Education & Public Outreach
February 2022

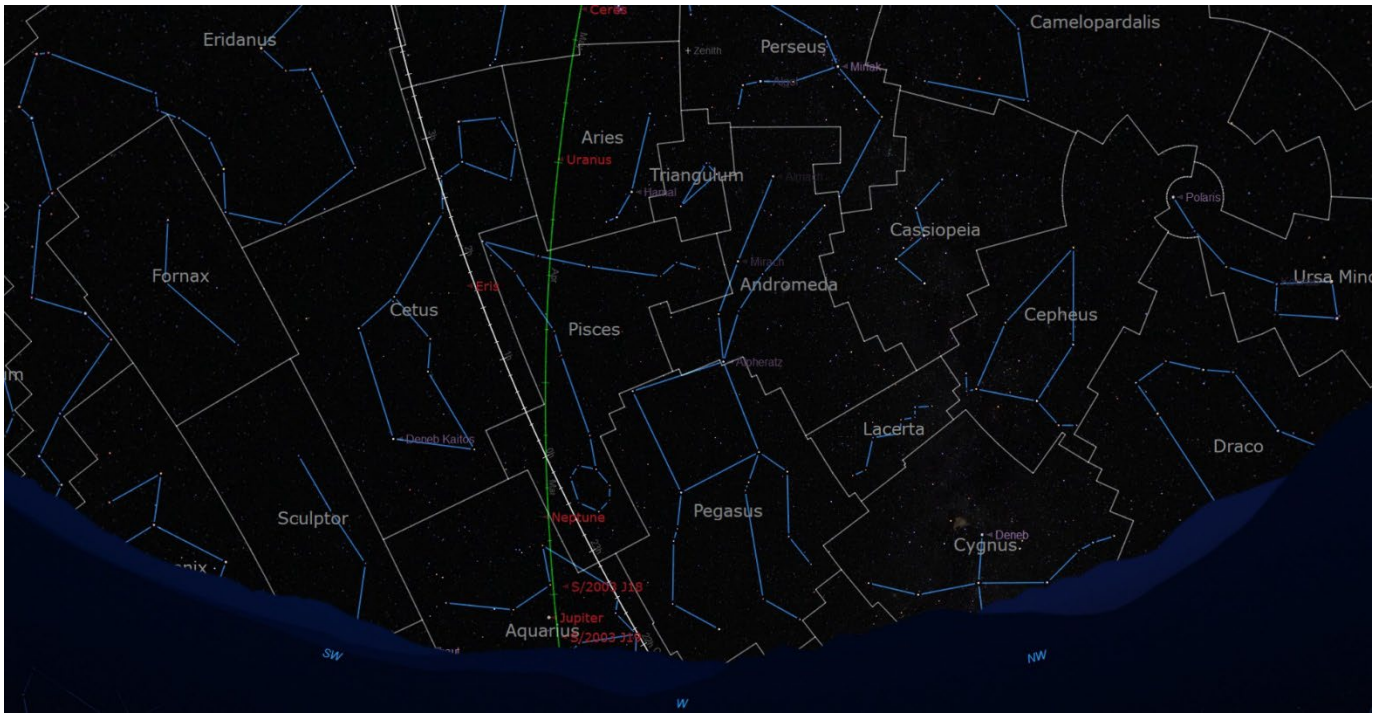
Introduction:

This is our first official Newsletter after the end of our Girl Scout Stars NASA Grant. As I promised, Don and I will be continuing to send Newsletters, though the format may change. As you know, at some point, one is repeating information from older Newsletters. Other than the positions of the Moon and planets, the stars and constellations repeat themselves once a year! I also have a harder and harder time finding new constellations to highlight and Sky Stories to tell (the one that I have this month is from 2008, long before most of you were getting the Newsletter). We still have "Winter" here in Tucson, but nothing to compared to what some of you are going through with night temperatures near zero and snow (I might see snow in a few weeks when I go back to VATT on Mt. Graham in two weeks). I do have to cover some of our plants as they are frost sensitive and it has been getting down to the high 20s/low 30s occasionally. However, looking at what Nancy wrote in the February 2011 Newsletter, it did get down to 16 degrees at the end of January and we lost some of our cactus. Yes, I can hardly wait until Spring! Breaking news: Mid- to low 20s tonight!

February Special Events:

There are no meteor showers in February, but Astronomy Magazine highlighted the fact that zodiacal light is best seen when it gets dark after sunset in the west. The light is always there, but in the early part of the year, the ecliptic is steeply aligned, giving us our best view of the light from dark locations. Light is scattered off the dust that lies along the plane of the planets, the ecliptic, and this is what we see a zodiacal light.

Here is an image showing zodiacal light taken from Mauna Kea with the Submillimeter Array (lit by flash) in the foreground (January 2016), Steven Keys keysphotography.com (published in Wikipedia)



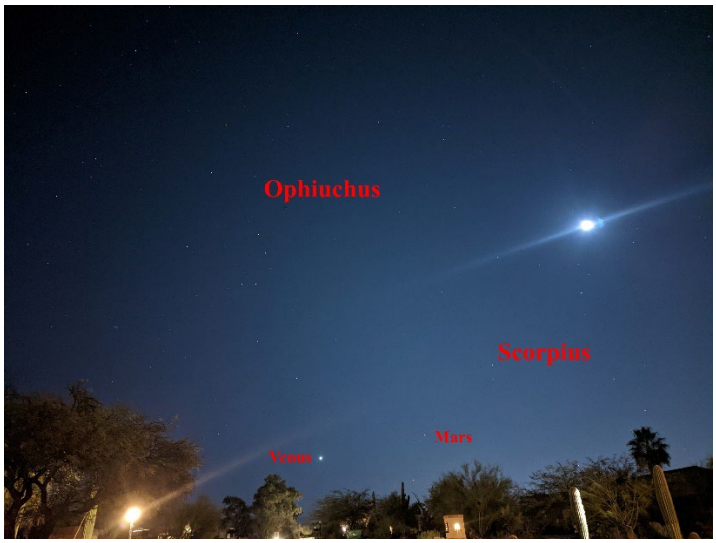
A Starry Night image showing the sky at 8:00 p.m. on February 1, 2022. You can see the planets and the dwarf planet Ceres lying along the ecliptic. The cone-shaped zodiacal light stretches out along this line.

Tucson Gem and Mineral Show:

The Tucson Gem and Mineral Show is going on now for the next two weeks. I visited my favorite room and purchased meteorites for small educational kits (contact me if interested) that I give out at workshops and some lunar and martian [it is lower case unless it relates to Marvin and his friends] meteorites for some of the big outreach kits and for friends. I will NOT be visiting many locations (the show fills up many hotels and other venues around town) as there were too many people without masks and some of whom were talking about the dangers of the vaccine!

Some Images:

Venus is now a morning object, as I will expand on below. Here are some pictures that I took on the morning of January 27 at 6:00 a.m. (cold, but clear) of the Moon in Scorpius as it approaches Mars and Venus. I was able to get more pictures on January 28, 29 (when the Moon was near Mars), and January 30. On January 30, it was cloudy in the morning but cleared just enough to get the Moon 40 hours before New Moon. New Moon is at 10:46 pm. (Tucson time) on January 31, 2022, so just after midnight on February 1 EST. Mercury was above the horizon by 7:00 a.m. on January 31, to the left of the Moon, but it was already too bright and too hazy to see it.

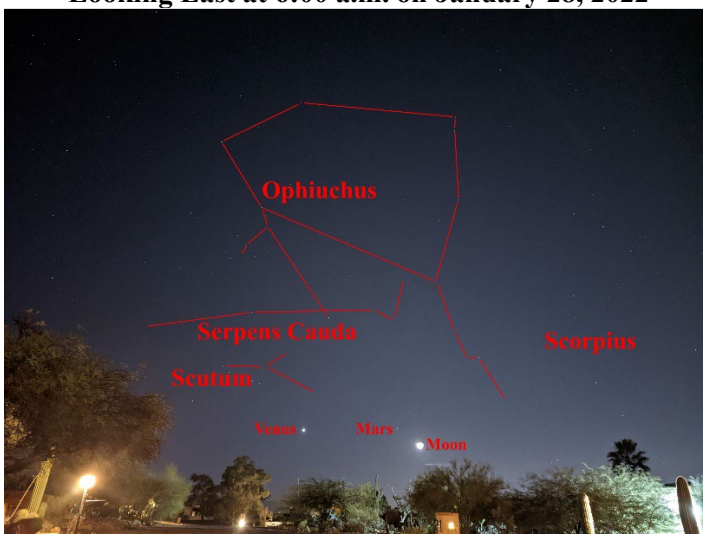


Looking East at 6:00 a.m. on January 27, 2022

The waning crescent 24.3-day-old Moon magnified 20X

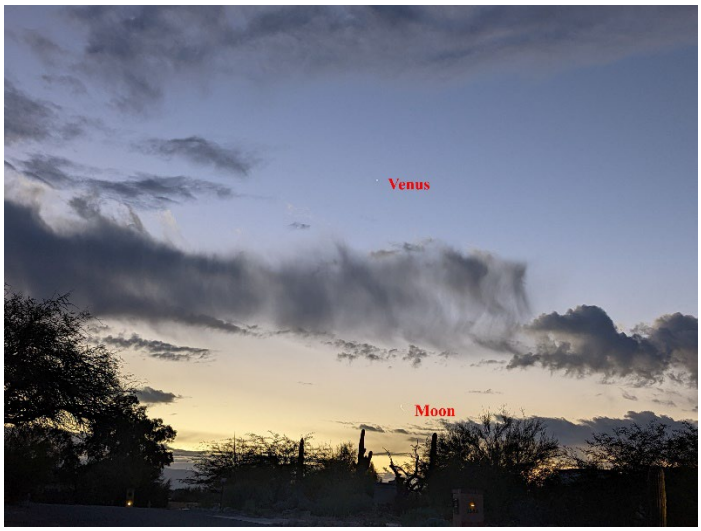
Looking East at 6:00 a.m. on January 28, 2022

The waning crescent 25.4-day-old Moon magnified 20X



Looking East at 6:00 a.m. on January 29, 2022

The waning crescent 26.5-day-old Moon magnified 20X, overexposed to show Earth-lit night side of Moon



Looking East at 6:56 a.m. Too hazy to see Mercury

The waning crescent 27.6-day-old Moon magnified 20X

Astronomy in the News

NASA, ESA, and Other Missions:

- ***JWST Update:***
  JWST is now in its final orbit, turned on the high-gain communications antenna, and is going through the alignment and focusing of it mirrors. Here are some recent articles that show JWST's orbit and location of various of its components.

  https://earthsky.org/space/webb-at-l2-testing-phase

  https://www.universetoday.com/154189/webb-has-arrived-successfully-at-l2/

  https://www.dailymail.co.uk/sciencetech/article-10459147/Space-NASA-turns-James-Webb-Space-Telescopes-high-gain-antenna.html?ito=1490

- ***JWST Update from Don:***
  JWST has arrived at its destination—Lagrange Point #2 (aka, L2). Although the trip took about one month, this location is only 1% farther than the Earth is from the Sun, i.e., 1.01 Astronomical Units (AU). One reason for the long travel time is that JWST had to approach its destination gradually. If it overshot, then the spacecraft could not turn its engines around to reverse direction without pointing the observatory at the Sun! I like to say that JWST traveled like the "little engine that could" and just barely reached its destination, gradually but exactly.

  JWST's 18 mirror segments have now been unlocked, so they can be moved into precise alignment. However, we must wait for the infrared instruments to cool down to their operating temperatures (–380° F, –193° C, 80 K) before taking pictures. At first, the 18 images will be scattered around and out of focus. We must identify each image and then aim them, by tilting the respective mirror segment, to overlap identically and in focus. Then, the challenge is to "phase" the mirrors so they perform "coherently" as a team, i.e., as a single 6.5-meter-diameter mirror so that starlight reflecting from each mirror arrives near-simultaneously at the focus to within one millionth of a millionth of a second. Accomplishing that precision is expected to require ~3 months of work. [Note: NIRCam will be used to accomplish this]

- ***JWST in Our Local Newspaper, Just This Morning:***
  https://tucson.com/news/local/new-space-telescope-powers-up-instruments-designed-with-help-from-ua-researchers/article_60ba2db0-8368-11ec-a39c-978bf7667205.html

- ***Mars Crater:***
  Here is a nice image of a crater taken by the ESA/Roscosmos ExoMars Trace Gas Orbiter, showing the complex history of this small (8 or 9 kilometers in diameter) crater.
  https://www.esa.int/ESA_Multimedia/Images/2022/01/Crater_tree_rings

- ***TESS Update:***
  TESS, which has been in operation since mid-2018 has now detected more than 5,000 TESS Objects of Interest. This is more than detected by the Kepler mission. However, because of the lag of confirmations by other techniques, only 176 of these have been confirmed to date. This is consistent with Kepler that completed its mission in 2013 and has over 2,700 confirmed exoplanets, but over 2,000 yet to be confirmed.
  https://www.space.com/tess-mission-hits-5000-planet-candidates

  https://www.universetoday.com/154217/5000-exoplanets/

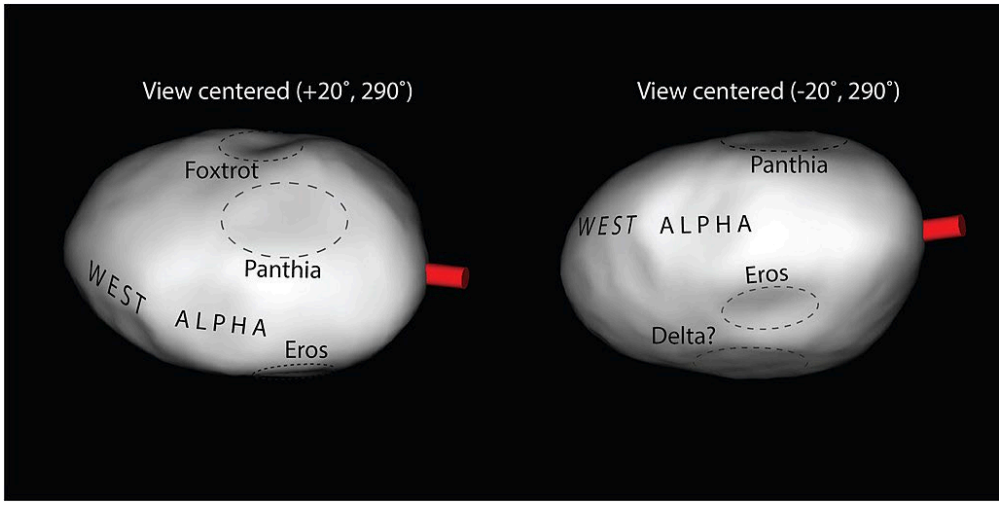
- ***China's Mars Orbiter Images:***
  China's Tianwen-1 mission has been in orbit around Mars for nearly a year and its Zhurong rover has been operational since May (it has traveled 1.6 km, according to NASA). So far, all that has been released are nice images from orbit and on the surface. The one surprise is that the orbiter appears to have released a smaller craft that has taken images of the main orbiter.
  https://www.sciencealert.com/feast-your-eyes-on-these-gorgeous-otherworldly-images-from-china-s-mars-orbiter

- ***Parker Solar Probe Video:***
  Here is a video showing details of what the Parker Solar Probe observed as it passed through the solar corona in April.
  https://www.space.com/sun-coronal-streamers-parker-solar-probe-video

Meteors, Meteorites, Asteroids, and Comets:
As of February 1, 2022, there are 1,166,250 minor planets (23,100 more than last month's total on Dec. 31). Of these, 612,011 are numbered (5,000 more!). In addition, there are 4,390 known comets. There are 20,083 (92 more) Near-Earth Objects (NEOs) of which 2,260 (69 less than last update thanks to improved orbits, I would assume) are considered Potentially Hazardous Asteroids (could collide with the Earth in the future). In addition, there are 110 Near-Earth Comets (no change). There are 457 asteroids, Centaurs, and Trans-Neptunian Objects with companions (2 more than previous update). There are 441 binary systems (up 2), 14 triple systems (no change), 1 quadruple (130 Elektra), and 1 sextuple system (Pluto), for a total of 477 (up 2) companions.

Asteroid Close Approaches:
Since the beginning of January, 13 asteroids have been observed to have come closer to the Earth than the Moon with estimated diameters from 3 to 34 meters in diameter (if bright or dark, respectively) down to one meter in diameter. With no additional observations other than possible lightcurves (to get their shape), there is usually a large uncertainty in their estimated diameters for most of these. They may reflect as much as 40% of the sunlight (lower estimated diameter) down to about 5% of the sunlight (higher estimated diameter). Four asteroids came with 0.20 to 0.26 lunar distances. On January 18, 2022, the 1-km asteroid 7482 1994 PC1 will pass by the Earth at a distance of 5.15 lunar distances. Two additional asteroids with estimated diameters between 100 and 200 meters passed with 15 to 20 lunar distances of the Earth. Between now and the end of March, six asteroids with estimated diameters between 100 and 600 meters will pass by the Earth between 10 and 20 lunar distances of the Earth.

- ***Asteroid Psyche Mission:***
  NASA's Psyche mission will launch later this year on a 2.5-year journey to the main belt asteroid Psyche (hence the name) and will orbit the asteroid for about two years. At one time, it was thought that Psyche was an iron asteroid, the core of a once much larger asteroid. This would imply a density of about 8 grams/cc. However, its density is about 3.9 gm/cc, 15% denser than asteroid Vesta, and recent observations seem to imply Psyche is metal-rich, but not solid iron and nickel (like an iron meteorite). The article does not include the most recent observations of Psyche that were made with the Very Large Telescope with adaptive optics. I have included some images below (Shepard, 2021 from Wikipedia). The surface appears to be consistent with iron-rich silicate regions and regions that may be closer to pure iron. Along with this, water in clay minerals has been confirmed (my grad student and I did the original detection) which again implies that there is a lot of silicate material on the surface. Note that the red "stick" is just for orientation purposes and is on the equator.
  https://www.spacedaily.com/reports/How_NASAs_Psyche_Mission_Will_Explore_an_Unexplored_World_999.html



- ***NASA Mission to a Small NEO:***
  When NASA launches its new Space Launch System in a few months, it will carry 10 small payloads, one of which will be a spacecraft that will fly by a small, 18-meter (60 feet) diameter, asteroid. The spacecraft will not have the ability to go into orbit around the asteroid, but it will fly by very slowly [remember the Unknown Planet activity when you fly by the "planet"]. Several comments on the article: first, it states that the resolution of the camera is 4-inches, but that will be when the spacecraft is closest to the asteroid. Second, you cannot tell if an asteroid is solid or a rubble pile just by taking

images of it. When the spacecraft is close, it will get a shape model, with which you can determine its volume, and measure its gravitational pull, which gives a mass. With mass and volume, you can then calculate density.

https://www.nasa.gov/feature/jpl/nasa-solar-sail-mission-to-chase-tiny-asteroid-after-artemis-i-launch

https://www.jpl.nasa.gov/news/nasa-solar-sail-mission-to-chase-tiny-asteroid-after-artemis-i-launch [same article?]

https://www.spacedaily.com/reports/NASA_Solar_Sail_Mission_to_Chase_Tiny_Asteroid_After_Artemis_I_Launch_999.html

Moons, Dwarf Planets, and Planets:

- ***Water on the Moon:***
  China's Chang'E-5 rover that collected and returned a lunar sample to Earth also detected small amounts of water in surface rocks. This water may have come from the interior of the Moon, which would be unexpected) or it could have come from rocks brought to the Moon through impacts.
  https://www.sciencealert.com/chang-e-5-has-made-the-first-on-site-detection-of-water-on-the-moon

- ***Contrasting Mars Craters:***
  This short article shows a region on Mars that has contrasting craters: a volcanic crater and a crater that form in an ice-rich region.
  https://www.esa.int/Science_Exploration/Space_Science/Mars_Express/Making_a_splash_in_a_lava_sea

- ***Rolling Stones on Mars:***
  Here is a portion of the wider image in the article that shows a cliff where streaks have been made by boulders breaking free from the top of the cliff and rolling downslope to the base of the cliff.
  https://www.esa.int/ESA_Multimedia/Images/2022/01/Rolling_stones_on_Mars

Exoplanet Update:

As of February 1, 2022, there are 4,963 confirmed extra-solar planets (58 than the last update in early December) orbiting 3,657 stars (28 more), with 810 star systems having more than one exoplanet orbiting them (2 more). In addition, there are 2,625 candidate (unconfirmed) exoplanets (5 more) orbiting 2,433 stars (5 more), with 161 stars having more than one exoplanet orbiting them (no change). Most of these candidate exoplanets are likely to be real but need to be confirmed by more detailed ground-based observations or other

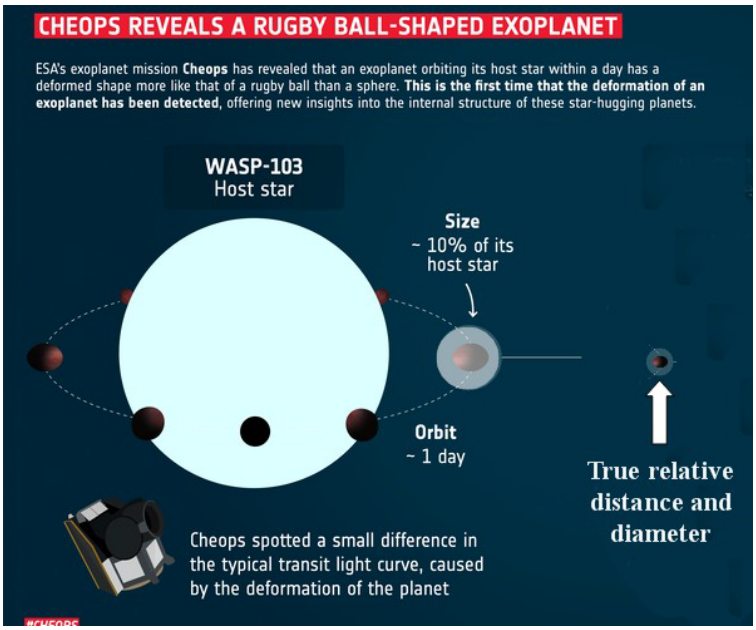
techniques. The following was updated on July 21. There are 217 exoplanets (up 66 from the previous update) in 154 binary star systems (up 51). In 132 of these systems, the planets are orbiting one of the stars and in 22 of these systems, the planets are orbiting both stars (usually one planet orbiting two stars, but in 3 cases there are two planets orbiting both stars). There are 51 planets (up 15) in 35 (up 9) multiple star systems (3 or more stars). Seven of these multiple star systems have 2 or more exoplanets (1 with 6 exoplanets, 1 with 5 exoplanets, and 1 with 4 exoplanets) for a total of 23 exoplanets. In all cases, the planets orbit only 1 of the stars. In addition, there are 36 planets in two-star systems that are yet to be confirmed.

- ***Exomoon Discovery:***
  Astronomers have potentially discovered their second exomoon, an object about 2.6 times the diameter of Earth. For comparison, Neptune is 3.9 times the diameter of Earth. At the moment, neither exomoon has been confirmed and there are other astronomers who question the detection. These discoveries will not be official until they are reobserved by a different technique or a different telescope.

  https://www.spacedaily.com/reports/Astronomers_find_evidence_for_a_second_supermoon_beyond_our_solar_system_999.html

  https://earthsky.org/space/new-exomoon-candidate-kepler-1708-b-i

- ***Rugby Ball-Shaped Exoplanet:***
  Two years ago, ESA launched its CHEOPS (CHaracterising ExOPlanets Satellite) which uses a small telescope and CCD camera to precisely measure the visible light from known transiting exoplanets and from exoplanets detected by radial velocity that are thought to be transiting their host star. From transits, CHEOPS can measure a lightcurve as an exoplanet goes in front of and behind its host star, getting size and shape. If the object was previously observed by the radial velocity method, there is a known mass that then can be used to calculate density. In this paper, the scientists have been able to measure the size, shape, and density of a hot Jupiter orbiting an F8 (yellow-white) star, WASP-103. I looked up some additional information (not in these articles) about the star and the orbit of the exoplanet. Given the diameter of the star (1.4 times the Sun) and the exoplanet's published orbital radius of 0.01987 AU, I was able to modify the published image above to show the actual relative size and distance of the exoplanet from the host star (I added the arrow to point to my calculated position).



  https://www.esa.int/Science_Exploration/Space_Science/Cheops_reveals_a_rugby_ball-shaped_exoplanet

  https://www.sciencealert.com/for-the-first-time-we-ve-been-able-to-measure-the-shape-

- ***Exoplanet Atmosphere:***
  In this article astronomers using a large Earth-based telescope, have been able to determine the composition and layering of the atmosphere of a hot Jupiter exoplanet as it transits its host star. Again, not in the article, the star's designation, WASP, implies it was first detected by ESA's WASP (Wide Angle Search for Planets) mission that uses radial velocity (the tug of an exoplanet on its host star) to discover exoplanets. The exoplanet was then confirmed by CHEOPS which showed that the exoplanet was transiting the star. Then, astronomers could observe the spectrum of the transiting exoplanet (as

the light from the star passes through the exoplanet's atmosphere) to study the atmosphere of the exoplanet.

https://www.sciencealert.com/the-atmosphere-of-this-extreme-exoplanet-has-an-intriguing-similarity-to-earth-s

Stars and White Dwarfs:

- ***Ancient Solar Storm:***
  Scientists have found radioactive isotopes in ice cores that would have been created when a massive solar corona mass ejection (CME) impacted Earth. What I am not clear on (not being an expert) is how they can determine that the event was a CME and not a nearby supernova. This is not addressed in the article, which focuses of the effects such an event would have on communications and power grids.

  https://www.livescience.com/ancient-solar-storm-solar-minimum?utm_source=notification

  https://www.sciencealert.com/signs-of-a-strange-ancient-solar-tsunami-have-been-found-deep-inside-ice-cores

- ***Interstellar Intruder:***
  Astronomers used two southern hemisphere radio arrays—ALMA (Atacama Large Millimeter/submillmeter Array) and VLA (Very Large Array)—to image, it detail, the protoplanetary disk around the young (about a million years old) proto-binary-star system Z CMA. The morphology (shape) of the disk implies that it has been gravitationally disrupted by the close flyby of a star.

  https://www.spacedaily.com/reports/ALMA_Catches_Intruder_Redhanded_in_Rarely_Detected_Stellar_Flyby_Event_999.html

February Night Sky

Nancy used to include sections called Night Sky Viewing, Morning Viewing, and Constellation of the Month. I am bringing these back so that we can connect better with our night sky. Please let me know if you find these useful! If so, I will continue to include them in the Newsletters.

Sky Stories:

Here is some information that Nancy and her friend Thea wrote in their, unfortunately, never published "Winter Sky Stories." In this they include some information about the importance of water in skylore and a story from ancient China about the Hyades, the open star cluster in the constellation Taurus.

Part I: Water and Rain

Many legends associated with the constellations and stars of the Winter Hexagon are connected with water or rain. The eyes of the seven sisters blur the light of the Pleiades as the cry in fear of Orion. The tears of the Hyades bring rain to the Earth as they mourn their drowned brother. The light of Procyon is dimmed by the tears of Suhail's youngest sister when she cannot swim across the Milky Way. The Chinese god Yu Shih (in the Hyades) provides rain for drinking water and crops.

These stars and constellations often had practical meanings for ancient observers, also often associated with water. Capella was considered a bad omen for sailors, since its rising coincided with the beginning of the stormy season in the Mediterranean. The appearance of the Hyades in the morning sky signaled the spring rainy season, and their appearance near the horizon was said to cause storms on both land and sea. Another name for the Hyades is the Little Pigs, since their appearance meant muddy roads!

In Africa, the rainy season begins when Sirius disappears from the evening sky in May. In South America, the disappearance of the Pleiades in April signals the beginning of the rainy season and the end of boat travel. Their appearance in November signals the beginning of the dry season.

The constellation Gemini was known as the protector of sailors. It was supposed to rid the seas of buccaneers and pirates. Gemini was often seen as flames above a ship's mast (St. Elmo's Fire). When Gemini rises just before sunrise, the calm weather of summer begins.

Castor and Pollux were among the heroes on Jason's ship, Argo. They were said to have protected the Argonauts during a storm at sea, and Gemini is still associated with electrical phenomena often seen during storms at sea. A double light was considered favorable to sailors, while a single light was a bad sign associated with Castor and Pollux's sister, Helen.

Part II: Yu Shi, The God of Rain
In the far, far past before Earth was the home of living things, and even before there was an Earth, the great Chinese goddess Nu Kua looked about at the loneliness of space and decided to create our world. Nu Kua used her powers to create the land with its mountains, valleys, and plains, and the oceans, rivers, and seas. Four gigantic pillars held up the sky, and at each pillar she placed an enormous animal as guardian: a dragon, a bird, a tiger, and a tortoise. Nu Kua's new Earth was a beautiful place with fertile land and sparkling oceans.

But there were evil beings jealous of Nu Kua's creation. These were the dragon kings. Led by a fearsome giant named Kung Kung, they caused the water of the oceans to rise up and wash over all the land. The whole planet was flooded! Luckily Nu Kua had one ally, the God of Fire. Together they worked furiously to move back the waters and overpower Kung Kung's forces. The God of Fire used his scorching heat to dry up the flood waters, and Nu Kua repaired the damages to the land.

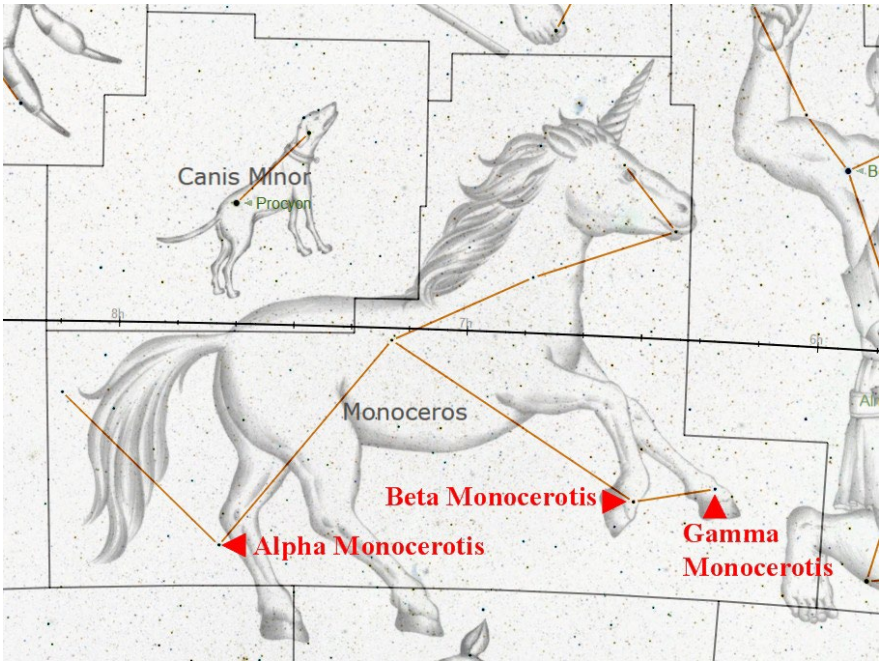
Nu Kua and the God of Fire were victorious. They banished Kung Kung to the distant regions of space. As the giant started to leave, he fell onto the sky, and the four pillars holding it up came crashing down and shattered. Nu Kua quickly rescued the Earth again. She took the tortoise's legs to prop up the sky as the pillars had done before. That is why tortoises have such short and stumpy legs today.

As a last act, Kung Kung granted his power over water to his child, a son named Yu Shih. Although very young, Yu Shih had great wisdom. He saw that the Earth created by Nu Kua was a good place. He swore to be a friend to the Earth and to the plants and animals on it. Nowadays when we need water for drinking and for our crops, Yu Shih sends the blessing or rain to us. We see Yu Shih, son of the giant Kung Kung, in the five stars of the Hyades cluster.

Featured Constellations for February—Monoceros

Our featured constellation this month is Monoceros (the Unicorn) The Starry Night image on the right shows the usual stick figure for Monoceros. I have included the illustration for it. This is not an ancient constellation and dates back to the Dutch cartographer Petrus Plancius in 1612 or 1613. Monoceros is a faint constellation but sits among the constellations of the Winter Hexagon (see the Starry Night image for February 15 in the evening, looking south).

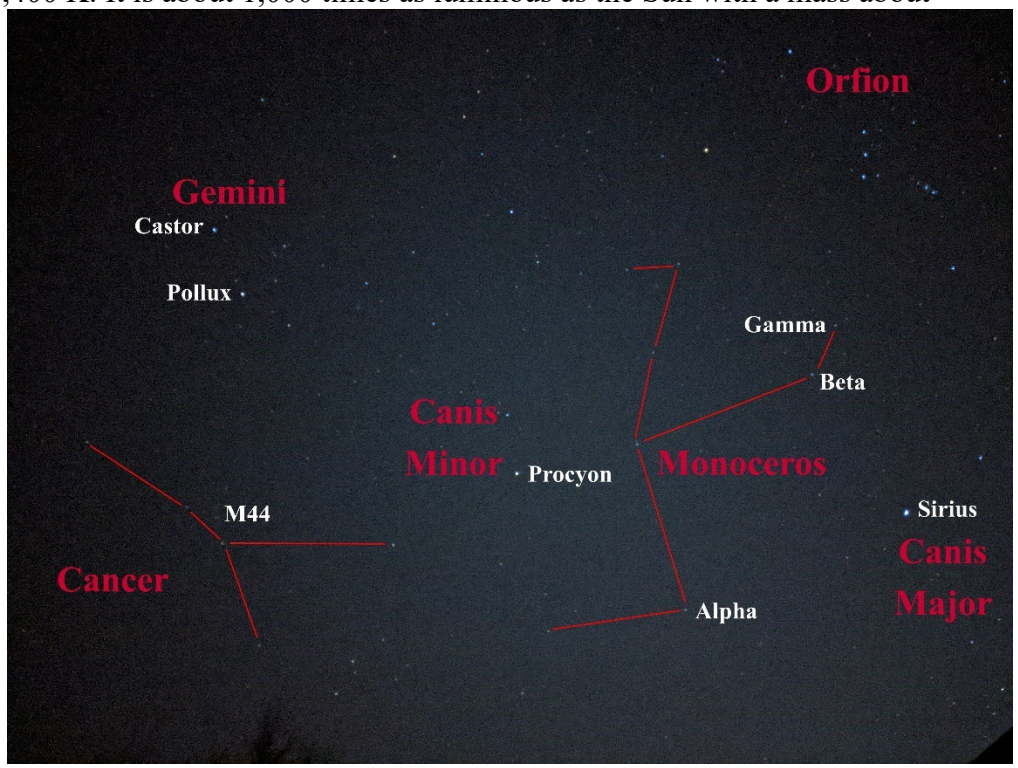
Monoceros has two stars brighter than magnitude 4.0 and one star that appears to be at magnitude 3.7 but is a combination of three fainter stars. Monoceros has 14 stars with a total of 15 confirmed exoplanets plus one that has not yet been confirmed.



Looking south in mid-February at 10:00 p.m. Standard Time.

The two brightest stars in the constellation of Monoceros are Alpha Monocerotis at magnitude 3.94 and Gamma Monocerotis at magnitude 3.99. Beta Monocerotis (A+B+C) appears to be magnitude 3.74. Alpha Monocerotis is a G9 (yellow) or K0 (orange) star (depending on your source, so call it yellow-orange) that has evolved into a giant with a surface temperature (visible surface) of 4,900 K. It is 60 times as luminous as the Sun with a mass of about 2 times that of the Sun and about 10 times the diameter of the Sun. It is about 148 light-years from us. Alpha Monocerotis is about 1.2 billion years old.

Gamma Monocerotis is a K1.5 (orange) star that has evolved off the Main Sequence, with a surface temperature (visible surface) of 4,400 K. It is about 1,000 times as luminous as the Sun with a mass about 4.5 to 5 times that of the Sun and about 55 times the diameter of the Sun. It is about 500 light-years from us. Gamma Monocerotis is estimated to be about 100 million years old. The atmosphere of Gamma Monocerotis appears to contain unusually large amounts of barium and other heavy elements that would imply that it was pulling off material from a unseen white dwarf companion. But this white dwarf has yet to be detected. However, Gamma Monocerotis appears to have two 13th-magnitude companions, but these are thought to be just two, more distant stars.



This picture taken on the evening (9:53 p.m.) of January 5, 2022, looking southeast.

Beta Monocerotis is listed as magnitude 3.74, but it is, in reality, a 3-star system with stars at magnitude 4.6, 5.0, and 5.3. These are known as Herschel's stars as William Herschel in 1781 discovered this triple-star system. They have surface temperatures (visible surfaces) of about 18,000 K They are all Be (blue-white) stars with masses about 6 to 7 times that of the Sun and luminosities about 1,000 to 3,000 times that of the Sun. They are all estimated to be about 28 million years old.

On the left is an image of Beta Monocerotis posted by ssmith on cloudynights.com

Binocular and Camera Targets:
Some of this information repeats from January. Nights are getting shorter. Jupiter and its satellites are always a nice target for binoculars. Saturn, however, is gone, not to reappear until the end of February at dawn. The Pleiades are ideal for binoculars as is the Orion Nebula (M42) in the sword of Orion. The Moon will be an evening object for most of the month. You may also want to try "splitting" the star Castor in Gemini into two images. In fact, Castor is composed of six stars! They are all about 700 light-years from us.

Evening Sky Viewing:
New Moon was January 31 (February 1 EST). Because of the timing of New Moon (10:46 p.m. MST), this is the second New Moon of January according to timeanddate.com, this makes the New Moon a Black Moon (except in the eastern time zone). First Quarter Moon is on February 8. Full Moon, the Snow Moon, is on February 16 (I will be on the telescope around that time). Last (Third) Quarter Moon is on February 23. The Moon is at perigee (367,789 km [228,533 miles] from the Earth) on February 26. The Moon is at apogee (404,896 km [251,591 miles] from the Earth) on February 10. The nearly 2-day-old crescent Moon passes 4 degrees south of Jupiter on February 2. In the morning, the waning crescent Moon passes 9 degrees south of Venus and then 4 degrees south of Mars on February 27. The Moon passes 4 degrees south of Mercury and a few hours later 4 degrees south of Saturn on February 28. Both of these are during the day, so look for the Moon, Mercury, and Saturn early in the morning, though it might be too light out to see them, depending on your eastern horizon.

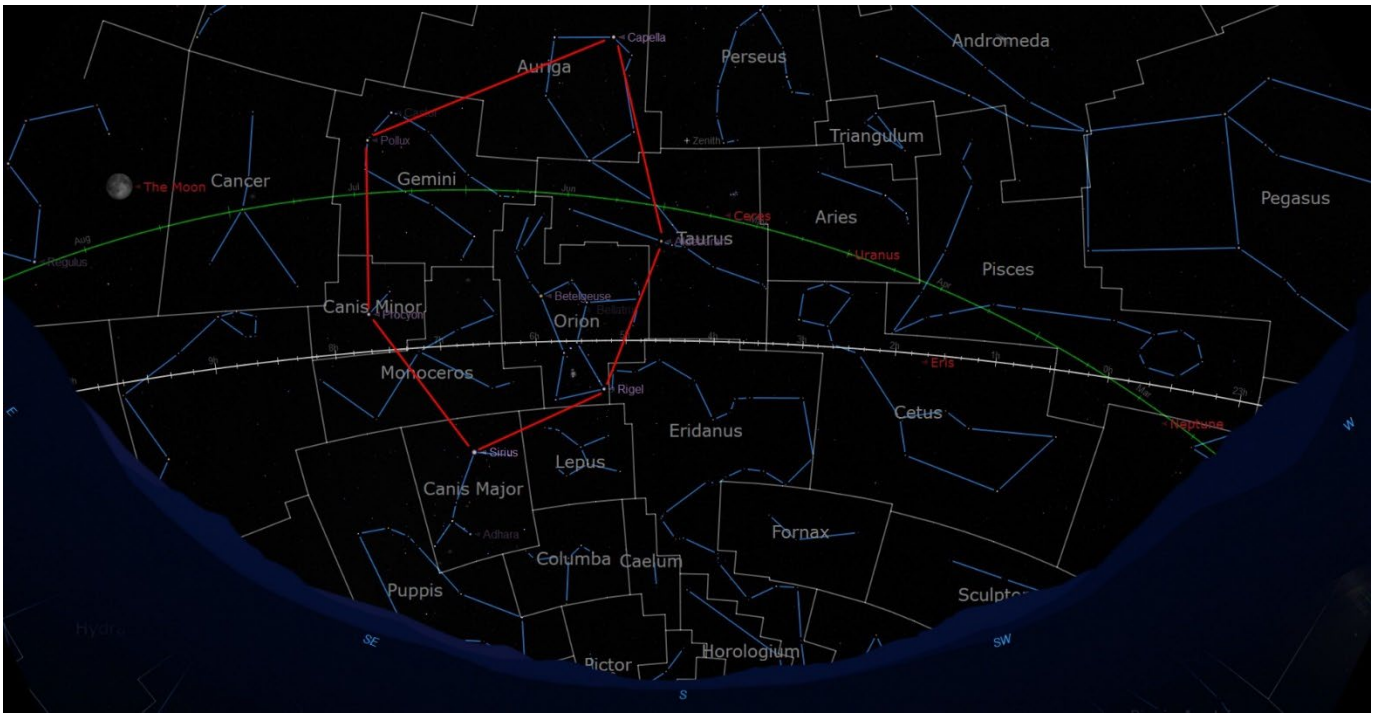
Looking North at about 7:00 p.m., by mid-February, the Big Dipper asterism is passing east of Polaris (handle down, bowl above), while the Little Dipper is below Polaris. By 7:00 p.m., Cassiopeia is now above and a little west of Polaris. Leo is completely above the horizon in the east by about 9:00 p.m. by mid-February. Camelopardalis, the Giraffe, is directly above Polaris.

February 15, 2022 looking North at 7:00 p.m. The + marks the Zenith (overhead).

Looking South, February continues to be an excellent time to view the Winter Hexagon high in the sky as it

moves from east to west over the course of the night. Orion is high in the south at about 8:00 p.m. (two hours earlier than in January). As I mentioned last month, there are two open star clusters to be seen in the constellation Taurus, the Bull: the well-known Pleiades and the Hyades. The Hyades forms the "V" of the bull's nose (just below the bright, red star Aldebaran, the bull's "eye") and can be found using Orion's belt as a pointer, moving up and to the right through the belt stars to find Aldebaran.

In the southwest, we are now saying goodbye to Pegasus and then Andromeda. They are both set by 10:00 and are soon followed by Pisces.

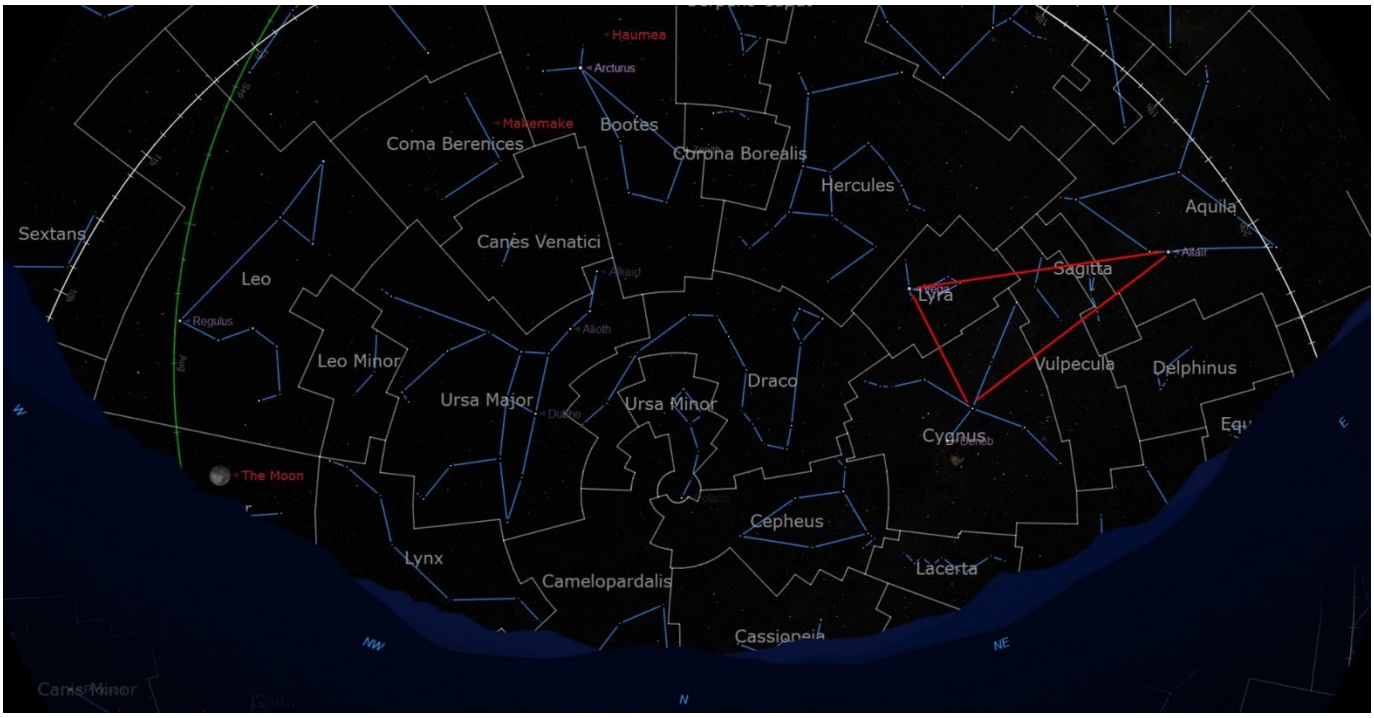


February 15, 2022 looking South at 7:00 p.m. The + marks the Zenith (overhead).

Early Morning Viewing:

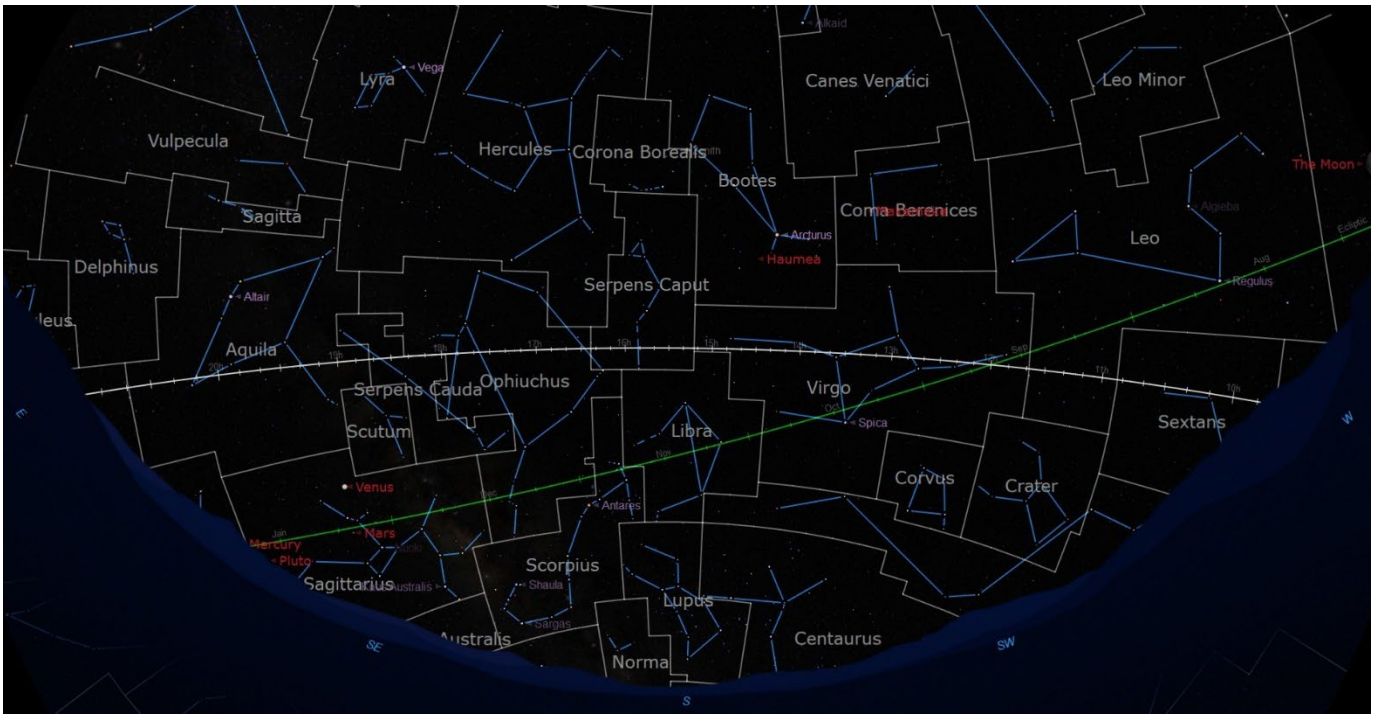
By the middle of the February, it starts getting light before 6:00 a.m. Astronomical twilight is at 5:43 a.m. (15 minutes earlier than on January 15) and civil twilight is at 6:40 a.m. (18 minutes earlier, too light to see any stars).

Looking North, in mid-February, Ursa Major (the Big Dipper asterism) is on its back (on its tail) west (left) of Polaris, followed by Boötes the Herdsman) and Hercules (the Greek Hero). Ursa Minor and Draco are both directly above Polaris. Lyra (the Lyre) is in the northeast. Lyra is joined by Cygnus (the Swan) and Aquila (the Eagle)—the Summer Triangle is well up in the predawn sky!



January 15, 2022 looking North at 6:00 a.m. The + marks the Zenith (overhead).

Looking South in mid-February at 6:00 a.m., it is easy to find Leo in the southwest, get closer to the horizon as the month progresses. In the southeast, you will see Scorpius and its bright, red star Antares. Ophiuchus is also in the southeast.



February 15, 2022 looking South at 6:00 a.m. The + marks the Zenith (overhead).

Where are the Planets?

Mercury is now a morning object. It rises about 1 hour before sunrise on February 1, 2022 at magnitude 1.1 and brightens by about 0.5 magnitudes over the next week. As of January 31, I could not see it in the light of dawn because of the mountains, trees, and thin clouds on my horizon. It reaches greatest western elongation on February 16 when it will be magnitude 0.0.

Venus starts off the month of February at magnitude -4.6, brightens to magnitude -4.9 around February 12 (when it is 26% illuminated) and then fades back to -4.6 by the end of the month. Venus is in Sagittarius (the Archer) all month.

Mars is also in Sagittarius all month. Mars brightens from magnitude 1.4 to magnitude 1.2 by the end of the month. Venus passes north of Mars on February 12 at a distance of about 7 degrees. They stay relatively close for the rest of February when they are about 5 degrees apart.

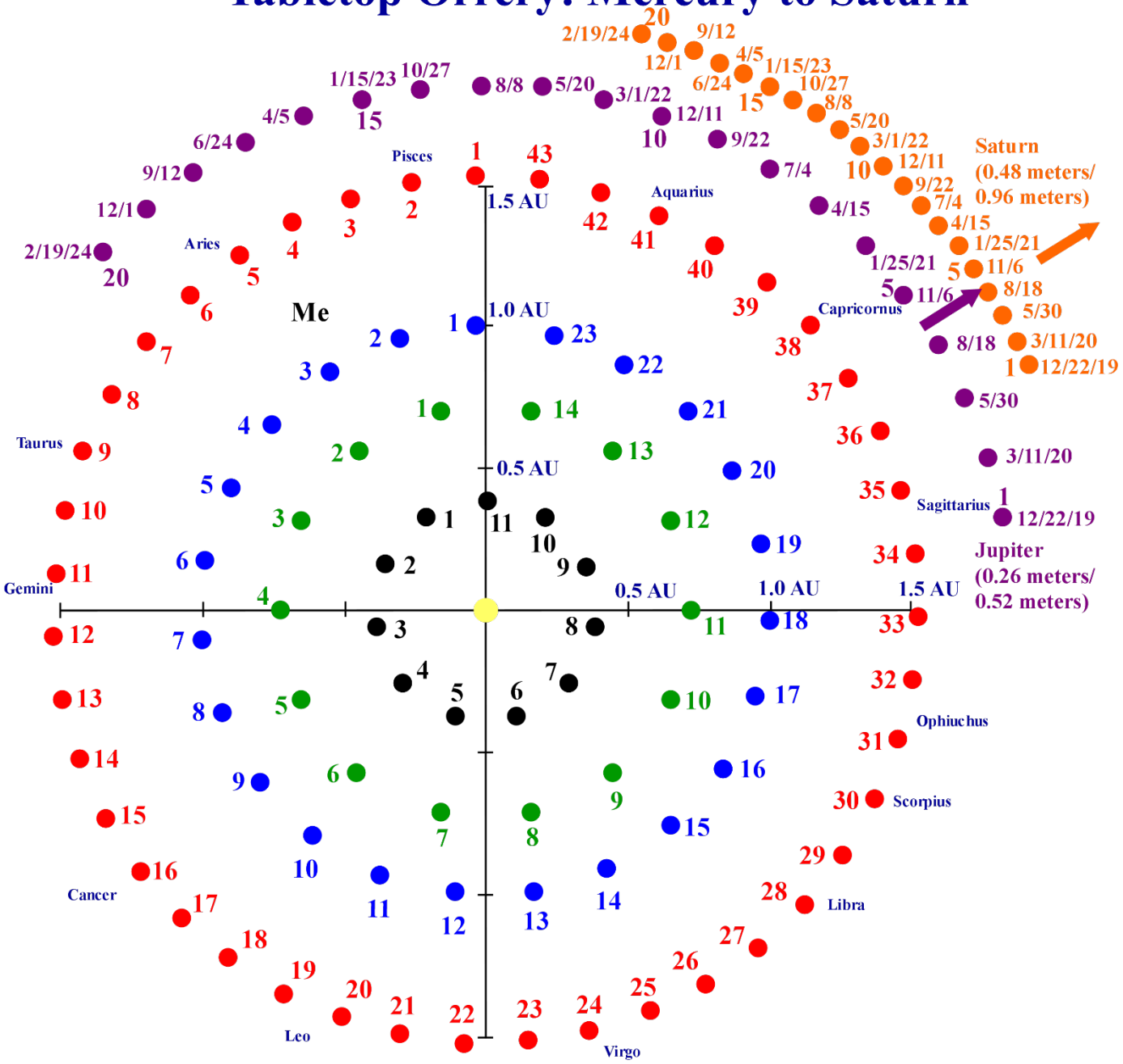
Jupiter is very low in the west just after sunset the first week of February. Jupiter is in Aquarius all month, shining at magnitude -2.0. However, it is lost in the evening twilight after the first week of February. Jupiter is at solar conjunction on March 5. **Saturn** is at solar conjunction on February 4 and starts to reappear in the morning sky late in February.

Connecting with the Human Orrery

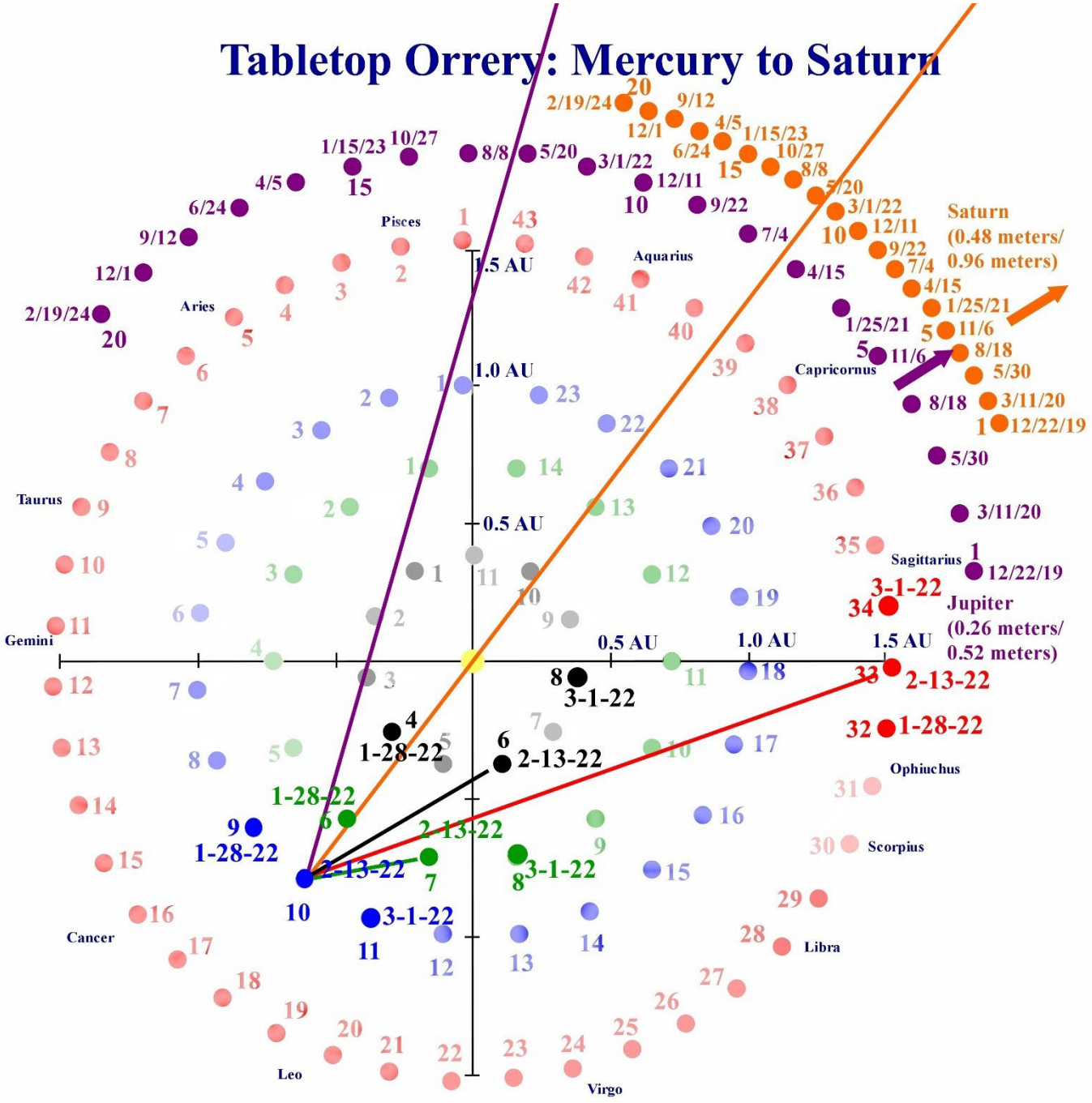
Using the Orrery, it is easy to model the positions of the planets relative to each other and to the Sun. As we like to remind you, because the stars in the constellations are not at their true relative distances (many kilometers away in this model), the positions of the planets relative to the constellations may be "off" by more than a constellation. The same is true for Jupiter and Saturn. The first Orrery image is just the standard one that is designed to be printed out at full scale of 16 inches by 21 inches (10 cm = 1 AU, the Sun-Earth distance). The second Orrery has circles relevant for January only, centered on February 13, 2022. Printed out on standard paper gives a scale of 5 cm =1 AU. On the page-sized scale, Jupiter is 26 cm from the Sun's position and Saturn is 48 cm from the Sun's position. Because Jupiter and Saturn are "off the page," the lines from the Earth to Jupiter and Saturn go off the page toward their true relative positions.

Using the Orrery, you can see that **Venus**, **Mars**, and **Mercury** are all morning objects, rising in that order. Venus and Mars are near to each other in the sky during the last half of February. **Jupiter** is still just barely visible just after sunset. **Saturn** is on the far side of the Sun and becomes visible at dawn at the very end of February.

Tabletop Orrery: Mercury to Saturn



5 centimeters = 1 AU (Earth-Sun distance), page-sized
10 centimeters =1 AU, full size (16 inches by 21 inches)
Mercury (0.39 AU, orbital period = 88.0 days, 47.4 km/s)
Venus (0.72 AU, orbital period = 224.7 days, 35.0 km/s)
Earth (1.00 AU, orbital period = 365.25 days, 29.8 km/s)
Mars (1.52 AU, orbital period = 687.0 days, 24.1 km/s)
Jupiter (5.2 AU, orbital period = 11.86 years; 13.1 km/s)
Saturn (9.6 AU, orbital period =29.46 years; 9.7 km/s)
Step size: Mercury = 8 days
Venus, Earth, and Mars = 16 days
Jupiter = 80 days
Saturn = 80 days



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