7.1, ISO 100. RAW image processed by the Editor with Canon Digital Professional 4.

Transit of Mercury in Hydrogen Alpha by Robin Stuart



As of early November 2019, I had seen twice as many transits of Venus (two) as transits of Mercury (one)! It was not for want of trying but I had been thwarted by clouds on numerous occasions. I started watching the forecasts a week in advance. It appeared that southern North Carolina offered the best prospects and on the day before the event I decided on Kitty Hawk, NC for my observing site. On the actual day the sky was not quite as pristine as I had been hoping. There were some intermittent high clouds that increased during the course of the transit, and I even saw a Sun Dog during it. I did however manage to get some usable images of the early part of the transit.

This north-up composite of the solar disk and prominences was taken through a Televue Pronto 70mm f/6.9 refractor equipped with a Coronado narrowband Hydrogen-alpha filter. I used a Meade LPI-G monochrome video camera. The disk and prominences are stacks of approximately 50 and 90 frames respectively. At the image scale used, Mercury moves by 1 pixel in about 10 seconds. Mercury presents the only blemish on the otherwise bland face of the Sun, which reflects the very deep solar minimum we are currently experiencing.

Robin Stuart

Globular Clusters in M31

We received two lovely images of M31 by members.

Leandro Bento imaged from Ward Pound on October 4th using a William Optics Redcat 51 250mm FL, 51mm aperture. Canon T3i, unmodified, Ioptron SkyGuider Pro tracker. Thirty-one 3 minute frames with darks, bias and flats subtracted and processed in PixInsight. The Moon was 40% illuminated, but fortunately was separated from the galaxy by 110 degrees. Leandro said that this was "my first good DSO photo" and indeed it is very good!

Gary Miller sent a higher-magnification shot, taken through a 127 mm ED refractor on a Losmandy GM811G mount. Forty-one 2½ minute guided exposures, darks and bias frames subtracted, processed in PixInsight,

Gary mentioned that some of what appear to be stars in images of M31 are actually not Milky Way objects but globular clusters surrounding the galaxy. While these are not visible in usual-sized amateur telescopes (12 inches and down), larger instruments might capture them visually, and they are certainly present on images. There are estimated to be around 350 globular clusters surrounding M31 in its immediate neighborhood, of which 250 are brighter than magnitude 15.0, according to the Sloane Digital Sky Survey. A map of the clusters surrounding M31 was made by Texas astrophotographer Val Ricks, who goes by the blogger handle "Polaris B." His image and map is on the next page.

Map of globular clusters around M31 by Val Ricks, used with permission.

https://polarisb.blogspot.com/2011/12/m31-andromeda-galaxy-and-sixty-four.html

Large galaxies like M31 grow by accumulating some of the contents of the smaller galaxies that surround them. These satellite galaxies are subject to intense tidal forces and their structures are disrupted. Stellar streams have been detected around the Milky Way and M31 as evidence of past interactions between the galaxy and its peripheral companions. Some, if not all, of these smaller galaxies have their own globular clusters, and these too are flung about during the merger process. A recent study focused on globular clusters in the outer zone of M31.

In a paper in *Nature* published on October 3rd, an international group led by Dougal Mackey of the Australian National University reported the results of Pan-Andromeda Archaeological Survey (using telescopes in Arizona, Hawaii and the Canary Islands). They found a halo of tidally disrupted dwarf galaxies surrounding M31 and a substantial number of globular clusters at radii much larger than those seen the images above. There were two distinct populations of outlying globular clusters rotating perpendicular to each other. These streams are taken as evidence of two distinct accretion episodes, separated by perhaps billions of years. The later accretion epoch left stellar streams, while any stellar streams from the earlier epoch have been dissipated and are much less visible.

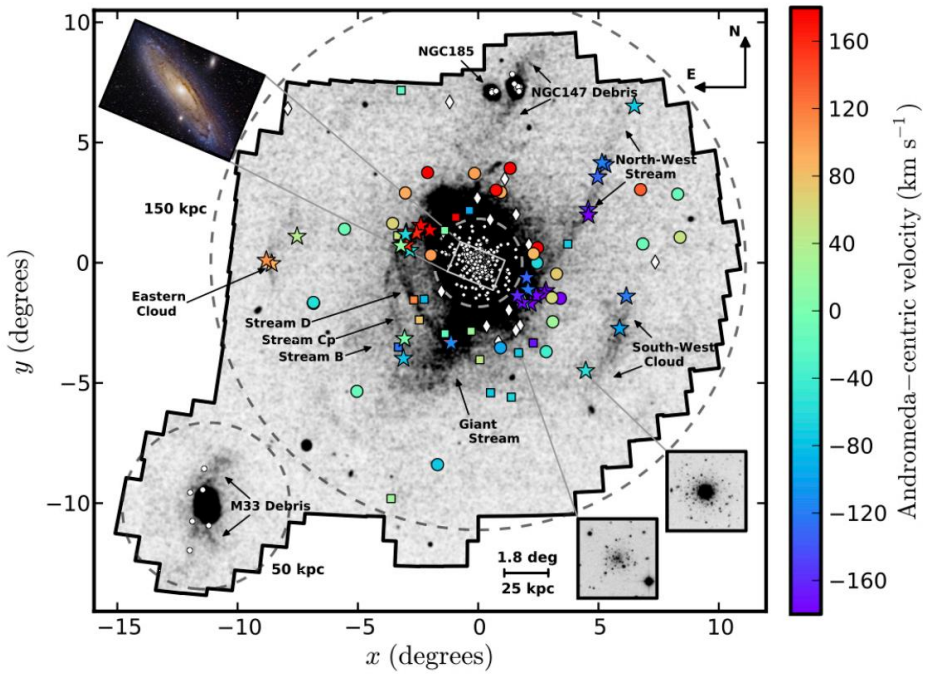


Fig. 1 from Mackey et. al.

Mackey, D, et. al., Two major accretion epochs in M31 from two distinct populations of globular clusters, *Nature* 2019; 574: 69-71. You can access it on the arXiv pre-print server at: https://arxiv.org/ftp/arxiv/papers/1910/1910.00808.pdf.

Research Highlight of the Month

Cross-sectional association between outdoor artificial light at night and sleep duration in middle-to-older aged adults: The NIH-AARP Diet and Health Study. Qian Xiao, Gilbert Gee, Rena R. Jones, Peng Jia, Peter James, Lauren Hale. *Environmental Research*, Volume 180, January 2020, 108823 (posted on-line 12 October 2019)

Abstract

INTRODUCTION: Artificial light at night (ALAN) can disrupt circadian rhythms and cause sleep disturbances. Several previous epidemiological studies have reported an association between higher levels of outdoor ALAN and shorter sleep duration. However, it remains unclear how this association may differ by individual- and neighborhood-level socioeconomic status, and whether ALAN may also be associated with longer sleep duration.

METHODS: We assessed the cross-sectional relationship between outdoor ALAN and self-reported sleep duration in 333,365 middle- to older-aged men and women in the NIH-AARP Diet and Health Study. Study participants reported baseline addresses, which were geocoded and linked with outdoor ALAN exposure measured by satellite imagery data obtained from the U.S. Defense Meteorological Satellite Program's Operational Linescan System. We used multinomial logistic regression to estimate the multinomial odds ratio (MOR) and 95% confidence intervals (CI) for the likelihood of reporting very short (<5 h), short (<7 h) and long (≥9 h) sleep relative to reporting 7-8 h of sleep across quintiles of LAN. We also conducted subgroup analyses by individual-level education and census tract-level poverty levels.

RESULTS: We found that higher levels of ALAN were associated with both very short and short sleep. When compared to the lowest quintile, the highest quintile of ALAN was associated with 16% and 25% increases in the likelihood of reporting short sleep in women (odds ratio Q1 vs Q5, 1.16, 95% confidence interval 1.10-1.22) and men (odds ratio 1.25, CI 1.19-1.31), respectively. Moreover, we found that higher ALAN was associated with a decrease in the likelihood of reporting long sleep in men (OR 0.79, CI 0.71-0.89). We also found that the associations between ALAN and short sleep were larger in neighborhoods with higher levels of poverty.

CONCLUSIONS: The burden of short sleep may be higher among residents in areas with higher levels of outdoor LAN, and this association is likely stronger in poorer neighborhoods. Future studies should investigate the potential benefits of reducing light intensity in high ALAN areas in improve sleep health.

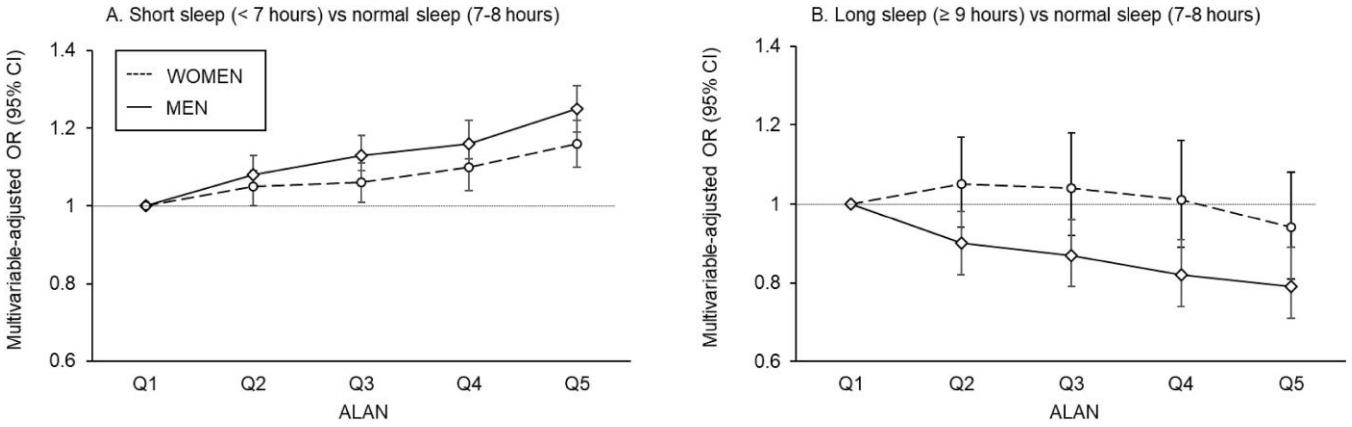


Fig. 1. Multivariable-adjusted association between ALAN and sleep duration in men and women in the NIH-AARP Diet and Health Study. Models were adjusted for age, race, marital status, state of residency, smoking, alcohol, vigorous physical activity, TV viewing, and median home value, population density and poverty rate at census tract level. A) presents results for short sleep (<7 h, including both the <5 h and 5–6 h groups); and B) presents results for long (≥9 h) sleep. Abbreviations: ALAN, artificial light at night; CI, confidence interval; OR, odds ratio. Q1-5=Quartiles of ALAN (Q5 has highest amount of ALAN).

Editor's Note [The Editor is a physician.]: Reduced sleep duration has been associated with a number of negative human health outcomes, among them obesity, diabetes, heart disease, cognitive dysfunction, and increased accidents. A recent study showed an association of ALAN with several cancers. ALAN has many negative impacts on animals as well. And, it's terrible for astronomy!

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Celestron 8" SCT on Advanced VX mount	Purchased in 2016. Equatorial mount, portable power supply, polar scope, AC adapter, manual, new condition.	$1200	Santian Vataj spvataj@hotmail.com
Celestron CPC800 8" SCT (alt-az mount)	Like-new condition, perfect optics. Starizona Hyperstar-ready secondary (allows interchangeable conversion to 8" f/2 astrograph if you get a Hyperstar and wedge). Additional accessories: see August 2018 newsletter for details. Donated to WAA.	$1000	WAA ads@westchesterastronomers.org
Explore Scientific Twilight I Mount	Manual Alt/Az, capacity 18 lb. Steel tripod. Excellent condition. Used fewer than 10 times. Great for grab-and-go viewing. Owner upgrading to an EQ mount.	$100	Eugene Lewis genelew1@gmail.com
Celestron StarSense autoalign	Brand-new condition in original packaging. Accurate auto-alignment. Works with all recent Celestron telescopes (fork mount or GEM). See info on Celestron web site. Complete with hand control, cable, both mount brackets. Printed documentation. List $359. Donated to WAA.	$175	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.	$240	Eugene Lewis genelew1@gmail.com
Celestron 6-inch f/5 reflector OTA	Same optical tube as the famous Orion 6" StarBlast. 1¼" rack-and-pinion focuser, Celestron 25 mm eyepiece, tube rings and dovetail plate. 5x30 straight through finder. Heavy-duty dark canvas carrying case with compartments and plenty of room for accessories. Excellent condition, unblemished optics. These scopes are 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 scope, admittedly with a 2" Crayford focuser but no case, lists for $339. Donated to WAA.	$175	WAA ads@westchesterastronomer.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 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!