WHAT'S UP IN OCTOBER

By Bernie Reim

The month of October always marks the first full month of fall for us in the northern hemisphere. Autumn will bring with it a slow and gradual transformation of our lush green summer landscape into the dramatic and memorable flaming foliage for which New England is so famous. This is also a great time to get outside under the night sky as the days are getting shorter and cooler and the weather is still mostly clear.

We all need to experience more of the night's ongoing and completely natural wonders which are especially needed in today's hectic times on Earth. We sometimes forget that we are all important parts of this continually unfolding and changing natural drama of our greater environment about which we still know so little.

Just as the surface of part of the earth was being transformed into a tender green half a year ago when spring started, it is once again being transformed into a myriad of vibrant colors as the leaves lose their green chlorophyll and activate their colored pigments as they wrap up their productive summer season and prepare for their dormant period in winter. Each leaf is part of a remarkably efficient process that we have not yet completely figured out.

The vast celestial vault above our limited terrestrial view is also being slowly transformed as the top of the Winter Hexagon begins to appear once again above our Eastern horizon before 10 pm and we say a long good bye to summer as Scorpius and Sagittarius finally disappear below our southwestern horizon.

Notice that any given star will rise 4 minutes earlier each night, so that the whole sky seems to move ahead two hours each month. The sky will look the same on the first of October at 10 pm as it does on the first of November at 8 pm and the first of December at 6 pm. The later you stay up, the farther into the next season you are seeing. That is why it is always a surprise to see the top of the Winter Hexagon, a star named Capella in Auriga, already clear the eastern horizon a little after 10 pm during late summer while the Summer Triangle is still above the western horizon. We will not completely lose the Summer Triangle until after winter starts. The Summer Triangle, consisting of Vega in Lyra, Deneb in Cygnus, and Altair in Aquila the Eagle is roughly opposite the Winter Hexagon in our sky.

The highlights for this month include a nice conjunction of Mercury and Mars low in the western evening sky half an hour after sunset in Libra on the 19th when they will be less than 2 degrees apart.

Saturn is still close to its best for the year and now rises just before sunset. Jupiter is getting closer and brighter and is rising earlier each night in Gemini. The moon will occult some of the stars in the Pleiades for different parts of this country. We will be able to see some of these occultations here from the East Coast. That will happen around 11 pm on Thursday, October 9.

To top off some nice highlights this month we have Comet Lemmon passing through Boötes near the Big Dipper during the last 2 weeks this month. It should become visible in a pair of binoculars since it should reach 8th magnitude. Then you have the elusive 31 ATLAS that many people are talking about since this is only the third comet from outside our solar system that has ever been spotted from Earth. The other two were Oumuamua and Comet Borisov. Then you have a favorable year for viewing the Orionid Meteor Shower since there will be no moon to interfere with one of nature's greatest shows next to eclipses and the Aurora Borealis.

Mars has been slowly dropping lower into our evening sky on its way to conjunction with the sun next month. Before that happens, Mercury will join the Red Planet very low in the western evening sky. They will be at their closest on the 19th. You may need a pair of binoculars and a clear western horizon to say farewell to Mars for the year. Then keep watching as a slender waxing crescent moon joins the pair on the 23rd.

Although Saturn reached opposition last month and is now slowly getting smaller again as it is drifting farther away from us, the Ringed Planet is still very close to its best and brightest for the year in Aquarius. Notice that the angle of the tilt of its rings will decline a little from 1.5 degrees down to just half a degree. Two more nice transits of Titan, its largest moon at 3000 miles in diameter, will occur.

Brilliant Venus continues to rise a little later each morning as it is getting farther away from us also. It starts the month in Leo and crosses into Virgo by the 9th It is joined by the waning crescent moon on the 19th when it will rise at 5:30 a.m. and be nearly fully illuminated by the sun.

As opposed to Saturn, Mars, and Venus which are all getting a tiny bit fainter and smaller each night, Jupiter is still getting closer and brighter. It starts the month rising just after midnight in Gemini and it will end the month by rising around 11 pm. Shining at magnitude minus 2.2, it is only about 4 times fainter than Venus, the brightest object in our sky after the sun and the moon. Jupiter will also undergo some nice transits of its moons this month, so look for that in a telescope. The first one is on October 4th at 4 am. Europa and Io will perform a double transit that day. That day in 1957 is also when the first satellite ever made by humans was launched Sputnik 1.

The waning gibbous moon will occult or cover up some of the stars in the Pleiades open star cluster in Taurus It will start around 11 pm on the evening of Thursday the 9th and last for a couple of hours. Check for more details based on your location as to exactly which stars in the Pleaides will be occulted. The first one to be covered is called Electra. In mythology the Pleiades are the daughters of the Titan Atlas who were turned into stars to escape the hunter Orion.

I remember watching an extremely rare graze occultation of the moon over the Pleaides once about 30 years ago. The sunlight streaming through the valleys on the moon made one of the Pleaides appear as if it were blinking on and off instead of just being suddenly covered like it will be this time. You would need a pair of binoculars to see this occultation this month. The star will be covered by the bright part of the moon, but then it will reappear later from behind the dark limb of the moon, which will give it more contrast and be much easier to see. While you are watching all of this, remember that the moon is always traveling about 2000 mph around the earth even while all of these other motions are going on. The Earth-moon system is actually orbiting a common center of gravity called the barycenter which is located about 1000 miles below the surface of the 8000-mile-in-diameter Earth.

In real life the Pleiades are an open star cluster of about 500 stars located about 400 light years away. That means that the light from this interesting star cluster that looks like a miniature Little Dipper, even though it only covers about 1 degree of the sky instead of 20 degrees like the real Little Dipper, left there about the same time that Galileo turned the first telescope to the heavens and discovered all kinds of hard-to-believe things like the moons of Jupiter forming a mini solar system, the rings of Saturn, sunspots on the sun, the phases of Venus, and many more.

Comet Lemmon was discovered this January using the Mt. Lemmon survey in Arizona. This comet came in from the Oort's cloud were most of our comets some from. This is a huge shell of trillions of comets that surrounds our entire solar system stretching from 2000 to 200,000 astronomical units. One astronomical unit is 93 million miles which is the average distance between the earth and the sun or just over 8 minutes at the speed of light. The outer edge of the Oort's cloud is about one light year away, which is 6 trillion miles.

Comet Lemmon is passing through Boötes the Herdsman now just above the bright orange star named Arcturus. A good way to orient yourself in the sky for much of the year is to follow the arc of the Big Dipper to Arcturus and then speed on to Spica, which is the brightest star in Virgo on the ecliptic. The saying goes "Arc to Arcturus and speed on to Spica".

Look for this comet closer to new moon. It could reach as bright as 8th magnitude, so maybe you will be able to see it with just a good pair of binoculars. Its nucleus is about a mile across.

Now we get to the far more interesting comet that many people are talking about, Comet 3I Atlas. That is not 31, but 3I. The 3 stands for only the third comet ever seen that came in from another solar system and not from the Oort's cloud or orbiting any of our outer planets. The first one was Oumuamua in 2017 and the second one was Comet Borisov in 2019. The letter I stands for "Interstellar" since it did not originate in our own solar system like almost all of the other comets do.

Comet 3I Atlas will be closest to the sun, or perihelion, in late October and closest to Earth in December at 170 million miles or inside the orbit of Mars. Understanding the orbit of this extremely rare comet is a whole lesson in math and conic sections. The hyperbolic orbit of this rare comet follows one of the 4 conic sections. If you slice through a cone parallel to the flat ground you would get a circle with an eccentricity of 0, If you slice through at any angle, you would get an ellipse whose eccentricity can go from anything just above 0 to just below 1. If it reaches one, it becomes a parabola. Then if you slice

Comet 3I ATLAS was discovered on July 1 of this year by an automated telescope whose purpose is to discover comets low on the horizon that people could miss. It stands for Asteroid Terrestrial Impact Last Alert System, which is rather ominous-sounding for a mere telescope that could actually save our lives!

It turns out that Comet 3I ATLAS is heavier and larger than either of the first two interstellar objects that have visited us. Its nucleus is about 3 miles across and it weighs about 33 billion tons. It is traveling at 130,000 miles per hour, or twice the speed that we are always traveling around the sun. The JWST has already seen high levels of carbon monoxide and carbon dioxide along with water and water ice and carbonyl sulfide (OCS) in its coma. It also found pure nickel without the usual iron that other comets and asteroids have. It is about 8 billion years old, or nearly twice as old as anything in our own solar system. On top of all that strange chemistry, comets like this one may actually be vehicles to transfer life from one star to another and even possibly seed new planets. To me that would make it even more interesting than if it were some kinds of an alien spaceship sent into our solar system to investigate! We could be watching an amazing natural process that does not require any aliens to explain it.

The last major highlight this month is a favorable display of the annual Orionid Meteor Shower. It is active from October 2nd right through November 7, but the peak on Tuesday morning on the 21st around 5 am nicely coincides with the new moon, which happens just 3

hours later. Due to that fact, you can expect about 20 meteors per hour from a dark sky site away from any light pollution.

This meteor shower is caused by tiny sand-grain-sized particles of dust and ice in the trail of the most famous of all comets, Halley's. Normally we would only pass through a comet's dust and debris trail once each year, if at all, but we actually pass through the trail of Halley's comet twice, on October 21 AND May 4, which results in the Eta Aquarid meteor shower in spring.

Find a wide-open field with a good view of at least the southern sky as far away from any light as you can get. All of these meteors will emanate from a point in the sky in Orion just above the red giant star Betelgeuse, hence the name Orionids. You can see them anywhere in the sky, but they will all originate from this part of the sky. To see the most meteors look about 45 degrees away from the radiant. Then keep scanning the sky. You can also photograph them by setting a camera on a tripod and leaving the shutter open for a few minutes with a wide-angle lens.

Most of these tiny pieces of Halley's comet will burn up about 60 miles high in our sky. That is about the distance from Portland to Augusta, but straight up. That is called the Karman line, where space begins and the sky turns black because there are no more air molecules to scatter out the sunlight. That is also where many of the northern lights take place in our sky. The International Space Station orbits at about 250 miles high, or another 4 times higher. It orbits about 35 times faster than a jet plane and is about 35 times higher.

Find a good, dark, open sky site and be prepared with a lawn chair or blanket if needed and settle in to enjoy a spectacle of nature that can really connect you to the vast cosmos always above us if you let it and understand it.

Oct. 1. On this day in 1897 the Yerkes 40-inch refractor was dedicated. Designed by Geroge Ellery Hale it was the largest telescope in the world at the time. He also designed the next 3 large telescopes, each one being the largest in the world at the time. His last one was the famous 200-inch reflector at Mt. Palomar that was dedicated in 1948.

Oct.2 Mercury passes 1.9 degrees north of Spica in Virgo.

Oct. 3. Dwarf planet Ceres is at opposition in Cetus the Whale the morning.

Oct.4. On this day in 1957 Sputnik 1 was launched, marking the start of the space age.

Oct. 5. The moon passes 5 degrees north of Saturn today. Neil deGrasse Tyson was born on this day in 1958.

Oct. 6. The moon passes 3 degrees north of Neptune this morning. Notice that Neptune is still visible just to the left and above Saturn through a telescope. Full moon is at 11:48 p.m. EDT. This one is the famous Harvest Moon because it is a day closer to the fall equinox than the September full moon was.

Oct. 7. Neils Bohr was born on this day in 1885. He was one of the early pioneers in the quantum mechanics revolution, which made a lot of our modern technology possible.

Oct. 9. Kepler's supernova was first seen on this day in 1604 in Ophiuchus the Serpent-Bearer. It was about 20,000 light years away. This was a Type 1A supernova. It remained visible to the naked eye for about 18 months after that time.

Oct. 13 Last quarter moon is at 2:13 p.m. The moon passes 4 degrees north of Jupiter.

Oct. 14. Pluto is stationary, ending its retrograde motion today in Aquarius which began on May 4. It takes Pluto 248 years to complete just one orbit of the sun even though it is traveling at 10,600 miles per hour. That is about 6 times faster than the average bullet and still about 7

times slower than we move around the sun. Pluto spends just over 20 years in each of the 12 zodiac constellations.
Oct. 15. Asaph Hall, an American astronomer who discovered both of the moons of Mars, Phobos and Deimos, was born on this day in 1829. Thomas Bopp, an American amateur astronomer who co-discovered the brightest recent comet, Hale-Bopp back in 1996, was born on this day in 1949.
Oct. 16. The moon passes 1.2 degrees north of Regulus today.
Oct. 19. The Indian-American astronomer Subrahmanyan Chandrasekhar was born on this day in 1910. He won the 1983 Nobel prize in physics and discovered the limit at which a Type 1A supernova like Kepler's supernova always has to explode as matter from a nearby red giant feeds onto the surface of a while dwarf. That limit is 1.4 solar masses. Once we know that we can use this type of supernova to figure out the distance to galaxies billions of light years away because a supernova becomes about as bright as the entire galaxy it resided in when it explodes. The moon passes 4 degrees south of Venus this morning.
Oct. 21. Mercury passes 2 degrees south of Mars this evening low in the southwestern sky. The Orionid meteor shower peaks. New moon is at 8:25 a.m. EDT.
Oct. 22. Karl Jansky was born on this day in 1905. He was an American physicist and radio engineer. He found radio waves from an extraterrestrial source and started radio astronomy.
Oct. 23. The moon passes near Mercury and Mars tonight.
Oct. 24. The moon passes half a degree south of Antares tonight.
Oct. 29. First quarter moon is at 12:21 p.m. Mercury is at greatest eastern elongation from the sun today.
Oct. 31. Venus passes 4 degrees north of Spica this morning.