# WHAT'S UP IN JULY

**By Bernie Reim**

The month of July is named after Julius Caesar and was once the fifth month of the year when March was the first month. July always marks the first full month of summer for us in the northern hemisphere and the nights remain quite short.

There are a few interesting highlights this month that will be worth looking for even with the short nights and potential heat and bugs that will try to diminish your experience of the celestial beauty of the night sky. However, no more epic celestial adventures that can lift you right off the surface of earth and put you in tune with the cosmic like the April 8 total solar eclipse and the May 10 fantastic display of the northern lights, visible all the way down to parts of Texas and Florida, are scheduled for this month.

Some events are perfectly accurately and mathematically predictable for over 100,000 years into the future, like all the different kinds of eclipses and some events are just more likely to occur at certain times, like northern lights when the sun is more active, like right now and into next year. Then there are even less predictable events like when a new comet might appear that will become visible to the naked eye. Then there are extremely short term unpredictable events like any given bright and colorful fireball streaking through the sky. That could happen at any time through the night, but is more likely during a good meteor shower like the Perseids, Geminids, or Leonids.

Then you have another class of events that are predictable within a certain time frame like about half a year. We are looking for one of those right now with great anticipation and this will be an once-in-a-lifetime opportunity for most of us. A star in Corona Borealis, or the Northern Crown, T Corona Borealis, nicknamed the "Blaze star" is expected to get over 1000 times brighter sometime between now and September. This is called a recurrent nova, and this is the brightest one in the entire sky and undergoes this extreme brightening about every 80 years.

Discovered in 1866 by John Birmingham, this star has also been recorded to brighten so spectacularly 4 times already, in 1217, 1787, 1866, and 1946. Now we are ready for the fifth time. The physics is fairly simple, but still fascinating because of the huge scale involved and the other potential outcomes of a similar explosion. There is an extremely dense and small white dwarf, about the size of the earth which is being orbiting by a red giant star many times larger than the sun about 50 million miles away from the white dwarf. The whole system is about 3,000 light years away in the constellation of Corona Borealis, now easily visible right next to Hercules and just south of the Big Dipper. It is a semicircular upside down crown of 7 stars. The Blaze star will appear just below the second star from the left of this crown.

A white dwarf by itself is already an expression of an interesting quantum mechanical phenomenon called electron degeneracy. About 95 % of all the stars in our galaxy including our own sun will turn into a white dwarf, so it is important to learn more about them. As the electrons in this very dense remainder of a star keep getting pushed to higher energy states, they generate an actual pressure that holds these stars together. Once this pressure can no longer balance self-attraction of the strong gravitational fields, a part or all of the white dwarf has to explode. A white dwarf by itself with no red giant star close to it is very stable and can live for hundreds of billions of years, much older than the entire known universe, which is only 13.8 billion years. When it no longer emits any heat at all, it will turn into a black dwarf.

Some white dwarves could have crystallized diamond cores since they are basically carbon under extremely high pressure. A white dwarf has nearly the mass of the entire original star compressed into the volume of Earth, which is 333,000 times less massive than the sun and over a million times less volume than the sun. Their density is around 1 million kilograms per cubic meter. By comparison, a neutron star is another 11 orders of magnitude more dense than a white dwarf, an entire sun shrunk down to the size of a single city. A single teaspoon of neutron star material would weigh about a trillion kilograms or 10 million tons.

There is an accretion disk around the very dense white dwarf as it is continually pulling hydrogen gas from the much larger and less dense red giant very close to it. This continues to build up until a brief and intense flare of nuclear fusion occurs about every 80 years, making the star about 1,000 times brighter, from its current $10^{th}$ magnitude to the brightness of Polaris, which is 2.1 magnitude, making it only the $48^{th}$ brightest star in our sky. As soon as the extra hydrogen is gone, the pair quickly returns to their normal state. So you will only have a short window to see this for yourself without any binoculars or telescopes.

The much more extreme case of this basic process is called a type 1A supernova. In that case the extra hydrogen gas forming the accretion disk doesn't just flare up into a temporary nuclear explosion involving only a small part of the star, but now it is a runaway nuclear explosion so powerful that it permanently destroys the entire system.

An Indian-American astronomer named Chandrasekhar won the Nobel Prize in physics in 1983 for the discovering the exact limit when this happens, along with many other important discoveries about the structure and evolution of stars, neutron stars, and black holes. The limit is 1.44 solar masses. Once you know this and can accurately measure the brightness of such a powerful explosion, which becomes billions of times brighter than the original white dwarf and red giant, then you can figure out is distance.

Type 1A supernovae are cosmic yardsticks or standard candles which can be used to accurately determine distances out to billions of light years near the "edge" of the known universe. Since these Type 1A supernovae appeared dimmer than they should have once all the other factors were ruled out, two science teams independently discovered that the expansion of the whole universe was accelerating in 1998 and won the Nobel Prize in physics for this great discovery in 2011. The exact cause of this continuing acceleration is unknown. We have simply called it "dark energy". It is not just the vacuum energy of empty space, because that is about 100 orders of magnitude more powerful than the observed energy.

The planets have spread out now and 2 of them have returned to grace our evening skies, Mercury and Venus. Look for Venus very low in our western sky right after sunset in Cancer the Crab, just to the left of Gemini. It will slowly get higher in our evening sky as the faster moving Venus is catching up with Earth in our orbits.

Then look for Mercury about 10 degrees above and to the left of Venus towards Leo the Lion. Notice that a very thin waxing crescent moon will be directly above Mercury and Venus 20 minutes after sunset on July 7.

Saturn now rises at midnight in Aquarius. Through a telescope you will notice that its rings are getting very thin now, only tilted 2 degrees from edge-on. The rings will open up a little through the rest of this year, and then they will close up again to exactly edge-on in March of 2025. This last happened in 1996 and it happens every 29 years, since that it the time it takes

for Saturn to orbit the sun once. I remember seeing Saturn without its rings in 1996 when it looked more like Jupiter.

Mars rises next around 2 am in Taurus the Bull. Notice that Mars will have almost the same brightness and orange color as Aldebaran, the brightest star in Taurus at 0.8 magnitude. Since Aldebaran marks the eye of Taurus in the Hyades star cluster which marks the face of Taurus, Taurus will appear to have two orange eyes for this whole month.

Then Jupiter is the next one to rise around 3:30 am also in Taurus just to the left of Aldebaran. About one hour before sunrise on Tuesday, July 30, a waning crescent moon with earthshine will be visible just above Mars and Jupiter and just below the Pleiades open star cluster. You can also spot Uranus just to the right of the Pleiades and just above Jupiter and Mars with a pair of binoculars or a small telescope. Taurus is a busy region of the sky this month.

The largest and brightest asteroid, Ceres, will be easily visible in a pair of binoculars in Sagittarius near the center of our Milky Way galaxy all month long at 7.3 magnitude.

We will finally get the first good meteor shower since May of this year on the last day of this month as the southern Delta Aquarid meteor shower peaks. You can expect 25 meteors per hour emanating from its radiant in Aquarius just below where Saturn is now located. Caused by Comet 96P/Machholz, this is only one of 8 meteor showers related to this comet which has an orbital period of 5.3 years. This shower will be active from the middle of July into the middle of August. Also start looking for early Perseid meteors emanating from Perseus the hero in the northeastern sky near Cassiopeia. They will peak on the 12$^{th}$ of August.

There are two comets visible right now in a small telescope. Comet C/2023 (Tsuchinshan-ATLAS) is traveling westward through Leo this month. It is only shining at 8$^{th}$ magnitude now, but it is on track to becoming easily visible to the naked eye in October when it reemerges from behind the sun.

The other one is 9$^{th}$ magnitude 13P/Olbers which is traveling through Lynx and Leo Minor.

July 1. The moon passes 4 degrees north of Mars this morning.

July 3. The moon passes 5 degrees north of Jupiter this morning.

July 4. Henrietta Swan Leavitt was born on this day in 1868. She was part of the famous "Harvard Computers" who developed the spectral classification system of stars. She went farther and also discovered the period-luminosity of Cepheid Variables which allows us to use these rare and special stars as cosmic yardsticks or standard candles similar to Type 1A supernovae. However, since Cepheid variables are not nearly as bright, they are only good to a few hundred million light years instead of billion of light years. This is also called Leavitt's Law.

July 5. Earth is at aphelion or farthest from the sun for the year at 94.5 million miles today. New moon is at 6:57 p.m. EDT.

July 7. The moon passes 3 degrees north of Mercury this evening.

July 11. Skylab, our first space station, reentered our atmosphere on this day in 1979.

July 13. First quarter moon is at 6:49 p.m. EDT. Jupiter passes 5 degrees north of Aldebaran this morning.

July 15. Mars passes less than one degree south of Uranus this morning.

July 18. On this day in 1980, India became only the 7$^{th}$ nation to launch a satellite. India now has about 120 working satellites. China has about 550, Russia about 200, and we have over 4,000.

July 20. On this day in 1969 Armstrong and Aldrin became the first two humans to ever walk anywhere other than Earth. Only 10 more humans have ever walked on the moon since then up until December of 1972. Now we have the Artemis mission and are planning to go back to the moon on a permanent basis starting next year. Viking 1 landed on Mars on this day in 1976.
July 21. Full moon is at 6:17 a.m. This is also known as the Hay, Buck, or Thunder Moon.
July 27. Last quarter moon is at 10:52 p.m.
July 30. The southern Delta Aquarid meteor shower peaks.