AOH Newsletter

Autumn 2020

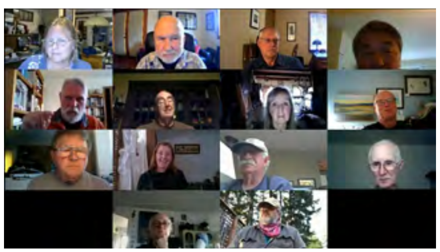
News and Notes

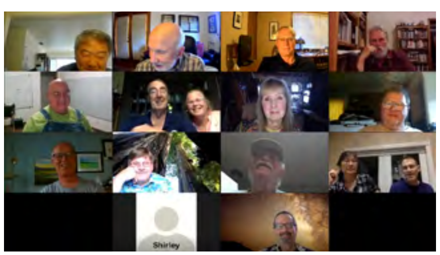
Despite the curtailment of our usual summer outreach program, AOH members have remained in touch with each other and with the heavens. We've held Zoom meetings, and have been out observing (and photographing) individually.

Thanks to all who provided photos for this issue, to Grace for writing a superb article on observing the planets, to Susie for her clever cartoon, and to Susan for proofreading and for her helpful suggestions.

Contributions to the newsletter are always welcome. Send stuff in at any time to ken@astrohum.org.

Zoom





Meetings from June 20, August 1, and August 29. Summaries can be found at the members-only pages of the website at www.astrohum.org/members only/reports.php.

Comet NEOWISE

The first really good comet in a decade made its appearance this summer. It has the reputation of being the most photographed comet of all time. AOH members were not left out of the action.

Clockwise from upper left: Don Wheeler, Joe Eiers, Bob Zigler, Rick Gustafson.

Perseids

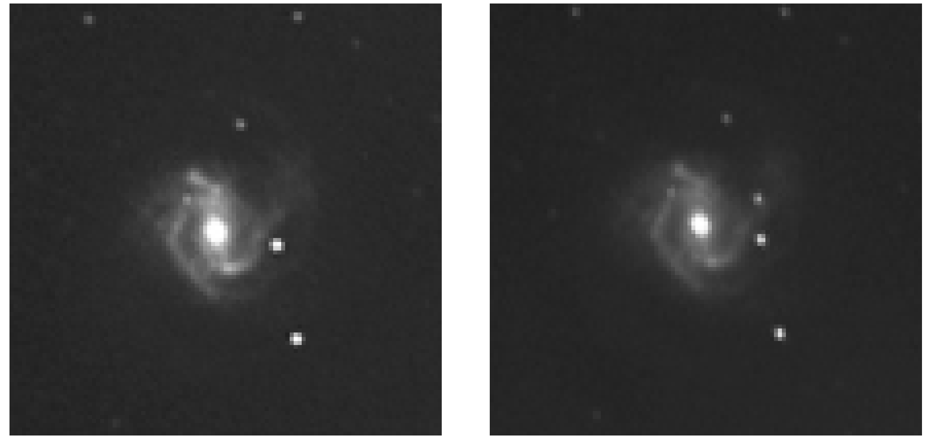
Some members went up to our old stomping grounds on Horse Mountain, some went to Bald Hills Road or to Kneeland, and some (like me) stayed home and watched from their backyard. We had reports of a goodly number or meteors as well as some pretty spectacular fireballs. Here's a composite of three Perseids and one sporadic meteor (across the top). Photos by Rick Gustafson. Click on the photo to see the negative, where it's easier to see the short Perseid trails and where the radiant (R) is.

Planets

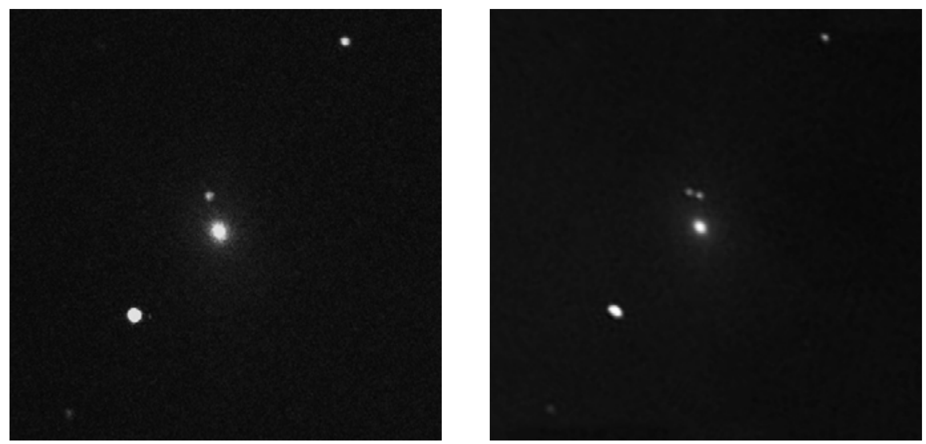
Grace Wheeler has been busy observing the bright planets. Here's her shot of a rare double shadow transit of the moons of Jupiter, taken on August 14, 2020. See her article beginning on page 3 for an explanation of this picture and tips on viewing Jupiter as well as Saturn, Mars, and Venus.

Supernovas

Any given galaxy is expected to host a supernova about once a century. So it is a special treat to get two within reach of amateur telescopes a few months apart. Here are Grace Wheeler's photos. See the article beginning on page 6 for everything you have always wanted to know about these cosmic fireworks.



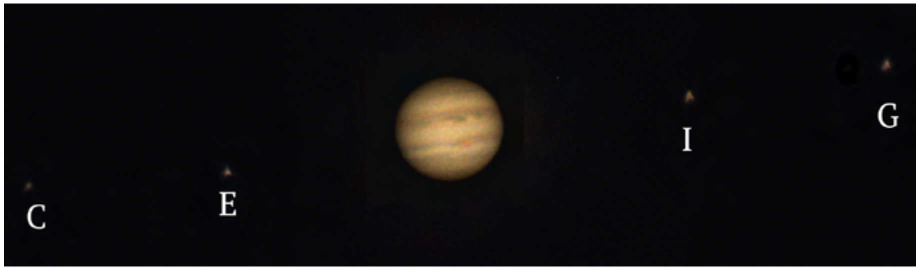
Left, Galaxy M61 in Virgo, with a few foreground stars, 03/13/18. Right, the same field, taken 05/24/20, showing SN 2020 jfo. This was a type II supernova, discovered by ZTF (Zwicky Transient Facility).



Left, Galaxy M85 in Coma Berenices, 03/21/20. Right, the same field, taken 07/25/20, showing SN 2020 nlb. This was a type Ia supernova, discovered by ATLAS (Asteroid Terrestrial-Impact Last Alert System).

Backyard Astronomy: Planets in 2020

by G.D. Wheeler



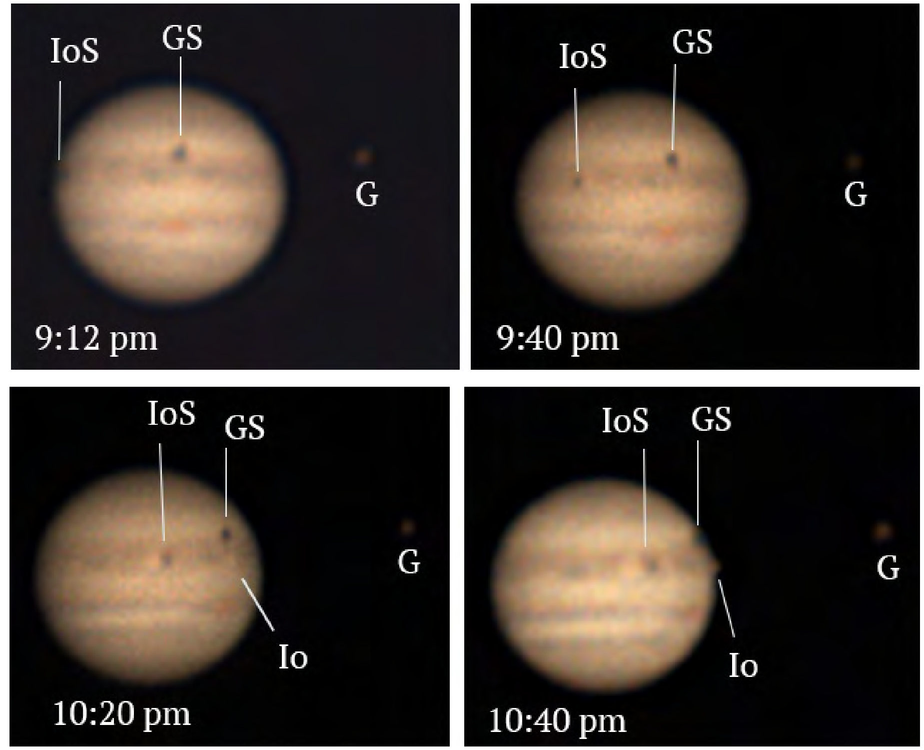
Jupiter on August 9, 2020 with the moons Callisto (C), Europa (E), Io (I), and Ganymede (G). Photos by GDW.

Shadows on Jupiter

Jupiter reached opposition on July 15th, and from now until the middle of October will be up from early evening until late at night.

A typical view of Jupiter is a bright disk with bands accompanied by the four Galilean moons: Io, Europa, Ganymede, and Callisto. One of the interesting phenomena that is seen with Jupiter is the transit of one or more of the Galilean moon across the disk. As the moons transit the Jovian disk during their orbit, the moons seem to disappear against the background. A telltale sign of a transit is the shadow that a moon casts onto the tops of clouds.

On August 14th there was a rare double shadow transit that involved Ganymede and Io. The images in the next column show the westward migration of the moons and their respective shadows across the Jovian disk. Note: since the transit was occurring after opposition, the shadow transit lags behind that of the moon (the opposite is seen before opposition when the shadow transit precedes the transit of the moon). The first image at 9:12 p.m. shows that Io's shadow (IoS) begins its ingress at the eastern limb (start of the double shadow transit). The moon Io is to the right of the shadow but is lost in the background. Ganymede has migrated off the disc while its shadow (GS) is midway through its transit. The image at 9:40 shows the westward movement of the shadows (IoS, GS). At 10:20 p.m., GS approaches the western limb while IoS is in mid-transit. Io becomes visible as it approaches the darkening at the limb. At 10:40 p.m., the shadow of Ganymede egresses at the western limb (end of the double shadow transit). The moon Io is also seen to exit the disk while its moon (IoS) approaches the limb. The shadow of Io will egress 30 minutes later at 11:20 p.m.



Double Shadow Transit of Io and Ganymede. The images were taken through an 8 inch SCT with a ZWO ASI290 planetary camera. The images were stacked in Autostakkert, and processed in Registax. Photos by GDW.

A convenient tool to predict when transits of the Jovian moons and their shadows will occur can be found at https://shallowsky.com/galilean/. Shadow transits can be easily viewed with a moderate-sized telescope while seeing transiting moons requires a large telescope. While there are no double shadow transits left in the 2020 season (that are viewable from our area), single transits of Io, Europa, and Ganymede can still be seen.

The Rings of Saturn

Saturn reached opposition on July 20th about five days after Jupiter's opposition. Saturn is seven degrees east of Jupiter, and is dimmer and has a golden hue. Like Jupiter, Saturn can be viewed from the early evening until late at night through mid-October. In 2020, Saturn's rings are tilted downward so that we see the northern face (top) of the rings. The tilt of the rings currently obscures the southern hemisphere of the planet. Starting in 2021, the rings start to tilt upward and the southern hemisphere becomes visible.

Saturn in the summer of 2020. The image of Saturn was taken on August 9th through an 8-inch SCT. The images were stacked in Autostakkert, and processed in Registax. Photos by GDW.

Mars Opposition 2020

The opposition of Mars on October 13th marks the last of three consecutive perihelic oppositions that started in 2016. While the 2018 opposition was the best of the three, the 2020 opposition is also favorable with the Martian disc being only slightly smaller (22.4 arcseconds) than the one seen in 2018 (24.2 arcseconds).

The images in the next column show the Syrtis Major face of Mars and reveal the increase in the size of the disk as well as in the surface details as Mars approaches opposition. Currently, Mars is partially illuminated (85-89%) and appears gibbous. At around the time of opposition, the disk will become fully illuminated and will be at its maximum diameter.

Currently, Mars is in the constellation Pisces and can be seen after midnight as a bright red "star". By September 24, Mars surpasses Jupiter in brightness. Prime viewing for Mars will be from September through early November. With a moderate-sized telescope, it is possible to make out the polar ice caps and craters, and large dark features such as Syrtis Major and Meridiani Planum. 2020 will be the last time to get a close view of Mars until 2033. More about Martian oppositions can be found at https://www.skyatnightmagazine.com/advice/skills/how-to-observe-mars/.

The growth of the Martian disk as Mars approaches opposition in October 2020. The dark triangular plain is Syrtis Major Planum, an ancient shield volcano. Lying beneath Syrtis Major is Hellas Planitia, an enormous impact crater. The whitish area at the southern tip is Planum Australe, or the south polar ice cap. Mars was imaged with an 8-inch SCT and a ZWO ASI290. The images were stacked in Autostakkert, and processed in Registax. Photos by GDW.

The Phases of Venus

Venus alternates between being an evening and a morning planet. The transition between the two occurs at the inferior solar conjunction when Venus passes directly between the Earth and the Sun. Before inferior conjunction, Venus lies to the east of the sun and is visible in the evening. After inferior conjunction, Venus lies to the west of the sun and is seen at dawn.

From Earth's perspective, Venus changes in size and phases as it approaches Earth during its orbit around the sun. These phases are similar to the lunar phases. When Venus is far away and near the sun (superior solar conjunction), the planet is small and gibbous. Venus is in the quarter phase when the planet is at its greatest elongation, i.e. the angular distance between Venus and the sun is 47 degrees as seen from Earth. As Venus nears Earth, the diameter of the planet reaches its maximum and is in the crescent phase. The minimum illumination of the disk can be observed when Venus is near inferior solar conjunction when the crescent is very thin.

On June 3rd, Venus passed between the Earth and the Sun during inferior solar conjunction, thus beginning the planet's morning apparition. As Venus has moved away farther from Earth, the apparent diameter of the disk has decreased, and the phases have transitioned from a waxing crescent to the quarter phase (August 12th) to a waxing gibbous. As Venus approaches superior solar conjunction in March 2021, the diameter will continue to decrease as the disc becomes fully illuminated.

Venus can be seen in the predawn skies throughout October. In November and December, Venus sinks back towards the sun, but the planet remains visible at dawn.

More about the phases of Venus can be found at https://astrobob.areavoices.com/2020/05/12/the-crescent-venus-is-within-your-reach/.

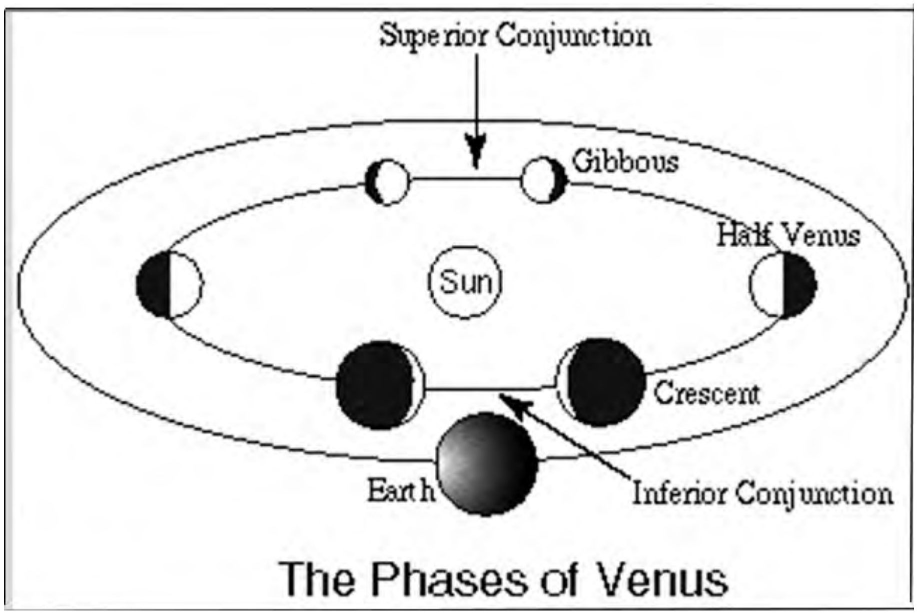


Diagram from: http://www.physics.ucla.edu/~huffman/venus.htm.

Left: 6/10/20, 1.8% illuminated, 56.4"
Center: 7/08/20, 25% illuminated, 38.2"
Right: 8/12/20, 50% illuminated, 23.7"
Venus was imaged through an 8 inch SCT, and ZWO ASI290 camera.
Images were stacked with Autostakkert and processed with Registax.
Photos by GDW.

And Don't Forget Mercury!

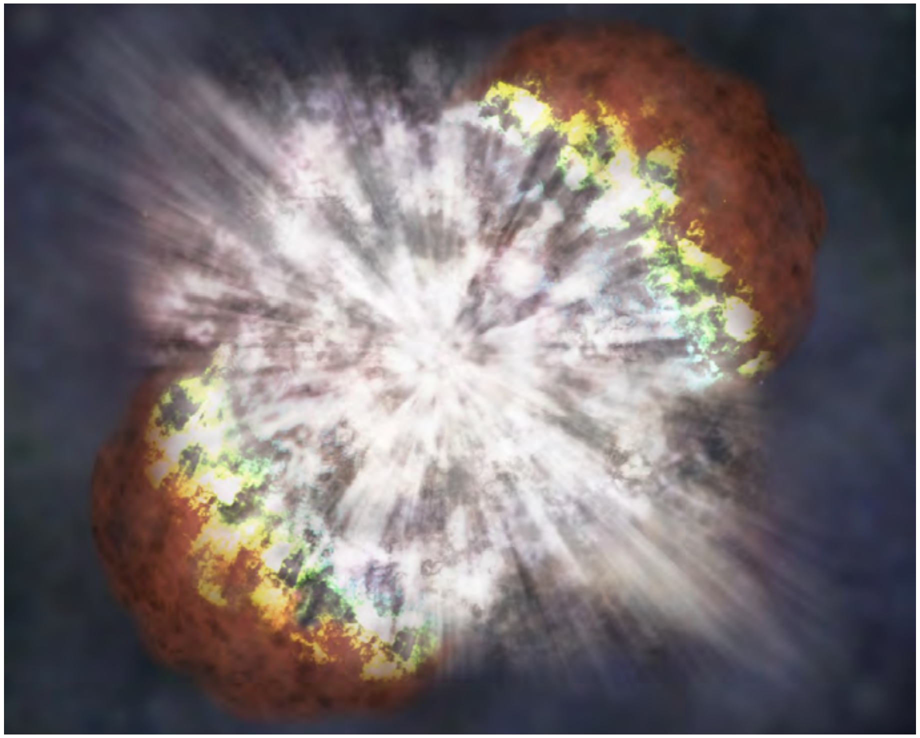
Although Mercury spends most of its time too close to the Sun (from our point of view) to be seen, it will reach its Greatest Western Elongation on the morning of November 10, 2020. This means it will be rising significantly before the Sun on that day (and in fact for a week or so around that date). Go out and look east around 6:00 am. You'll see the crescent Moon with brilliant Venus below it. And below Venus, about 8 degrees above the horizon, you'll see 0th magnitude Mercury in the lightening sky. Of course you'll need an unobstructed eastern horizon, and if there's any low-lying haze. binoculars might be useful.

This is a "fairly good" elongation for us Northern Hemisperians, since the ecliptic will be tilted 65° to our horizon, which puts Mercury higher in the sky while the Sun is still below the horizon. Our colleagues at 40° south latitude have a horizon tilted 80° to ours, which makes the ecliptic tilt only 35° to their horizon. So for them Mercury is still quite low when the eastern sky gets light. Sometines, of course, the situation is reversed, so we should take advantage of planetary geometry when we can.

—addendum by KY

This article is excerpted from Scioly.org, https://scioly.org/wiki/index.php/Astronomy/Type_Ia_Supernovae and https://scioly.org/wiki/index.php/Astronomy/Type_II_Supernovae. This material is available under a Creative Commons License.

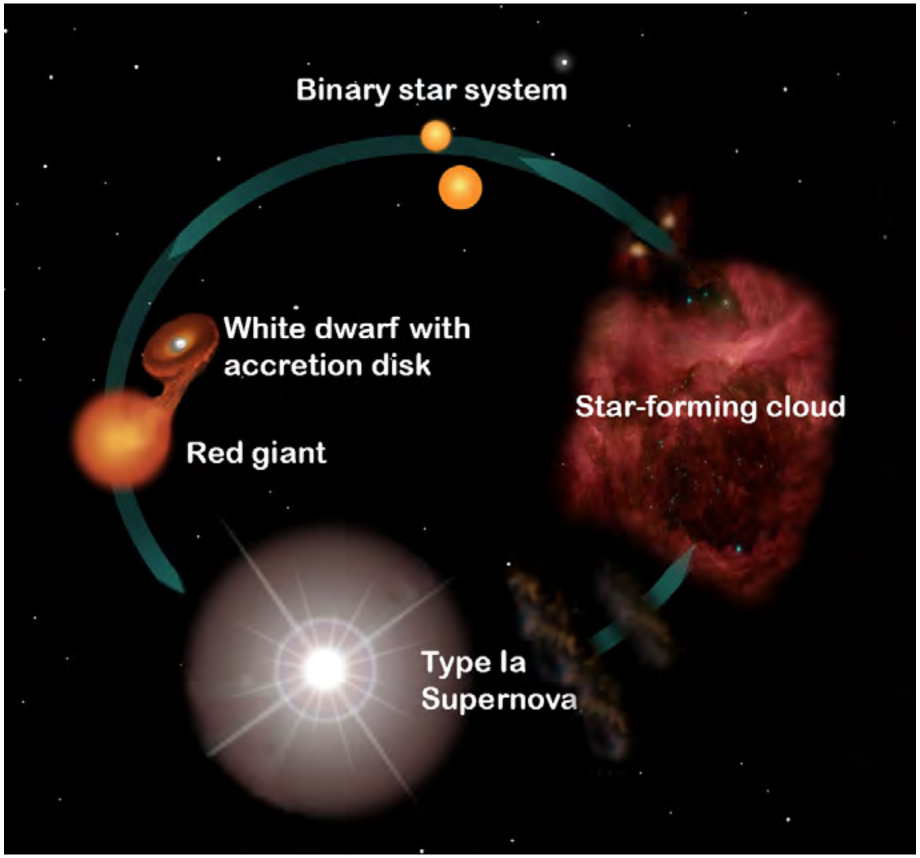
Supernovae



A supernova is, in short, the explosion of a star. This term can apply to several different types of explosions, though, and so, like many other astronomical terms, there are classifications. Type Ia supernovae are explosions of white dwarfs in binary systems that pull mass off their partner and accumulate enough pressure for a supernova. Type Ib and Ic supernovae are formed when a large star is stripped of its outer hydrogen layers. The Type I supernovae are generally associated with binary systems. Type II supernovae are explosions of supergiant stars that occur when the star fuses iron in its core. Some Type II supernovae are hypernovae, occuring in hypergiants, even larger and brighter than regular supergiants.

Basically, type Ia supernovae are the explosions of white dwarfs. All type Ia supernovae emit roughly the same amount of energy because they result from the same type of star (a carbon/oxygen white dwarf around 1.4 solar masses), making them a good tool to determine galaxy distances. These supernovae also have very distinctive light curves that fall off quickly and steadily, as compared to the gradual fall-off of Type II supernovae. The spectrum is also distinctive, since exploding dwarfs don’t have hydrogen absorption lines.

Type Ia supernovae occur because of the Pauli Exclusion Principle, which states that two particles of the same type can’t be in the same quantum state (position, velocity, energy level, spin, etc.). Quantum mechanics says that as a white dwarf gains mass and its electrons



are squeezed into a smaller and smaller space, they have to move faster to avoid being in the same quantum state as other electrons. As a white dwarf approaches 1.4 solar masses, its electrons start moving at nearly the speed of light! Since nothing in the universe can move faster than the speed of light, a white dwarf can't exist above 1.4 solar masses, and instead collapses into a neutron star or a black hole. This limit of about 1.4 solar masses is known as the Chandrasekhar Limit.

The most common model for a type 1a supernovae consists of a binary star system of two main sequence stars. The larger of the stars will expend the hydrogen in its core faster and evolve into a red giant before its partner. Eventually, the larger star becomes a white dwarf and the smaller evolves into a red giant. The orbital period of the binary star system then decreases and can be as low as a few hours. As the angular momentum of the system is lost, the stars spiral together with the white dwarf accreting gas off the red giant. Ultimately, the white dwarf explodes for reasons listed above.

Another model is where two white dwarfs orbit each other quickly and begin to fall toward each other. Eventually, they will collide in the center of the system, and the resulting body will have a mass of over 1.4 solar masses, thus exceeding the Chandrasekhar Limit and resulting in a supernova.

Type Ia supernovae are interesting objects, but how can we figure out if an explosion is a Type Ia supernova and not, say, type II? Luckily, there are a couple ways that can verify whether the object we are looking at is truly a Type Ia supernova.

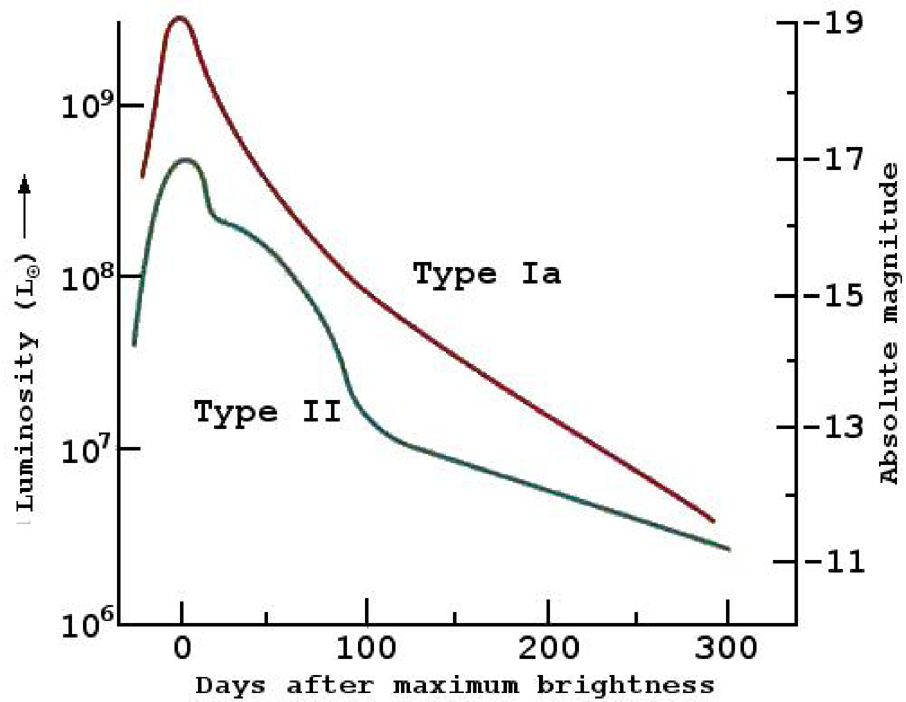
One of the ways astronomers identify Type Ia Supernovae is through their light curves. All of the light curves have a similar shape, with a sharp increase, followed by a decrease that begins steeply and gets flatter. Also, because Type Ia supernovae originate in the same basic way, they all have a peak absolute magnitude of around -19.3, which is useful as a standard candle (see next section). This is one of the main ways that they are differentiated from Type II supernovae, whose curves have distinctly different shapes.

All Type Ia supernovae also have very similar emission spectra, since they all originate from white dwarfs. The two major characteristics of Type Ia are that they are lacking in hydrogen (common to all Type I supernovae) and have strong Si II lines (only characteristic of Ia).

An important characteristic for Type Ia supernovae is that they can act as a standard candle. All Type Ia supernovae have an absolute magnitude of about -19.3 (sometimes cited as -19.6), so by measuring the apparent magnitude observed from the explosion on Earth, one can simply use the distance modulus formula to determine the distance to the object.

The distance modulus is given by: $m-M=5(\log_{10}(d)-1)$, with distance in parsecs. Since the absolute magnitude at the peak must be -19.3, you can substitute this into the equation as the value for M: $m+19.3=5(\log_{10}(d)-1)$. Or, if the equation is rearranged to get distance on one side: $d=10^{(m+19.3\}/5+1.}$ So once you know how bright the supernova appeared from Earth at its peak, you can then determine its distance fairly accurately.

Type II Supernovae result from the collapse of massive stars, resulting from the collapse of the star's iron core. This usually occurs once the star starts fusing silicon—the end product is iron, which burns through fission rather than fusion. This results in the formation of a



series of layers within the star. When the iron core reaches the Chandrasekhar mass limit of about 1.4 solar masses, the electron degeneracy pressure (in layman's terms, the unwillingness of electrons to be squeezed into a smaller and smaller space) which had kept it from collapsing before then, isn't enough to hold the core up. Protons and electrons in the core are forced together to form neutrons and neutrinos. The neutrinos produce a huge outward force simply because there are so many of them (they don't usually interact with regular matter). The force can not be successively countered, and the star will implode and send off a shockwave that becomes the supernova explosion.

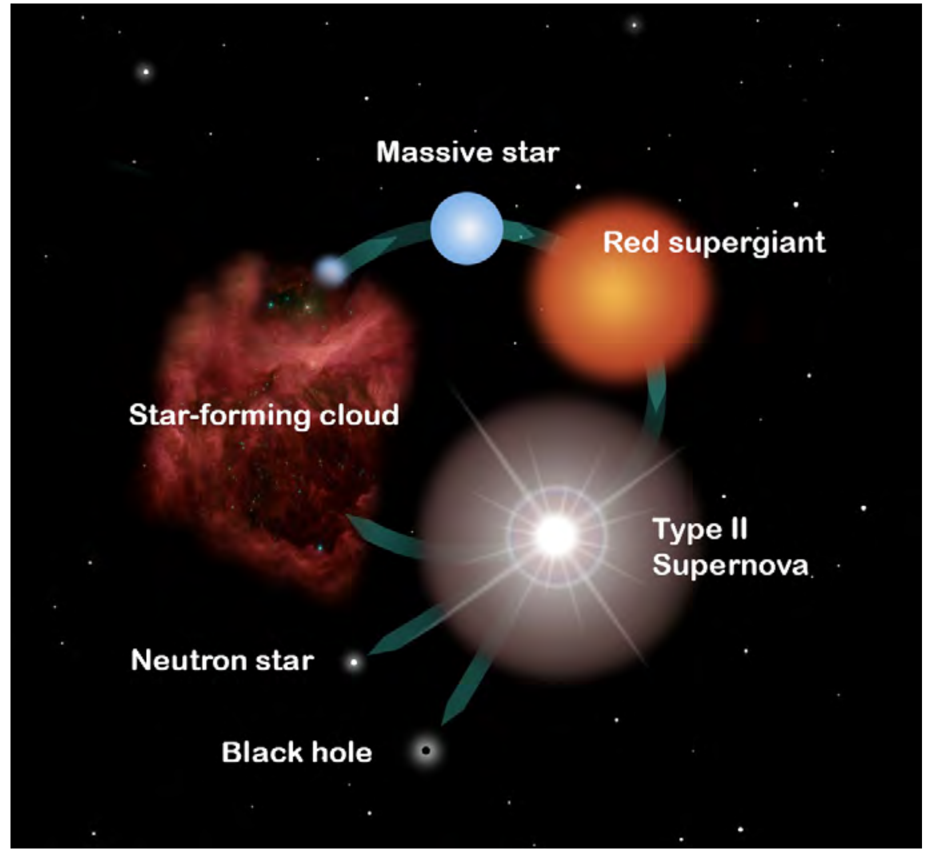
Meanwhile, the outer layers of the star fall inward, due to gravity, as the core collapses. When the core stops collapsing because of neutron degeneracy pressure, the outer layers crash into the core and "bounce" outwards, creating a shock wave. Along with the outward pressure from the neutrinos, this shock wave is what causes the star (except for the core) to blow itself apart in a Type II supernova.

"Massive" stars generally need to be at least eight solar masses to be categorized as such, though much more massive stars are known to exist. The theoretical maximum mass for a star is defined through the Eddington limit, though there have been observed cases that seemingly break it. The more massive the star, the faster it will go through the stages of fusion and eventually collapse.

Because massive stars are metal-rich (they're the only ones capable of even fusing and creating most metals), they tend to be Population I stars, located in Open Clusters, where there are younger and more metal heavy stars. As a result, Type II Supernovae are generally thought to occur in Population I stars and Open Clusters.

The results of a Type II Supernova are either neutron stars or black holes, along with a supernova remnant. The energy and mass that make up a supernova remnant spread out and become a part of the interstellar medium, fueling the creation of new stellar objects. In this way, supernovae contribute to the "life cycle" of the universe—as stars collapse and reach their ends, parts get recycled to help create new stars and objects.

Neutron stars are composed of, as said before, neutrons, leaving the star with no electrical charge. Though there is no fusion, the star keeps itself together through degeneracy pressure. This can be further



explained by the Pauli Exclusion Principle, stating that no two subatomic particles can occupy the same place and state simultaneously. Because of the Pauli Exclusion Principle, the neutrons repel each other and keep in motion, with the sheer number of neutrons creating a force that keeps the object together.

If the core ends up with over 2-3 solar masses of matter (because some of the matter in the outer layers fell back onto the core when the star went supernova), even neutron degeneracy pressure can't support the core against its own gravity and it collapses into a black hole. Once the core contracts to a small enough size, the escape velocity becomes greater than the speed of light! Nothing - not even light - can escape the gravitational pull of the collapsed core. Because of this, we can't even see the black hole itself; all we can see are its effects on nearby matter.

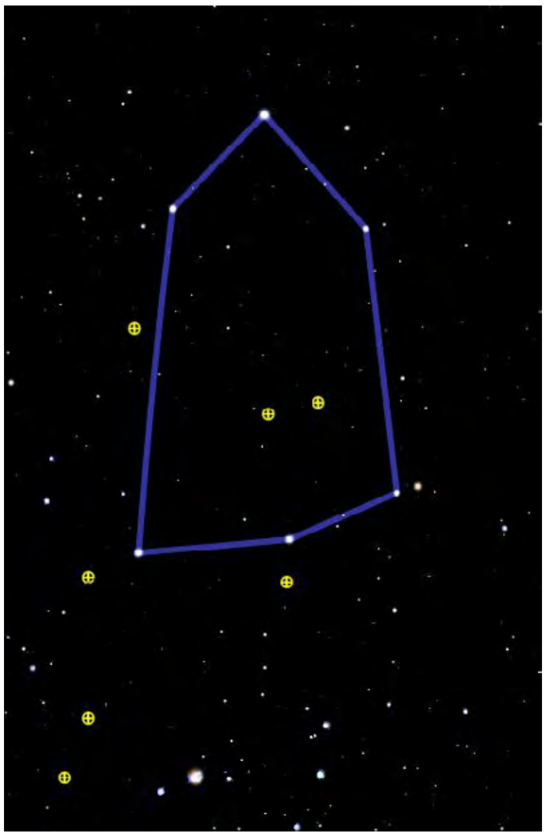
But that's another story.

The Snake Handler

by Ken Yanosko

In late Summer and early Fall, the Milky Way overhead directs our attention to the southern constellations of Scorpius and Sagittarius and the wonders of the centrtal regions of the Galaxy. But the next time you're out under the stars, take a look at the constellation Ophiuchus ("aw-fee-YOU-cuss"), standing just north of the scorpion. His name means "Snake Handler"—in some western languages he's called "Serpentarius". He's standing in between the two halves of the divided constellation Serpens.

Exactly who he is and what he's doing there is a matter of opinion. Some say he's a personification of the god Apollo, who battled the snake Python which had been the guardian of the temple at Delphi. After his victory Apollo put his image in the sky to remind everybody who's boss. Another story relates Ophiuchus to the famous healer Asclepius who learned medicine by studying snakes. Asclepius was such a good doctor that Zeus killed him, fearing that humans would become immortal and crowd out the gods. Asclepius was given his heavenly post as a sort of compensation. Still another story says Ophiuchus is really Laocoön, the Trojan who warned his fellow Trojans against taking in the horse ("Beware of Greeks bearing gifts"). Laocoön was strangled by a snake for interfering with the gods' plans, and was put in the sky as *his* compensation award.

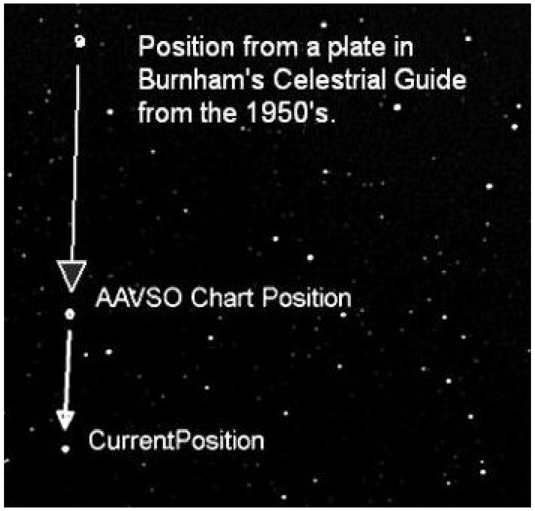


Personally, I can't look at Ophiuchus without being reminded of a character from our modern mythololögical canon. Click on the Stellarium picture at lower left and you'll see who I mean.

There's another aspect of modern mythology, one in which poor Ophiuchus doesn't get any respect. Although the ecliptic, the apparent path of the sun across the sky, runs through Ophiuchus, he is not considered to be one of the "signs of the zodiac". But if you are a believer in birth signs, and are born between November 29 and December 17, Ophiuchus is your guy. Since the astrologers ignore him, you can feel free to make up your own description. "Ophiuchi are strong, perceptive, good with animals, . . ."

Ophiuchus hosts no fewer than 7 Messier globular clusters. At his knees are M10 and M12, and M14 is at his elbow. At the bottom of his cape are M9 and M107. And, in the picture, to the lower left, are M19 and M62. The latter two are frequently thought of as belonging to Scorpius, since they are just to the left of Antares (you can see Antares and the rest of Scorpius's claw at the bottom of the picture), but they are really in Ophiuchus's territory.

Finally, inconspicuous at magnitude 9.5, near Ophiuchus's eastern shoulder, is the red dwarf Barnard's Star, which, at six light years distance, happens to be our sun's fourth nearest neighbor, after the three suns of Alpha Centauri. It's noted for its high proper motion, moving across our line of sight at a rate of 10 arcseconds a year, which comes out to a third of the moon's diameter in 60 years. And, to top things off, Barnard's Star has a planet, a super-Earth, right at its frost line. Could there be real-life Ophiuchans, handling snakes, right here in our neighborhood?



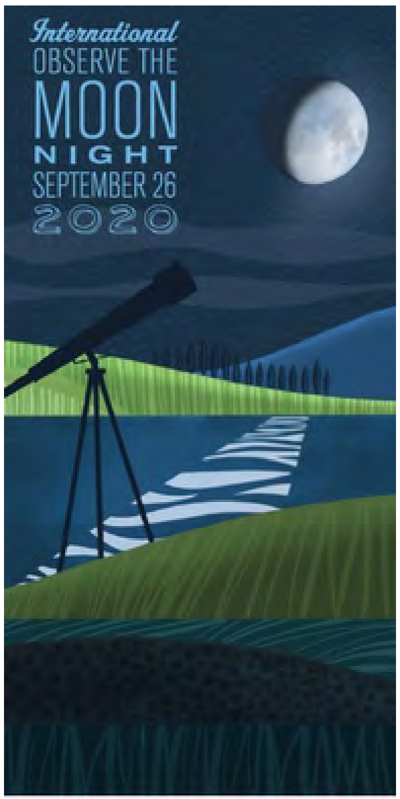
http://templeresearchobservatory.com/images-tro/

International Observe the Moon Night

September 26, 2020 is International Observe the Moon Night. It is a time to come together with fellow Moon enthusiasts and curious people worldwide. Everyone on Earth is invited to learn about lunar science and exploration, take part in celestial observations, and honor cultural and personal connections to the Moon.

This event occurs annually in September or October, when the Moon is around first quarter—a great phase for evening observing. Furthermore, a first-quarter Moon offers excellent viewing opportunities along the terminator (the line between night and day), where shadows enhance the Moon's cratered landscape.

Once again AOH members and friends are invited to join in. (Last year we held the event at Arts Alive.) This year we are asking everyone—beginners, intermediates, and experts, to participate. Here's what you do: on September 26, or the first clear evening thereafter, go out and observe the moon. Record your observation by making a sketch (simple pencil-and-paper is fine), or taking a photo (a cell phone photo will be great), or setting up your scope and taking a closeup of your favorite lunar feature. Then send in your picture to us, by text, email, or snail mail.

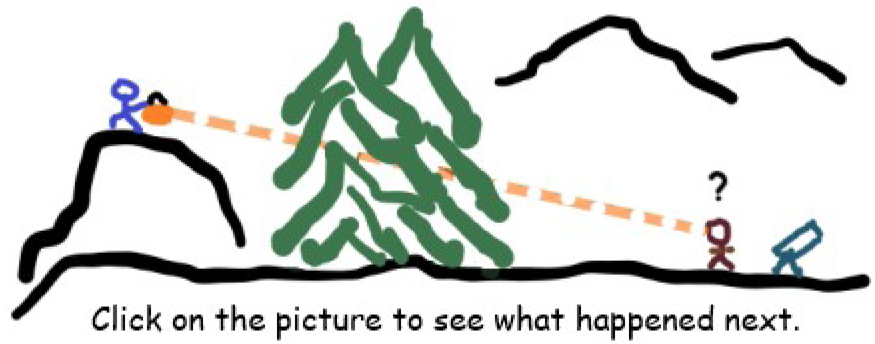


This is a family event—kids are especially invited to join in. Everyone who does will receive an official Certificate of Participation from NASA, and acknowledgement in our next Newsletter. Go to https://www.astrohum.org/moon.html for more details.

Stay safe, and have fun!

After Words

True story. Recently, a friend of mine was out at a dark-sky site in a clearing in the woods. Sudddenly, he saw an orange light shining through the trees. "Uh oh," he thought. "Somebody's coming down the trail with a lantern. Maybe I'm inadvertently trespassing. Maybe I've stumbled onto an illegal grow. Maybe I should pack up and leave."



Heavenly Bodies by Susie Christian