WHAT'S UP 2007: 365 DAYS OF SKYWATCHING

Tammy Plotner

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I open my scuttle at night and see the far-sprinkled systems,
And all I see, multiplied as high as I can cipher, edge but the rim of the farther systems.

Wider and wider they spread, expanding, always expanding,
Outward and outward, and forever outward.

–Walt Whitman, from Leaves of Grass

"Cerro Tololo Skies"
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FOREWORD

Greetings, fellow SkyWatchers! Are you ready for another year of "What's Up" in the night sky? Then come along as we take a deeper look at lunar features, the Messier catalog, Herschel objects and various selections from alternative catalogs. These studies were designed with you in mind...to help you achieve your various observing goals whatever optics you use. Here you will find objects well suited to the beginner, as well as challenging studies meant to intrigue the seasoned amateur astronomer.

New this year are two charts at the beginning of each month. On the left hand pages are basic constellation charts, which are just that—basic. They will provide you with a rough idea of what our study areas will be for the month. On the right are All Sky charts will give you a rough look at how the night sky will appear for the northern hemisphere. While it would be wonderful to provide you with detailed maps, it is difficult to produce ones that are suitable for printing. I highly suggest using a great freeware program such as Cartes Du Ciel (www.astrosurf.com/astropc/cartes/) or Your Sky (www.fourmilab.ch/yoursky/) to create your own, or purchase a reputable sky atlas or lunar program such as Lunar Phase Pro (http://lunarphasepro.nightskyobserver.com/).

As the year advances, the studies here become more and more challenging, and I think you will be very pleased with what you will learn in the course of this book. Don't be afraid if you are just beginning in astronomy, or only use your eyes! There are things here designed to intrigue all levels—from users of binoculars to those with large telescopes. Just remember that lunar features and planetary predictions are all very general and meant to cover readers the world over.

Excellent resources for accurate times and locations are readily available, and I also recommend you check IOTA—the International Occultation Timing Association (www.lunar-occultations.com/iota/iotandx.htm), the pages of Mr. Eclipse -Fred Espenak (www.mreclipse.com), the AAVSO—American Association of Variable Star Observers (www.aavso.org), Space Weather (www.spaceweather.com) and Heavens Above (www.heavens-above.com). Wonderful periodicals such as "Sky and Telescope" (www.skyandtelescope.com) and "Astronomy" (www.astronomy.com) also offer current observing information—and excellent updates are found on Universe Today (www.universetoday.com)!

For the reader familiar with the "What's Up" series, general sky instructions such as a fistwidth (10 degrees), handspan (20 degrees), or fingerwidth (2 degrees) are still used this year. These are not meant to have pinpoint accuracy, and are included to help you steer to the right area of the sky. While oftentimes this basic instruction is enough to spot an object in the finderscope or binoculars, more difficult objects require more specific directions—and you will also find right ascension and declination for challenging studies. For those wishing to pursue organized observing, be sure to visit the Astronomical League (www.astroleague.org) for clubs in your area and awards programs.

If you are just beginning in astronomy, I also urge you to take a look my articles at Beginner's Guide to Astronomy (www.beginnersguide.com/astronomy) to learn more about how the sky moves and how to choose equipment. If you are already familiar with telescopes and astronomy, then you'd like for me to quit talking and get on with it. So without further ado...

Here's what's up!

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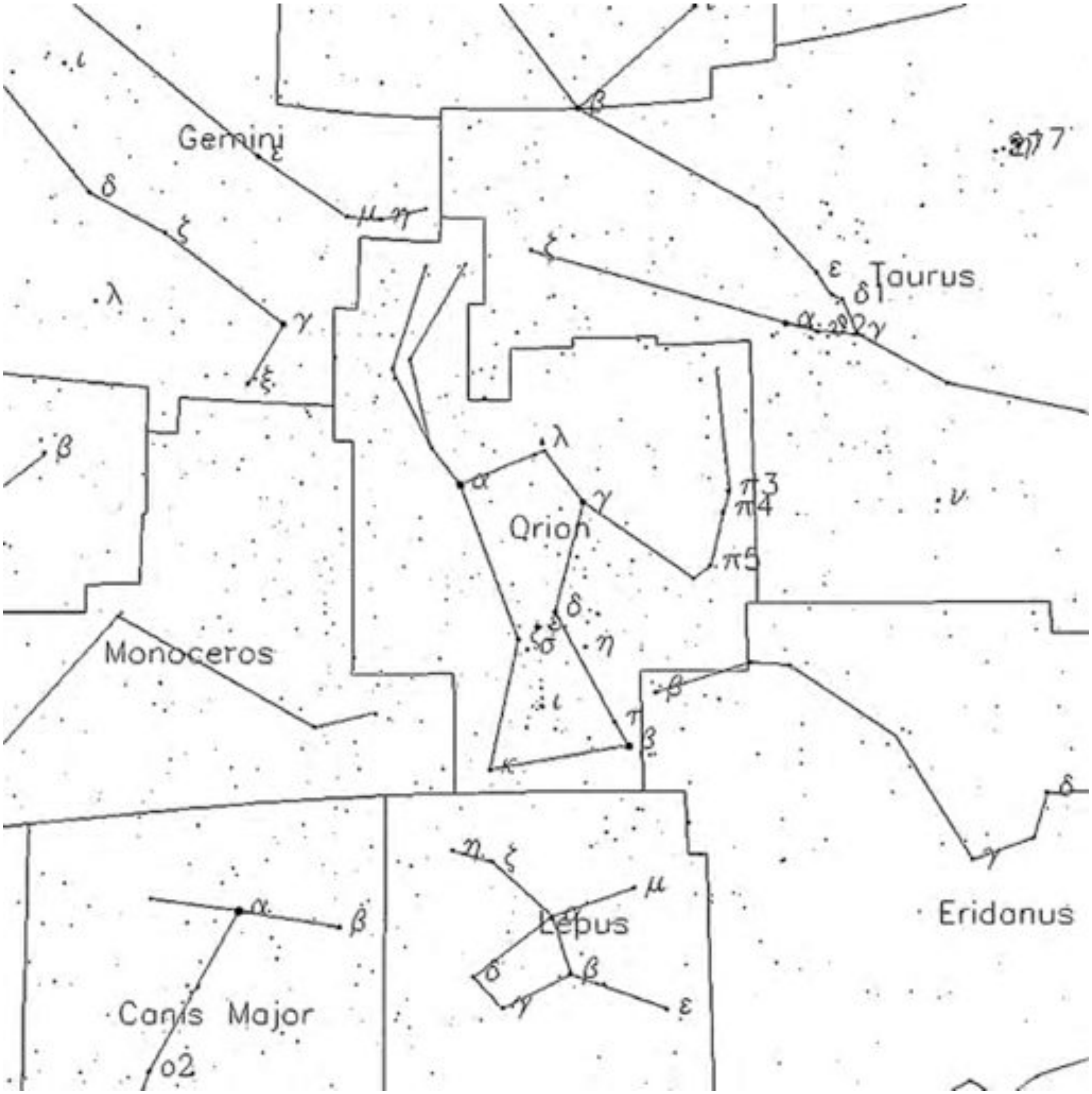
Gemini
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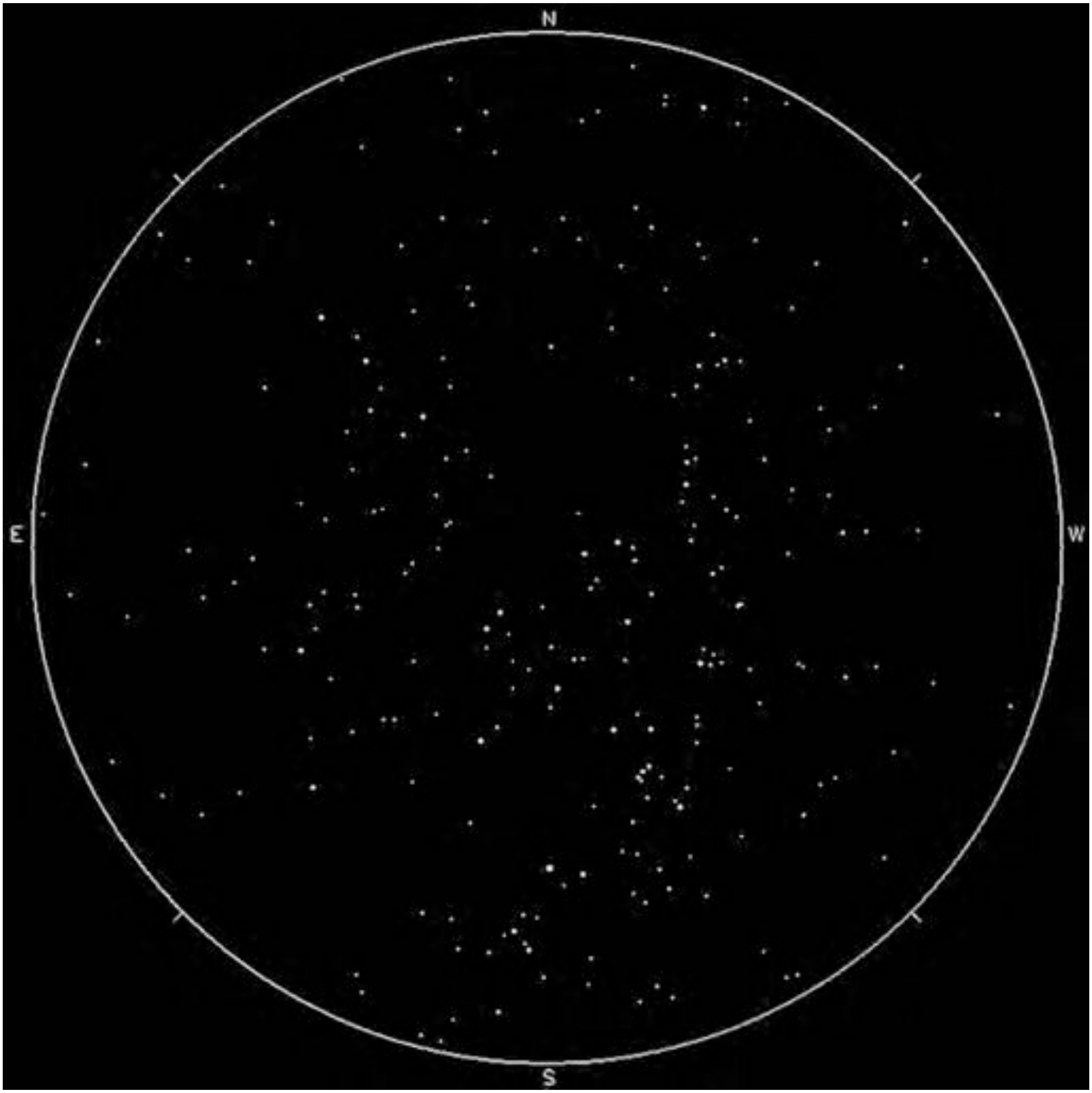
JANUARY 2007



JAN 1
MONDAY

Greetings, fellow SkyWatchers! We start our observing evening with the beautiful Moon and an opportunity to practice some selenography. In binoculars or small telescopes, one of the most prominent features will be the ancient and graceful Gassendi standing at the north edge of Mare Humorum. The mare itself is around the size of the state of Arkansas and is one of the oldest of the circular maria on the visible surface. As you view the bright ring of Gassendi, look for evidence of the massive impact which may have formed Humorum. It is believed the original crater may have been in excess of 462 kilometers in diameter, indenting the lunar surface almost twice over. Over time, similar smaller strikes formed the many craters around its edges and lava flow gradually gave the area the ridge- and rille-covered floor we see tonight. Its name is the "Sea of Moisture," but look for its frozen waves in the long dry landscape.

On this night in 1801, the skies were clear in Italy and astronomer Giuseppe Piazzi had just made a discovery—what would eventually become the first known asteroid. Unlike today's instant communications, Piazzi had to relate his observations to others via the mail—but by the time they received it, his discovery had moved too close to the Sun and was lost. What we now know as minor planet Ceres was not relocated until it returned in September of that same year. With some help from Gauss and his method of calculating orbits, Ceres was identified again on the last day of 1801 and reconfirmed again on this date in 1802. While Ceres isn't safely visible tonight, you can try your hand at another bright asteroid, Iris, which is well placed right now in the constellation of Aries.

Mare Humorum
Credit: Tammy Plotner

In 1959, the USSR launched the very first Moon probe. Named Luna 1, it became the first extraterrestrial spacecraft. The spacecraft carried no propulsion system of its own, but after having reached escape velocity, its third stage released a payload of sodium gas, which left a glowing trail that reached a brightness of sixth magnitude, allowing astronomers to trace it. Luna 1 made outstanding contributions to science, including the first confirmation that the Moon had no magnetic field. The probe was designed to impact the surface, and although it failed to do so, it did achieve another first with its flyby.

Tonight turn your eyes towards the Moon as we perform a "flyby" of our own and identify a feature known as the "Cow Jumping over the Moon." It is strictly a visual phenomenon—a combination of dark maria which looks like the back, forelegs and hindlegs of the shadow of that mythical animal. It's not only fun, but an Astronomical League Lunar Challenge as well!

If you're up for another challenge, then it's time to identify the Oceanus Procellarum—the Ocean of Storms. Like many mythically based astronomy names, Oceanus Procellarum came from a superstition associated with its appearance. Once upon a time, it was believed that sighting this feature precluded bad weather, but backyard astronomers know it only forecasts the coming Full Moon. Formed by volcanic eruptions, this largest of all maria is little more than an expanse of long hardened magma stretching from north to south a distance of around 2500 kilometers. Although to the eye it may seem featureless, it is home to some very unusual features and some historic missions that we will study in the future.

Luna 1
Credit: NASA

Nearly full Moon
Credit: Roger Warner

JAN 3
WEDNESDAY

Tonight is the Full Wolf Moon. Its name comes from the North American Indians who would hear the wolves howling in search of food in the snow-covered, cold and barren landscape. In Europe it was referred to as the Moon after Yule and 387 years ago on this night, Galileo Galilei changed the face of astronomy when he observed it. Pointing his newly developed telescope at our nearest celestial neighbor, his observation of mountains and craters on the surface opened the world's eyes to what lay just beyond the range of human sight. Said Galileo, "It is a beautiful and delightful sight to behold the body of the Moon."

Today is the birth date of Russian astronomer Grigori Neujmin (1886.) His important discovery was the rotating asteroid Gaspra. This is also the date that Stephen Synnot discovered Juliet and Portia, two additional moons belonging to Uranus.

Although skies will be bright, be sure to keep a watch for members of the Quadrantid meteor shower. Its radiant is in an extinct constellation once known as Quadran Muralis, but any meteors will seem to come from the general direction of bright Arcturus and Boötes. This is a very narrow stream, which may have once belonged to a portion of the Aquarids. Over time, Jupiter's gravity will continue to perturb the meteoroid stream. In another 400 years or so, this shower will be as extinct as the constellation for which it was named.

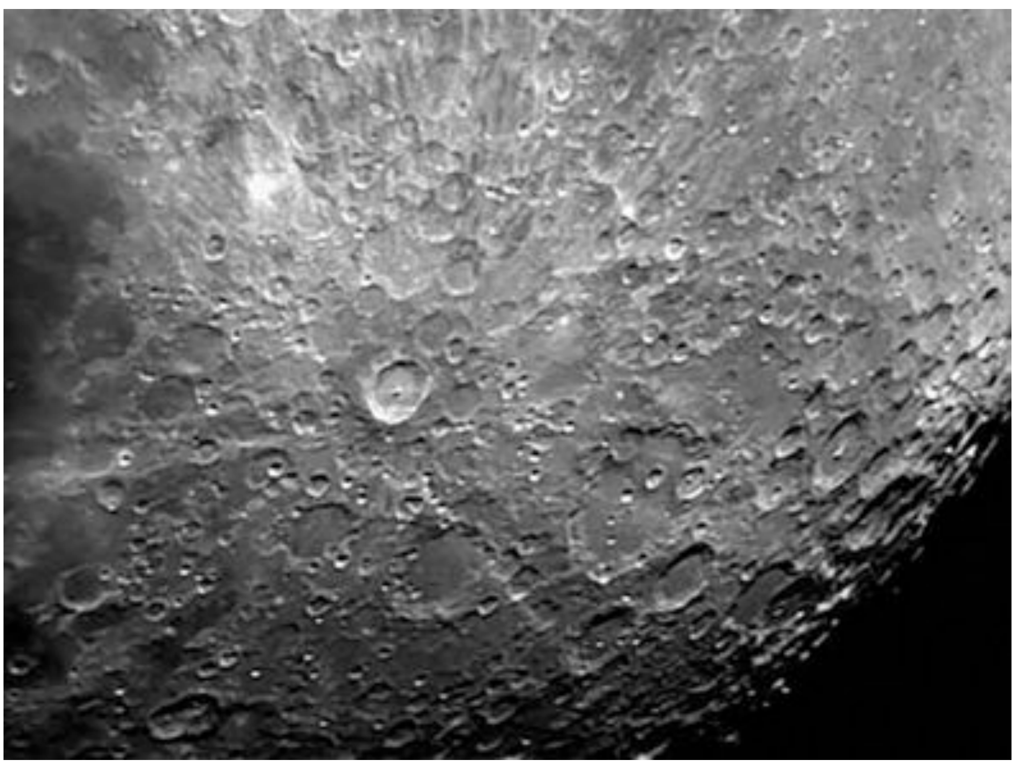
Full Moon
Credit: Greg Konkel

Tonight the Moon will look nearly full and it is a good time to spot yet another lunar asterism, "The Rabbit in the Moon." While it is nothing more than a compilation of dark maria, look for the long expanse of Mare Frigoris which creates the rabbit's "ear." Maria Serenitatis, Tranquillitatis, Nectaris and Fecunditatis will form the hindquarters and legs, while Oceanus Procellarum and Mare Humorum denote the head and forelegs. All rabbits have a tail, so be sure to look for Mare Crisium!

Today is also the birthdate of Wilhelm Beer (1797), an amateur astronomer who with Johann Madler created an exhaustive and first of its kind map of the Moon—Mappa Selenographia. Tonight discover for yourself what Galileo and Beer saw. Using any type of optical aid, trace the bright lunar rays extending from the brilliant Tycho or the deep impact crater Copernicus.

But, if you hear a wolf howl...perhaps it might be the "Dog Star" on the rise. Alpha Canis Majoris, better known as Sirius, is the fifth nearest star known and has played an important role throughout the history of astronomy. The rising and setting times of Sirius can be followed deep into antiquity - into the records of the Babylonian Chaldaea. While some may believe these ancient records to be of little value, their documentation of this star's appearance and position precisely confirms our modern day calculations of Sirius' movements and position. A position that indicates Sirius was observed from the island of Zylos in the Persian Gulf on the 29th of April—in the year 11,542 BC!

Watch its dazzling appearance while it is still fairly low and flashing all colors of the rainbow. The light you see from this main sequence star left almost 9 years ago and was seen by Ptolemy, Homer and Plutarch. The ancient Egyptians revered it and the Greeks and Romans feared it. Enjoy it tonight and we'll be back to study...



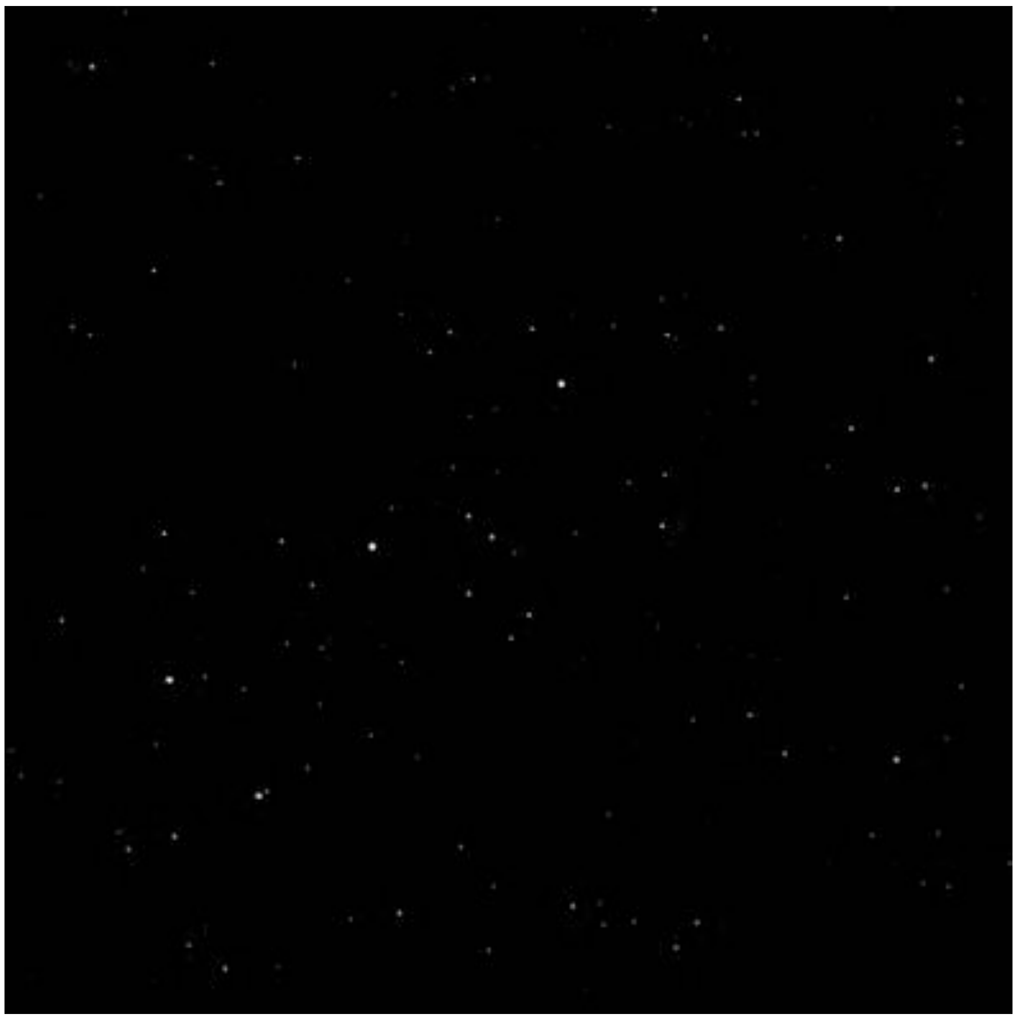
Tycho's Ray System
Credit: Roger Warner

JAN 5
FRIDAY

With very little time before the Moon rises tonight, let's turn our attention towards the constellation of Orion and a binocular and small telescope cluster known as Collinder 69. While many of us have looked at Orion's triangular head before, what we may not have realized is that the area surrounding third magnitude Lambda is an open cluster. Containing approximately 19 stars that range from fifth to ninth magnitude, look for a southward extending chain that gives this collection its signature.

As you look at the brightest star, let me introduce you—its name is Meissa. The cluster itself is considered young, and probably formed no more than 10 million years ago. On a dark night, look again to see if you can spot some nebulous filaments that remain from its birth!

Now look at Orion's belt. Almost all of us have seen these three stars time and again, but did you know they are also part of an open cluster? Turn your binoculars there and have a look. In an area spanning about three degrees are around 100 stars known as Collinder 70. Look for many mixed magnitudes, chains and pairings. This area has been used in the search for brown dwarfs!



Collinder 70
(generated star chart)

JAN 6
SATURDAY

Today in 1949, the first atomic clock built on theoretical work by Isidor Rabi and Norman Ramsey went into operation. This model used ammonia as its "pendulum," but only 8 years later the first cesium beam device was built. Clocks using this primary standard are now keeping time to about one-millionth of a second per year. Like clockwork, objects that we can view also keep incredibly accurate time. Tonight return again to Orion's belt as we have a closer look at its westernmost star—Mintaka.

Located around 1500 light-years away, Delta Orionis usually holds a magnitude of 2.20, but orbiting it in a clockwise orbit of 5.7325 days is a nearly equal star around 8 million kilometers away. Mintaka is a prime example of an eclipsing binary star, and although visually you won't really notice a .2 magnitude drop in light, let's take a closer look with binoculars.

As one of the few easy binocular double challenges, Mintaka will easily reveal its 6.7 magnitude companion star to its north. For over 100 years, the eclipsing physical AB pair has been closely watched and no movement between the half light-year apart physical pair has been detected. For those with larger telescopes—power up—and see if you can discover the 13th magnitude C star southwest of the primary.

No matter how you look at Mintaka, this fascinating star has been a part of history. It was the very first to display stationary spectral lines which proved the existence of interstellar matter!

First Atomic Clock
(widely used image)

JAN 7
SUNDAY

On this night in 1610, Galileo discovered three of Jupiter's four largest satellites using his simple telescope. This revelation changed the face of a previously Earth-centered Universe. This morning before dawn, why not take out your binoculars and see if you, too, can discover the "Galilean moons" with simple equipment. You'll find the largest of all the planets in our solar system making a wonderful morning apparition along the ecliptic in Scorpius with Mars following behind!

Tonight let's return to Orion's "belt" and starting with just our eyes, look around a thumb's length south to discover an asterism of stars referred to as the "sword." On a clear, dark night away from city lights you can spot a glowing cloud of dust and gas surrounding Theta that has long held a place in astronomy history. It was first noted only one year after Galileo first used his telescope, and the discovery is credited to Nicholas Peiresc in 1611. It wasn't until Christian Huygens sketched it in 1656 that it became well known for containing a "heart of stars."

Now, take out your binoculars and have a look. Stars are still being born in a dense cloud behind the nebula, and hundreds of them are less than a million years old. Compared to our own Sun's age of over four billion years, these would seem almost new! But think again at what you are looking at...the light you see tonight left this area around 1900 years ago.

So magnificent are the many details that can be seen in the Orion Nebula, that chapter upon chapter could be devoted to its riches. For now, feast your eyes upon this 30 light-year expanse of dust, neutral and ionized hydrogen, and doubly-ionized oxygen illuminated by the ultraviolet starlight of this stellar nursery. It is more than 20,000 times larger than our own solar system and its mass could form 10,000 stars like our own Sun!

The Great Orion Nebula
Credit: NOAO/AURA/NSF

On this day in 1942—precisely 300 years after the death of Galileo, Stephen Hawking was born. The British theoretical astrophysicist, despite his physical limitations, became one of the world's foremost leaders in cosmological theory and his book "A Brief History of Time" remains one of the best written on the subject.

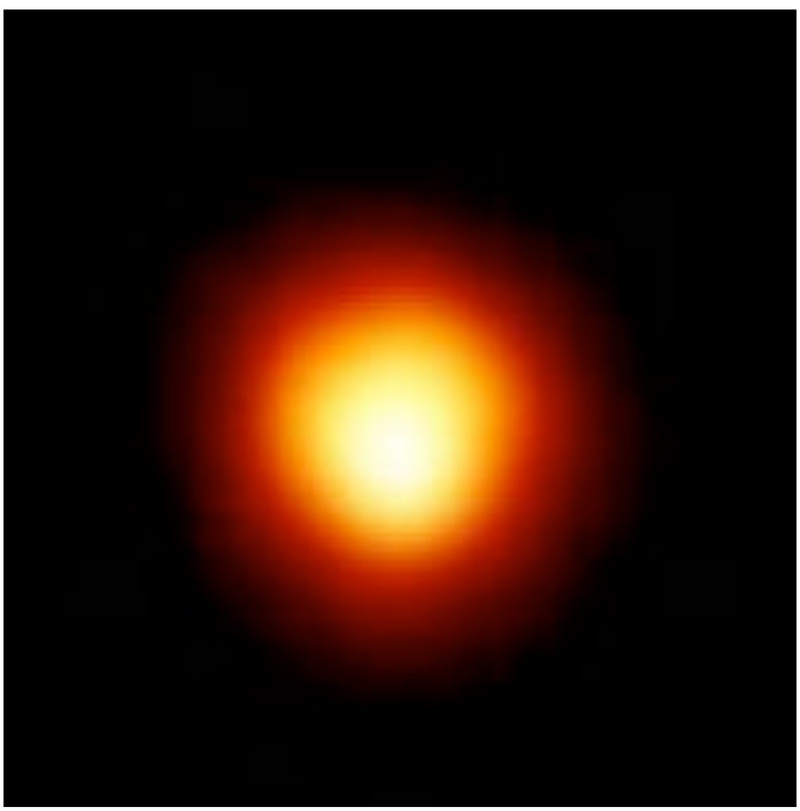
Also born on this day in 1587 was Johannes Fabricius, son of the discoverer of variable star Mira, David Fabricius. Like many father and son teams, the pair went on to study astronomy together, and some of their most frightening work dealt with viewing sunspots through an unfiltered telescope—a practice which eventually blinded Galileo!

To honor them both tonight, let's take a look at a variable star and a distant sun so large that astronomers have even observed "hot spots" on the surface—Alpha Orionis, more commonly known as Betelgeuse. This star is so massive that if it were to replace our own Sun, it would fill our solar system out to the distance of the orbit of Jupiter, and so distant that resolving it would be like aiming a telescope at a car headlight from 9656 kilometers away. It is an irregularly pulsing, red supergiant that changes roughly every 5.7 years and can drop in intensity by as much as a magnitude. It is also well known that Betelgeuse is a multiple star system, with four companions ranging from 11th to 14th magnitude, but it is believed its variability is caused by internal changes rather than an eclipsing body.

As you view this giant star tonight, keep in mind how much of its hydrogen has been expended and how many times it has expanded and contracted in the 425 years it took for this light to reach your eyes. When it finally does go supernova, it will be almost half a century before we know it!

Stephen Hawking
(widely used public image)

Fabricius
(widely used public image)



Hubble Image of Betelgeuse
Credit: NASA

JAN 9
TUESDAY

Today in 1839, Scottish astronomer Thomas Henderson was the first to measure the distance to a star while stationed at the Cape of Good Hope. Using geometrical parallax, Alpha Centauri became the first stellar standard other than our own Sun. Although Henderson began as a lawyer's clerk, his impressive list of 60,000 star positions led to his appointment as the first Astronomer Royal in Scotland.

With the Moon absent during the early evening, our goal for tonight is Iota Orionis. Known to the Arabs as "the Bright One of the Sword," we know it as the southern-most star in its asterism's namesake. Iota is estimated to be around 2000 light-years away and is about 20,000 times brighter than our own Sun. In the small telescope you will find Iota to be an easy and charming triple star. The bluish B star is relatively close at 11" in separation, but a bright 6.9 in magnitude. Much more distant at 50" is the disparate, magnitude 11 reddish C star. Iota itself is a spectroscopic binary and you will note another "white" double (Struve 747) unrelated to Iota about 8' to the southwest.

Staying at high power, the reason I ask you to look here tonight is to conquer a Herschel 400 object and study a region of the sky that would be far more impressive if it weren't for its alluring neighbor. If you look closely, you will see that Iota is involved in a region of the emission nebula known as NGC 1980, along with a small open cluster known as H 31. To be sure, the area is vague, as are all low surface brightness nebulae, but do look to the east of Iota where a much brighter, roundish area makes an unmistakable appearance!

The next objects require the use of high magnification. The reason I ask you to look in this area tonight is to conquer a Herschel 400 object—and to study a region of the sky that would be far more impressive if it weren't for its alluring neighbor, Iota. If you look closely, you will see the star is surrounded by a region of the emission nebula known as NGC 1980...

NGC 1980
Credit: Palomar Observatory, courtesy of Caltech

Robert W. Wilson was born this day in 1936. Wilson is the co-discoverer, along with Arno Penzias, of the cosmic microwave background, and in 1978 he won the Physics Nobel Prize. While we're "listening in," on this day in 1946, the US Army's Signal Corps became the first to successfully bounce radar waves off the Moon. Although this might sound like a minor achievement, let's look just a bit further into what it really meant!

Known as "Project Diana," scientists were hard at work to find a way to pierce the Earth's ionosphere with radio waves—a feat believed at that time to be impossible. Headed by Lt. Col. John DeWitt, and working with only a handful of full-time researchers, a modified SCR-271 bedspring radar antenna was set up in the northeast corner of Camp Evans. The power was cranked up and it was aimed at the rising Moon. A series of radar signals were broadcast, and in each case, the echo was picked up in exactly 2.5 seconds—the time it takes light to travel to the Moon and back. The significance of Project Diana cannot be overestimated. The discovery that the ionosphere could be pierced, and that communication was possible opened the way to space exploration. Although it would be another decade before the first satellites were launched into space, they were later followed by manned rockets. Project Diana paved the way for all those achievements.

Let's return again to Orion tonight, but preferably with binoculars since we will be studying a very large region known as "Barnard's Loop." Extending in a massive area about the size of the "bow," you will find Barnard's photographic namesake to the eastern edge of Orion, where it extends almost half the size of the constellation between Alpha and Kappa.

Because the Orion complex contains so many rapidly evolving stars, it stands to reason that a supernova should have occurred there at some time. "Barnard's Loop" is quite probably the shell leftover from such a cataclysmic event. If taken as a whole, it would encompass 10 degrees of sky! For the most past, the nebula itself is very vague, but the eastern arc (where we are observing tonight) is relatively well defined against the starry field. Although it is similar to the Cygnus Loop—the Veil Nebula—our Barnard Loop is far more ancient. If you have transparent, dark skies? Enjoy! You can trace several degrees of this ancient remnant using just binoculars.

Project Diana
(widely used public image)

JAN 11
THURSDAY

Tonight in 1787, Sir William Herschel discovered two of Uranus' multiple moons—Oberon and Titania.

Tonight let's head for the "holy grail" of multiple star systems as we look into the fueling core of M42—Theta Orionis. Are you ready to walk into "the Trap?" Even the smallest of telescopes can reveal the four bright stars that comprise the quadrangle at the heart of the Great Orion Nebula known as the "Trapezium." Both the beginner and the seasoned veteran know that there are actually eight stars in this region and the journey we are about to undertake requires both aperture and fine skies. What can you really see?

All four primary stars are easy. A steady hand with binoculars and even the most modest of telescopes make this foursome an awesome sight... And they seem to be in a dark "notch" of their own, don't they? A mid-sized scope will reveal two additional 11th magnitude stars, but excellent skies could mean the even smaller aperture could detect them as "red" companions to the "blue/white" primary stars. The remaining two components average about magnitude 16, putting them within reach of large amateur scopes, but what would you see?

When I first began observing the Trapezium area with a 12.5" telescope, I was sure that I would never see the two faintest members of the group. I was new to challenging double stars and had never looked at a diagram. (To this day, I still prefer to observe and describe things first and confirm them later. Knowing in advance what you are "supposed" to see influences what you "can" see.) I had seen the fainter stars that appeared as doubles, along with a faint wink here and there as well as one to the outside that made the whole thing appear like a pentagon. Little did I realize I was perceiving all eight members, and there seemed to be so much more just on the edge of my perception. Thus began my own personal quest to study the "Trapezium" on a more professional level, just like challenging galaxy studies.

Using the 31" reflector at Warren Rupp Observatory, it was time to "walk into the Trap" and to answer all my observing questions through visual confirmation. While at first glance with a small telescope, the background region in this area might appear a black void, it is not. The nebula continues here, but changes form. Instead of seeing "smoke-like" filaments, the region around the Trapezium is scalloped, like fish scales. You can never see this in a photograph! I realized immediately that both the G and H stars that I had always questioned were quite within range of my 12.5" as I recognized the pattern. Then a moment of perfect clarity came and the view literally exploded in dozens of stars buried within the field surrounding these eight known as the "Trapezium."

Upon formal study, I found that there are around 300 such stars within 5' of the Theta Orionis complex that exceed magnitude 17. According to Strand, the expansion rate puts them at an approximate age of 30,000 years, making it the youngest star cluster known. Regardless of what size telescope you use, you owe it to yourself to take the time to power up on the "Trap." Since the time the area was revealed to my eyes in all its open glory, I have seen scallops in the nebula and both fainter members on nights with exceptional seeing in much smaller telescopes. No matter how many stars you are able to resolve out of this region, you are looking into the very beginnings of starbirth...

Today in 1830 celebrates the founding of what—in 1831—would become the Royal Astronomical Society. The RAS was conceived by John Herschel, Charles Babbage, James South, and several others. The RAS has published its Monthly Notices continuously since 1831. Believed to have been born today in 1907 was Sergei Pavlovich Korolev. While few people recognize Korolev's name, he was a Soviet rocket engineer whose contributions to the science made him as important to the Russian space program as Robert Goddard was to that of the United States. His developments led to Sputnik, Vostok, Voskhod, and eventually the Soyuz programs.

Tonight our study region is to the northeast of the Great Orion Nebula (M42) and has a designation of its own—M43. Discovered by De Mairan in the latter half of the 18th century, this emission nebula appears to be separate from M42, but the division known as "the Fish Mouth" is actually caused by dark gas and dust within the nebula itself. At the heart of it is 7th magnitude "Bond's Star"—and wouldn't 007 be proud? This unusually bright OB star is creating a matter-bound Stromgren sphere!

Translated loosely, this star is actually ionizing the gas near it, making an orb-shaped area of glowing hydrogen gas. Its size is governed by the density of both the gas and dust that surround Bond's Star. This "exciting" star of our show is more properly known as Nu Orionis and near it lies a dense concentration of neutral material known as the "Orion Ridge." It is this combination of dust—mixed with gases—that make for a well balanced area of star formation.

And besides... It's just cool!

Sergei Korolev
Image Credit: NASA

M43
Credit: N. A. Sharp/NOAO/AURA/NSF

JAN 13
SATURDAY

Tonight let's return to Orion's sword to have a look for something you might have missed. Starting with M42 and M43, be sure to log these two Messier catalog studies for your binocular or small telescope records, but have a much closer look about one degree north.

NGC 1981 is a 4th magnitude open cluster that looks like a stellar member of the Orion group to the unaided eye. In small binoculars, it is easily resolved into around a dozen members with its brightest star weighing in at around magnitude 6. In the small telescope, as many as twenty individual members are resolved in chains and small groups. The region of NGC 1981 has been studied for rotational movement in the Orion arm of our galaxy and it was found that the stars in this cluster are actually rotating around our galactic center faster than the stars in the Perseus arm.

Well suited to even urban skies, NGC 1981 is also an Astronomical League Binocular Deep Sky object that you will very much enjoy. For larger telescopes looking for a real challenge, double star Struve 750 is part of this entertaining and easy galactic cluster!

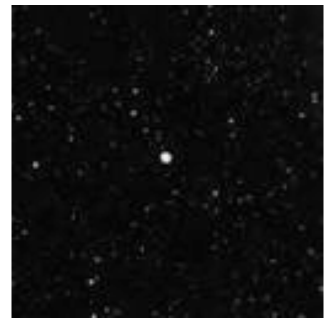
NGC 1981
Credit: Palomar Observatory, courtesy of Caltech

Tonight it's big scope challenge time as we take on two Hershel 400 objects. Let's start with NGC 2202—located about two fingerwidths southeast of Lambda Orionis, directly in line with Betelgeuse.

This 12.9 magnitude planetary nebula isn't for everybody and one of the reasons the Herschel studies are what they are is because it is challenging. Appearing like a stellar point, H 34 is not particularly bright, but will take on the form of a slightly fuzzy and slightly green planetary nebula at high power. Be sure to look at a detailed chart carefully if you are using a smaller scope to correctly identify this object.

It wouldn't be a challenge if it were easy!

The next is more readily achievable in smaller scopes and more easily found by heading north of Beta Eridani about two fingerwidths. The molecular cloud of reflection nebulae known as NGC 1788 is roughly 1 to 3,000 light-years away and shows more as a faint, squarish nebulosity with embedded stars. Best at low power or with rich field scopes, this small glowing patch is sure to please!



NGC 2022
Credit: Palomar Observatory, courtesy of Caltech

NGC 1788
Credit: Adam Block/NOAO/AURA/NSF

JAN 15
MONDAY

If you're up before dawn today, the Moon will be very near Antares, with an occultation in some areas (Check IOTA for details.) Jupiter will also be very near this pair, with Mars lower down in the eastern sky. With plenty of dark sky tonight, let's head around a fingerwidth northeast of Zeta Orionis and right on the celestial equator for a delightful bright nebula known as M78 (NGC 2068). This is both a binocular and small telescope Messier challenge object.

Often overlooked in favor of the Great Orion Nebula, this 8th magnitude diffuse area is easily captured under dark skies. Discovered by Méchain in 1789, M78 is part of the vast complex of nebulae and star birth that comprise the Orion region. Fueled by twin 10th magnitude stars, the nebula almost appears to binoculars to resemble a "double comet." Upon close scrutiny with a telescope, observers will note two lobes separated by a dark band of dust. Each lobe bears its own designation—NGC 2067 to the north and NGC 2064 to the south.

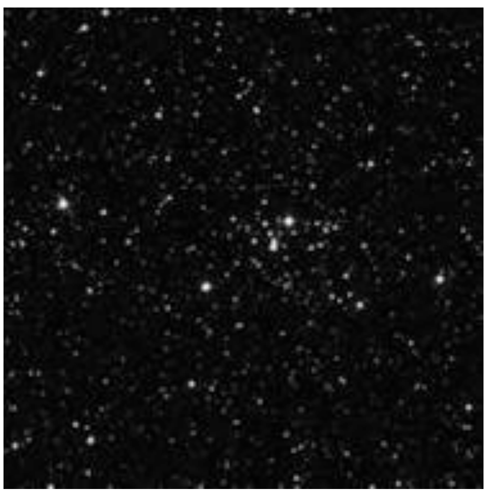
While studying, you will notice the entire area is surrounded by a region of absorption, making the borders appear almost starless. Filled with T Tauri-type stars and residing 1,600 light-years away, this reflection nebula is a cloud of interstellar dust which reflects the light of these young stars, the brightest of which is HD 38563A. In 1919, Vesto Slipher was the first to discover its reflective nature. As of 1999, seventeen Herbig-Haro objects are also associated with M78, and are believed to be jets of matter being expelled from newly forming stars.

M78
Credit: Kent Patterson and Adam Block/NOAO/AURA/NSF

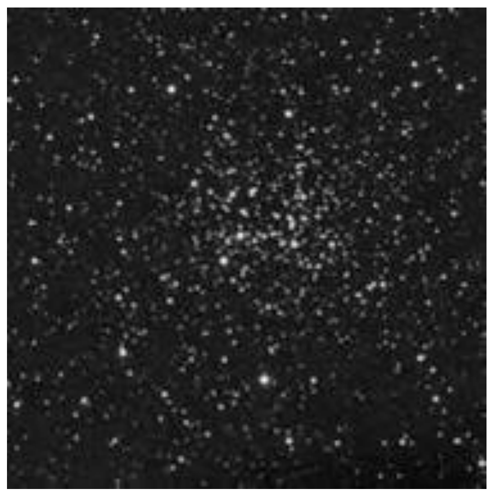
Wake up! Early this morning will be the peak of Delta Cancrid meteor shower. Yes, it's a pretty obscure one—no exciting parent comet or disintegrating asteroid to blame it on—but since the Moon will only be a slim crescent, why not give it a go? The radiant will be just slightly west of the M44 "Beehive Cluster," making a worthy trip with binoculars. The Delta Cancrids are not exactly prolific—with a rate of only about 4 per hour—but they are very fast!

Tonight let's have a go at two Herschel 400 objects as we start about four fingerwidths southeast of Betelgeuse for NGC 2186. This large, loose open cluster is well suited to larger binoculars or small telescopes and contains around 50 or so members that range in magnitude from 9 to 11. Look for many distinct pairings! NGC 2186 has been a study area for astronomers and is known to contain circumstellar disks, which may be either newly-forming solar systems or just regenerated materials left over from formation.

The next hop is just northwest of apparent double Kappa Orionis. NGC 2194 is also a Herschel object and at magnitude 8.5 is well suited to smaller scopes. This rich galactic cluster can be well resolved in larger scopes and the similar magnitude members make it a delightful spray of stars.

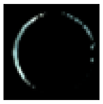


NGC 2186
Credit: Palomar Observatory, courtesy of Caltech



NGC 2194
Credit: Palomar Observatory, courtesy of Caltech

JAN 17
WEDNESDAY

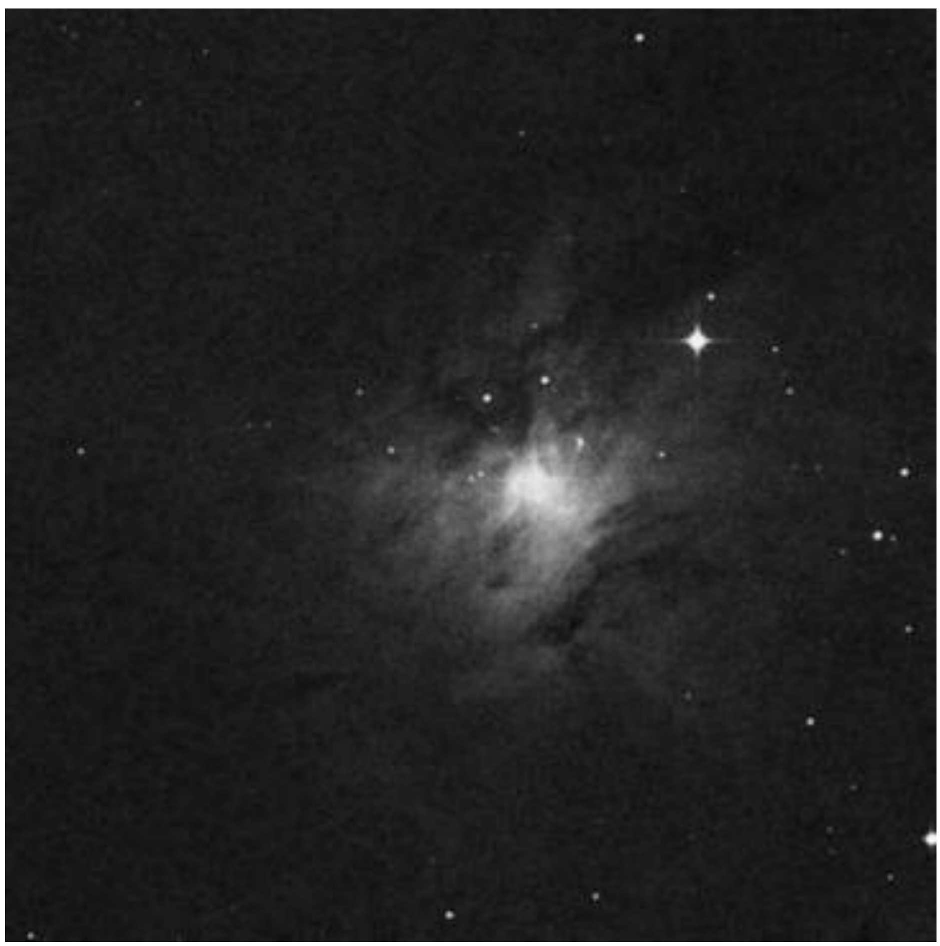


Tonight let's continue with our study of the Orion complex of nebulae associated with a molecular cloud. Known as LDN 1630 in Lynds' Catalogue of Dark Nebulae, it has many fine regions for study with a smaller scope under dark skies. Tonight return to M78 and let's look about one half degree northeast for the much fainter NGC 2071.

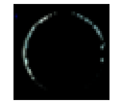
At its core is the smallest protoplanetary disc yet detected. Rotating around a young star, this "disc" could have the potential to form a solar system, and in size it is very similar to the orbit of Neptune. Located 1300 light-years away, it contains compact clusters of water molecules that allow researchers to study its motion through their radio emissions. Known as masers, these regions amplify radio emissions, and the entire area has been subject to jet activity. Although we cannot see the disc itself, you can detect a faint nebula associated with a 9th magnitude star in an average telescope. As with many types of objects, sometimes high magnification is not the answer. Try staying with minimal power to spot NGC 2071.

Now lace up your Nikes and let's head out to find "The Running Man"...

Located just a half a degree north of M43, this tripartite nebula consists of three separate areas of emission and reflection nebulae that seem to be visually connected. NGCs 1977, 1975 and 1973 would probably be pretty spectacular if they were a bit more distant from their grand neighbor! This whispery soft, conjoining nebula's fueling source is multiple star 42 Orionis. To the eye, a lovely triangle of bright nebulae with several enshrouded stars makes a wonderfully large region for exploration. Can you see the "Running Man" within?



NGC 2071
Credit: Palomar Observatory, courtesy of Caltech



If you are up before dawn, why not spend a moment or two looking at the sky? Just before dawn is your opportunity to spot the "New Moon in the Old Moon's Arms!"

Tonight let's do some study of open clusters that belong to different catalogs. The first three are known as "Dolidzes," and your marker star is Gamma Orionis.

The first is an easy hop of about one degree northeast of Gamma—Dolidze 21. Here we have what is considered a "poor" open cluster. Not because it isn't nice—but because it isn't populous. It is home to around 20 or so low wattage stars of mixed magnitude with no real asterism to make it special. The second is about one degree northwest of Gamma—Dolidze 17. The primary members of this bright group could easily be snatched with even small binoculars and would probably be prettier in that fashion. Five very prominent stars cluster together with some fainter members that are, again, poorly constructed. But it includes a couple of nice visual pairs. Low power is a bonus on this one to make it recognizable.

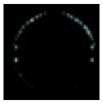
The last is about two degrees north of Gamma—Dolidze 19. Two well-spaced roughly 8th magnitude stars stand right out with a looping chain of far fainter stars between them and a couple of relatively bright members dotted around the edges. With the very faint stars added in, there are probably three dozen stars all told and this one is by far the largest concentration of this "Do" trio.

Now let's have a look at a deceptive open cluster located in Barnard's Loop around 2 degrees northeast of M78. While billed at a magnitude of roughly 8, NGC 2112 might be a binocular object, but it's a challenging one. This open cluster consists of around 50 or so stars of mixed magnitudes and only the brightest can be seen in small aperture. Add a little more size in equipment and you'll find a moderately concentrated, small cloud of stars that is fairly distinguishable against a stellar background.

Also known as Collinder 76, this unusual cluster resides in the galactic disc—an area of mostly very old, metal poor stars. It is believed that NGC 2112 is of a more intermediate age, based on recent photometric and spectroscopic data.

NGC 2112
Credit: Palomar Observatory, courtesy of Caltech

JAN 19
FRIDAY



Jacobus Kapteyn
(widely used public image)

Johann Bode was born today in 1747. He was the publicizer of the Titus-Bode law, a nearly geometric progression of the distances of the planets from the Sun. Also born today, but in 1851, was Jacobus Kapteyn. Kapteyn studied the distribution and motion of half a million stars and created the first modern model of the size and structure of the Milky Way Galaxy.

Are you ready for a New Moon challenge? Then take advantage of dark sky time to head to the eastern-most star in the belt—Zeta Orionis.

Alnitak resides at a distance of some 1600 light-years, but this 1.7 magnitude beauty contains many surprises—like being a triple system. Fine optics, high power and steady skies will be needed to reveal its members. About 15' east and you will see that Alnitak also resides in a fantastic field of nebulosity which is illuminated by our tripartite star. NGC 2024 is an outstanding area of emission that holds a rough magnitude of 8—viewable in small scopes but requiring a dark sky. So what's so exciting about a fuzzy patch? Look again, for this beauty is known as the Flame Nebula.

Larger telescopes will deeply appreciate this nebula's many dark lanes, bright filaments and unique shape. For the large scope, place Zeta out of the field of view to the north at high power and allow your eyes to re-adjust. When you look again, you will see a long, faded ribbon of nebulosity called IC 434 to the south of Zeta that stretches for over a degree. The eastern edge of the "ribbon" is very bright and mists away to the west, but look almost directly in the center for a small dark notch with two faint stars to the south. You have now located one of the most famous of the Barnard dark nebulae—B33.

B33 is also known as the Horsehead Nebula. It's a very tough visual object—the classic chess piece shape is only seen in photographs—but those of you who have large aperture can see a dark "node" that is improved with a filter. B33 itself is nothing more than a small area cosmically (about 1 light-year in expanse) of obscuring dark dust, non-luminous gas, and dark matter—but what an incredible shape. If you do not succeed at first attempt? Do not give up. The "Horsehead" is one of the most challenging objects in the sky and has been observed with apertures as small as 150mm.

The Horsehead Nebula
Credit: R. Jay GaBany

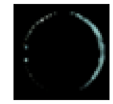
Simon Mayr was born today in 1573. Although Mayr's name is not usually recognized, we all recognize names that he's given. Mayr was also observing the moons of Jupiter at nearly the same time as Galileo and he was the one who assigned them the Greek names in use today. If you're up before dawn, look for Jupiter and see if you can spot Io, Ganymede, Callisto and Europa for yourself! While you're out, take a few minutes to watch the skies for the peak of the Coma Berenicid meteor shower. Although the activity for this one is fairly weak, with an average fall rate of about seven per hour, it still warrants study.

So what makes this particular shower of interest? Noted first in 1959, the stream was eventually tied in 1973 to another minor shower in the same orbit known as the December Leo Minorids. As we know, meteoroid streams are traditionally tied to the orbit of a comet, and in this case the comet was unconfirmed! Observed in 1912 by B. Lowe, an Australian amateur astronomer, the comet was officially designated as 1913I and was only seen four times before losing it to sunrise.

Using Lowe's observations, independent researchers computed the comet's orbit and it was basically forgotten about until 1954. At that time, Fred Whipple was studying meteoroid orbits and made the association between his photographic studies and the enigmatic comet Lowe. By continuing to observe the annual shower, it was determined that the orbital period of the comet was about 75 years, but the two major streams occurred about 27 and 157 years apart. Thanks to the uneven dispersion of material, it may be another decade before we see some real activity from this shower, but even one meteor can make your day!

And if you want to make your "night" an early one, why not trying looking for another odd meteor shower? Tonight will be the peak of the Delta Arietids! These unusual meteors also bear a resemblance to last week's Geminids, for the source of the stream appears to be a sun-grazing asteroid named Icarus. The hourly fall rate will be about 12 fast and bright "shooting stars." Be sure to watch early as the constellation of Aries will be in the best position for only a few hours after dark.

JAN 20
SATURDAY



Simon Mayr
(widely used illustration)

JAN 21
SUNDAY

John Couch Adams
(public domain image)

John Couch Adams was born today in 1792. Adams predicted the existence of Neptune. Also born today in 1908 was Bengt Stromgren—the developer of the theory of ionization nebulae (H II regions). Tonight after the "Old Moon in the New Moon's Arms" sets, we'll take a look at an ionization nebula as we return for an in-depth look at M42.

Known as the Great Orion Nebula, we've already learned where to find it—now let's learn what makes it up.

M42 is actually a great cloud of glowing gases whose size is beyond our comprehension. More than 20,000 times larger than our own solar system, its light is mainly fluorescent. For most people, the Great Orion Nebula will appear to have a slight greenish color—the result of doubly ionized oxygen. At the fueling heart of this immense region is an area known as the Trapezium, its four easily seen stars perhaps the most celebrated multiple system in the night sky. The Trapezium itself belongs to a faint cluster of stars which are now approaching the main sequence stage in an area known as the "Huygenian Region."

Buried in this cloud of mainly hydrogen gas there are many star forming regions amidst the bright ribbons and curls. Appearing like "knots" in the structure, these are known as "Herbig-Haro objects" and are believed to be stars in their earliest states. There are also a great number of faint reddish stars and erratic variables—very young stars that may be of the accreting T Tauri type. Along with these are "flare stars" whose rapid variations mean that amateur astronomers have a chance to witness new activity.

While you view M42, note that the region appears very turbulent. There is a very good reason. The Great Nebula's many different areas move at different speeds both in recession and approach. The expansion rate at the outer edges of the nebula is an indication of radiation from the very youngest stars known. Although it may be as many as 23,000 years since the Trapezium brought it to "light," it is entirely possible that new stars are still forming in M42.

The Great Orion Nebula
Credit: R. Jay GaBany

Be out early tonight to catch the slender crescent Moon as we begin our journey designed to acquaint you with specific craters. Around midway on the terminator, you will spot a conspicuous old crater called Langrenus. Named for Belgian engineer and mathematician Michel Florent van Langren, this handsome old crater stretches out over 132 kilometers in diameter. Look closely at its walls, they rise above the surface by 1981 meters and the deepest part of the floor drops down below 4937 meters—deeper than Mount Cotacachi in Ecuador is tall. Is the Sun rising over its brilliant east wall? If so, look closely and see if you can spot Langrenus' central mountain peak rising up 1950 meters. Then get out your skis, because that's as high as the base elevation in Jackson Hole, Wyoming!

Tonight we're going in search of another Herschel 400 object, despite the Moon. Wait until Orion has well risen and our lunar companion has ducked west. Our mark will triangulate with Xi and Nu and point back in the direction of Betelgeuse. It's name? Collinder 83...

It is believed that it may have been observed by Hodierna before 1654, but its discovery is credited to William Herschel in 1784 and cataloged by him as H VIII.24. It hangs out in space some 3600 light-years away and most catalogs refer to it as NGC 2169. At a rough magnitude of 6, it is very well suited to even smaller binoculars. Although diffuse nebulosity accompanies this 50 million year old cluster, even a small telescope should be able to resolve out its 30 or so stellar members. But no matter which optics you chose to look at this cluster with, one bright asterism will stand out—the number '37.' Enjoy and write down your observations!

NGC 2169
Credit: Palomar Observatory, courtesy of Caltech

Langrenus
Credit: Alan Chu

JAN 23
TUESDAY

During the early hours, take the time to view the northeast quadrant of the Moon and identify the emerging Mare Crisium. The "Sea of Crises" stretches out about 400 by 500 kilometers—an area about the size of the state of Washington. Mare Crisium is not only unique for its lack of connection with any other maria, but it is home to a gravitational anomaly called a mascon. This "mass concentration" might possibly be the fragments of the asteroid or comet whose impact with the lunar surface created the basin buried beneath the lava flow. The mascon creates an area of high gravity and causes changes in orbits of lunar probes. This excess gravity has even been known to cause low orbiting lunar satellites to either crash land or be flung out into space!

Tonight I ask you to once again take out your telescopes and explore a region with me that we have previously visited—M78. It is for the very sake of amateur astronomy that I ask you to do this... And here is why.

Jay McNeil
(press release photo)

On January 23, 2004 a young backyard astronomer named Jay McNeil was checking out his new 3" telescope by taking some long exposures of M78. Little did Jay know at the time, but he was about to make a huge discovery! When he later developed his photographs, there was a nebulous patch there that had no designation. When he reported his findings to the professionals, they confirmed it had no official designation and that Jay had stumbled onto something quite unique! It is believed that Jay's discovery was a variable accretion disc around a newborn star—IRAS 05436-0007. Little is known about the region, but it seems that it had been caught in a photo once in the past but never studied. Even the Digital Sky Surveys had no record of it!

Although Jay's discovery might not be bright enough tonight to be seen just south of M78, it is a variable and circumstance plays a big role in any observation. Before you think that being a backyard astronomer has no real importance to science—remember a teenager in a Kentucky backyard with a 3" telescope...

Catching what professionals had missed!

McNeil's Nebula
Credit: Adam Block/NOAO/AURA/NSF

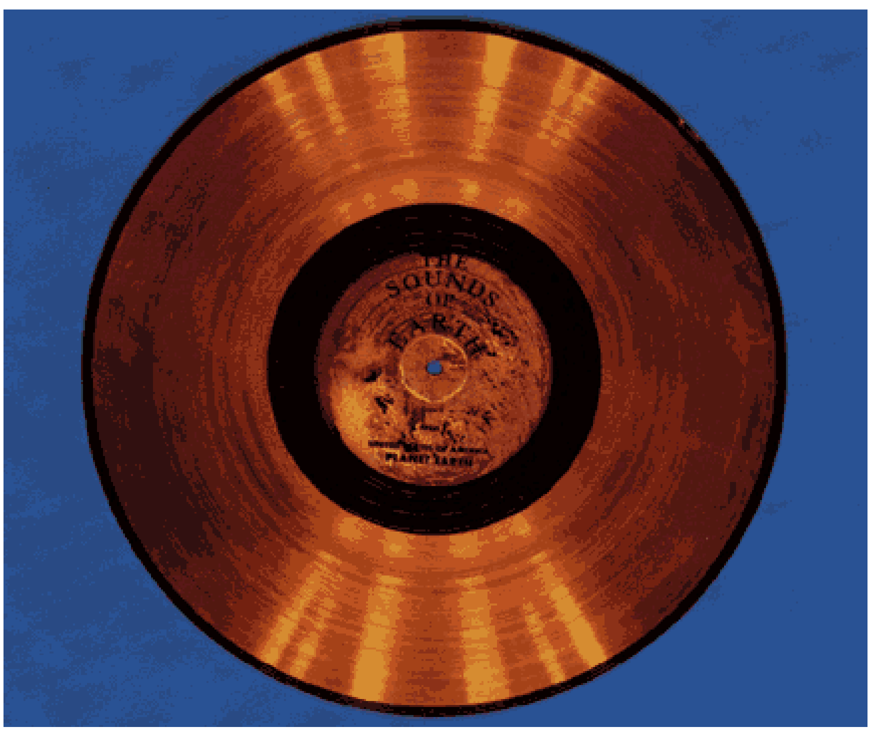
JAN 24
WEDNESDAY

Today is the birthday of American solar astronomer Harold Babcock. Born in 1882, Babcock proposed in 1961 that the sunspot cycle was a result of the Sun's differential rotation and magnetic field. Would you like to have a look at the Sun? Although solar observing is best done with a proper filter, it is perfectly safe to use the "projection method."

First off, NEVER look at the Sun directly with the eye or with any unfiltered optical device, such as binoculars or a telescope! We're not joking when we say this will blind you. Exposed film, mylar, and smoked glass are also UNSAFE. But don't be afraid, because we're here to tell you how you, too, can enjoy the Sun. A safe way to observe sunspots is to "project" an image of the Sun through a telescope or binoculars onto a screen. This can be a simple as cardboard, a paper plate, a wall or whatever you have handy. If you're using a telescope, be sure that finderscope is securely covered. If you'd like to try binoculars, just keep the cover on one of the two tubes. By using the shadow method, you will see a bright circle of light on your makeshift screen. This is the solar disc. Adjust the focus by moving the distance of the screen from your scope or binoculars until it is about the size of a small plate. If the image is blurry, use your manual focus until the edges of the disc become sharp. Even though it might take a little practice, you'll soon become proficient at this method and you'll be able to see a surprising amount of detail in and around sunspot areas. Happy and SAFE viewing to you all!

Today in 1986, the United States Voyager 2 was the first spacecraft to fly by Uranus, providing us on Earth some of the most outstanding photographs and information on the planet to date. After 10,382 days of successful operation, Voyager 2 still continues on towards the stars carrying a phonograph record of "The Sounds of Earth."

Harold Babcock
(widely used public image)



"The Sounds of Earth"
Credit: NASA

JAN 25
THURSDAY

Joseph Lagrange
(widely used public image)

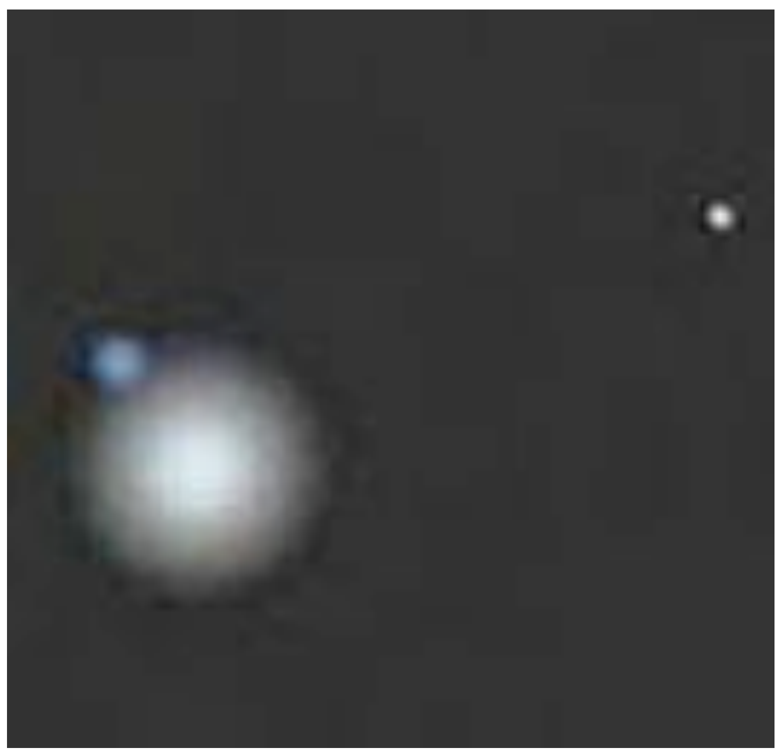
Today is the birthday of Joseph Louis Lagrange. Born in 1736, this French mathematician made important contributions to the field of celestial mechanics.

Tonight let's journey to the lunar surface to have our first look of the year at crater Posidonius. Located on the north-eastern shore of Mare Serenitatis, this huge, old, mountain-walled plain in considered a class V crater. Spanning 84 by 98 kilometers, you can plainly see where Posidonius is shallow—dropping only 2590 meters below the surface. Tonight it will resemble a bright, elliptical pancake on the surface, but we'll return to study it later in the year.

For now, let us return to Orion and have a much closer look at the blue/white giant—Beta Orionis.

The seventh brightest star in the sky is known by the name Rigel. Very little is known about its true distance from Earth, but it is widely accepted that it is around 900 light-years away. This white-hot star has a surface temperature of about 12,000 degrees Kelvin and is thousands of times more powerful than our own Sun. If it were as close to us as Sirius, it would shine with a light as bright as 20% of the full Moon! But look closely at the brilliant star... Intermediate sized telescopes under good conditions will find a 6.7 magnitude blue companion. Although it is not always an easy double star, you'll find it on the list for many challenges. But, chances are, we'll never see the C star that accompanies the B!

Even if you just view Rigel with your eyes tonight, marvel at this young and powerful star. When the light you see left this star, the Crusades had began...the Vikings were sailing to discover America...the Mayan Empire was beginning to crumble...paper was a new concept...and the very numbers we use today were just beginning to catch on!



Rigel
Credit: NASA

Today in 1962, the US space program launched a lunar probe named Ranger 3. Its mission was to image the Moon right up until impact, land a seismometer, study gamma rays and report on surface reflectivity of radar... But, it didn't happen. Two days after launch, the ill-fated Ranger 3 was on a runaway course towards the lunar surface when it received a reverse command and lost contact with Earth. As a result, it overshot its mark by 36,800 kilometers and still remains in heliocentric orbit.

Tonight all of Mare Serenitatis and Mare Tranquillitatis will be revealed and it is fitting that we should take a look at both the "Serene" and "Tranquil" seas. Formed some 38,000,000 years ago, these two areas of the Moon have been home to most of mankind's lunar exploration. Somewhere scattered on the basalt landscape on the western edge of Tranquillitatis, perhaps a few remains of the Ranger 6 mission lay scattered about, forming a small impact crater of their own. Its eyes were open, but blinded by a malfunction...forever seeing nothing. To the southwest edge lie the remnants of the successful Ranger 8 mission which sent back 7137 glorious images during the last 23 minutes of its life. Nearby, the intact Surveyor 5 withstood all odds and made space history by managing to perform an alpha particle spectrogram of the soil while withstanding temperatures considerably greater than the boiling point. Not only this, but it also took over 18,000 pictures!

Look closely at the maps and you will find this is also home to the Apollo 11, Apollo 16 and Apollo 17 landers, as well as Luna 21. It is an area that you can deeply appreciate for its historical significance...and an Astronomical League Lunar Challenge!

Ranger 3
Credit: NASA

JAN 27
SATURDAY

On this day in 1967, tragedy struck at Pad 34. During a training exercise atop a Saturn 1B rocket, astronauts Command Pilot Virgil I. Grissom, Senior Pilot Ed White, and Pilot Roger B. Chaffee gave their lives to further human exploration of space as fire swept through their module. Named Apollo One, stop for a moment tonight to remember these brave souls. "They gave their lives in service to their country in the ongoing exploration of humankind's final frontier. Remember them not for how they died but for those ideals for which they lived." (From the memorial on Launch Complex 34.)

Tonight we will begin our lunar explorations as we look to the north and identify the "Sea of Cold"—Mare Frigoris. This long, vast lava plain extends 1126 kilometers across the surface from east to west, yet never ranges more than 72 kilometers from north to south.

Look for the unmistakable dark ellipse of crater Plato caught on Frigoris' southern central shore. Named after the famous philosopher, this Class V crater spans approximately 101 kilometers but is a shallow one kilometer deep. The bright rim of Plato's enclosure is very ragged and can rise as high as 2 kilometers above the surface, casting unusual shadows on the lava covered floor.

At around 3 million years old, Plato is more ancient than Mare Imbrium to its south. For 300 years astronomers have been keeping a watchful eye on this crater. Hevelius called it the "Greater Black Lake," due its low albedo (surface reflectivity). Despite its dark appearance, Plato is well known as a home for lunar transient phenomena such as flashes of light, unusual color patterns and areas that could be outgassing. Enjoy this lunar feature which will point the way to others in the future!

Apollo 1 Crew
Credit: NASA

JAN 28
SUNDAY

Today take the time to honor shuttle commander Dick Scobee, pilot Mike Smith, astronauts Ellison Onizuka, Judy Resnik, Ron McNair and Greg Jarvis, and teacher Christa McAuliffe. They were the crew onboard the Challenger when it exploded on this day in 1986. "We will never forget them, nor the last time we saw them, this morning, as they prepared for the journey and waved goodbye and slipped the surly bonds of Earth to touch the face of God." (President Ronald Reagan) Godspeed...

Today also celebrates the birth of Johannes Hevelius (1611) who published the first detailed maps of the Moon. This evening let's honor our brave crew and Hevelius as we have a deeper look at the "Sea of Rains." Our mission is to explore the disclosure of Mare Imbrium—home to Apollo 15.

Stretching out over 1123 kilometers over the Moon's northwest quadrant, Imbrium was originally formed when a huge object impacted the lunar surface creating a gigantic basin around 38 million years ago. The basin itself is surrounded by three concentric rings of mountains. The most distant ring reaches a diameter of 1300 kilometers and involves the Montes Carpatus to the south, the Montes Apenninus southwest, and the Caucasus to the east. The central ring is formed by the Montes Alpes, and the innermost has long been lost except for a few low hills that still show their 600 kilometer pattern through the eons of lava flow.

Mare Imbrium
(widely used public image)

Originally the impact basin was believed to be as much as 100 kilometers deep. So devastating was the event that a Moon-wide series of fault lines appeared as the massive strike shattered the lunar lithosphere. Imbrium is also home to a huge mascon and images of the far side show areas opposite the basin where seismic waves traveled through the interior and shaped its landscape. The floor of the basin rebounded from the cataclysm and filled in to a depth of around 12 kilometers. Over time, lava flow and regolith added another 5 kilometers of material, yet evidence remains of the ejecta which was flung more than 800 kilometers away, carving long runnels through the landscape.

Challenger Crew
Credit: NASA

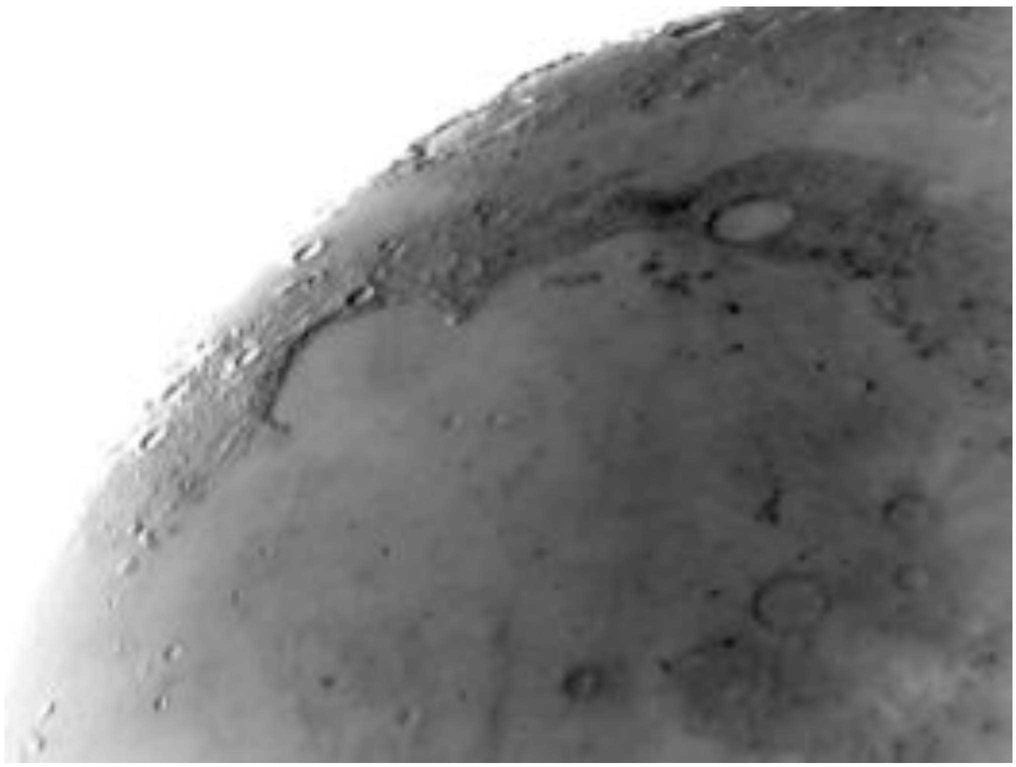
JAN 29
MONDAY

Tonight we will return again to the lunar surface to have a look through binoculars or telescopes at another tremendous impact region.

The Sinus Iridium is one of the most fascinating and calming areas on the Moon. At around 241 kilometers in diameter and ringed by the Juras Mountains, it's known by the quiet name of the Bay of Rainbows, but was formed by a cataclysm. Science speculates that a minor planet around 201 kilometers in diameter once impacted our forming Moon with a glancing strike and the result of that impact caused "waves" of material to wash up to a "shoreline" forming this delightful C-shaped lunar feature.

The impression of looking at an earthly bay is stunning as the smooth inner sands show soft waves called "rilles," broken only by a few small impact craters. The picture is complete as Promontoriums Heraclides and LaPlace tower above the surface, at 1800 meters and 3000 meters respectively, and appear as distant "lighthouses" set on either tip of Sinus Iridum's opening.

Enjoy this serene feature tonight... It's a lunar club challenge!



Sinus Iridum
Credit: Greg Konkel

JAN 30
TUESDAY

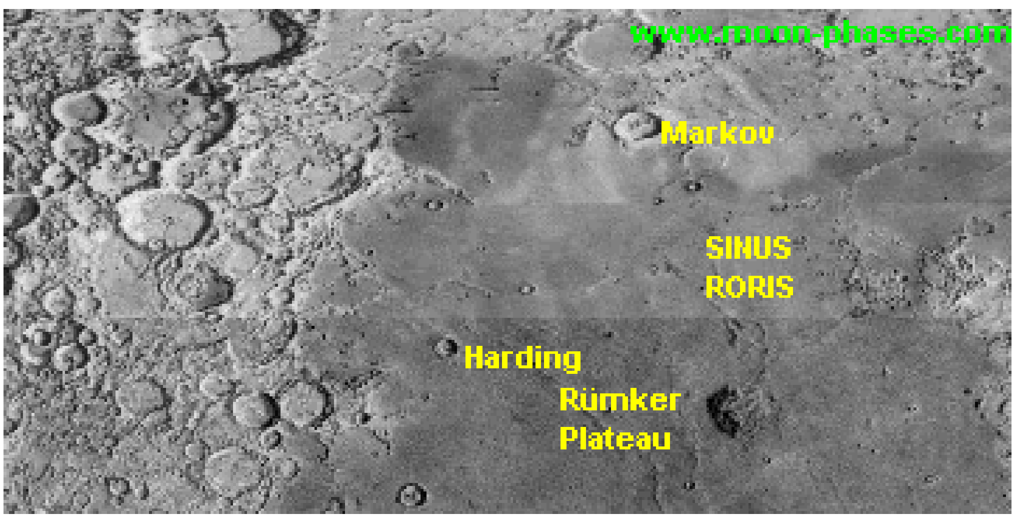
Tonight we'll head further north as we explore another challenge region—Sinus Roris.

"The Bay of Dew" is actually a northern extension of the vast region of the Oceanus Procellarum. Expanding around 202 kilometers wide, many lunar maps aren't quite true to Sinus Roris' dimensions. Its borders are not exactly clear given the curvature on which we see this feature, but we do know the eastern edges join Mare Frigoris. You will note as you view the area that it is much lighter than most features of this type. If you seek answers, then look further north as Roris' high albedo can be attributed to the ejecta of many impacts in this area.

It holds a fanciful place in history as we take a look at an excerpt from "Man on the Moon" by Wernher van Braun:

There's one section of the moon that meets all our requirements, and unless something better turns up on closer inspection, that's where we'll land. It's an area called Sinus Roris, or "Dewy Bay," on the northern branch of a plain known as Oceanus Procellarum, or "Stormy Ocean" (so called by early astronomers who thought the moon's plains were great seas.) Dr. Fred L. Whipple, chairman of Harvard University's astronomy department, says Sinus Roris is ideal for our purpose—about 650 miles from the lunar North Pole, where the daytime temperature averages a reasonably pleasant 40 degrees and the terrain is flat enough to land on, yet irregular enough to hide in.

Journey there tonight... And look for the "Man in the Moon!"



Sinus Roris
Credit: Alwyn Botha

JAN31
WEDNESDAY

Today in 1961, Mercury Redstone 2 launched, carrying Ham the chimpanzee into a suborbital flight and to fame. In 1966, Luna 9 was launched. In 1958, the first US satellite—Explorer 1—was launched and met a milestone as it proved the Earth was surrounded by intense bands of radiation which we now refer to as the Van Allen Belts.

In 1971 Apollo 14 was headed towards the Moon—and so are we as we take a look at Mare Cognitum, "The Sea That Has Become Known."

Also formed by an impact, the remains of the basin ring still exist as the bright semi-circle of the Montes Riphaeus which borders it to the northwest. Look for the very bright point of Euclid to guide you. Just to its north is the Fra Mauro formation, the landing area for Apollo 14. Now let's talk about why exploration in this area was so important!

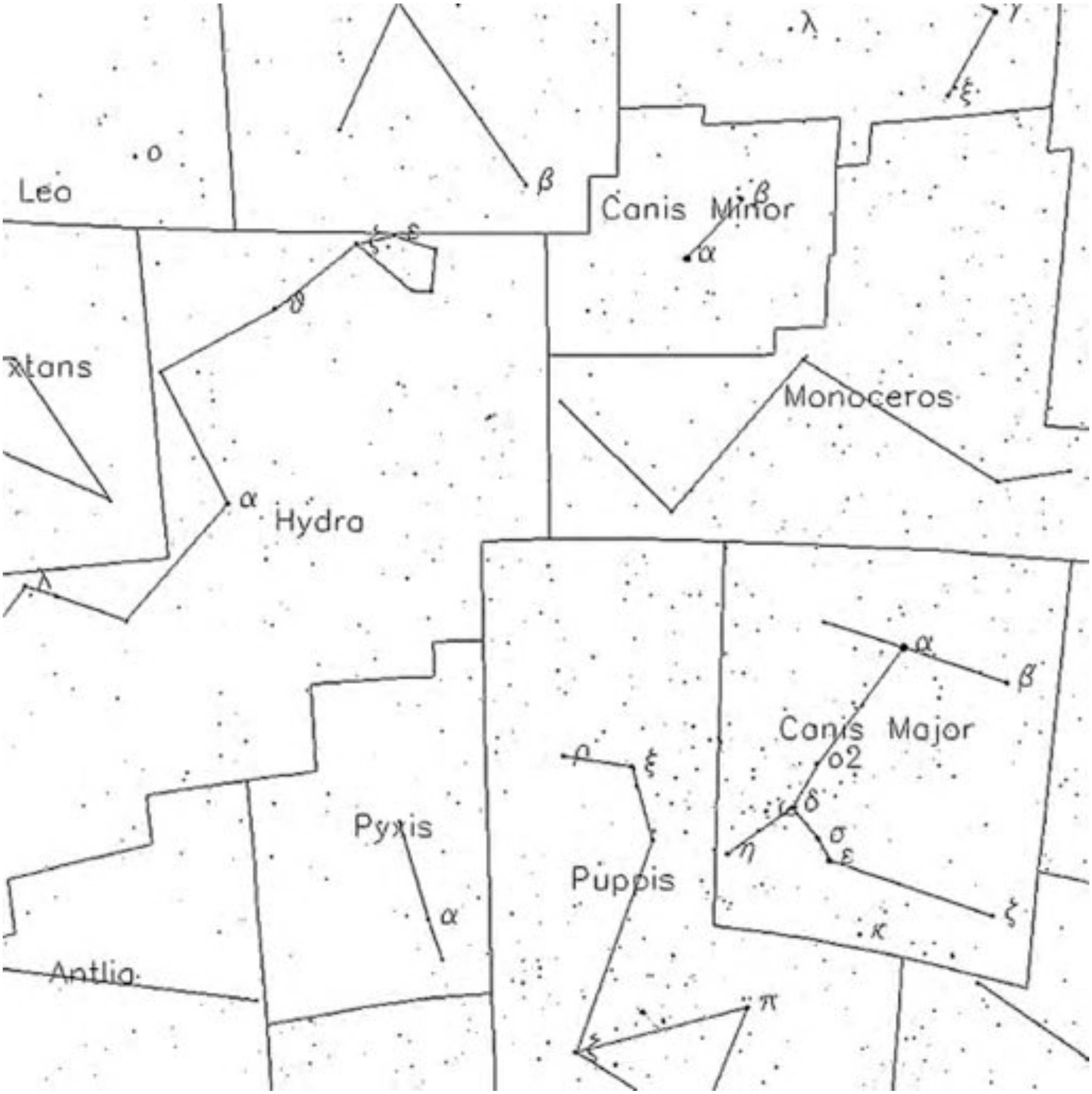
Named for the 80 kilometer diameter Fra Mauro crater, the highlands are an area of hills that are believed to be ejecta from the impact which formed Imbrium. This debris may have came from as deep as 161 kilometers below the surface and would help us understand the physical and chemical nature of the area below the lunar crust.

The Fra Mauro formation became more interesting to scientists when the Apollo 12 seismometer at Surveyor crater 110 miles (177 km) to the west relayed to Earth signals of monthly moonquakes believed to have originated in the Fra Mauro crater as the Moon passed through its perigee. Apollo 14 landed in the hills at the edge of the crater Fra Mauro near a newer impact region called Cone crater—around 305 meters across and 76 meters deep. Astronauts Shepard and Mitchell took samples from the crater's outer walls and photographed the interior. We'll return in the future to study this fascinating area, but be sure to check out how near Pollux is tonight!

In 1862, Alvan Graham Clark, Jr. was at the eyepiece and made an unusual discovery. While watching Sirius, Clark uncovered the intense star's faint companion while testing an 18 inch refractor being built at Dearborn Observatory. The scope itself was built by Clark, his father and his brother. Imagine his excitement when it turned up the white dwarf—Sirius B! Friedrich Bessel had proposed its existence back in 1844, but this is the first time it was confirmed visually.

Why not try your own hand at turning up this difficult double star? If you have problems finding the companion, don't worry. Back in 1948, the first test photos using the Hale 5-meter (200-inch) telescope at Mt. Palomar were being taken. Believe it or not, problems with the configuration and mounting of the mirror meant that it was almost 2 years later before the first observing run was made by a scheduled astronomer!

"Ham"
Credit: NASA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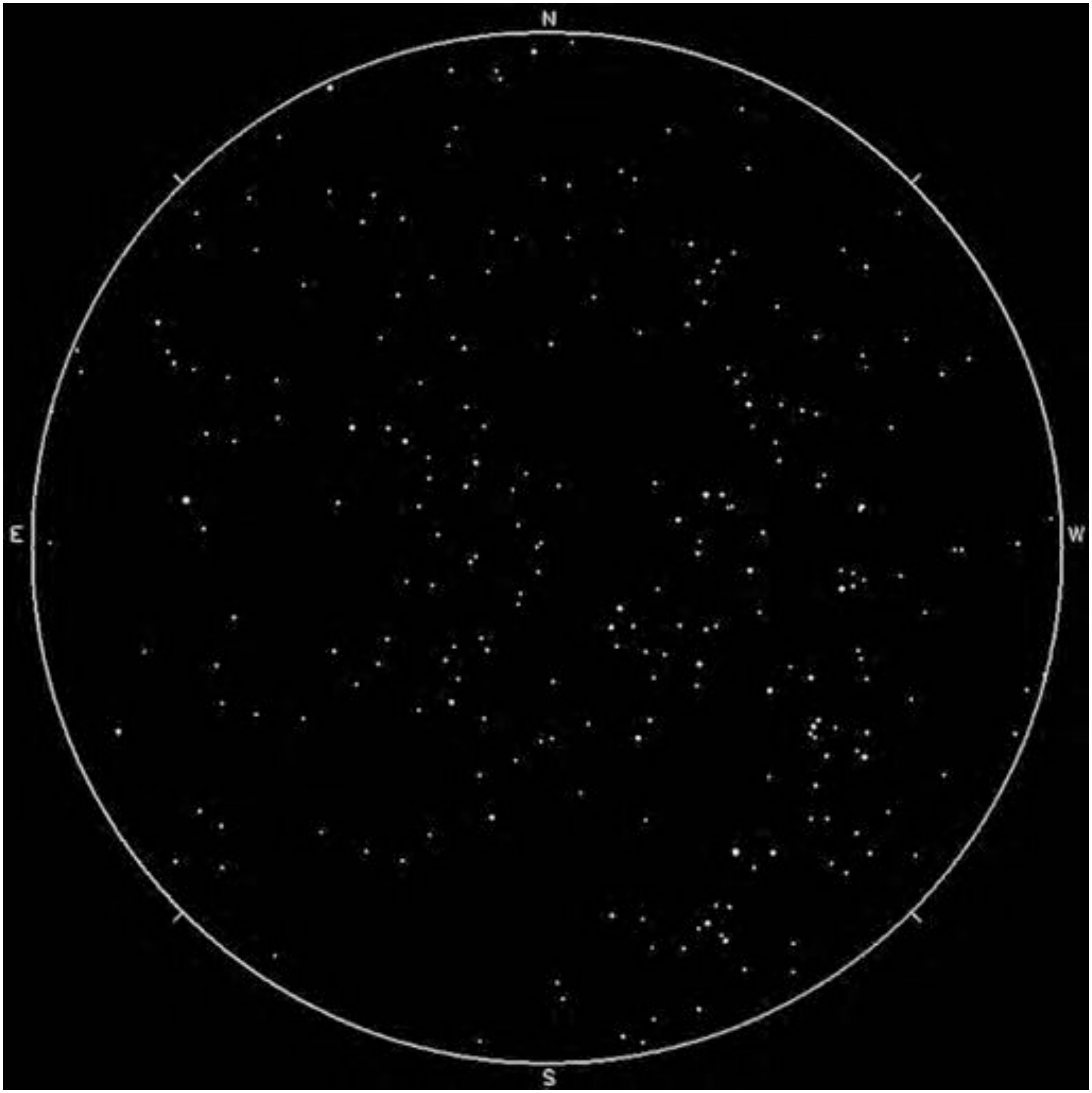
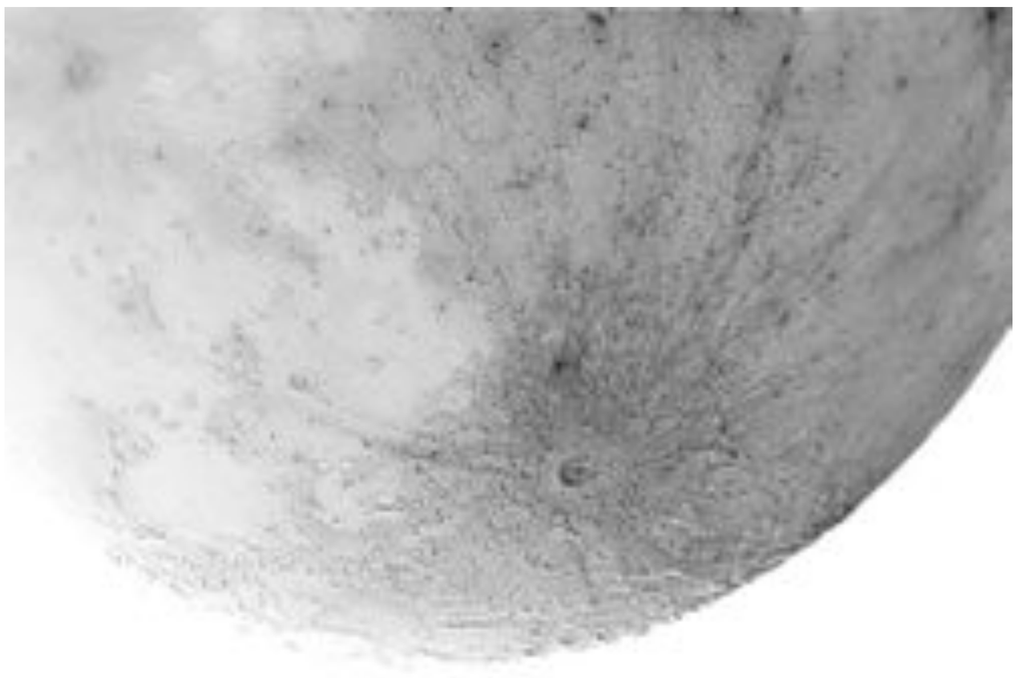


FEB 1
THURSDAY

With tonight's near full Moon, we'll use an unmistakable feature to help guide us to interesting points on the lunar surface. Even small binoculars will reveal the outstanding presence of crater Tycho with its bright ejecta pattern splashing across the surface. Look closely at one of the brightest of the rays, for it passes over Mare Nubium—the Sea of Clouds. This exceptionally dark, irregular plain stretches out over 563 by 464 kilometers and has many features that we will explore over the year.

Look closely at the bright ray of material thrown across its dark floor from the impact that caused Tycho. It is easy to see that it is laid "over" the surface of the lava flow and this is an important clue to the age of lunar features. One of these rays crosses the Apollo 17 landing site 2000 kilometers from Tycho itself and may have caused a landslide from the mountains where the astronauts sampled. This suggests that Tycho is about 100 million years old.

While this might seem like a great age, the Sea Of Clouds could be between 3 to 4 billion years old. Once upon a time, an impact formed its basin as well. Thanks to the Moon's lack of atmosphere, the lava flow quietly filled the basin and left it as we see it tonight.



Tycho and the Sea of Clouds
Credit: Roger Warner

Tonight is the Full Moon. The month of February in the northern hemisphere is usually heavy in snow in the upper regions. Native Indian tribes of the north and east most often called February's full Moon the Full Snow Moon. Some tribes also referred to this Moon as the Full Hunger Moon. This is very understandable since the artic weather conditions in their areas made hunting very unproductive.

Tonight let's have a look at the far away world as we return again with binoculars to identify the maria once again. Take the time to repeat the names to yourself and to study a map. One of the keys to successfully learning to identify craters is by starting with large, easily recognized features.

The second rule of observation is to look closely at everything in an area. Scan around the Moon and tell me what you see. What's that? Yes, it is Saturn! For some parts of the world, this close appearance tonight could mean an occultation or grazing event. Congratulations for spotting it and check with IOTA for times in your area!

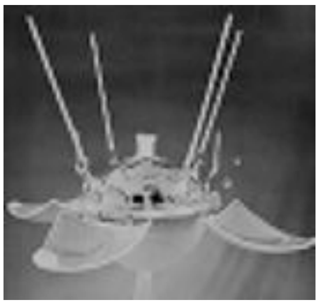
Full Moon
Credit: Roger Warner

FEB 3
SATURDAY

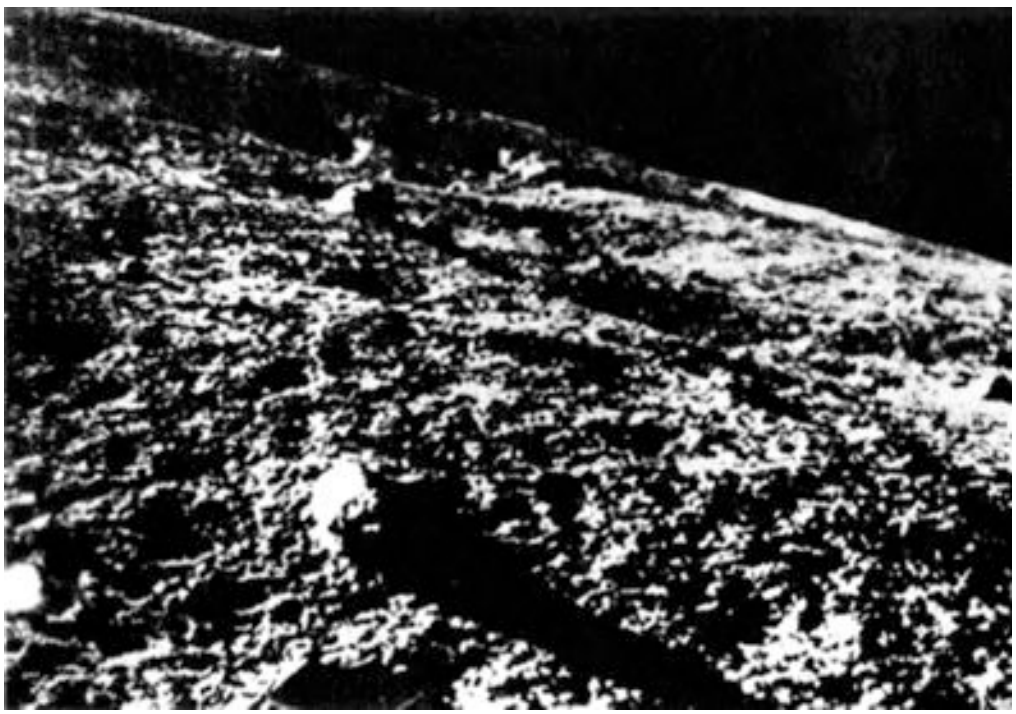
Tonight we celebrate the success of Luna 9, also known as Lunik 9. On this day in 1966, the unmanned Soviet lunar probe became the first to achieve a soft landing on the Moon's surface and successfully transmit photographs back to Earth. The lander weighed in at 99 kg, and the four petals, which formed the spacecraft, opened outward. Within five minutes of landing, antennae sprang to life and the television cameras began broadcasting back the first panoramic images of the surface of another world, proving that a landing would not simply sink into the lunar dust. Last contact with the spacecraft occurred just before midnight on February 6, 1966.

Tonight you can view the area of the first successful landing on the Moon as you turn your scopes towards Oceanus Procellarum—the Ocean of Storms. While the area will be brightly lit and it will be difficult to pick out small features, Procellarum is the long, dark expanse that runs from lunar north to south. On its western edge, you can easily identify the dark oval of Grimaldi. About one Grimaldi-length northward and on the western shore of Procellarum is where you would find the remains of Luna 9.

While no earthly-bound telescope could ever hope to achieve resolution of mission remains, it is still a wonderful way to improve your skills and enjoy a bit of history at the same time. Did you spot Regulus nearby? This could be an occultation, so please check with IOTA!



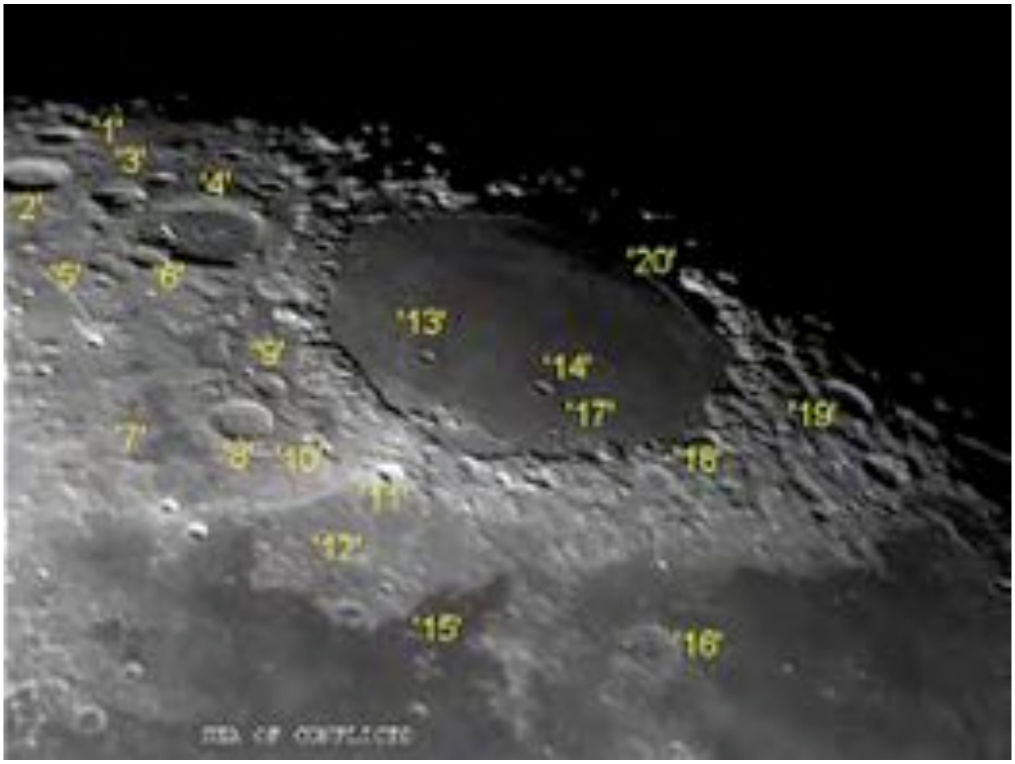
Luna 9 landing capsule
Credit: NASA



Luna 9 surface image
Credit: NASA

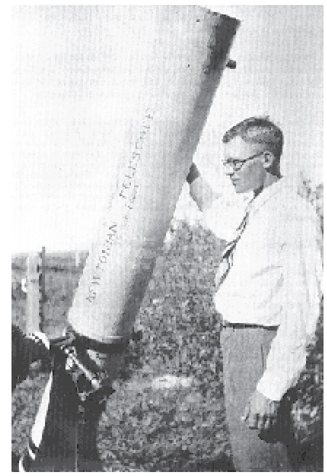
Today is the birthday of Clyde Tombaugh. Born in 1906, Tombaugh was the discoverer of Pluto and it happened 24 years and two weeks after his birth.

As the Moon begins to wane, we see features in a much different light. Tonight let us return to Mare Crisium and power up with the telescope to discover some of the wonderful details that can be seen. Use the map below to help you discover these wonderful features:



(1) Bernoulli, (2) Geminus, (3) Burckhardt, (4) Cleomides, (5) Debes, (6) Tralles, (7) Lacus Bonitatis, (8) Macrobius, (9) Tisserand, (10) Fredholm, (11) Proclus, (12) Palus Somni, (13) Swift and Pierce, (14) Picard, (15) Sinus Concordiae, (16) Taruntius, (17) Lick, (18) Shapely, (19) Firmicus, (20) Promontorium Agarum.

Crisium Region
Image Credit: Roger Warner
Annotations: Tammy Plotner



Clyde Tombaugh
(widely used public image)

You see? It's just as easy as knowing where to look! Don't despair if you are clouded out tonight and cannot go crater hunting. You will see the Moon this way many times over the coming year and there are several more great things right in that area we haven't even identified yet. You **can** do it!

FEB 5
MONDAY

Maarten Schmidt
(widely used public image)

On this day in 1963, Maarten Schmidt measured the first quasar redshift and in 1974 the first close-up photography of Venus was made by Mariner 10. With a bit of time to spare before the Moon rises tonight, let's begin our journey further south into Lepus as we take a look at Alpha. Its name is Arneb and it is a quality double star that resides around 900 light-years distant. Arneb's 11th magnitude disparate companion will take a larger scope to resolve. Its wide separation of 35.5" means it is probably not a true physical companion, but it is a challenge worthy of your time.

For binoculars and small scopes, hop due east of Alpha about a fingerwidth for a brilliant multiple star system that is also designated as an open cluster—NGC 2017.

First cataloged by Sir William Herschel at the Cape of Good Hope, this interesting group of stars will show in the same field as Alpha Leporis in binoculars, but come to colorful life in the telescope. The stars in this small open cluster are all gravitationally bound to each other and are a well-studied source of both radio and infrared emissions. NGC 2017 produces a dense wind from a thin H II region hidden within it, which may be from a loose distribution of gas and dust. Power up. As aperture increases—so does resolution. Watch as the primary colorful members begin to split into disparate pairs as magnification increases. It's a much underrated jewel box!

NGC 2017
Credit: Palomar Observatory, courtesy of Caltech

On this day in 1971, astronaut Alan Shepherd became the first "lunar golfer," as he teed off on the Moon's surface. Think the ball is still in orbit? Then think again as his shot made a successful "hole in one" in a crater tens of meters away! If you haven't had a chance to view the Apollo 14 landing site, then try again when the Moon rises. You'll find it about midway along the bright peninsula-like feature that extends into Mare Nubium from the north.

While we're waiting on the Moon to rise, let's celebrate the fiery return of the Soviet Space Station Salyut 7. Launched into orbit in 1982, the space station was doomed by electrical and maneuvering problems. At the time, cosmonauts would remain as long as eight months before returning to Earth. The project was abandoned in 1986, but some of the equipment and supplies were transferred to the orbiting Mir. On this day in 1991, Salyut re-entered our atmosphere and was lost.

Salyut 7
(widely used public image)

Have you ever wondered if you can spot orbiting spacecraft? Yes, you can. Many objects are visible to the unaided eye if you know where and when to look. Try checking with heavens-above.com for highly accurate information for your specific area. Many events are wonderful to witness. Among the most spectacular is the Iridium flare—the Sun reflecting off the highly polished sides of a communications satellite. Watching the ISS fly-over is also a wonder to behold! Try it tonight...

Shepard Golfing on the Moon
Credit: NASA

FEB 7
WEDNESDAY

On this day in 1889, the first national astronomy organization in the USA was born—the Astronomical Society of the Pacific.

With plenty of time to spare before the Moon rises tonight, let's return again to Lepus and an even more challenging double star—Beta. At a distance of 115 light-years, only a large telescope can hope to achieve an 11th magnitude companion no more than 2.5" distant. No luck? Then try your hand at 29 light-year distant Gamma. Even a very small telescope can easily split this colorful pair. The 3.5 magnitude primary star has a slightly yellow hue, while the 6.1 magnitude secondary appears redder.

Now, return to Beta and look west for Epsilon. Forming an isosceles triangle to the south is faint star ADS 3954—also a closely matched double star. You will find M79 just about a fingerwidth northeast.

Originally discovered by Méchain in October of 1780, Messier himself didn't get around to looking at one of the very few globular clusters of winter until December of that year. On a good night, this small "round fuzzy" can be spotted with binoculars as an AL challenge object, but truly takes a telescope to appreciate. Moving away from us at 303 kilometers per second (188 miles per second), the 8th magnitude M79 will show as a concentrated ball of unresolvable stars to small aperture and begin resolution with larger scopes. At around 42 light-years away, this often over-looked Messier object is one of the very few globular clusters that resides further out in Milky Way galaxy than our own solar system!

Heads up for Southern Hemisphere observers, over the next two nights will be the peak of the Centaurid meteor shower. Discovered by Michael Buhagiar of Australia, this stream has two radiants—Alpha and Beta. While both occur at roughly the same time and roughly from the same place, tonight's Alpha peak has a regular fall rate of around 3 per hour and an average magnitude of 2.4 while tomorrow's Beta stream varies with up to 14 per hour and far brighter at magnitude 1.6. Enjoy!

M79
Credit: NOAO/AURA/NSF

FEB 8
THURSDAY

If you are up well before dawn this morning, be sure to check out the close appearance of bright Spica with the Moon. Information points toward an occultation event, so be sure to check with IOTA for possible times and locations!

Today celebrates the discovery of the Sayh al Uhaymir 094 “Mars Meteorite.” Found this day in 2001, scientists had long known Mars’ surface was home to many impact craters which may have caused space-born debris. It was only a matter of time before a bit of this debris would be captured by Earth’s gravity and be brought down as a meteorite. Upon study, tiny gas deposits were discovered in its composition that nearly matched the atmosphere of Mars as measured by the Viking Landers, and its mineral composition also leads science to believe the meteor originated from Mars.

Mars Meteorite SaU 094
Credit: NASA

And where is Mars? If you’re out looking for Spica and the Moon, you’ll find it low on the horizon just before dawn.

Tonight’s goal with be a rather simple one—a star of singular beauty. Located about three fingerwidths southwest of Rigel, or a little more than a fingerwidth northwest of Mu in the constellation of Lepus, is R Leporis—better known as “Hind’s Crimson Star.”

Discovered in October of 1845 by J. R. Hind, R Leporis will require optical aid to view since it is a Mira-type variable that moves from approximately magnitude 6 to as low as magnitude 11 in about 432 days. As a carbon star, this particular example is well worth viewing for its intense ruby color when near minimum. As R Leporis undergoes its changes, it produces amazing amounts of carbon. To understand what makes it dim, think of an oil lamp. As the carbon “soot” collects on the glass, like the star’s outer atmosphere, the light decreases until it is sloughed off and the process is repeated. At a rough distance of approximately 1500 light-years, Hind’s Crimson Star will become an observing favorite and is also a challenge on many lists. Enjoy!

R Leporis
Credit: Adam Block/NOAO/AURA/NSF

FEB 9
FRIDAY

If you haven't had a chance to spot Mercury in the evening skies, why not have a look tonight? It reached its greatest elongation for this appearance two days ago and is now about a handspan above the horizon at sunset for most viewers. Try using binoculars as you view the swift inner planet. Be sure to look for Venus and Uranus nearby!

With the Moon long absent from early evening skies, it's time to get more serious about Lepus and do some galaxy hunting. Our first marks will be Mu Leporis and NGC 1832 in the same field to its north.

At a rough magnitude of 12, this small galaxy isn't for the small scope, but is reasonably bright and easy to study with aperture. As an ongoing study for spiral arm pattern, rotation rates and star forming, a supernova incident was discovered in 2004 by LOSS and Federico Manzini. Look for a slightly oval shape that orients from north to south and brightens towards the core. A faint star can be seen at the edge of the arm structure to the northeast and it is best at mid-magnifications.

Our second hop takes us about one degree southeast of Beta and into a stellar field for NGC 1964. At a visual magnitude of 10.8, this Herschel 400 galaxy shows an oval disc elongated from the northeast to southwest with a bright core area and several faint stars that overlay the galaxy but are not involved with it. It can be spotted with scopes as small as 4.5", but truly requires larger aperture to appreciate.

NGC 1832
Credit: Palomar Observatory, courtesy of Caltech

NGC 1964
Credit: Palomar Observatory, courtesy of Caltech

Tonight Saturn is at opposition, meaning that it rises at the same time as the Sun sets and will be viewable all night.

With dark skies still in our favor, let's continue on through our tour of Lepus and the galaxy hunt. Tonight we'll go from one corner to the other as we begin with Iota and hop 2 degrees west for NGC 1784.

At magnitude 11.8, this barred spiral can be spotted in mid-aperture scopes as a misty oval with a slightly brighter center. With larger telescopes and optimal conditions, the central bar structure can be revealed as an elongated brightness towards the core region with some brighter knots noted in the arms. In studies done by Doug Ratay in radio wavelengths, NGC 1784 was mapped for its distribution of hydrogen gas both within and outside the galaxy structure. His incredible findings showed an orbiting area of gas that could be a small galaxy located about 100 million light-years away.

Our second mark is slightly more than more than 3 degrees south-southwest of Epsilon—NGC 1744. Despite seeming to be possible—its magnitude is 12.3—this north/south inclined barred spiral is anything but easy from the Northern Hemisphere—or the South! Very low surface brightness means this particular galaxy is a tough customer even for large telescopes and at best will show as a thin, nebulous area with no definition.

NGC 1784
Credit: Palomar Observatory, courtesy of Caltech

NGC 1744
Credit: Palomar Observatory, courtesy of Caltech

FEB 11
SUNDAY

NGC 2179
Credit: Palomar Observatory, courtesy of Caltech

On this day in 1970 Lambda 4S-5, the first Japanese satellite, was launched. If you are up before dawn this morning, please take the time to have a look at the Moon and very nearby Antares. This outstanding pair frequently occults for viewers around the world, so be sure to check IOTA!

Tonight let's continue onward with deeper studies in the constellation of Lepus as we take on three galaxy challenges very worthy of the most seasoned amateur astronomer. Our goal area lies about a fistwidth southeast of Alpha Leporis as we start the hunt.

The first galaxy, NGC 2179 (RA 06 08 02.10 Dec -21 44 48.0) holds an average magnitude of 13 which puts it in large telescope range, but does not make it easy. This very small galaxy will show as nothing more than a faint, round contrast change with some concentration towards the nucleus. It is bracketed on either side by stars and at lower power will show a slightly yellow and blue double star in the field. While this galaxy doesn't seem particularly spectacular, it contains one of the most massive dark matter halos so far discovered!

Next up is NGC 2196 (RA 06 12 10.00 Dec -21 48 24.0). At magnitude 12.6, this spiral is much larger and much brighter than our last. It is very round and shows some concentration towards the core that disappears at higher magnifications. Achievable in mid-sized telescopes, this particular galaxy is a lopsided spiral that shows gas accretion in its disc.

Before we leave the area, let's have a look at NGC 2139 (RA 06 01 07.90 Dec -23 40 21.3). Holding a magnitude of 12.2, this peculiar spiral is also a faint object to detect. It's small, evenly dispersed, and better seen at lower powers along with the apparent double in the field. Keep an eye on this Seyfert, there was a supernova event in 1995!

NGC 2196
Credit: Palomar Observatory, courtesy of Caltech

NGC 2139
Credit: Palomar Observatory, courtesy of Caltech

Celestial scenery alert! As the Moon moves along the ecliptic, it has now neared Jupiter and you'll find the pair less than half a fistwidth apart in the morning skies.

Today is also the anniversary (2001) of NEAR landing on asteroid Eros. The Near Earth Asteroid Rendezvous (NEAR) mission was the first to ever orbit an asteroid, successfully sending back thousands of images. Although it was not designed to land on Eros, it survived the low speed impact and continued to send back data. And where is asteroid Eros? You'll find our 11.3 magnitude friend scooting along through Ophiuchus well ahead of the dawn.

Tonight we'll continue onward with our studies of Lepus as we head for two more of the coveted Herschel 400 objects. Our hop starts with beautiful Gamma and NGC 2073.

Located less than a fingerwidth northeast of Gamma (RA 05 45 53.90 Dec -21 59 59.0), NGC 2073 might be magnitude 12.4, but its small size makes it anything but easy. Even if it does have some highly studied molecular cloud structure, be prepared to see nothing but a tiny, egg-shaped contrast change in the elliptical Herschel 241.

NEAR image of Eros
Credit: NASA

Continue northeast a little more than 2 degrees (RA 05 54 52.30 Dec -20 05 03.0) to encounter Herschel 225—NGC 2124. Although it is slightly fainter, we are at least picking up something with more recognizable structure. Oriented north/south, Herschel 225 is an inclined spiral with a bright nucleus. Set in a wonderfully rich star field, it's difficult to spot at first with low power, but its slim structure holds up well to magnification. This one is really a pleasure.

NGC 2073
Credit: Palomar Observatory, courtesy of Caltech

NGC 2124
Credit: Palomar Observatory, courtesy of Caltech

FEB 13
TUESDAY

J.L.E. Dreyer
(widely used public image)

If you haven't caught Mercury yet, this evening might be a good opportunity as it reaches its stationary position.

Today is the birthday of J.L.E. Dreyer. Born in 1852, the Danish-Irish Dreyer came to fame as the astronomer who compiled the New General Catalogue (NGC) published in 1878. Even with a wealth of astronomical catalogs to chose from, the NGC objects and Dreyer's abbreviated list of descriptions still remain the most widely used today.

Tonight let's make Dreyer proud as we finish up our Herschel 400 studies. For binoculars, return again to beautiful star cluster NGC 2017. For telescopes it's time to head a degree and a half northeast of this anchor for Herschel 267.

At magnitude 13, NGC 2076 is a lot less forgiving of scope size and sky conditions than some galaxies, but if aperture and sky cooperate, you are in for a real treat! Although it is fairly small and somewhat faint, NGC 2076 is an edge-on that will show indications of a dark dustlane across its brighter nucleus, when using aversion. The lane itself has been highly studied for dust extinction and star forming properties and as recently as 2003 a supernova event was reported just south of the nucleus.

Now let's drop south about one degree and pick up Herschel 270!

Far brighter at magnitude 11.9, don't let the ordinary elliptical NGC 2089 fool you. What would appear to be a stellar nucleus is indeed stellar. Studies done by AAVSO have shown that the bright point of light is actually a line of sight star!

Congratulations on your studies and be sure to write down your Herschel "homework!"

NGC 2017
Credit: Palomar Observatory, courtesy of Caltech

NGC 2089
Credit: Palomar Observatory, courtesy of Caltech

FEB 14
WEDNESDAY

Happy Valentine's Day! Today is the birthday of Fritz Zwicky. Born in 1898, Zwicky was the first astronomer to identify supernovae as a separate class of objects. His insights also proposed the possibility of neutron stars. Among his many achievements, Zwicky also catalogued galaxy clusters and designed jet engines.

In mythology, Lepus the Hare is hiding in the grass at Orion's feet. As we have seen, there are many objects of beauty hidden within what seems to be a very ordinary constellation. Before we leave the "Rabbit" for this year, there is one last object that is worthy of attention. If you look to the feet of Orion and the brightest star of Lepus, you will see that they make a triangle in the sky. Tonight we are headed towards the center of that triangle for a singular object—the Spirograph Nebula.

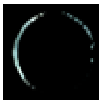
Fritz Zwicky
(widely used public image)

Shown in all its glory through the eye of the Hubble Telescope, the light you see tonight from the IC 408 planetary nebula left in the year 7 AD. Its central star, much like our own Sol, was in the final stages of its life at that time, and but a few thousand years earlier was a red giant. As it shed its layers off into about a tenth of a light-year of space, only its superheated core remained—its ultraviolet radiation lighting up the expelled gas. Perhaps in several thousand years the nebula will have faded away, and in several billion years more the central star will have become a white dwarf—a fate that also awaits our own Sun.

At magnitude 11, it is well within reach of a small to mid-size telescope. Like all planetary nebulae, the more magnification—the better the view. The central star is easily seen against a slightly elongated shell and larger telescopes bring an "edge" to this nebula that makes it very worthwhile studying. Spend some quality time with this object. With larger scopes, there is no doubt a texture to this planetary that will delight the eye... and touch the heart!

The Spirograph Nebula
Credit: Hubble Heritage Team (NASA)

FEB 15
THURSDAY



Galileo
Credit: NASA

Born on this day in 1564 was the man who fathered modern astronomy—Galileo Galilei. Two and a half centuries ago, he became first scientist to use a telescope for astronomical observation and his first target was the Moon. Just before dawn this morning you will have the opportunity to observe the waning crescent and the tiny crater named for Galileo. Almost central along the terminator and caught near the edge of Oceanus Procellarum, you will see a small, bright ring. This is Reiner Gamma and you will find Galileo just a short hop to the northwest as a tiny, circular crater. What a shame the cartographers did not pick a more vivid feature to name after the great Galileo! But, look around... Even the skies honor Galileo this morning. Did you spot Mars nearby?

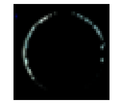
With absence of the Moon in our favor, it's time to learn the constellation of Monoceros as the skies darken and Orion begins to head west. By using the red giant Betelgeuse, diamond-bright Sirius and the beacon of Procyon, we can see these three stars form a triangle in the sky with Sirius pointing towards the south. The "Unicorn" is not a bright constellation, and most of its stars fall inside this area with its Alpha star almost a handspan south of Procyon.

Using the belt of Orion as a guide, look a handspan east, this is Delta. A fistwidth away to the southeast is Gamma; with Beta about two fingerwidths further along. About a palmwidth southeast of Betelguese is Epsilon. Although this might seem simplistic, knowing these stars will help you find many wonderful objects. Let's start our journey tonight two fingerwidths northwest of Epsilon…

NGC 2186 is a triangular open cluster of stars set in a rich field that can be spotted with binoculars and reveals as many as 30 or more stars to even a small telescope. Not only is this a Herschel 400 object that can be spotted with simple equipment, but a highly studied galactic cluster that contains circumstellar discs!

NGC 2186
Credit: Palomar Observatory, courtesy of Caltech

On this day in 1948, Gerard Kuiper was celebrating his discovery of Miranda—one of Uranus' moons. Just 42 years earlier on this day, both Kopff and Metcalf were also busy—discovering asteroids! Today is the birthday of Francois Arago. Born in 1786, Arago became the pioneer scientist in the wave nature of light. His achievements were many and he is also credited as the inventor of the polarimeter and other optical devices.



Tonight let's celebrate Arago's achievements in polarization as we return again to Epsilon Monocerotis. Our destination is around a fingerwidth east as we seek out another star cluster that has an interesting companion—a nebula!

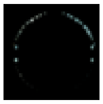
NGC 2244 is a star cluster embroiled in a reflection nebula spanning 55 light-years and most commonly called "The Rosette." Located about 2500 light-years away, the cluster heats the gas within the nebula to nearly 18,000 degrees Fahrenheit, causing it to emit light in a process similar to that of a fluorescent tube. A huge percentage of this light is hydrogen-alpha, which is scattered back from its dusty shell and becomes polarized.

Francois Arago
(widely used public image)

While you won't see any red hues in visible light, a large pair of binoculars from a dark sky site can make out a vague nebulosity associated with this open cluster. Even if you can't, it is still a wonderful cluster of stars crowned by the yellow jewel of 12 Monocerotis. With good seeing, small telescopes can easily spot the broken, patchy wreath of nebulosity around a well-resolved symmetrical concentration of stars. Larger scopes, and those with filters, will make out separate areas of the nebula which also bear their own distinctive NGC labels. No matter how you view it, the entire region is one of the best for winter skies.

The Rosette Nebula
Credit: N. A. Sharp/NOAO/AURA/NSF

FEB 17
SATURDAY



Tonight is New Moon and perhaps the very best time for us to go hunting some obscure objects that will require the darkest of skies. Once again, we'll use our guidestar Epsilon and tonight we'll be heading about three fingerwidths northeast for a vast complex of nebulae and star clusters.

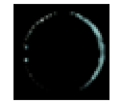
To the unaided eye, 4th magnitude S Monocerotis is easily visible and to small binoculars so are the beginnings of a rich cluster surrounding it. This is NGC 2264. Larger binoculars and small telescopes will easily pick out a distinct wedge of stars. This is most commonly known as the "Christmas Tree Cluster," its name given by Lowell Observatory astronomer Carl Lampland. With its peak pointing due south, this triangular group is believed to be around 2600 light-years away and spans about 20 light-years. Look closely at its brightest star—S Monocerotis is not only a variable, but also has an 8th magnitude companion. The group itself is believed to be almost 2 million years old.

The nebulosity is beyond the reach of a small telescope, but the brightest portion illuminated by one of its stars is the home of the Cone Nebula. Larger telescopes can see a visible V-like thread of nebulosity in this area which completes the outer edge of the dark cone. To the north is a photographic only region known as the Foxfur Nebula, part of a vast complex of nebulae that extends from Gemini to Orion.

Northwest of the complex are several regions of bright nebulae, such as NGC 2247, NGC 2245, IC 446 and IC 2169. Of these regions, the one most suited to the average scope is NGC 2245, which is fairly large, but faint, and accompanies an 11th magnitude star. NGC 2247 is a circular patch of nebulosity around an 8th magnitude star, and it will appear much like a slight fog. IC 446 is indeed a smile to larger aperture, for it will appear much like a small comet with the nebulosity fanning away to the southwest. IC 2169 is the most difficult of all. Even with a large scope a "hint" is all!

Enjoy your nebula quest...

The Region of NGC 2264
Credit: T. A. Rector and B.A. Wolpa/NOAO/AURA/NSF



On this day in 1930, a young man named Clyde Tombaugh was very busy checking out some photographic search plates taken with the Lowell Observatory's 13" telescope. His reward? The discovery of Pluto!

This evening let us return to the realm of binoculars and small telescopes as we head now for Beta Monocerotis and a little more than a fingerwidth north for NGC 2232. This wonderful collection of stars sparkles with chains and various magnitudes—the brightest of which is 5th magnitude 10 Monocerotis. Well resolved with a small telescope, its apparent size of about a full moon-width makes it a true delight and it can even be spotted unaided from a dark sky site. Be sure to note it, because it is on many open cluster study lists.

Now head back to Beta and about the same distance west for Class D cluster NGC 2215. At magnitude 8, it is still within the realm of binoculars, but will look like a small fuzzy patch beyond resolution. Try this one with a telescope! Set in a rich field, the compressed area of near equal magnitude stars isn't the most colorful in the sky, but you can add another to your Herschel hits!

NGC 2232
Credit: Palomar Observatory, courtesy of Caltech

NGC 2215
Credit: Palomar Observatory, courtesy of Caltech

FEB 19
MONDAY

Nicholas Copernicus
(widely used public image)

Today is the birthday of Nicolas Copernicus. Born in 1473, he was the creator of the modern solar system model which illustrated the retrograde motion of the outer planets. Considering this was well over 530 years ago, and in a rather "unenlightened" time, his revolutionary thinking about what we now consider natural is astounding.

While we still have dark skies on our side, let's head for a handful of difficult nebulae in a region just west of Gamma Monocerotis.

For binoculars, check out the region around Gamma, it is rich in stars and very colorful! You are looking at the very outer edge of the Orion spiral arm of our galaxy. For small scopes, have a look at Gamma itself—it's a triple system that we'll be back to study. For larger scopes? It's Herschel hunting time...

NGC 2183 and NGC 2185 will be the first you encounter as you move west of Gamma. Although they are faint, just remember they are nothing more than a cloud of dust illuminated by faint stars on the edge of the galactic realm. The stars that formed inside provided the light source for these wispy objects and at their edges lies intergalactic space.

To the southwest is the weaker NGC 2182, which will appear as nothing more than a faint star with an even fainter halo about it, with NGC 2170 more strongly represented in an otherwise difficult field. While the views of these objects might seem vaguely disappointing, you must remember that not everything is as bright and colorful as seen in a photograph. Just knowing that you are looking at the collapse of a giant molecular cloud that's 2400 light-years away is pretty impressive!

NGC 2170
Doc G., Dick Goddard and Adam Block/NOAO/AURA/NSF

FEB 20
TUESDAY

Today in 1962, John Glenn became the first American to orbit the Earth three times while aboard Friendship 7.

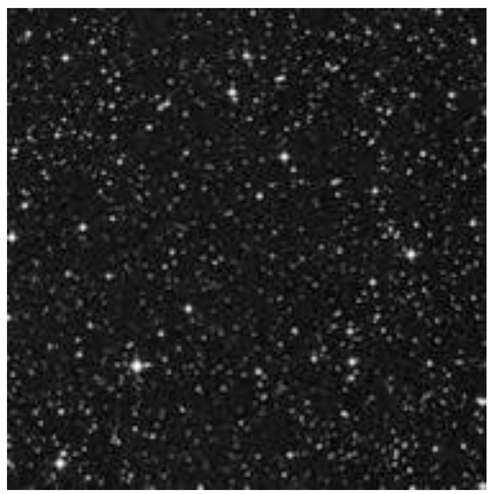
Today in history also celebrates the Mir space station launch in 1986. Mir (Russian for "peace") was home to both cosmonauts and astronauts as it housed 28 long duration crews during its 15 years of service. To date it is one of the longest running space stations and a triumph for mankind. *Spaseba!*

Tonight the slender first crescent of the Moon makes its presence known on the western horizon. Before it sets, take a moment to look at it with binoculars. The beginnings of Mare Crisium will show to the northeast quadrant, but look just a bit further south for the dark, irregular blotch of Mare Undarum—the Sea of Waves. On its southern edge, and to lunar east, look for the small Mare Smythii—the "Sea of Sir William Henry Smyth." Further south of this pair and at the northern edge of Fecunditatis is Mare Spumans—the "Foaming Sea." All three of these are elevated lakes of aluminous basalt belonging to the Crisium basin.

For telescope users, wait until the Moon has set and return to Beta Monocerotis and head about a fingerwidth northeast for an open cluster challenge—NGC 2250. This vague collection of stars presents itself to the average telescope as about 10 or so members that form no real asterism and makes one wonder if it is indeed a cluster. So odd is this one, that a lot of star charts don't even list it!

John Glenn and Friendship 7
Credit: NASA

Mir
Credit: NASA



NGC 2250
Credit: Palomar Observatory, courtesy of Caltech

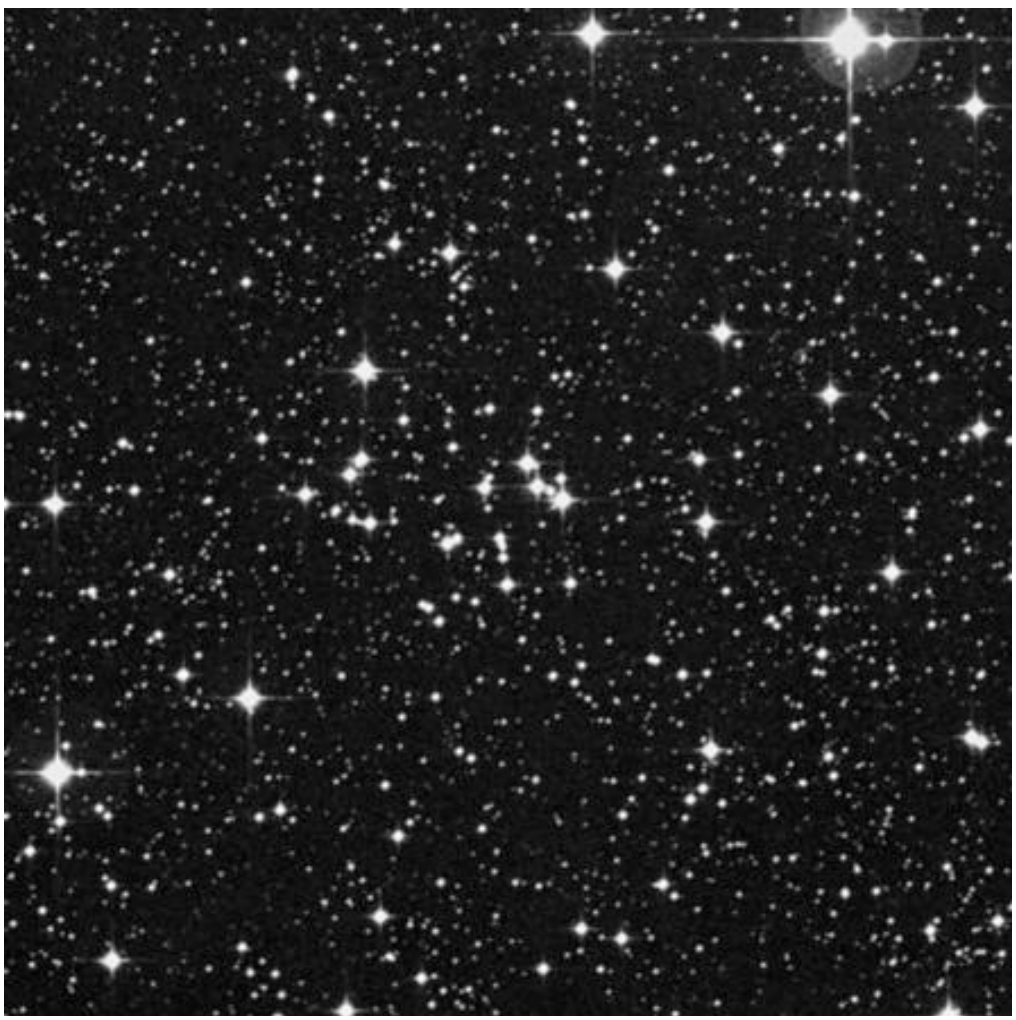
FEB 21
WEDNESDAY

Mare Humboldtianum
Credit: NASA

Tonight the Moon begins its westward journey after sunset in a position much easier to observe. The lunar feature we are looking for is at the north-northeast of the lunar limb and its view is often dependent on libration. What are we seeking? "The Sea of Alexander von Humboldt"...

Mare Humboldtianum is seen in this picture as fully revealed, yet sometimes it can be hidden from view because it is an extreme feature. Spanning 273 kilometers, the basin in which it is contained extends for an additional 600 kilometers and continues around to the far side of the Moon. The mountain ranges which accompany this basin can sometimes be glimpsed under perfect lighting conditions, but ordinarily are just seen as a lighter area. The mare was formed by lava flow into the impact basin, yet more recent strikes have scarred Humboldtianum. Look for a splash of ejecta from crater Hayn further north, and the huge, 200 kilometer strike of crater Bel'kovich on Humboldtianum's northeast shore.

When the Moon begins to wester, let's head for Beta Monocerotis and hop about 3 fingerwidths east for an 8.9 magnitude open cluster that can be spotted with binoculars and is well resolved with a small telescope—NGC 2302. This very young stellar cluster resides at the outer edge of the Orion spiral arm. While binoculars will see a handful of stars in a small V-shaped pattern, telescope users should be able to resolve 40 or so fainter members.



NGC 2302
Credit: Palomar Observatory, courtesy of Caltech

FEB 22
THURSDAY

Today in 1966, Soviet space mission Kosmos 110 was launched. Its crew was canine, *Veterok* (Little Wind) *Ugolyok* (Little Piece of Coal); both history making dogs. The flight lasted 22 days and held the record for living creatures in orbit until 1974—when Skylab 2 carried its three-man crew for 28 days.

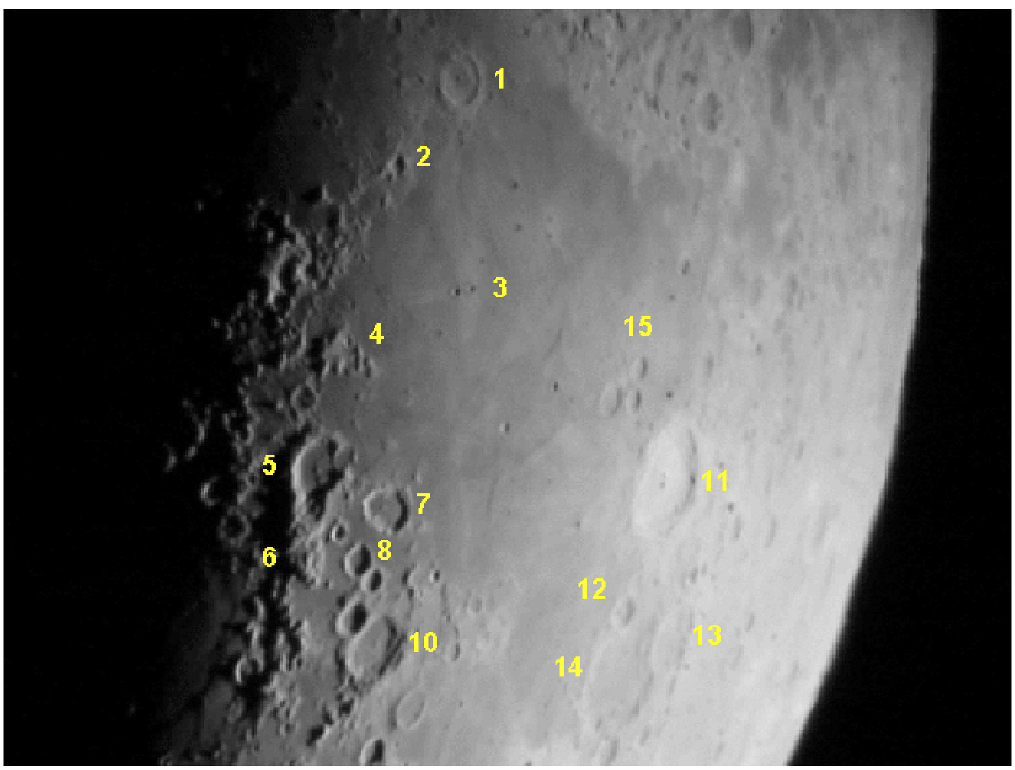
With tonight's Moon in a much higher position to observe, let's begin with an investigation of Mare Fecunditatis—the Sea of Fertility.

Stretching 1463 kilometers in diameter, the combined area of this mare is equal in size to the Great Sandy Desert in Australia—and almost as vacant in interior features. It is home to glasses, pyroxenes, feldspars, oxides, olivines, troilite and metals in its lunar soil, which is called regolith. Studies show the basaltic flow inside of the Fecunditatis basin perhaps occurred all at once, making its chemical composition different from other maria. The lower titanium content means it is between 3.1 and 3.6 billion years old!

Veterok and Ugolyok
Courtesy of Alexander Chernov

The western edge of Fecunditatis is home to features we share terrestrially—grabens. These down-dropped areas of landscape between parallel fault lines occur where the crust is stretched to the breaking point. On Earth, these happen along tectonic plates, but on the Moon they are found around basins. The forces created by lava flow increase the weight inside the basin, causing a tension along the border which eventually fault and cause these areas. Look closely along the western shore of Fecunditatis where you will see many such features.

Now, let's take a walk across the Sea of Fertility and see how many lunar challenge features you can identify!



(1) Taruntius, (2) Secchi, (3) Messier and Messier A, (4) Lubbock, (5) Guttenberg, (6) Montes Pyrenees, (7) Goclenius, (8) Magelhaens, (9) Columbo, (10) Webb, (11) Langrenus, (12) Lohse, (13) Lame, (14) Vendelinus, (15) Luna 16 landing site

Fecunditatis Region
Image Credit: Greg Konkel
Annotation: Tammy Plotner

FEB 23
FRIDAY

In 1987, Ian Shelton made an astonishing visual discovery—SN 1987a. This was the brightest supernova in 383 years.

Since the stars of our study constellation of Monoceros are quite dim when the Moon begins to interfere, why not spend a few days really taking a look at the Moon's surface and familiarizing yourself with its many features? Tonight would be a great time for us to explore "The Sea of Nectar."

At around 1000 meters deep, Mare Nectaris covers an area of the Moon equal to that of the Great Sandhills in Saskatchewan, Canada. Like all maria, it is part of a gigantic basin that is filled with lava, and evidence of grabens exists along its western basin edge. While Nectaris' basaltic flows appear darker than those in most maria, it is one of the older formations on the Moon and as the terminator progress, you'll be able to see where ejecta belonging to Tycho crosses its surface.

For now? Let's have a closer look at the mare itself and its surrounding craters… Enjoy these many features which are also lunar challenges—and we'll be back to study each later in the year!

Nectaris Region
Image Credit: Greg Konkel
Annotation: Tammy Plotner

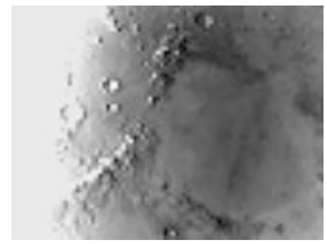
(1) Isidorus, (2) Madler, (3) Theophilus, (4) Cyrillus, (5) Catharina, (6) Dorsum Beaumont, (7) Beaumont, (8) Fracastorius, (9) Rupes Altai, (10) Piccolomini, (11) Rosse, (12) Santbech, (13) Pyrenees Mountains, (14) Guttenberg, (15) Capella

FEB 24
SATURDAY

Tonight let your imagination sweep you away as we go mountain climbing—on the Moon! Tonight all of Mare Serenitatis will be revealed and along its northwestern shore lie some of the most beautiful mountain ranges you'll ever view—The Caucasus to the north and the Apennines to the south.

Like it's earthly counterpart, the Caucasus Mountain range stretches almost 550 kilometers and some of its peaks reach upwards to 6 kilometers—a summit as high as Mount Elbrus!

Slightly smaller than its terrestrial namesake, the lunar Apennine mountain range extends some 600 kilometers with peaks rising as high as 5 kilometers. Be sure to look for Mons Hadley, one of the tallest peaks that you will see at the northern end of this chain. It rises above the surface to a height of 4.6 kilometers, making that single mountain about the size of asteroid Toutatis.

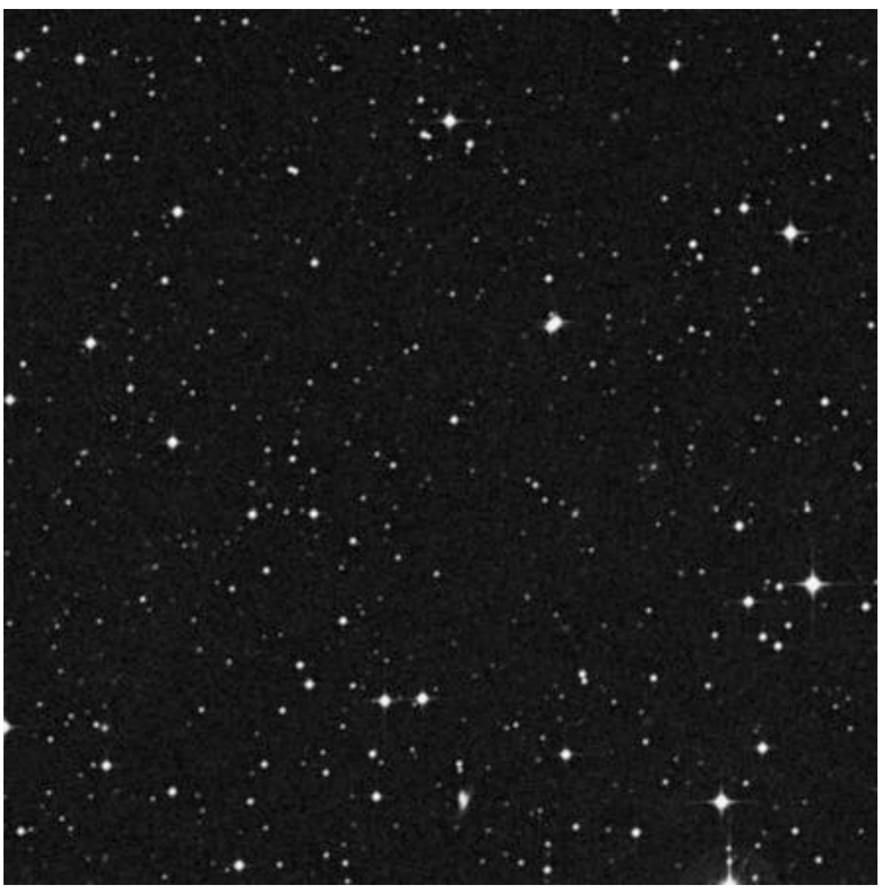


The Caucasus and Apennine Mountains
Credit: Greg Konkel

Today in 1968, during a radar search survey, the first pulsar was discovered by Jocelyn Bell. The co-directors of the project, Antony Hewish and Martin Ryle, matched these observations to a model of a rotating neutron star, winning them the 1974 Physics Nobel Prize and proving a theory of J. Robert Oppenheimer from 30 years earlier.

Jocelyn Bell
(widely used public image)

Would you like to get a look at a region of the sky that contains a pulsar? Then wait until the Moon has well westered and look for guidestar Alpha Monocerotis to the south and bright Procyon to its north. By using the distance between these two stars as the base of an imaginary triangle, you'll find pulsar PSR 0820+02 at the apex of your triangle pointed east. In the picture below, I wonder which "star" it is?



PSR 0820+02
Credit: Palomar Observatory, courtesy of Caltech

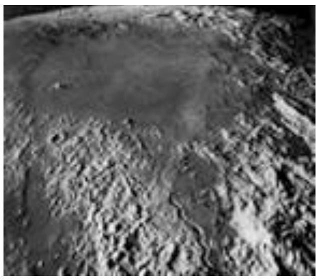
FEB 25
SUNDAY

Tonight your lunar assignments are relatively easy. We will begin by identifying "The Sea of Vapors."

Look for Mare Vaporum on the southwest shore of Mare Serenitatis. Formed from newer lava flow inside an old crater, this lunar sea is edged to its north by the mighty Apennine Mountains. On its northeastern edge, look for the now washed-out Haemus Mountains. Can you see where lava flow has reached them? This lava has come from different time periods and the slightly different colorations are easy to spot even with binoculars.

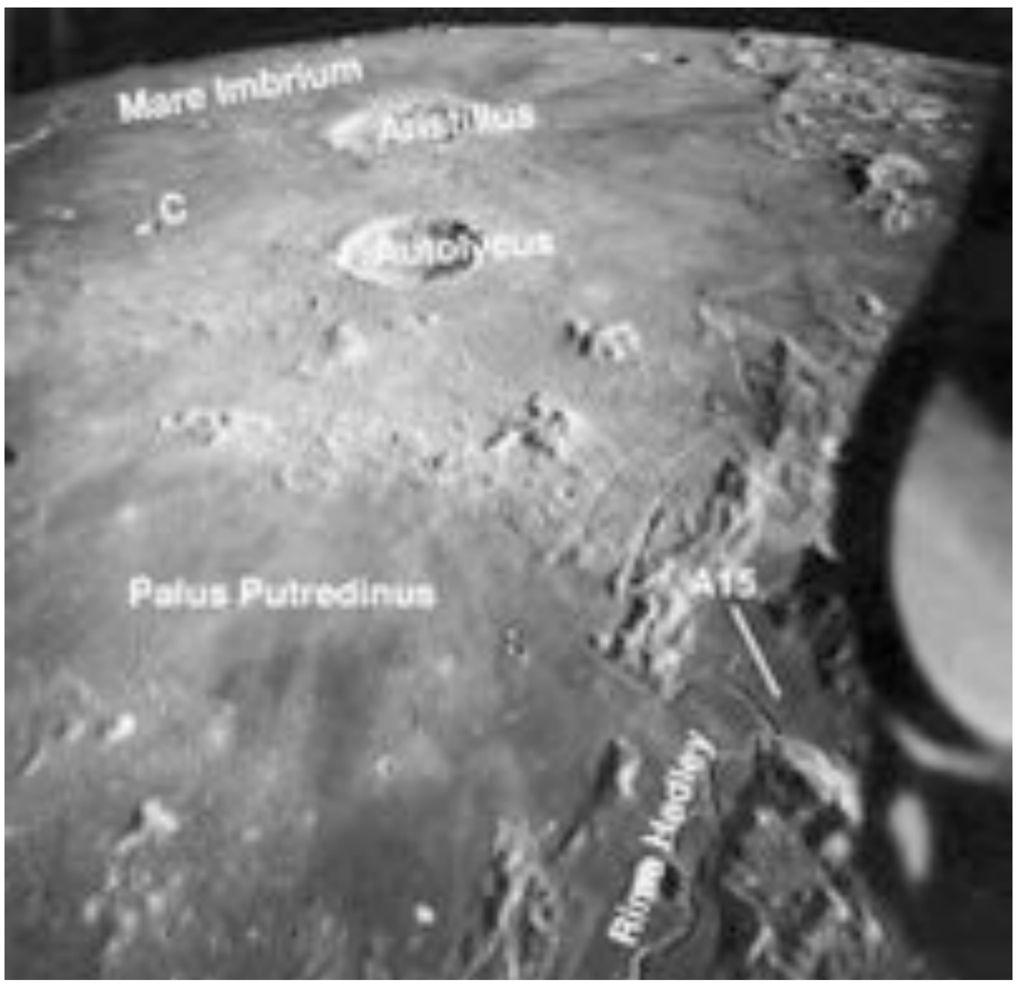
Further south and edged by the terminator is Sinus Medii—"The Bay in the Middle." With an area about the size of both Massachusetts and Connecticut, this lunar feature is the mid-point of the visible lunar surface. In 1930, experiments were underway to test this region for surface temperature—a project begun by Lord Rosse in 1868. Surprisingly enough, results of the two studies were very close, and during full daylight temperatures in Sinus Medii can reach the boiling point as evidenced by Surveyors 4 and 6—which landed near its center.

Now take a hop north of Mare Vaporum for a look at "The Rotten Swamp"—Palus Putredinus. More pleasingly known as the "Marsh of Decay," this nearly level surface of lava flow is also home to a mission—the hard-landing of Lunik 2. On September 13, 1959 astronomers in Europe reported seeing the black dot of the crashing probe. The event lasted for nearly 300 seconds and spread over an area of 40 kilometers.



Mare Vaporum as seen from Apollo
Credit: NASA

Surveyor 6 Sampling Sinus Medii
Credit: NASA



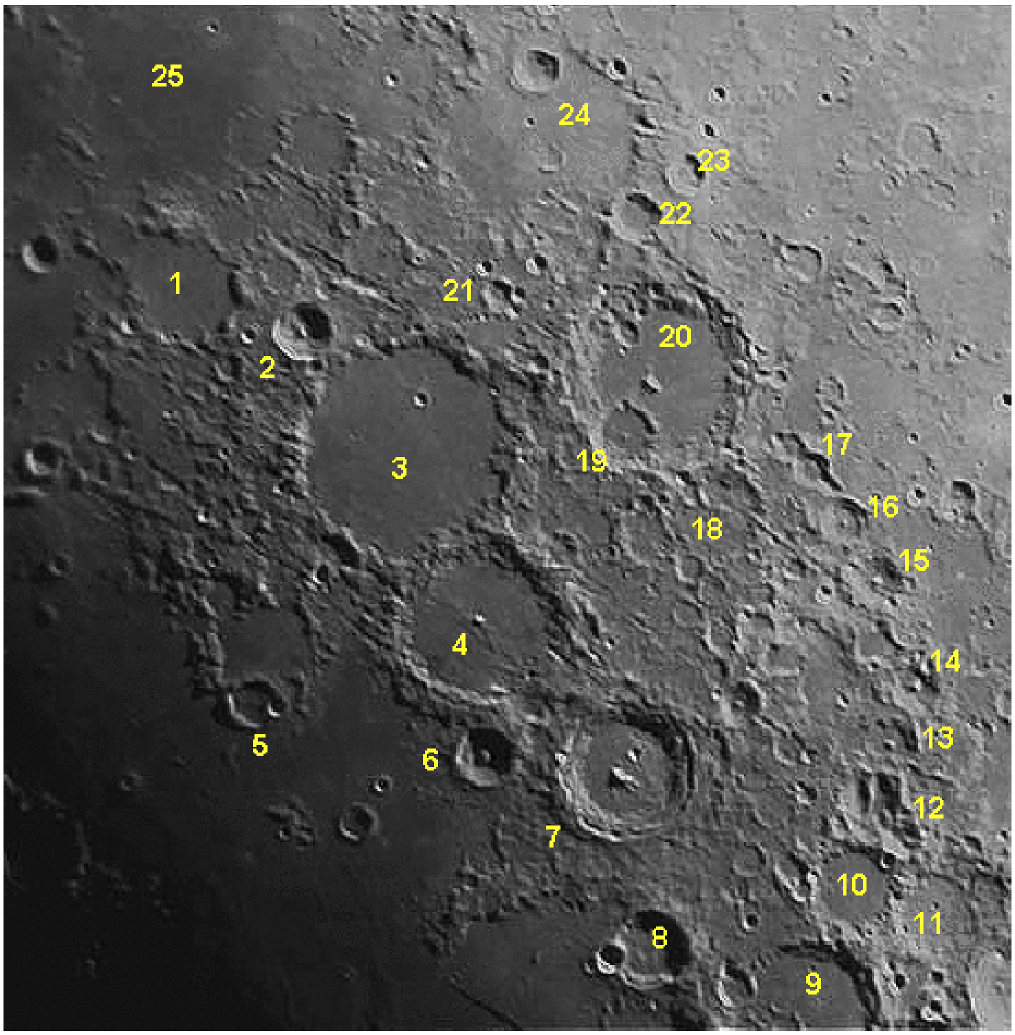
Palus Putredinus as seen from Apollo
Credit: NASA

FEB 26
MONDAY

Today is the birthdate of Camille Flammarion. Born in 1842, he became a widely read author in astronomy and conceived the idea that we were not alone—the idea of extraterrestrial life. Yet, Flammarion was just a little bit more than the great-grandfather of SETI. In 1877, Flammarion had an unusual chance that most of us only dream of. He had his hands on a personal copy and notes of the Messier Catalog. Using it as a reference, he later revised it, but his studies led him to identify M102 with NGC 5866 before 1917. By 1921, Flammarion had added M104—now known as NGC 4594—to the catalog as well, and it became the first of many additions.

This evening will be your opportunity to have a look at the crater named for Flammarion. Located just south of Sinus Medii, the walk isn't an easy one because the Southern Highlands contain so many craters. How about some help?

Camille Flammarion
(widely used public image)



(1) Flammarion, (2) Herschel, (3) Ptolemaeus, (4) Alphonsus, (5) Davy, (6) Alpetragius, (7) Arzachel, (8) Thebit, (9) Purbach, (10) Lacaille, (11) Blanchinus, (12) Delaunay, (13) Faye, (14) Donati, (15) Airy, (16) Argelander, (17) Vogel, (18) Parrot, (19) Klein, (20) Albategnius, (21) Muller, (22) Halley, (23) Horrocks, (24) Hipparchus, (25) Sinus Medii

Albategnius Region
Image Credit: Roger Warner
Annotation: Tammy Plotner

After that, it's time to relax and enjoy the Delta Leonid meteor shower. Burning through our atmosphere at speeds of up to 24 kilometers per second, these slow travelers will seem to radiate from a point around the middle of Leo's "back." The fall rate is rather slow at around 5 per hour, but they are still worth keeping a watch for!

FEB 27
TUESDAY

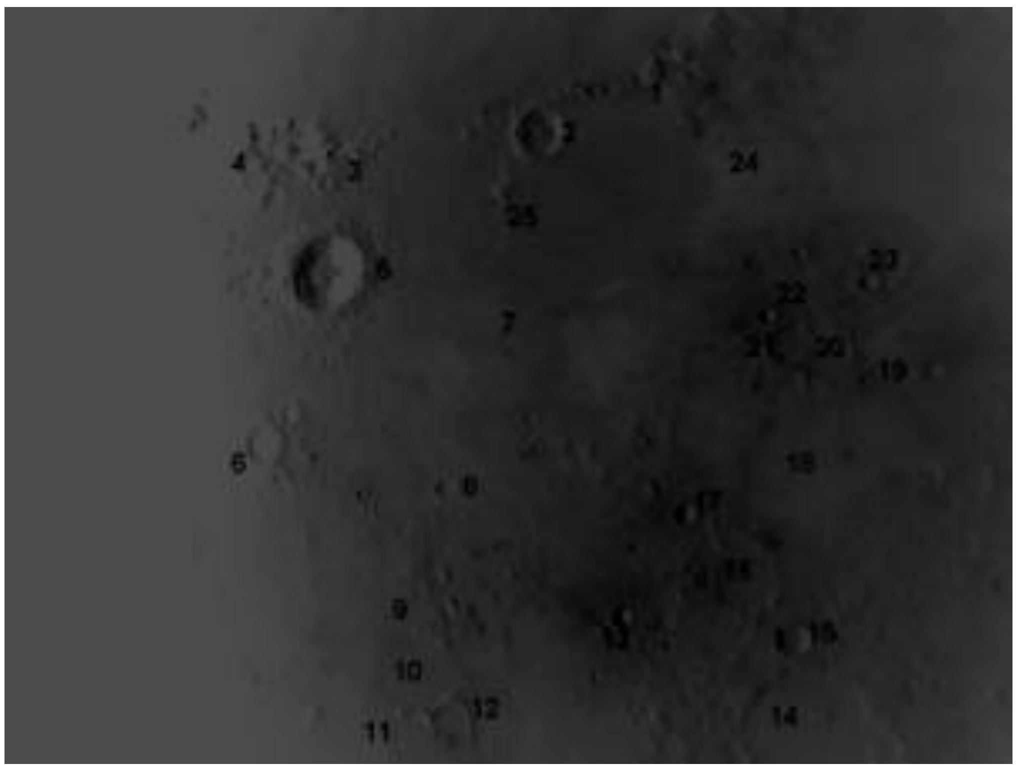
Bernard Lyot
(widely used public image)

Today is the birthday of Bernard Lyot. Born in 1897, Lyot went on to become the inventor of the coronagraph in 1930. By all accounts, Lyot was a wonderful and generous man who sadly died of a heart attack when returning from a trip to view a total eclipse.

Tonight's bright skies are brought to you by the Moon! Have you noticed how difficult it is to see any stars belonging to Monoceros with these conditions? Don't worry. We'll be back. For now, let's continue onwards with our lunar studies as we locate the emerging "Sea Of Islands."

Mare Insularum will be partially revealed tonight as one of the most prominent of lunar craters—Copernicus—now comes into view. While only a small section of this reasonably young mare is now visible southeast of Copernicus, the lighting will be just right to spot its many different colored lava flows. To the northeast is a lunar club challenge: Sinus Aestuum. Latin for the Bay of Billows, this mare-like region has an approximate diameter of 290 kilometers, and its total area is about the size of the state of New Hampshire. Containing almost no features, this area is low albedo—providing very little surface reflectivity.

Now let's take a look and see what we can identify!



Copernicus Region
Image Credit: Greg Konkel
Annotation: Tammy Plotner

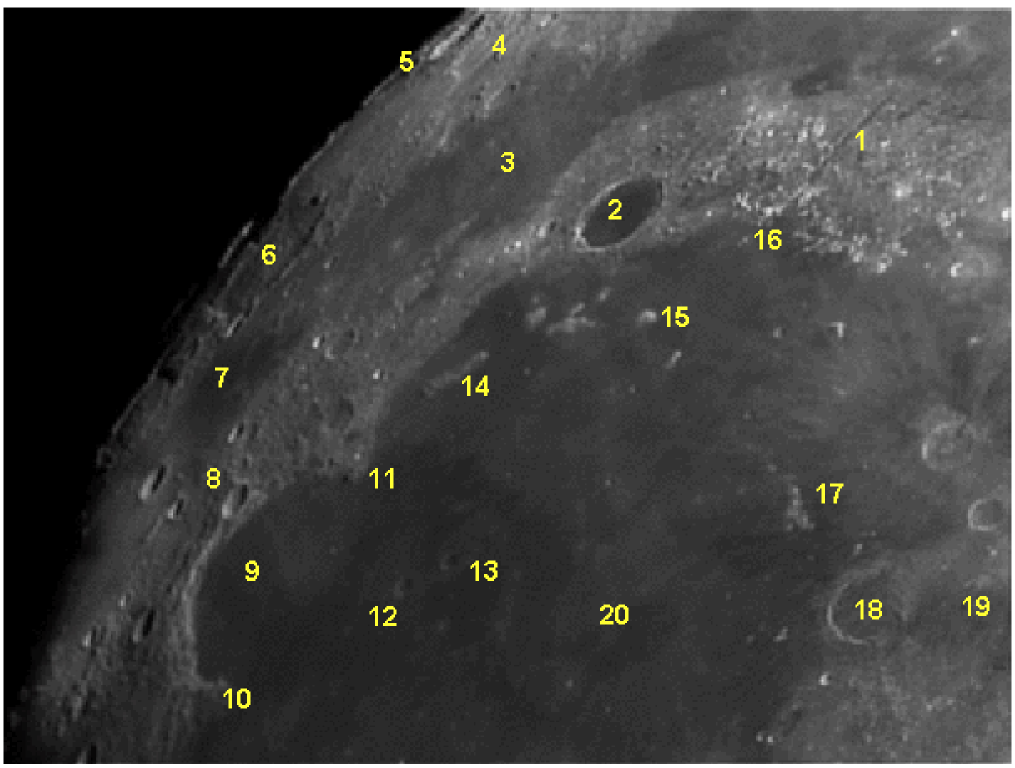
(1) Mons Wolf, (2) Eratosthenes, (3) Gay-Lussac, (4) Montes Carpatus, (5) Copernicus, (6) Reinhold, (7) Mare Insularum, (8) Gambart, (9) Apollo 14 landing site, (10) Frau Mauro, (11) Bonpland, (12) Parry, (13) Lalande, (14) Ptolemaeus, (15) Herschel, (16) Flammarion, (17) Mosting, (18) Sinus Medii, (19) Triesnecker, (20) Murchison, (21) Pallas, (22) Bode, (23) Ukert, (24) Sinus Aestuum, (25) Stadius

Happy Hunting!

With the Moon moving further east each night it has now passed Pollux and is headed towards Saturn. Even though it's not full yet, can you see the effect that it has on nearby stars? Now that it is further from Orion and Taurus, those primary stars are beginning to appear again—yet there are still none visible to the unaided eye in Monoceros. Even 4.6 magnitude Beta doesn't show!

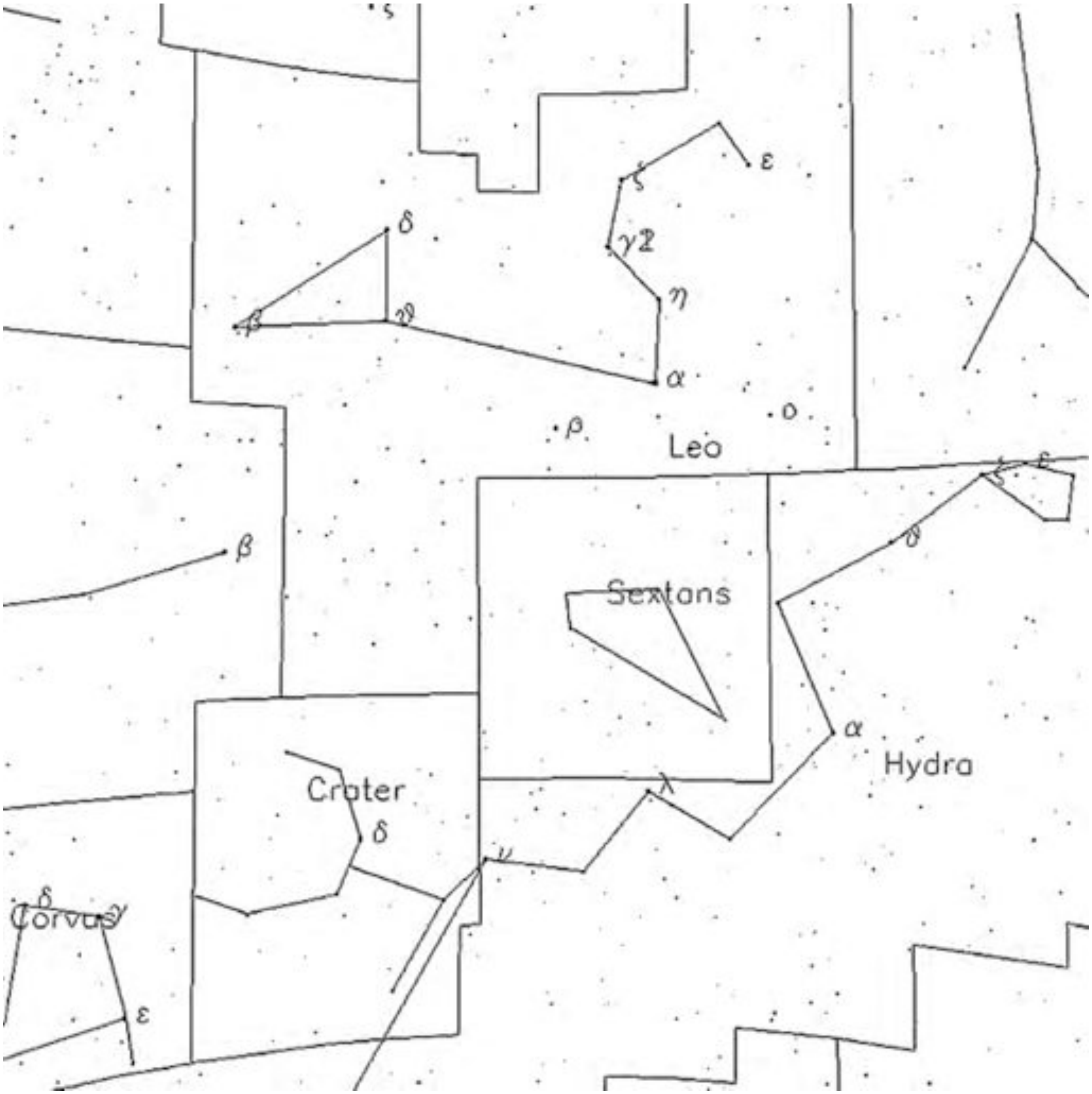
Tonight let's return again to the lunar surface to study how the terminator has moved and take a close look at the way features change as the Sun brightens the moonscape. Can you still see Langrenus? How about Theophilus, Cyrillus and Catharina? Does Posidonius still look the same? Each night features further east become brighter and harder to distinguish—yet they also change in subtle and unexpected ways. We'll look at that in the days ahead, but tonight let's walk the terminator as one of the most beautiful features has now come into view—"The Bay of Rainbows."

Sinus Iridum's C-shape is easily recognizable in even small binoculars—yet there are a wonderland of small details in and around the area for the small telescope that we'll study as the year goes by. Take the chart with you tonight and see how many of these features you can identify and add to your lunar challenges!

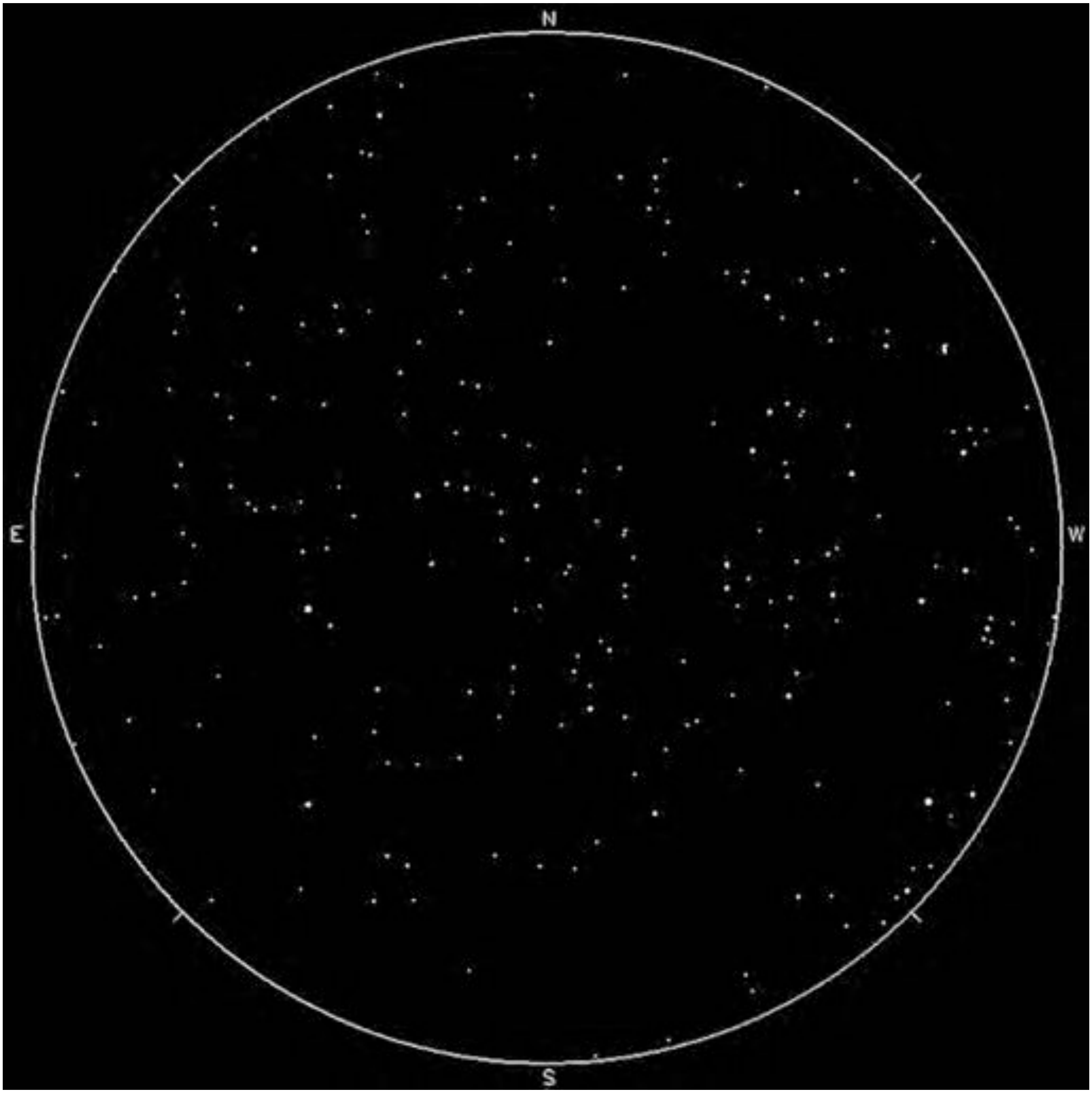


(1) Alpine Valley, (2) Plato, (3) Mare Frigoris, (4) Philolaus, (5) Anaximenes, (6) J. Herschel, (7) Sinus Roris, (8) Bianchini, (9) Sinus Iridum, (10) Promontorium Heraclides, (11) Promontorium LaPlace, (12) Helicon, (13) Leverrier, (14) Straight Range, (15) Mons Pico, (16) Mons Piton, (17) Montes Spitzbergen, (18) Archimedes, (19) Apollo 15 landing area, (20) Mare Imbrium

Iridum Region
Image Credit: Roger Warner
Annotation: Tammy Plotner


Leo
Sextans
Hydra
Crater
Corvus

MARCH 2007



MAR 1
THURSDAY

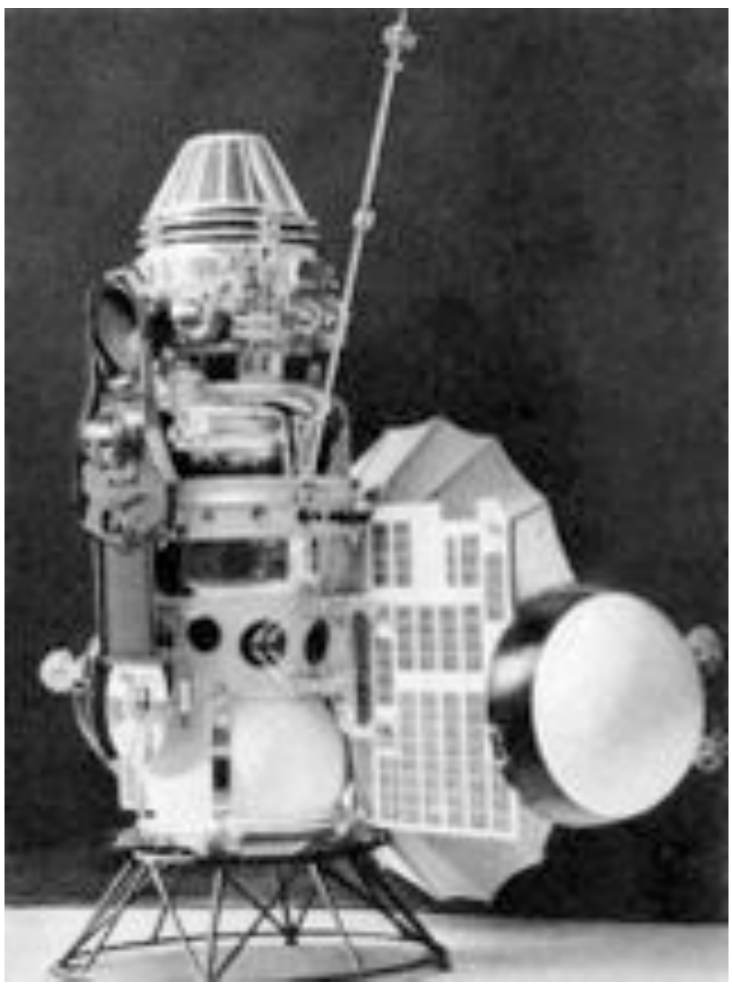
George Abell
(widely used image)

In 1966 Venera 3 became the first craft to touch another world as it impacted Venus. Although its communications failed before it could transmit data, it was a milestone achievement. If you're up before dawn, be sure to have a look a Venus and say Spaseba!

George Abell was born on this day in 1927. Abell was the man responsible for cataloging 2712 clusters of galaxies from the Palomar sky survey, which was completed in 1958. Using these plates, Abell put forth the idea that the grouping of such clusters distinguished the arrangement of matter in the universe. He developed the "luminosity function," which shows relationship between brightness and number of members in each cluster, allowing you to infer their distances.

Abell also discovered a number of planetary nebulae and developed the theory (along with Peter Goldreich) of their evolution from red giants. Abell was a fascinating lecturer and a developer of many television series dedicated to explaining science and astronomy in a fun and easy to understand format. He was also a president and member of the Board of Directors for the Astronomical Society of the Pacific, as well as serving in the American Astronomical Society, the Cosmology Commission of the International Astronomical Union, and he accepted editorship of the Astronomical Journal just before he died.

If you live in the Americas, be on alert tonight for the Moon occulting Saturn. This event crosses international date lines!!



Venera 3
Credit: NASA

Celestial Alert! Today is going to be very unusual as two occultation events are about to occur—one with Saturn, and the other with Regulus.

At roughly 02:21:00 UT a great many observers the world over will get a unique opportunity as the Moon slips over Saturn. While no special equipment is needed to see the event, binoculars will allow you to see the bright planet right up until the last second. For telescope users, here's an opportunity you won't want to miss.

Many observers will use this opportunity to spot an exterior ring on Saturn, while others will take critical timings to better understand the Moon's topography and position. If conditions are right, you may even get to see one of the "Ring King's" satellites occulted as well.

Did you know you can take pictures with very little practice and even with a disposable camera? This method is called "parfocal," and can be done with any 35mm camera—or a camcorder! Focus for 20/20 vision in a wide field, low power eyepiece and circle your thumb and index finger around the top of the barrel taking care not to touch the interior lens. Then "mate" the camera lens to the eyepiece, hold as steady as possible—and shoot! The results can sometimes be very astonishing. For camcorders, this is exceptionally pleasing because you can use both the focus and zoom of the camera to get more details.

An occultation of Saturn is well worth trying!

At roughly 22:00 UT, Regulus will also be occulted—making this a very rare event and a great deal more dependent on your location. Be very sure to check IOTA information which will give precise times and locations for your area. You won't want to miss it!

Moon occulting Saturn
Credit: NASA

MAR 3
SATURDAY

Tonight will be another astronomical celebration as western Australia, Asia, Europe, Africa and the Americas have an opportunity to view a total lunar eclipse with totality lasting one hour and fourteen minutes. Be aware this event crosses international date lines and those in the Far East will see this occur in the early morning hours of March 4 as the Moon is setting. Viewers more centrally located, such as those in Africa and western Europe will have a view of the entire eclipse, while the eastern Americas will see it in progress as the Moon rises. For observers in the western portions of the Americas, you will see the event ending as the Moon rises in your location.

While it might not seem like a big deal, a total lunar eclipse is a wonderful example of the precision of orbital paths. The relationship between the Sun, Earth and Moon now become apparent as our satellite passes through our cone of shadow—instead of just above or just below. A round body, such as a planet, casts a shadow "cone" through space. When it's at Earth, the cone is widest at 13,000 kilometers in diameter, yet by the time it reaches the Moon it has narrowed to only 9,200 kilometers. Considering the distance to the Moon is 384,401 kilometers, that's hitting a very narrow corridor in astronomical terms!

Regardless of whether or not you can experience the whole event, there is something very wonderful about viewing an eclipse and watching the clockwork movements of orbit. It is both enlightening and spiritual.

Enjoy this peaceful experience...

Total Lunar Eclipse
Credit: Tammy Plotner

MAR 4
SUNDAY

In 1835, Giovanni Schiaparelli opened his eyes for the very first time and opened ours with his accomplishments! As the director of the Milan Observatory, Schiaparelli (and not Percival Lowell) was the fellow who popularized the term "Martian canals" somewhere around the year 1877. Far more importantly, Schiaparelli was the man who made the connection between the orbits of meteoroid streams and the orbits of comets almost eleven years earlier!

While the excitement of the last two days are going to be hard to best, let's use the very brief time before the Moon overpowers the sky and have a look about a fistwidth north-northwest of Sirius—for Beta Monocerotis.

Discovered by Sir William Herschel in 1781, Beta is perhaps one of the most outstanding triple systems in the sky, with each of its three bright, white components near equal magnitude. Residing about 100-200 light-years away, these identical spectral type stars are separated by no more than 400 AU and don't appear to have changed positions since measured by Struve in 1831.

Although you won't be able to split this system with binoculars, even a small telescope will pick apart their brilliancy and make Beta a star to remember!

Giovanni Schiaparelli
(widely used public image)

Beta Monocerotis
Credit: Palomar Observatory, courtesy of Caltech

MAR 5
MONDAY

Today is the birthday of Gerardus Mercator, famed mapmaker, who started his life in 1512. Mercator's time was a rough one for astronomy, but despite a prison sentence and the threat of torture and death for his "beliefs," he went on to design a celestial globe in the year 1551.

Tonight we'll use both Sirius and Beta Monocerotis as our guides to have a look at one fantastic galactic cluster for any optical aid—M50. Hop about a fistwidth east-southeast of Beta, or northeast of Sirius...and be prepared!

Perhaps discovered as early as 1711 by G. D. Cassini, it was relocated by Messier in 1772 and confirmed by J. E. Bode in 1774. Containing perhaps as many as 200 members, this colorful old cluster resides almost 3000 light-years away. The light of the stars you are looking at tonight left this cluster at a time when iron was first being smelted and used in tools. The Mayan culture was just beginning to develop, while the Hebrews and Phoenicians were creating an alphabet. Do you wonder if it looked the same then as it does now?

In binoculars you will see an almost heart-shaped collection of stars, while telescopes will begin to resolve out color and many fainter members—with a very notable red one in its midst. Enjoy this worthy cluster and make a note that you've captured another Messier object!

Gerardus Mercator
(widely used public image)

M50
Credit: NOAO/AURA/NSF

If you get a chance to see sunshine today, then celebrate the birthday of Joseph Fraunhofer, who was born in 1787. As a German scientist, Fraunhofer was truly a "trailblazer" in terms of modern astronomy. His field? Spectroscopy!

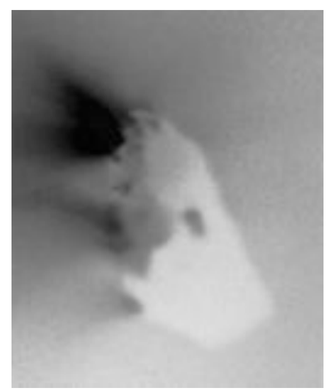
After having served his apprenticeship as a lens and mirror maker, Fraunhofer went on to develop scientific instruments, specializing in applied optics. While designing the achromatic objective lens for the telescope, he was watching the spectrum of solar light passing through a thin slit and saw the dark lines which make up the "rainbow bar code." Fraunhofer knew that some of these lines could be used as a wavelength standard so he began measuring. The most prominent of the lines he labeled with letters that are still in use today!

His skill in optics, mathematics and physics led Fraunhofer to design and build the very first diffraction grating which was capable of measuring the wavelengths of specific colors and dark lines in the solar spectrum. Did his telescope designs succeed? Of course! His work with the achromatic objective lens is the design still used in modern telescopes!

In 1986, the first of eight consecutive days of flybys began as VEGA 1 and Giotto became the very first spacecraft to reach Halley's Comet. Although there may not be a bright comet for us to observe tonight, we can have a look at a wonderful comet-shaped object that displays all the "blues" of Fraunhofer's work. You'll find it about 3 fingerwidths northeast of Epsilon, about 2 degrees northeast of star 13 in Monoceros.

NGC 2261 is more commonly known as "Hubble's Variable Nebula." Named for Edwin Hubble, this 10th magnitude object can be seen in smaller telescopes and is very blue in appearance to larger apertures. Its cometary shape isn't what's so unusual, but the variability of the nebula itself. The illuminating star—R Monocerotis does not display normal stellar spectrum and may be a protoplanetary system. R is usually lost in the high surface brightness of the structure of the nebula, yet the whole thing varies with no predictable timetable—perhaps due to dark masses shadowing the star.

Joseph Fraunhofer
(widely used public image)



Giotto image of Comet Halley's nucleus
Credit: NASA

Hubble's Variable Nebula
Credit: Carole Westphal and Adam Block/NOAO/AURA/NSF

MAR 7
WEDNESDAY

Today the only child of William Herschel (the discoverer of Uranus) was born in 1792—John Herschel. He became the first astronomer to thoroughly survey the southern hemisphere's sky, and he was discoverer of photographic fixer. Also born on this day, but in 1837, was Henry Draper—the man who made the first photograph of a stellar spectrum.

Before we leave the constellation of Monoceros, let's head about 5 degrees east-southeast of Alpha and pick up another Herschel 400 study object—NGC 2506. On a dark night, this is perhaps one of the most impressive of the Monoceros open clusters. Caught in a chain of stars, it displays a rich concentration, so it has been used to study old, metal poor galactic clusters. Its evolution has enriched its iron content, and despite its extreme age—it is still a beauty!

Take the time tonight to have a look at Delta Monocerotis with binoculars. Although it is not a difficult double star, it is faint enough to require some optical aid. If you are using a telescope, hop to Epsilon. It's a lovely yellow and blue system that's perfect for small apertures.

Tonight our Moon is at apogee and bright Spica will accompany it as it rises. For many observers, this could be an occultation, so be sure to check IOTA information.

John Herschel
(widely used public image)

Henry Draper
(widely used public image)

NGC 2506
Credit: Palomar Observatory, courtesy of Caltech

MAR 8
THURSDAY

On this day in 1977, the NASA airborne occultation observatory made a unique discovery—Uranus had rings!

Tonight let's head towards the upside-down Y of the constellation of Canis Major and pick up some studies while dark skies are in our favor. Our first destination lies about three fingerwidths south of brilliant Sirius and is viewable with any optical aid—and even without under dark skies!

Messier object 41 was recorded as far back as Aristotle's time in 325 BC. Since it resides at a distance of around 2350 light-years—the light you see tonight in fact came from the time of Aristotle! Hosting around 100 true members of various magnitudes, this open cluster is very bright and totally resolved to larger telescopes. Its central star is a K-type red giant and many blue giants can also be seen.

For the large telescope, head north about another three degrees to spot NGC 2283. This small, faint spiral galaxy has a bright nucleus and is very difficult to spot because it's involved with a small field of stars. Because Sirius is slightly more than a degree north, very good sky conditions are needed to spot this tough Herschel object!

M41
Credit: NOAO/AURA/NSF

NGC 2283
Credit: Palomar Observatory, courtesy of Caltech

MAR 9
FRIDAY

Today is also the anniversary of the Sputnik 9 launch in 1966 which carried a dog named Chernushka (Blackie). Also today we recognize the birth of David Fabricius. Born in 1564, Fabricus was the discoverer of the first variable star—Mira. Tonight let's start with an unusual variable star as we look at Beta Canis Majoris—better known as Murzim.

Located about three fingerwidths west-southwest of Sirius, Beta is a member of a group of stars known as quasi-Cepheids—stars which have very short term and small brightness changes. First noted in 1928, Beta changes no more than .03 in magnitude, and its spectral lines will widen in cycles longer than those of its pulsations.

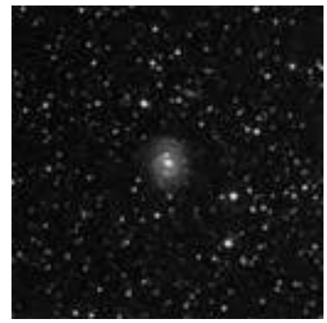
When you've had a look at Beta, hop another fingerwidth west-southwest for open cluster NGC 2204. Chances are, this small collection of stars was discovered by Caroline Herschel in 1783, but it was added to William's list. This challenging object is a tough call for even large binoculars and small telescopes, since only around a handful of its dim members can be resolved. To the larger scope, a small round concentration can be seen, making this Herschel study one of the more challenging. While it might not seem like it's worth the trouble, this is one of the oldest of galactic clusters residing in the halo and has been a study for "blue straggler" stars.

NGC 2204
Credit: Palomar Observatory, courtesy of Caltech

Since this is a weekend night, why not break out the big telescope and do a little galaxy hopping in the region south of Beta Canis Majoris.

Our first mark will be NGC 2207—a 12.3 magnitude pair of interacting galaxies. Located some 114 million light-years away, this pair is locked in a gravitational tug of war. The larger of the pair is NGC 2207, and it is estimated the encounter began with the Milky Way-sized IC 2163 about 40 million years ago. Like the M81 and M82 pair, NGC 2207 will cannibalize the smaller galaxy—yet the true space between the stars is so far apart that actual collisions may never occur. While our eyes may never see as grandly as a photograph, a mid-sized telescope will make out the signature of two galactic cores with intertwining material. Enjoy this great pair!

Now shift further southeast for NGC 2223. Slightly fainter and smaller than the previous pair, this round, low surface brightness galaxy shows a slightly brighter nucleus area and a small star caught on its southern edge. While it seems a bit more boring, it did have a supernova event as recently as 1993!



NGC 2223
Credit: Palomar Observatory, courtesy of Caltech

NGC 2207
Credit: Thalia and Norman Terrell/Adam Block/NOAO/AURA/NSF

MAR 11
SUNDAY

If you're up before dawn this morning, be sure to have a look at the Moon. Beautiful, red Antares is less than a degree away and this could be an occultation event in your area! Today is also the birthday of Urbain Leverrier. Born in 1811, Leverrier predicted the existence of Neptune, leading to its discovery. While you're waiting for the occultation you can have a look at the lunar feature named for him. No feature on the Moon will be more prominent than the "C" of Sinus Iridium, and just outside in Mare Imbrium even small telescopes can resolve Helicon to the north and Leverrier to the southeast.

Tonight let's return to Canis Major with binoculars and have a look at Omicron 1, the western-most star in the central Omicron pair. While this bright, colorful gathering of stars is not a true cluster, it is certainly an interesting group.

For larger binoculars and telescopes, hop on to Tau northeast of Delta and the open cluster NGC 2362. At a distance of about 4600 light-years, this rich little cluster contains about 40 members and is one of the youngest of all known star clusters. Many of the stars you can resolve have not even reached main sequence yet! Still gathering themselves together, it is estimated this stellar collection is less than a million years old. Its central star, Tau, is believed to be a true cluster member and one of the most luminous stars known. Put as much magnification on this one as skies will allow—it's a beauty!

Urbain Leverrier
Credit: NASA

NGC 2362
Credit: Palomar Observatory, courtesy of Caltech

Tonight let's return again to NGC 2362 and start at the cluster's north-northeast corner to have a look at a single, unusual star—UW Canis Majoris. At magnitude 4.9, this super-giant spectroscopic binary is one of the most massive and luminous in our galaxy. Its two stars are separated by only 27 million kilometers (17 million miles_ and revolve around each other at a frenzied pace— in less than four and a half days. This speed means the stars themselves are flattened and would appear to be almost egg-shaped. The primary itself is shedding material that's being collected by the secondary star.

Now drop southwest of NGC 2362 for another open cluster—NGC 2354. While at best this will appear as a small, hazy patch to binoculars, NGC 2354 is actually a rich galactic cluster containing around 60 metal-poor members. As aperture and magnification increase, the cluster shows two delightful circle-like structures of stars, similar to a figure 8. Be sure to make a note... You've captured another Herschel 400 object!

NGC 2354
Credit: Palomar Observatory, courtesy of Caltech

MAR 13
TUESDAY

On this day in 1781, Uranus was discovered by William Herschel. Also on this day, in 1855, Percival Lowell was born in Boston. Educated at Harvard, Lowell went on to found the observatory which bears his name in Flagstaff, Arizona, and spent a lifetime studying Mars. This morning, you can honor Lowell by seeing Mars yourself before sunrise. While there won't be a great many details, think of how many strides have been made since Lowell's time and how advanced our knowledge of Mars has become!

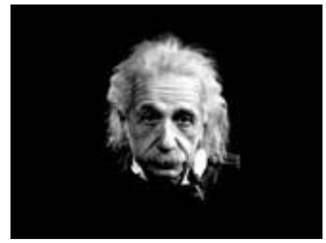
Tonight let's hop about four fingerwidths east-northeast of Sirius. Look for 5th magnitude SAO 152641 to guide you to a faint patch of stars in binoculars and a superb cluster in a telescope—NGC 2360. Comprised of around eighty 10th magnitude and fainter stars, this particular cluster will look like a handful of diamond dust scattered on the sky. Discovered by Caroline Herschel in 1783, this intermediate-aged galactic cluster is home to red giants and heavy in metal abundance. Mark your notes, because not only is this a Herschel object, but is known as Caldwell 58 as well!

Percival Lowell
(widely used public image)

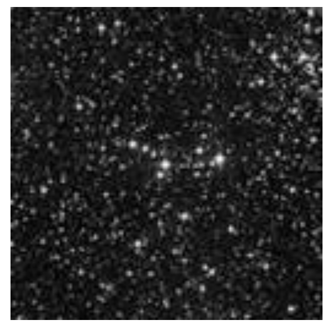
NGC 2360
Credit: Palomar Observatory, courtesy of Caltech

Today is the birthday of Albert Einstein. Born in 1879, Einstein was one of the finest minds of our times. He developed the theory of gravity in terms of spacetime curvature—dependent on the energy density. Winner of the 1921 Physics Nobel prize, Einstein's work on the photoelectric effect is the basis of modern light detectors.

Tonight let's hop about a fistwidth north of bright Eta Canis Majoris and have a look at a "double cluster"—NGC 2383 and NGC 2384. Just showing in binoculars as a faint patch, this pair will begin resolution with larger scopes. Studied photometrically, it would appear these fairly young clusters have contaminated each other by sharing stars—which has also occurred in some clusters located in the Magellanic Clouds. Enjoy this unusual collection of stars...



Albert Einstein
(widely used public image)



NGC 2384
Credit: Palomar Observatory, courtesy of Caltech

NGC 2383
Credit: Palomar Observatory, courtesy of Caltech

MAR 15
THURSDAY

Nicolas Lacaille
(widely used public image)

Today celebrates the birth of Nicolas Lacaille. Born in 1713, Lacaille's measurements confirmed the Earth's equatorial bulge. He also named fourteen southern constellations. To honor Lacaille tonight, let's begin some explorations in a constellation he named—Puppis!

For SkyWatchers living in high northern latitudes, you'll never see all of this constellation, but there will be some things for you to explore, as well as a great deal for our friends in the southern hemisphere. The first is a Herschel object that lies directly on the galactic equator around five degrees north-northwest of Xi.

NGC 2421 is a magnitude 8.3 open cluster that will look like an exquisitely tiny "Brocchi's Cluster" in binoculars and begin good resolution of its 50 or so members to an intermediate telescope, in an arrowhead-shaped pattern. It's bright, it's fairly easy to find, and it's a great open cluster to add to your challenge study lists!

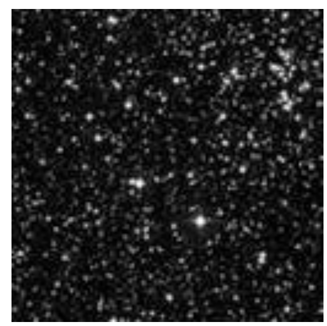
NGC 2421
Credit: Palomar Observatory, courtesy of Caltech

On this day in 1926, Robert Goddard launched the first liquid-fuel rocket. But he was first noticed in 1907 when a cloud of smoke issued from a powder rocket fired in the basement of the physics building in Worcester Polytechnic Institute. Needless to say, the school took an interest in the work of this shy student. Thankfully they did not expel him, and thus began his lifetime of work in rocket science. Goddard was also the first to realize the full implications of rocketry for missiles and space flight, and his lifetime of work was dedicated to bringing this vision to realization. While most of what he did went unrecognized for many years, tonight we celebrate the name of Robert H. Goddard. This first flight may have gone only 12 meters, but forty years later on the date of his birth, Gemini 8 was launched, carrying Neil Armstrong and David Scott into orbit!

Tonight we'll pick up a challenge cluster and a planetary nebula on the Herschel list by returning to NGC 2421 and hopping about a fingerwidth northeast for NGC 2432. This small, loose open cluster is rather dim and contains around 20 or so faint members shaped like the letter B. About another degree northeast is NGC 2440—an elongated, small 11th magnitude planetary nebula. Look for its central star to cause a brightening and up the magnifying power to reveal it.

While out, be on watch for the Corona-Australids meteor shower. While the fall rate is low—5 to 7 per hour—our friends in the southern hemisphere might stand a chance with this one!

Robert Goddard
Credit: NASA



NGC 2432
Credit: Palomar Observatory, courtesy of Caltech

NGC 2440
Credit: Palomar Observatory, courtesy of Caltech

MAR 17
SATURDAY

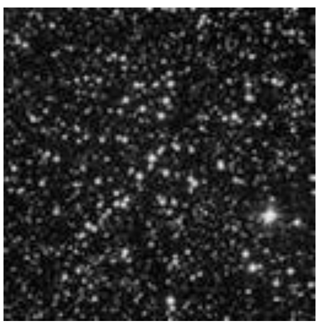
If you're up before dawn this morning, Mercury will be about 1 degree north of Moon. This could be an occultation from your area, so be sure to check IOTA!

On this day in 1958, the first solar-powered spacecraft was launched. Named Vanguard 1, it was an engineering test satellite. From its orbital position, the data taken from its transmission helped to redefine the true shape of the Earth.

Tonight let's return to Xi Puppis and head less than a fingerwidth east-northeast for Herschel study NGC 2482. At magnitude 7, this small fuzzy spot in binoculars will resolve into around two dozen stars to the telescope. Look for the diagonal chain of stars along its edge.

Now drop about two fingerwidths south of Rho Puppis for another! NGC 2527 is much larger and brighter, as well as more compressed. It shows to binoculars as "just on the edge" of resolution, and splits nicely with mid-aperture telescopes. Look for around three dozen stars that range slightly in magnitude and appear in chains.

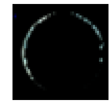
Vanguard 1
Credit: NASA



NGC 2482
Credit: Palomar Observatory, courtesy of Caltech

NGC 2527
Credit: Palomar Observatory, courtesy of Caltech

MAR 18
SUNDAY



Although you can't see it with just your eyes, Uranus is less than a degree from the Moon this morning. For some areas this could be an occultation, so be sure to check IOTA information!

Today in 1965, the first ever spacewalk was performed by Alexei Leonov onboard the Soviet Voskhod spacecraft. The "walk" only lasted around 20 minutes and Alexei had problems in re-entering the spacecraft because his space suit had enlarged slightly. Imagine his fear as he had to let air leak out of his space suit in order to squeeze back inside. When they landed off target in the heavily forested Ural Mountains, the crew of two had to spend the night in the woods surrounded by wolves. It took over twenty-four hours before they were located and workers had to chop their way through the forest and recover them on skis. Brave men!

Tonight let's honor them by studying a small area which contains not only three Herschel objects—but two Messiers as well—M46 and M47. You'll find them less than a handspan east of Sirius and about a fistwidth north of Xi Puppis.

Alexei Leonov
Credit: NASA

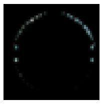
The brighter of the two clusters is M47 and at 1600 light-years away, it's a glorious object for binoculars. It is filled with mixed magnitude stars that resolve fully to aperture with the double Struve 1211 near its center. While M47 is in itself a Herschel object, look just slightly north (about a field of view) to pick up another cluster which borders it. At magnitude 6.7, NGC 2423 isn't as grand, but it contains more than two dozen fairly compressed faint stars with a lovely golden binary at its center.

Now return to M47 and hop east to locate M46. While this star cluster will appear to be fainter and more compressed in binoculars, you'll notice one star seems brighter than the rest. Using a telescope, you'll soon discover the reason. 300 million year old M47 contains a Herschel planetary nebula known as NGC 2438 in its northern portion. The cluster contains around 150 resolvable stars and may involve as many as 500. The bright planetary nebula was first noted by Sir William Herschel and then again by John. While it would appear to be a member of the cluster, the planetary nebula is just a little closer to us than the cluster. Be sure to mark your notes...There's a lot there in just a little area!

M48
Credit: NOAO/AURA/NSF

M47
Credit: NOAO/AURA/NSF

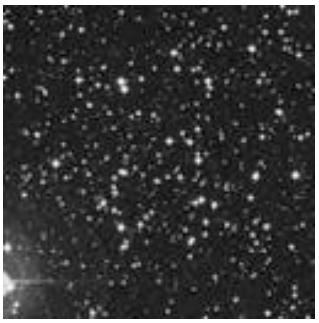
MAR 19
MONDAY



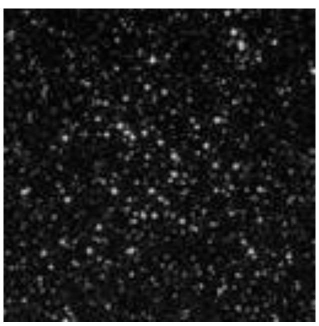
Heads up for viewers in Alaska and Asia! There will be a partial solar eclipse visible in your area on this universal date. Be sure to check www.mreclipse.com for information in your area. It's great fun to watch the Moon take a "bite" out of the Sun!

And if the Moon is between the Earth and the Sun, you know what that means... New Moon! Tonight we'll start in northern Puppis and collect three more Herschel studies as we begin at Alpha Monoceros and drop about four fingerwidths southeast to 19 Puppis.

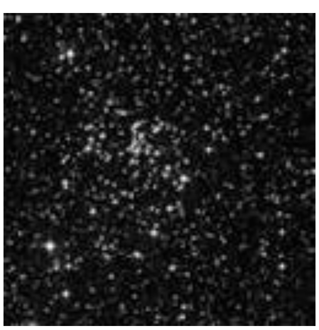
NGC 2539 averages around 6th magnitude and is a great catch for binoculars as an elongated hazy patch with 19 Puppis on the south side. Telescopes will begin resolution on its 65 compressed members, as well as split 19 Puppis—a wide triple. Shift about 5 degrees southwest and you find NGC 2479 directly between two finderscope stars. At magnitude 9.6 it is telescopic only and will show as a smallish area of faint stars at low power. Head another degree or so southeast and you'll encounter NGC 2509—a fairly large collection of around 40 stars that can be spotted in binoculars and small telescopes.



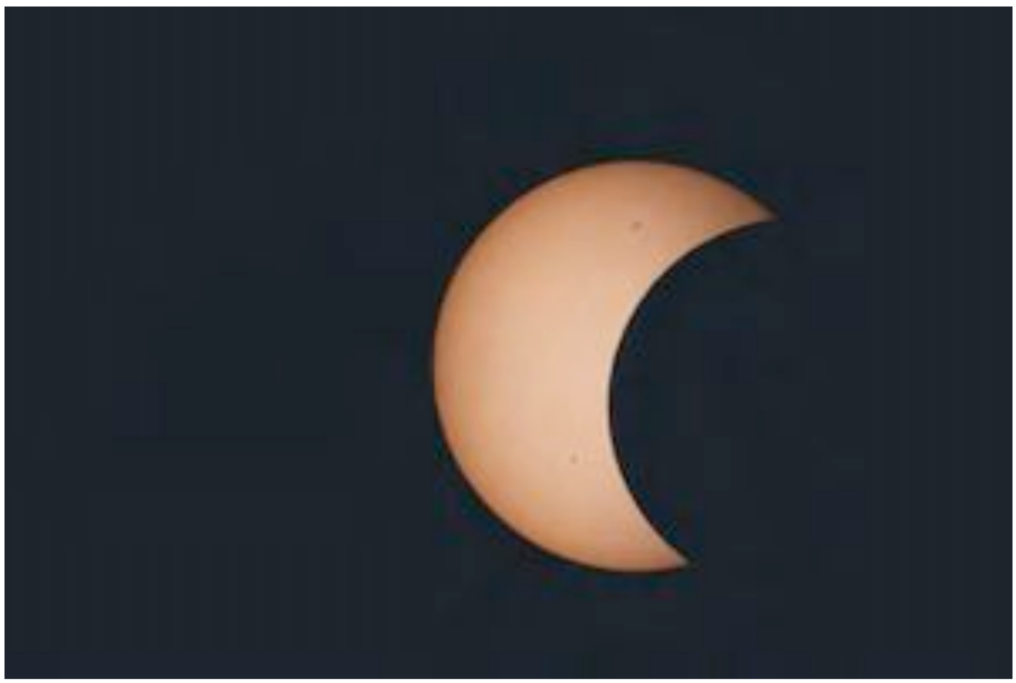
NGC 2539
Credit: Palomar Observatory, courtesy of Caltech



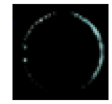
NGC 2479
Credit: Palomar Observatory, courtesy of Caltech



NGC 2509
Credit: Palomar Observatory, courtesy of Caltech



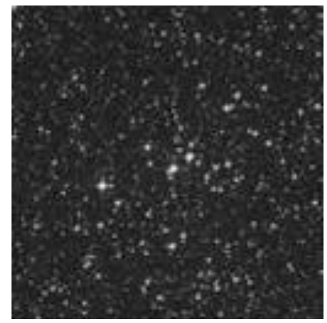
Partial Solar Eclipse
Credit: Tammy Plotner



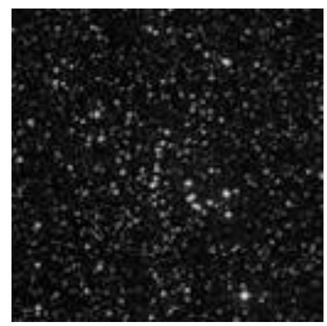
With the Moon still out of the picture, let's finish our study of the Herschel objects in Puppis. Only three remain, and we'll begin by dropping south-southeast of Rho and center the finder on a small collection of stars to locate NGC 2489. At magnitude 7, this bright collection is worthy of binoculars, but only the small patch of stars in the center is the cluster. Under aperture and magnification you'll find it to be a loose collection of around two dozen stars formed in interesting chains.

The next are a north-south oriented pair around 4 degrees due east of NGC 2489. You'll find the northernmost—NGC 2571—at the northeast corner of a small finderscope or binocular triangle of faint stars. At magnitude 7, it will show as a fairly bright hazy spot with a few stars beginning to resolve with around 30 mixed magnitude members revealed to aperture. Less than a degree south is NGC 2567. At around a half magnitude less in brightness, this rich open cluster has around 50 members to offer the larger telescope, which are arranged in loops and chains.

Congratulations on completing these challenging objects!



NGC 2571
Credit: Palomar Observatory, courtesy of Caltech



NGC 2567
Credit: Palomar Observatory, courtesy of Caltech

NGC 2489
Credit: Palomar Observatory, courtesy of Caltech

MAR 21
WEDNESDAY

Today is Vernal Equinox, one of the two times of the year that day and night become equal in length. From this point forward, the days will become longer—and our astronomy nights shorter! To the ancients, this was a time a renewal and planting—led by the goddess Eostre. As legend has it, she saved a bird whose wings were frozen from the winter's cold, turning it into a hare which could also lay eggs. If you would like to see two goddesses tonight, be sure to watch the western horizon as the Sun sets for the super slender crescent of Selene being accompanied by brilliant Venus.

What a way to usher in the northern spring!

Take your telescopes or binoculars out tonight to look just north of Xi Puppis for a celebration of starlight known as M93. Discovered in March of 1781 by Charles Messier, this bright open cluster is a rich concentration of various magnitudes that will simply explode in sprays of stellar fireworks in the eyepiece of a large telescope. Spanning 18 light-years of space and residing more than 3400 light-years away, it contains not only blue giants, but lovely golds as well. Jewels in the night…

M93
Credit: NOAO/AURA/NSF

MAR 22
THURSDAY

If you haven't had a chance to spot Mercury yet, be sure to have a look this evening just after the Sun sets. The swift inner planet has reached its greatest elongation for this apparition.

Today in 1799 Friedrich Argelander was born. He was a compiler of star catalogues, studied variable stars and created the first international astronomical organization. Tonight let's have a look at an object from an alternative catalog that was written by Lacaille, and which is about two fingerwidths south of Eta Canis Majoris.

Also known as Collinder 140, Lacaille's 1751 catalog II.2 "nebulous star cluster" is a real beauty for binoculars and very low power in telescopes. More than 50% larger than the Full Moon, it contains around 30 stars and may be as far as 1000 light-years away. When re-cataloged by Collinder in 1931, its age was determined to be around 22 million years. While Lacaille noted it as nebulous, he was using a 15mm aperture reflector, and it is doubtful that he was able to fully resolve this splendid object. For telescope users, be sure to look for easy double Dunlop 47 in the same field.

When the Moon has set, enjoy a spring evening with two meteor showers. In the northern hemisphere, look for the Camelopardalids. They have no definite peak, and a screaming fall rate of only one per hour. While that's not much, at least they are the slowest meteors—entering our atmosphere at speeds of only 7 kilometers per second!

Far more interesting to both hemispheres will be the March Geminids which peak tonight. They were first discovered and recorded in 1973 and then confirmed in 1975. With a much faster fall rate of about 40 per hour, these slower than normal meteors will be fun to watch! When you see a bright streak, trace it back to its point of origin. Did you see a Camelopardalid, or a March Geminid?

Friedrich Argelander
(widely used public image)

Collinder 140
Credit: Palomar Observatory, courtesy of Caltech

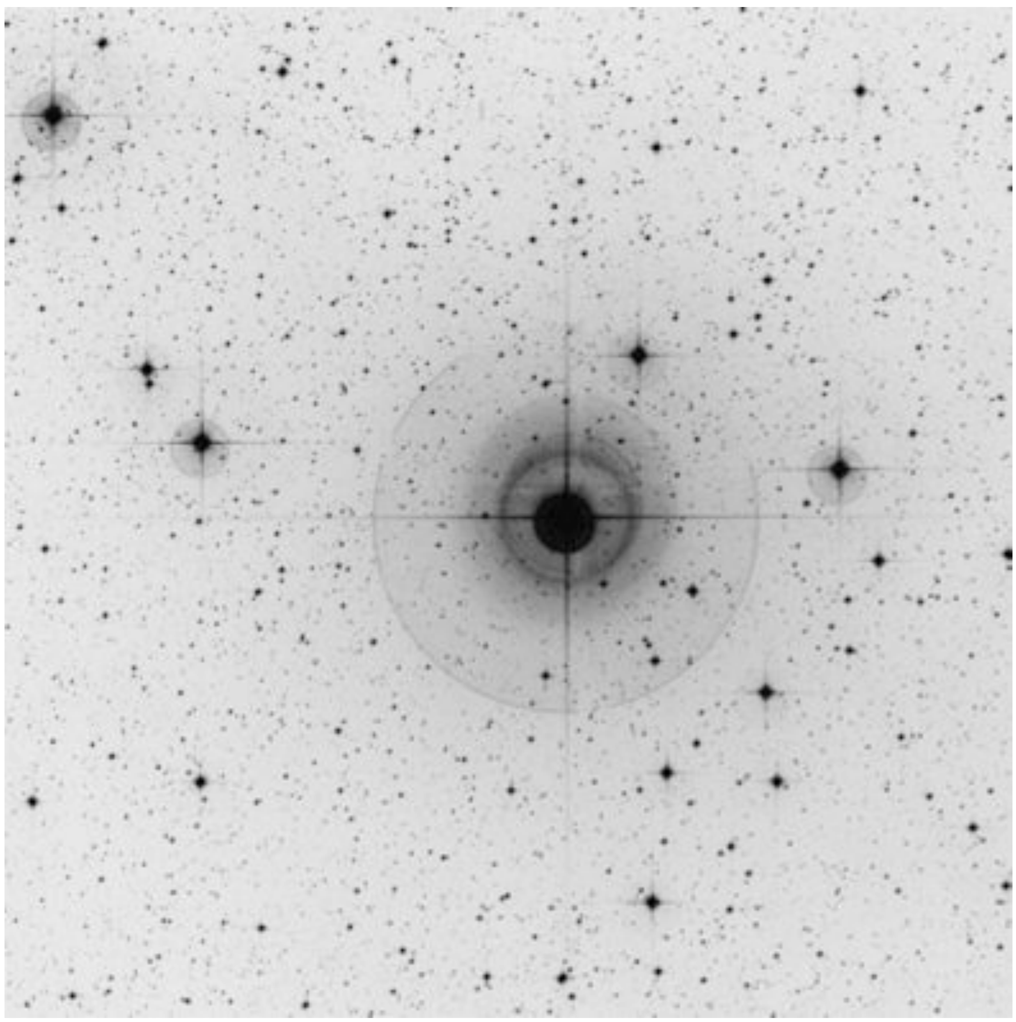
MAR 23
FRIDAY

J. W. Draper's daguerreotype
of the Moon
Courtesy of New York University

Today in 1840, the first photograph of the Moon was taken. The daguerreotype was exposed by American astronomer and medical doctor J. W. Draper. Draper's fascination with chemical responses to light also led him to another first—a photo of the Orion Nebula.

Before we chase the stars tonight, take the time to do a little lunar observing. Don't forget to look for crater Langrenus about midway along the Moon's crescent, and shallower and featureless Vendelinus south of it. Return to the Mare Crisium area and look for conspicuous crater Cleomides to its north. All three are lunar club challenges!

Before the Moon commands the sky, let's have a look at an object that's better suited for southern declinations—NGC 2451. As both a Caldwell object (Collinder 161) and a southern skies binocular challenge, this 2.8 magnitude cluster was probably discovered by Hodierna. Consisting of about 40 stars, its age is believed to be around 36 million years. It is very close to us at a distance of only 850 light-years. Take the time to closely study this object—for it is believed that due to the thinness of the galactic disk in this region, we are seeing two clusters superimposed on each other.



NGC 2451
Credit: Palomar Observatory, courtesy of Caltech

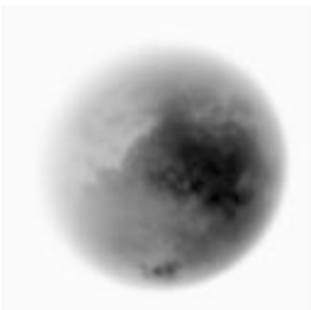
Today is the birthday of Walter Baade. Born in 1893, Baade was the first to resolve the Andromeda galaxy's individual stars using the Hooker telescope during World War II blackout times, and he also developed the concept of stellar populations. He was the first to realize that there were two types of Cepheid variables, thereby refining the cosmic distance scale. He is also well known for discovering an area towards our galactic center which is relatively free of dust, now known as "Baade's Window."

Tonight let's return to the Moon's wonderful surface and have a look at an ancient and ruined crater that lies on the southern shore of Mare Nectaris. To binoculars, it will look like a shallow, light colored ring, but a telescope will reveal that its northern wall is missing—perhaps melted away by the lava flow which formed the mare. This is all that remains of a once grand crater which was more than 117 kilometers in diameter. The tallest of its eroded walls still stand at an impressive 1758 meters, placing them as high as the base elevation of Mt. Hood, yet in areas nothing more than a few ridges and low hills still stand to mark its remains. Power up and look for interior craterlets. Be sure to mark your lunar observing challenge notes with your observations!

Walter Baade
(widely used public image)

Fracastorius
Credit: Wes Higgins

MAR 25
SUNDAY



Titan
Credit: NASA

Today in 1655, Titan—Saturn's largest satellite—was discovered by Christian Huygens. He also discovered Saturn's ring system during this same year. 350 years later, the probe named for Huygens stunned the world as it reached Titan and sent back information on this distant world.

Tonight we take on another lunar club challenge as we look mid-way along the terminator at the west shore of Mare Tranquillitatis for crater Julius Caesar. This is also a ruined crater, but it met its demise not through lava flow—but from a cataclysmic event. The crater is 88 kilometers long and 73 kilometers wide. Although its west wall still stands over 1200 meters high, look carefully at the east and south walls. At one time, something plowed its way across the lunar surface, breaking down Julius Caesar's walls and leaving them to stand no higher than 600 meters at the tallest.

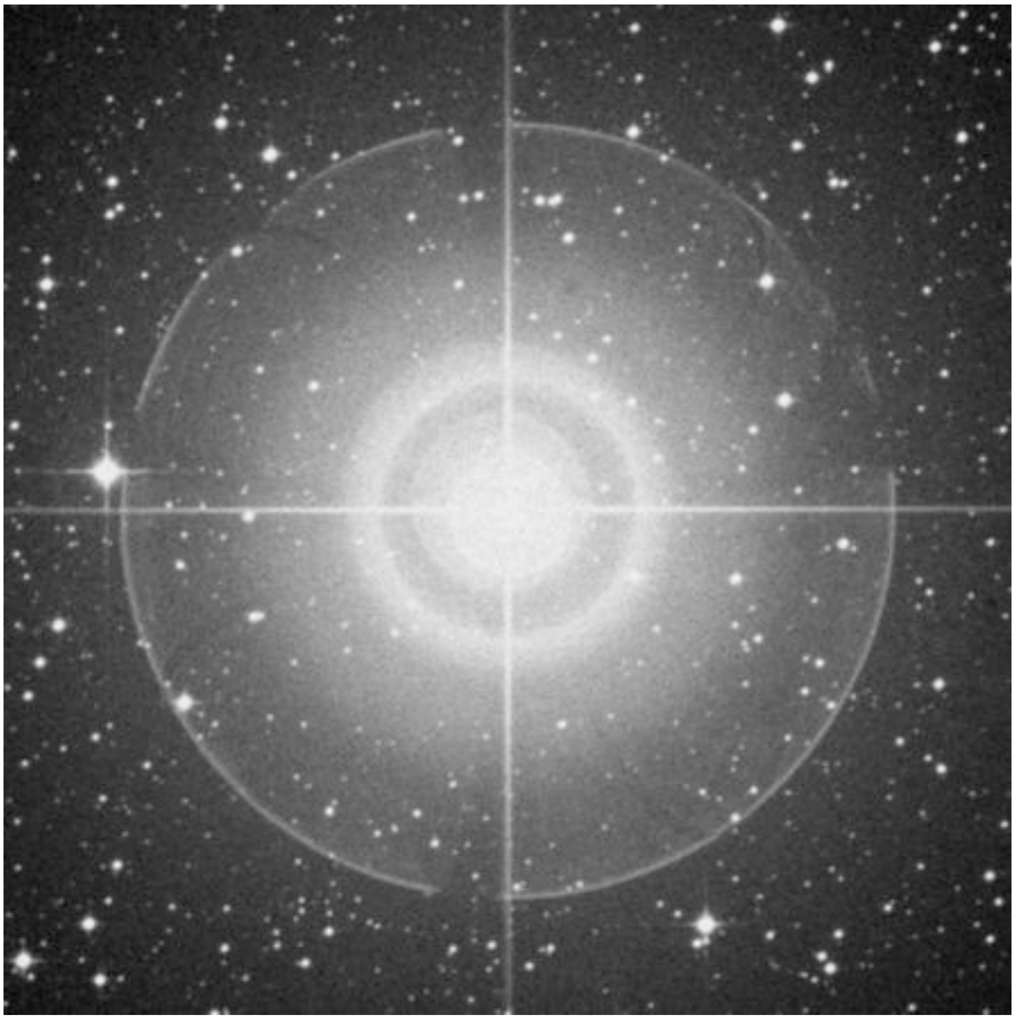
On this day in 1951, 21 cm wavelength radiation from atomic hydrogen in the Milky Way was first detected. 1420 MHz H I studies continue to form the basis of a major part of modern radio astronomy. If you would like to have a look at a source of radio waves known as a pulsar, then aim your binoculars slightly more than a fistwidth east of bright Procyon. The first two bright stars you encounter will belong to the constellation of Hydrus and you will find pulsar CP0 834 just above the northernmost—Delta.

Julius Caesar
Credit: Wes Higgins

Much like our crater from last night, tonight we we'll explore the lunar surface for another surface scar caused by a glancing blow. Head to the north near the terminator as the incredible Alpine Valley now comes into view.

Cutting its way through the lunar Alps with a width of 1.5 to 27 kilometers and stretching 177 kilometers long, it is possible this unusual feature formed naturally, but it is unlikely. Viewable through binoculars as a thin, dark line, telescopic observers at highest powers will enjoy a wealth of details around this area such as a crack that runs inside its boundaries. No matter how it came to be, it is a very unusual feature and a lunar club challenge. Catch it tonight!

While you're out, this would also be a good time to have a look at Epsilon Canis Majoris—a great double star. While its companion is quite disparate at roughly magnitude 8, the pair can be easily separated with a small telescope.

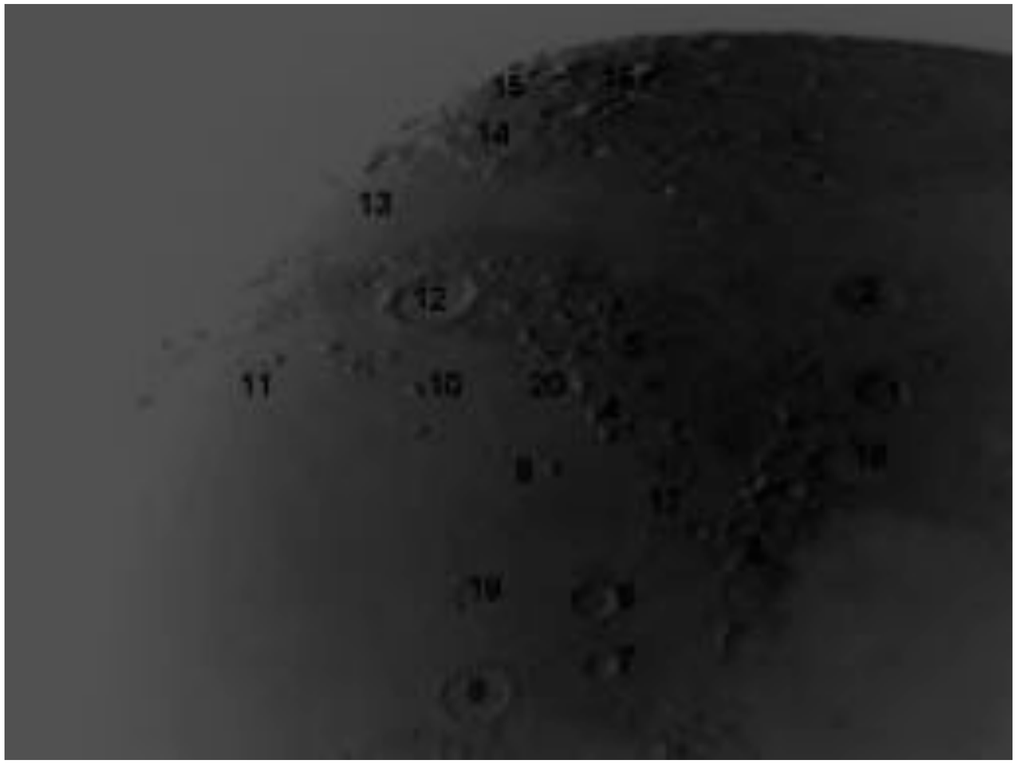


Epsilon Canis Majoris
Credit: Palomar Observatory, courtesy of Caltech

MAR 27
TUESDAY

Tonight as the skies darken, be sure to look for the bright star Pollux less than two fingerwidths away from the Moon.

Tonight the northern area of the Moon will offer up wonderful details to help you on your way to lunar studies. Last month we reviewed the south at this phase, so why don't we do the same for the north? Many of these features can be spotted in binoculars and are very easy with a telescope at mid-range magnifications. Let's have a look at...



Plato Region
Image Credit: Greg Konkel
Annotation: Tammy Plotner

(1) Eudoxus, (2) Aristotle, (3) Caucasus Mountains, (4) Lunar Alps, (5) Valles Alpes, (6) Aristillus, (7) Autolycus, (8) Archimedes, (9) Mons Piton, (10) Mons Pico, (11) Straight Range, (12) Plato, (13) Mare Frigoris, (14) W. Bond, (15) Barrow, (16) Meton, (17) Cassini, (18) Alexander, (19) Montes Spitzbergen, (20) Mons Blanc.

How many of these craters are lunar club challenges? Be sure to note your observations!

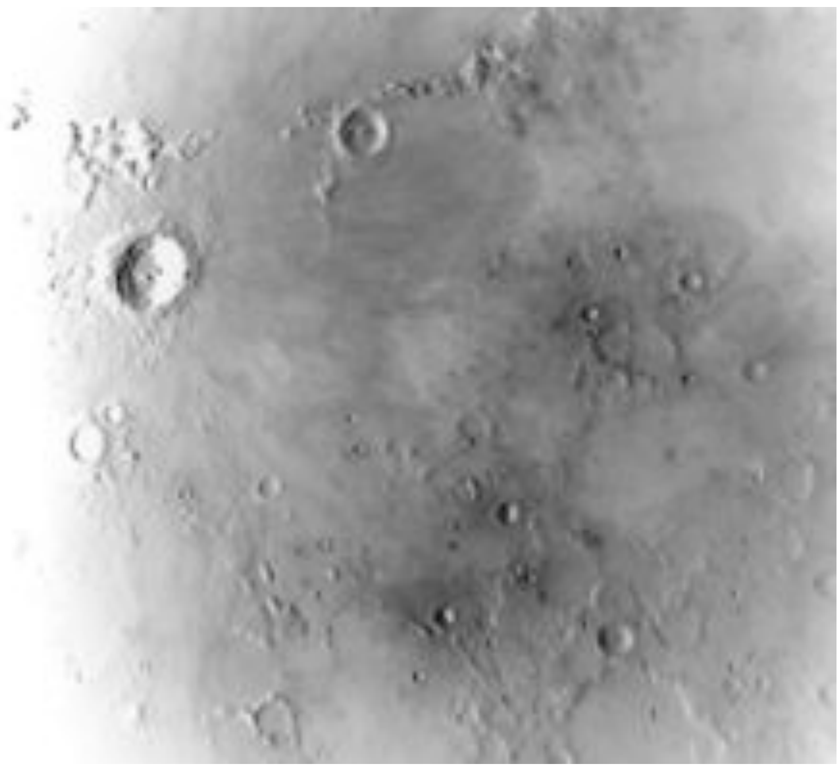
Born today in 1749, Pierre LaPlace was the mathematician who invented the metric system and the nebular hypothesis for the origin of the solar system. Also born on this day 1693 was James Bradley, an excellent astrometrist who discovered the aberration of starlight (1729) and the nutation of the Earth. And, in 1802, Heinrich W. Olbers discovered the second asteroid, Pallas, in the constellation Virgo while making observations of the position of Ceres, which had only been discovered fifteen months earlier. Five years later on this same date in 1807, Vesta—the brightest asteroid—was discovered by Olbers in Virgo, making it the fourth such object found.

Your assignment, should you choose to accept it, is to locate both Pallas and Vesta. Both are viewable before dawn—with Vesta quite near M107 and Pallas not far from Mars. While asteroid chasing is not for everyone, both are bright enough to be identified with just binoculars. Use a resource like heavens-above.com to get accurate locator charts and keep a record of spotting these solar system planetoids!

Keep in mind the name LaPlace as we'll look for an area on the lunar surface named for him tomorrow night. Tonight we want to have a look at the Moon with either telescopes or binoculars to reveal two excellent lunar club challenges that are easily identified—Eratosthenes and Copernicus. Be sure to note both features and we'll return in time to have a closer look at both of these incredible features.

Pierre LaPlace
(widely used image)

Asteroid Vesta
Credit: NASA



Eratosthenes and Copernicus
Credit: Greg Konkel

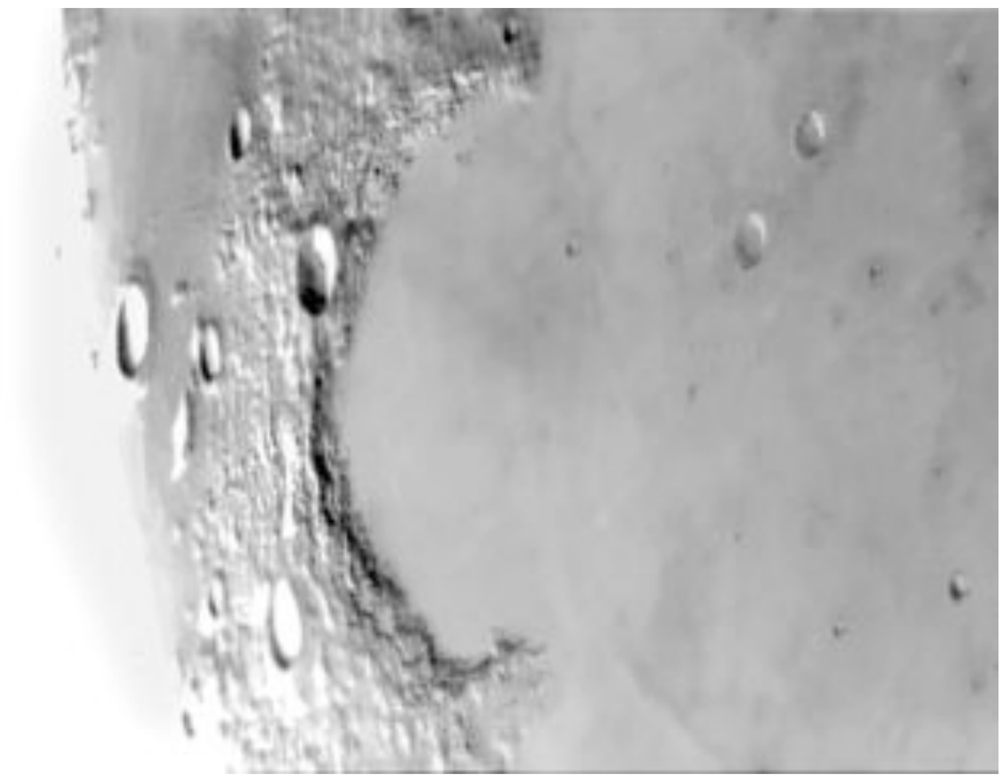
MAR 29
THURSDAY

Mariner 10
Credit: NASA

Today celebrates the first flyby of Mercury by Mariner 10 in 1974. Mariner 10 was unique. It was the first spacecraft to use a gravity assist from the planet Venus to help it travel on to Mercury. Due to the geometry of its orbit, it was only able to study half the surface, but its 2800 photographs gave us the knowledge that Mercury looks similar to our Moon, has an iron-rich core, a magnetic field, and a very thin atmosphere.

Before we have a look at the lunar surface, be sure to have a look at what's near! The planet Saturn is around 1 degree away from the Moon and this could be an occultation for your area. Be sure to check IOTA.

On the Moon, the terminator has now revealed the placid Sinus Iridum. The two features we will look closely at tonight are the Promontoriums which guard the opening of Iridum like two lighthouses. The easternmost is LaPlace, named for Pierre. Little more than 56 kilometers in diameter, it rises above the "Bay of Rainbows" some 3019 meters, making it almost identical to Buttermilk Summit at Aspen Park. Promontorium Heraclides covers roughly the same area, yet rises to little more than half of LaPlace's height. Both are telescopic lunar club challenges so be sure to mark your notes!

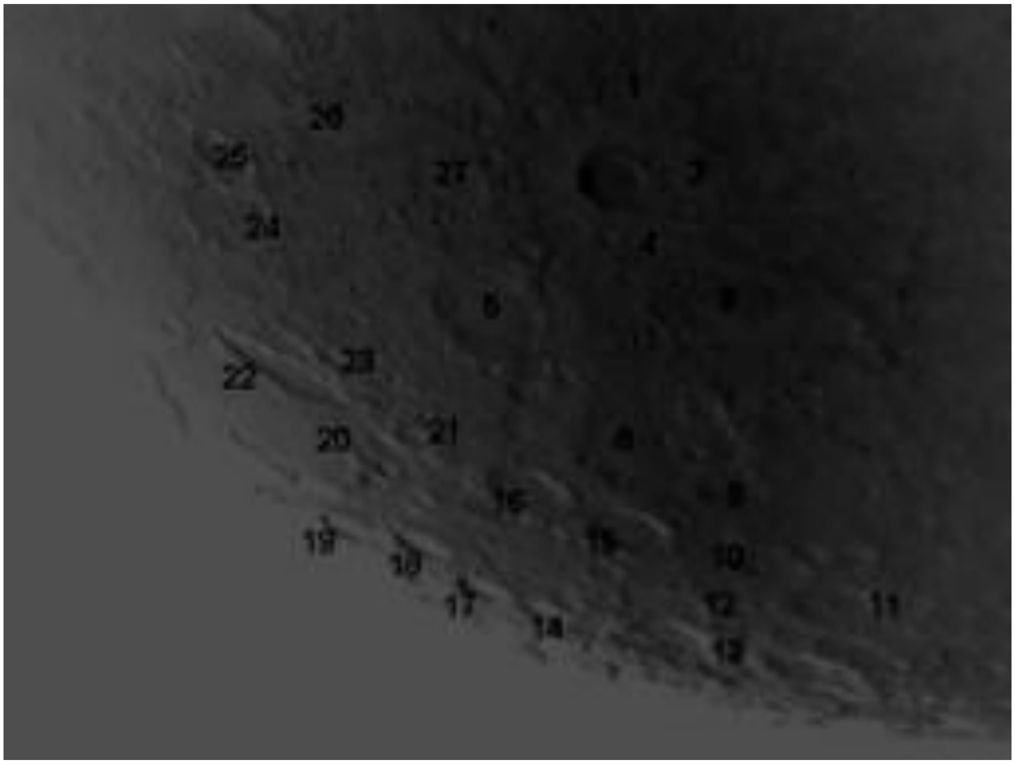


Sinus Iridum
Credit Roger Warner

MAR 30
FRIDAY

Tonight as the Moon rises, look for Regulus to have taken Saturn's place less than a degree away from the Moon. For some areas of the world, this could be an occultation, so be sure to check IOTA information.

Tonight it's time to walk the Southern Highlands again as crater Schiller comes into view. While Schiller itself is rather recognizable, as the Sun lights up the moonscape many craters change appearance as new ones become more dramatic. Let's take a look at what can be seen during this phase and how many you can identify!



Region around Schiller
Image Credit: Greg Konkel
Annotations: Tammy Plotner

(1) Sasserides, (2) Tycho, (3) Pictet, (4) Street, (5) Longomontanus, (6) Clavius, (7) Porter, (8) Rutherford, (9) Maginus, (10) Gruemberger, (11) Moretus, (12) Klaproth, (13) Casatus, (14) Wilson, (15) Blancanus, (16) Scheiner, (17) Kircher, (18) Bettinus, (19) Zucchius, (20) Segner, (21) Rost, (22) Schiller, (23) Bayer, (24) Mee, (25) Hainzel, (26) Lacus Timoris, (27) Wilson.

Best of luck and be sure to use this map whenever this area comes into view!

MAR 31
SATURDAY

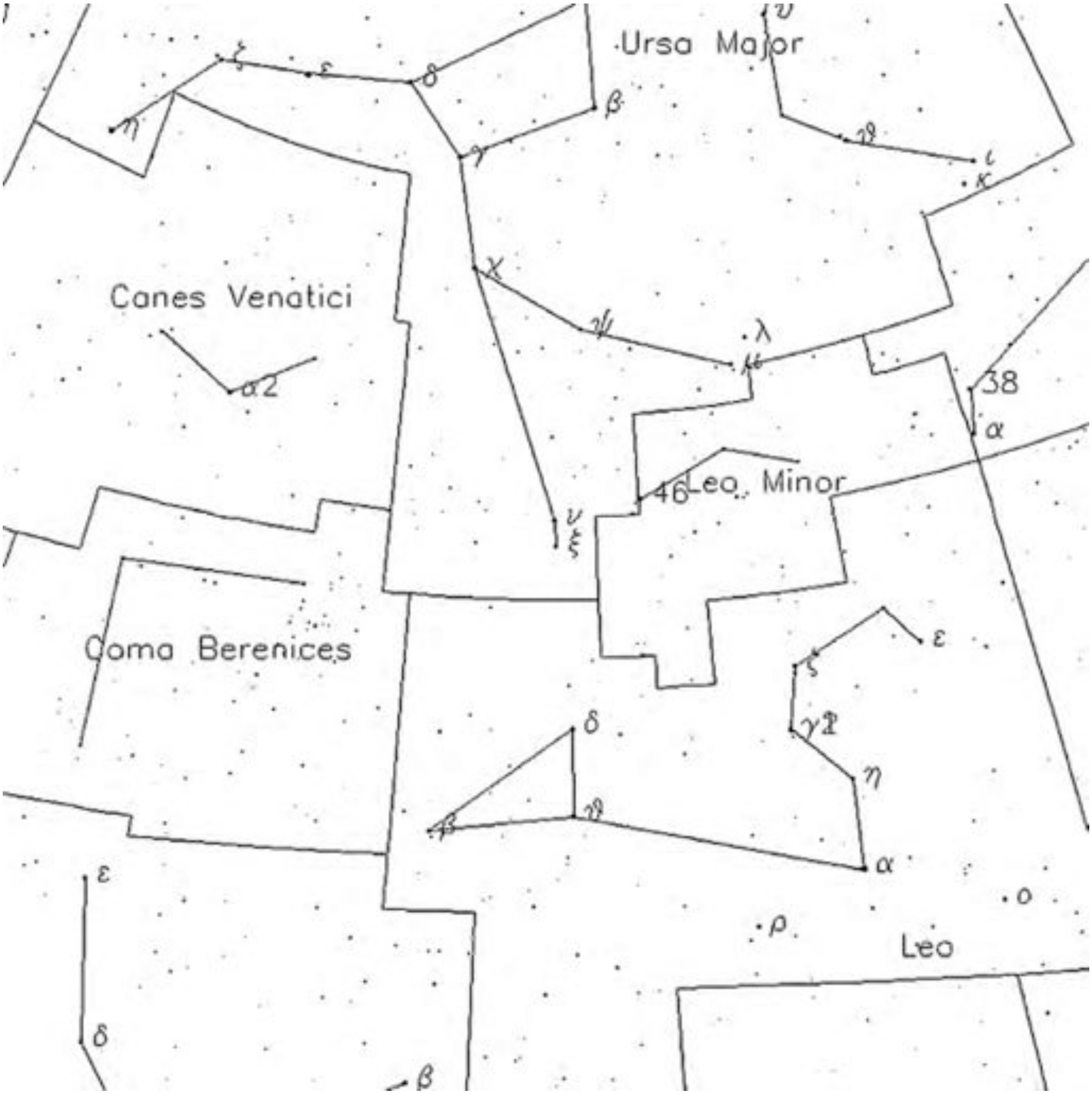
Although the Moon will be overpoweringly bright, be sure to have a look at its western edge for the dark oval of Grimaldi and the bright point of Kepler to its northeast.

Today in 1966, Luna 10 was on its way to the Moon. The unmanned, battery powered Luna 10 was a USSR triumph. Launched from an Earth orbiting platform, the probe became the first to successfully orbit another solar system body. During its 460 orbits, it recorded infrared emissions, gamma rays, and analyzed lunar composition. It monitored the Moon's radiation conditions—measuring the belts and discovering what eventually would be referred to as "mascons"—mass concentrations below maria surfaces which magnetically affect orbiting bodies.

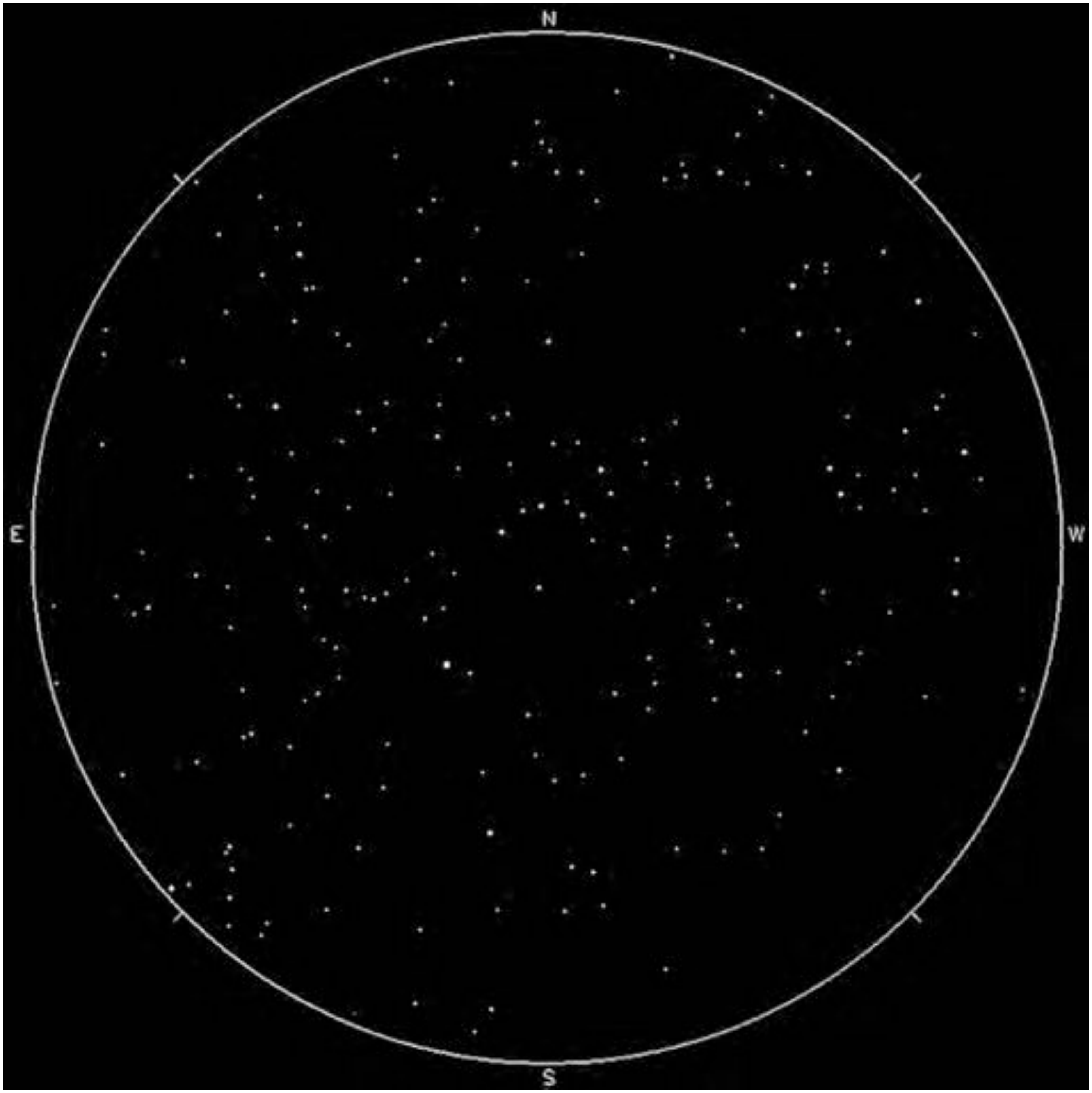
While the Moon will be nearly overpowering tonight, let's take a look at a pair of orbiting bodies as we head for Kappa Puppis—a bright double of near equal magnitudes. This one is well suited to northern observers with small telescopes. For the southern observer, try your hand at Sigma Puppis. At magnitude 3, this bright orange star holds a wide separation from its white 8.5 magnitude companion. Sigma's B star is a curiosity, because at a distance of 180 light-years it would be about the same brightness as our own Sun placed at that distance!

Luna 10
Credit: NASA

Sigma Puppis
Credit: Palomar Observatory, courtesy of Caltech


Ursa Major
Canes Venatici
Leo Minor
Coma Berenices
Leo
38
46
α2

APRIL 2007



APR 1
SUNDAY

Today in 1960, the first weather satellite—Tiros 1—was launched. While today we think of these types of satellites as commonplace, the Television InfraRed Observation Satellite was quite an achievement. Weighing in at 120 kilograms, it contained two cameras and magnetic tape recorders—along with an on-board battery supply and 9200 solar cells to keep them charged. While it only operated successfully for 78 days, for the first time ever we were able to see the face of the Earth's changing weather.

No matter how clear the skies are tonight, we're not going to be able to escape the Moon! So let's turn an eye towards an ever-changing planet—Saturn. Even a small telescope can resolve Saturn's rings, and at high magnification you can see significant details. Look for things like the broad Cassini division in the ring plane, as well as the shadow of the planet on the rings. Be sure to take note of Saturn's many moons as well! While Titan orbits well outside the rings and is bright enough to be noticed even in a small telescope, apertures of 4" or more can pick up the smaller moons which orbit close to the ring system. No matter how you choose to look at it, Saturn is one of the most mysterious and fascinating of our solar system's members.

First Earth Image from Space:
TIROS 1
Credit: NASA

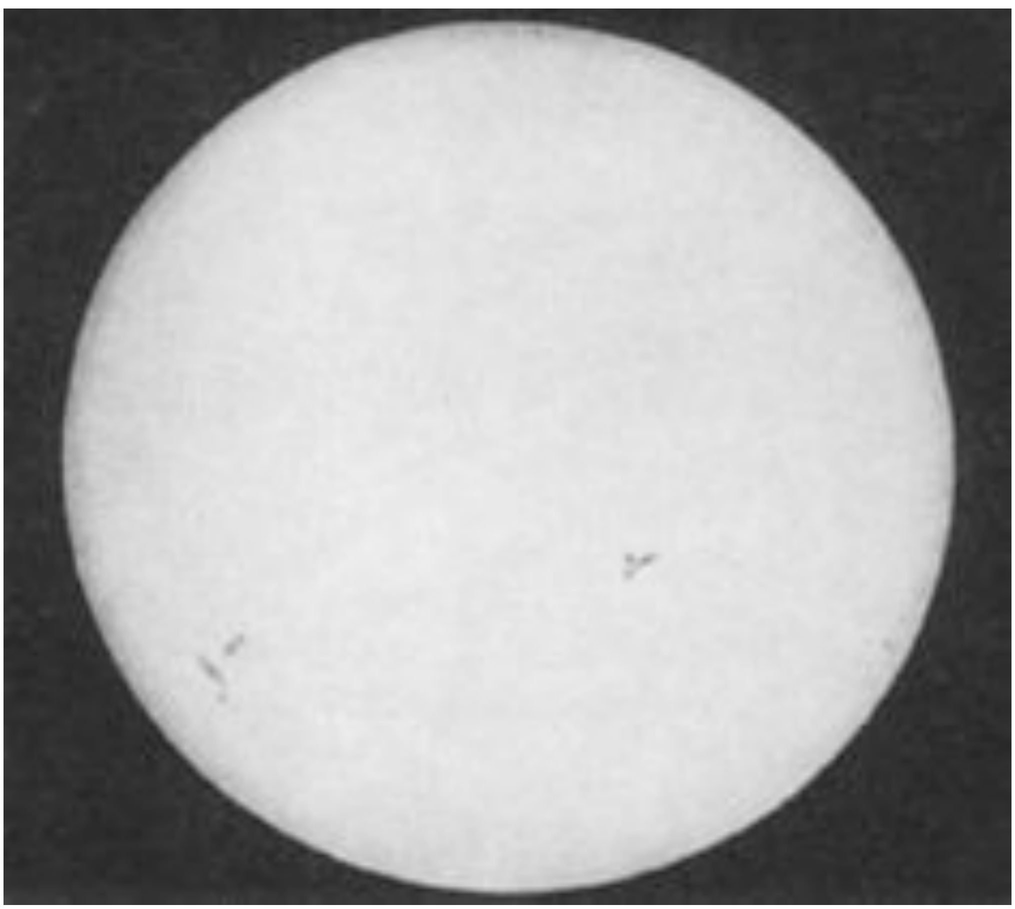
Saturn
Credit: Wes Higgins

Today in 1889, the Harvard Observatory's 13" refractor arrived at Mt. Wilson. Just one month later, it went into astronomical service at Lick Observatory, located at Mt. Hamilton. It was here that the largest telescopes in the world resided from 1908 to 1948. The 60" for the first decade, followed by the 100". This latter mirror is still the largest solid piece ever cast in plate glass and weighed 4.5 tons. Would you believe it's just 13 inches thick?

Today in 1845, the first photograph of the Sun was taken. While solar photography and observing is the domain of properly filtered telescopes, no special equipment is necessary to see some effects of the Sun—only the correct conditions. Right now Earth's magnetosphere and magnetopause (the point of contact) are positioned correctly to interact with the Sun's influencing interplanetary magnetic field (IMF)—and the plasma stream which flows past us as solar winds. During the time around equinox, this leaves the door wide open for one of the most awesome signs of spring—aurora! Visit the Geophysical Institute to sign up for aurora alerts and use their tools to help locate the position of the Earth's auroral oval.

The Hooker Telescope
Credit: NASA

Tonight's Full Moon is often referred to as the "Pink Moon" of April. As strange as the name may sound, it actually comes from the herb known as moss pink—or wild ground phlox. April is the time of blossoming and the "pink" is one of the earliest widespread flowers of the spring season. As always, this Moon is known by other names as well, such as the Full Sprouting Grass Moon, the Egg Moon, and coastal tribes referred to it as the Full Fish Moon. Why? Because spring was the season the fish swam upstream to spawn!



First photograph of the Sun
Credit: NASA

APR 3
TUESDAY

If you're up well before dawn this morning, be on alert as the Moon is within about one degree of Spica. For many parts of the world, this could mean an occultation, so be sure to check IOTA information!

With very little time before the Moon rises tonight, let's begin a new adventure as we move into the constellation of Cancer. This will be an ideal time to familiarize yourself with its dim stars and one very bright open cluster. Try using both Pollux and Procyon to form the base of an imaginary triangle. Now aim your binoculars or finderscope near the point of the apex to discover M44—the Beehive.

According to ancient lore, this group of stars (often called the Praesepe) foretold a coming storm if it was not visible in otherwise clear skies. Of course, this came from a time when combating light pollution meant asking your neighbors to dim their candles. But, once you learn where it's at, it can be spotted unaided even from suburban settings. Hipparchus called it the "Little Cloud," but not until the early 1600s was its stellar nature revealed.

Believed to be about 550 light-years away, this awesome cluster consists of hundreds of members—with at least four orange giants and five white dwarfs. M44's age is similar to that of the Pleiades, and it is believed that both clusters have a common origin. Although you won't see any nebulosity in the Beehive, even the very smallest of binoculars will reveal a swarm of bright stars and large telescopes can resolve down to 350 faint stars. Capture it tonight!

M44: The Beehive Cluster
Credit: NOAO/AURA/NSF

While you're out tonight, be on watch for the Kappa Serpentid meteor shower. Its radiant will be near the "Northern Crown," the constellation known as Corona Borealis. The fall rate is small with an average 4 or 5 per hour.

With a bit more time to spare before the Moon interferes, look again to identify the upside down Y of the constellation of Cancer. If you can spot M44, the star just south of it is Delta. About three fingerwidths southeast of Delta is Alpha, and we'll begin by exploring this star.

130 light-year distant Alpha Cancri—Acubens—is around 4th magnitude and is also a great double star for a small telescope. Its name translates as the "claw" and you will find it clutches a disparate 11.8 magnitude companion star nearby.

Now hop just one fingerwidth west for a stunning sight—galactic cluster M67. Hanging out in space some 2500 light-years away and containing more than 500 members, this grand cluster is a rule breaker in age. Believed to be about 10 billion years old, it is one of the oldest star clusters in our galaxy. Its stars have literally "switched off" from the main sequence, and have passed through the red giant stage and are returning back to their blue youth!

In binoculars you will see it as almost galaxy-like in structure, while even small telescopes resolve individual stars. Large telescopes will reveal stars beyond stars, like a globular cluster that has been smeared across the night. It is truly one of the most beautiful and mysterious of all open clusters.

M67
Credit: Nigel Sharp and Mark Hanna/NOAO/AURA/NSF

APR 5
THURSDAY

We'll return again tonight to Cancer to have a look at some curiosities. The first is about four fingerwidths away from Delta—Zeta Cancri. Its name is Tegmeni and it is a handsome double star for the small telescope. Both components are nearly the same magnitude and neatly split for mid-magnification ranges.

About a fingerwidth due east is V Cancri—a Mira-type variable star. While many such variables are difficult to follow with amateur equipment, V Cancri breaks the rules. It changes from magnitude 7.9 to magnitude 12.8 in a period of 125 days. When it swells to its maximum, it reaches a size about that of the orbit of Mars.

For those of you who use only your eyes to observe—look again at the Beehive and concentrate on Delta to the southeast. Known as Asellus Australis, this is a yellow optical double star often called the "southern donkey."

Delta Cancri
Credit: Palomar Observatory, courtesy of Caltech

Zeta Cancri
Credit: Palomar Observatory, courtesy of Caltech

APR 6
FRIDAY

The weekend has arrived at last and the early evening will buy us some time to do some galaxy hunting in Cancer. You'll find NGC 2672 just about a degree northeast of Delta.

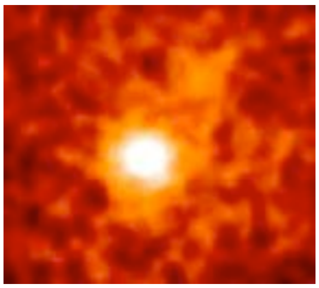
At magnitude 12.3, it's a galaxy meant for a larger scope. This small elliptical is noteworthy because it also has a companion—NGC 2673—on its eastern edge. Now we're entering the realm of 15th magnitude studies and very large telescopes only. Just slightly to the southwest, see if you can spot NGC 2677 as well. This one is extremely challenging.

If you're enjoying this small cluster of galaxies, move no more than a third of a degree west, or let the field drift. Your reward will be another galactic pair—NGC 2667. These are so close as to be in the same field at high power, and are designated as A and B galaxies. Be aware that they require very averted vision and they are among the most difficult of studies! Look for two almost stellar nuclei...

NGC 2667
Credit: Palomar Observatory, courtesy of Caltech

NGC 2672/73
Credit: Palomar Observatory, courtesy of Caltech

APR 7
SATURDAY



Quasar as seen in gamma rays
Credit: CGRO/NASA

Quasar 0839+187 (center of image)
Credit: Palomar Observatory, courtesy of Caltech

If you are up in the wee hours of the night, be sure to look for Antares extremely close to the Moon. This could be an occultation for some parts of the world, so be sure to check IOTA information.

Today in 1991, the Compton Gamma Ray Observatory (CGRO) was deployed. While it may sound strange, this observatory sees the sky in gamma ray photons. These photons go off the edge of ultra violet—imperceptible to the human eye. Unfortunately, we can't study gamma rays from Earth because our atmosphere blocks it, but the CGRO has shown a universe beyond our direct comprehension.

If there were a place that we could choose to look at in gamma rays, Cancer would be prime. Riddled with quasars, this constellation has got to produce some amazing things! Have a look at a quasar for yourself tonight. You'll find 0839+187 about half a degree away from Delta Cancri. 0851+202 lies two degrees northeast and 3C215 is five degrees east-southeast. 3C212 and 3C208 are within two degrees north of Alpha, and are less than a degree apart, with radio source 3C208.1 in between them! While they will appear as nothing more than stellar points located in the center of the images, these are quite probably our only visual points of reference for the black holes at their hearts.

While you're out, watch for bright streaks belonging to the Delta Draconid meteor shower. Its radiant is near the Cepheus border. The fall rate is quite low with around 5 meteors per hour and your best chance is before the Moon rises!

Impression of CGRO in flight
Credit: NASA

APR 8
SUNDAY

If you are up before dawn this morning, be sure to have a look at the sky as Jupiter makes a very scenic appearance less than a fistwidth away from the waning Moon.

With tonight's dark skies, it's time to go Herschel hunting again as we take on spiral galaxy NGC 2775. You'll find it located roughly five degrees southeast of Alpha Cancri.

At magnitude 11.8, this elongated spiral with a bright core is suited to mid-sized telescopes. Some 60 million light-years away, NGC 2775 is a curious spiral galaxy. Its bulging core region and tight pattern of spiral arms have been home to five supernova events within the last 30 years.

For those with very large telescopes, there is a reason why NGC 2775 is an active region. To its northeast is NGC 2777, an amorphous galaxy with a tidally interacting, uncataloged companion—a situation which also exists in the more studied M81/82 system. NGC 2777 is producing a streamer of material flowing towards NGC 2775, yet the "companion" lies between them—possibly a galaxy in formation. Northeast is NGC 2773, which is far fainter, but still achievable with a large scope. Even if you only catch NGC 2775, you've not only captured another Herschel, but Caldwell 48 as well!

NGC 2775 and companions
Credit: Palomar Observatory, courtesy of Caltech

NGC 2775
Credit: Jeff Newton and Adam Block/NOAO/AURA/NSFa

APR 9
MONDAY

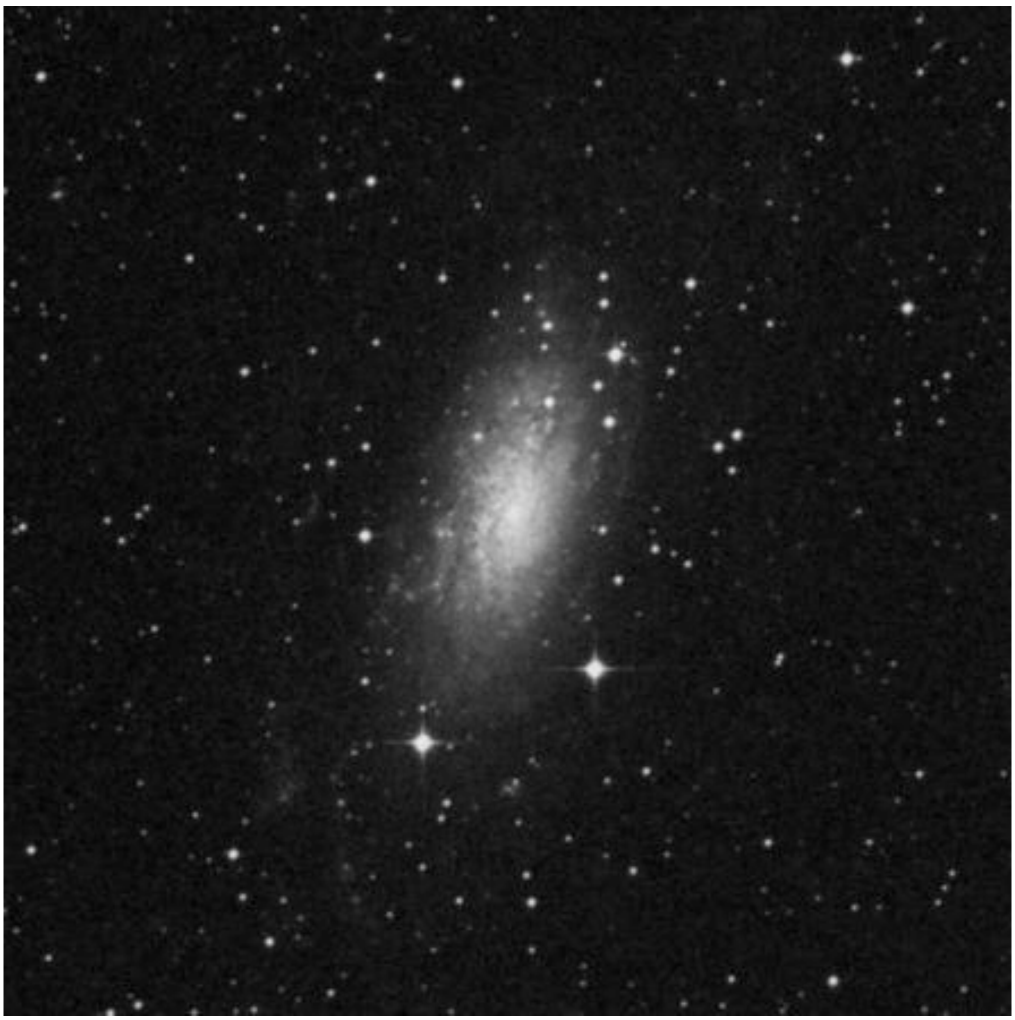
With a limited amount of time before the Moon returns, let's begin some work in the extended constellation of Hydra. To identify Alpha, try extending a full handspan southwest of Regulus. Our mark is NGC 2811 and it resides about a fistwidth southwest of Alpha Hydrae and just south of a parallelogram of finderscope stars.

As Herschel object H II 502, you'll find this 13th magnitude galaxy to be just within the grasp of mid-sized aperture. With a larger telescope you will discover it to be fairly direct, and elongated north to south. This galaxy with a bright core and a hint of a spiral arm had a supernova event as recently as 2005—but don't confuse the line of sight stars along its border with supernovae! While these faint beauties are not for everyone, spring is the season of galaxies.

NGC 2811
Credit: Palomar Observatory, courtesy of Caltech

Our next study will involve a more difficult star hop. For this one, it is best for those in northern observing locations to wait until the constellation of Corvus is fairly high in the south since the area we're studying is quite low. The marker star we will need is Xi Hydrae which is around a fistwidth southwest of Alpha Corvi. It will be the southwest corner of a line of five dim stars in this area. NGC 3621 is about four degrees west-southwest and will be just east of a triangle of finderscope stars.

Fortunately, Herschel H I 241 is a big, bright galaxy—one bright enough to be caught in large finderscopes and decent binoculars. Its elongated structure shows quite well and offers up a bright nucleus for even mid-sized telescopes. For large aperture, expect a pretty face-on spiral galaxy that shows some knots in its loose arms. At a distance of 22 million light-years, astronomers have used some of NGC 3621's brightest stars as standard candles. Now relax and enjoy the Virginid meteor shower. The radiant point will be near Gamma in the bowl of Virgo. The fall rate is above average at 20 per hour, and with the Moon out of the equation for awhile, we stand a good chance at catching a "falling star!"



NGC 3621
Credit: Palomar Observatory, courtesy of Caltech

APR 11
WEDNESDAY

William Campbell
(widely used public image)

Today is the birthday of William Wallace Campbell. Born in 1862, Campbell went on to become the pioneer observer of stellar motions and radial velocities. He was the director of Lick Observatory from 1901 to 1930 and he also served as president of the University of California and the National Academy of Sciences. Also born on this day, but in 1901, was Donald H. Menzel—assistant astronomer at Lick Observatory, Director of Harvard Observatory, expert on the Sun's coronosphere, and genuine UFO buff. Today in 1960, the first radio search for extraterrestrial civilizations was started by Frank Drake and named Project Ozma. In 1986, Halley's Comet was also closest to the Earth for this apparition and was at a distance of 65 million kilometers.

After such a grand day in history, it seems only fitting that we celebrate it with a grand object! Our mark lay due west of Alpha Crateris and can be found most easily by hopping northeast to Nu Hydrae, west past Phi 1 and 2, center on Mu and drop south less than 2 degrees.

Suitable for even small telescopes and larger binoculars, this handsome planetary nebula—NGC 3242—is often referred to as the "Ghost of Jupiter." For aperture at high power, this nebula comes alive with an inner star revealed and an eye-like ring structure. With high surface brightness, it will take all the magnification that sky conditions allow and return structure. Be sure to use averted vision to pick up many faint details in this incredible planetary nebula known as Herschel H IV 27 and Caldwell 59!

NGC 3242: The Ghost of Jupiter
Credit: Adam Block/NOAO/AURA/NSF

If you're up before dawn, the planet Uranus will be less than 2 degrees away from the Moon. This could mean an occultation, so check IOTA. Mars will also make a grand appearance less than 3 degrees away.

Today in 1961, Yuri Gagarin became the first man in space as he made one full orbit of the Earth aboard Vostok 1. And, in 1981, Columbia became the first Space Shuttle to be launched. Today also celebrates the 1851 date of Edward Maunder's birth—a bank teller turned assistant Royal Astronomer. Assigned to photographing and cataloging sunspots, Maunder was the first to discover solar minimum times and equate these with climactic change. Maunder was also the first to propose that Mars had no "canals," only delicate changes in surface features. Smart man!

For those working on planetary nebulae studies, here's a good one—NGC 2610 (RA 08 33 23.32 Dec -16 08 57.7) near the Hydra/Puppis/Pyxis border. At 13th magnitude, it's not for the beginner, but a worthy study for seasoned veterans. Its position near two 7th magnitude stars will help reveal its position at low power. Magnify to catch a slightly elliptical shell, a stellar point on its northeast edge and a wink of a central star. Note that this object is also cataloged as Herschel IV 65.

Edward Maunder
(widely used public image)

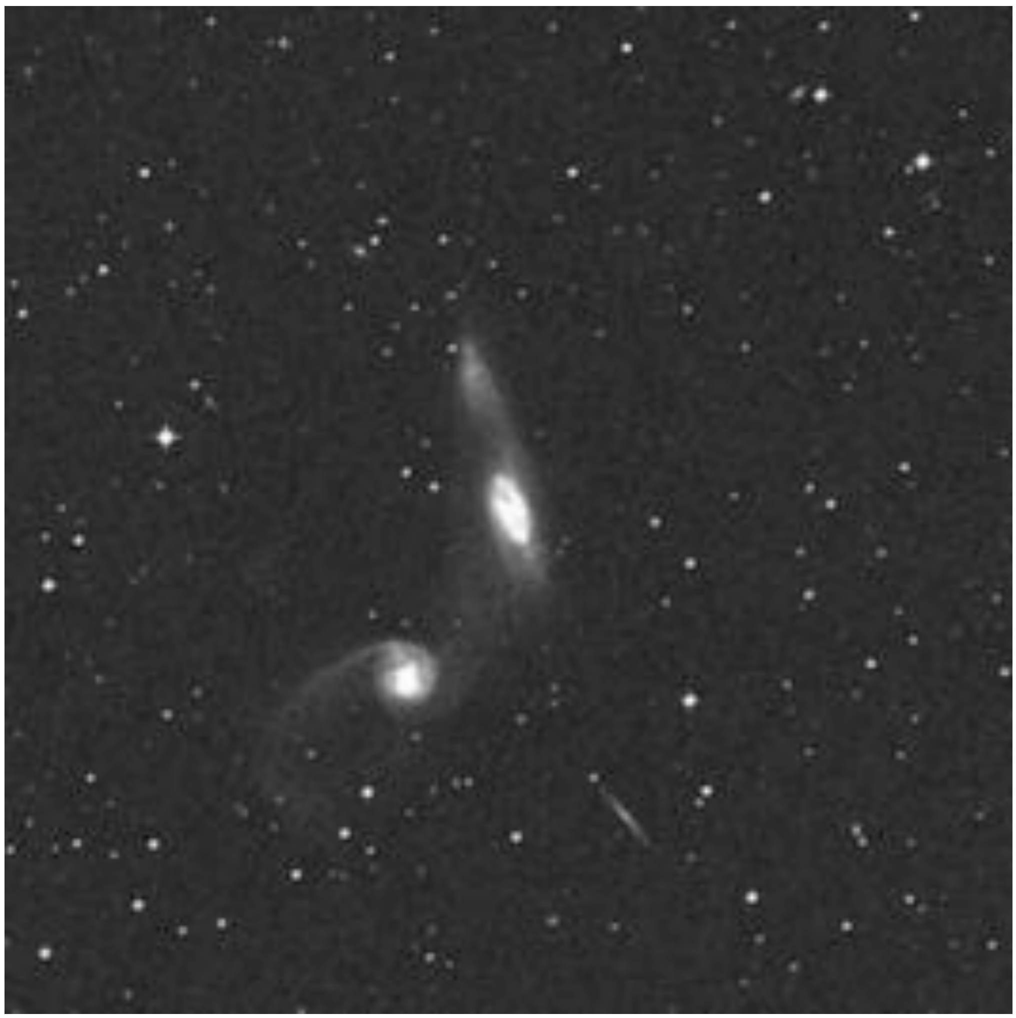
NGC 2610
Credit: Palomar Observatory, courtesy of Caltech

APR 13
FRIDAY

It's Friday night. You've got dark skies ahead and an itch to see something out of the ordinary with your telescope. If this is the case, then look no further than 2 degrees west of Upsilon Hydrae for unique galactic pair—NGC 2992/93.

At magnitude 13, these two small galaxies will show their core regions cleanly to mid-aperture telescopes but come to life in larger ones. NGC 2992 is a Seyfert type 2 galaxy that has a wisp that extends from its galactic plane—divided by a dust lane. It is surmised that an incredibly powerful stellar wind drives from the core of this galaxy, perhaps producing massive starbursts.

NGC 2992 is interacting with starburst galaxy NGC 2993 and they share mutual tidal forces. When they began to approach each other a "bridge" was created between the galactic nuclei in the form of ejected stars and gas—triggering violent star formation. Eventually this action will destroy their disc structure and they will merge to create a single elliptical galaxy.



NGC 2992/93
Credit: Palomar Observatory, courtesy of Caltech

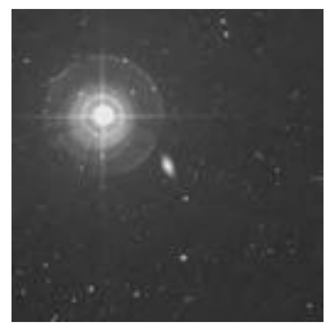
Today is the birthday of Christian Huygens. Born in 1629, the Dutch scientist went on to become one of the leaders in his field during the 17th century. Among his achievements were developing a theory of light and patenting the pendulum clock. And Huygens was the first to discover Saturn's rings and largest satellite—Titan.

While you're out enjoying great, dark, weekend skies, be sure to at least take a glance at Saturn and pay your respects to a man who was chasing photons some 380 years before us—and with equipment far more primitive. As you look at Titan, remind yourself of just much we've achieved since Chris' time!

This is also a wonderful chance to catch up on studies that you many have been clouded out on—as well as seasonal favorites from past years. If you're in the mood, turn an eye towards Lambda Hydrae, not only is this a beautiful collection of stars in binoculars, but it holds a surprise for the telescope as well. Power up to help darken the field and look for NGC 3145 to the primary star's southwest. Although it will take a mid-aperture telescope to make out the smooth, faint form of this spiral galaxy, it presents a wonderful challenge to larger scopes.

Saturn
Credit: Wes Higgins

Christian Huygens
(widely used public image)



NGC 3145
Credit: Palomar Observatory, courtesy of Caltech

APR 15
SUNDAY

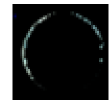
Did you spot the "Old Moon in the New Moon's Arms" this morning? While outside, keep a watch for the "April Fireballs." This unusual name has been given to what may be a branch of the complex Virginid stream which began earlier in the week. The absolute radiant is unclear, but keep your eyes on the ecliptic near Virgo. These bright bolides can possibly arrive in a flurry depending on how much Jupiter's gravity has perturbed the meteoroid stream. Even if you only see one tonight, keep watching in the days ahead. The April Fireballs will last for two more weeks!

Tonight we're off to study another Hershel object (H II 506) in Hydra that's a 7 degree drop south of Alpha—NGC 2907 (RA 09 31 42.1 Dec -16 44).

While it will require at least a mid-aperture telescope to reveal, this edge-on galaxy is quite worth the trouble. It's highly prized because of research on its dust extinction properties, which in some ways greatly resemble those of our own Milky Way galaxy. For larger telescopes, averted vision will call up a hint of a dark dustlane across a bright core. While it is neither particularly huge, nor particularly bright, it will present an interesting challenge for those with larger scopes looking for something a bit out of the ordinary.

NGC 2907
Credit: Palomar Observatory, courtesy of Caltech

APR 16
MONDAY

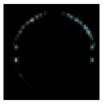


Before binocular observers begin to feel that we have deserted them, let's drop in on a binocular and very small telescope galaxy that resides roughly a handspan below Spica—M83. Starhop instructions are not easy for this one, but look for a pair of twin stars just west of the easily recognized "box" of Corvus—Gamma and R Hydrae. You'll find it about four fingerwidths further south of R.

As one of the brightest galaxies around, the "Southern Pinwheel" was discovered by Lacaille in 1752. Roughly 10 million light-years distant, M83 has been home to a large number of supernova events—one of which was even detected by an amateur observer. To binoculars it will appear as a fairly large, soft, round glow with a bright core set in a delightful stellar field. As aperture increases, so do details—revealing three well defined spiral arms, a dense nucleus and knots of stars. It is truly a beauty and will become an observing favorite!

M83
Credit: Bill Schoening/NOAO/AURA/NSF

APR 17
TUESDAY

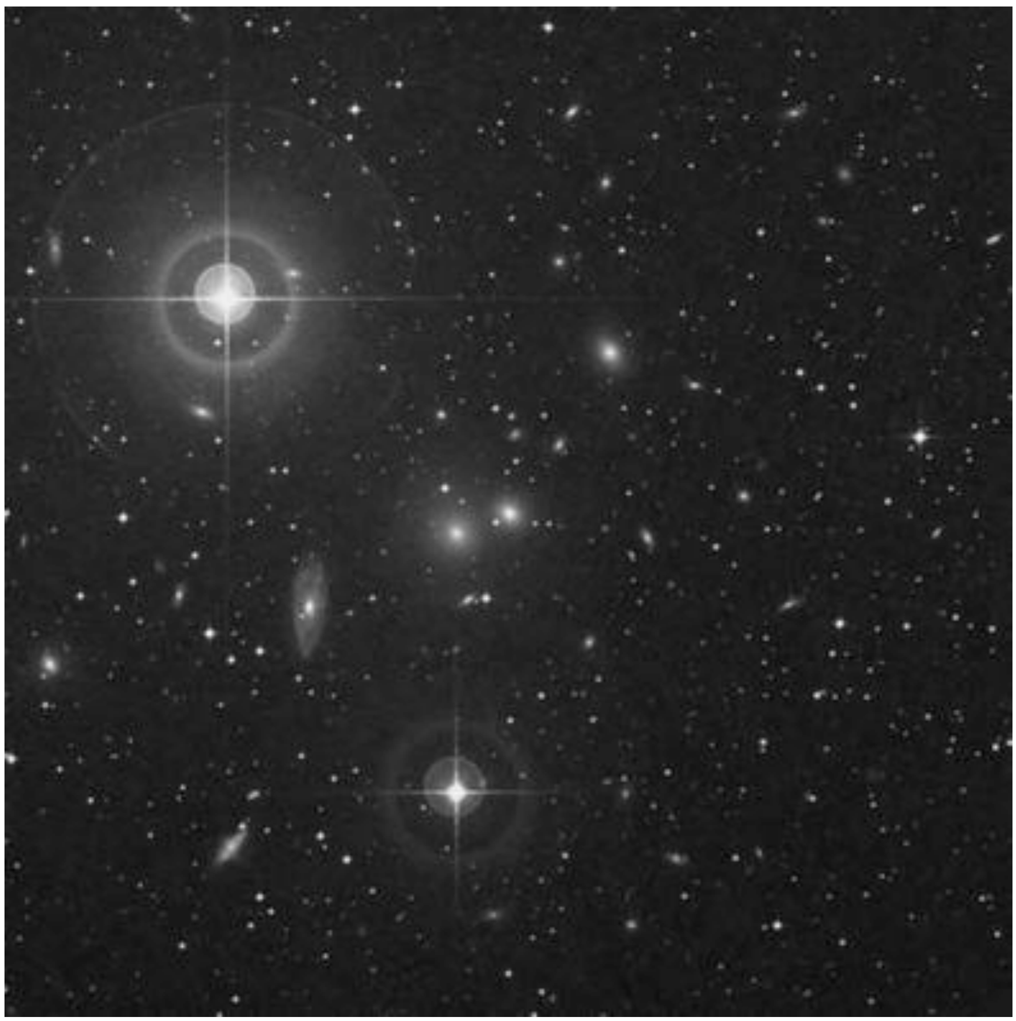


Today in 1976, the joint German and NASA probe Helios 2 came closer to the Sun than any other spacecraft so far. One of its most important contributions helped us to understand the nature of gamma ray bursts.

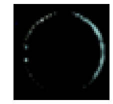
Tonight is New Moon and are you ready for even more meteors? Tonight is the peak of the Sigma Leonids. The radiant is located at the Leo/Virgo border, but has migrated to Virgo in recent years. Thanks to Jupiter's gravity, this shower may eventually become part of the Virginid Complex as well. The fall rate is very low at around one to two per hour.

With tonight's dark skies, this would be a perfect time for larger telescopes to discover an unusual galaxy grouping in Hydra about 5 degrees due west of the Xi pairing (RA 10 36 35.72 Dec -27 31 03.2).

Centralmost are two fairly easy ellipticals, NGC 3309 and NGC 3311, accompanied by spiral NGC 3322. Far fainter are other group members, such as NGC 3316 and NGC 3314 to the east of the 7th magnitude star and NGC 3305 north of the 5th magnitude star. While such galaxy clusters are not for everyone, studying those very faint fuzzies is a rewarding experience for those with large aperture telescopes.



NGC 3308 Region
Credit: Palomar Observatory, courtesy of Caltech



Before we have any Moon to contend with, let's head out in search of an object that is one royal navigation pain for the northern hemisphere, but makes up for it in beauty. Start with the southernmost star in Crater—Beta. If you have difficulty identifying it, it's the brightest star east of the Corvus rectangle. Now hop a little more than a fistwidth southeast to reddish Alpha Antilae. Less than a fistwidth below, you will see a dim 6th magnitude star that may require binoculars in the high north. Another binocular field further southwest and about 4 degrees northwest of Q Velorum is our object—NGC 3132 (RA 10 07 01.76 Dec -40 26 11.1). If you still have no luck, try waiting until Regulus has reached your meridian and head 52 degrees south.

More commonly known as the "Southern Ring" or the "Eight Burst Planetary," this gem is brighter than the northern "Ring" (M57) and definitely shows more details. Capturable in even small instruments, larger ones will reveal a series of overlapping shells, giving this unusual nebula its name.

NGC 3132
Credit: Palomar Observatory, courtesy of Caltech

APR 19
THURSDAY

M68
Credit: Palomar Observatory, courtesy of Caltech

Today in 1971, the world's first space station was launched—the Soviet research vessel Salyut 1. Six weeks later, Soyuz 11 and its crew of three docked with the station, but a mechanism failed denying them entry. The crew carried out their experiments, but were sadly lost when their re-entry module separated from the return spacecraft and depressurized. Although the initial phase of Salyut 1 seemed doomed, the mission continued to enjoy success through the early 1980s and paved the way for Mir.

Did you spot the tender crescent of the Moon tonight just after sunset? Be sure to mark your notes as the "Old Moon in the New Moon's Arms." Now, let's try picking up a globular cluster in Hydra that is located about 3 fingerwidths southeast of Beta Corvus and just a breath northeast of double star A8612—M68.

This class X globular was discovered in 1780 by Charles Messier and first resolved into individual stars by William Herschel in 1786. At a distance of approximately 33,000 light-years, it contains at least 2000 stars, including 250 giants and 42 variables. It will show as a faint, round glow in binoculars, and small telescopes will perceive individual members. Large telescopes will fully resolve this small globular to the core!

Salyut 1
Credit: NASA

Tonight our first voyage is to the Moon's surface. Look along the terminator in the southern quadrant for ancient old crater Furnerius. Named for French Jesuit mathematician George Furner, this crater spans approximately 125 kilometers and is a lunar club challenge. Power up and look for two interior craters. The smaller is crater A and it spans a little less than 15 kilometers and drops to a depth of over 1000 meters. The larger crater C is about 20 kilometers in diameter, but goes far deeper, to more than 1400 meters. That's about as deep as a coral will grow under the Earth's oceans!

Now let's return to eastern Hydra and pick up another combination Messier/Herschel object. You'll find M48 easily just a little less than a handspan southeast of Procyon.

Often called the "missing Messier," Charles discovered this in one in 1711, but cataloged its position incorrectly. Even the smallest of binoculars will enjoy this rich galactic cluster filled with more than 50 members including some yellow giants. Look for a slight triangle shape with a conspicuous chain of stars across its center. Larger telescopes should use lowest power since this will fill the field of view and resolve splendidly. Be sure to mark your notes for both a Messier object and Herschel catalog H VI 22!

M48
Credit: NOAO/AURA/NSF

Furnerius as imaged by Apollo 15
Credit: NASA

APR 21
SATURDAY

It's Saturday night and we've got Moon! No matter, what we really want to do is check out a changeable, sometimes transient, and eventually bright feature on the lunar surface—crater Proclus. At around 28 kilometers in diameter and 2400 meters deep, Proclus will appear on the terminator on the west mountainous border of Mare Crisium. For many viewers tonight, it will seem to be about 2/3 black, but 1/3 of the exposed crater will be exceptionally brilliant—and with good reason. Proclus has an albedo, or surface reflectivity, of about 16%, which is an unusually high value for a lunar feature. Watch this area over the next few nights as two rays from the crater will widen and lengthen, extending approximately 322 kilometers to both the north and south. Congratulations on another lunar club challenge!

Now let's check out a dandy little group of stars that are about a fistwidth southeast of Procyon and just slightly more than a fingerwidth northeast of M48.

Called C Hydrae, this group isn't truly gravitationally bound, but is a real pleasure to large binoculars and telescopes of all sizes. While they share similar spectral types, this mixed magnitude collection will be sure to delight you!

C Hydrae
Credit: Palomar Observatory, courtesy of Caltech

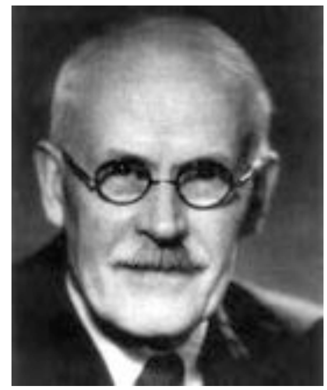
Proclus Region
Credit: NASA

APR 22
SUNDAY

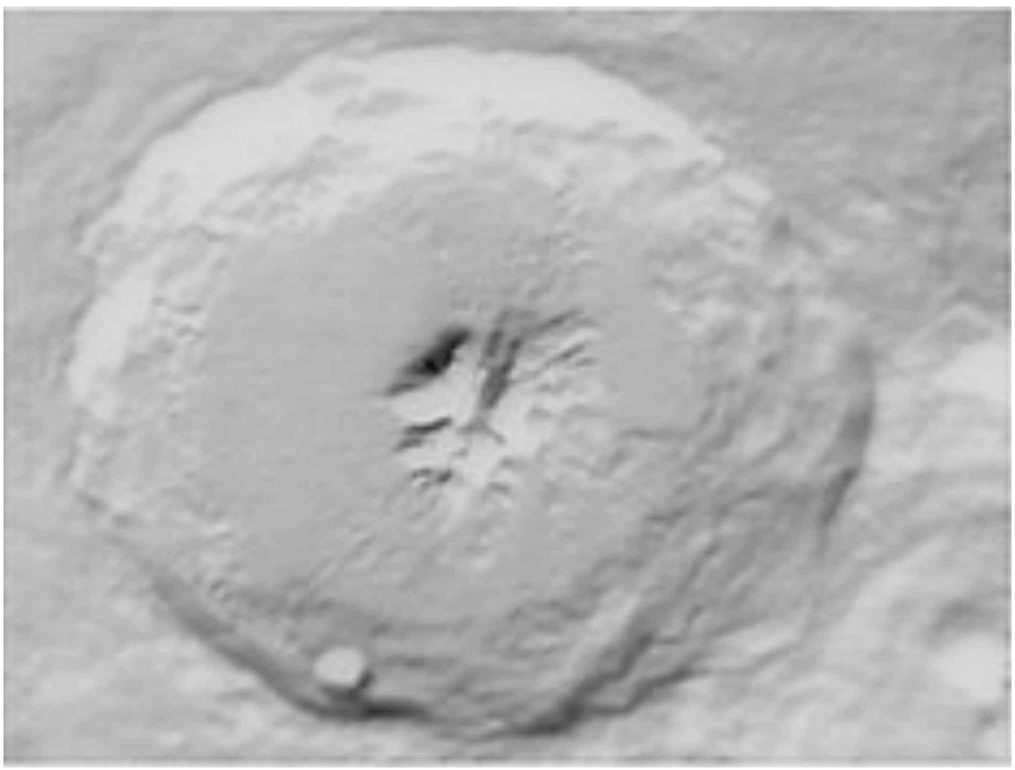
Today celebrates the birthday of Sir Harold Jeffreys, who was born in 1891. Jeffreys was an astrogeophysicist and the first person to envision Earth's fluid core. He also helped in our understanding of tidal friction, general planetary structure, and the origins of our solar system.

Start your moonless morning off before dawn with a chance to view the peak of the Lyrid meteor shower. Since the radiant is near Vega, you will improve your chances of spotting them when the constellation of Lyra is as high as possible. This stream's parent is Comet Thatcher, and it produces around 15 bright, long-lasting meteors per hour.

Tonight we're heading towards the lunar surface to view a very fine old crater on the northwest shore of Mare Nectaris—Theophilus. Slightly south of mid-point on the terminator, this crater contains an unusually large multiple-peaked central mountain which can be spotted in binoculars. Theophilus is an odd crater, one that is a parabola—with no area on the floor being flat. It stretches across a distance of 100 kilometers and dives down 440 meters below the surface. Tonight it will appear dark, shadowed by its massive west wall, but look for sunrise on its 1400 meter summit!



Sir Harold Jeffreys
(widely used public image)



Theophilus
Credit: Wes Higgins

APR 23
MONDAY

Max Planck
(widely used public image)

Pioneer quantum physicist Max Planck was born on this day in 1858. In 1900, Max developed the Planck equation to explain the shape of blackbody spectra (a function of temperature and wavelength of emission). A "blackbody" is any object that absorbs all incident radiation—regardless of wavelength. For example, heated metal has blackbody properties because the energy it radiates is thermal. The blackbody spectrum's shape remains constant, and the peak and height of an emitter can be measured against it—be it cosmic background radiation or our own bodies.

Now, let's put this knowledge into action. Stars themselves approximate blackbody radiators, because their temperature directly controls the color we see. A prime example of a "hot" star is Alpha Virginis, better known as Spica. Compare its color to the cooler Arcturus... What colors do you see? There are other astronomical delights that radiate like blackbodies over some or all parts of the spectrum as well. You can observe a prime example in a nebula such as M42, in Orion. By examining the radio portion of the spectrum, we find the temperature properly matches that of electrons involved in the process of fluorescence. Much like a common household fixture, this process is what produces the visible light we can see.

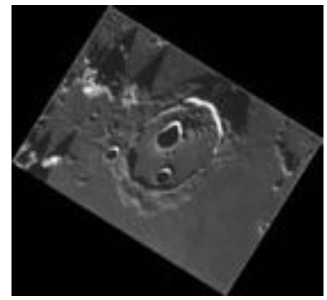
Tonight's outstanding lunar feature will be crater Maurolycus just southwest of the three rings of Theophilus, Cyrillus and Catharina. This lunar club challenge spans 114 kilometers and goes below the lunar surface by 4730 meters. Be sure to look for Gemma Frisius just to its north.

APR 24
TUESDAY

Today in 1970, China launched its first satellite. Named Shi Jian 1, it was a successful technological and research craft. This achievement made China the fifth country to send a vessel into space.

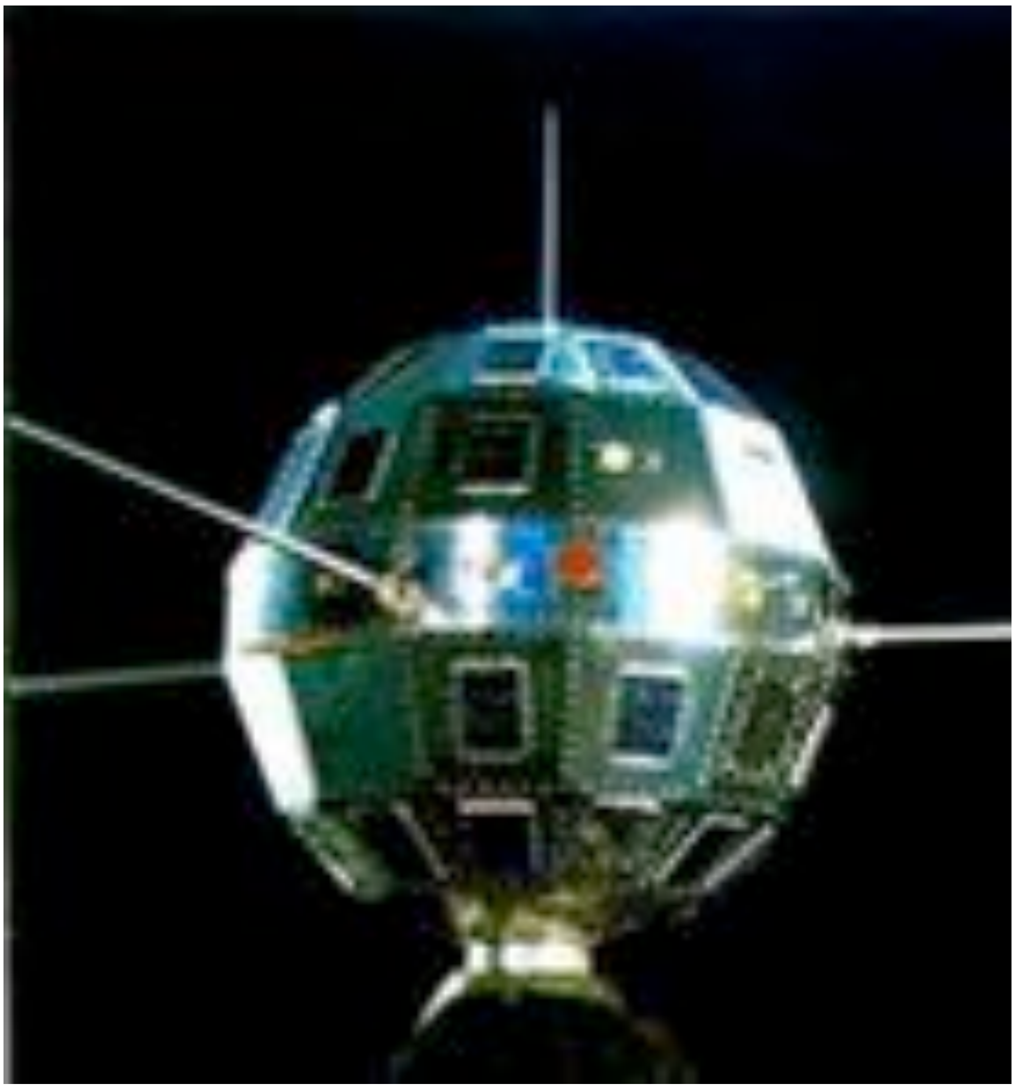
Before we explore space, let's have a look at the Moon tonight as challenge craters Cassini and Cassini A now come into view just south of the black slash of the Alpine Valley. The major crater spans 57 kilometers and reaches a floor depth of 1240 meters. The challenge is to also spot the central crater A, which is only 17 kilometers wide, yet drops down another 2830 meters below the surface.

Now let's have a look at 140 light-year distant Epsilon Hydrae—the northernmost star in the small circlet east of Procyon. While it and Rho will make a beautiful visual double for binoculars, Epsilon itself is a multiple system. Its A and B components are a tough split for any scope, but the 8th magnitude C star is easier. The D component is a dwarf star.



Cassini
Credit: Wes Higgins

Epsilon Hydrae
Credit: Palomar Observatory, courtesy of Caltech



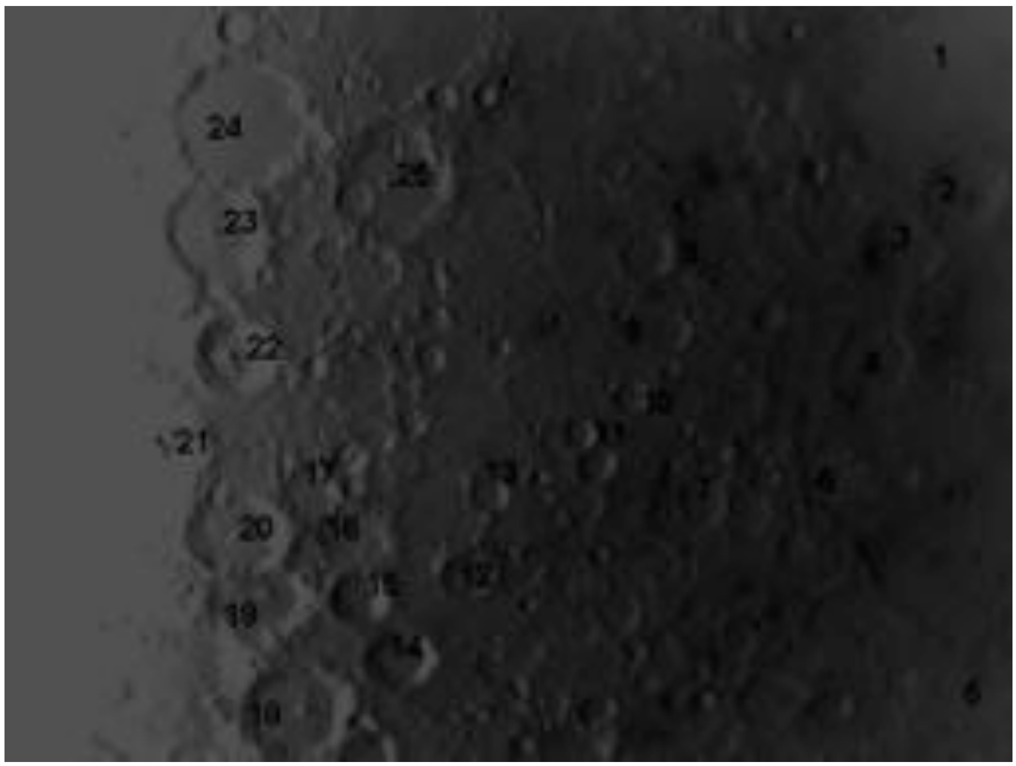
SJ-1
(widely used public image)

APR 25
WEDNESDAY

Today marks the 15th anniversary of the deployment of Hubble Space Telescope. While everyone in the astronomical community is well aware of what this magnificent telescope "sees," did you know that you can see it with just your eyes? The HST is a satellite that can be tracked and observed. Visit heavens-above.com and enter your location. This page will provide you with a list of visible passes for your area. Although you can't see details of the scope itself, it's great fun to track with binoculars or see the Sun glinting off its surface in a scope.

Keep a watch on the skies tonight as the Mu Virginid meteor shower reaches its peak at 7 to 10 per hour. With dark skies tonight, you still might catch one of these medium speed meteors radiating from a point near the constellation of Libra.

Tonight look for Saturn one degree south of the Moon. This could be an occultation, so check IOTA information! As we look at the lunar surface, the terminator is silently moving west revealing old craters in a new light. Let's have a look:



Ptolemaeus Area
Image Credit: Greg Konkel
Annotations: Tammy Plotner

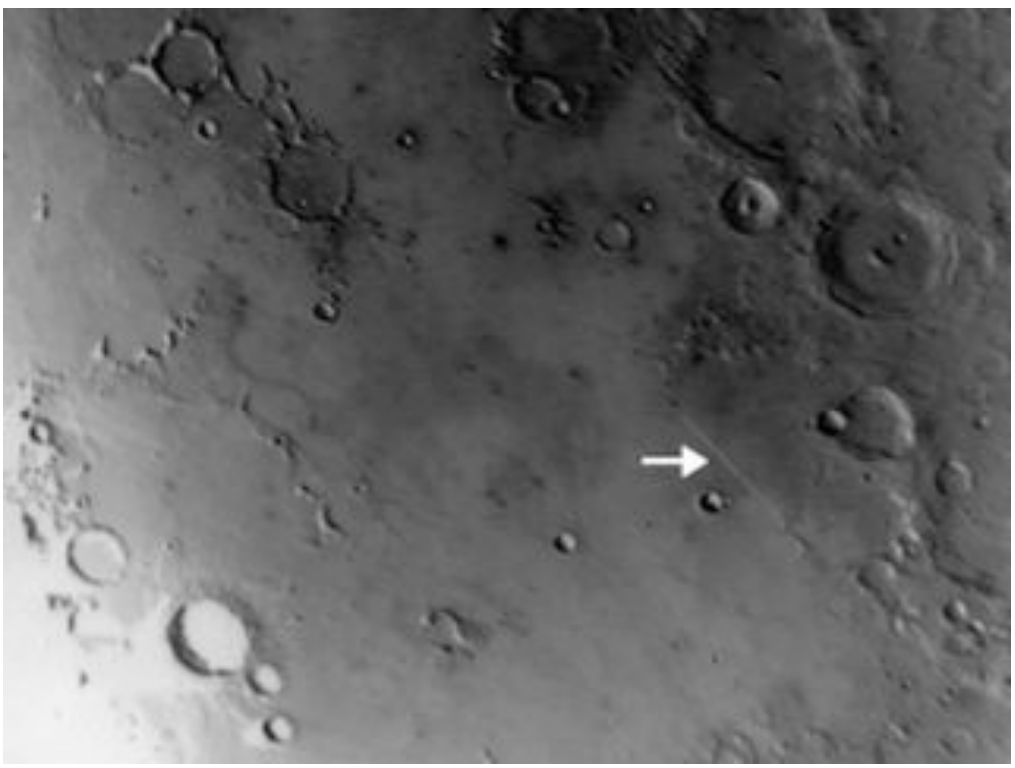
(1) Sinus Asperitatis, (2) Theophilus, (3) Cyrillus, (4) Catharina, (5) Rupes Altai, (6) Piccolomini, (7) Sacrobosco, (8) Abulfeda, (9) Almanon, (10) Taylor, (11) Abenezra, (12) Apianus, (13) Playfair, (14) Aliacensis, (15) Werner, (16) Blanchinus, (17) Lacaille, (18) Walter, (19) Regiomontanus, (20) Purbach, (21) Thebit, (22) Arzachel, (23) Alphonsus, (24) Ptolemaeus, (25) Albategnius.

On this date in 1920, the Shapely-Curtis debate raged in Washington on the nature of and distance to spiral nebulae. Shapely claimed they were part of one huge galaxy to which we all belonged, while Curtis maintained they were distant galaxies of their own. Thirteen years later on the same date, Arno Penzias was born. He went on to become a Nobel Prize winner for his part in the discovery of the cosmic microwave background radiation, through searching for the source of the "noise" coming from a simple horn antenna. His discovery helped further our understanding of cosmology in ways that Shapely and Curtis could have never dreamed of.

Tonight Regulus is less than a degree away from the waxing gibbous Moon. Check IOTA! On the lunar surface, we can enjoy a strange, thin feature. If you used last night's map, you're well acquainted with this area! Look toward the lunar south where you will note the prominent rings of craters Ptolemaeus, Alphonsus, Arzachel, Purbach, and Walter descending from north to south. Just west of them, you'll see the emerging Mare Nubium. Between Purbach and Walter you will see the small, bright ring of Thebit with a crater caught on its edge. Look further west and you will see a long, thin, dark feature cutting across the mare. Its name? Rupes Recta—better known as The Straight Wall, or sometimes Rima Birt. It is one of the steepest known lunar slopes rising around 366 meters from the surface at a 41 degree angle.

Be sure to mark your lunar challenge notes and we'll visit this feature again!

Arno Penzias
(widely used public image)



Rupes Recta: The Straight Wall
Credit: Greg Konkel

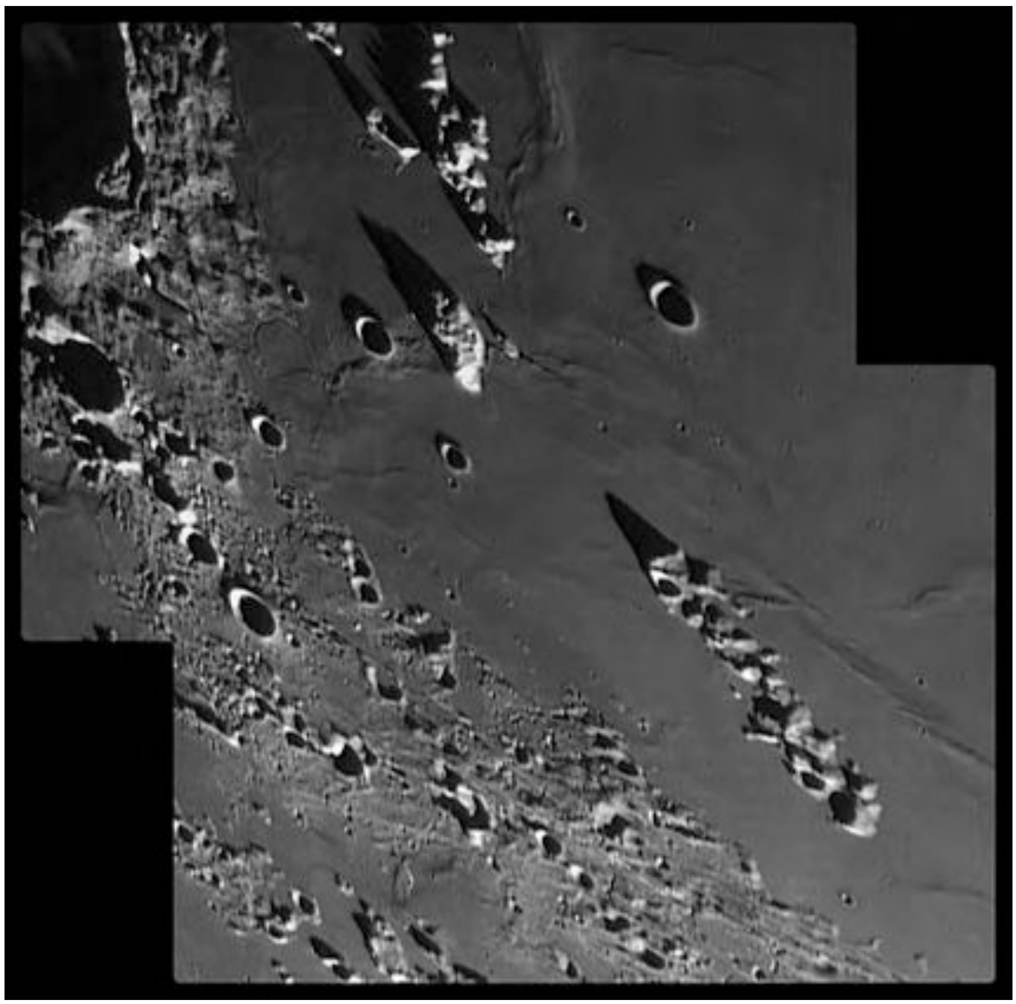
APR 27
FRIDAY

27 Hydrae
Credit: Palomar Observatory,
courtesy of Caltech

Tonight we'll use what we learned last month to locate another unusual feature—Montes Recti or the "Straight Range." You'll find this curiosity tucked between Plato and Sinus Iridum on the north shore of Mare Imbrium.

To binoculars or small scopes at low power, this isolated strip of mountains will appear as a white line drawn across the grey mare. It is believed this feature may be all that is left of a crater wall from the Imbrium impact. It runs for a distance of around 90 kilometers, and is approximately 15 kilometers wide. The Straight Range and some of its peaks reach up to 2072 meters! Although this doesn't sound particularly impressive, that's over twice as tall as the Vosges Mountains in central western Europe, and on the average very comparable to the Appalachian Mountains in the eastern United States.

Now have a look at 27 Hydrae about a fingerwidth southwest of Alpha. It's an easy double for any equipment with its slightly yellow 5th magnitude primary and distant, white, 7th magnitude secondary. Although it is wide, the pair is a true binary system.



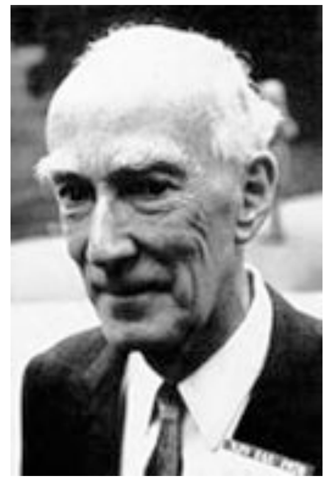
Montes Recta: The Straight Range
Credit: Wes Higgins

Today was a very busy day in astronomy history. Newton published his Principia in 1686 on April 28. In 1774, Francis Baily was born. He went on to revise star catalogs and explain the phenomenon at the beginning and ending of a total solar eclipse which we know as "Baily's Beads." 1900 saw the birth of Jan Hendrick Oort, who quantified the Milky Way's rotation characteristics and envisioned the vast, spherical area of comets outside our solar system that we now call the Oort Cloud. Last, but not least, was the birth of Bart Jan Bok in 1906 who studied the structure and dynamics of the Milky Way.

Tonight you are on your own without a map. Lunar features are easy when you become acquainted with them! Return to the Moon and explore with binoculars or telescopes the area to the south around another easy and delightful lunar feature, the crater Gassendi. At around 110 kilometers in diameter and 2010 meters deep, this ancient crater contains a triple mountain peak in its center. As one of the most "perfect circles" on the Moon, the south wall of Gassendi has been eroded by lava flows over a 48 kilometer expanse and offers a great amount of detail to telescopic observers on its ridge- and rille-covered floor.

For those observing with binoculars? Gassendi's bright ring stands on the north shore of Mare Humorum...an area about the size of the state of Arkansas!

For SkyWatchers, no equipment is necessary to enjoy the Alpha Bootid meteor shower—despite the Moon. Pull up a comfortable seat and face orange Arcturus as it climbs the sky in the east. These slow meteors have a fall rate of 6 to 10 per hour and leave very fine trails, making an evening of quiet contemplation most enjoyable.



Jan Oort
(widely used public image)

Bart Jan Bok
(widely used public image)

Gassendi
Credit: Wes Higgins

APR 29
SUNDAY

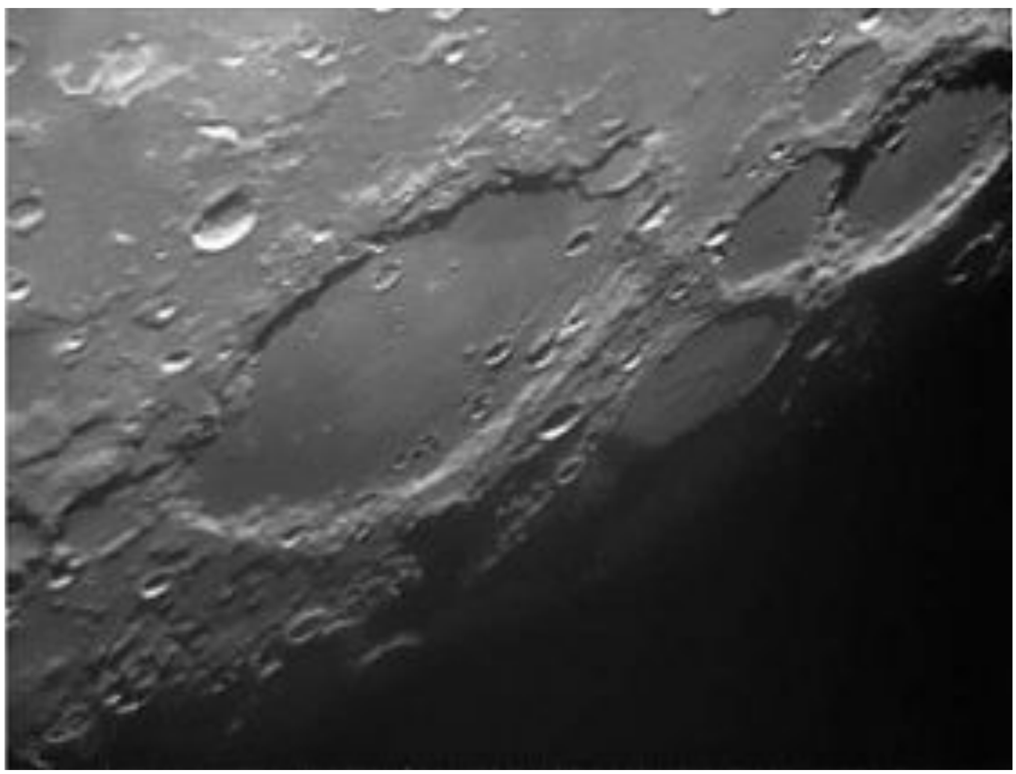
If you're up before dawn and would like to catch Uranus in binoculars, you'll find it less than a degree north of Mars!

Return to the Moon tonight to have a look on the terminator near the southern cusp for two outstanding features. The easiest is crater Schickard—a class V mountain-walled plain that spans 227 kilometers. Named for German astronomer Wilhelm Schickard, this beautiful old crater with the subtle interior details has another crater caught on its northern wall named Lehmann.

Look further south for one of the Moon's most incredible features—Wargentin. Among the many strange things on the lunar surface, Wargentin is unique. Once upon a time, it was a very normal crater and had been that way for hundreds of millions of years—then it happened. Either a fissure opened in its interior, or the meteoric impact that formed it caused molten lava to begin to rise. Oddly enough, Wargentin's walls were without large enough breaks to allow the lava to escape and it continued to fill the crater to the rim. Often referred to as "the Cheese," enjoy Wargentin tonight for its unusual appearance and be sure to note Nasmyth and Phocylides as well!

While we're out, have a look at R Hydrae about a fingerwidth east of Gamma—which is a little more than fistwidth south of Spica. R is a beautiful, red, long-term variable first observed by Hevelius in 1662. Located about 325 light-years from us, it's approaching—but not that fast. Be sure to look for a visual companion star as well!

R Hydrae
Credit: Palomar Observatory, courtesy of Caltech



Schickard and Wargentin
Credit: Roger Warner

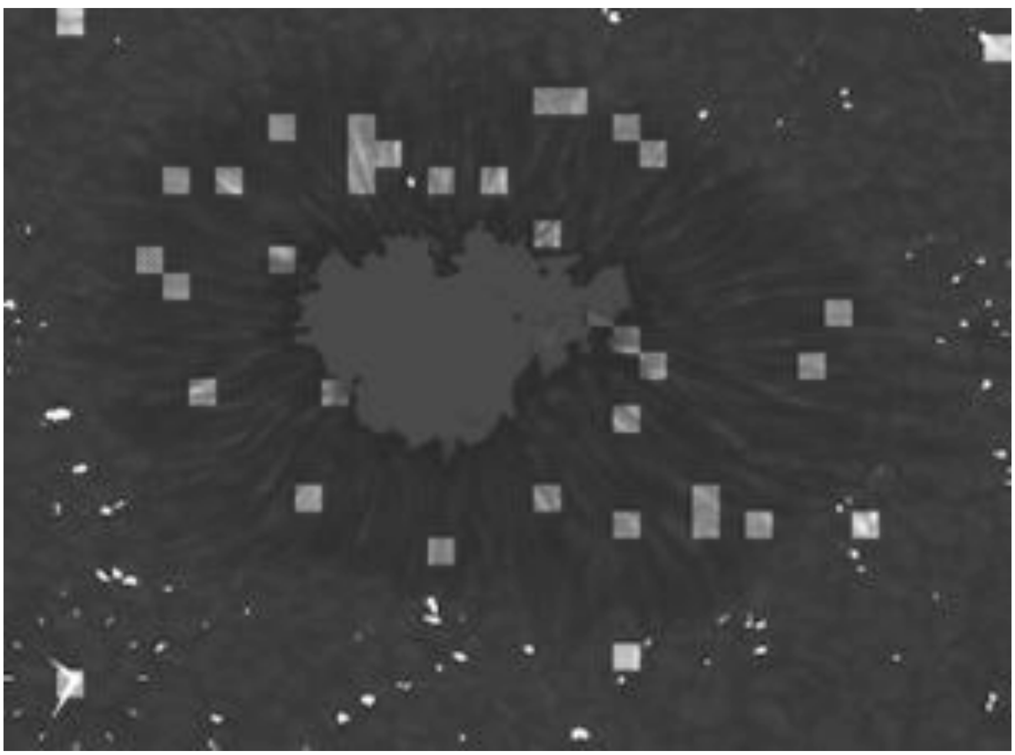
Karl Frederich Gauss was born on this day in 1777. Known as the "Prince of Mathematics," Gauss contributed to the field of astronomy in many ways—from computing asteroid orbits to inventing the heliotrope. Out of Gauss' many endeavors, he is most recognized for his work in magnetism. We understand the term "gauss" as a magnetic unit—a refrigerator magnet carries about 100 gauss while an average sunspot might go up to 4000. On the most extreme ends of the magnetic scale, the Earth produces about 0.5 gauss at its poles, while a magnetar can produce as much as 10 to the 15th power in gauss units!

While we cannot directly observe a magnetar, those living in the Southern Hemisphere can view a region of the sky where magnetars are known to exist—the Large Magellanic Cloud—or you can use the projection method to view a sunspot! If you have a proper solar filter, magnetism distorts sunspots as they near the limb—called the "Wilson Effect"

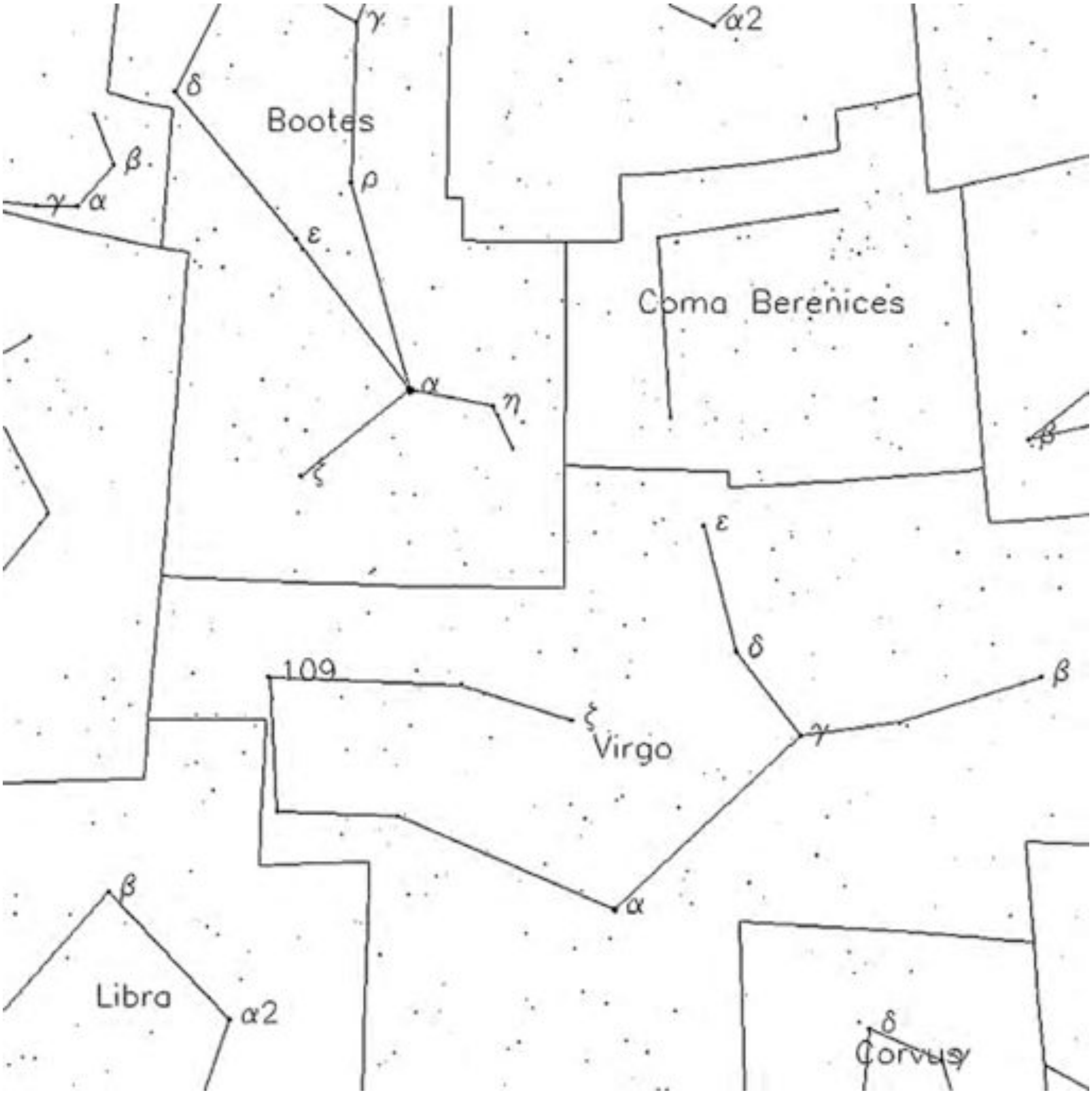
While both magnetars and sunspots are areas of awesome magnetic energy, what happens when you find magnetism in a very unlikely place? Tonight have a look at the lunar surface just a little southeast of the grey oval of Grimaldi. The area we are looking for is called the Sirsalis Rille and on an orb devoid of magnetic fields—it's magnetic! Like a dry river bed, this ancient "crack" on the surface runs 480 kilometers along the surface and branches in many areas. Be sure to look for Spica nearby!

Karl Frederich Gauss
(widely used public image)

Sirsalis Rille
Credit: Alan Chu
(note: image is inverted
and reversed L/R)



Sunspot
Credit: NASA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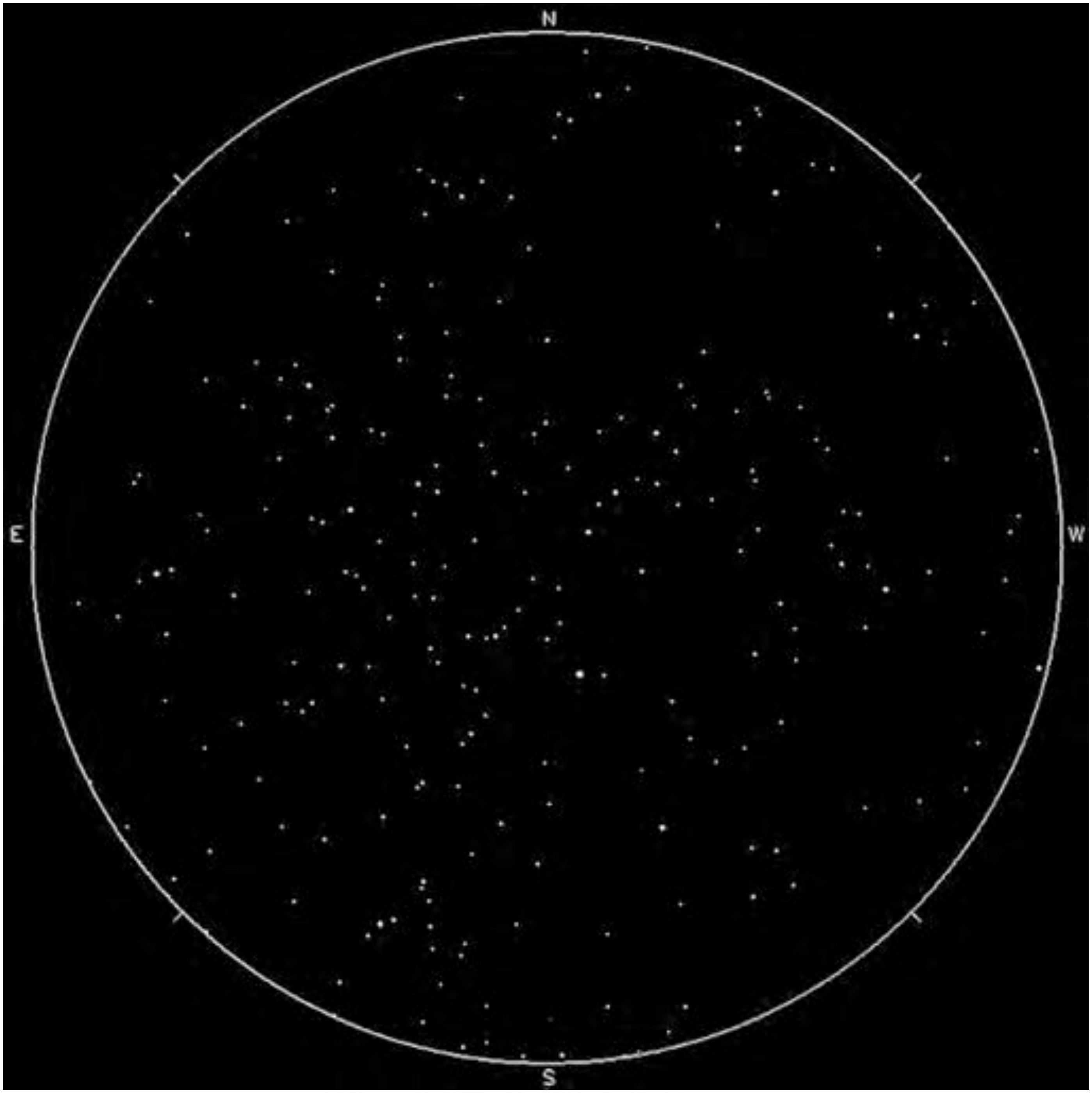
MAY 2007



MAY 1
TUESDAY

Delta Corvi
Credit: Palomar Observatory, courtesy of Caltech

On this day in 1949 Gerard Kuiper discovered Nereid, a satellite of Neptune. If you're game, you can find Neptune about two fingerwidths northeast of Gamma Capricorni about an hour before dawn. While it can be seen in binoculars as a bluish "star," it takes around a 6" telescope and some magnification to resolve its disc. Today's imaging technology can even reveal its moons!

While you're out this morning, keep an eye on the sky for the peak of the Phi Bootid meteor shower, whose radiant is near the constellation of Hercules. While the best time to view a meteor shower is around 2:00 a.m. local time, you will have best success watching for these meteors when the Moon is as far west as possible. The average fall rate is about 6 per hour.

This is the beginning of Astronomy Week for amateurs the world over. While the Moon is incredibly near full, it will still be an awesome sight for those who have never seen it through a telescope. Invite someone to visit with you, or offer to take your telescope to a public area. Power up on bright features like Tycho's rays, it's an inspiring sight!

Another great target for a bright night is Delta Corvi. 125 light-years away, it displays a yellowish color primary and slightly blue secondary that's an easily split star in any telescope, and a nice visual double with Eta in binoculars. Use low power and see if you can frame this bright grouping of stars in the same eyepiece field.

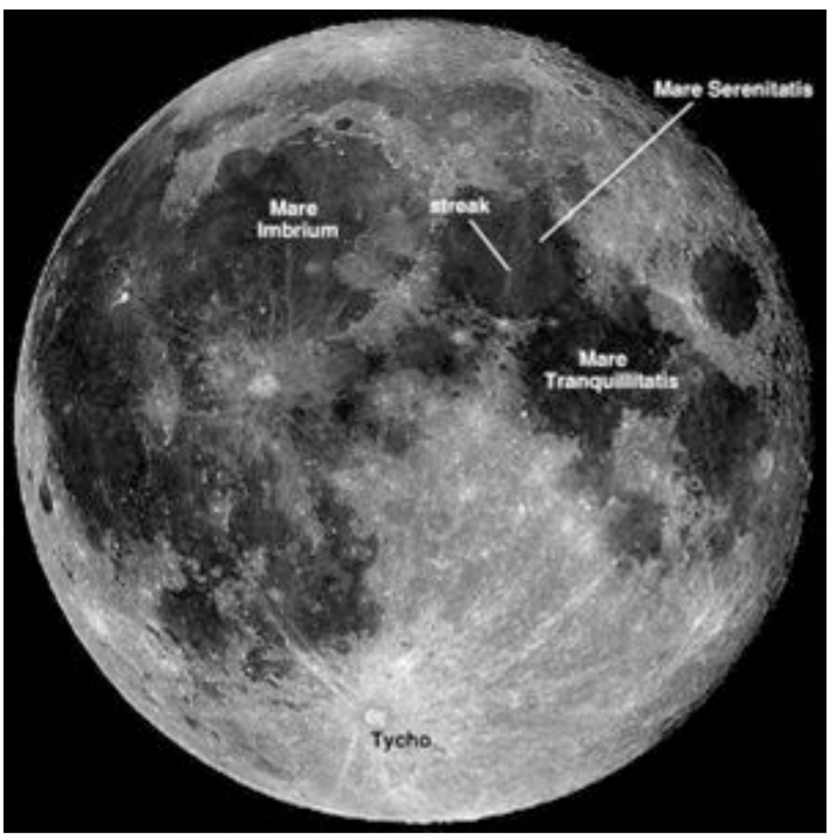
Tycho
Credit: Roger Warner

Tonight is Full Moon. By May in most areas, flowers are everywhere, so it's not hard to imagine how this became to be known as the "Full Flower Moon." Since the Earth is awakening again, agriculture has re-emerged and so it is sometimes known as the "Full Corn Planting Moon," or the "Milk Moon." No matter what you call it, it's still majestic to watch rise!

To participate in another lunar club challenge and do some outreach work, you can demonstrate the "Moon Illusion" to someone. While we know it's purely psychological and not physical—the fact remains that the Moon seems larger on the horizon. Using a small coin held at arm's length, compare it to Luna as it rises, and then again as it seems to "shrink" as it gets higher! You've now qualified for extra credit...

Even though the Moon is very bright when full, try using colored or Moon filters to have a look at the many surface features which throw amazing patterns across its surface. If you have none, a pair of sunglasses will suffice. Look for things you might not ordinarily notice—such as the huge streak which emanates from crater Menelaus. Look at the pattern projected from Proclus—or the intense little dot of little-known Pytheas north of Copernicus. It's hard to miss the blinding beacon of Aristarchus! Check the southeastern limb where the edge of Furnerius lights up the landscape...or how a nothing crater like Censorinus shines on the southeast shore of Tranquillitatis, while Dionysus echoes it on the southwest. Could you believe Manlius just north of central could be such a perfect ring—or that Anaxagoras would look like a northern polar cap?

While it might be tempting to curse the Moon for hiding the stars when it's full, there is no other world out there that we can view in such detail… Even if you just look with your eyes!



Full Moon
Credit: NASA

MAY 3
THURSDAY

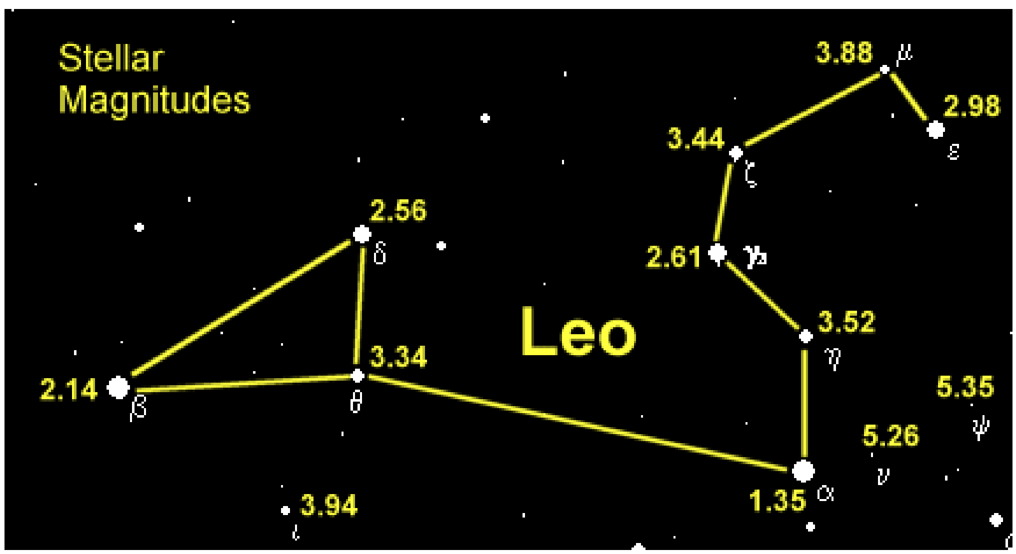
With just a little bit of time before the Moon rises, let's take a look at the constellation of Leo and its brightest stars. For our first destination we'll travel 85 light-years to learn about "The Little King"—Regulus.

Ranking as the twenty-first brightest star in the night sky, 1.35 magnitude Alpha Leonis is a helium type star about 5 times larger and 160 times brighter than our own Sun. Speeding away from us at 3.7 kilometers per second, Regulus is also a multiple system whose 8th magnitude companion is easily seen in small telescopes. The companion is itself a double at around magnitude 13 and is a dwarf of an uncertain type. There is also a 13th magnitude fourth star in this grouping, but it is believed that it is not associated with Regulus since the "Little King" is moving toward it and will be about 14" away in 785 years.

Northeast of Regulus by about a fistwidth is 2.61 magnitude Gamma Leonis—also known as Algieba. This is one of the finest double stars in the sky, but a little difficult at low power since the pair is both bright and close. Separated by about twice the diameter of our own solar system, this 90 light-year distant pair is slowly widening.

Another two fingerwidths north is 3.44 magnitude Zeta—also named Aldhafera. Located about 130 light-years away, this excellent star has an optical companion which is viewable in binoculars—35 Leonis. Remember this pair, because it will lead you to galaxies later!

Before we leave, let's have a look east at 3.34 magnitude Theta. Also known as Chort, mark this one in your memory, as well as 3.94 magnitude Iota to the south as markers for a galaxy hop. Last is easternmost 2.14 magnitude Beta. Denebola is the "Lion's Tail" and has several faint optical companions.



Stellar Magnitudes in Leo
Credit: NASA

Tonight there will be a short while for us to enjoy a galaxy hop before the Moon interferes. Using our knowledge of Leo, this galaxy pair is relatively easy for larger binoculars and small telescopes. You'll find them almost perfectly mid-way between Theta and Iota and their names are M65 and M66.

Discovered by Méchain in March 1780, apparently Mr. Messier didn't notice the bright pair when a comet passed between them in 1773. At around 35 million light-years away, you will find M66 to be slightly brighter than its 200,000 light-year distant western neighbor—M65. While both are Sb classed spirals, the two couldn't appear more different. M65 has a bright nucleus and a smooth spiral structure with a dark dustlane at its eastern edge. M66 has a more stellar core region with thick, bright arms that show knots to larger scopes—as well as a wonderful extension from the southern edge.

If you are viewing with a larger scope, you may notice to the north of this famous pair yet another galaxy! NGC 3628 is a similar magnitude edge-on beauty with a great dissecting dark dustlane. This pencil-slim, low surface brightness galaxy is a bit of a challenge for smaller scopes, but larger ones will find its warped central disc well worth high power study.

Congratulations on spotting the "Leo Trio" and a member of the Arp's Peculiar Galaxy Catalog! Now be sure to watch as the Moon rises bringing with it Antares a half degree away. Be sure to check IOTA for possible occultations!

M65, M66 and NGC 3628: The Leo Trio
Credit: REU Program/NOAO/AURA/NSF

MAY 5
SATURDAY

In 1961 Alan Shepard became the first American in "space" (as we now refer to that region above the sky), taking a 15 minute suborbital ride aboard the Mercury craft Freedom 7.

Tonight let's head for another trio of galaxies that are suited best for mid-to-large aperture telescopes. Begin by heading west about a fistwidth from Regulus and identify 52 Leonis. Our mark is one and a half degrees south. At lower power you will see a triangle of galaxies.

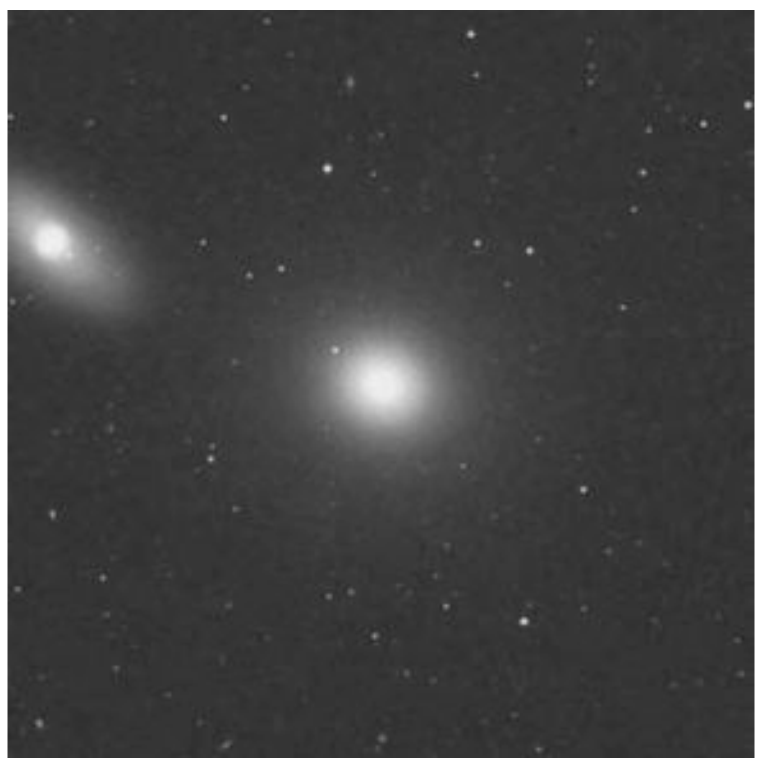
The largest and brightest is M105, discovered by Méchain on March 24, 1781. This dense elliptical galaxy would appear to be evenly distributed, but the Hubble Space Telescope revealed a huge area within its core to be equal to about 50 million solar masses. The companion elliptical to the northeast—NGC 3384—will reveal a bright nucleus as well as an elongated form. The faintest of this group—NGC 3389—is a receding spiral and for larger scopes will reveal "patchiness" in structure.

Continue another degree south and enjoy another galactic pair. The widely spaced M96 and M95 are part of the galaxy grouping known as Leo I. The dusty spiral—M96—will appear as a silver oval, whose nucleus is much sharper than its faint spiral arms. M96 hosted a supernova as recently as 1998. To its west, you will discover one very beautiful barred spiral—M95. While both of these were discovered by Méchain only four days earlier than M105, it wasn't until recent years that they became a prime target of the Hubble Space Telescope. We enjoy M95 for its unique ring-like arms and unmistakable barred core, but the HST was looking for Cepheid variables to help determine the Hubble Constant. While we don't need a space telescope to view this group of galaxies, we can now appreciate knowing that we can see 38 million light-years away from our own backyard!

If you're still out when the Moon rises, be sure to look for Jupiter about a fistwidth away.

M96
Credit: Palomar Observatory, courtesy of Caltech

M95
Credit: Palomar Observatory, courtesy of Caltech

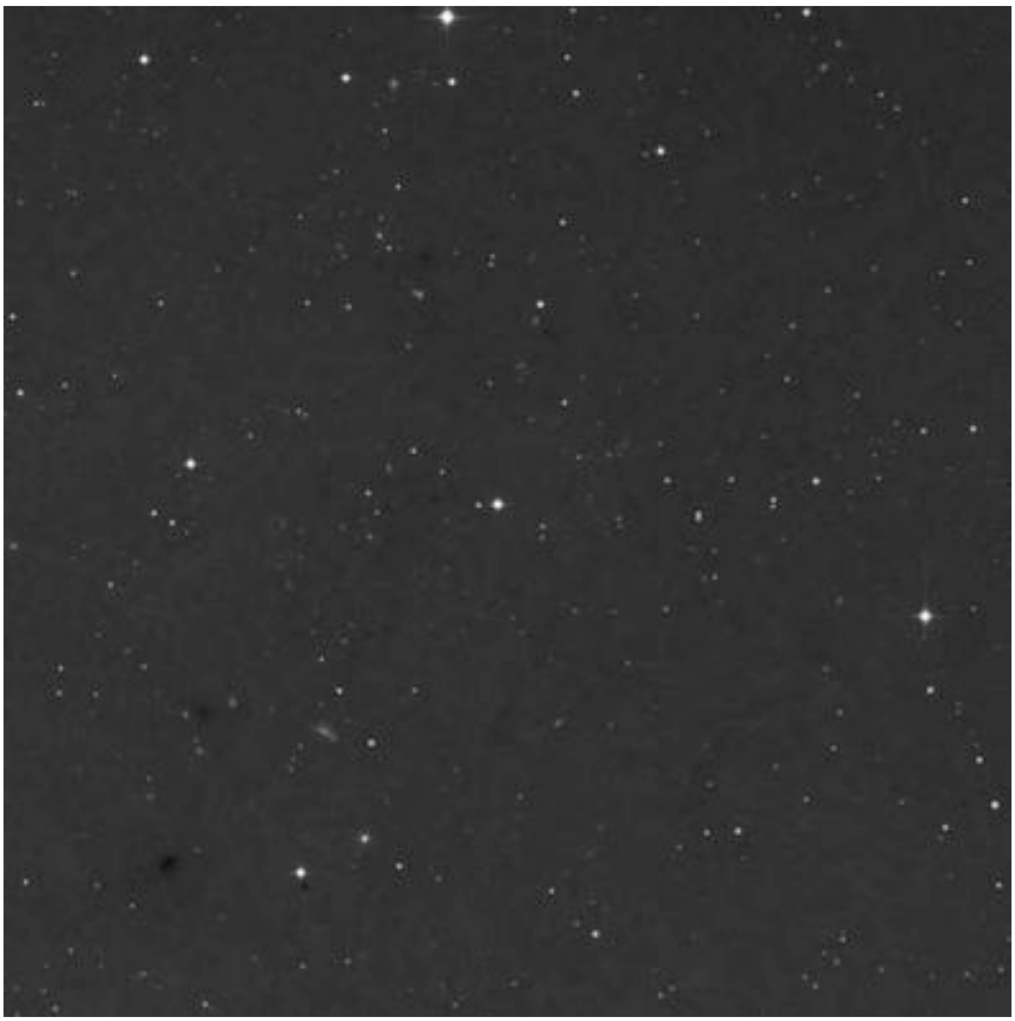


M105
Credit: Palomar Observatory, courtesy of Caltech

For those who like curiosities, our target for tonight will be 1.4 degrees northwest of 59 Leonis, which is itself about a degree southwest of Xi. While this type of observation may not be for everyone, what we are looking for is a very special star—a red dwarf named Wolf 359 (RA 10 56 28.99 Dec +07 00 52.0). Although it is faint at approximately 13th magnitude, you will find it precisely at the center of the highly accurate half degree field photo below.

Discovered photographically by Max Wolf in 1959, charts from that time period will no longer be accurate because of the star's large proper motion. It is one of the least luminous stars known, and we probably wouldn't even know it was there except for the fact that it is the third closest star to our solar system. Located only 7.5 light-years away, this miniature star is about 8% the size of our Sun—making it roughly the size of Jupiter. Oddly enough, it is also a "flare star"—capable of jumping another magnitude brighter at random intervals.

It might be faint and difficult to spot in mid-sized scopes, but Wolf 359 is definitely one of the most unusual things you will ever observe!



Wolf 359
Credit: Palomar Observatory, courtesy of Caltech

MAY 7
MONDAY

Before we leave Leo to softly exit west, there is another galaxy that is so worth your time to visit that even binoculars can spot it. You'll need to identify slightly fainter Lambda to the southwest of Epsilon and head south about one fingerwidth for NGC 2903.

This awesome oblique spiral galaxy was discovered by William Herschel in 1784. At a little brighter than magnitude 9, it is easily in range of most binoculars. It is odd that Messier missed this one considering both its brightness and the fact that three of the comets he discovered passed by it! Perhaps it was cloudy when Messier was looking, but we can thank Herschel for cataloging NGC 2903 as H I 56.

While small optics will only perceive this 25 million light-year distant beauty as a misty oval with a slightly brighter core region, larger aperture will light this baby up. Soft suggestions of its spiral arms and concentrations will begin to appear. One such knot is star cloud NGC 2905—a detail in a distant galaxy so prominent that it received its own New General Catalog designation.

NGC 2903 is roughly the same size as our own Milky Way, and includes a central bar—yet the nucleus of our distant cousin has "hot spots" that were studied by the Hubble Telescope and extensively by the Arecibo telescope. While our own galactic halo is filled with ancient globular clusters, this galaxy sports brand new ones!

Be sure to mark your notes with your observations, because many different organizations consider this to be on their "Best of" lists.

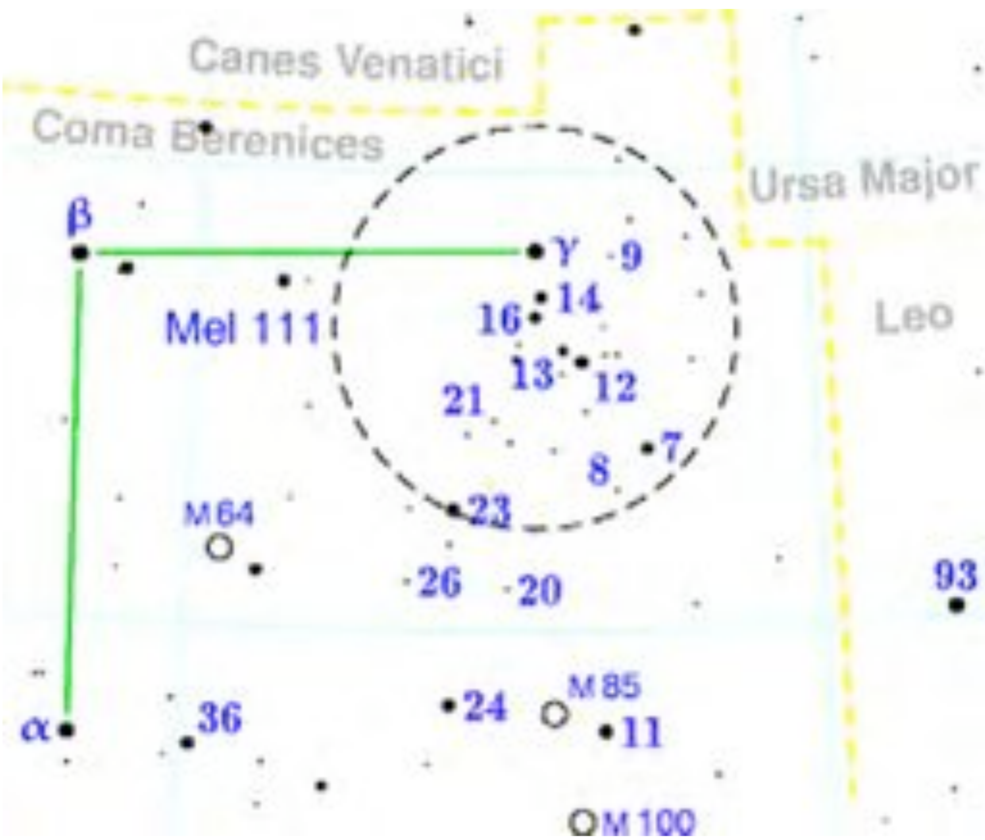
NGC 2903
Credit: Palomar Observatory, courtesy of Caltech

MAY 8
TUESDAY

Tonight we'll start with an object that can be viewed unaided from a dark location and is splendid in binoculars. Just northeast of Beta Leonis, look for a hazy patch of stars known as Melotte 111. Often called the "Queen's Hair," this five degree span of 5th to 10th magnitude stars is wonderfully rich and colorful. As legend has it, Queen Berenice offered her beautiful long tresses to the gods for the King's safe return from battle. Touched by her love, the gods took Berenice's sacrifice and immortalized it in the stars.

The cluster is best in binoculars because of its sheer size, but you'll find other things of interest there as well. Residing about 260 light-years away, this collection is one of the nearest of all star clusters, including the Pleiades and the Ursa Major moving group. Although Melotte 111 is more than 400 million years old, it contains no giant stars, but its brightest members have just begun their evolution. Unlike the Pleiades, The Queen's Hair has no red dwarfs and a low stellar concentration which leads astronomers to believe it is slowly dispersing.

Like many clusters, it contains double stars—most of which are spectroscopic. For binoculars, it is possible to split star 17, but it will require very steady hands.



Melotte 111
Credit: Wikipedia

MAY 9
WEDNESDAY

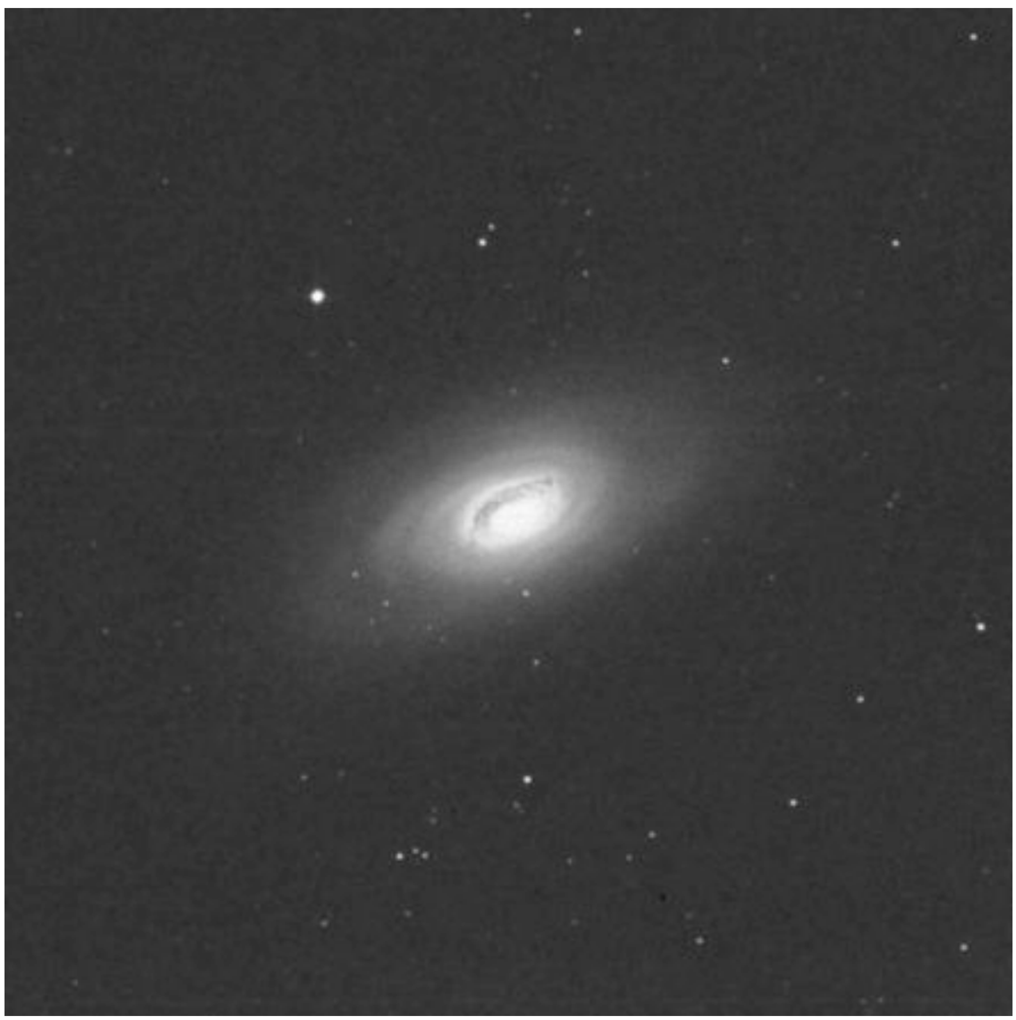
While our destination tonight isn't quite so romantic, I think you'll enjoy getting a "Blackeye." You'll find it located just one degree east-northeast of 35 Coma Berenices and it is most often called M64.

Originally discovered by Bode about a year before Messier cataloged it, M64 is about 25 million light-years away and holds the distinction of being one of the more massive and luminous of spiral galaxies. It has a very unusual structure and is classified as an Sa spiral in some catalogs and an Sb in others. Overall, its arms are very smooth and show no real resolution to any scope—yet its bright nucleus has a incredible dark dustlane that consumes the north and eastern regions around its core—giving rises to its nickname—the Blackeye Galaxy.

In binoculars, this 8.5 magnitude galaxy can be perceived as a small oval with a slightly brighter center. Small telescope users will pick out the nucleus more easily, but will require both magnification and careful attention to dark adaptation to catch the dustlane. In larger telescopes, the structure is easily apparent and you may catch the outer wisps of arms on nights of exceptional seeing.

No matter what you use to view it, this is one compact and bright little galaxy!

Today in 1962, the first Earth-based laser was aimed at crater Albategnius. When the Moon rises tonight, Albategnius will be just west of the terminator and 1.5 light seconds away!



M64
Credit: Palomar Observatory, courtesy of Caltech

MAY 10
THURSDAY

If you're up before dawn this morning, you'll find Neptune less than two degrees north of the Moon!

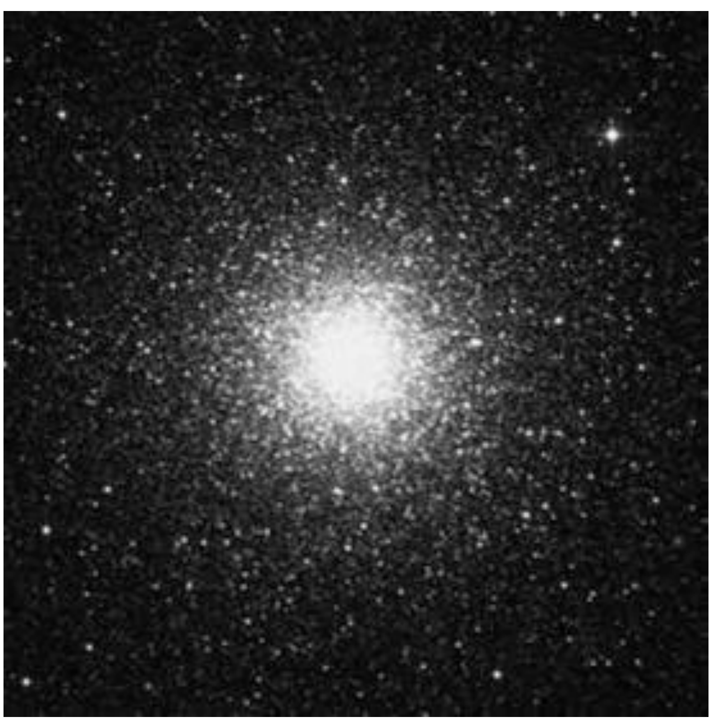
Tonight let's use our binoculars and telescopes to hunt down one of the best globular clusters for the northern hemisphere—M3. You will discover this ancient beauty about halfway between the pair of Arcturus and Cor Caroli—just east of Beta Comae. The more aperture you use, the more stars you will resolve. Discovered by Charles Messier on May 3, 1764, this ball of approximately a half million stars is one of the oldest formations in our galaxy. At around 40,000 light-years away, this awesome globular cluster spans about 220 light-years and is believed to be as much as 10 billion years old. To get a grasp on this concept, our own Sun is less than half that age!

Let's further our understanding of distance and how it affects what we see. As you know, light travels at an amazing speed of about 300,000 kilometers per second. To get a feel for this, how many seconds are there in a minute? An hour? A week? A month? How about a year? Ah, you're beginning to see the light! For every second—300,000 kilometers.

M53
Credit: Palomar Observatory, courtesy of Caltech

M3 is 40,000 years away traveling at the speed of light. In terms of kilometers—that's far more zeros than most of us can possibly understand—yet we can still see this great globular cluster. Now let's locate M53 near Alpha Comae. Aim your binoculars or telescopes there and you will find M53 about a degree northeast.

This very rich, magnitude 8.7 globular cluster is almost identical to M3, but look at what a difference an additional 25,000 light-years can make to how we see it! Binoculars can pick up a small round fuzzy, while larger telescopes will enjoy the compact bright core as well as resolution at the cluster's outer edges. As a bonus for scopes, look one degree to the southeast for the peculiar round cluster NGC 5053. Classed as a very loose globular, this magnitude 10.5 grouping is one of the least luminous objects of its type due to its small stellar population and the wide separation between members—yet its distance is almost the same as that of M3.



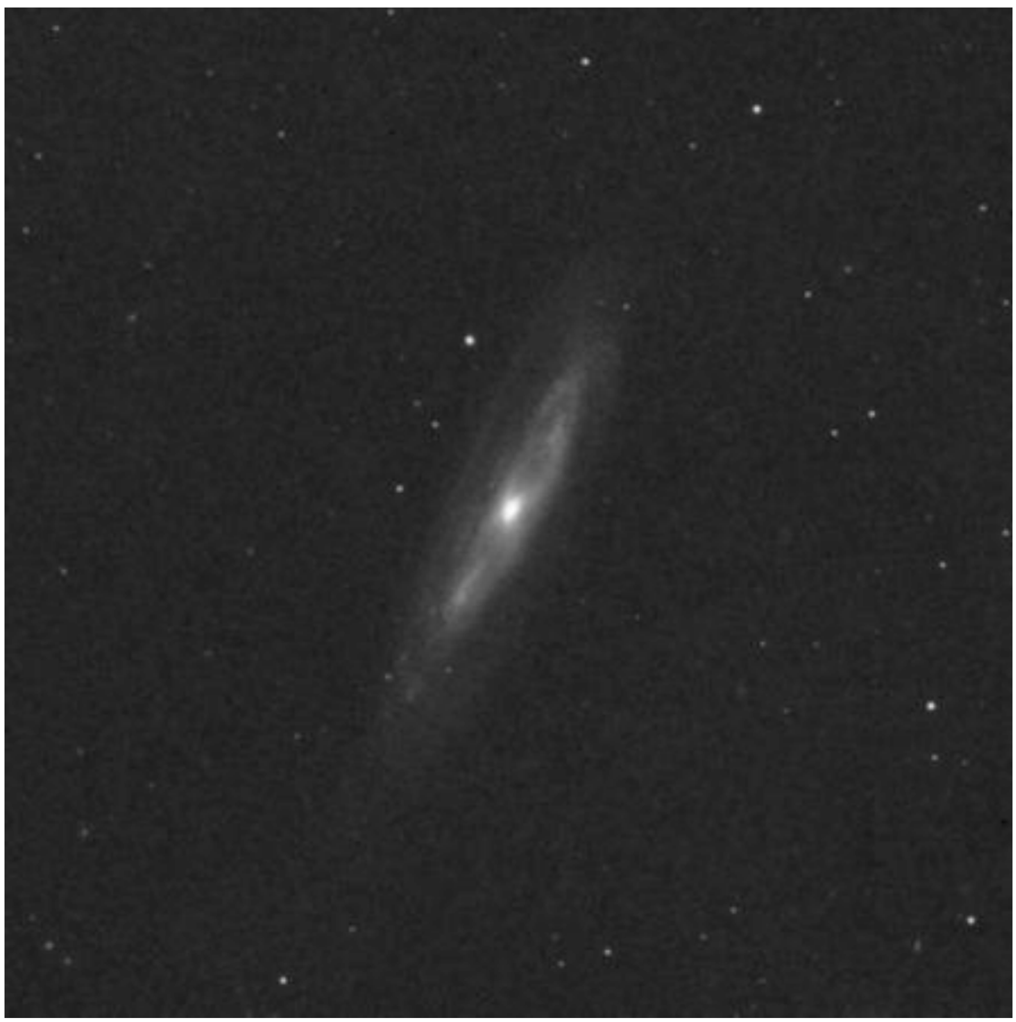
M3
Credit: Palomar Observatory, courtesy of Caltech

MAY 11
FRIDAY

Tonight, start by locating 5th magnitude 6 Comae Berenices about three fingerwidths east of Beta Leonis. Remember this star! We are going on a galaxy hop to a Méchain discovery that is less than a degree west, and its designation is M98.

At magnitude 10, this beautiful galaxy is a telescope-only challenge and a bit on the difficult side for small aperture. Long considered to be part of the Virgo Cluster, M98 is approaching us at a different rate than other cluster members, giving rise to speculation that it may simply be in the line of sight. Quite simply put, it has a blue shift instead of red! But considering that all these galaxies (and far fainter ones than we can see), are in close proximity leads some researchers to believe it is a true member by virtue of the extreme tidal forces which must exist in the area—pushing it toward us at this point in time, rather than away.

In a small telescope, M98 will appear like a slim line with a slightly brighter nucleus—a characteristic of an edge-on galaxy. To large aperture, its galactic disk is hazy and contains patchiness in structure. These are regions of newly forming stars and vast regions of dust—yet the nucleus remains a prominent feature. It's a very large galaxy, so be sure to use a minimum of magnification and plenty of aversion to make out small details in this fine Messier object!



M98
Credit: Palomar Observatory, courtesy of Caltech

It would well be worth getting up early this morning, as Uranus is occulted by the Moon. Be sure to check IOTA for times and locations. If nothing else, nearby Mars makes for an equally inspiring sight!

Tonight we'll return once again to 6 Coma Berenices and head no more than a half degree southwest for another awesome galaxy—M99.

Discovered by Pierre Méchain on the same night as he found M98, this is one of the largest and brightest of the spiral galaxies in the Virgo Cluster. Recognized second after M51 for its structure, Lord Rosse proclaimed it to be "a bright spiral with a star above." It is an Sc class, and unlike its similarly-structured neighbors—it rotates clockwise. Receding from us at 2324 kilometers per second, its speedy retreat through the galaxy fields and close pass to approaching M98 may be the reason that it is asymmetrical—with a wide arm extending to the southwest. Three documented supernovae have been recorded in M99—in 1967, 1972 and 1986.

Possible in large binoculars with excellent conditions, this roughly 9th magnitude object is low surface brightness and requires clean skies to see details. For a small telescope, you will see this one as fairly large, round, wispy, and with a bright nucleus. But, unleash aperture if you have it!

For large scopes, the spiral pattern is very prominent and the western arm shows well. Areas within the structure are patchworked with bright knots of stars and thin dustlanes which surround the concentrated core region. During steady seeing, a bright, pinpoint stellar nucleus will come out of hiding. A worthy study!

M99
Credit: Palomar Observatory, courtesy of Caltech

MAY 13
SUNDAY

Tonight we'll return again to 6 Comae and our hunt will be for the last of the three galaxies discovered by Méchain on that same wonderful night in 1781. You'll find it just a fingerwidth northeast of 6. Its name is M100.

M100 is one of the brightest member galaxies of the Virgo Cluster of galaxies—and its design is much like our own galaxy. From our point of view, we see M100 "face on," and even Lord Rosse in 1850 was able to detect a spiral form. Thanks to its proximity to other galactic members, it has two grand arms in which recently-formed, young, hot, massive stars reside. Regardless of what seems to be perfect form, the nucleus shows that younger stars have formed more to the south side than the north. Perhaps interaction with its dwarf neighbors?

Achievable in binoculars as a soft round glow, and about the same in a small telescope, extensive photography has shown M100 to be far larger than previously believed—with a substantial portion of its mass contained in faint outer regions. The Hubble Telescope discovered over 20 Cepheids variables and one nova contained inside our spiral friend and was more able to accurately determine its distance at 6 million light-years. In addition, NASA's Ultraviolet Imaging Telescope has shown starburst and formation activity at the edges of M100's inner spiral arms.

Larger telescopes will see this galaxy's intense core region as slightly elliptical and sometimes reveal patchiness in the structure. With good sky conditions, even smaller scopes can reveal a spiral pattern, and this improves significantly with aperture. Be sure to look carefully because five supernovae events have been observed in this hot galaxy—one as recently as February 2006!

M100
Credit: Palomar Observatory, courtesy of Caltech

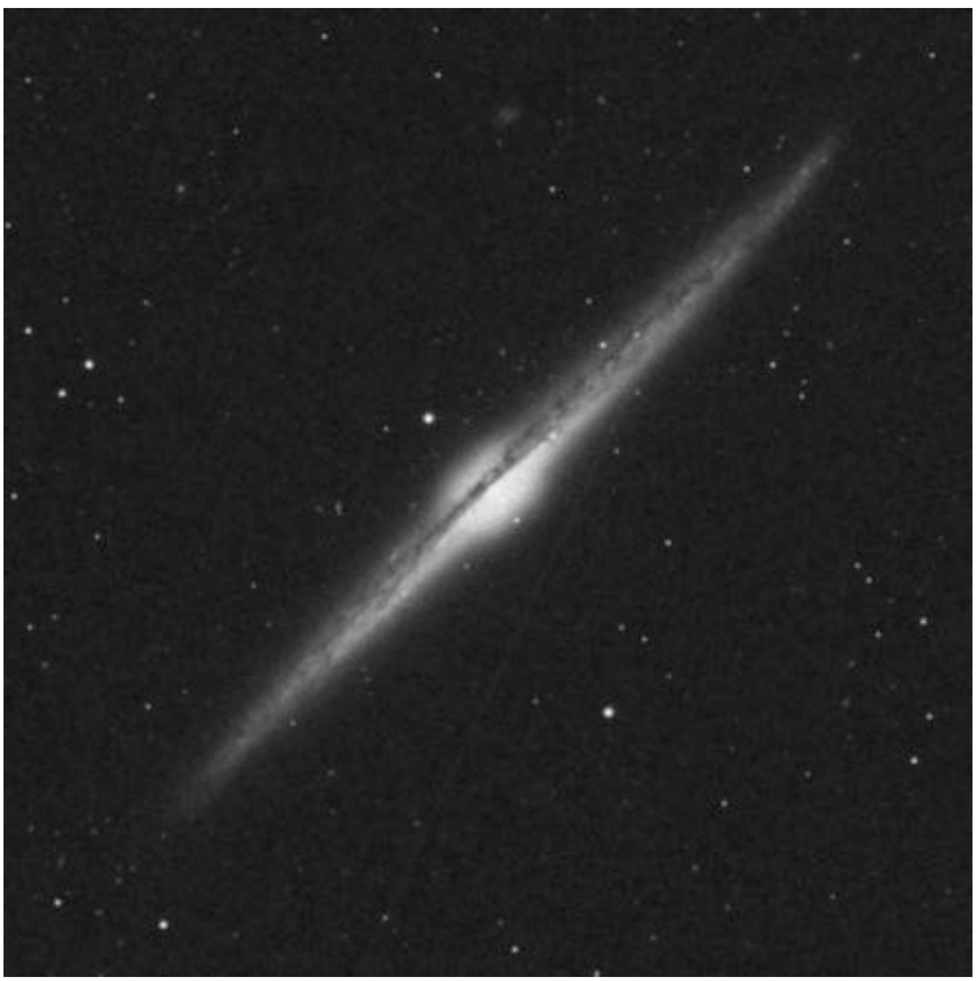
No galactic tour through Coma Berenices would be complete without visiting one of the most incredible "things that Messier missed." You'll find NGC 4565 located less than two degrees east of 17 Comae...

Residing at a distance of around 30 million light-years, this large 10th magnitude galaxy is probably one of the finest edge-on structures you will ever see. Perfectly suited for smaller scopes, this ultra-slender galaxy with the bright core has earned its nickname of "The Needle." Although photographs sometimes show more than what can be observed visually, mid-to-large aperture can easily trace out NGC 4565's full photographic diameter.

Although Lord Rosse in 1855 saw the nucleus of the "Needle" as stellar, most telescopes will resolve a bulging core region with a much sharper point in the center and a dark dustlane upon aversion. The core itself has been extensively studied for its cold gas and emission lines, pointing to the fact that it has a barred structure. This is much how the Milky Way would look if viewed from the same angle! It, too, shines with the light of 30 billion stars...

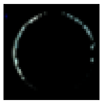
Chances are NGC 4565 is an outlying member of the Virgo Cluster, but its sheer size points to the fact that it is probably closer than any of the others. If we were to gauge it at a distance of 30 million years as is accepted, its diameter would be larger than any galaxy yet known!

Get acquainted with it tonight...



NGC 4565
Credit: Palomar Observatory, courtesy of Caltech

MAY 15
TUESDAY



AX Microscopii/Lacaille 8760
Credit: Palomar Observatory, courtesy of Caltech

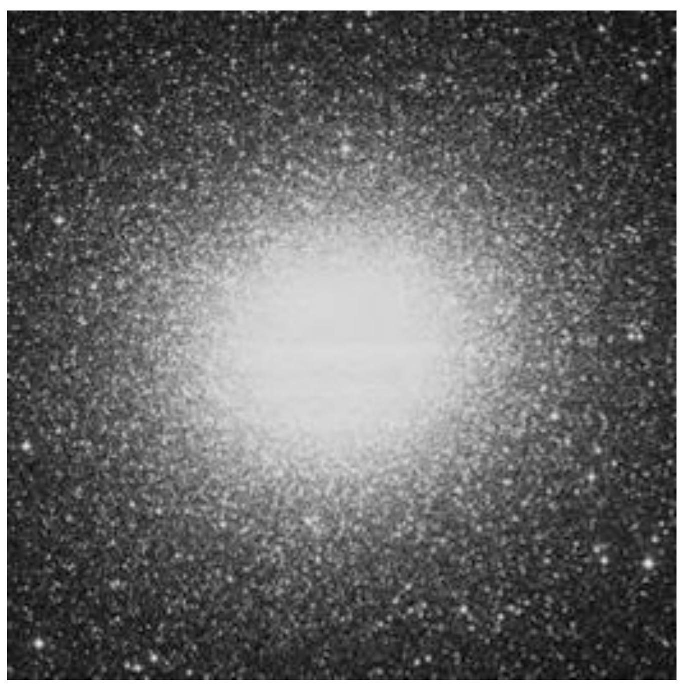
Tonight we'll take a closer look at the work of Abbé Nicholas Louis de la Caille (or de Lacaille). Born in 1731, the French astronomer and mapmaker was the first to demonstrate Earth's bulge at its equator. From 1751 to 1753, he had the great fortune to observe southern skies and, putting his cartography skills to use, he mapped the southern skies and established the 14 constellations that remain in use to this day - including Musca. Even though Lacaille was best known for the constellation names, he and his productive half-inch telescope also cataloged 9766 stars in his two year observing period. Of these, one stands out for good reason—Lacaille 8760.

Its designation is also AX Microscopii, and it is a dwarf red flare star which resides only 12.9 light-years from us. While it might not seem that important, it is the target of interferometer studies in search of planets that may have formed in a "habitable zone" around life-giving stars similar to our own. Even though AX is slightly smaller than Sol, this cool main sequence star might be inhospitable due to its daily flare activity.

Since it will be awhile before the constellation of Microscopium rises high enough for southern observers to capture this star, let's have a look at an object from Lacaille's catalog known as I.5.

Located less than two handspans south of Spica, most of us know this globular cluster best as NGC 5139—or Omega Centauri. As the most luminous of all globular clusters, Lacaille reported it as a "nebula in Centaurus; with simple view, it looks like a star of 3rd magnitude viewed through light mist, and through the telescope like a big comet badly bounded." Yet, through even the most modest of today's telescopes, Omega Centauri will explode into a fury of stars. Located about 17,000 light-years away, it took around 2 million years to form and it is believed that it may be the remnant of another galaxy's core captured by our own. With more than one million members, it's the size of a small galaxy in itself!

While this object is very low to northern observers, it is not impossible for those who live lower than 40 degrees north. Our atmosphere will rob this giant of a galaxy of some of its beauty, but I encourage you to try! It's a sight you'll never forget...



Omega Centauri
Credit: Palomar Observatory, courtesy of Caltech

MAY 16
WEDNESDAY

Tonight is New Moon and we're heading for the galaxy fields of Virgo about four fingerwidths east-southeast of Beta Leonis. As part of Markarian's Chain, this set of galaxies can all be fitted within the same field of view with a 32mm eyepiece and a 12.5" scope, but not everyone has the same equipment. Set your sights toward M84 and M86 and let's discover!

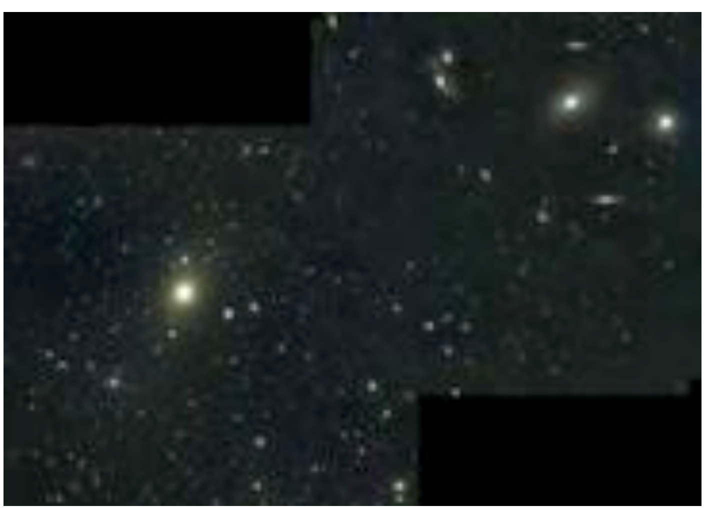
Good binoculars and small telescopes reveal this pair with ease as a matched set of ellipticals. Mid-sized telescopes will note the western member of the pair—M84—is seen as slightly brighter and visibly smaller. To the east and slightly north is larger M86—whose nucleus is broader, and less intensely brilliant. In a larger scope, we see the galaxies literally "leap" out of the eyepiece at even the most modest magnifications. Strangely though, additional structure fails to be seen.

As aperture increases, one of the most fascinating features of this area becomes apparent. While studying the bright galactic forms of M84/86 with direct vision, aversion begins to welcome many other mysterious strangers into view. Forming an easy triangle with the two Messiers and located about 20 arc-minutes south lies NGC 4388. At magnitude 11.0, this edge-on spiral has a dim star-like core to mid-sized scopes, but a classic edge-on structure in larger ones.

At magnitude 12, NGC 4387 is located in the center of a triangle formed by the two Messiers and NGC 4388. NGC 4387 is a dim galaxy—hinting at a stellar nucleus to smaller scopes, while the larger ones will see a very small face-on spiral with a brighter nucleus. Just a breath north of M86 is an even dimmer patch of nebulosity—NGC 4402—which needs higher magnifications to be detected in smaller scopes. Large apertures at high power reveal a noticeable dust lane. The central structure forms a curved "bar" of light. Luminosity appears evenly distributed end to end, while the dust lane cleanly separates the central bulge of the core.

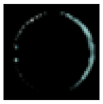
East of M86 are two brighter NGC galaxies—4435 and 4438. Through average scopes, NGC 4435 is easily picked out at low power with a simple star-like core and wispy round body structure. NGC 4438 is dim, but even large apertures make elliptical galaxies a bit boring. The beauty of NGC 4435 and NGC 4438 is simply their proximity to each other. 4435 shows true elliptical structure, evenly illuminated, with a sense of fading toward the edges... But 4438 is quite a different story! This elliptical is much more elongated. A highly conspicuous wisp of galactic material can be seen stretching back toward the brighter, nearby galaxy pair M84/86.

Happy hunting!



Wide field image of the Virgo galaxy cluster with M84/86 region to the upper right
Credit: NOAO/AURA/NSF

MAY 17
THURSDAY



Norman Lockyer
(widely used public image)

Today in 1835, J. Norman Lockyer was born. While that name might not stand out, Lockyer was the first to note previously unknown absorption lines while making visual spectroscopic studies of the Sun in 1868. Little did he know at the time, he had correctly identified the second most abundant element in our universe—helium—an element not discovered on Earth until 1891! Also known as the "Father of Archeoastronomy," Sir Lockyer was one of the first to make the connection with ancient astronomical structures such as Stonehenge and the Egyptian pyramids. (As a curious note, 14 years after Lockyer's notation of helium, a sun-grazing comet made its appearance in photographs of the solar corona taken during a total eclipse in 1882... It hasn't been seen since.)

If you would like to see a helium rich star, look no further tonight than Alpha Virginis—Spica. As the sixteenth brightest star in the sky, this brilliant blue/white "youngster" appears to be about 275 light-years away and is about 2300 times brighter than our own Sun. Although we cannot see it visually, Spica is a double star. Its spectroscopic companion is roughly half its size and is also helium rich.

Now, shake your fist at Spica... Because that's all it takes to find the awesome M104, eleven degrees due west. (If you still have trouble finding M104, don't worry. Try this trick! Look for the upper left hand star in the rectangle of Corvus—Delta. Between Spica and Delta is a diamond-shaped pattern of 5th magnitude stars. Aim your scope or binoculars just above the one furthest south.)

Also known as the "Sombrero," this gorgeous 8th magnitude galaxy was discovered by Pierre Méchain in 1781, added by hand to Messier's catalog and observed independently by Herschel as H I.43—who was probably the first to note its dark inclusion. The Sombrero's rich central bulge is comprised of several hundred globular clusters and can be hinted at in just large binoculars and small telescopes. Large aperture will revel in this galaxy's "see through" qualities and bold, dark dustlane—making it a seasonal favorite!

M104: The Sombrero
Credit: R. Jay GaBany

On this day in 1910, Comet Halley transited the Sun, but could not be detected visually. Since the beginning of astronomical observation, transits, eclipses and occultations have provided science with some very accurate determinations of size. Since Comet Halley could not be spotted against the solar surface, we knew almost a century ago that the nucleus had to be smaller than about 100 km.

Tonight the slender crescent Moon will make a very brief appearance at dusk along the western skyline. If your atmosphere is very steady, why not set the telescope down on it and look for some very unusual features that will soon wash out as the Sun overtakes the moonscape. Almost central along the eastern lunar limb, look for Mare Smythii and Mare Marginis to its north. Between them you will see the long oval crater Neper bordered by Jansky at the very limb.

Once it has set and the sky has become fully dark, it is time to get serious. For the large telescope and seasoned observer, your challenge for this evening will be five and a half degrees south of Beta Virginis and one half degree west. Classified as Arp 248, and more commonly known as "Wild's Triplet," these three very small interacting galaxies are a real treat! Best with around a 9mm eyepiece, use wide aversion and try to keep the star just north of the trio at the edge of the field to cut glare. Be sure to mark your Arp Galaxy challenge list!

Arp 248: Wild's Triplet
Credit: Adam Block/NOAO/AURA/NSF

MAY 19
SATURDAY

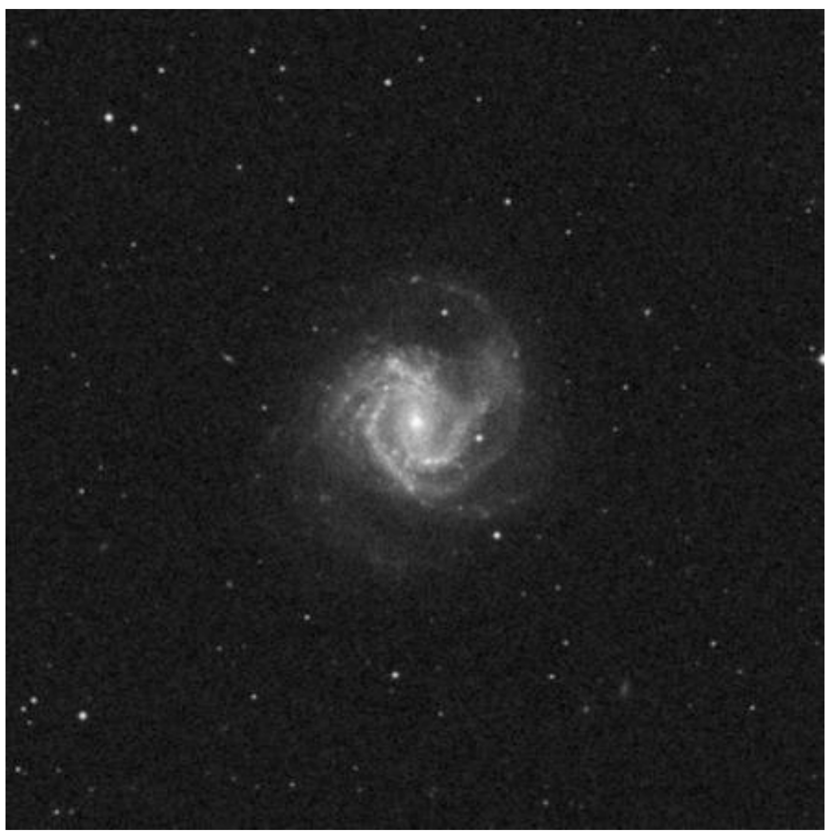
Tonight the Moon is a little bit older and brilliantly lit with earthshine. Power up and let's go look for crater named for historian and theologian Denis Pétau—Petavius!

Located almost centrally along the terminator in the southeast quadrant, a lot will depend tonight on your viewing time and the age the moon itself. Perhaps when you look, you'll see 177 kilometer diameter Petavius cut in half by the terminator. If so, this is a great time to take a close look at the small range of mountain peaks contained in its center as well as a deep rima which runs for 80 kilometers across its otherwise fairly smooth surface. To the east lies a long furrow in the landscape. This deep runnel is Palitzsch and its Valles. While the primary crater that forms this deep gash is only 41 kilometers wide, the valley itself stretches for 110 kilometers. Look for crater Haas on Petavius' southern edge with Snellius to the southwest and Wrottesley along its northwest wall.

Once the Moon has quit the sky, let's take a look about five degrees north of Eta Virginis for M61.

This 9.7 magnitude galaxy was discovered on May 5, 1779 by man named Barnabus Oriani while following the same comet as Charles Messier, who also observed it on the same night and mistook it for the comet itself for two additional nights. (Nice shootin', Chuck!) Happily enough, Mr. Herschel also assigned it his own designation of H I.139 seven years later.

It is one of the largest galaxies of the Virgo Cluster and small telescopes will make out a faint, round glow with a brighter nucleus, while larger aperture will see the core as more stellar with notable spiral structure. Four supernova events have been observed in M61, as recently as 1999, and surprisingly two of them were exactly 35 years apart... But don't confuse an event with foreground stars!



M61
Credit: Palomar Observatory, courtesy of Caltech

MAY 20
SUNDAY

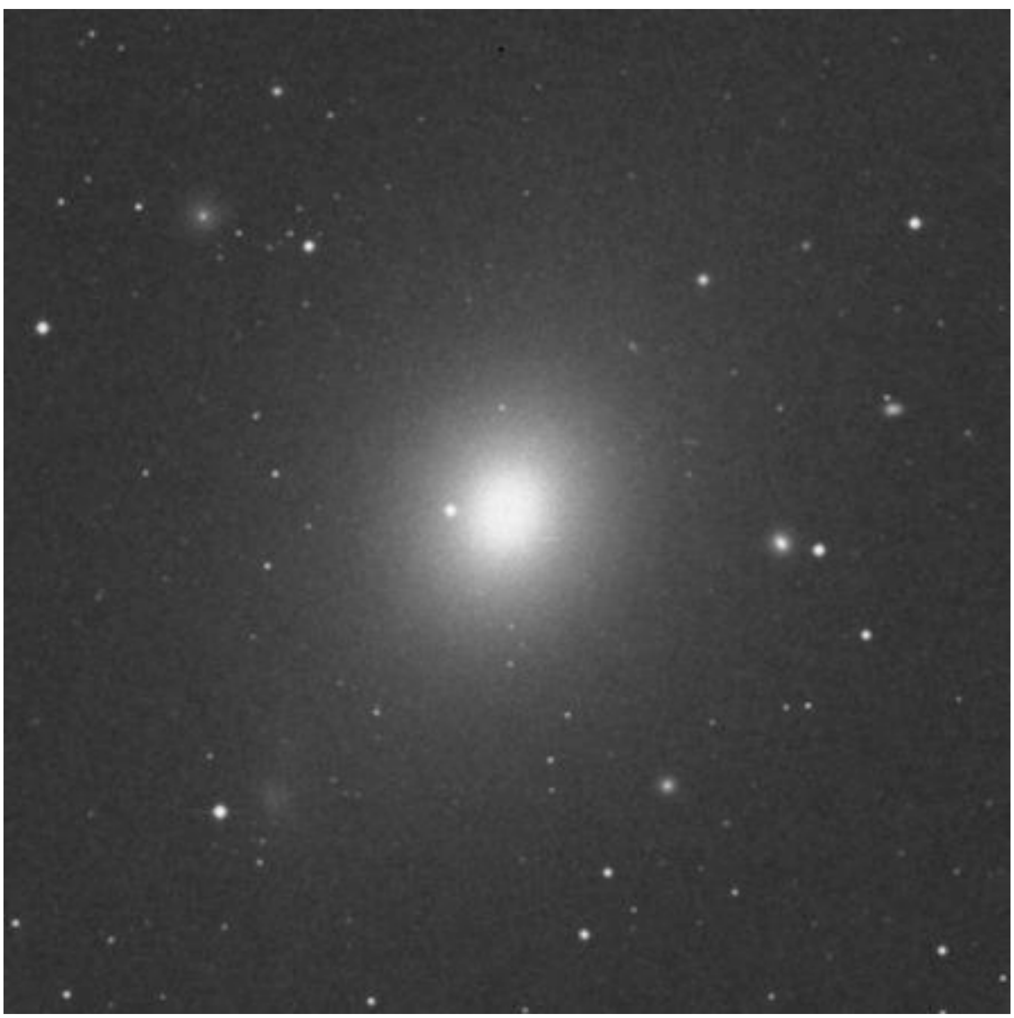
Celestial scenery alert! Tonight as the Sun leaves the sky, look west as the Moon, Pollux and Venus make beautiful and close companions in the twilight.

If you chose to scope tonight, we're going in search of another lunar club challenge that will prove difficult because you'll be working without a map. Relax! This will be much easier than you think. Starting at Mare Crisium, move along the terminator to the north following the chain of craters until you identify a featureless oval that looks similar to Plato seen on a curve. This is Endymion...and if you can't spot it tonight don't worry. We'll take a look in the days ahead at some features that will point you to it!

Since tonight will be our last chance to galaxy hunt for awhile, let's take a look at one of the brightest members of the Virgo Cluster—M49.

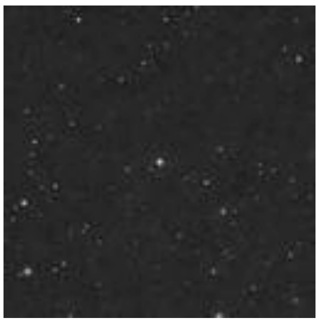
Located about 8 degrees northwest of Delta Virginis almost directly between a pair of 6th magnitude stars, giant elliptical M49 holds the distinction of being the first galaxy in the Virgo cluster to be discovered—and the second beyond our local group. At magnitude 8.5, this type E4 galaxy will appear as an evenly illuminated egg shape in almost all scopes, and as a faint patch in binoculars. While a possible supernova event occurred in 1969, don't confuse the foreground star noted by Herschel with something new!

Although most telescopes won't be able to pick this region apart—especially with the Moon so near, there are also many fainter companions near M49, including NGC 4470. But a sharp-eyed observer named Halton Arp noticed them and listed them as "Peculiar Galaxy 134"—one with "fragments!"



M49
Credit: Palomar Observatory, courtesy of Caltech

MAY 21
MONDAY



W Virginis
Credit: Palomar Observatory, courtesy of Caltech

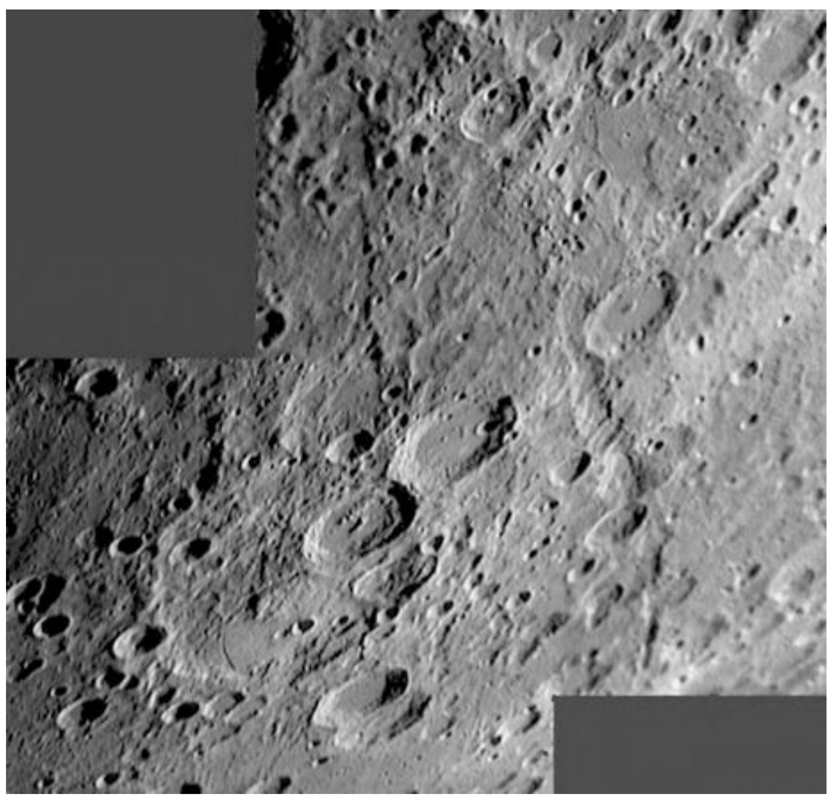
In 1961, United States President John F. Kennedy launches the country on a journey to the Moon as he makes one of his most famous speeches to Congress: "I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space..."

Tonight let's take our own journey to the Moon as we look at a beautiful series of craters—Fabricius, Metius and Rheita.

Bordered on the south by shallow Jannsen, lunar club challenge Fabricius is a 78 kilometer diameter crater highlighted by two small interior mountain ranges. To its northeast is Metius, which is slightly larger with a diameter of 88 kilometers. Look carefully at the two. Metius has much steeper walls, while Fabricius shows differing levels and heights. Metius' smooth floor also contains a very prominent B crater on the inside of its southeast crater wall.

Further northeast is the lovely Rheita Valley which stretches almost 500 kilometers and appears more like a series of confluent craters than a fault line. 70 kilometer diameter crater Rheita is far younger than this formation because it intrudes upon it. Look for a bright point inside the crater which is its central peak.

While the Moon is still west, let's have a look at telescopic star W Virginis located about three and a half degrees southwest of Zeta (RA 13 26 01.99 Dec -03 22 43.4). This 11,000 light-year distant Cepheid type variable is oddly enough a Population II star that lies outside the galactic plane. This expanding and contracting star goes through its changes in a little over 17 days and will vary between 8th and 9th magnitude. Although it is undeniably a Cepheid, it breaks the rules by being both out of place in the cosmic scheme and displaying abnormal spectral qualities!



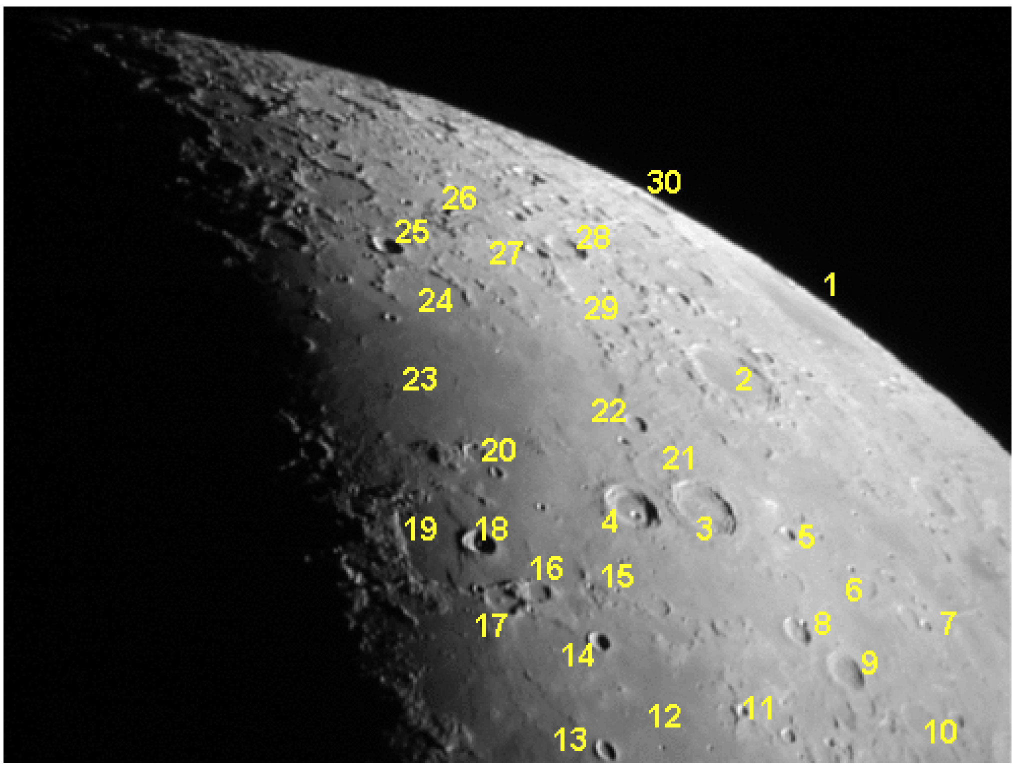
Fabricius, Metius and Rheita
Credit: Alan Chu

MAY 22
TUESDAY

Tonight the Moon will be our companion. Now well risen above atmospheric disturbance, this would be a great time to have a look for several lunar club challenges that you might have missed.

Most prominent of all will be two craters to the north named Atlas and Hercules. The eastern-most Atlas was named for the mythical figure which bore the weight of the world on his shoulders, and the crater spans 87 kilometers and contains a vivid Y-shaped rima in the interior basin. Western Hercules is considerably smaller at 69 kilometers in diameter and shows a deep interior crater called G. Power up and look for the tiny E crater which marks the southern crater rim. North of both is another unusual feature which many observers miss. It is a much more eroded and far older crater which only shows a basic outline and is only known as Atlas E.

Since we're here, let's take a crater walk and see how many features we can identify… Good luck and clear skies!



(1) Mare Humboldtianum, (2) Endymion, (3) Atlas, (4) Hercules, (5) Chevalier, (6) Shuckburgh, (7) Hooke, (8) Cepheus, (9) Franklin, (10) Berzelius, (11) Maury, (12) Lacus Somniorum, (13) Daniel, (14) Grove, (15) Williams, (16) Mason, (17) Plana, (18) Burg, (19) Lacus Mortis, (20) Baily, (21) Atlas E, (22) Keldysh, (23) Mare Frigoris, (24) Democritus, (25) Gartner, (26) Schwabe, (27) Thales, (28) Strabo, (29) de la Rue, (30) Hayn.

Image Credit: Greg Konkel
Annotations: Tammy Plotner

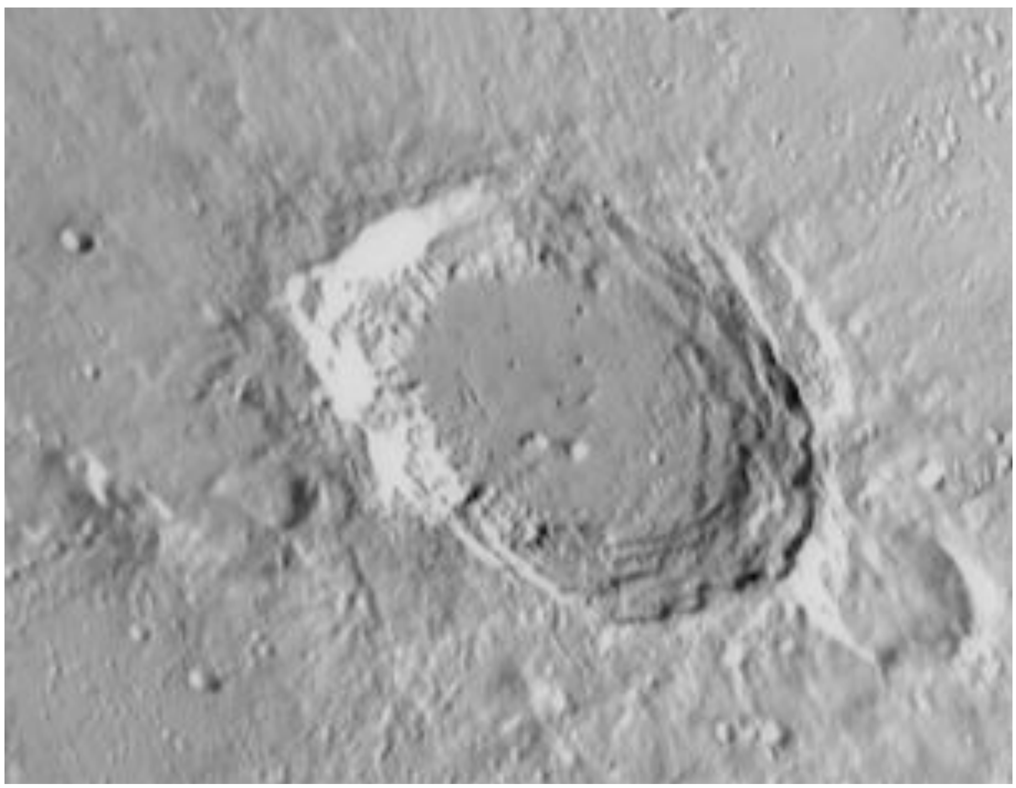
MAY 23
WEDNESDAY

Iota Virginis
Credit: Palomar Observatory, courtesy of Caltech

Tonight no two lunar features in the north will be more prominent than Aristoteles and Eudoxus. Viewable even in small binoculars, let's take a closer look at larger Aristoteles to the north.

As a Class I crater, this ancient old beauty has some of the most massive walls of all lunar features. Named for the great philosopher, it stretches across 87 kilometers of lunar landscape and drops below the average surface to a depth of 366 meters—a height which is similar to Earth's tallest waterfall, the Silver Cord Cascade. While it has a few scattered interior peaks, the crater floor remains almost unscarred. As a telescopic lunar club challenge, be sure to look for a much older crater that sits on Aristoteles eastern edge. Tiny Mitchell is extremely shallow by comparison and only spans 30 kilometers. Look carefully at the formation, for although Aristoteles overlaps Mitchell, the smaller crater is actually part of the vast system of ridges which supports the larger.

Now let's have a look at Iota Virginis. While there is nothing particularly special about this spectral F type star, it does reside in a very interesting field for low power. Enjoy the colors!



Aristoteles
Credit: Wes Higgins

MAY 24
THURSDAY

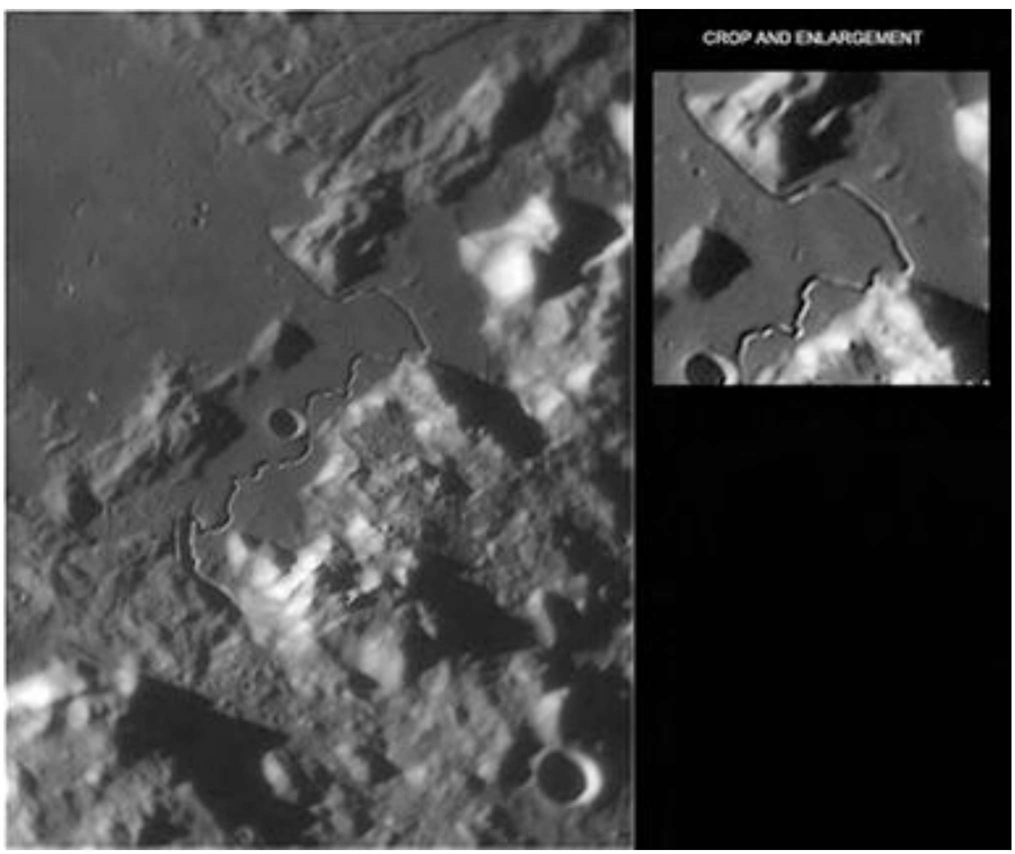
While the Moon moves quietly towards Virgo, our first challenge for the evening will be a telescopic one on the lunar surface known as the Hadley Rille. Using our past knowledge of Mare Serenitatis, look for the break along its western shoreline that divides the Caucasus and Apennine mountain ranges. Just south of this break is the bright peak of Mons Hadley. You'll find this area of highest interest for several reasons, so power up as much as possible.

Impressive Mons Hadley measures about 24 by 48 kilometers at its base and reaches up an incredible 4572 meters. If this mountain was indeed caused by volcanic activity on the lunar surface, this would make it comparable to some of the very highest volcanically caused peaks on Earth, such as Mount Shasta or Mount Rainer. To its south is the secondary peak Mons Hadley Delta—the home of the Apollo 15 landing site just a breath north of where it extends into the cove created by Palus Putredinus.

Apollo 15 at Hadley Rille
Credit: NASA

Along this ridgeline and smooth floor, look for a major fault line known as the Hadley Rille, winding its way across 120 kilometers of lunar surface. In places, the rille spans 1500 meters in width and drops to a depth of 300 meters below the surface. Believed to have been formed by volcanic activity some 3.3 billion years ago, we can see the impact that lower gravity has had on this type of formation, since earthly lava channels are less than 10 kilometers long and only around 100 meters wide.

During the Apollo 15 mission, Hadley Rille was visited at a point where it was only 1.6 kilometers wide—still a considerable distance as seen in respect to astronaut James Irwin and the lunar rover. Over a period of time, its lava may have continued to flow through this area, yet it remains forever buried beneath years of regolith.



Hadley Rille
Credit: Wes Higgins

MAY 25
FRIDAY

Gamma Virginis: Porrima
Credit: Palomar Observatory, courtesy of Caltech

Tonight on the Moon we'll be looking for another challenging feature and a crater which conjoins it—Stofler and Faraday.

Located along the terminator to the south, crater Stofler was named for Dutch mathematician and astronomer Johan Stofler. Consuming lunar landscape with an immense diameter of 126 kilometers and dropping 2760 meters below the surface, Stofler is a wonderland of small details in an eroded surrounding. Breaking its wall on the north is Fernelius, but sharing the southeast boundary is Faraday.

Named for English physicist and chemist Michael Faraday, it is more complex and deeper at 4090 meters, but far smaller at 70 kilometers in diameter. Look for myriad smaller strikes which bind the two together!

When you're done, let's have a look at another delightful pair that's joined together—Gamma Virginis...

Better known as Porrima, this is one cool binary with almost equal spectral types and brightnesses. Discovered by Bradley and Pound in 1718, John Herschel was the first to predict this pair's orbit in 1833 and state that one day they would become inseparable to all but the very largest of telescopes—and he was right. In 1920 the A and B stars had reached their maximum separation, and during 2007 they will be as close together as they will ever be. Observed as a single star in 1836 by William Herschel, its 171 year periastron will put Porrima in the exact position now as it was when Sir William saw it!

Stofler and Faraday
Credit: Wes Higgins

MAY 26
SATURDAY

Are you ready to explore some more history? Then tonight have a look at the Moon and identify Alphonsus—it's the centermost in a line of rings which looks much like the Theophilus, Cyrillus and Catharina trio.

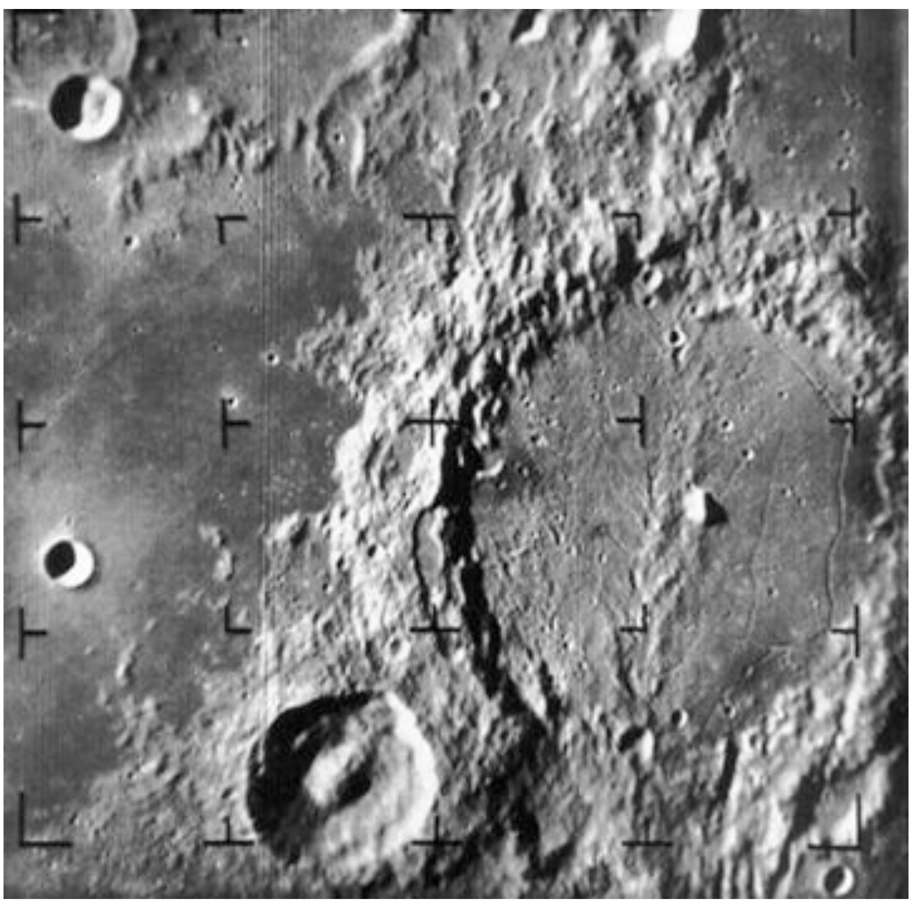
Alphonsus is a very old, Class V crater which spans 118 kilometers in diameter and drops below the surface by about 2730 meters and contains a small central peak. Partially flooded, Eugene Shoemaker had made of study of this crater's formation and found dark haloes on the floor. Again, this could be attributed to volcanism and Shoemaker believed them to be maar volcanoes, and the haloes to be dark ash. Power up and look closely at the central peak, for not only did Ranger 9 hard land just northeast, but this is the only area on the Moon where an astronomer has observed a change and back up that observation with photographic proof.

On November 2, 1958 Nikolai Kozyrev's long and arduous study of Alphonsus was about to be rewarded. Some two years earlier Dinsmore Alter had taken a series of photographs from the Mt. Wilson 60" reflector that showed hazy patches in this area that could not be accounted for. Night after night, Kozyrev continued to study at the Crimean Observatory—but with no success. During the process of guiding the scope for a spectrogram the unbelievable happened—a cloud of gas containing carbon molecules had been captured!

Selected as the last target for the Ranger photographic mission series, Alphonsus delivered 5814 spectacular high-resolution images of this mysterious region before Ranger 9 splattered nearby.

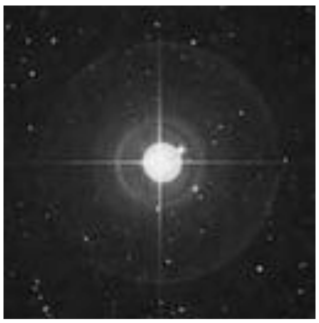
Capture it yourself tonight!

Alphonsus central peak taken 54 seconds before Ranger 9 impact
Credit: NASA



Ranger 9 image of Alphonsus taken 3 minutes before impact
Credit: NASA

MAY 27
SUNDAY

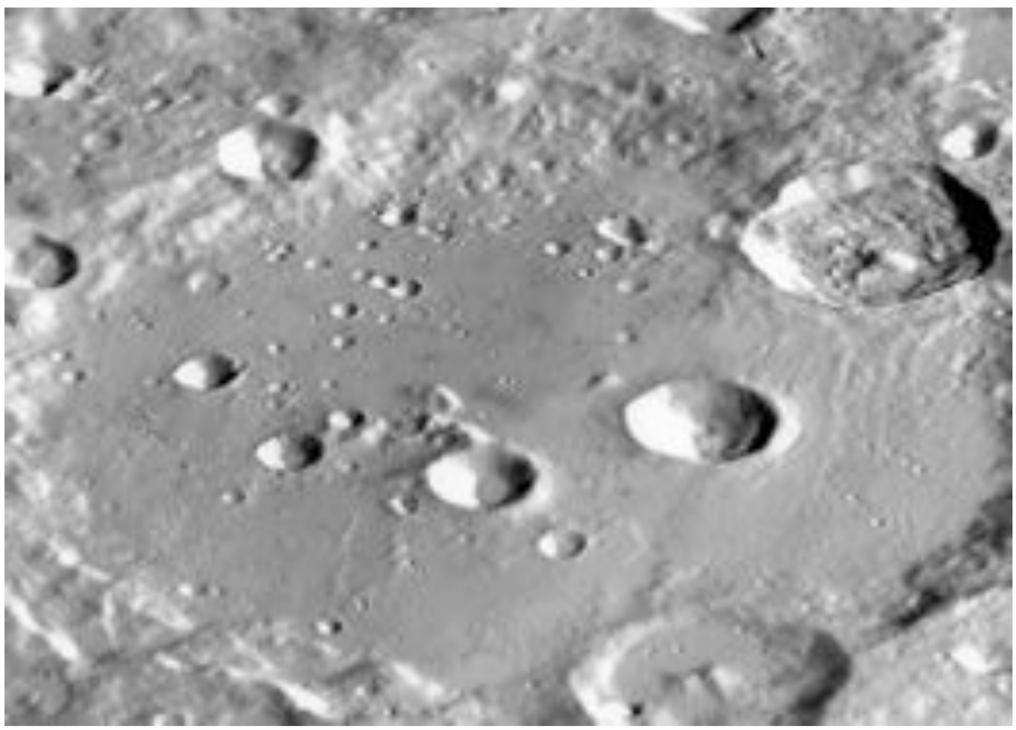


Theta Virginis
Credit: Palomar Observatory, courtesy of Caltech

As we begin the evening, let's have a look at awesome crater Clavius. As a huge mountain-walled plain, Clavius will appear near the terminator tonight in the lunar southern hemisphere, rivaled only in sheer size by similar structured Deslandres and Baily. Rising 1646 meters above the surface, the interior wall slopes gently downward for a distance of almost 24 km and a span of 225 km. Its crater-strewn walls are over 56 km thick!

Clavius is punctuated by many pockmarks and craters; the largest on the southeast wall is named Rutherford. Its twin, Porter, lies to the northeast. Long noted as a test of optics, Clavius crater can offer up to thirteen such small craters on a steady night at high power. How many can you see?

If you want to continue with tests of resolution, why not visit nearby Theta Virginis? It might be close to the Moon, but it's 415 light-years away from Earth! The primary star is a white A-type subgiant, but it's also a spectroscopic binary of two companions which orbit each other about every 14 years. In turn, this is orbited by a 9th magnitude F-type star which is a close 7.1 arc-seconds away from the primary. Look for the fourth member of the Theta Virginis system well away at 70 arc-seconds, but shining at a feeble magnitude 10.4.



Clavius
Credit: Wes Higgins

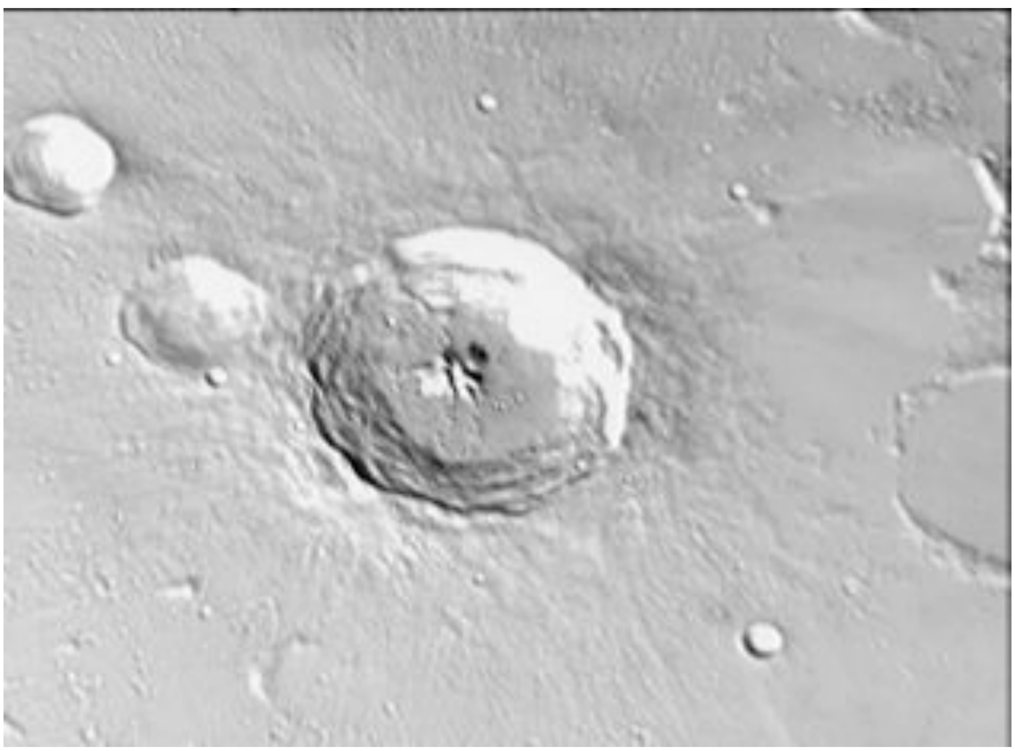
On this day in 1959, the first primates made it to space. Abel (a rhesus monkey) and Baker (a squirrel monkey) lifted off in the nose cone of an Army Jupiter missile and were carried to sub-orbital flight. Recovered unharmed, Abel died just three days later from anesthesia during an electrode removal, but Baker lived on to a ripe old age of 27.

Tonight let's monkey around the stars as we head towards the Moon and see Spica, just a little more than a degree to the north. Although at first glance tonight crater Copernicus will try to steal the scene, head further south to capture another lunar club challenge—Bullialdus. Even binoculars can make out this crater with ease near the center of Mare Nubium. If you're scoping—power up—this one is fun! Very similar to Copernicus, note Bullialdus' thick, terraced walls and central peak. If you examine the area around it carefully, you can note it is a much newer crater than shallow Lubiniezsky to its north and almost non-existent Kies to the south. On Bullialdus' southern flank, it's easy to make out its A and B craters, as well as the interesting little Koenig to the southwest.

Now let's head about four fingerwidths northwest of Beta Virginis for another unusual star—Omega. Classed as an M-type red giant, this 480 light-year distant beauty is also an irregular variable which fluxes by about half a magnitude. Although you won't notice much change in this 5th magnitude star, it has a very pretty red coloration and is worth the time to view.

Abel
Credit: NASA

Omega Virginis
Credit: Palomar Observatory, courtesy of Caltech



Bullialdus
Credit: Wes Higgins

MAY 29
TUESDAY

Today in 1919, a total eclipse of the Sun occurred and stellar measurements taken along the limb agreed with predictions based on Einstein's General Relativity theory—the first such confirmation. Although we call it gravity, spacetime curvature deflects the light of stars near the limb, causing their apparent positions to differ slightly. Unlike today's astronomy, at that time you could only observe stars near the Sun's limb (within less than an arc second) during an eclipse. It's interesting to note that even Newton had his own theories on light and gravitation which predicted some deflection!

Tonight would be a wonderful opportunity for Moongazers to return to the surface and have a look at the peaceful Sinus Iridum area. If you've been clouded out before, be sure to have a look for telescopic lunar club challenges—Promontoriums Heraclides and LaPlace.

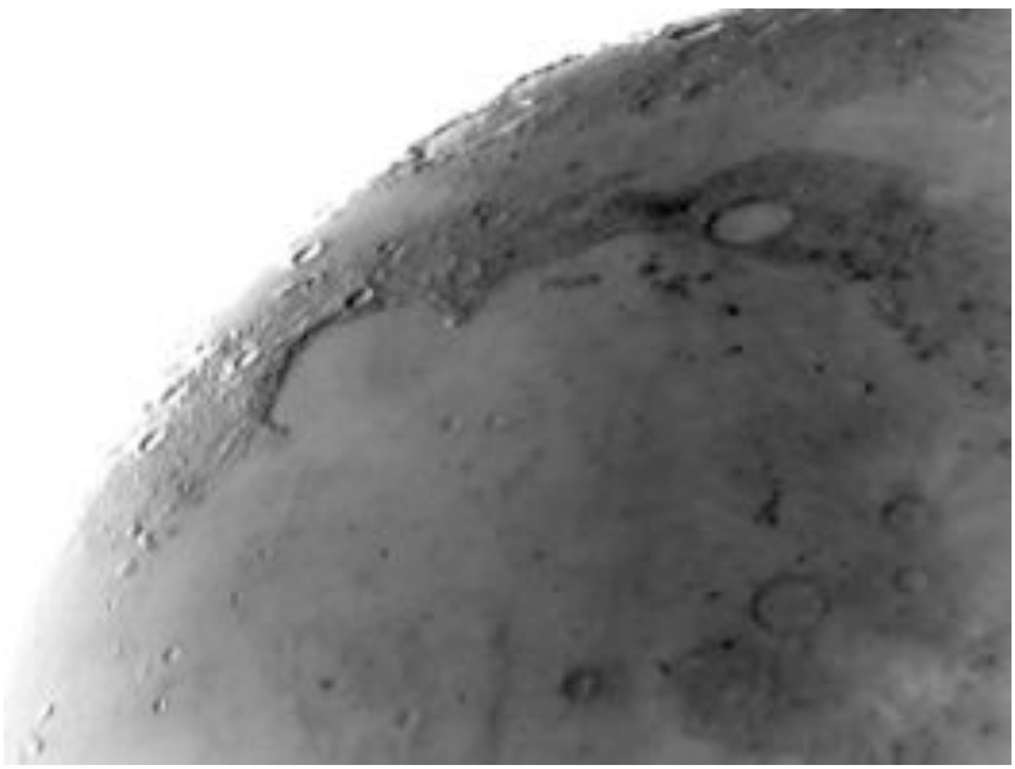
70 Virginis
Credit: Palomar Observatory, courtesy of Caltech

If you're up for a bit more of a challenge, then let's head about 59 light-years away in Virgo for star 70. You'll find it located about 6 degrees northeast of Eta and right in the corner of the Coma, Boötes, and Virgo border. So what's so special about this G-type, very normal-looking 5th magnitude star?

It's a star that has a planet.

Long believed to be a spectroscopic binary because of its 117 day shifts in color, closer inspection has revealed that 70 Virginis actually has a companion planet. Roughly 7 times larger than Jupiter and orbiting no further away than Mercury from its cooler-than-Sol parent star, 70 Virginis B just might well be a planet cool enough to support water in its liquid form.

How "cool" is that? Try about 85 degrees Celsius...



Sinus Iridum
Credit: Greg Konkel

MAY 30
WEDNESDAY

Tonight let's have a look at a very bright and changeable lunar feature that is often over-looked. Starting with the great grey oval of Grimaldi, let your eyes slide along the terminator towards the south until you encounter the bright crater Byrgius.

Named for Joost Burgi, who made a sextant for Tycho Brahe, this "seen on the curve" crater is really quite large with a diameter of 87 kilometers. Perhaps one of the most interesting features of all is high albedo Byrgius A, which sits along its east wall line and produces a wonderfully bright ray system. While it is not noted as a lunar club challenge, it's a great crater to help add to your knowledge of selenography!

Now let's add to our double star list as we hunt down Zeta Boötes located about 7 degrees southeast of Arcturus. This is a delightful multiple star system for even small telescopes.

Byrgius
Credit: Alan Chu\

Zeta Boötes
Credit: Palomar Observatory, courtesy of Caltech

MAY 31
THURSDAY

While tonight the Moon will appear about as full as it gets to some observers, the date won't be "official" until tomorrow. While the glare will make it difficult to do many things, we can still have a look at other bright objects! Let's start tonight by going just north of Zeta Boötes for Pi. With a wider separation, this pair of whites will easily resolve to the smaller telescope.

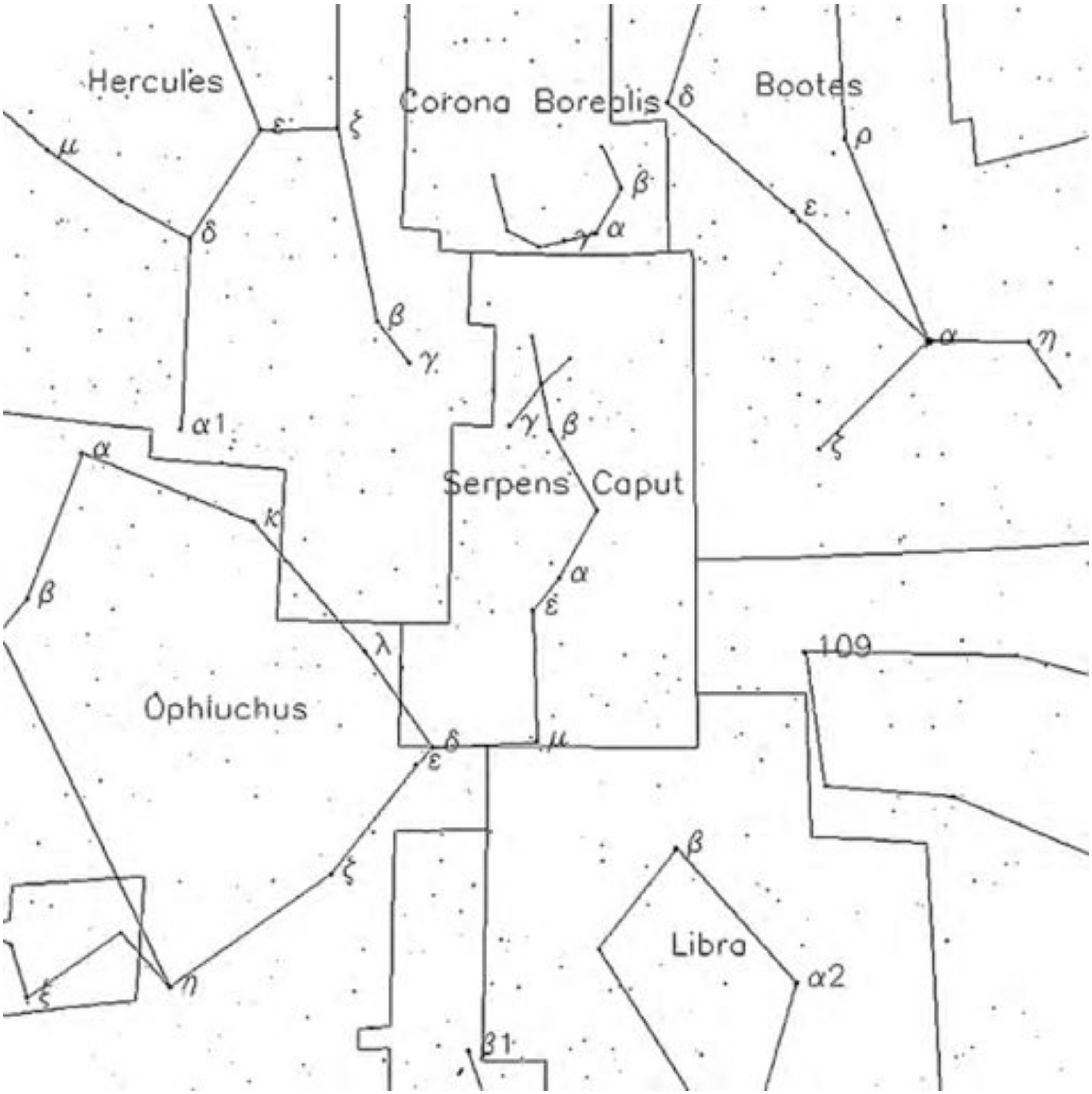
Now skip up northeast about a degree for Omicron Boötes. While this is not a multiple system, it makes for a nice visual pairing for a binocular challenge. For telescopes, the southeastern star holds interest as a small asterism.

Continue northeast another two degrees to discover Xi Boötes. This one is a genuine multiple star system with magnitude 5 and 7 companions. Not only will you enjoy this G-type sun for its duplicity, but for the fine field of stars in which it resides!

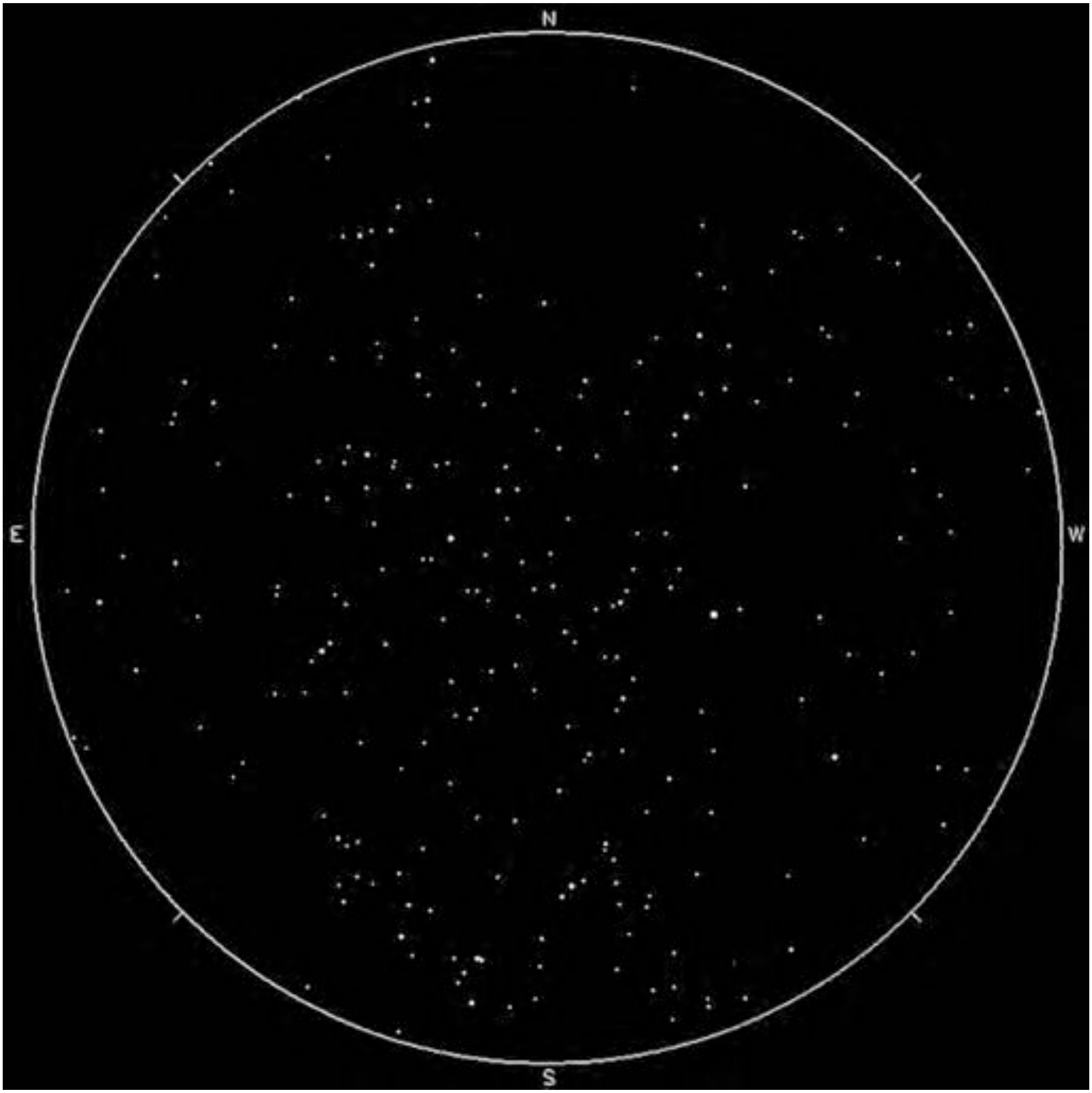
Omicron Boötes
Credit: Palomar Observatory, courtesy of Caltech

Xi Boötes
Credit: Palomar Observatory, courtesy of Caltech

Pi Boötes
Credit: Palomar Observatory, courtesy of Caltech


Hercules
Corona Borealis
Bootes
Serpens Caput
Ophiuchus
Libra
109
α1
α2
β1

JUNE 2007



JUN 1
FRIDAY

Tonight the Moon is full. Often referred to as the Full Strawberry Moon, this name was a constant to every Algonquin tribe in North America. But, our friends in Europe referred to it as the Rose Moon. The North American version came about because the short season for harvesting strawberries comes each year during the month of June—so the full Moon that occurs during that month was named for this tasty red fruit!

Tonight before it rises and the light commands the sky, let's have a look at a tasty red star—R Hydrae. You'll find it about a fistwidth south of Spica or about a fingerwidth west of Gamma Hydrae.

R was the third long term variable star to be discovered and it is credited to Maraldi in 1704. While it had been observed by Hevelius some 42 years earlier, it was not recognized immediately because its changes happen over more than a year. At maximum, R reaches near 4th magnitude—but drops well below human eye perception to magnitude 10. During Maraldi's and Hevelius' time, this incredible star took over 500 days to change, but it has speeded up to around 390 days in the present century.

R Hydrae
Credit: Palomar Observatory, courtesy of Caltech

Why such a wide range? Science isn't really sure. R Hydrae is a pulsing M-type giant whose evolution may be progressing more rapidly than expected due to changes in structure. What we do know is that it is around 325 light-years away and is approaching us at around 10 kilometers per second.

In the telescope, R will have a pronounced red coloration which deepens near minima. Nearby is 12th magnitude visual companion star Ho 381, which was first measured for position angle and distance in 1891. Since that time no changes in separation have been noted, which leads us to believe that the pair may be a true binary.

Nearside of the Moon as imaged by Apollo 11
Credit: NASA

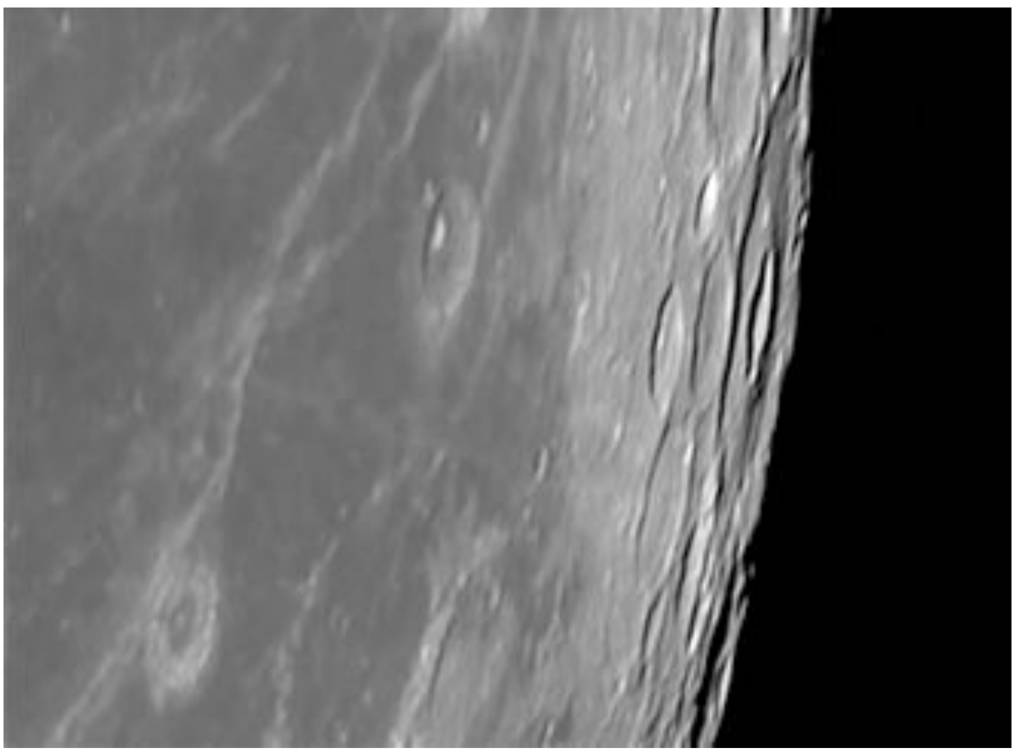
JUN 2
SATURDAY

Before the Moon rises tonight, let's return again to R Hydrae. While observing a variable star with either the unaided eye, binoculars, or a telescope can be very rewarding, it's often quite difficult to catch changes in long-term variables, because there are times when the constellation is not visible. While R Hydrae is unique in color, let's drop about half a degree to the southeast to visit another variable star—SS Hydrae.

SS is a quick change artist—the Algol-type. While you will need binoculars or a telescope to see this normally 7.7 magnitude star, at least its fluctuations are far more rapid, with a period of only 8.2 days. With R Hydrae we have a star that expands and contracts causing the changes in brightness—but SS is an eclipsing binary. While less than a half magnitude is not a noteworthy amount, you will notice a difference if you view it over a period of time. Be sure to note that this is actually a triple star system, for there is also a 13th magnitude companion star located 13" from the primary. Watch if as often as possible and see if you can detect changes in the next few weeks!

When the Moon rises tonight, take a look at the northwestern limb about half the distance between Grimaldi and Sinus Iridum. Our search is for an "on the edge" crater known as Einstein. Use the prominent crater Kraft to help guide you to this extreme edge feature!

SS Hydrae
Credit: Palomar Observatory, courtesy of Caltech



Crater Einstein
Credit: Alan Chu

JUN 3
SUNDAY

If you're up early, why not keep a watch out for the peak of the Tau Herculids meteor shower? These are the offspring of comet Schwassman-Wachmann 3, which broke up in 2006. The radiant is near Corona Borealis and we'll be in this stream for about a month. At best when the parent comet has passed perihelion, you'll catch about 15 per hour maximum. Most are quite faint and the westering Moon will interfere, but sharp-eyed observers will enjoy it.

While we have a bit of time tonight to spare before the Moon rises, let's try a visual double for the unaided eye—Eta Virginis. Can you distinguish between a 4th and 6th magnitude pair?

Eta Virginis
Press Release Photo

The brighter of the two is Zaniah (Eta), which through occultation had been discovered to be a triple star. In 2002, Zaniah became the first star imaged by combining multiple telescopes with the Navy Prototype Optical Interferometer. This was the first time the three were split. Two of them are so close that they orbit in less than half the distance between the Earth and Sun!

Binocular users should take a look at visual double Rho Virginis about a fistwidth west-southwest of Epsilon. This pair is far closer and will require an optical aid to separate. The brighter of this pair—Rho—is a white, main sequence dwarf with a secret... It's a variable! Known as a Delta Scuti type, this odd star can vary slightly in magnitude in anywhere from 30 minutes to two and a half hours as it pulsates.

For mid-to-large telescopes, Rho offers just a little bit more. The visual companion star has a visual companion as well! Less than a half degree southwest of Rho is a small, faint spiral galaxy—NGC 4608—at 12th magnitude, it's hard to see because of Rho's brightness...but it's not alone. Look for a small, but curiously shaped galaxy labeled NGC 4596. Its resemblance to the planet Saturn makes it well worthwhile!

Rho Virginis and NGC 4596
Credit: Palomar Observatory, courtesy of Caltech

JUN 4
MONDAY

Tonight we'll use Rho Virginis as a stepping stone to more galaxies. Get on your mark and move one and a half degrees north for M59...

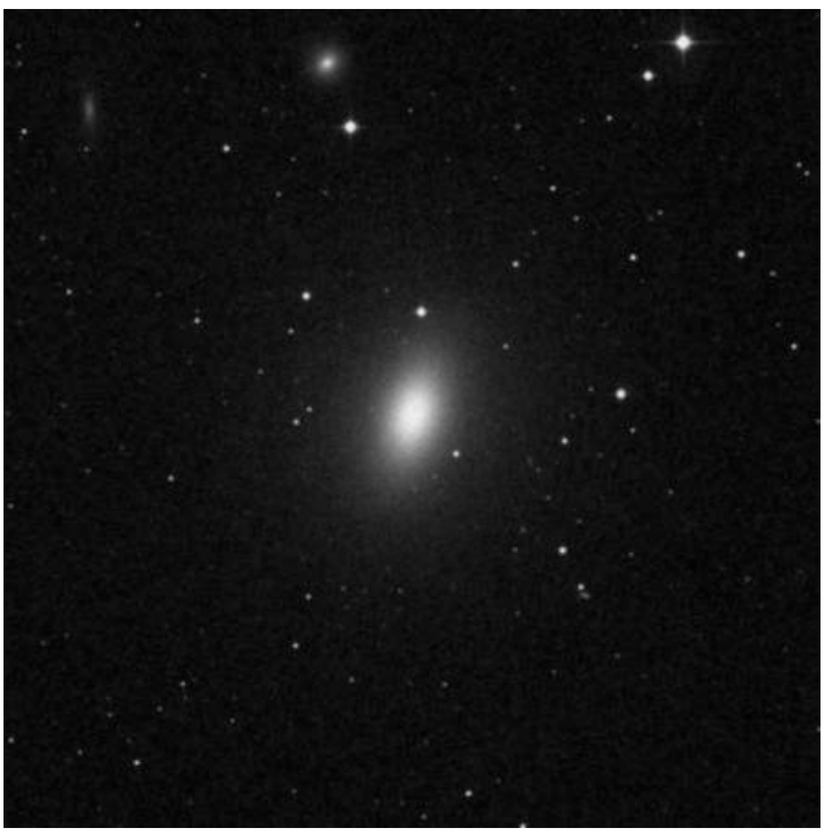
First discovered in 1779 by J. G. Koehler while studying a comet, this 11th magnitude elliptical galaxy was observed and labeled by Messier who was just a bit behind him. Much denser than our own galaxy, M59 is only about one-fourth the size of the Milky Way. In a smaller telescope, it will appear as a faint oval, while larger telescopes will make out a more concentrated core region.

Now shift one half degree east for brighter and larger M60. Also caught first by Koehler on the same night as M59, it was "discovered" a day later by yet another astronomer who had missed M59! It took Charles Messier another four days until this 10th magnitude galaxy interfered with his comet studies and was cataloged.

M60 and NGC 4647
Credit: Palomar Observatory, courtesy of Caltech

At around 60 million light-years away, M59 is one of the largest ellipticals known and has five times more mass than our galaxy. As a study object of the Hubble Telescope, this giant has shown a concentrated core with over 2 billion solar masses. Photographed and studied by large terrestrial telescopes, M59 may contain as many as 5100 globular clusters in its halo.

While our backyard equipment is essentially revealing M59's core, there is a curiosity here. It shares "space" with spiral galaxy NGC 4647. Telescopes of even modest aperture will pick up the nucleus and faint structure of this small face-on galaxy. Harlow Shapely found the pair odd because—while they are relatively close in astronomical terms—they are very different in age and development. Halton Arp also studied this combination of an elliptical galaxy affecting a spiral and cataloged it as "Peculiar Galaxy 116." Be sure to mark your notes!



M59
Credit: Palomar Observatory, courtesy of Caltech

JUN 5
TUESDAY

Tonight we'll go back to Rho once again and about a fingerwidth northwest for yet another bright galaxy—M58—a spiral galaxy actually discovered by Messier in 1779!

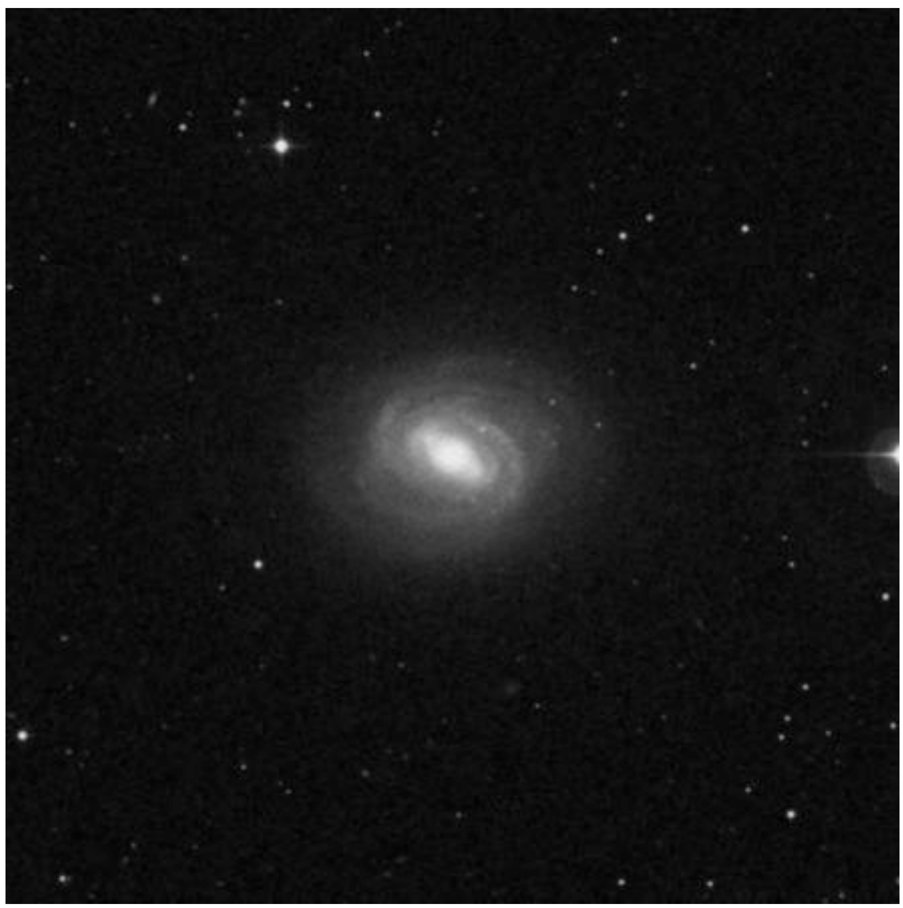
As one of the brightest galaxies in the Virgo cluster, M58 is one of only four that have barred structure. It was cataloged by Lord Rosse as a spiral in 1850. In binoculars, it will look much like our previously studied ellipticals, but a small telescope under good conditions will pick up the bright nucleus and a faint halo of structure—while larger ones will see the central concentration of the bar across the core. Chalk up another Messier study for both binoculars and telescopes and let's get on to something really cool!

NGC 4567/68: The Siamese Twins
Credit: Palomar Observatory, courtesy of Caltech

Around a half degree southwest are NGC 4567 and NGC 4569. L. S. Copeland dubbed them the "Siamese Twins," but this galaxy pair is also considered part of the Virgo cluster. While seen from our viewpoint as touching galaxies, no evidence exists of tidal filaments or distortions in structure, making them a line of sight phenomenon and not interacting members. While that might take little of the excitement away from the "Twins," a supernova event has been spotted in NGC 4569 as recently as 2004.

While the duo is visible in smaller scopes as two, with soft twin nuclei, intermediate and larger scopes will see an almost V-shaped or heart-shaped pattern where the structures overlap. If you're doing double galaxy studies, this is a fine, bright one! If you see a faint galaxy in the field as well, be sure to add NGC 4564 to your notes.

For all you Stargazers, keep watch for the Scorpid meteor shower. Its radiant will be near the constellation of Ophiuchus, and the average fall rate will be about 20 per hour with some fireballs.



M59
Credit: Palomar Observatory, courtesy of Caltech

JUN 6
WEDNESDAY

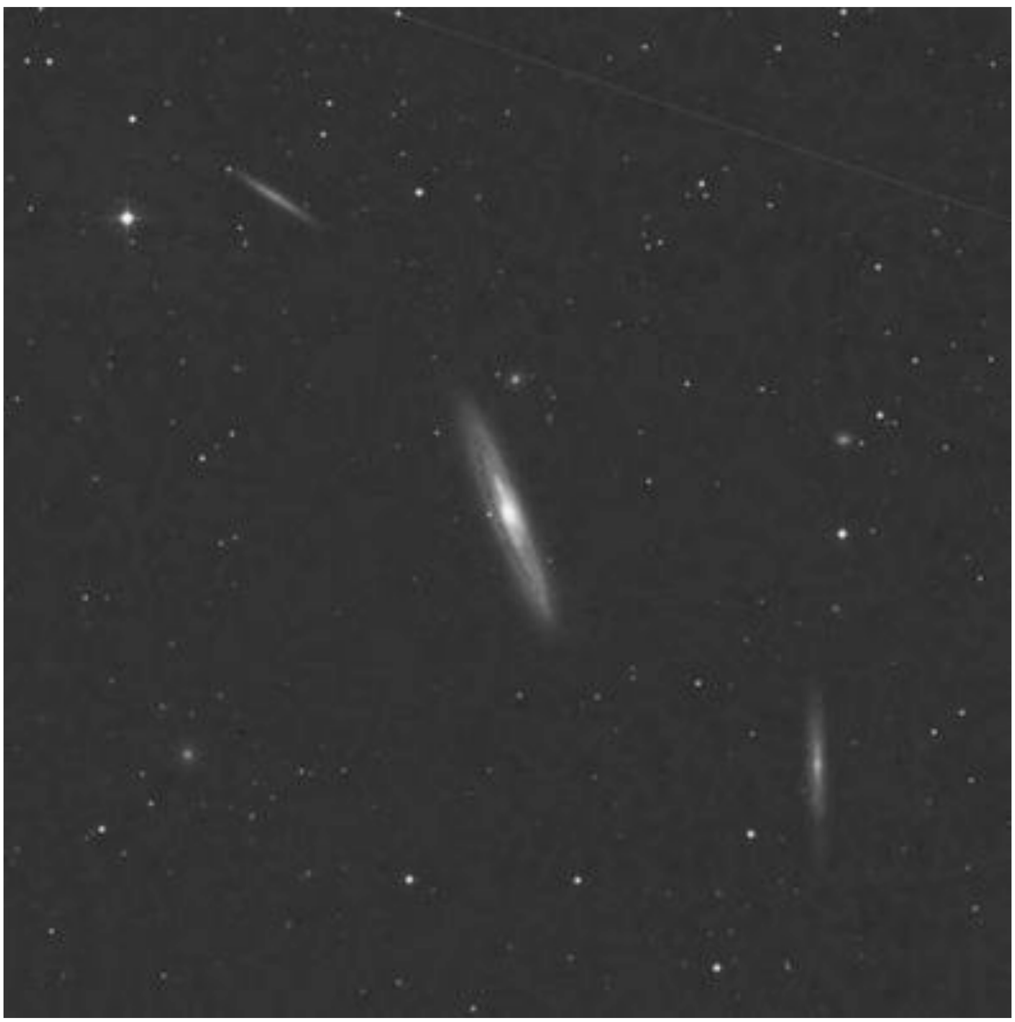
So far we've studied many Herschel objects in disguise as Messier catalog items—but we haven't really focused on some mighty fine galaxies that are within the power of the intermediate to large telescope. Tonight let's take a serious skywalk as we head to 6 Comae and drop two degrees south.

At magnitude 10.9, Herschel catalog object H I.35 is also known by its New General Catalog number of 4216. This splendid edge-on galaxy has a bright nucleus and will walk right out in larger telescopes with no aversion required. But, the most fascinating part about studying anything in the Virgo cluster is about to be revealed.

While studying structure in NGC 4216, averted vision picks up magnitude 12 NGC 4206 to the south. This is also a Herschel object—H II.135. While it is smaller and fainter, the nucleus will be the first thing to catch your attention—and then you'll notice it is also an edge-on galaxy! As if this weren't distracting enough, while re-centering NGC 4216, sometimes the movement is just enough to allow the viewer to catch yet another edge-on galaxy to the north—NGC 4222. At magnitude 14, you can only expect to be able to see it in larger scopes, but what a treat this trio is!

Is there a connection between certain types of galaxy structures within the Virgo cluster? Science certainly seems to think so. While low metallicity studies involving these galaxies are going on, research into evolution of galaxy clusters themselves continue to make new strides forward in our understanding of the universe.

Capture them tonight!



NGC 4222 (top), NGC 4216 (center) and NGC 4206 (bottom)
Credit: Palomar Observatory, courtesy of Caltech

JUN 7
THURSDAY

If you're up before dawn the next two days or out just after sunset, enjoy the peak of the June Arietid meteors - the year's strongest daylight shower - with up to 30 visible per hour.

If you'd like to try your ear at radio astronomy with the offspring of sungrazing asteroid Icarus, tune an FM radio to the lowest frequency not receiving a clear signal. An outdoor antenna pointed at the zenith increases your chances, but even a car radio can pick up strong bursts! Simply turn up the static and listen. Those hums, whistles, beeps, bongs, and occasional snatches of signals are our own radio signals being reflected off the meteor's ion trail!

Tonight let's study a radio-source galaxy so bright it can be seen in binoculars—8.6 magnitude M87, about two fingerwidths northwest of Rho Virginis.

M87 and satellites
Credit: Palomar Observatory, courtesy of Caltech

This giant elliptical was discovered by Charles Messier in 1781 and cataloged as M87. Spanning 120,000 light-years, it's an incredibly luminous galaxy containing far more mass and stars than the Milky Way—gravitationally distorting its four dwarf satellites galaxies. M87 is known to contain in excess of several thousand globular clusters—up to 150,000—and far more than our own 200.

In 1918, H. D. Curtis of Lick Observatory discovered something else—M87 has a jet of gaseous material extending from its core and pushing out several thousand light-years into space. This highly perturbed jet exhibits the same polarization as synchrotron radiation—a property of neutron stars. Containing a series of small knots and clouds as observed by Halton Arp at Palomar in 1977, he also discovered a second jet in 1966 erupting in the opposite direction. Thanks to these two properties, M87 made Arp's "Catalog of Peculiar Galaxies" as number 152.

In 1954 Walter Baade and R. Minkowski identified M87 with radio source Virgo A, discovering a weaker halo in 1956. Its position over an x-ray cloud extending through the Virgo cluster make M87 a source of an incredible amount of x-rays. Because of its many strange properties, M87 remains a target of scientific investigation. The Hubble has shown a violent nucleus surrounded by a fast rotating accretion disc, whose gaseous make-up may be part of a huge system of interstellar matter. As of today, only one supernova event has been recorded—yet M87 remains one of the most active and highly prized study galaxies of all. Capture it tonight!

Jet from M87's nucleus
Credit: NASA

Born on this date in 1625 was Giovanni Cassini—the most notable observer following Galileo. As head of the Paris Observatory for many years, he was the first to observe seasonal changes on Mars and measure its parallax (and so, its distance). This set the scale of the solar system for the first time. Cassini was the first to describe Jovian features, and studied the Galilean moons' orbits. He also discovered four moons of Saturn, but he is best remembered for being the first to see the namesake division between the A and B rings.

Giovanni Cassini
(widely used public image)

Tonight let's honor Cassini by taking a look at both planets—beginning with the westering Saturn. To the unaided eye, this creamy-yellow "star" outshines most stars in the region and holds competition with Regulus in Leo. To binoculars, it reveals itself as a planet—one with ears! While great detail cannot be seen, even the slightest optical aid makes it a joy.

To the small telescope, Saturn's ring system becomes very clear, and bright Titan can easily be seen. To the mid-sized telescope, the "Lord of the Rings" easily shows the Cassini division as well as other small details and reveals the many smaller moons that dance along the ring edge. For the large telescope, Saturn continues to be one of the most fascinating of planets. Several ring divisions are easily apparent and subtle shading details on the planet's surface are easily discerned. Titan shines very brightly and under good conditions will display a certain amount of limb darkening, making it perceivable as an orb. Tethys, Rhea and Dionne are easily visible, and the dimensionality of Saturn revealed through shadow-play is incredible.

To the east, Jupiter is rising... But give it some time to clear the atmospheric distortion! By far brighter than neighboring stars to the unaided eye, giant Jupiter will move slowly along the ecliptic plane over the course of the evening. To smaller binoculars it is easily observed as an orb with two grey bands across the middle. To larger binoculars, the equatorial belts become much clearer and the four Galilean moons are easily seen with steady hands. To the small telescope, no planet offers greater details. Even at very low magnifying power, the north, south and central equatorial zones are easily observable and all four moons are clear and steady.

To the mid-sized telescope, far greater details begin to appear—such as temperate belts on the planet's surface and the soft appearance of the Great Red Spot. Finer details are visible during steady seeing, and small things like being able to see which satellite is closer to—or further away from—our vantage point become very easy. Simple things, like watching a moon transit the surface and the resulting shadow on the planet are much easier. With a large telescope, Jupiter depends more on seeing conditions for details. While more aperture allows finer views—conditions are everything when it comes to the Mighty Jove!

Saturn
Credit: Wes Higgins

Jupiter
Credit: Wes Higgins

JUN 9
SATURDAY

Johann Galle
(widely used public image)

Today is the birthday of Johann Gottfried Galle. Born in Germany in 1812, Galle was the first observer to locate Neptune. He is also known for being Encke's assistant—and he's one of the few astronomers ever to have observed Halley's Comet twice. Unfortunately, he died two months after the comet passed perihelion in 1910, but at a ripe old age of 98! I wonder if he knew Mark Twain?

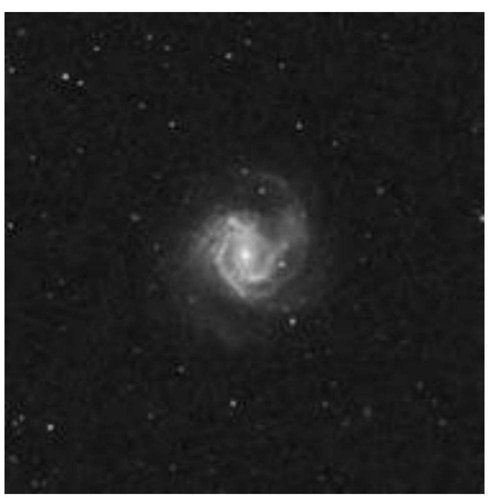
For unaided observers, be sure to check out brilliant Venus as it reaches greatest elongation just after sunset!

Tonight while we're out, let's have a look at a Virgo galaxy bright enough for smaller instruments and detailed enough to delight larger scopes. Starting at Delta Virginis, move about a fistwidth to the west where you will see two fainter stars, 16 (south) and 17 (north) Virginis. You'll find M61 located about one-half degree south of the yellow double star 17.

Its discovery was credited to Barnabus Oriani during that fateful year of 1779 when Messier was so avid about chasing a comet that he mistook it for one. While Charles had seen it on the same night, it took him two days to figure out it wasn't moving and four more before he cataloged it. Fortunately, 7 years later Mr. Herschel assigned it his own number of H I.139, even though he wasn't fond of assigning his own number to Messier catalog objects.

At near 10th magnitude, this spiral galaxy will show a slightly elongated form and brighter core area to small telescopes, and really come to life in larger ones. Close to our own Milky Way galaxy in size, this larger member of the Virgo cluster has great spiral arm structure that displays both knots and dark dustlanes—as well as a beautifully developed nucleus region. M61 has also been host to four supernova events between 1926 and 1999—all of which have been well within range of amateur telescopes.

For an added Herschel treat tonight for larger scopes, hop back to star 17 and head about one half degree due west for near galactic pair NGC 4281 (H II.573) and NGC 4273 (H II.569). Here is a study of two galaxies similar in magnitude (12) and size—but of different structure. Northeastern NGC 4281 is an elliptical, and by virtue of its central concentration will appear slightly larger and brighter—while southwestern NGC 4273 is an irregular spiral which will appear brighter in the middle but more elongated and faded along its frontiers. Sharp-eyed observers may also note fainter (13th magnitude) NGC 4270 north of this pairing.



M61
Credit: Palomar Observatory, courtesy of Caltech

NGC 4281 and NGC 4273
Credit: Palomar Observatory, courtesy of Caltech

JUN 10
SUNDAY

Although no one likes to get up early, this morning will be a great time to catch the close pairing of Mars and the waning Moon!

While I'm sure that unaided eye viewers and binocular users are tired of the galaxy hunt, be sure to take the time to look at many old favorites that are now in view. To the eye, one of the most splendid signs of the changing seasons is the Ursa Major Moving Group which sits above Polaris for northern hemisphere observers. For the southern hemisphere, the return of Crux serves the same purpose.

Old favorites have now begun to appear again, such as Hercules, Cygnus and Scorpius... and with them a wealth of starry clusters and nebulae that will soon come into view as the night deepens and the hour grows late. Before we leave Virgo for the year, there is one last object that is seldom explored and such a worthy target that we must visit it before we go. Its name is NGC 5634 and you'll find it halfway between Iota and Mu Virginis (RA 14 29.37 Dec -05 58.35)... First discovered by Sir William Herschel on March 5, 1785 and cataloged as H I.70, this magnitude 9.5 small globular cluster isn't for everyone, but thanks to an 11th magnitude line-of-sight star on its eastern edge, it sure is interesting. At class IV, it's more concentrated than many globular clusters, although its 19th magnitude members make it near impossible to resolve with backyard equipment.

Located a bit more than 82,000 light-years from our solar system and about 69,000 light-years from the galactic center, you'll truly enjoy this globular for the randomly scattered stellar field which accompanies it. In the finderscope, an 8th magnitude star will lead the way—not truly a member of the cluster, but one that lies between us. Capturable in scopes as small as 4.5", look for a concentrated central area surrounded by a haze of stellar members—a huge number of which are recently discovered variables. While you look at this globular, keep this in mind...

Based on observations with the Italian Telescopio Nazionale Galileo, it is now surmised that the NGC 5634 globular cluster has the same position and radial velocity as does the Sagittarius dwarf spheroidal galaxy. Because of the dwarf galaxy's metal-poor population of stars, it is believed that NGC 5634 may have once been part of the dwarf galaxy—and been pulled away by our own tidal field to become part of the Sagittarius stream!

NGC 5634
Credit: Palomar Observatory, courtesy of Caltech

JUN 11
MONDAY

Tonight we make the jump to Serpens Caput, which is in itself a challenge to recognize with the unaided eye. Using bright Spica as a guide, look about a handspan northeast for two of the brightest stars in the constellation—Alpha, and Lambda to its northeast. Using binoculars, locate a pairing with Delta to the north-northwest and Mu to the south. Now return to Alpha and hop a little less than a fistwidth to the southwest where you will encounter double star 5 Serpens and the mighty M5.

While Gottfried Kirch and his wife Maria were watching a comet on May 5, 1702, they stumbled across a huge, bright object that they considered a "nebulous star." Forty-two years later, it was found again by Messier who labeled it as M5 and described it as a round nebula which didn't contain any stars. But, thank heaven for William Herschel! Some 27 years later he counted up to 200 resolvable stars in this globular cluster and reported "the middle is so compressed that it is impossible to distinguish the components."

Even in today's binoculars, M5 shows a grainy texture that begins resolution to even the smallest of telescopes and invites larger ones to an explosion of stellar population. Slightly elliptical in appearance, M5 is believed to be one of the oldest globular clusters with a calculated age of 13 billion years, and it contains 105 known variable stars—as well as a dwarf nova. At a distance of 24,500 light-years and stretching across 165 light-years of space, this magnificent object so dominates its territory that it would gather in any stars straying within 400 light-years of its tidal influence!

Mid-to-larger telescopes will begin such awesome resolution on M5's many chains and its bright core region that it will be a cluster you will visit again and again over the years. No matter what size binoculars or telescope you use, this 5.6 magnitude class V globular cluster is one of the five brightest of all!

M5
Credit: Hillary Mathis/REU Program/NOAO/AURA/NSF

JUN 12
TUESDAY

As with all astronomical projects, there are sometimes difficult ones needed to complete certain study fields—such as challenging globular clusters. Tonight we'll take a look at one such cluster needed to complete your list and you'll find it by using M5 as a guide.

Palomar 5 is by no stretch of the imagination easy. For those using GoTo systems and large telescopes, aiming is easy... But for star hoppers a bit of instruction goes a long way. Starting at M5 drop south for the double 5 Serpens and again south and slightly west for another, fainter double. Don't confuse it with 6 Serpens to the east. About half a degree west you'll encounter an 8th magnitude star with 7th magnitude 4 Serpens a half degree south. Continue south another half degree where you will discover a triangle of 9th magnitude stars with a southern one at the apex. This is home to Palomar 5 (RA 15 16 05.30 Dec -00 06 41.0).

Discovered by Walter Baade in 1950, this 11.7 magnitude, Class XII globular is anything but easy. At first it was believed to be a dwarf elliptical and possibly a member of our own Local Group of galaxies due to some resolution. Later studies showed that Palomar 5 was indeed a globular cluster—but one that was being ripped apart by the tidal forces of the Milky Way.

75,000 light-years away from us and 60,000 light-years from the galactic center, Palomar 5's members are escaping and leaving trails that span 13,000 light-years...a process which may have been happening for several billion years. Although it is of low surface brightness, even telescopes as small as 6" can distinguish just a few individual members northwest of the 9th magnitude marker star—but even telescopes as large as 31" fail to show much more than a faint sheen (under excellent conditions) with a handful of resolvable stars.

Even though it may be one of the toughest you'll ever tackle, be sure to take the time to make a quick sketch of the region to complete your studies. Good luck!

Palomar 5
Credit: Palomar Observatory, courtesy of Caltech

JUN 13
WEDNESDAY

If you're up before dawn this morning, be sure to check out the slender crescent Moon just before dawn. The "Old Moon in The New Moon's Arms" is worth getting up for!

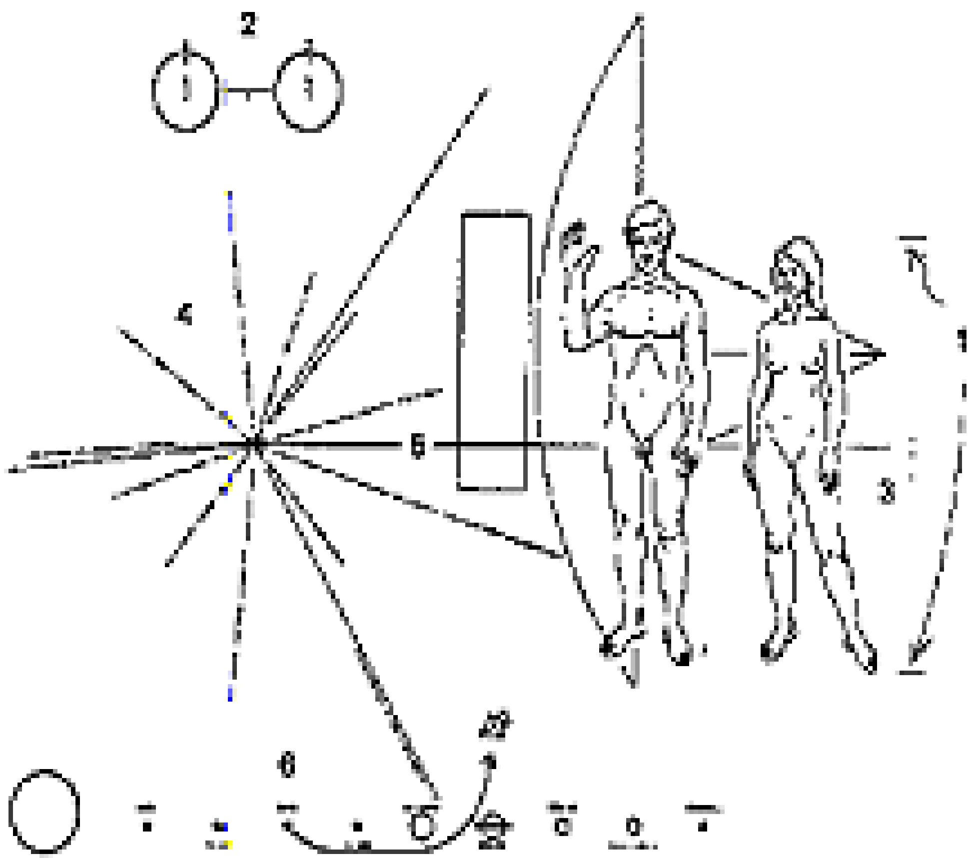
Today in 1983, Pioneer 10 becomes the first manmade object to leave the solar system. What wonders would it see? Are there other galaxies out there like our own? Will there be life like ours? While we can't see through Pioneer's "eyes," tonight let's use our own as we quest for a look in the mirror...

Our object will be Herschel II.76—also known as NGC 5970. Begin by identifying Beta and Delta Serpens Caput and look for finderscope Chi between them. Less than a degree southwest you will see a similar magnitude double star. Hop about 1/3 degree northwest and you will find your galaxy mark just a fraction southwest of a 7th magnitude star (RA 15 38 30.12 Dec -12 11 10.9).

NGC 5970
Credit: Palomar Observatory, courtesy of Caltech

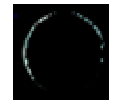
NGC 5970 is not particularly easy for smaller scopes even near 11th magnitude because of low surface brightness, but it could be a distant twin of our own galaxy, so similar is it to the Milky Way in structure. At 105 million light-years away, it is no great surprise that we see it as faint—for its light left around the time the dinosaurs ruled the Earth. Stretching across 85,000 light-years of space, this grand spiral has been extensively studied in its nucleus region, obscuring dust regions, and stellar population. And—like us—it is also part of its own local group.

While smaller telescopes will make out a slight elongated mist, in mid-to-large aperture NGC 5970 will appear oval shaped with a bright core and evidence of a central bar. While the edges of the galaxy seem well defined, look closely at the narrower ends where material seems more wispy. While averted in this fashion, the nucleus will sometimes take on a stellar appearance—yet lose this property with direct vision. Be sure to mark your Herschel notes on this one!



Pioneer 10 "Greetings"
Credit: NASA

JUN 14
THURSDAY



As the new hours of the day begin and you wait on dawn, keep watch for the peak of the Ophiuchids meteor shower with the radiant near Scorpius. The fall rate is poor with only 3 per hour, but fast moving bolides are common. This meteor stream will last for 25 days.

Tonight, while we have plenty of dark skies to go around, let's go south in Libra and have a look at the galaxy pairing NGC 5903 and NGC 5898. You'll find them about three degrees northeast of Sigma, and just north of a pair of 7th magnitude stars.

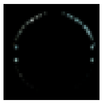
While northernmost NGC 5903 seems to be nothing more than a faint elliptical with a brighter concentration towards the center and an almost identical elliptical—NGC 5898—to the southwest, you're probably asking yourself... Why the big deal over two small ellipticals? First off, NGC 5903 is Herschel III.139 and NGC 5898 is Herschel III.138... two more to add to your studies. And second? The Very Large Array has studied this galaxy pair in the spectral lines of neutral hydrogen. The brighter of the pair, NGC 5898, shows evidence of ionized gas which has been collected from outside its galactic realm—while NGC 5903 seems to be running streamers of material towards it. A double-galaxy, double-accretion event!

But there's more...

Look to the southeast and you'll double your pleasure and double your fun as you discover two double stars instead of just one! Sometimes we overlook field stars for reasons of study—but don't do it tonight. Even mid-sized telescopes can easily reveal this twin pair of galaxies sharing "their stuff," as well as a pair of double stars in the same low power field of view. (Psst... slim and dim MCG 043607 and quasar 1514-241 are also here!) Ain't it grand?

NGC 5903 and NGC 5898 field
Credit: Palomar Observatory, courtesy of Caltech

JUN 15
FRIDAY



Tonight is officially New Moon. Before you hunt down the faint fuzzies and spend the rest of the night drooling on the Milky Way, let's go globular and hunt up two very nice studies worthy of your time. Starting at Alpha Librae, head five degrees southeast for Tau and yet another degree southeast for the splendid field of NGC 5897 (RA 15 17 24.40 Dec -21 00 36.4).

This class XI globular might appear very faint to binoculars, but it definitely makes up for it in size and beauty of field. It was first viewed by William Herschel on April 25, 1784 and logged as H VI.8—but with a less than perfect notation of position. When he reviewed it again on March 10, 1785 he logged it correctly and relabeled it as H VI.19. At a distance of a little more than 40,000 light-years away, this 8.5 magnitude globular will show some details to the larger telescope, but remain unresolved to smaller ones. As a halo globular cluster, NGC 5897 certainly shows signs of being disrupted and has a number of blue stragglers as well as four newly discovered variables of the RR Lyrae type.

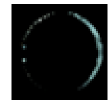
NGC 5694
Credit: Palomar Observatory, courtesy of Caltech

Now let's return to Alpha Librae and head about a fistwidth south across the border into Hydra and two degrees east of star 57 for NGC 5694—also in an attractive field (RA 14 39 36.52 Dec -26 32 18.0).

Also discovered by Herschel, and cataloged as H II.196, this class VII cluster is far too faint for binoculars at magnitude 10, and barely within reach of smaller scopes. As one of the most remote globular clusters in our galaxy, few telescopes can hope to resolve this more than 113,000 light-year distant ball of stars whose brightest is magnitude 16.5—and it also possesses no variables. Traveling at 190 kilometers per second, metal-poor NGC 5694 will not have the same fate as NGC 5897... For this is a globular cluster that is not being pulled apart by our galaxy—but escaping it!

NGC 5897
Credit: Palomar Observatory, courtesy of Caltech

JUN 16
SATURDAY



No matter if you stayed up late chasing deep sky, or got up early, right now is the time to catch the peak of the June Lyrids meteor shower. Although it's not the most outstanding of displays, no Moon will make it one of the best prospects of the year for those wishing to log their meteor observations. Look for the radiant near bright Vega—you may see up to 15 faint blue meteors per hour from this branch of the May Lyrid meteor stream.

Today in 1963, Valentina Tereshkova, aboard the Soviet Vostok 6, became the first woman ever to go into space. Her solo flight is still unique. Twenty years later, on the 18th, Sally Ride became the first American woman in orbit, aboard the Space Shuttle.

If you have an open western horizon, a true challenge tonight will be to spot Mercury a little more than 5 degrees south of a very tender and very young crescent Moon. If you miss it, don't be dismayed for the coming days will bring up some of the most delightful celestial scenery of all!

For observers of all skill levels and equipment, it's simply time to stop and have a look at a seasonal favorite which is now nearly overhead—M13. You'll find this massive globular cluster quite easy to locate on the western side of the Hercules "keystone" about 1/3 the way between the northern and southern stars—Eta and Zeta.

At a little brighter than magnitude 6, this 25,100 light-year distant globular cluster can be seen unaided from a dark sky location. First noted by Edmond Halley in 1714, the "Great Hercules Cluster" was cataloged by Messier on June 1, 1764. Filled with hundreds of thousands of stars, yet only one young blue star, M13 could be as much as 14 billion years old.

Thirty-three years ago, the Great Hercules Cluster was chosen by the Arecibo Observatory as the target for the first radio message delivered into space, yet it will be a message that won't be received for over 25 centuries. Look at it with wonder tonight... For the light that left as you are viewing it tonight did so at a time when the Earth was coming out of the Ice Age. Our early ancestors were living in caves and learning to use rudimentary tools. How evolved would our civilization be if we ever received an answer to our call?!

M13: The Great Hercules Cluster
Credit: R. Jay GaBany

JUN 17
SUNDAY

Be sure to be outside as the Sun sets this evening to catch the very beginnings of the Moon as it joins bright star Pollux. This conjunction puts one of the Gemini "twins" less than two fingerwidths north. For the next two evenings, SkyWatchers will have some wonderful opportunities to view some of the best conjunctions of the year!

As the sky darkens, let's discover the wonderful world of low power. Start by re-locating the magnificent M13 and move about 3 degrees northwest. What you will find is a splendid loose open cluster of stars known as Dolidze/Dzimselejsvili (DoDz) 5—and it looks much like a miniature of the constellation of Hercules. Just slightly more than 4 degrees to its east and just about a degree south of Eta Hercules is DoDz 6, which contains a perfect diamond pattern and an asterism of brighter stars which resembles the constellation of Sagitta.

Now we're going to move across the constellation of Hercules towards Lyra. East of the "keystone" you will see a tight configuration of three stars—Omicron, Nu and Xi. About the same distance that separates these stars to the northeast you will find DoDz 9. Using minimal magnification, you'll see a pretty open cluster of around two dozen mixed magnitude stars that are quite attractive. Now look again at the "keystone" and identify Lambda and Delta to its south. About midway between them and slightly to the southeast you will discover the stellar field of DoDz 8. The last is easy—all you need to do is know the beautiful red/green double, Ras Algethi (Alpha). Move about 1 degree to the northwest to discover the star-studded open cluster DoDz 7. These great open clusters are very much off the beaten path and will add a new dimension to your large binocular or low power telescoping experiences.

Conjunction of Mercury, Venus and Saturn
Credit: R. Jay GaBany

JUN 18
MONDAY

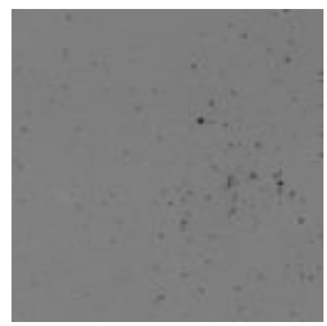
Mark your calendars for dusk tonight as brilliant Venus dances with the da Vinci Moon. The sparkling planet will be about one half degree south of the crescent and for some locations this could be an occultation! Be sure to check the IOTA website for locations and times in your area.

No special equipment is needed to see this event, and thanks to Leonardo da Vinci we can see the ghostly effect on the Moon as quite logical. He was the first to theorize that sunlight was reflecting off the Earth and illuminating the portion of the Moon not lit by the Sun. We more commonly refer to this as "Earthshine"—but no matter how scientific the explanations are for this phenomena, its appearance remains beautiful.

While you're out tonight, take a look at the skies for a circlet of seven stars that reside about halfway between orange Arcturus and brilliant blue/white Vega. This quiet constellation is named Corona Borealis—or the "Northern Crown." Just northwest of its brightest star is a huge concentration of over 400 galaxies that reside over a billion light-years away from us. This area is so small from our point of view that we could cover it with our thumbnails held at arm's length!

Earthshine and the Pleiades
Credit: John Cudworth

da Vinci Moon
Credit: Wojciech Rychlik/NASA



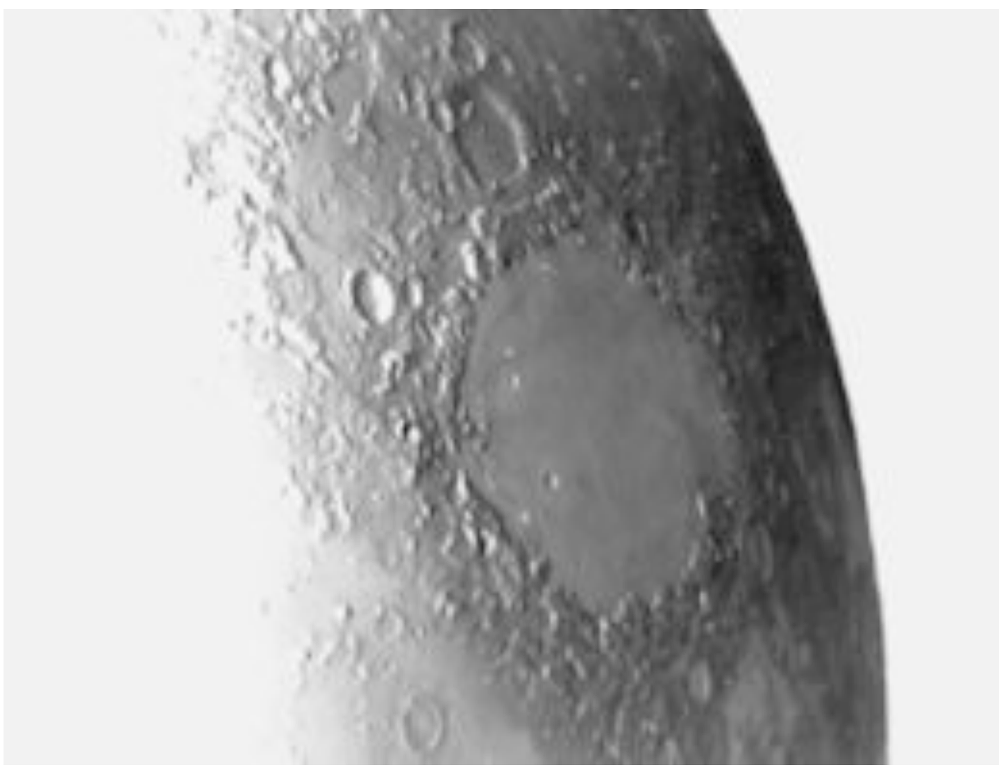
Abell 4065: The Corona Borealis Galaxy Cluster
Credit: Palomar Observatory, courtesy of Caltech

JUN 19
TUESDAY

Just when you thought watching the sky couldn't get any better... It does. Tonight the mighty Saturn will be less than one half degree from the Moon—and will present a splendid occultation opportunity for many observers. If you don't have a chance to see this one, perhaps you will fare better with Regulus, which is also less than one half degree from the Moon and presents an occultation opportunity. Be sure to check IOTA for precise information. Even if an event doesn't happen for your location, this will be a sight you won't want to miss!

While you're watching the event, be sure to take the time to view the lunar surface for a couple of telescopic challenges that are easy to catch—all you have to know is Mare Crisium! On the southeastern shoreline is a peninsula which reaches into Crisium's dark basin. This is Promontorium Agarum. On the western shore, bright Proclus lights the banks, but look into the interior for the two dark pock marks of Pierce to the north and Picard to the south. Be sure to mark them on your notes!

When you're finished, point your binoculars or telescopes back towards Corona Borealis and about three fingerwidths northwest of Alpha for variable star R (Ra 15. 48.6 Dec +28 09). This star is a total enigma. Discovered in 1795, most of the time R carries a magnitude near 6, but can drop to magnitude 14 in a matter of weeks—only to unexpectedly brighten again! It is believed that R emits a carbon cloud which blocks its light. When studied at minima, the light curve resembles a "reverse nova," and has a peculiar spectrum. It is very possible this ancient Population II star has used all of its hydrogen fuel and is now fusing helium to carbon. It's so odd that science can't even directly determine its distance!



Mare Crisium
Credit: Greg Konkel

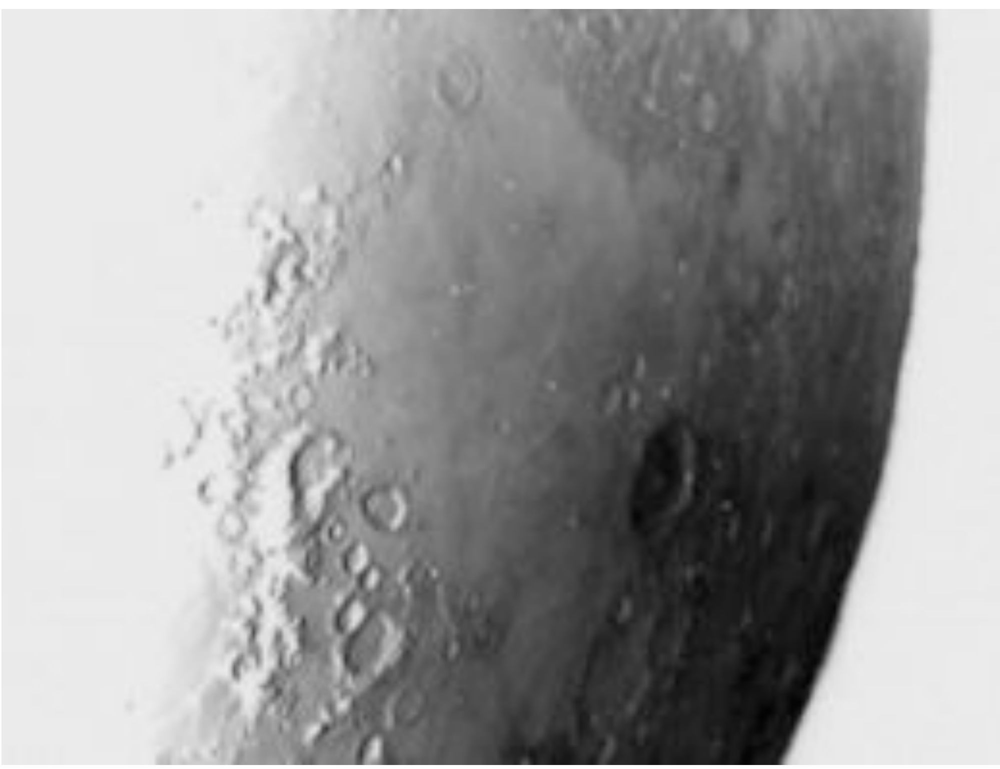
With no Moon to contend with in the predawn hours, we welcome the "shooting stars" as we pass through another portion of the Ophiuchid meteor stream. The radiant for this pass will be nearer Sagittarius and the fall rate varies from 8 to 20, but it can sometimes produce unexpectedly more.

Tonight we'll return again to the lunar surface first to pick off another study object on our list—Messier and Messier A.

Located in Mare Fecunditatis about 1/3 its width from west to east, this pair of twin craters will be difficult in binoculars, but not hard for even a small telescope and intermediate power. Indeed named for famed French astronomer, Charles Messier, the easternmost crater is somewhat oval in shape with dimensions of 9 by 11 kilometers. At high power, Messier A to the west appears to have overlapped a smaller crater during its formation and it is slightly larger at 11 by 13 kilometers. Although it is not on the challenge list, you'll find another point of interest to the northwest. Rima Messier is a long surface crack which runs diagonally across Mare Fecunditatis' northwestern flank and reaches a length of 100 kilometers.

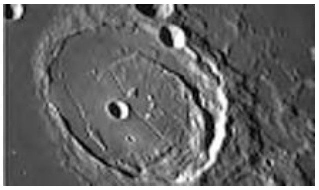
For variable star fans, let's return again to Corona Borealis and focus our attention on S—located just west of Theta—the westernmost star in the constellation's arc formation. At magnitude 5.3, this long-term variable takes almost a year to go through its changes; usually far outshining the 7th magnitude star to its northeast—but will drop to a barely visible magnitude 14 at minimum. Compare it to the eclipsing binary U Coronae Borealis about a degree northwest. In slightly over three days this Algol-type will range by a full magnitude as its companions draw together.

Theta Corona Borealis
Credit: Palomar Observatory, courtesy of Caltech



Mare Fecunditatis/Messier/Messier A
Credit: Greg Konkel

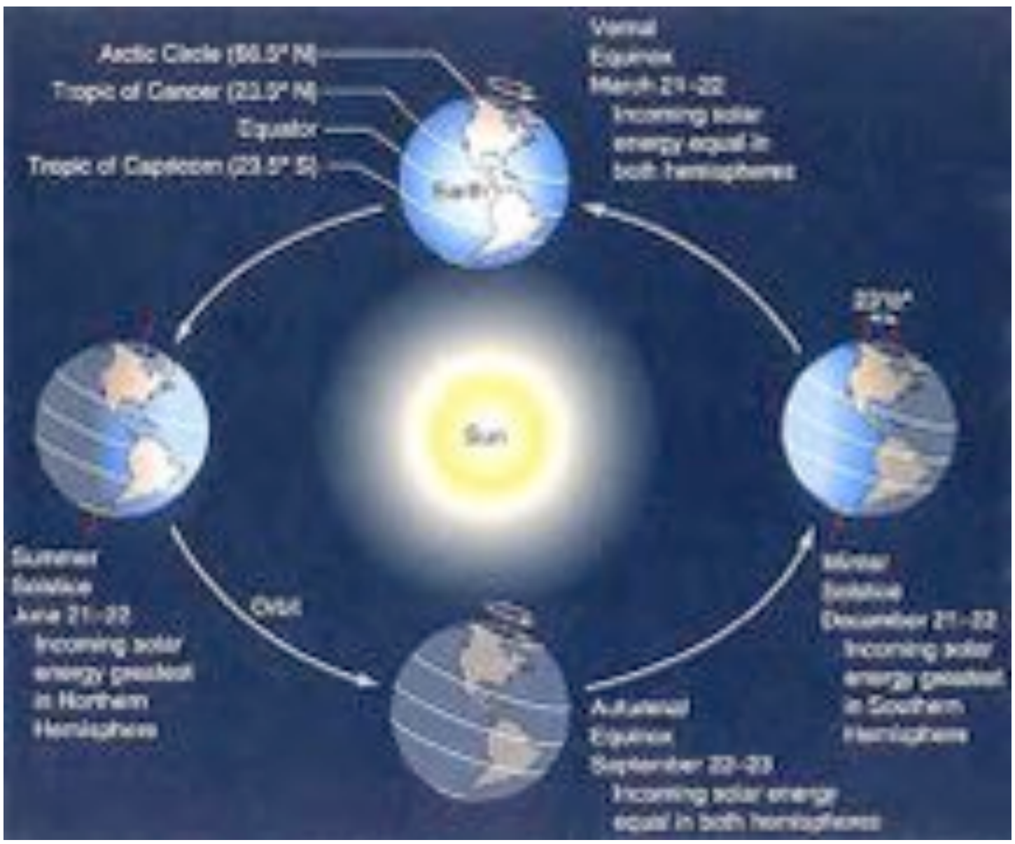
JUN 21
THURSDAY



Posidonius
Credit: Wes Higgins

Summer Solstice occurs today at 12:26 UT. So what exactly is it? Solstice is nothing more than an astronomical term for the moment when one hemisphere of the Earth is tilted the most toward the Sun. Today, the sun is about 24 degrees above the celestial equator—its highest point of the year. The day of summer solstice also has the longest period of daylight...and the shortest of night; this occurs around 6 months from now for the Southern Hemisphere.

If you haven't had the chance to pick up crater Posidonius for your lunar studies, tonight would be a great time to power up and really study this ancient mountain-walled plain. Standing on the northeast shore of Mare Serenitatis near the terminator, this melted-down and lava-filled area looks very flat, with gently stepped walls. Still, it stretches an admirable 95 kilometers in diameter and drops to a depth of 2300 meters at the floor. During this sunrise phase, it is possible to spot some of the huge systems of rimae which line its floor, even in binoculars. This extended system of cracks gives mute testimony to Posidonius' volcanic history, and several strikes—such as the A crater near the center—help this crater to show its age well!



Solstice and Equinox
Credit: NASA

JUN 22
FRIDAY

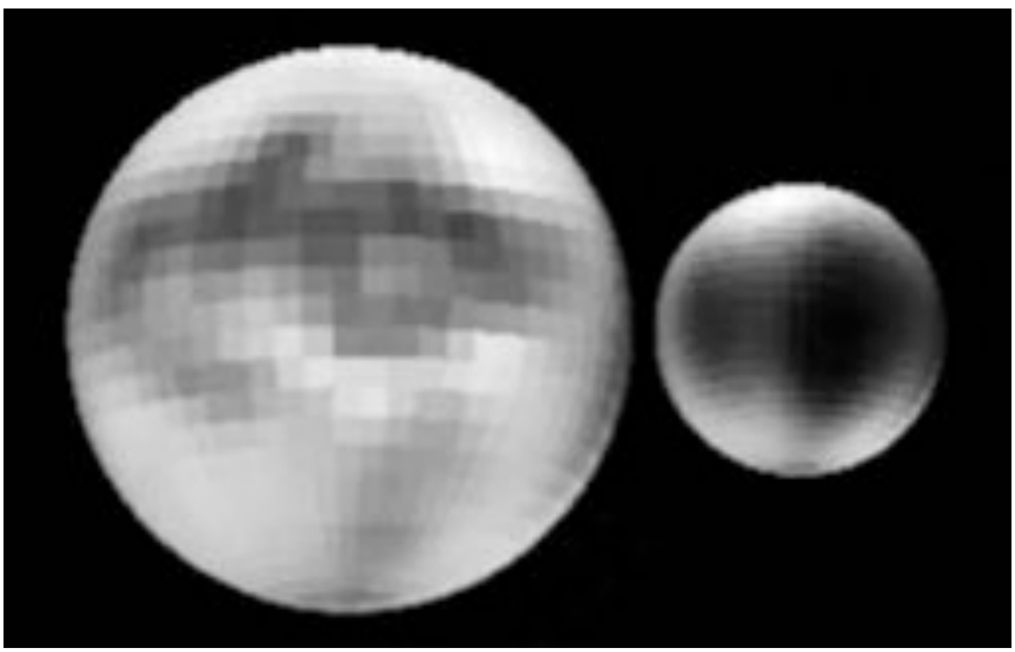
Today celebrates the founding of the Royal Greenwich Observatory in 1675. That's 332 years of astronomy! Also on this date in history, in 1978, James Christy of the US Naval Observatory in Flagstaff Arizona discovered Pluto's satellite Charon.

While observing Pluto is quite possible with a mid-sized (8") telescope, careful work is needed to separate and identify it from field stars. Just a few days ago, Pluto reached opposition, meaning it is viewable all night. Since it will take several nights of observation for confirmation, right now would be an excellent time to begin your Pluto quest. With a little research you'll find plenty of on-line locator charts to help guide you on your way!

If you observe the Moon tonight, be sure to note both Gemma Frisius and Maurolycus on your lunar challenge list. While at Gemma Frisius, let's look for a little more "off the beaten path" crater about halfway towards Catharina. Under tonight's lighting at low power, you'll see it first as a sunken oval—but power up and let's explore Sacrobosco.

Sacrobosco
Credit: Wes Higgins

Named for the English mathematician "John of Holywood" (Johannes Sacrobuschus), this class III crater spans 98 kilometers and drops down to a floor level of 2800 meters—making those crater walls about as high as the West Ridge of Mt. Everest. On its troubled floor you will see the evidence of three far newer impacts: Crater C to the north which spans 13 kilometers and drops down 2630 meters; Crater A to the west which is 18 kilometers in diameter and 1830 meters deep; and Crater B to the east at 15 kilometers wide and 1210 meters deep. While these strikes are fascinating... look again. Sacrobosco itself is imprinted over the top of a far older crater!



Pluto and Charon
Credit: NASA

JUN 23
SATURDAY

Our lunar challenge feature for this evening is prominent enough to be spotted in binoculars, but well worth the time to power up with the telescope and explore. Starting with the recognizable slash of the Alpine Valley, follow the mountain trail south to the double strike of crater Cassini.

Named for Giovanni Cassini, this smashing old Class V crater rises above the lunar topography by 1067 meters, making its shallow walls alone as tall as the Catskill Mountains. It covers about 57 kilometers of lunar landscape in its rough diameter and the crater floor is 1240 kilometers below the surface. At one time Cassini may very well have had a central peak, but something quite took care of that when it formed Cassini A. This double-stepped feature is 57 kilometers in diameter and drops down an additional 2830 meters. While both Cassini and Cassini A are lunar club challenges, look carefully for yet another interior crater. Small crater B is often referred to as the "Washbowl" for its almost perfect concave structure.

Delta Serpens
Credit: Palomar Observatory, courtesy of Caltech

While we're out, let's have a look at Delta Serpens. To the eye and binoculars, 4th magnitude Delta is a widely separated visual double star... But power up in the telescope to have a look at a wonderfully difficult binary. Divided by no more than 4 arc seconds, 210 light-year distant Delta and its 5th magnitude companion could be as old as 800 million years and on the verge of becoming evolved giants. Separated by about 9 times the distance of Pluto from our Sun, the white primary is a Delta Scuti-type variable which changes subtly in less than four hours. Although it takes the pair 3200 years to orbit each other, you'll find Delta Serpens to be an excellent challenge for your optics.

Cassini and Cassini A
Credit: Wes Higgins

On this day in 1881, Sir William Huggins made the first photographic spectrum of a comet (1881 III) and discovered cyanogen (CN) emission at violet wavelengths. Unfortunately, his discovery caused public panic around 29 years later when Earth passed through the tail of Halley's Comet. What a shame the public didn't realize that cyanogens are also released organically! More than fearing what is in a comet's tail, they should have been thinking about what might happen should a comet strike. Tonight look at the wasted Southern Highland area of the Moon with new eyes... Many of these craters you see were caused by impacts—some as large as the nucleus of Halley itself.

Now let's turn binoculars or telescopes towards magnitude 2.7 Alpha Librae—the second brightest star in the celestial "Scales." Its proper name is Zuben El Genubi, and even as "Star Wars" as that sounds, the "Southern Claw" is actually quite close to home at a distance of only 65 light-years.

No matter what size optics you are using, you'll easily see Alpha's 5th magnitude companion widely spaced and sharing the same proper motion. Alpha itself is a spectroscopic binary which was verified during an occultation event, and its inseparable companion is only a half magnitude dimmer according to the light curves. Enjoy this easy pair tonight!

Sir William Huggins
(widely used public image)

Alpha Librae
Credit: Palomar Observatory, courtesy of Caltech

Southern Highlands
Credit: Greg Konkel

JUN 25
MONDAY

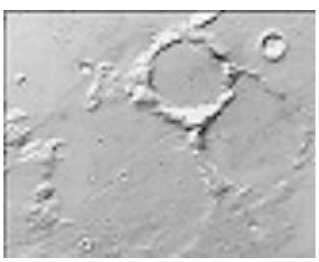
Today celebrates the birth of Hermann Oberth—who has often been considered the father of modern rocketry. Born in Transylvania in 1894, Oberth was a visionary who was convinced space travel would one day be possible. Inspired by the works of Jules Verne, Oberth studied rockets and wrote many books devoted to the possibility of achieving spaceflight. He was the first to conceive of rocket "stages"—allowing vehicles to expend their fuel and lose dead weight. But tonight you won't need one of Oberth's rockets to travel to the Moon, as we look at the northeast shore of Mare Cognitum and the Apollo 14 mission landing site—Fra Mauro.

As craters go, 3.9 billion year old Fra Mauro is on the shallow side and spans 95 kilometers. At some 730 meters deep, standing at one of its walls would be like standing at the bottom of the Grand Canyon...Yet, time has so eroded this crater that its west wall is completely missing and its floor is covered with fissures.

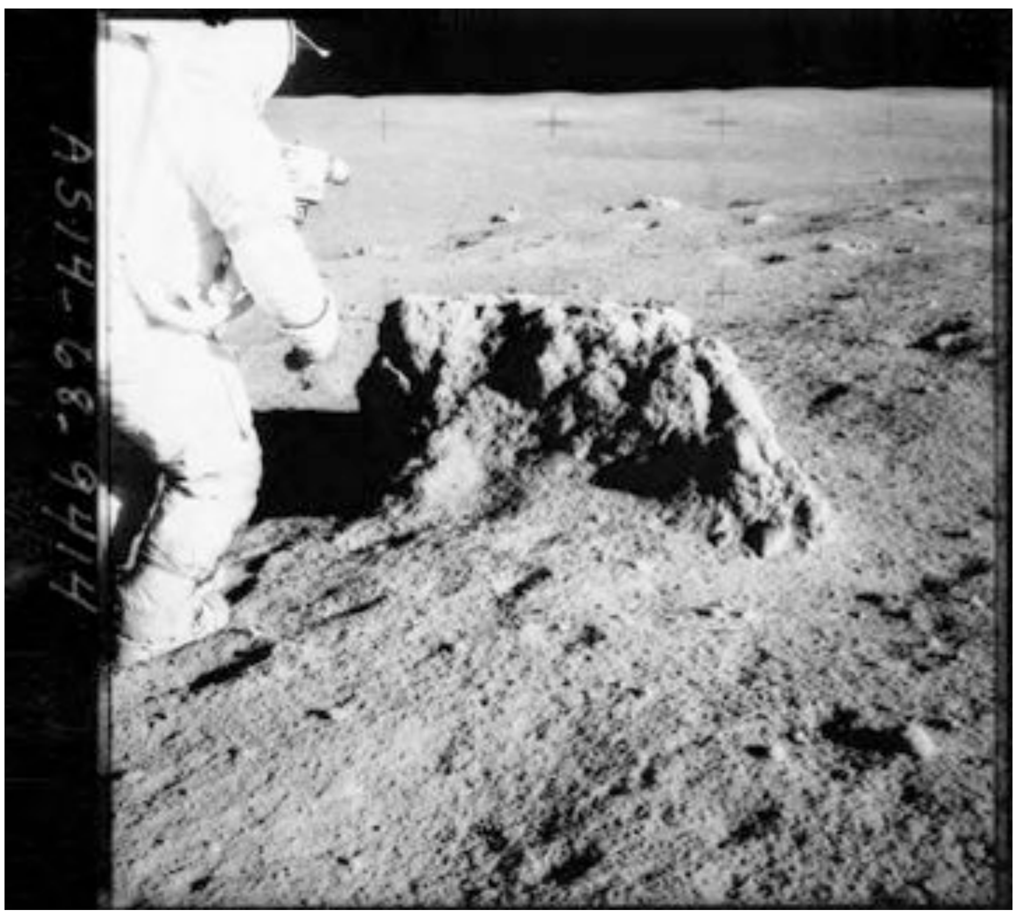
Even though ruined Fra Mauro seems like a foreboding place to land a manned mission, it remained high on the priority list because it is geologically rich. Ill-fated Apollo 13 was to land in a formation north of the crater formed by ejecta belonging to the Imbrium Basin—material that had already been mapped telescopically. By returning samples of this material from deep within the Moon's crust, scientists could then determine the exact time these changes came about.

As you view Fra Mauro tonight, picture yourself in a lunar rover traversing this barren ground and rock-strewn landscape thrown out from a long-ago impact. How willing would you be to take on the vision of Oberth and travel to another world?

Hermann Oberth
(widely used public image)



Fra Mauro
Credit: Greg Konkel



Apollo 14: Alan Shepherd at Fra Mauro
Credit: NASA

JUN 26
TUESDAY

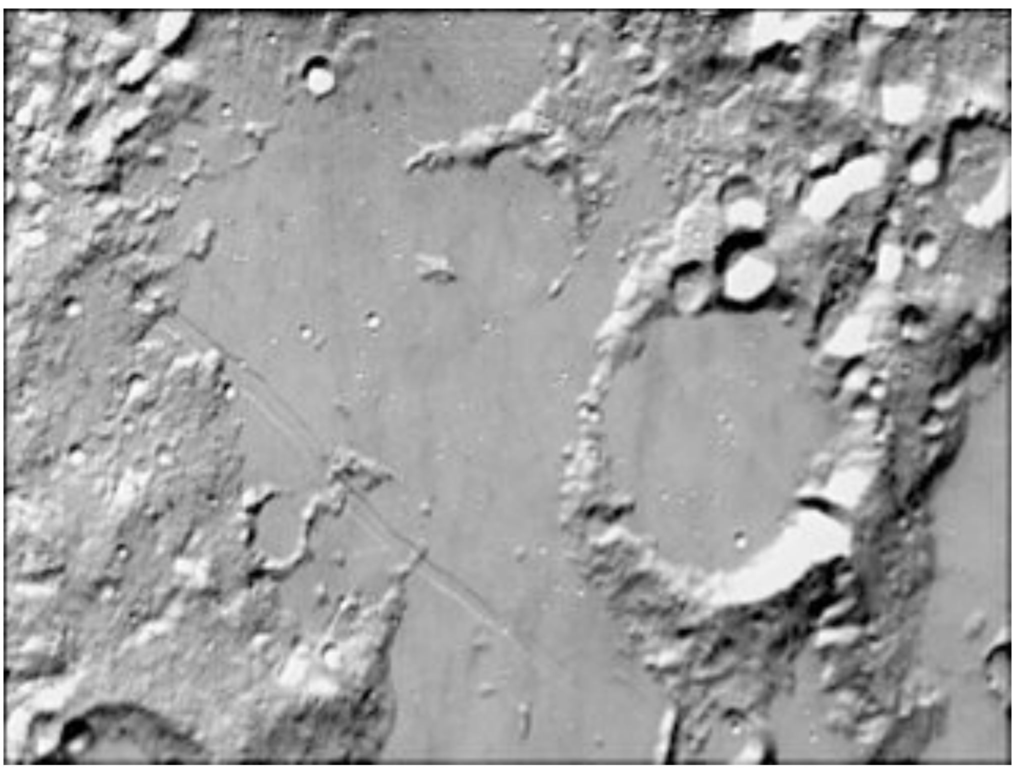
On this day in 1949, asteroid Icarus was discovered on a 48-inch Schmidt plate made nine months after that telescope went into operation, and just prior to the beginning of the multi-year National Geographic-Palomar Sky Survey. The asteroid was found to have a highly eccentric orbit and a perihelion distance of just 27 million kilometers, closer to the Sun than Mercury, giving it its unusual name. It was just 6.4 million kilometers from Earth at the time of discovery, and variations in its orbital parameters have been used to determine Mercury's mass and test Einstein's theory of general relativity.

But, today is even more special because it is the birthday of none other than Charles Messier, the famed French comet hunter. Born in 1730, Messier is best known for cataloging the 100 or so bright nebulae and star clusters that we now refer to as the Messier objects. The catalog was intended to keep both Messier and others from confusing these stationary objects with possible new comets.

Charles Messier
(widely used public image)

Tonight let's venture towards the south shore of Palus Epidemiarum to have a high power look at crater Capuanus. Named for Italian astronomer Francesco Capuano di Manfredonia, this 60 kilometer wide crater boasts a still tall southwest wall, but the northeast one was destroyed by lava flow. At its highest, it reaches around 1900 meters above the lunar surface, yet drops to no more than 300 meters at the lowest. Look for several strikes along the crater walls as well as more evidence of a strong geological history. To its north is the Hesiodus Rima...a huge fault line that extends 300 kilometers across the surface!

Now see how many Messier objects that you can capture and wish Charles a happy 263rd birthday!



Capuanus
Credit: Wes Higgins

JUN 27
WEDNESDAY

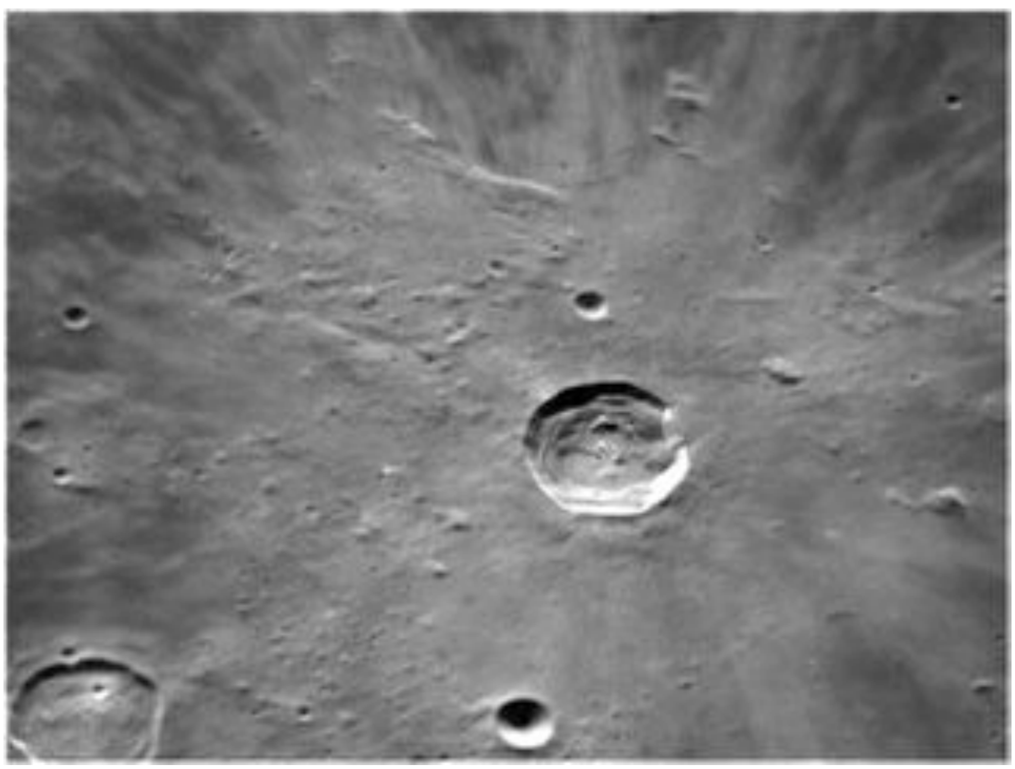
Iota Librae
Credit: Palomar Observatory, courtesy of Caltech

As we wait on the sky to darken tonight, let's start our adventures by taking a close look at crater Kepler. Situated just north of central along the terminator tonight, this great crater named for Johannes Kepler only spans 32 kilometers, but drops to a deep 2750 meters below the surface. This class I crater is a geological hotspot!

As the very first to be mapped by the U.S. Geological Survey, the area around Kepler contains many smooth lava domes that extend no more than 30 meters or so above the plains. According to records, in 1963 a glowing red area was spotted near Kepler and extensively photographed. Normally one of the brightest regions of the Moon, the brightness value at the time nearly doubled! Although it was rather exciting, scientists later determined the phenomenon was caused by high energy particles from a solar flare reflecting from Kepler's high albedo surface. In the days ahead all details around Kepler will be lost, so take this opportunity to have a good look at one awesome small crater!

When skies are dark, it's time to have a look at the 250 light-year distant silicon star Iota Librae. This is a real challenge for binoculars—but not because the components are so close. In Iota's case, the near 5th magnitude primary simply overshadows its 9th magnitude companion! In 1782, Sir William Herschel measured them and determined them to be a true physical pair. Yet, in 1940 Librae A was determined to have an equal magnitude companion only .2 arc seconds away.... And the secondary was proved to have a companion of its own that echoes the primary. A four star system!

While you're out, keep a watch for a handful of meteors originating near the constellation of Corvus. The Corvid meteor shower is not well documented, but you might spot as many as ten per hour.



Kepler
Credit: Wes Higgins

JUN 28 THURSDAY

Are you ready to study the Moon again tonight? Be sure to look for the "Cow Jumping over the Moon"—but power up with a telescope to study some very wild looking features—lunar lava domes.

North of Aristarchus, west of Promontorium Heraclides, and near the terminator is Rumker—the largest of the lunar lava domes. Only visible when near the terminator, this roughly 77 kilometer diameter "soft hill" ranges anywhere from 60 to 760 meters tall. Although it is not much more than a bump on the lunar surface, it does contain a few summit craters at its highest points. What we are looking at is really an important part of the geology which shaped the Moon's surface. In all likelihood, Rumker is a shield volcano...in an area of many!

Now continue east towards the prominent crater Marian set in a bright peninsula extending into Sinus Roris and Mare Imbrium. Just southwest are two more—Mons Gruithuisen Gamma (the "Megadome") and Mons Gruithuisen Delta. While you might not find these features particularly impressive, consider that we're looking at something only 20 kilometers wide and only meters high!

When you're finished with your lunar observations, tonight let's try a challenging double star—Upsilon Librae. This beautiful red star is right at the limit for a small telescope, but quite worthy as the pair is a widely disparate double. Look for the 11.5 magnitude companion to the south in a very nice field of stars!

Upsilon Librae
Credit: Palomar Observatory, courtesy of Caltech

Marian and the Megadome
Credit: Wes Higgins

JUN 29
FRIDAY

George Ellery Hale
(widely used public image)

Today we celebrate the birthday of George Ellery Hale, who was born in 1868. Hale was the founding father of the Mt. Wilson Observatory. Although he had no education beyond his baccalaureate in physics, he became the leading astronomer of his day. He invented the spectroheliograph, coined the word astrophysics, and founded the Astrophysical Journal and Yerkes Observatory. At the time, Mt. Wilson dominated the world of astronomy, confirming what galaxies were and verifying the expanding universe cosmology, making Mt. Wilson one of the most productive facilities ever built. When Hale went on to found Palomar Observatory, the 5-meter (200") telescope was named for him and dedicated on June 3, 1948. It continues to be the largest telescope in the continental United States.

Now let's go deep south and have look at an area which once held something almost half a bright as tonight's Moon and over four times brighter than Venus. Only one thing could light up the skies like that—a supernova.

According to historical records from Europe, China, Egypt, Arabia and Japan, 1001 years ago the very first supernova event was noted. Appearing in the constellation of Lupus, it was at first believed to be a comet by the Egyptians, yet the Arabs saw it as an illuminating "star."

Located less than a fingerwidth northeast of Beta Lupus (RA 15 02 48.40 Dec -41 54 42.0) and a half degree east of Kappa Centaurus, no visible trace is left of a once grand event that spanned five months of observation beginning in May, and lasting until it dropped below the horizon in September, 1006. It is believed all the force created from the event was converted to energy and very little mass remains. In the area, a 17th magnitude star shows a tiny gas ring and radio source 1459-41 remains our best candidate for pinpointing this incredible event.

Field of SN 1006
Credit: Palomar Observatory, courtesy of Caltech

JUN 30
SATURDAY

Tonight is the Full Moon—but is it Blue? According to modern folklore, anytime there is a second Full Moon within one calendar month it's called "blue." The explanation of the term is a rather long one involving old almanacs, mistakes in literary sources, and even urban legend. No matter if the definition is right or wrong, we can still enjoy a relatively rare occurrence—but how rare is it?

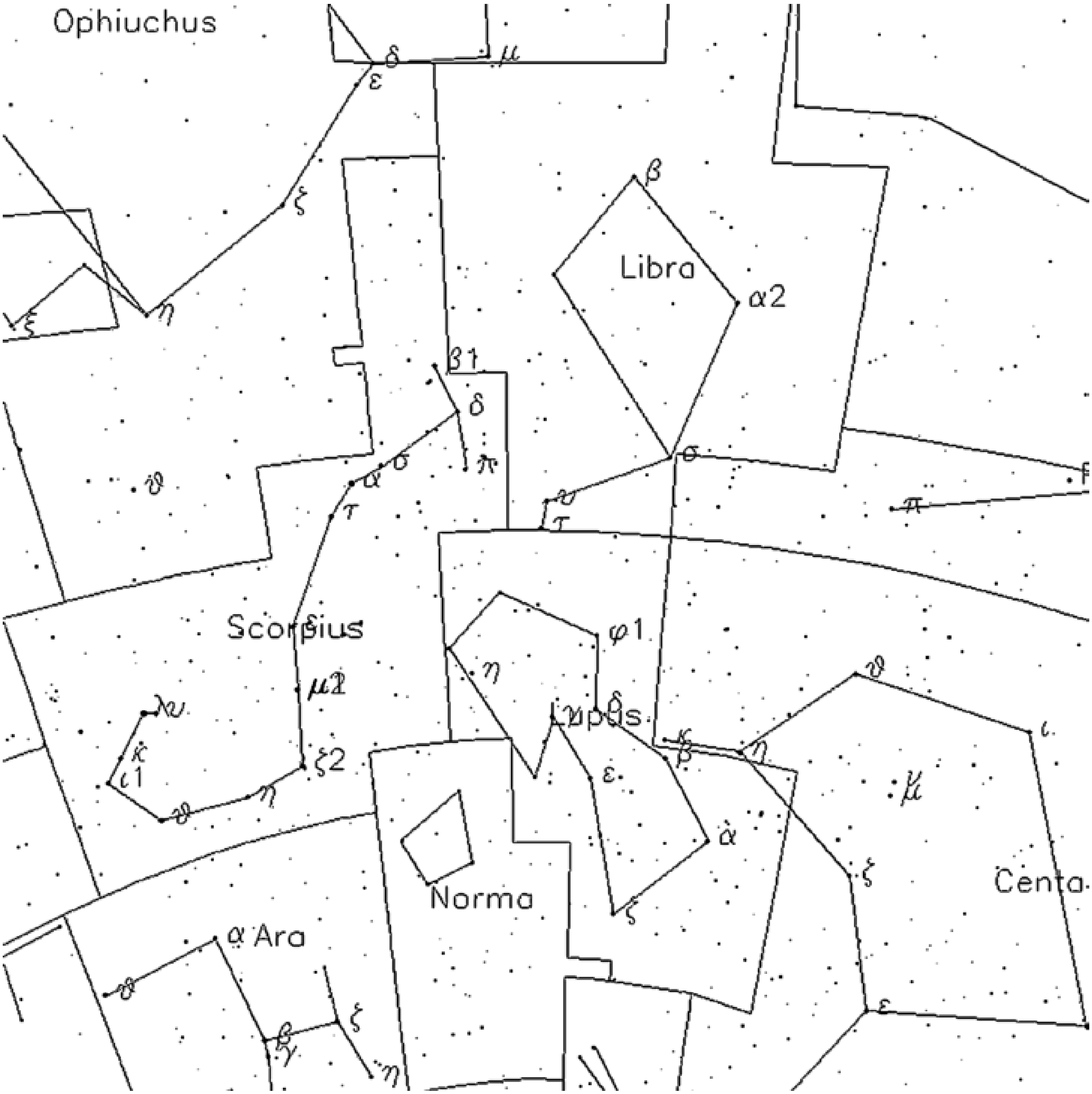
Most of the time a calendar month will only have one Full Moon, yet it's a given that any event separated by 29 days will eventually catch up to calendar time—around every two and half years. Chances are good that you'll only see the same pearl colored Moon as always when it rises—but if your area is affected by volcanic eruptions or forest fires—it just might be blue! (But then you'd best be running and not out Moongazing...) This is caused by the light scattering properties of small particles in the atmosphere—much like what causes our daylight skies to be blue, or noctilucent clouds to have their strange colors.

Mu Librae
Credit: Palomar Observatory, courtesy of Caltech

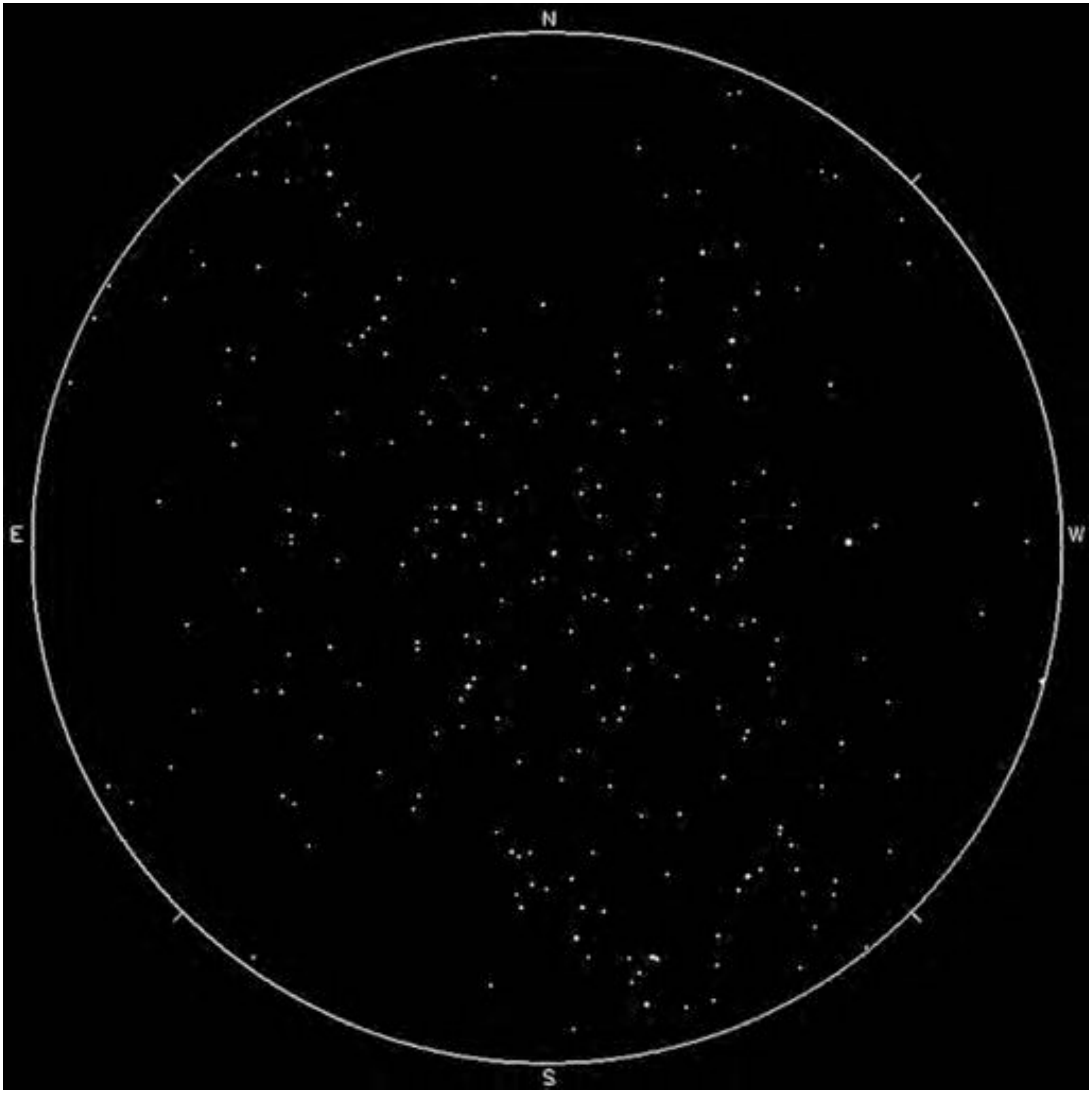
Still got the blues? Then try your hand at a super challenging double—Mu Librae. This pair is only a magnitude apart in brightness and right at the limit for a small telescope. Up the power slowly and look for the companion just to the southwest of the primary. Good luck and mark your observation because Mu's blues are on many observing lists!

And out of the blue comes a meteor shower! Keep watch tonight for the June Draconids. The radiant for this shower will be near handle of Big Dipper—Ursa Major. The fall rate varies from 10 to 100 per hour, but tonight's bright skies will toast most of the offspring of comet Pons-Winnecke. On a curious note, today in 1908 was when the great Tunguska impact happened in Siberia. A fragment of a comet, perhaps?

Blue Moon
Credit: Kostian Iftica/NASA


Ophiuchus
Libra
Scorpius
Lupus
Norma
α Ara
Centa

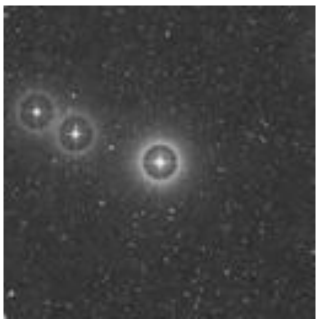
JULY 2007



JUL 1
SUNDAY

Today In 1917, the astronomers at Mt. Wilson were celebrating as the 100" primary mirror arrived. Up until that time, the 60" Hale telescope (donated by George Hale's father) was the premier creation of St. Gobrain Glassworks—which was later commissioned to create the blank for the Hooker telescope. Thanks to the funds provided by John D. Hooker (and Carnegie), the dream was realized after years of hard work and ingenuity to create not only a building to properly house it—but the telescope workings as well. It saw "first light" five months later on November 1.

As anxious astronomers waited for this groundbreaking moment, the scope was aimed at Jupiter but the image was horrible—to their dismay, workmen had left the dome open and the Sun had heated the massive mirror! Try as they might to rest until it had cooled—no astronomer slept. Fearful of the worst, sometime around three in the morning they returned again long after Jupiter had set. Pointing the massive scope towards a star, they achieved a perfect image!



Theta Lupi
Credit: Palomar Observatory, courtesy of Caltech

Tonight start your stargazing evening off right by having a look at the western skyline at twilight. Venus and Saturn are waltzing together less than a degree apart! Not only is this an eye appealing conjunction to the unaided observer, but a wonderful opportunity to see both planets at once in the same low power telescope field!

While you're out, take the time to look at lowly Theta Lupi about a fistwidth south-southwest of the mighty Antares. While this rather ordinary looking 4th magnitude star appears to be nothing special—there's a lesson to be learned here. So often in our quest to look at the bright and incredible—the distant and the impressive—we often forget about the beauty of a single star. When you take the time to seek the path less traveled, you just might find more than you expected. Hiding behind a veil of the "ordinary" lies a trio of three spectral types and three magnitudes in a diamond-dust field. An undiscovered gem....

The 100" Hooker Telescope
(widely used public image)

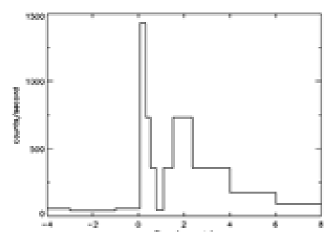
JUL 2
MONDAY

Orbiting in space 40 years ago, the Vela 3 and 4 satellites were quietly keeping watch on Earth's nuclear test ban treaty. The Vela satellites were greatly successful and far exceeded their life expectancy. While checking data on this day just before the launch of the fifth Vela, scientists found an event recorded by Vela 4—an event also strong enough to trigger a response from the Vela 3 satellite. While placement wasn't accurate enough at the time to pinpoint the source, the scientists realized they had caught the first recorded gamma ray burst.

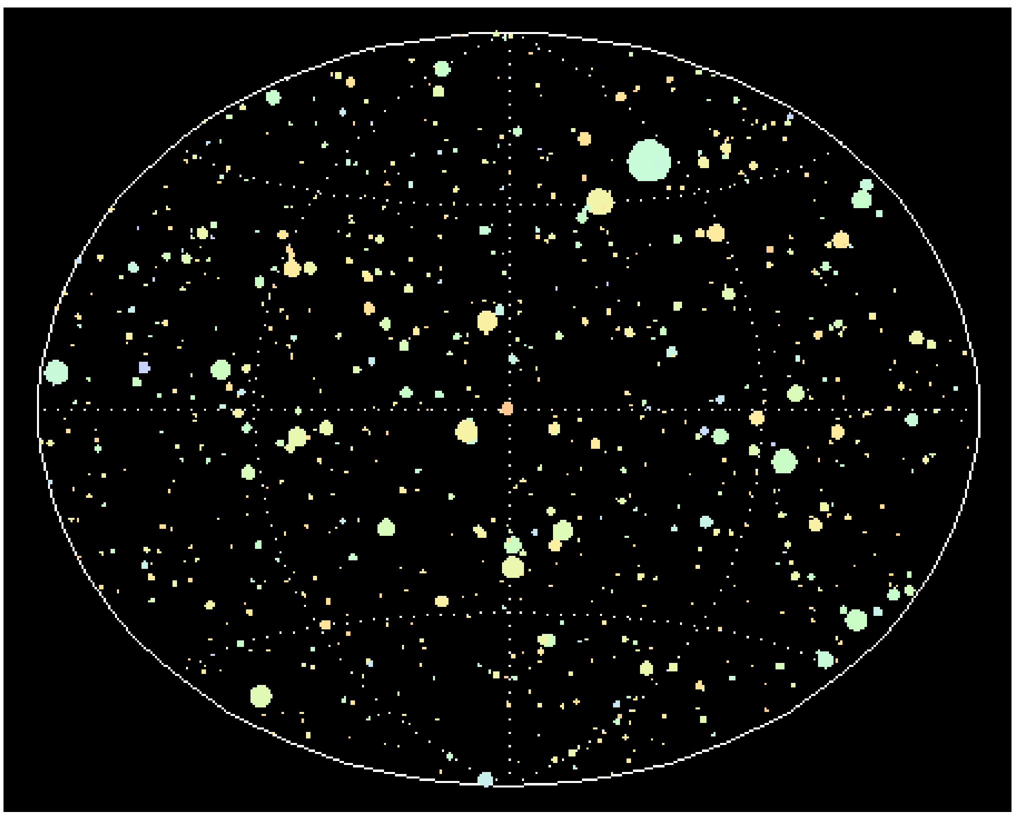
While very little is known about these mysterious events, we do know that they occur about once a day with a photon energy of 100 million electron volts. While some of them occur in our own Milky Way, science is unclear about the source of more distant explosions—and over 800 have been charted on a single map! One such source for gamma rays is a special type of star known as a Wolf-Rayet—a hot, huge star which is undergoing significant mass loss and exposing its central core.

Tonight for more southern viewers, take the time to look up one such incredible system, IC 4406. You'll find it about 5 degrees northwest of Alpha Lupi, or just about a fingerwidth northwest of the Tau collection (RA 14 22 26.28 Dec -44 09 04.3). This roughly 10th magnitude planetary nebula is sometimes referred to as the "Retina Nebula" for its photographic resemblance to the human retina. This square appearing patch is a Wolf-Rayet nebula and color photographs show evidence of gamma rays as green sparkles!

IC 4406
Credit: Palomar Observatory, courtesy of Caltech



First gamma ray burst
Credit: NASA



Gamma Ray Sky
Credit: NASA

JUL 3
TUESDAY

If you're up before dawn, this morning would be a great opportunity to easily find Neptune around one degree north of the Moon.

Tonight for all observers, let's take a closer look at the fascinating constellation of Lupus southwest of brilliant Antares. While more northerly latitudes will see only roughly half of this constellation, it sits well at this time of year for those in the south. So why bother?

Cutting through our Milky Way galaxy at a rough angle of about 18 degrees is a disc shaped zoned called Gould's Belt. Lupus is part of this area, and its perimeter contains star-forming regions that came to life about 30 million years ago when a huge molecular cloud of dust and gas compressed—much like in the Orion area. In Lupus we find Gould's Belt extending above the plane of the Milky Way!

Region of B 288
Credit: Palomar Observatory, courtesy of Caltech

Return again to the beautiful Theta and head around 5 degrees west for NGC 5986 (RA 15 46 03.44 Dec -37 47 10.1). It's a 7th magnitude globular cluster which can be spotted with binoculars with good conditions. While this Class VII cluster is not particularly dense, many of its individual stars can be resolved in a small telescope.

Now sweep the area north of NGC 5986 (RA 17 57 06.00 Dec -37 05 -0.0) and tell me what you see. That's right! Nothing. This is the dark nebula B 288—a cloud of dark, obscuring dust which blocks incoming starlight. Look carefully at the stars you *can* see and you'll notice they appear quite red. Thanks to B 288, much of their emitted light is absorbed by this region, providing us with a pretty incredible on-the-edge view of something you can't see—a Barnard dark nebula.

NGC 5986
Credit: Palomar Observatory, courtesy of Caltech

Did you know that celestial fireworks occurred in 1054 on this day? It is believed that the bright supernova recorded by Chinese astronomers occurred at this point in history, and today we know its remnants as M1—the "Crab Nebula."

But could such an event happen again in our own celestial "backyard?" Look no further than HR 8210 (RA 21 26 26.66 Dec +19 22 32.3). It may be nothing more than a white dwarf star hiding out in late night Capricornus, but it's a star that has run out of most of its fuel. This rather ordinary binary system has a companion white dwarf star that's 1.15 times the mass of our Sun. As the companion also expends its fuel, it will add mass to HR 8210 and push it over the Chandrasekhar limit—the point of no return in mass. This will result in a supernova event located only 150 light-years away from our solar system...50 light-years too close for comfort!

470 light-years away in the Gould Belt, and roughly 1.5 million years ago, a similar massive star exploded in the Upper Scorpius association. No longer able to resist its own gravitational mass by nuclear fusion, it unleashed a supernova event which left its evidence as a layer of iron here on Earth, and may have caused a certain amount of extinction when its gamma rays directly affected our ozone layer.

Take a long look at Antares tonight—for it is part of that association of stars, and is no doubt a massive red star also poised at the edge of extinction. At a safe distance of 500 light-years, you'll find this pulsing red variable equally fascinating to the eye as well as to the telescope. Unlike HD 8210, Alpha Scorpii also has a companion star which can be revealed to small telescopes under steady conditions. Discovered on April 13, 1819 during a lunar occultation, this 6.5 magnitude green companion isn't the easiest to split from such a bright primary—but it's certainly fun to try!

JUL 4
WEDNESDAY

HR 8210
Credit: Palomar Observatory, courtesy of Caltech

Moon occulting Antares on March 3, 2005
Credit: Tammy Plotner

JUL 5
THURSDAY

If the outer planets call you, then make a date before dawn to catch Uranus. Easily spotted in binoculars, the seventh planet from the Sun can be found about 1.7 degrees south of the Moon.

Tonight let's have a look at a real little powerpunch globular cluster located in northern Lupus—NGC 5824. Although it's not an easy star hop, you'll find it about 7 degrees southwest of Theta Librae and exactly the same distance south of Sigma Librae (RA 15 03 58.50 Dec -33 04 03.9). Look for a 5th magnitude star in the finderscope to guide you to its position southeast.

As a Class I globular cluster, you won't find any that is more concentrated than this. Holding a rough magnitude of 9, this little beauty has a deeply concentrated core region that is simply unresolvable. Discovered by E. E. Barnard in 1884, it enjoys its life in the outer fringes of the galactic halo about 104 light-years away from Earth, and contains many recently discovered variable stars. Oddly enough, this metal poor globular may have been formed by a merger. In researching evidence found about NGC 5824's stellar population, it is believed that two less dense and differently-aged globulars may have approached one another at a low velocity and combined to form this ultra-compact structure.

Be sure to mark your observing notes on this one! It also belongs to the Bennett catalog and is part of many globular cluster studies. Enjoy...

NGC 5824
Credit: Palomar Observatory, courtesy of Caltech

Today in 1687, Isaac Newton's "Principia" was first published with the help of Edmund Halley. Although Newton was indeed a very strange man with a highly checkered history, one of the keys to Newton's work with the theory of gravity was the idea that one body could attract another across the vastness of space.

Now let's have a look at things gravitationally bound as we start at Eta Lupi, which is a fine double star that can even be resolved with binoculars. Look for the 3rd magnitude primary and 8th magnitude secondary separated by a wide 15". You'll find it by staring at Antares and heading due south two binocular fields to center on bright H and N Scorpii—then one binocular field southwest.

When you are done, hop another roughly five degrees southeast to encounter the fine open cluster NGC 6124. Discovered by Lacaille, and known as object I.8, this 5th magnitude open cluster is also known as Dunlop 514, as well as Melotte 145 and Collinder 301. Situated about 19 light-years away, it will show as a fine, round, faint spray of stars to binoculars and be resolved into about 100 stellar members to larger telescopes.

While NGC 6124 is on the low side to northern observers, it's worth the wait for it to hit best position and at least try! Be sure to mark your notes, since this delightful galactic cluster is a Caldwell object and a southern skies binocular award.

NGC 6124
Credit: Palomar Observatory, courtesy of Caltech

JUL 7
SATURDAY

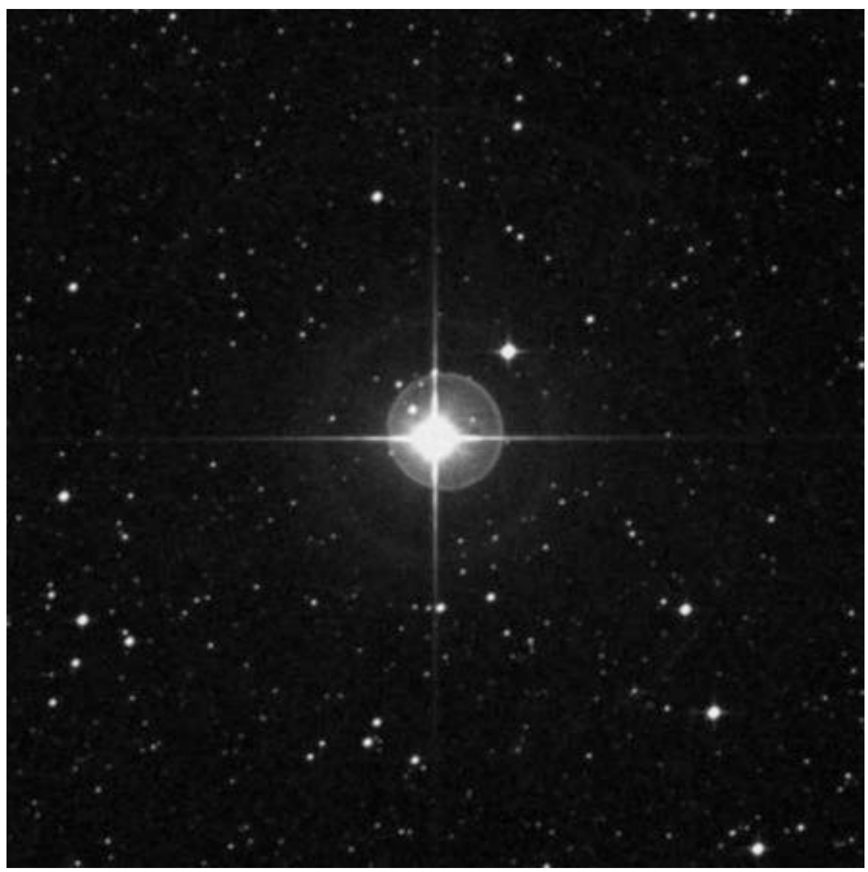
M107
Credit: Palomar Observatory, courtesy of Caltech

Tonight for unaided observers, let's begin by identifying Zeta Ophiuchi, the centermost in a line of stars marking the edge of the constellation of Ophiuchus, about a handspan north of Antares. As a magnificent 3rd magnitude blue/white class O, this hydrogen fusing dwarf is 8 times larger than our own Sun. Hanging out some 460 light-years away, it is dulled by the interstellar dust of the Milky Way and would shine two full magnitudes brighter if it were not obstructed. Zeta is a "runaway star"—a product of a one-time supernova event in a double star system. Now roughly halfway through its 8 million year life span, the same fate awaits this star!

Now point binoculars or small scopes about three fingerwidths south to have a look at Phi Ophiuchi. This is a spectroscopic double star, but it has several delightful visual companions!

Almost in between these two bright stars is our telescopic target for tonight—M107. Discovered by Pierre Méchain in 1782, but only added to the Messier catalog in 1947, it's probably one of the last of the Messier objects to be discovered, and it wasn't resolved into individual stars until studied by Herschel in 1793.

M107 isn't the most impressive of globulars, but this Class X is notable as a faint, diffuse area with a core region in binoculars, and is surprisingly bright in a small telescope. It's a curious cluster, for some believe it contains dark, dust-obscured areas which make it unusual. Located around 21,000 light-years away, this little beauty contains around 25 known variable stars. Visually, the cluster begins to resolve around the edges to mid-aperture and the structure is rather loose. If sky conditions permit, the resolution of individual chains at the globular's edges make this it well worth a visit to log as Herschel IV.40!



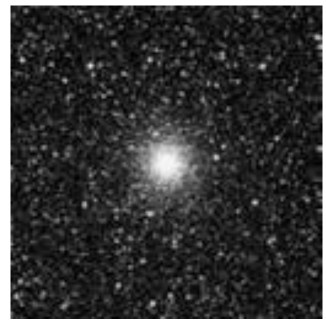
Phi Ophiuchi
Credit: Palomar Observatory, courtesy of Caltech

JUL 8
SUNDAY

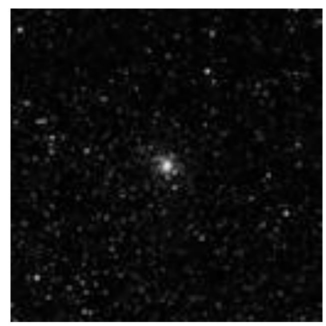
Tonight let's continue on our journey through the galactic halo and pick up the Class VIII globular cluster M9. You'll find it located around two fingerwidths east of Eta Ophiuchi.

Discovered by Messier in 1764, this particular globular cluster is one of the nearest to our galactic center and is around 2,600 light-years away from our solar system. Now let's study differences—check out the contrast between this small globular compared to last night's M107. With M9 we're seeing not only a strong central concentration, but a slight oval shape. This change in structure is caused by the strong absorption of starlight by dust along its northwest edge. Of its huge stellar population, only a dozen or so variable stars are known in M9, which is rather few for a cluster of its size. Visually, it appears more compact than M107, and slightly oblate. Rather than chains of stars resolving at the edges, M9 appears to have larger, individual stars in a random pattern—while M107 appears to have a solid core!

For those with larger scopes, you also have the opportunity to study two more globulars that are nearby—Class II NGC 6356 about a degree to the northeast and Class IV NGC 6342 to the southeast. You will find NGC 6356 to be rather small—but bright and concentrated. NGC 6342 appears to be even smaller and far less distinct. Compare them both to the structure of M9 and you will find 6356 to be the most concentrated of the three...a "class" act!



NGC 6356
Credit: Palomar Observatory, courtesy of Caltech



NGC 6342
Credit: Palomar Observatory, courtesy of Caltech

M9
Credit: Palomar Observatory, courtesy of Caltech

JUL 9
MONDAY

M80
Credit: Palomar Observatory, courtesy of Caltech

If you're up before dawn this morning, be sure to step outside and look at the waning Moon accompanied by ruddy Mars about 5 degrees to the south. This is definitely worth getting up early for!

Tonight we will hustle off to explore a single small globular—M80. Located about 4 degrees northwest of Antares (about two fingerwidths), this little globular cluster is a powerpunch. Located in a region heavily obscured by dark dust, M80 will shine like an unresolvable star to small binoculars and reveal itself to be one of the most heavily concentrated globulars to the telescope.

Discovered within days of each other by Messier and Méchain, respectively, in 1781, this intense Class I globular cluster is around 36,000 light-years distant. In 1860, M80 became the first globular cluster to host a nova. As stunned scientists watched, a centrally located star brightened to magnitude 7 over a period of days and became known as T Scorpii. The event then dimmed more rapidly than expected, making observers wonder exactly what they had seen.

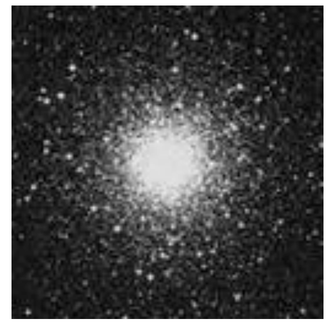
Since most globular clusters contain stars all of relatively the same age, the hypothesis was put forward that perhaps they had witnessed an actual collision of stellar members. Given that the cluster contains more than a million stars, the probability is that some 2700 collisions of this type may have occurred during M80's lifetime.

On this day in 1979, Voyager 2 quietly made its closest approach to Jupiter. How about if we take a close approach as well? Enjoy the waltz of the Galileans and all the fine details!

Jupiter
Credit: Wes Higgins

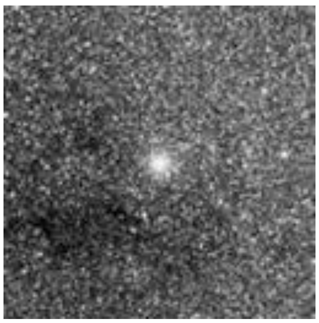
Tonight let's head on out towards two more giants that appear very differently from other recent studies (and from each other)—the same-field binocular pair M10 and M12. Located about half a fistwidth west of Beta Ophiuchi, M12 is the northernmost of this pair. Easily seen as two hazy round spots in binoculars, let's go to the telescope to find out what makes M12 tick. Since this large globular is much more loosely concentrated, smaller scopes will begin to resolve individual stars from this 24,000 light-year distant Class IX cluster. Note there is a slight concentration toward the core region, but for the most part the cluster appears fairly even. Large instruments will resolve out individual chains and knots of stars.

Now let's drop about three and a half degrees southeast and check out Class VII M10. What a difference in structure! Although they seem to be close together and close in size, the pair is actually separated by some 2,000 light-years. M10 is a much more concentrated globular showing a brighter core region to even the most modest of instruments. This compression of stars is what classifies one type of globular cluster from another, and M10 appears brighter, not because of this compression, but because it is about 2,000 light-years closer.



M10
Credit: Palomar Observatory, courtesy of Caltech

M12
Credit: Palomar Observatory, courtesy of Caltech



NGC 6528
Credit: Palomar Observatory, courtesy of Caltech

For hard core observers, tonight's globular cluster study will require at least a mid-aperture telescope, because we're staying up a bit later to go for a same-low-power-field pair—NGC 6522 and NGC 6528. You will find them easily at low power just a breath northwest of Gamma Sagittarii—better known as Al Nasl—the tip of the "teapot's" spout. Once located, switch to higher power to keep the light of Gamma out of the field and let's do some studying.

The brighter, and slightly larger, of the pair to the northeast is Class VI NGC 6522. Note its level of concentration compared to Class V NGC 6528. Both are located around 2,000 light-years away from the galactic center and seen through a very special area of the sky known as "Baade's Window"—one of the few areas towards our galaxy's core region not obscured by dark dust. While they are similar in concentration and distance, NGC 6522 has a slight amount of resolution towards its edges while NGC 6528 appears more random.

While both NGC 6522 and NGC 6528 were discovered by Herschel on July 24, 1784, and both are the same distance from the galactic core—they are very different. NGC 6522 has an intermediate metallicity. At its core, the red giants have been depleted—stripped tidally by evolving blue stragglers. It is possible that core collapse has already occurred. NGC 6528, however, contains one of the highest metal contents of any known globular cluster collected in its bulging core!

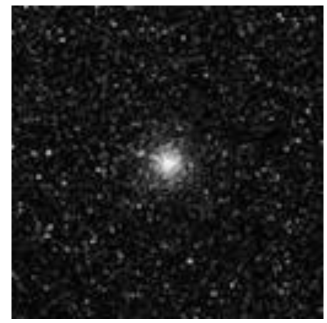
NGC 6522
Credit: Palomar Observatory, courtesy of Caltech

JUL 12
THURSDAY

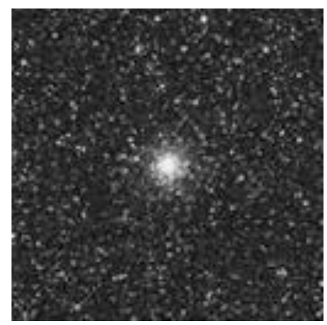
Tonight we're going to move back toward Ophiuchus and a globular cluster unlike any that we've seen so far—M19. First locate Antares. About a fistwidth to the east you will see Theta Ophiuchi, with fainter star 44 to its northwest and multiple system 36 to the southeast. Move around two degrees to the west of 36 and let's check it out.

With a visual magnitude of 6.8, this class VIII globular cluster can be seen with small binoculars, but requires a telescope to begin to take on form. Discovered by Messier in 1764, M19 is the most oblate globular known. Harlow Shapely, who studied globular clusters and cataloged their elliptical natures, estimated that there were about twice as many stars along the major axis as along the minor. This stretching of the cluster from its accepted round shape may very well have to do with its proximity to the Galactic Center—a distance of only about 5,200 light-years. This makes it only a tiny bit more remote from us than the very center of the Milky Way!

Very rich and dense, even smaller telescopes can pick up the faint blue tinge to this globular cluster. It is definitely one of the more interesting, due to its shape, but for the adventurous? There are two more. The Class VI NGC 6293 is about a degree and a half to the east-southeast and is far brighter than you might expect. It is much rounder, and is more concentrated directly in the core than its companion. Now move about a degree and a half to the north-northeast of M19 to find dimmer Class IX NGC 6284. Although it is the same size as NGC 6293, look how much more loosely this one is constructed!



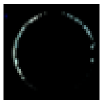
NGC 6293
Credit: Palomar Observatory, courtesy of Caltech



NGC 6284
Credit: Palomar Observatory, courtesy of Caltech

M19
Credit: Doug Williams/REU Program/NOAO/AURA/NSF

JUL 13
FRIDAY



Today is Friday the 13th. If you're not superstitious, but only having bad luck at finding some of these globular clusters—then how about if we take a look at one that's incredibly easy to find? All you have to know is Antares and go west...

Just slightly more than a degree away you find a major globular cluster perfectly suited for every size telescope and binoculars—M4. This 5th magnitude Class IX cluster can even be spotted unaided from a dark location! In 1746 Philippe Loys de Chéseaux happened upon this 7200 light-year distant beauty—one of the nearest to us. It was also included in Lacaille's catalog as object I.9 and in Messier's in 1764. Much to Charles' credit, he was the first to resolve it!

As one of the most loose, or open, globular clusters, M4 would be tremendous if we were not looking at it through a heavy cloud of interstellar dust. To binoculars, it is easy to pick out a very round, diffuse patch—yet it will begin resolution with even a small telescope. Large telescopes will also easily see a central "bar" of stellar concentration across M4's core region, which was first noted by Herschel.

As an object of scientific study, the first millisecond pulsar was discovered within M4 in 1987—one which is 10 times faster than the pulsar contained within the Crab Nebula. Photographed by the Hubble Space Telescope in 1995, M4 was found to contain white dwarf stars—the oldest in our galaxy—with a planet orbiting one of them! A little more than twice the size of Jupiter, this planet is believed to be as old as the cluster itself. At 13 billion years, it would be three times the age of the Sol system!

M4
Credit: Palomar Observatory, courtesy of Caltech

JUL 14
SATURDAY

Today in 1965, Mariner 4 became the first spacecraft to perform a flyby of Mars. If you're up early, be sure to salute the Red Planet! Tonight at sunset, look for the beautiful visages of Venus and Regulus about a degree apart. Something for both the morning and evening SkyWatcher...

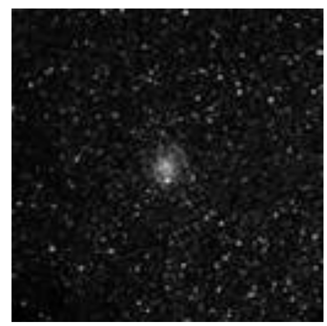
Tonight is New Moon and what better time to look for some alternate catalog objects? Let's start by Herschel hunting while we continue on our globular cluster studies. Our first stop is to return to brilliant Antares and head one-half degree northwest for the Bennett list cluster NGC 6144 (RA 16 27 14.14 Dec -26 01 29.0).

Originally discovered by Herschel in 1784 and labeled as HVI.10, this 9th magnitude Class II globular is around 8500 light-years from the galactic core. While it is only about one-third the size of M4, it is also three times more distant from our solar system. If you have trouble spotting it, try high magnification to keep Antares' glare at bay. Situated in the Rho Ophiuchi dust cloud, NGC 6144 has at least one slow variable of the RR Lyrae type.

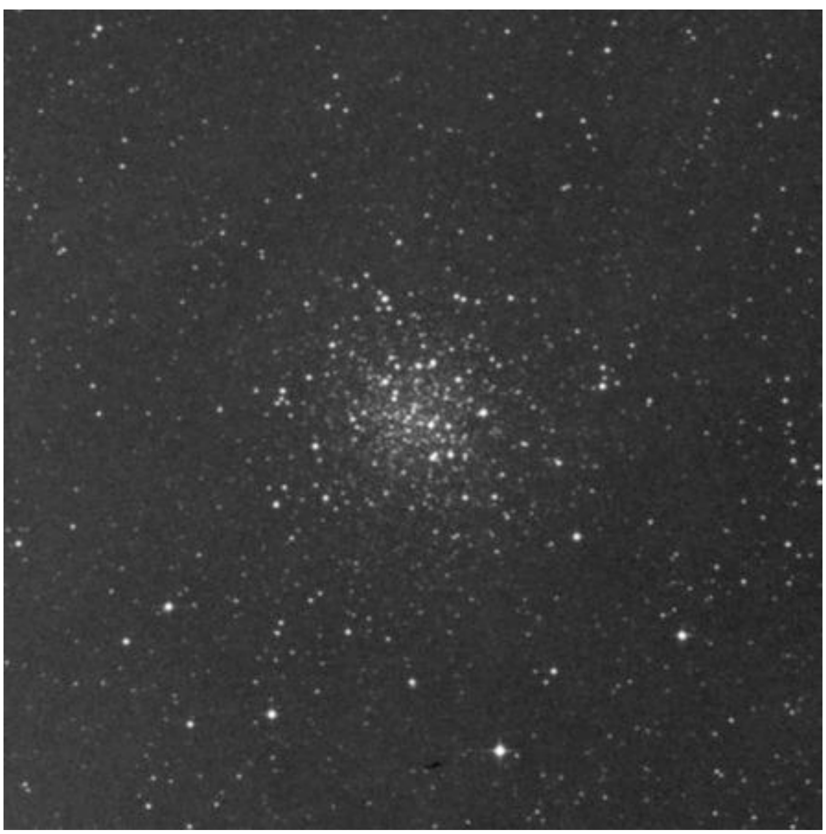
Now drop a little more than a fistwidth south of Antares for NGC 6139 (RA 16 27 40.43 Dec -38 50 55.6). Discovered by James Dunlop in 1820 and cataloged as Dun 536, this 9th magnitude Class II globular is much further from the galactic center at a distance of 11,700 light-years. Within the gravitational pull of this low metallicity cluster, at least six RR Lyrae type variables still cling to their host.

NGC 6139
Credit: Palomar Observatory, courtesy of Caltech

Now that we've seen two very concentrated globular clusters, let's look at one that isn't even classed. Drop a fingerwidth south of Lambda Scorpii for NGC 6380 (RA 17 34 28.00 Dec -39 04 09.0). This 11th magnitude globular is a challenge! Also discovered by Herschel and listed as h 3688, this one is also known as Tonantzintla 1—or Ton 1. It's so vague that it wasn't even classed as a globular cluster until research with a photographic plate! It's very metal-rich and contains red giants at its bulging heart... What's left of it!

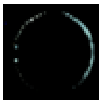


NGC 6380
Credit: Palomar Observatory, courtesy of Caltech



NGC 6144

JUL 15
SUNDAY



NGC 6426
Credit: Palomar Observatory, courtesy of Caltech

Tonight while dark skies are still in our favor, let's start off north in Hercules for a look at another globular study—M92. Although in a relatively open field for starhoppers, it's not too hard to find if you can imagine it as the apex of a triangle with northern keystone stars—Eta and Pi—as the base.

At near magnitude 6, Class IV M92 was discovered by Johann Bode in 1777 and cataloged as Bode 76. Independently recovered by Messier in 1781 and resolved by Herschel in 1783, this bright, compact globular is around 26,700 light-years away and may be from 12-16 billion years old. It contains 14 RR Lyrae variables among its 330,000 stars, and a very rare eclipsing binary.

Viewable unaided under the right conditions and very impressive in even small binoculars, M92 is a true delight to even the smallest of telescopes. It has a very bright and unresolvable core with many outlying stars that are easily revealed. Larger scopes will appreciate its fiery appearance!

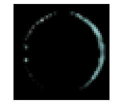
Now let's hop south to Beta Ophiuchi to have a look at NGC 6426, about a fingerwidth south. There's a very good reason why you'll want to at least try with Herschel II.587! It's even older than M92...

Discovered and cataloged by Sir William in 1786, this 11th magnitude globular Class IX globular looks destroyed in comparison. At 67,500 light-years away, it's far more than twice the distance from us as is M92! Residing 47,600 light-years from the galactic center, NGC 6426 contains 15 RR Lyrae variables (3 of which are newly discovered) and is the most metal-poor globular known. So what's the relation to M92? It's even older!

Forget about finding this one in binoculars and very small telescopes. For the mid-sized scope you'll find it conveniently located about halfway between Beta and Gamma Ophiuchi—but it's not easy. Faint and diffuse, a large telescope is required to begin resolution.

M92
Credit: Palomar Observatory, courtesy of Caltech

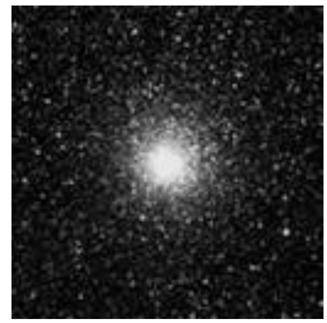
JUL 16
MONDAY



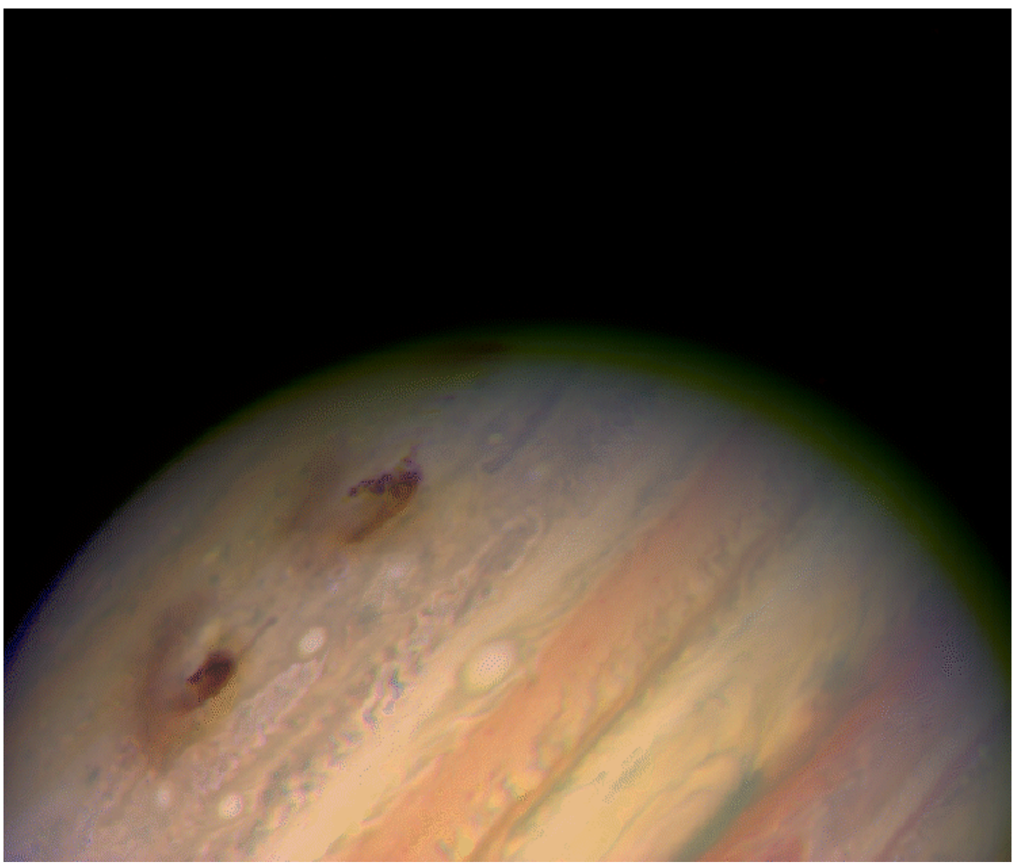
Today in 1850 at Harvard University, the first photograph of a star (other than the Sun) was made. The honors went to Vega! In 1994, an impact event was about to happen as nearly two dozen fragments of Comet Shoemaker-Levy 9 were speeding their way to the surface of Jupiter. The result was spectacular, and the visible features left behind on the planet's atmosphere were the finest ever recorded. Why not take the time to look at Jupiter again tonight while it still holds good sky position? No matter where you observe from, this constantly changing planet offers a wealth of things to look at—be it the appearance of the Great Red Spot, or just the ever changing waltz of the Galilean moons. Tonight the Moon and Saturn will not only be close—but very close! Be sure to check IOTA information for a visible occultation event!

Now let's return again to the oblate and beautiful M19 and drop two fingerwidths south for another misshapen globular—M62.

At magnitude 6, this 22,500 light-year distant Class IV cluster can be spotted in binoculars, but comes to wonderful life in the telescope. First discovered by Messier in 1771, Herschel was the first to resolve it and report on its deformation. Because it is so near to the galactic center, tidal forces have "crushed" it—much like M19. You will note when studying in the telescope that its core is very off center. Unlike M19, M62 has at least 89 known variable stars—85 more than its neighbor—and the dense core may have undergone collapse. A large number of X-ray binaries have also been discovered within its structure, perhaps caused by the close proximity of stellar members. Enjoy it tonight!



M62
Credit: Palomar Observatory, courtesy of Caltech



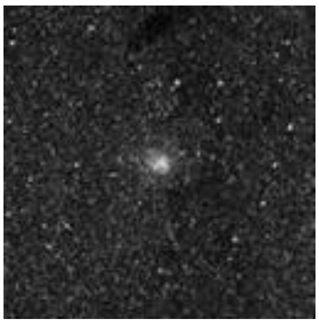
Shoemaker-Levy 9 impact on Jupiter
Credit: NASA

JUL 17
TUESDAY

Tonight the Moon has returned in a position to favor a bit of study. Start by checking IOTA information for a possible visible occultation of Regulus, and look for Saturn quite nearby as the slender crescent graces the early evening skies.

Although poor position makes study difficult during the first few lunar days, be sure to look for the ancient impact Vendelinus just slightly south of central. Spanning approximately 150 kilometers in diameter and with walls reaching up to 4400 meters in height, lava flow has long ago eradicated any interior features. Its old walls hold mute testimony to later impact events as you view crater Holden on the south shore and much larger Lame on the northeast edge and sharp Lohse northwest. Mark your challenge list!

If you're up to another challenge tonight, let's go hunting Herschel I.44, also known as NGC 6104. You'll find this 9.5 magnitude globular cluster around two fingerwidths northeast of Theta Ophiuchi and a little more than a degree due east of star 51 (RA 17 38 36.93 Dec -23 54 31.5).



NGC 6401
Credit: Palomar Observatory, courtesy of Caltech

Discovered by William Herschel in 1784 and often classed as "uncertain," today's powerful telescopes have placed this halo object as a Class VIII and given it a rough distance from the galactic center of 8,800 light-years. Although neither William nor John could resolve this globular, and they listed it originally as a bright nebula, studies in 1977 revealed a nearby suspected planetary nebula named Peterson 1. Thirteen years later, further study revealed this to be a symbiotic star.

Symbiotic stars are a true rarity—not a singular star at all, but a binary system. A red giant dumps mass towards a white dwarf in the form of an accretion disc. When this reaches critical mass, it then causes a thermonuclear explosion resulting in a planetary nebula. While no evidence exists that this phenomenon is physically located within metal-rich NGC 6401, just being able to see it in the same field makes this journey both unique and exciting!

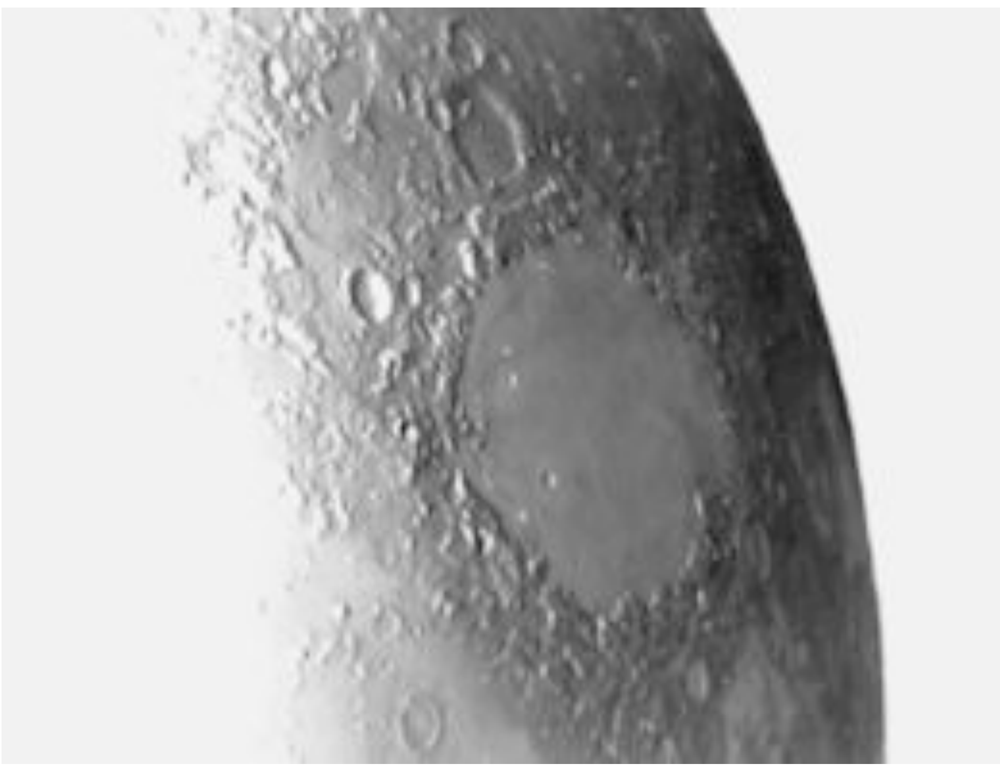
Vendelinus
Credit: Alan Chu

On this day 27 years ago, India launched its first satellite (Rohini 1), and 31 years ago in the United States Gemini 10 launched carrying John Young and Michael Collins to space. Tonight we'll launch our imaginations as we view the area around Mare Crisium and have a look at this month's lunar challenge—Macrobius. You'll find it just northwest of the Crisium shore...

Spanning 64 kilometers in diameter, this Class I impact crater drops to a depth of nearly 3600 meters—about the same as many of our earthly mines. Its central peak rises up 1100 meters, and may be visible as a small speck inside the crater's interior. Be sure to mark your lunar challenges and look for other features you may have missed before!

Since the moonlight will now begin to interfere with our globular cluster studies, let's waive them for a while as we take a look at some of the region's most beautiful stars. Tonight your goal is to locate Omicron Ophiuchi, about a fingerwidth northeast of Theta. At a distance of 360 light-years, this system is easily split by even small telescopes. The primary star is slightly dimmer than magnitude 5 and appears yellow to the eye. The secondary is near 7th magnitude and tends to be more orange in color. This wonderful star is part of many double star observing lists, so be sure to note it!

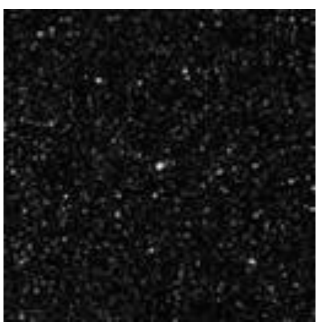
Omicron Ophiuchi
Credit: Palomar Observatory, courtesy of Caltech



Macrobius on the edge of Crisium
Credit: Greg Konkel

JUL 19 THURSDAY

Edward Pickering
(widely used public image)



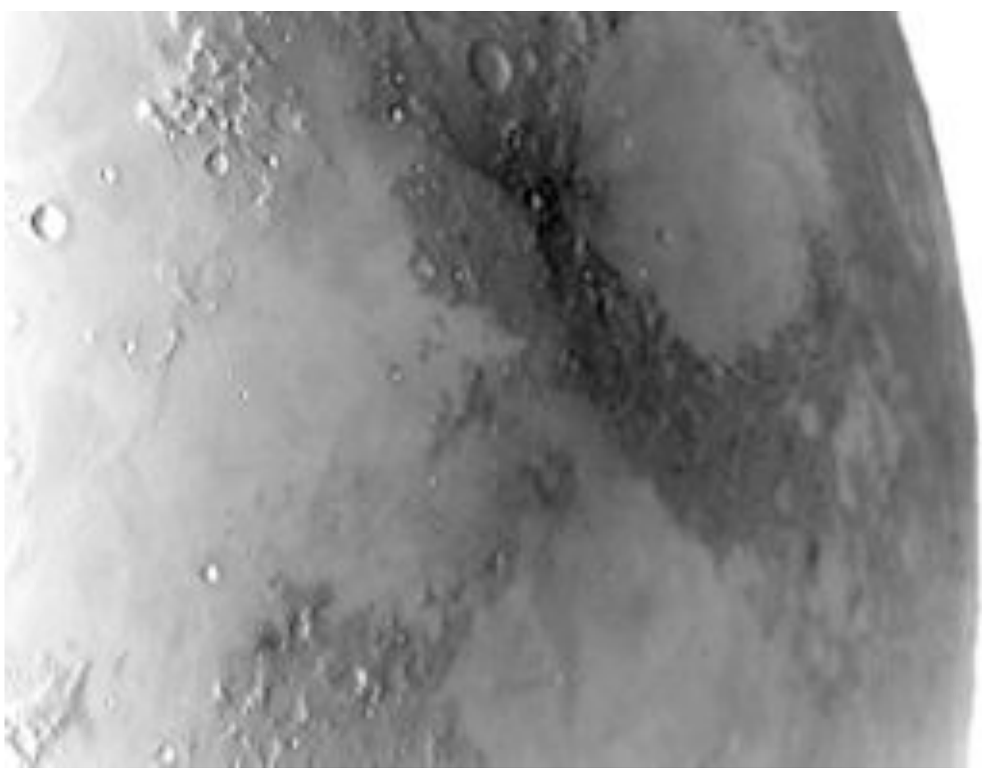
RR Scorpii in center of field
Credit: Palomar Observatory, courtesy of Caltech

Today in 1846, Edward Pickering was born. Although his name is not well known, he became a pioneer in the field of spectroscopy. Pickering was the Harvard College Observatory Director from 1876 to 1919, and it was during his time there that photography and astronomy began to merge. Known as the Harvard Plate Collection, these archived beginnings still remain a valuable source of data.

With plenty of Moon to explore tonight, why don't we try locating an area where many lunar exploration missions made their mark? Binoculars will easily reveal the fully disclosed areas of Mare Serenitatis and Mare Tranquillitatis, and it is where these two vast lava plains converge that we will set our sights. Telescopically, you will see a bright "peninsula" westward of where the two conjoin which extends toward the east. Just off that look for bright and small crater Pliny. It is near this rather inconspicuous feature that the remains Ranger 6 lie forever preserved where it crashed on February 2, 1964.

Unfortunately, technical errors occurred and it was never able to transmit lunar pictures. Not so Ranger 8! On a very successful mission to the same relative area, this time we received 7137 "postcards from the Moon" in the last 23 minutes before hard landing. On the "softer" side, Surveyor 5 also touched down near this area safely after two days of malfunctions on September 10, 1967. Incredibly enough, the tiny Surveyor 5 endured temperatures of up to 283 degrees F, but was able to spectrographically analyze the area's soil...And by the way, it also managed to televise an incredible 18,006 frames of "home movies" from its distant lunar locale.

When you're finished, why not have a look at something that would make Edward Pickering proud? He enthusiastically encouraged amateur astronomers, and founded the American Association of Variable Star Observers—so set your sights on RR Scorpius about two fingerwidths northeast of Eta and less than a fingerwidth southwest M62 (RA 16 56 37.84 Dec -30 34 48.2). This very red Mira type can reach as high as magnitude 5 and drop as low as 12 in about 280 days!



Moon Shot
Credit: Greg Konkel

Today was a busy day in astronomy history! In 1969, the world held its breath as the Apollo 11 lander touched down and Neil Armstrong and Edwin Aldrin became the first humans to touch the lunar surface. We celebrate our very humanity because even Armstrong was so moved that he messed up his lines! The famous words were meant to be "A small step for a man. A giant leap for mankind." That's nothing more than one small error for a man, and mankind's success continued on July 20, 1976 when Viking I landed on Mars—sending back the first images ever taken from that planet's surface.

Tonight let's celebrate 36 years of space exploration and walk on the Moon where the first man set foot. For SkyWatchers, the dark round area you see on the northeastern limb is Mare Crisium and the dark area below that is Mare Fecunditatis. Now look mid-way on the terminator for the dark area that is Mare Tranquillitatis. At its southwest edge, history was made.

In binoculars, trace along the terminator where the Caucasus Mountains stand—and then south for the Apennines and the Haemus Mountains. As you continue towards the center of the Moon, you will see where the shore of Mare Serenitatis curves east, and also the bright ring of Pliny. Continue south along the terminator until you spot the small, bright ring of Dionysius along the edge of Mare Tranquillitatis. Just to the southwest, you may be able to see the soft rings of Sabine and Ritter. It is near here where the base section of the Apollo 11 landing module—Eagle—lies forever enshrined in "magnificent desolation."

Apollo 11 Landing Area
Image Credit: Greg Konkel

For telescope users, the time is now to power up! See if you can spot small craters Armstrong, Aldrin and Collins just east. Even if you cannot, the Apollo 11 landing area is about the same distance as Sabine and Ritter are wide to the east-southeast.

Even if you don't have the opportunity to see it tonight, take the time during the next couple of days to point it out to your children, grandchildren, or even just a friend...The Moon is a spectacular world and *we've been there!*

Armstrong's "Small Step"
Credit: NASA

JUL 21
SATURDAY

Today in 1961, Mercury 4 was launched, sending Gus Grissom into suborbital space on the second manned flight, and he returned safely in Liberty Bell 7.

Long before the Sun sets, look for the Moon to appear in the still-blue sky. As it darkens, watch for brilliant blue/white Spica to be around a fingerwidth north of the Moon. Have you ever wondered if there was any place on the lunar surface that hasn't seen the sunlight? Then let's go searching for one tonight...

Our first order of business will be to identify crater Albategnius. Directly in the center of the Moon is a dark floored area known as Sinus Medii. South of it will be two conspicuously large craters—Hipparchus to the north and ancient Albategnius to the south. Trace along the terminator toward the south until you have almost reached its point (cusp) and you will see a black oval. This normal looking crater with the brilliant west wall is equally ancient crater Curtius. Because of its high southern latitude, we shall never see the interior of this crater—and neither has the Sun! It is believed that the inner walls are quite steep and that Curtius' interior has never been illuminated since its formation billions of years ago. Because it has remained dark, we can speculate that there may be "lunar ice" pocketed inside its many cracks and rilles that date back to the Moon's formation!

Curtius at center bottom
Credit: Greg Konkel

Because our Moon has no atmosphere, the entire surface is exposed to the vacuum of space. When sunlit, the surface reaches up to 385 K, so any exposed "ice" would vaporize and be lost because the Moon's gravity cannot hold it. The only way for "ice" to exist would be in a permanently shadowed area. Near Curtius is the Moon's south pole, and the Clementine spacecraft's imaging showed around 15,000 square kilometers in which such conditions could exist. So where did this "ice" come from? The lunar surface never ceases to be pelted by meteorites—most of which contain water ice. As we know, many craters were formed by just such impacts. Once hidden from the sunlight, this "ice" could remain for millions of years!

Grissom entering Liberty Bell 7
Credit: NASA

Tonight instead of lunar exploration, we will note the work of Friedrich Bessel, who was born on this day in 1784. Bessel was a German astronomer and mathematician whose functions, used in many areas of mathematical physics, still carry his name. But, you may put away your calculator, because Bessel was also the very first person to measure a star's parallax. In 1837, he chose 61 Cygni and the result was no more than a third of an arc second. His work ended a debate that had stretched back two millennia to Aristotle's time and the Greek's theories about the distances to the stars.

Although you'll need to use your finderscope with tonight's bright skies, you'll easily locate 61 between Deneb (Alpha) and Zeta on the eastern side. Look for a small trio of stars and choose the westernmost. Not only is it famous because of Bessel's work, but it is one of the most noteworthy of double stars for a small telescope. 61 Cygni is the fourth nearest star to Earth, with only Alpha Centauri, Sirius, and Epsilon Eridani closer. Just how close is it? Try right around 11 light-years.

Visually, the two components have a slightly orange tint, are less than a magnitude apart in brightness and have a nice separation of around 30" to the south-southeast. Back in 1792, Piazzi first noticed 61's abnormally large proper motion and dubbed it "The Flying Star." At that time, it was only separated by around 10" and the B star was to the northeast. It takes nearly 7 centuries for the pair to orbit each other, but there is another curiosity here. Orbiting the A star around every 4.8 years is an unseen body that is believed to be about 8 times larger than Jupiter. A star—or a planet? With a mass considerably smaller than any known star, chances are good that when you view 61 Cygni, you're looking toward a distant world!

Friedrich Bessel
(widely used public image)

61 Cygni
Credit: Palomar Observatory, courtesy of Caltech

JUL 23
MONDAY

Tonight let's continue our look at the lunar poles by returning to previous study crater Plato. North of Plato you will see a long horizontal area with a gray floor—Mare Frigoris. North of it you will note a double crater. This elongated diamond-shape is Goldschmidt and the crater which cuts across its western border is Anaxagoras. The lunar north pole isn't far from Goldschmidt, and since Anaxagoras is just about one degree outside of the Moon's theoretical "arctic circle," the lunar sun will never go high enough to clear the southernmost rim. As proposed with Saturday's study, this permanent darkness must mean there is ice! For that very reason, NASA's Lunar Prospector probe was sent there to explore. Did it find what it was looking for? Answer—Yes!

The probe discovered vast quantities of cometary ice which have hidden inside the crater's depths untouched for millions of years. If this sounds rather boring to you, then realize that this type of resource will greatly improve the prospects of establishing a manned base on the lunar surface!

On March 5, 1998, NASA announced that Lunar Prospector's neutron spectrometer data showed that water ice had been discovered at both lunar poles. The first results showed the ice was mixed in with lunar regolith (soil, rocks and dust), but long term data confirmed near pure pockets hidden beneath about 40 cm of surface material—with the results being strongest in the northern polar region. It is estimated there may be as much as 6 trillion kg (6.6 billion tons) of this valuable resource! If this still doesn't get your motor running, then realize that without it, we could never establish a manned lunar base because of the tremendous expense involved in transporting our most basic human need—water.

The presence of lunar water could also mean a source of oxygen, another vital material we need to survive! And for returning home or voyaging further, these same deposits could provide hydrogen which could be used as rocket fuel. So as you view Anaxagoras tonight, realize that you may be viewing one of mankind's future "homes" on a distant world!

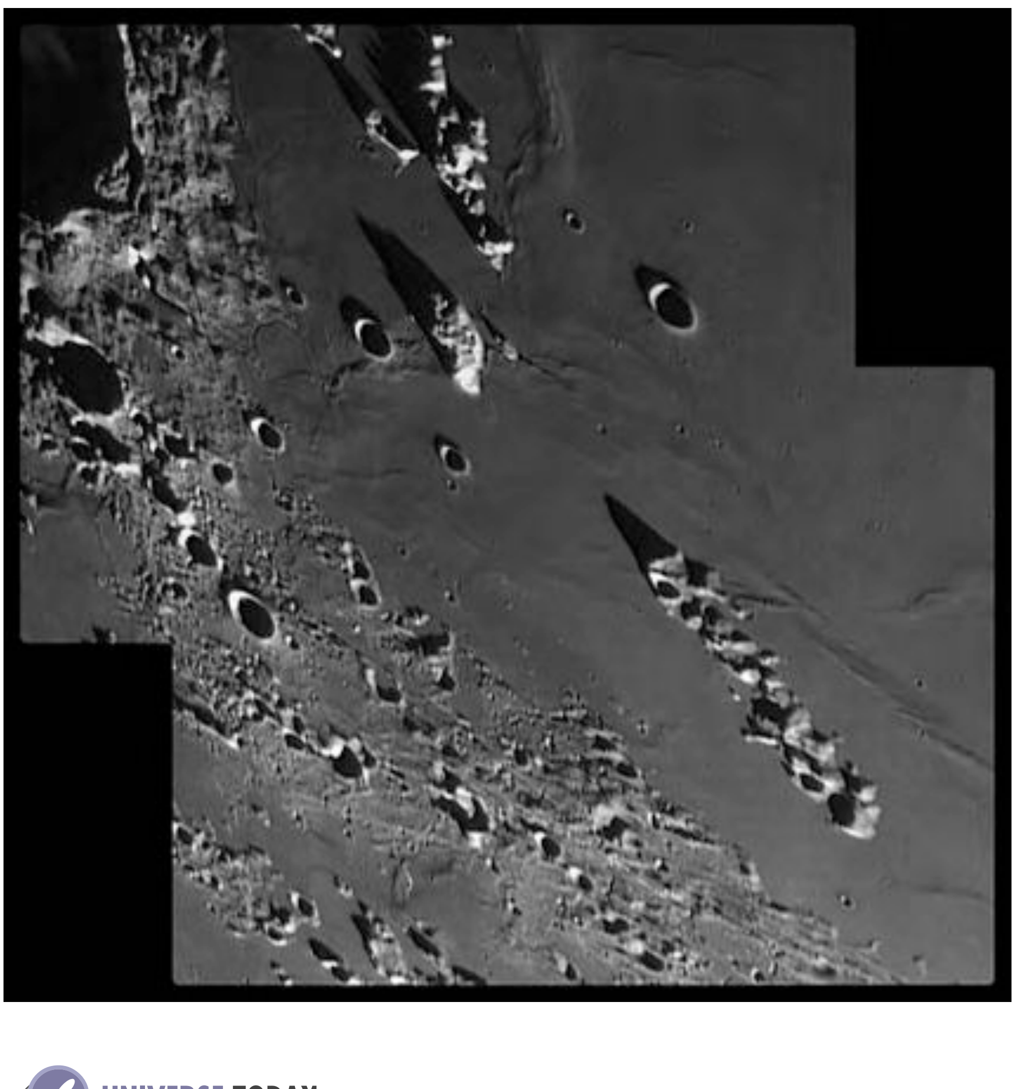
Lunar North Pole
Credit: NASA

JUL 24
TUESDAY

Tonight let's take an entirely different view of the Moon as we do a little "mountain climbing!" The most outstanding feature on the Moon will be the emerging Copernicus, but since we've delved into the deepest areas of the lunar surface, why not climb to some of its peaks?

Using Copernicus as our guide, to the north and northwest of this ancient crater lie the Carpathian Mountains, ringing the southern edge of Mare Imbrium. As you can see, they begin well east of the terminator, but look into the shadow! Extending some 40 kilometers beyond the line of daylight, you will continue to see bright peaks—some of which reach 2072 meters high! When the area is fully revealed tomorrow, you will see the Carpathian Mountains eventually disappear into the lava flow that once formed them. Continuing onward to Plato, which sits on the northern shore of Imbrium, we will look for the singular peak of Pico. It is between Plato and Mons Pico that you will find the scattered peaks of the Teneriffe Mountains. It is possible that these are the remnants of much taller summits of a once stronger range, but only around 1890 meters still survives above the surface.

Time to power up! To the west of the Teneriffes, and very near the terminator, you will see a narrow series of hills cutting through the region west-southwest of Plato. This is known as the Straight Range—Montes Recti—and some of its peaks reach up to 2072 meters. Although this doesn't sound particularly impressive, that's over twice as tall as the Vosges Mountains in central Europe and on the average very comparable to the Appalachian Mountains in the eastern United States. Not bad!



Montes Teneriffe and Montes Recti
Credit: Wes Higgins

JUL 25
WEDNESDAY

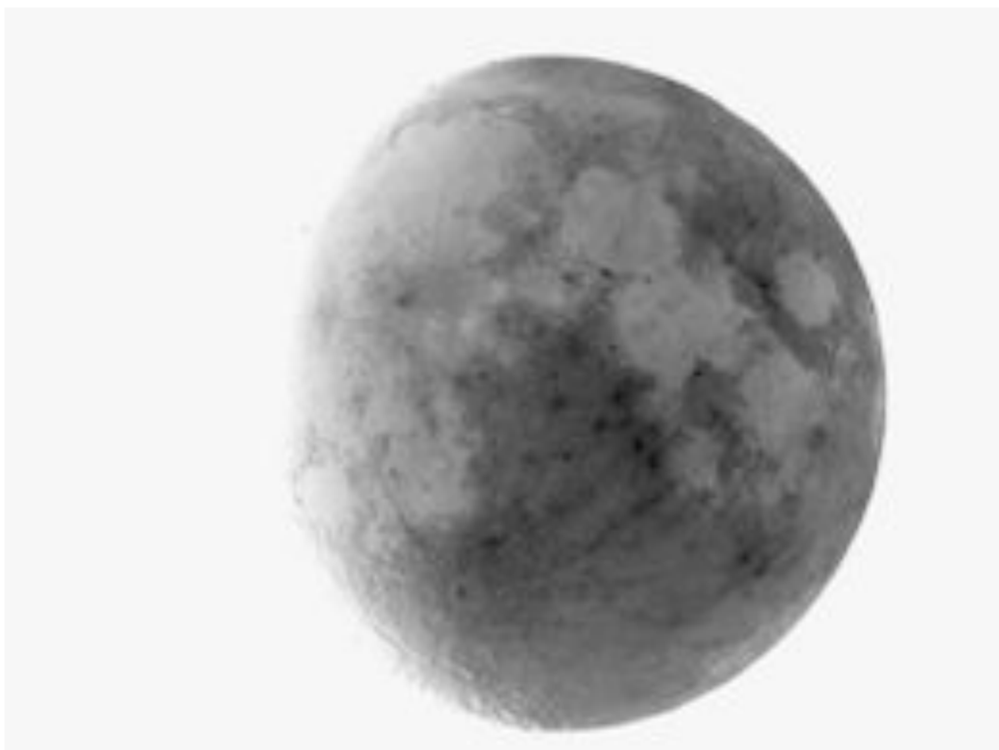
Delta Ophiuchi
Credit: Palomar Observatory, courtesy of Caltech

Today in 1971, Apollo 15 was launched on its way towards the Moon, and we'll continue our lunar mountain climbing expedition and look at the "big picture" on the lunar surface. Tonight all of Mare Imbrium is bathed in sunlight and we can truly see its shape. Appearing as a featureless ellipse bordered by mountain ranges, let's identify them again. Starting at Plato and moving east to south to west you will find the Alps, the Caucasus, and the Apennines, where Apollo 15 landed at the western end of Palus Putredinus. Next come the Carpathians Mountains just north of Copernicus. Look at the form closely... Doesn't this appear that perhaps once upon a time an enormous impact created the entire area? The Imbrium impact... Compare it to the younger Sinus Iridium. Ringed by the Juras Mountains, it may have also been formed by a much later and very similar impact.

And you thought they were just mountains...

Tonight let's have a look with our eyes first at Delta Ophiuchi. Known as Yed Prior ("The Hand"), look for its optical double Epsilon to the southeast: Yed Posterior. Now have a look in binoculars or a telescope at absolute minimum power for another undiscovered gem...

Delta Ophiuchi is 170 light-years from us, while Epsilon is 108—but look at the magnificent field they share. Stars of every spectral type are in an area of sky which could easily be covered by a small coin held at arm's length. Enjoy this fantastic field—from the hot, blue youngsters to the old red giants!



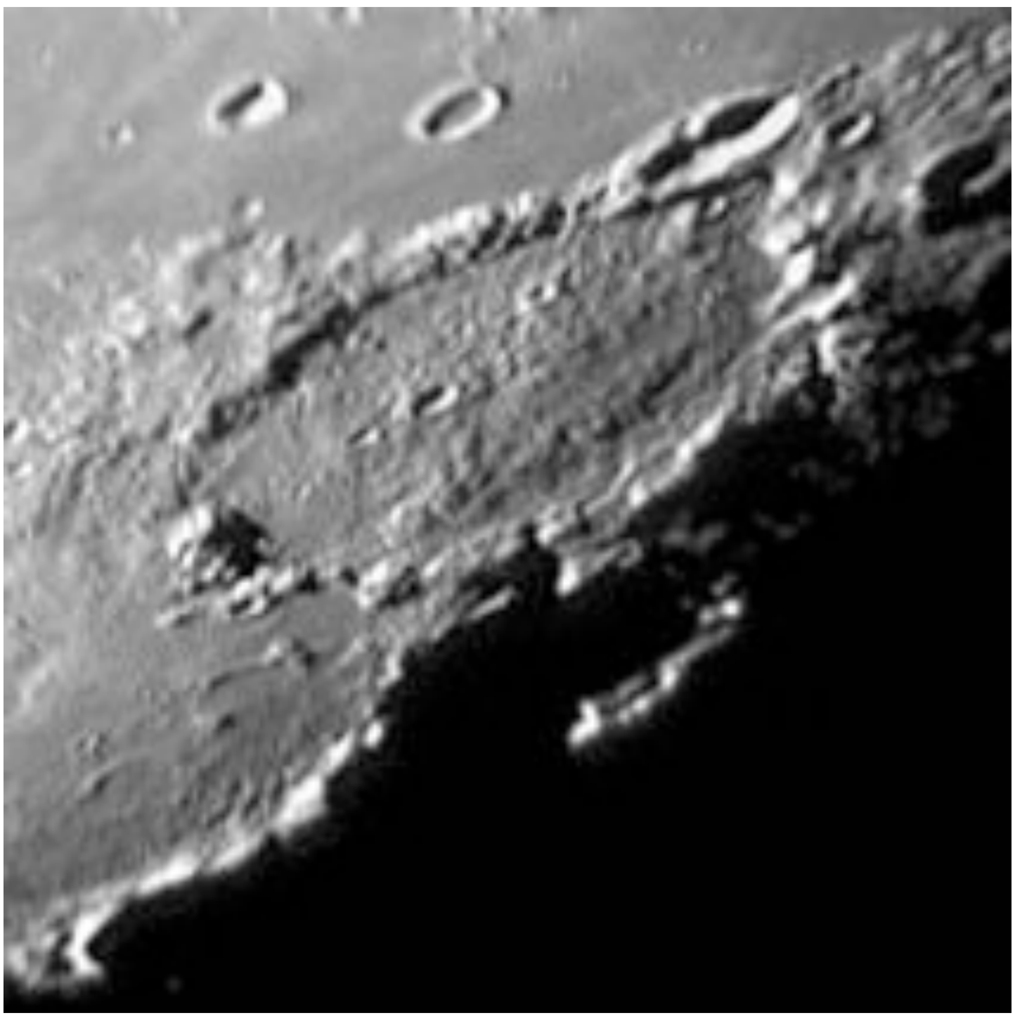
Gibbous Moon
Credit: Greg Konkel

Tonight let's head north of Sinus Iridum, across Mare Frigoris and northeast of the punctuation of Harpalus for a grand old crater—J. Herschel. Although it looks small because it is seen on the curve, this wonderful old walled plain named for John Herschel contains some very tiny details. Its southeastern rim forms the edge of Mare Frigoris and the small crater (24 km) Horrebow dots its southwest edge. The crater walls are so eroded with time that not much remains of the original structure. Look for many very small impact craters which dot J. Herschel's uneven basin and exterior edges. Power up! If you can spot the small central crater C, you are resolving a feature only 12 kilometers wide, from some 385,000 kilometers away!

While we're out, let's have a look at another astounding system called 36 Ophiuchi, located about a thumb's width southeast of Theta. Situated in space less than 20 light-years from Earth, even small telescopes can split this pair of 5th magnitude K type giants very similar to our own Sun, and larger telescopes can also pick up the C component as well.

Be sure to mark your lists with both of your observations tonight, because J. Herschel is a lunar club challenge and 36 Ophiuchi is on many doubles challenge lists.

36 Ophiuchi
Credit: Palomar Observatory, courtesy of Caltech

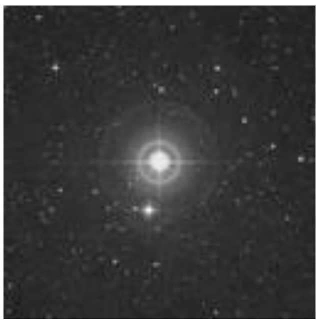


J. Herschel
Credit: Alan Chu

JUL 27
FRIDAY

Tonight let's start our lunar observations with a feature that's a bit less obvious—crater contrasts. The Oceanus Procellarum is the vast, grey "sea" that encompasses most of the northwestern portion of the Moon. On the terminator to its southwest edge, (and almost due west geographically) you will see two craters of near identical size and depth, but not identical lighting.

The southernmost is 46 kilometer wide Billy—one of the darkest-floored areas on the Moon. Named for French mathematician and astronomer Jacques de Billy, it will appear to have a bright ring (the crater rim) around it, but the interior is as featureless as a mare! To the north is 45 kilometer wide Hansteen—note how much brighter and more detailed it is. This far more featured area was named for Dutch geophysicist Christopher Hansteen, and if you power up you'll see the 30 kilometer wide base of Mons Hansteen between them, as well as a 25 kilometer-long rima to the west. It's easy to see that Billy was once filled with smooth lava flow, while counterpart Hansteen evolved much differently! Be sure to mark your notes on this lunar challenge.



Zeta Scorpii 1
Credit: Palomar Observatory, courtesy of Caltech

Now that we've looked at contrasting craters, let's have a look at a beautifully contrasting pair of stars—Zeta 1 and 2 Scorpii. You'll find them a little less than a handspan south-southeast of Antares and at the western corner of the J of the constellation's shape.

Although the two Zetas aren't a true physical pair, they are nonetheless interesting. The easternmost, orange sub-giant Zeta 2 appears far brighter for a reason... It's much closer at only 155 light-years away. But, focus your attention on western Zeta 1. It's a blue supergiant that's around 5700 light-years away and shines with the light of 100,000 suns and exceeds even Rigel in sheer power! The colorful pair is easily visible as two separate stars to the unaided eye, but a real delight in binoculars or a low power telescope field. Check them out tonight!

Hansteen and Billy
Credit: Alan Chu

Tonight as the skies darken, look for Jupiter to appear first about 5 degrees north of the Moon—with Antares around a half degree north. Antares could be a visible occultation, so be sure to check IOTA information!

While we're looking Selene's way, see if you can spot crater Grimaldi on the western edge without any aid… Then grab binoculars or telescope and let's have a look!

Named for Italian physicist and astronomer Francesco Grimaldi, this great old crater is one of the few which actually resembles a mare. It spans 222 kilometers from east to west and 430 kilometers from north to south. Along its southeastern flank, look for a 230 kilometer-long rima which extends its way to the double ring of Sirsalis. Grimaldi is a Class V mountain-walled plain whose floor is one of the darkest areas of the Moon, reflecting only 6% of the light. Look carefully at its walls… You'll find the northern area very eroded, while both foothills and mountains edge it to the east and west. Be sure to mark your lunar challenge list as having spotted the great Grimaldi!

Now grab a comfortable seat because the Delta Aquarid meteor shower reaches its peak tonight. It is not considered a prolific shower, and the average fall rate is about 25 per hour—but who wouldn't want to take a chance on observing a meteor about every 4 to 5 minutes? These travelers are considered to be quite slow, with speeds around 24 kilometers per second and are known to leave yellow trails. One of the most endearing qualities of this annual shower is its broad stream of around 20 days before and 20 days after peak. This will allow it to continue for at least another week and overlap the beginning stages of the famous Perseids.

The Delta Aquarid stream is a complicated one, and a mystery not quite yet solved. It is possible that gravity split the stream from a single comet into two parts, and each may very well be a separate stream. One thing we know for certain is they will seem to emanate from the area around Capricornus and Aquarius, so you will have best luck facing southeast and getting away from city lights. Although the Moon will interfere, just relax and enjoy a warm summer night. It's time to catch a "falling star!"

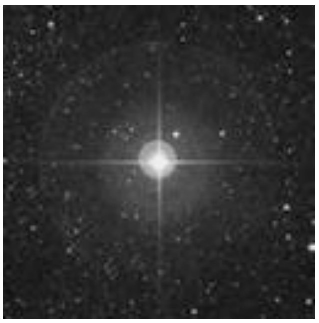
Grimaldi
Credit: Alan Chu

JUL 29
SUNDAY

Tonight our Moon stands poised on the edge of becoming Full in a matter of hours. If we could see it from space, we would know that it is readying itself to pass either just north or just south of the cone of shadow projected by Earth. Take the time to study the limbs of the Moon for the effects of libration. Follow Tycho's bright ray towards the southwest and see if you can spot the Doerfel Mountains as tiny bumps on the limb edge. While they might not appear to be much, they are three times higher than Mount Everest!

Now head about a palm's width east of Friday night's study star Zeta Scorpii for lovely Theta. Named Sargas, this 1.8 magnitude star resides around 650 light-years distant in a very impressive field of stars for binoculars or a small telescope. While all of these are only optical companions, the field itself is worth a look—and worth remembering for the future.

About three fingerwidths north is true double Lambda Scorpii, also known as Shaula (The Sting). As the brightest known star in its class, 1.6 magnitude Lambda is a spectroscopic binary which is also a variable of the Beta Canis Majoris type, changing ever so slightly in little more than 5 hours. Although we can't see the companion star, nearby is yet another that will make learning this starhop "marker" worth your time.



Lambda Scorpii
Credit: Palomar Observatory, courtesy of Caltech

Theta Scorpii
Credit: Palomar Observatory, courtesy of Caltech

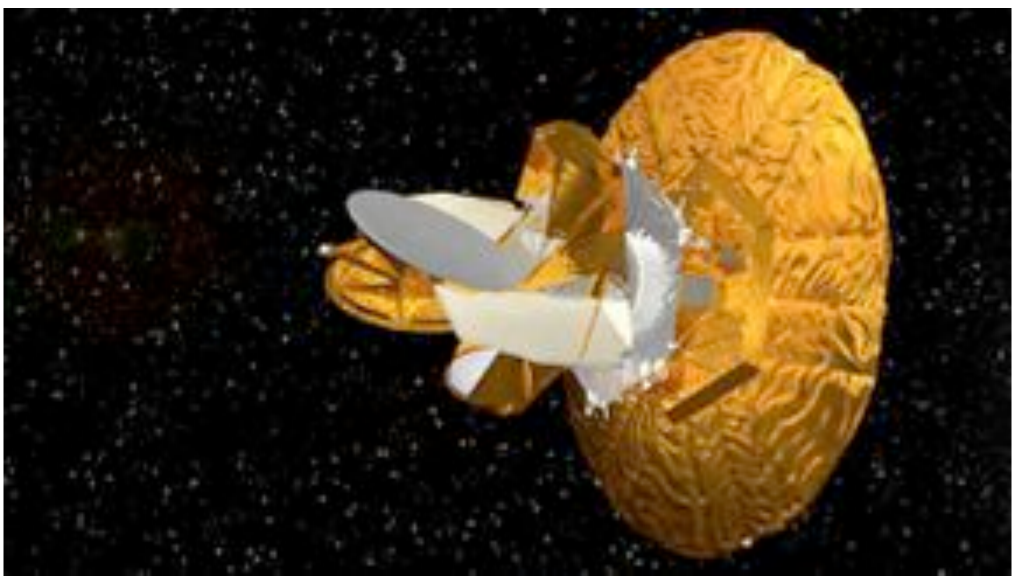
Today's history celebrates the 2001 flyby of the Moon by the Wilkinson Microwave Anisotropy Probe (WMAP) on its way to Lagrange Point 2 to study the cosmic microwave background radiation. Tonight we'll also fly right by the Full Buck Moon as we continue our studies to have a look at Mu 1 and Mu 2 Scorpii about two fingerwidths north of Zeta.

Very close to the same magnitude and spectral type, the twin Mu stars are easy to separate visually and most definitely worth a look in telescopes or binoculars. They are considered an actual physical pair because they share the exact same distance and proper motion, but they are separated by less than one light-year.

Hanging out in space some 520 light-years away, western Mu 1 is a spectroscopic binary—the very first discovered to have double lines. This Beta Lyrae-type star has an orbiting companion that eclipses it around every day and a half, yet causes no significant visual drop in magnitude—even though the orbiting companion is only 10 million kilometers away from it! While that sounds like plenty of distance, when the two pass, their surfaces would nearly touch each other!

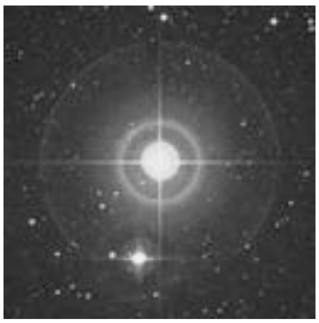
Now, relax and enjoy the peak of the Capricornid meteor shower. Although it is hard for the casual observer to distinguish these meteors from the Delta Aquarids, no one minds. Again, face southeast and enjoy! The fall rate for this shower is around 10 to 35 per hour, but unlike the Aquarids, this stream produces those great "fireballs" known as bolides. Enjoy...

Mu Scorpii
Credit: Palomar Observatory, courtesy of Caltech



WMAP
Credit: NASA

JUL 31
TUESDAY



Xi Scorpii
Credit: Palomar Observatory, courtesy of Caltech

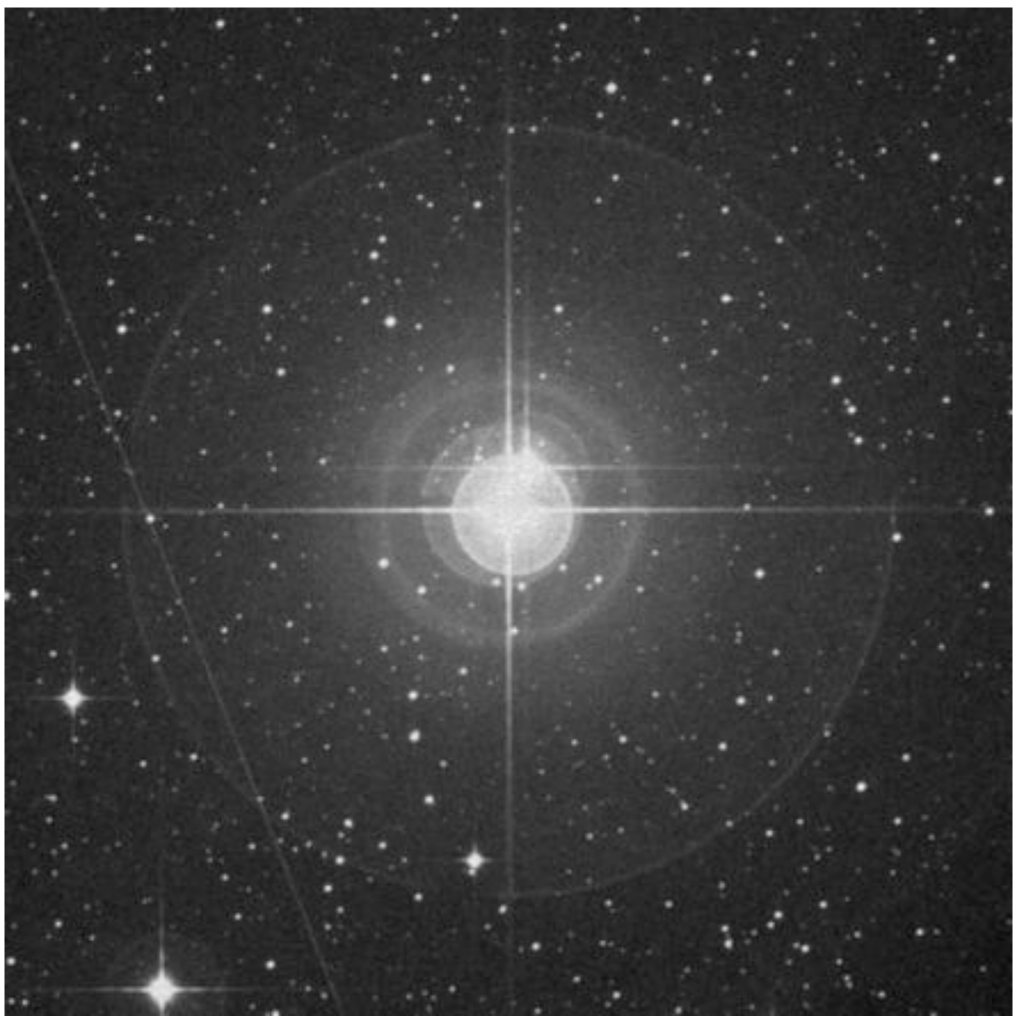
Tonight with the slightly later rise of the Moon, we'll take the opportunity to look at two multiple star systems—Nu and Xi Scorpii.

Starting with Nu about a fingerwidth east and slightly north of bright Beta, we find a handsome duo of stars in a field of nebulosity that will challenge telescopic observers much the way that Epsilon Lyrae does. With any small telescope, the observer will easily see the widely separated A and C stars. Add just a little power and take your time... The C star has a D companion to the southwest! For larger telescopes, take a very close look at the primary star. Can you separate the B companion to the south?

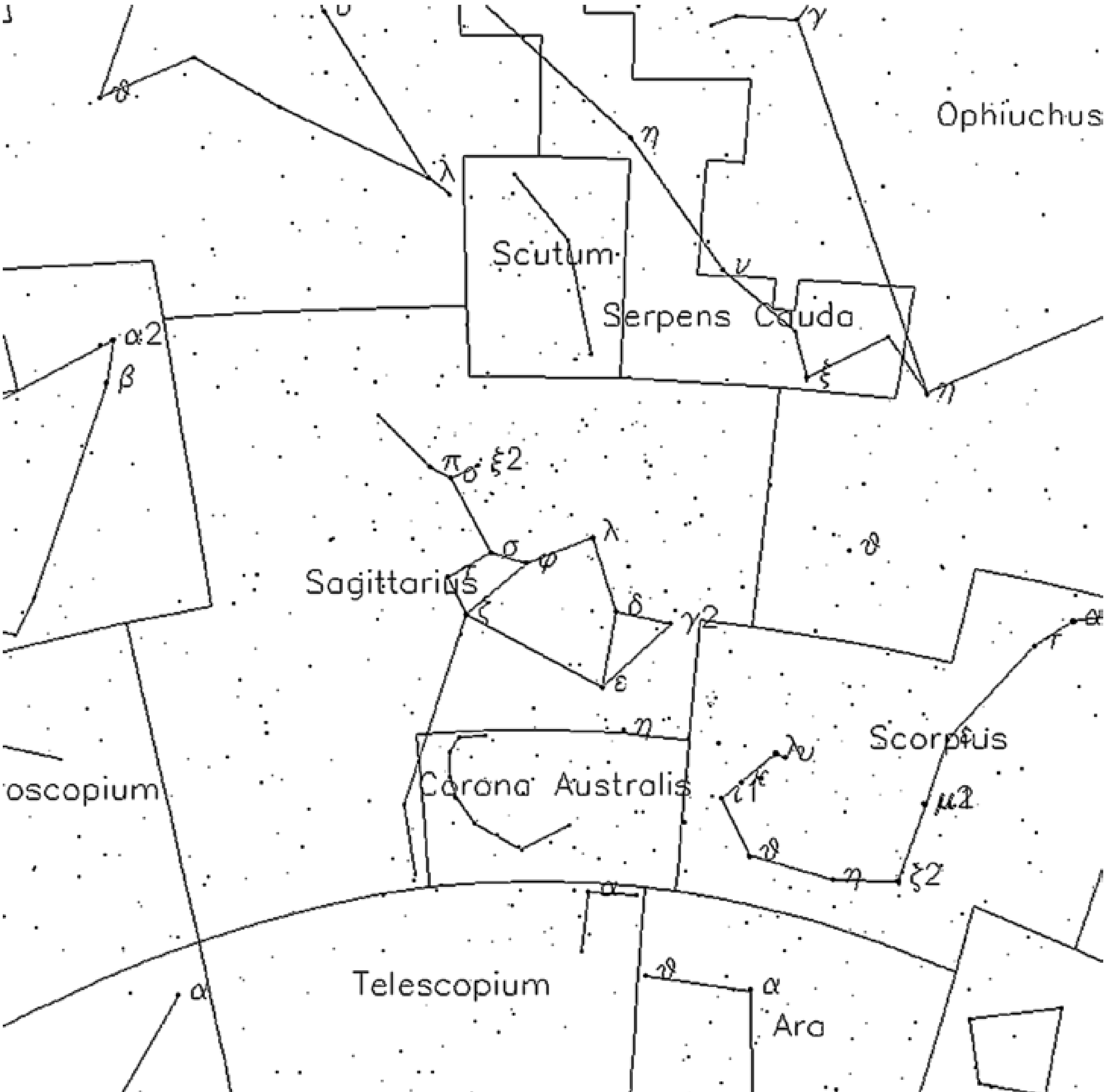
Now let's hop to Xi about four fingerwidths north of Beta.

Discovered by Sir William Herschel in 1782, this 80 light-year distant system poses a nice challenge for mid-sized scopes. The yellow-hued A and B pair share a very eccentric orbit about the same distance as Uranus is from our Sun. During the 2007 observing year they should be fairly well spaced, and the slightly fainter secondary should appear to the north. Look a good distance away for the 7th magnitude orange C component and south for yet another closely-matched double of 7th and 8th magnitude—the D and E stars.

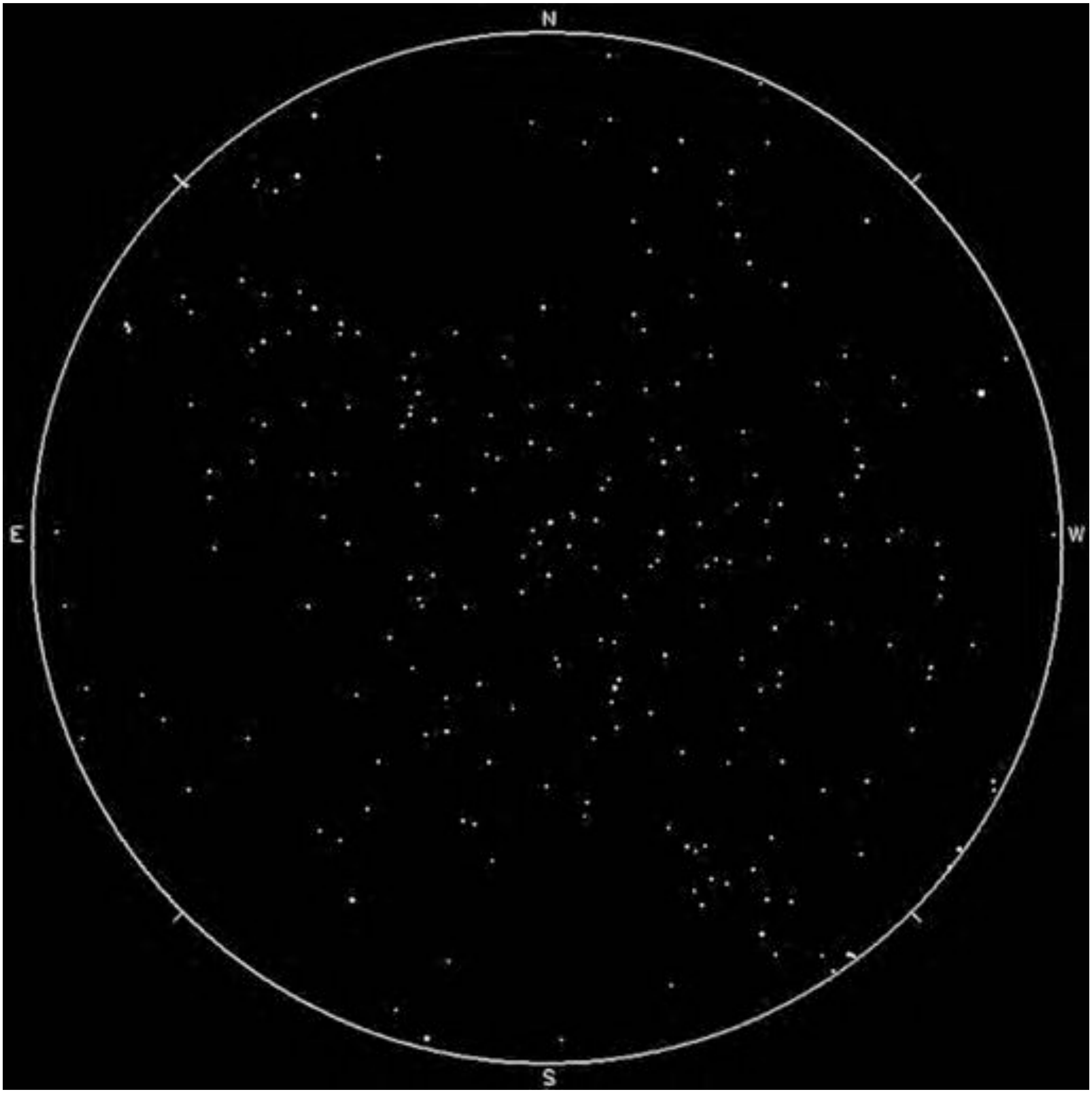
For the larger scope, this multiple star system does display a little bit of color. Most will see the A and B components as yellow/white, the C star as slightly orange, and the D/E pair as slightly tinged with blue. Be sure to mark your observations for this is one of the finest!



Nu Scorpii
Credit: Palomar Observatory, courtesy of Caltech

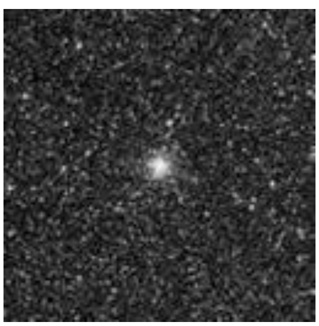

Ophiuchus
Scutum
Serpens Cauda
Sagittarius
Corona Australis
Scorpius
oscopium
Telescopium
Ara

AUGUST 2007



AUG 1
WEDNESDAY

Maria Mitchell
(widely used public image)



NGC 6642
Credit: Palomar Observatory, courtesy of Caltech

Today is the birthdate of Maria Mitchell. Born in 1818, Mitchell became the first woman to be elected as an astronomer to the American Academy of Arts and Sciences. She later rocketed to worldwide fame when she discovered a bright comet in 1847.

Tonight, let's continue our exploration of globular clusters. These gravitationally bound concentrations of stars contain anywhere from ten thousand to one million members and attain sizes of up to 200 light-years in diameter. At one time, these fantastic members of our galactic halo were believed to be round nebulae. Perhaps the very first to be discovered was M22 in by Abraham Ihle in 1665. This particular globular is easily seen in even small binoculars and can be located just slightly more than two degrees northeast of the "teapot's lid," Lambda Sagittarii.

Ranking third amongst the 151 known globular clusters in total light, M22 is probably the nearest of these incredible systems to our Earth with an approximate distance of 9600 light-years, and it is also one of the nearest globulars to the galactic plane. Since it resides less than a degree from the ecliptic, it often shares the same eyepiece field with a planet. At magnitude 6, the class VII M22 will begin to show individual stars to even modest instruments and will burst into stunning resolution for larger aperture. About a degree west-northwest, mid-sized telescopes and larger binoculars will capture smaller 8th magnitude NGC 6642. At class V, this particular globular will show more concentration toward the core region than M22. Enjoy them both!

M22
Credit: Palomar Observatory, courtesy of Caltech

AUG 2
THURSDAY

As we know, most globular clusters congregate around the galactic center in the Ophiuchus/Sagittarius region. Tonight let's explore what creates a globular cluster's form… We'll start with the "head of the class," M75.

Orbiting the galactic center for billions of years, globular clusters endured a wide variety of disturbances. Their component stars escape when accelerated by mutual encounters and the tidal force of our own Milky Way pulls them apart when they are near periapsis, that is, closest to the galactic center. Even close encounters with other masses, such as other clusters and nebulae, can affect them! At the same time, their stellar members are also evolving and this loss of gas can contribute to mass loss and deflation of these magnificent clusters. Although this happens far less quickly than in open clusters, our observable globular friends may only be the survivors of a once larger population, whose stars have been spread throughout the halo. This destruction process is never-ending, and it is believed that globular clusters will cease to exist in about 10 billion years.

Although it will be later evening when M75 appears on the Sagittarius/Capricornus border, you will find the journey of about 8 degrees southwest of Beta Capricorni worth the wait. At magnitude 8, it can be glimpsed as a small round patch in binoculars, but a telescope is needed to see its true glory. Residing around 67,500 light-years from our solar system, M75 is one of the more remote of Messier's globular clusters. Since it is so far from the galactic center—possibly 100,000 light-years distant—M75 has survived almost intact for billions of years to remain one of the few Class I globular clusters. Although resolution is possible in very large scopes, note that this globular cluster is one of the most concentrated in the sky, with only the outlying stars resolvable to most instruments.

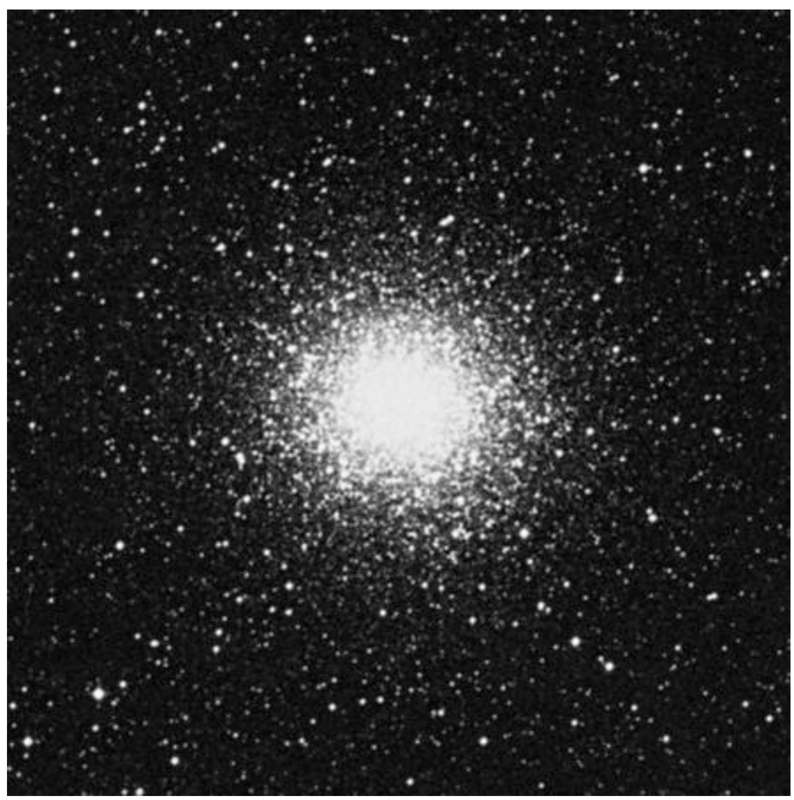
M75
Credit: Palomar Observatory, courtesy of Caltech

AUG 3
FRIDAY

Tonight let's return to earlier evening skies as we continue our studies with one of the globulars nearest to the galactic center—M14. Located about sixteen degrees (less than a handspan) south of Alpha Ophiuchi, this ninth magnitude, class VIII cluster can be spotted with larger binoculars, but will only be fully appreciated with the telescope.

When studied spectroscopically, globular clusters are found to be much lower in heavy element abundance than stars such as own Sun. These earlier generation stars (Population II) began their formation during the birth of our galaxy, making globular clusters the oldest of formations that we can study. In comparison, the disk stars have evolved many times, going through cycles of starbirth and supernovae, which in turn enrich the heavy element concentration in star forming clouds and may cause their collapse. Of course, as you may have guessed, M14 breaks the rules. It contains an unusually high number of variable stars—in excess of 70—with many of them known to be the W Virginis type. In 1938, a nova appeared in M14, but it was undiscovered until 1964 when Amelia Wehlau of the University of Ontario was surveying the photographic plates taken by Helen Sawyer Hogg. The nova was revealed on eight of these plates taken on consecutive nights, and showed itself as a 16th magnitude star—and was believed to be at one time almost 5 times brighter than the cluster members. Unlike 80 years earlier with T Scorpii in M80, actual photographic evidence of the event existed. In 1991, the eyes of the Hubble were turned its way, but neither the suspect star nor traces of a nebulous remnant were discovered. Then six years later, a carbon star was discovered in M14.

To a small telescope, M14 will offer little to no resolution and will appear almost like an elliptical galaxy, lacking in any central condensation. Larger scopes will show hints of resolution, with a gradual fading towards the cluster's slightly oblate edges. A true beauty!



M14
Credit: Palomar Observatory, courtesy of Caltech

As we explore globular clusters, we simply assume them all to be part of the Milky Way galaxy, but that might not always be the case. We know they are basically concentrated around the galactic center, but there may be four of them that actually belong to another galaxy. Tonight we'll look at one such cluster being drawn into the Milky Way's halo. Set your sights just about one and a half degrees west-southwest of Zeta Sagittarii for M54.

At around magnitude 7.6, M54 is definitely bright enough to be spotted in binoculars, but its rich class III concentration is more notable in a telescope. Despite its brightness and deeply concentrated core, M54 isn't exactly easy to resolve. At one time we thought it to be around 65,000 light-years distant, and rich in variables—with 82 known RR Lyrae types. We knew it was receding, but when the Sagittarius Dwarf Elliptical Galaxy was discovered in 1994, it was noted that M54 was receding at almost precisely the same speed! When more accurate distances were measured, we found M54 to coincide with the SagDEG distance of 80-90,000 light-years, and M54's distance is now calculated to be 87,400 light-years. No wonder it's hard to resolve—it's outside our galaxy!

M54
Credit: Palomar Observatory, courtesy of Caltech

AUG 5
SUNDAY

NGC 7006
Credit: Palomar Observatory, courtesy of Caltech

Today we celebrate the 76th birthday of Neil Armstrong, the first human to walk on the moon. Congratulations! Also on this date in 1864, Giovanni Donati made the very first spectroscopic observations of a comet (Tempel, 1864 II). His observations of three absorption lines led to what we now know as the Swan bands, from a form of the carbon radical C_2.

Our study continues tonight as we move away from the galactic center in search of a remote globular cluster that can be viewed by most telescopes. As we have learned, radial velocity measurements show us the majority of globulars are involved in highly eccentric elliptical orbits, which take them far outside the plane of the Milky Way. These orbits form a sort of spherical "halo" which tends to be more concentrated toward our galactic center. Reaching out several thousands of light-years, this halo is actually larger than the disk of our own galaxy. Since globular clusters aren't involved in our galaxy's disk rotation, they may possess very high relative velocities. Tonight let's head toward the constellation of Aquila and look at one such globular—NGC 7006.

Located about half a fist's width east of Gamma Aquilae, NGC 7006 is speeding towards us at a velocity of around 345 kilometers per second. At 150,000 light-years from the center of our galaxy, this particular globular could very well be an extra-galactic object. At magnitude 11.5, it's not for the faint of heart, but can be spotted in scopes as small as 150mm, and requires larger aperture to look like anything more than a suggestion.

Given its tremendous distance from the galactic center, it's not hard to realize this is a class I—although it is quite faint. Even the largest of amateur scopes will find it unresolvable!

Neil Armstrong
(widely used public image)

AUG 6
MONDAY

Today in 2001 the Galileo spacecraft made its flyby of the moon Io sending back incredible images of the surface. For southern hemisphere observers, be on watch as the Iota Aquarid meteor shower peaks on this Universal date.

Studies continue as we look deeper into structure. As a rule, globular clusters normally contain a large number of variable stars, and most are usually the RR Lyrae type such as in earlier study M54. At one time they were known as "cluster variables," with their number differing from one globular to another. Many globulars also contain vast numbers of white dwarfs. Some have neutron stars which are detected as pulsars, but out of all 151, only four have planetary nebulae in them… Read on!

Tonight our studies will take us toward the emerging constellation of Pegasus and the magnitude 6.5, class IV M15. Easily located with even small binoculars about four degrees northwest of Enif, this magnificent globular cluster is a true delight in a telescope. Amongst the globulars, M15 ranks third in variable star population with 112 identified. As one of the densest of clusters, it is surprising that it is considered to be only class III. Its deeply concentrated core is easily apparent, and has begun the process of core collapse. The central core itself is very small compared to the cluster's true size and almost half M15's mass is contained within it. Although it has been studied by the Hubble, we still do not know if this density is caused by the cluster stars' mutual gravity, or if it might disguise a supermassive object similar to those in galactic nuclei.

M15 was the first globular cluster in which a planetary nebula, known as Pease 1, could be identified. Larger aperture scopes can easily see it at high power. Surprisingly, M15 also is home to 9 known pulsars, which are neutron stars left behind from previous supernovae during the cluster's evolution, and one of these is a double neutron star. While total resolution is impossible, a handful of bright stars can be picked out against that magnificent core region and wonderful chains and streams of members await your investigation tonight!

M15
Credit: NOAO/AURA/NSF

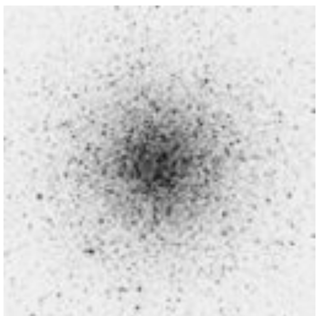
AUG 7
TUESDAY

On this date in 1959, Explorer 6 became the first satellite to transmit photographs of the Earth from its orbit.

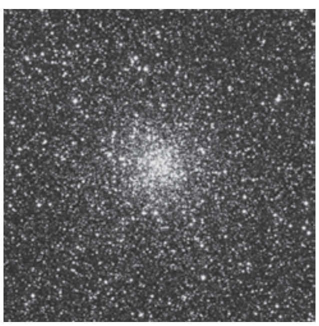
Tonight, let's return again to look at two giants roughly equal in size, but not equal in class. To judge them fairly, you must use the same eyepiece. Start first by re-locating previous study M4. This is a class IX globular cluster. Notice the powder-like qualities. It might be heavily populated, but it is not dense. Now return to previous study M13. This is a class V globular cluster. Most telescopes will make out at least some resolution and a distinct core region. It is the level of condensation that determines the class. It is no different from judging magnitudes and simply takes practice.

Try your hand at M55 along the bottom of the Sagittarius "teapot"—it's a class XI. Although it is a full magnitude brighter than class I M75, which we looked at earlier in the week, can you tell the difference in concentration? For those with GoTo systems, take a quick hop through Ophiuchus and look at the difference between NGC 6356 (class II) and NGC 6426 (class IX). If you want to try one that they can't even classify? Look no further than M71 in Sagitta. It's all a wonderful game and the most fun comes from learning!

In the meantime, don't forget all those other wonderful globular clusters such as 47 Tucanae, Omega Centauri, M56, M92, M28 and a host of others!



M55
Credit: Palomar Observatory, courtesy of Caltech



M71
Credit: Palomar Observatory, courtesy of Caltech

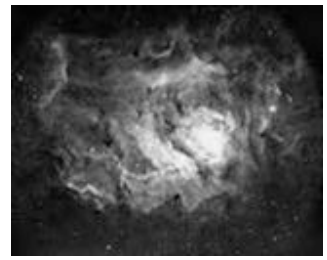
Explorer 6
Credit: NASA

AUG 8
WEDNESDAY

Today in 2001, the Genesis Solar Particle Sample Return mission was launched. In September of 2004, it crash landed in the Utah desert with its precious payload. Although some of the specimens were contaminated, some did survive the mishap. So what is "star stuff?" Mostly highly charged particles generated from a star's upper atmosphere and flowing out in a state of matter known as plasma...

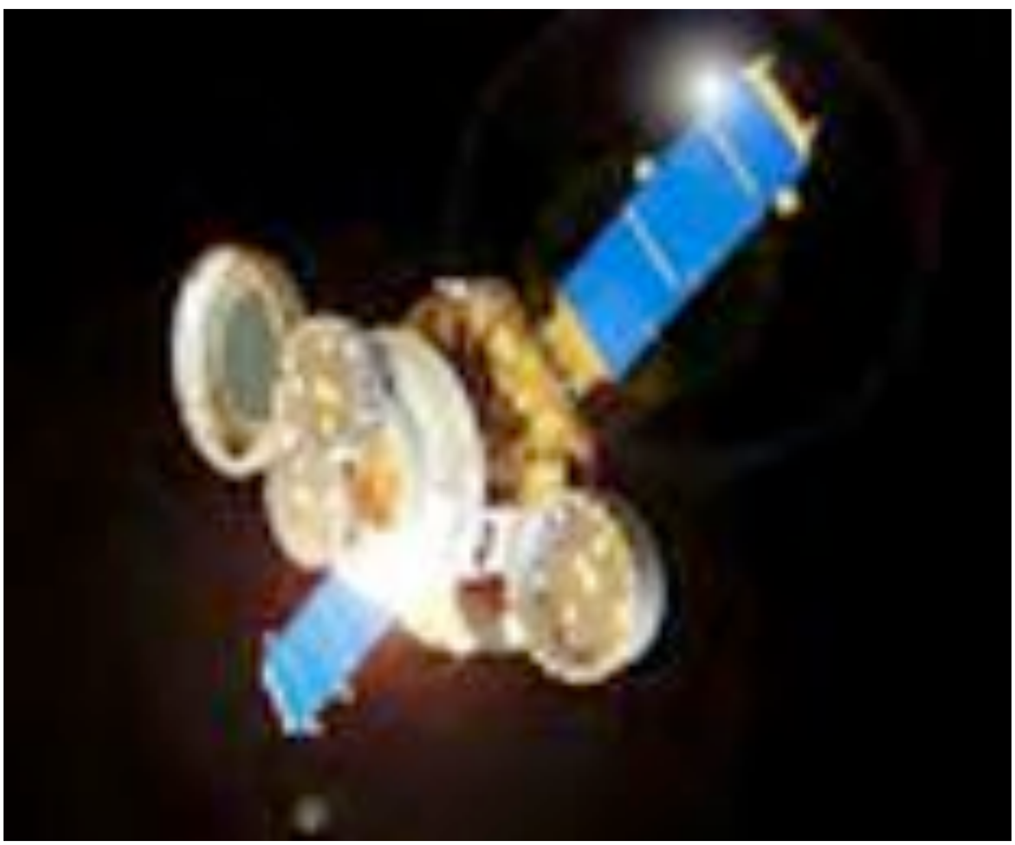
Tonight let's study one of the grandest of all solar winds as we seek out an area about three fingerwidths above the Sagittarius "teapot's spout" as we have a look at the magnificent M8, the "Lagoon Nebula."

Visible to the unaided eye as a hazy spot in the Milky Way, fantastic in binoculars, and an area truly worth study in any size scope, this 5200 light-year area of emission, reflection and dark nebulae has a rich history. Its involved star cluster—NGC 6530—was first discovered by Flamsteed around 1680, and the nebula by Le Gentil in 1747. Cataloged by Lacaille as III.14 about 12 years before Messier listed it as number 8, its brightest region was recorded by John Herschel and the dark nebulae were discovered by Barnard.



M8: The Lagoon Nebula
Credit: NOAO/AURA/NSF

Tremendous areas of starbirth are taking place in this region; while young, hot stars excite the gases in a are known as the "Hourglass," around the stars Herschel 36 and 9 Sagittarii. Look closely around cluster NGC 6530 for Barnard dark nebulae B89 and B296 at the nebula's southern edge. No matter how long you chose to swim in the "Lagoon" you will sure find more and more things to delight both the mind and the eye!



Artist concept of Genesis
Credit: NASA

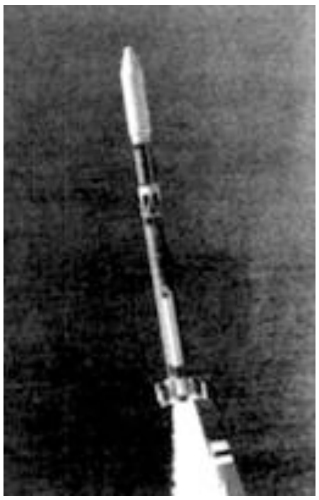
AUG 9
THURSDAY

Today in 1976, the Luna 24 mission was launched on a return mission of its own—not to retrieve solar winds samples, but lunar soil! Remember this mission as we take a look at its landing site in the weeks ahead.

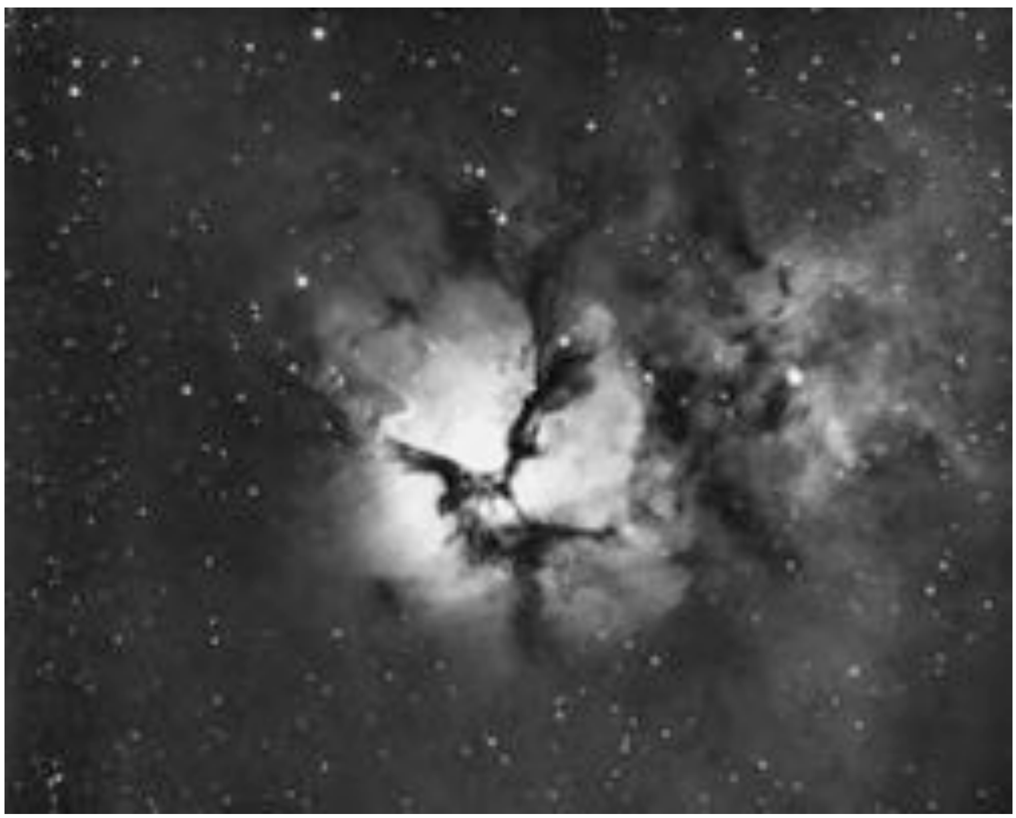
Tonight we'll return to the nebula hunt as we head about a fingerwidth north and just slightly west of M8 for the "Trifid"...

It was discovered by Messier on June 5, 1764, and much to his credit, he described it as a cluster of stars encased in nebulosity. This is truly a wonderful observation since the Trifid could not have been easy given his equipment. Some 20 years later William Herschel (although he usually avoided repeating Messier objects) found M20 of enough interest to assign separate designations to parts of this nebula—IV.41, V.10, V.11, V.12. The word "Trifid" was used to describe its beauty by John Herschel.

While M20 is a very tough call in binoculars, it is not impossible with good conditions to see the light of an area that left its home nearly a millennium ago. Even smaller scopes will pick up this round, hazy patch of both emission and reflection, but you will need aversion to see the dark nebula which divides it. This was cataloged by Barnard as B85. Larger telescopes will find the Trifid as one of the very few objects that actually appears much in the eyepiece as it does in photographs—with each lobe containing beautiful details, rifts and folds best seen at lower powers. Look for its cruciform star cluster and its fueling multiple system while you enjoy this triple treat tonight!

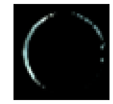


Luna 24 launch
(press release photo)



M8: The Trifid Nebula
Credit: NOAO/AURA/NSF

AUG 10
FRIDAY



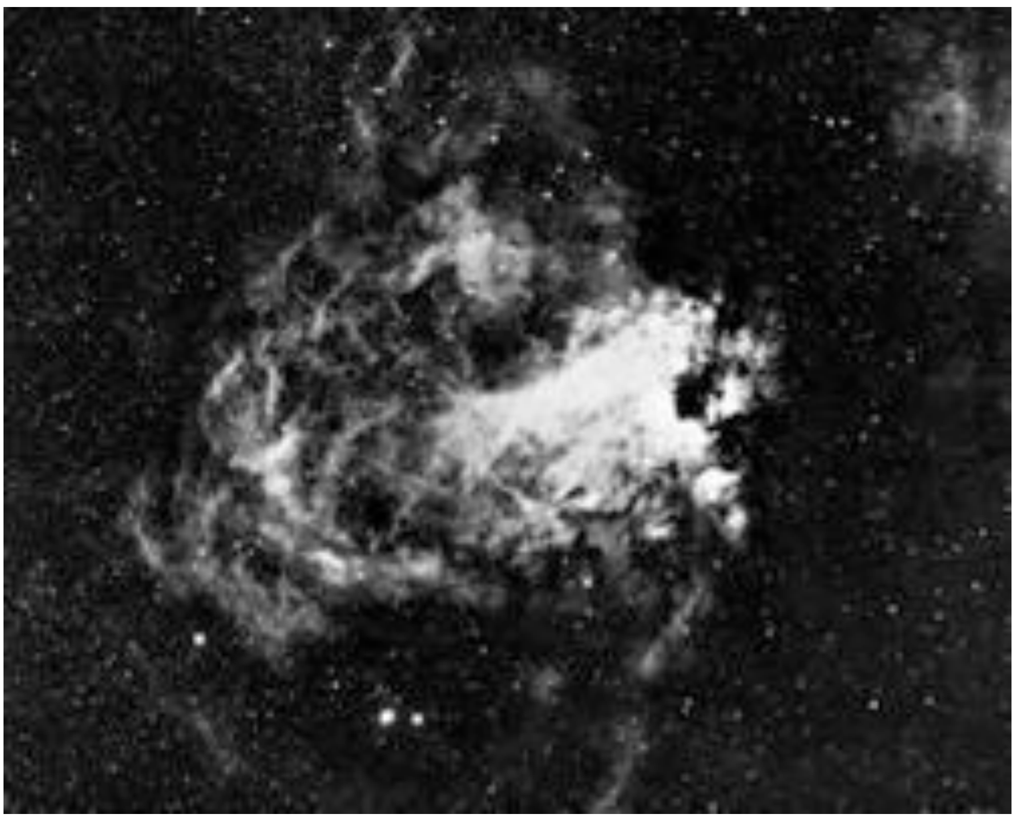
Today in 1966 Lunar Orbiter 1 was successfully launched on its mission to survey the Moon. In the days ahead, we'll take a look at what this mission sent back!

Tonight we'll look at another star forming region as we head about a palm's width north of the lid star (Lambda) in the Sagittarius teapot as we seek out "Omega"...

Easily viewed in binoculars of any size and outstanding in every telescope, the 5000 light-year distant Omega Nebula was first discovered by Philippe Loys de Chéseaux in 1745-46 and later (1764) cataloged by Messier as object 17. This beautiful emission nebula is the product of hot gases excited by the radiation of newly born stars. As part of a vast region of interstellar matter, many of its embedded stars don't show in photographs, but reveal themselves beautifully to the eye of the telescope. As you look at its unique shape, you realize that many of these areas are obscured by dark dust, and this same dust is often illuminated by the stars themselves.

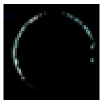
Often known as the "Swan," M17 will appear as a huge, glowing check mark or ghostly "2" in the sky—but power up if you use a larger telescope and look for a long, bright streak across its northern edge, with extensions to both the east and north. While the illuminating stars are truly hidden, you will see many glittering points in the structure itself and at least 35 of them are true members of this region spanning about 40 light-years that could contain up to 800 solar masses. It is awesome...

Lunar Orbiter 1
Credit: NASA



M17: The Omega Nebula
Credit: NOAO/AURA/NSF

AUG 11
SATURDAY



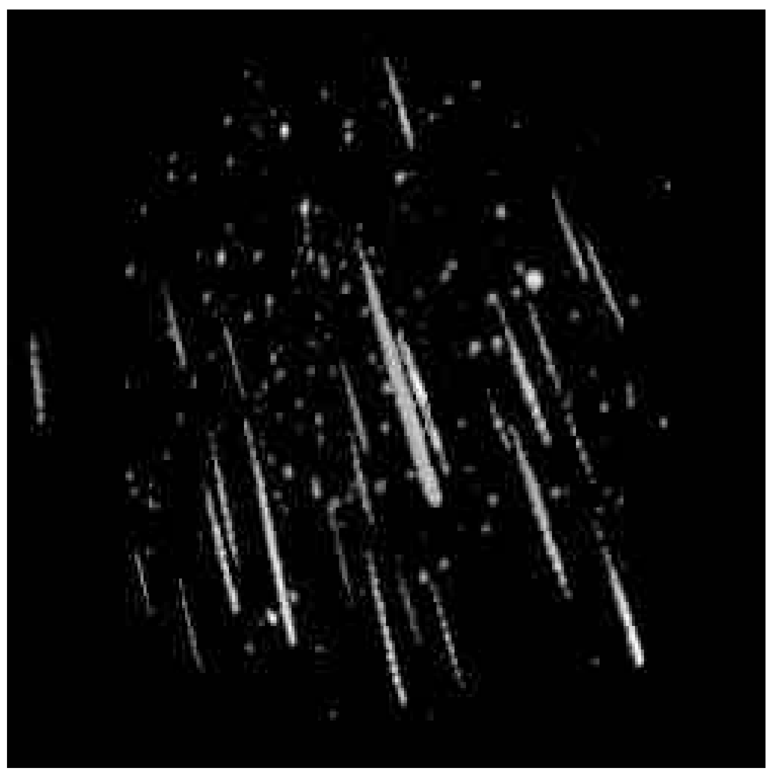
On this date in 1877, Asaph Hall of the U.S. Naval Observatory was very busy. This night would be the first time he would see Mars' outer satellite Deimos! Six nights later, he observed Phobos, giving Mars its grand total of two moons.

Tonight after midnight is the peak of the Perseid meteor shower, and this year there's no Moon! Now let's sit back and talk about the Perseids while we watch...

The Perseids are undoubtedly the most famous of all meteor showers and never fail to provide an impressive display. Their activity appears in Chinese history as far back as 36 AD. In 1839, Eduard Heis was the first observer to give an hourly count, and discovered their maximum rate was around 160 per hour at that time. He, and other observers, continued their studies in subsequent years to find that this number varied.

Giovanni Schiaparelli was the first to relate the orbit of the Perseids to periodic comet Swift-Tuttle (1862 III). The fall rates have both risen and fallen over the years as the Perseid stream was studied more deeply, and many complex variations were discovered. There are actually four individual streams derived from the comet's 120 year orbital period which peak on slightly different nights, but tonight through tomorrow morning at dawn is our accepted peak.

Meteors from this shower enter Earth's atmosphere at a speed of 60 km/sec (134,000 miles per hour), from the general direction of the border between the constellations Perseus and Cassiopeia. While they can be seen anywhere in the sky, if you extend their paths backward, all the true members of the stream will point back to this region of the sky. For best success, position yourself so you are generally facing northeast and get comfortable. The radiant will continue to climb higher in the sky as dawn approaches and the Moon officially becomes new. If you are clouded out, don't worry. The Perseids will be around for a few more days yet, so continue to keep watch!



Perseids
Credit: Sirko Molau, IMO, Archenhold-Sternwarte/NASA

AUG 12
SUNDAY

Did you mark your calendar to be up before dawn to view the Perseid meteor shower? Good! Because today is the official date of the New Moon, and hidden from our view the Moon is occulting Mercury as it heads between the Earth and the Sun.

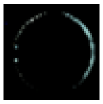
Tonight while darkest skies are on our side, we'll fly with the "Eagle" as we hop another fingerwidth north of M17 and head for one of the most famous areas of starbirth—IC 4703.

While the open cluster NGC 6611 was first discovered by Chéseaux in 1745-6, it was Charles Messier who cataloged the object as M16 and he was the first to note the nebula IC 4703, more commonly known as the "Eagle." At 7000 light-years distant, this roughly 7th magnitude cluster and nebula can be spotted in binoculars, but at best it is a hint. As part of the same giant cloud of gas and dust as neighboring M17, the Eagle is also a place of starbirth illuminated by these hot, high energy stellar youngsters which are only about five and a half million years old.

In small to mid-sized telescopes, the cluster of around 20 brighter stars comes alive with a faint nebulosity that tends to be brighter in three areas. For larger telescopes, low power is essential. With good conditions, it is very possible to see areas of dark obscuration and the wonderful "notch" where the Pillars of Creation lie. Immortalized by the Hubble Space telescope, you won't see them as grand or colorful as it did, but what a thrill to know they are there!

M16 and the Eagle Nebula
Credit: Bill Schoening/NOAO/AURA/NSF

Aug 13 Monday



Tonight, begin with just your eyes as you gaze about four fingerwidths above the top of the Sagittarius "teapot dome" for an open window on the stars and the magnificent M24...

This huge, hazy patch of stars is in reality an area of space known as "Baade's Window"—an area free of obscuring gas and dust. Cataloged by Messier in 1764 as object 24, even small binoculars will reveal the incredible vista of the "Sagittarius Star Cloud." Although it's actually not a cluster, but rather a clean view of an area of our own galaxy's spiral arm, that will not lessen the impact when viewed through a telescope. Spanning a degree and a half of sky, it is one of the few areas in which even a novice can easily perceive areas of dark dust.

For larger telescopes, look for the dim, open cluster NGC 6603 in the northeastern position of the Window. There are two very notable dark nebulae, B92 and B93, located in the northern segment as well. Near teardrop shaped B92 and its single central star, you should spot open cluster Collinder 469 and also Markarian 38 south of B93. You'll find B86 near Gamma Sagittarii . At the southern edge of the star cloud, look for emission nebula IC 1283-1284, along with the reflection nebulae NGC 6589 and NGC 6590 and open cluster NGC 6595. Still up for more? Then head west to see if you can find 12th-magnitude planetary nebula NGC 6567.

Even if you don't accept these challenges, you can still enjoy looking at a 560 light-year swatch of stars from one of the Milky Way's loving arms! (If you're out late, look for Mira... It was discovered by Fabricius on this date in 1596.)

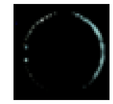
M24: The Sagittarius Star Cloud
Credit: Vanessa Harvey/REU Program/NOAO/AURA/NSF

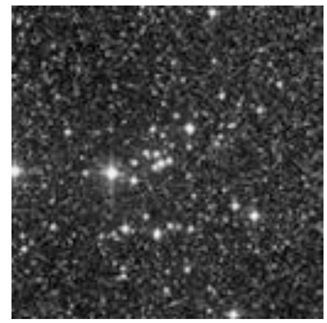
Your first challenge for tonight will be to see if you can spot the tender, slender, beginnings of the Moon as it graces the sky just as the Sun sets. It isn't easy, but it doesn't take any special equipment—just clear skies and a good view of the western horizon!

Tonight let's venture about three fingerwidths northeast of Lambda Sagittarii to visit a well-known but little visited galactic cluster—M25.

First discovered by Chéseaux and then cataloged by Messier, it was observed and recorded by William Herschel, Johann Elert Bode, Admiral Smythe and T.W. Webb...but never added to the NGC catalog of John Herschel! Thanks to J.L.E. Dreyer, it did make the second Index Catalog as IC 4725.

Seen with even the slightest optical aid, this 5th magnitude cluster contains two G-type giants as well as a Delta Cephei-type variable with the designation of U, which changes about one magnitude in a period of less than a week. It's very old for an open cluster, perhaps near 90 million years, and the light you see tonight left the cluster over 2000 years ago. While binoculars will see around a double handful of bright stars overlaying fainter members, telescopes will reveal more and more as aperture increases. At one time it was believed to have only about 30 members, but this was later revised to 86. But recent studies by Archinal and Hynes indicate it may have as many as 601 member stars!

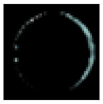




M25
Credit: Palomar Observatory, courtesy of Caltech

First Crescent
Credit: Greg Gerhart

AUG 15
WEDNESDAY



Tonight the Moon just after sunset will become a little more obvious, but it soon will be gone—leaving us to head back to Scorpius to have a look at three pristine open clusters. Begin your starhop at the colorful southern Zeta pair and head north less than one degree for NGC 6231.

Wonderfully bright in binoculars and well resolved to the telescope, this tight open cluster was first discovered by Hodierna before 1654. De Chéseaux cataloged it as object 9, Lacaille as II.13, Dunlop as 499, Melotte as 153, and Collinder as 315. No matter what catalog number you chose to put in your notes, you'll find the 3.2 million year young cluster shining as the "Northern Jewelbox!" For high power fans, look for the brightest star in this group—it's van den Bos 1833, a splendid binary.

About another degree north is loose open cluster Collinder 316, with its stars scattered widely across the sky. Caught on its eastern edge is another cluster known as Trumpler 24, a site where new variables might be found. This entire region is encased in a faint emission nebula called IC 4628—making this low power journey through southern Scorpius a red hot summer treat!

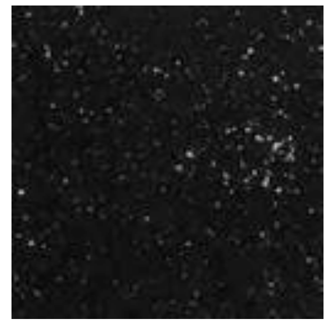
NGC 6231
Credit: Palomar Observatory, courtesy of Caltech

AUG 16
THURSDAY

If you did not get a chance to look at the Northern Jewelbox region in Scorpius, return again and sweep the area tonight. For those with larger telescopes, we're going to hop about a degree and a half south of twin Nu for NGC 6242.

Discovered by Lacaille and cataloged as I.4, it is also known as Dunlop 520, Melotte 155 and Collinder 317. At roughly magnitude 6, this open cluster is within binocular range, but truly needs a telescope to appreciate its fainter stars. While NGC 6242 might seem like nothing more than a pretty little cluster with a bright double star, it contains an x-ray binary which is a "runaway" black hole. It is surmised that it formed near the galactic center and was vaulted into an eccentric orbit when the progenitor star exploded. Its kinetic energy is much like a neutron star or a millisecond pulsar, and it was the first black hole confirmed to be in motion.

Now head a little more than a degree east-southeast for NGC 6268. At a rough magnitude of 9, this small open cluster can be easily observed in smaller scopes and resolved in larger ones. The cluster itself is somewhat lopsided, with more of its members concentrated on the western half of its borders. While it, too, might not seem particularly interesting, this young cluster is highly evolved and contains some magnetic, chemically peculiar stars and Be class, or metal-weak, members.



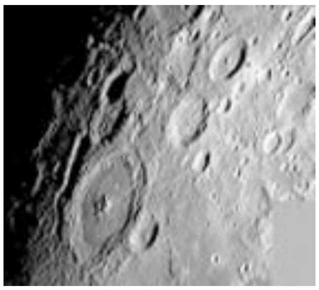
NGC 6268
Credit: Palomar Observatory, courtesy of Caltech

NGC 6242
Credit: Palomar Observatory, courtesy of Caltech

AUG 17
FRIDAY

Today in 1966 Pioneer 7 was launched. It was the second in a series of satellites sent to monitor the solar wind, and study cosmic rays, interplanetary space, and magnetic fields.

Tonight it's going to be very hard to ignore the Moon, so why don't we start by studying it and picking up another lunar club challenge? Your mission is to locate crater Petavius along the southeast shore of Mare Fecunditatis and have a look at the Petavius Wall...



Petavius
Credit: Alan Chu

While you're admiring Petavius and its branching rima, keep in mind this 80 kilometer long crack is a buckle in the lava flow across the crater floor. Now look along the terminator for the long, dark runnel which is often considered to be the Petavius Wall but is actually the fascinating crater Palitzsch. This 41 kilometer wide crater is confluent with a 110 kilometer long valley that is outstanding at this phase!

Although skies are bright, return to previous study star Lambda Scorpii and hop three fingerwidths northeast...We're hunting the "Butterfly!"

Easily seen in binoculars and tremendous in the telescope, this brilliant magnitude 4 open cluster was first discovered by Hodierna before 1654 and independently discovered by de Chéseaux as his object 1, before being cataloged by Messier as M6. Containing around 80 stars, the light you see tonight left its home in space around the year 473 A.D. It is believed to be around 95 million years old and contains a single yellow supergiant—the variable BM Scorpii. While most of M6's stars are hot, blue main sequence, the unique shape of this cluster gives it not only visual appeal, but wonderful color contrast as well!

M6: The Butterfly Cluster
Credit: Nigel Sharp and Mark Hannah/NOAO/AURA/NSF

AUG 18
SATURDAY

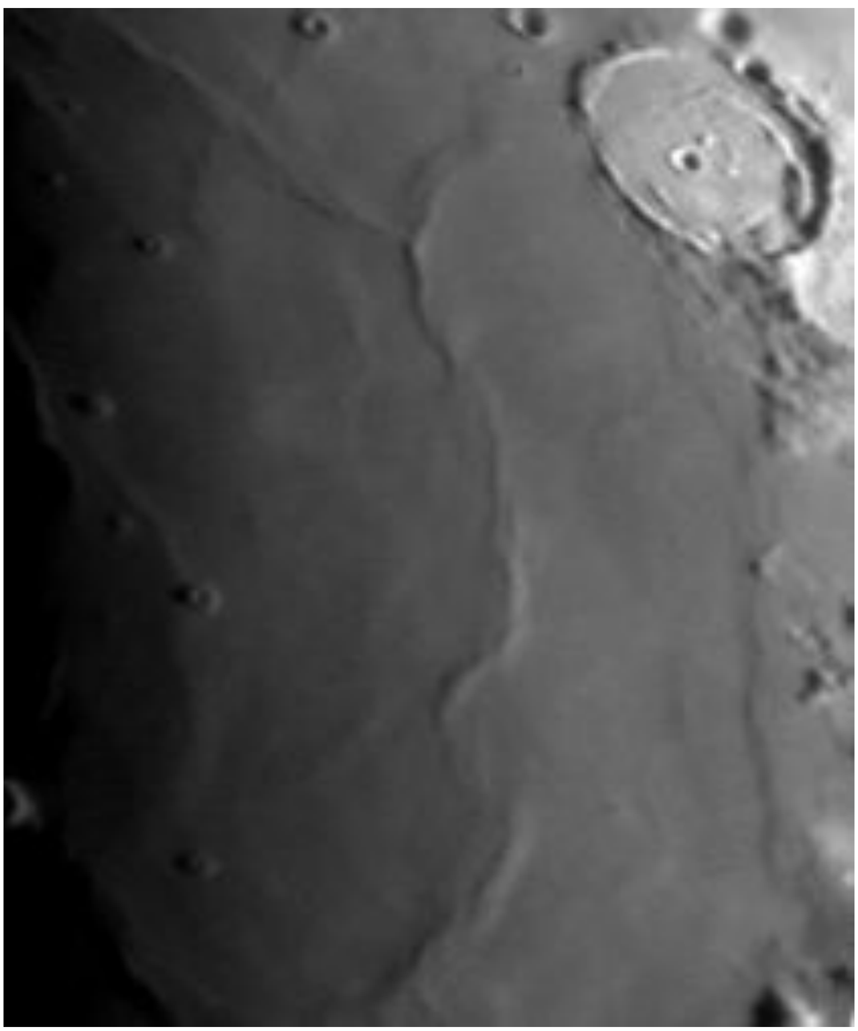
Tonight as the Sun sets and the stars begin to appear, look for Spica no more than a fingerwidth north of the Moon. As the skies darken, we'll venture to the surface near previous study Posidonius to have a look at the incredible Serpentine Ridge. Known more properly as Dorsa Smirnov, it meanders for 130 kilometers north to south across Mare Serenitatis. Can you spot tiny the crater Very in its center?

On this day in 1868, Norman Lockyer was very busy as he was the first to see helium absorption lines in the Sun's spectrum. Tonight we'll take a walk from helium rich Lambda Scorpii about three fingerwidths east-northeast to an even more prominent area of stars that was known to Ptolemy as far back as 130 AD.

Astronomers throughout the ages have spent time with this cluster: Hodierna as Ha II.2; Halley in 1678 as number 29, Derham in 1733 as number 16, De Chéseaux as number 10, Lacaille as II.14; Bode as 41; once for William Herschel and again for John as h 3710; Dreyer as NGC 6475... But we know it best as Messier Object 7.

Set against the backdrop of the Milky Way, even the smallest of binoculars will enjoy this bright open cluster while telescopes can resolve its 80 members. Roughly 800 light-years away, it contains many different spectral types in various stages of evolution, giving the cluster an apparent age of about 260 million years. Full of binaries and close doubles, an extreme test of tonight's lighting conditions would be to see if you can spot the 11th magnitude globular cluster NGC 6543 to the northwest!

M7: Ptolemy's Cluster
Credit: Palomar Observatory, courtesy of Caltech

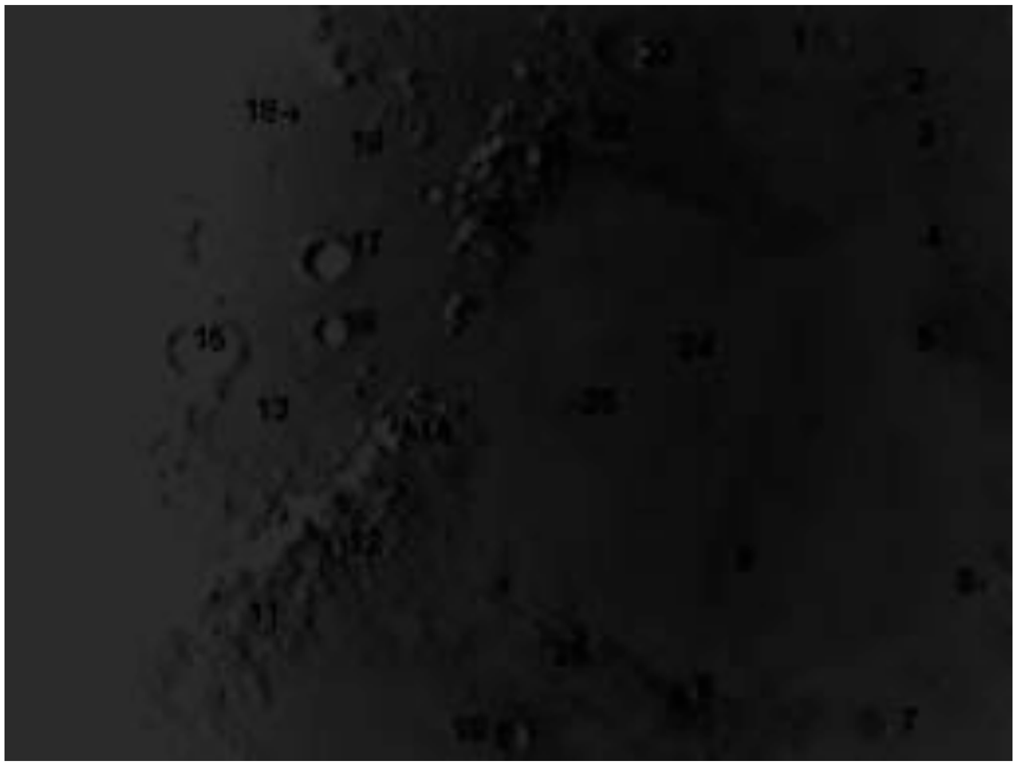


The Serpentine Ridge
Credit: Ricardo Borba

AUG 19
SUNDAY

Born today in 1646, let's have a look at John Flamsteed. He was an English astronomer with a passion for what he did. Despite a rather difficult childhood and no formal education, he went on to become the First Observer at the Royal Observatory and his catalog of 3000 stars was perhaps the most accurate yet published. Flamsteed star numbers are still in use. Also born on this day was Orville Wright, in 1871, and in 1891, Milton Humason, a colleague of Edwin Hubble at Mts. Wilson and Palomar. The latter was instrumental in measuring the faint spectra of galaxies, which in turn provided evidence for the expansion of the universe.

So... Are you ready to do a lunar walk for a challenge crater we haven't listed yet? Then look to the northwest shore of Mare Serenitatis for the pair of Aristoteles and Eudoxus. What's that? You see more? Then mark your notes for Eudoxus and let's have a look at many other studies you may not have noted yet!



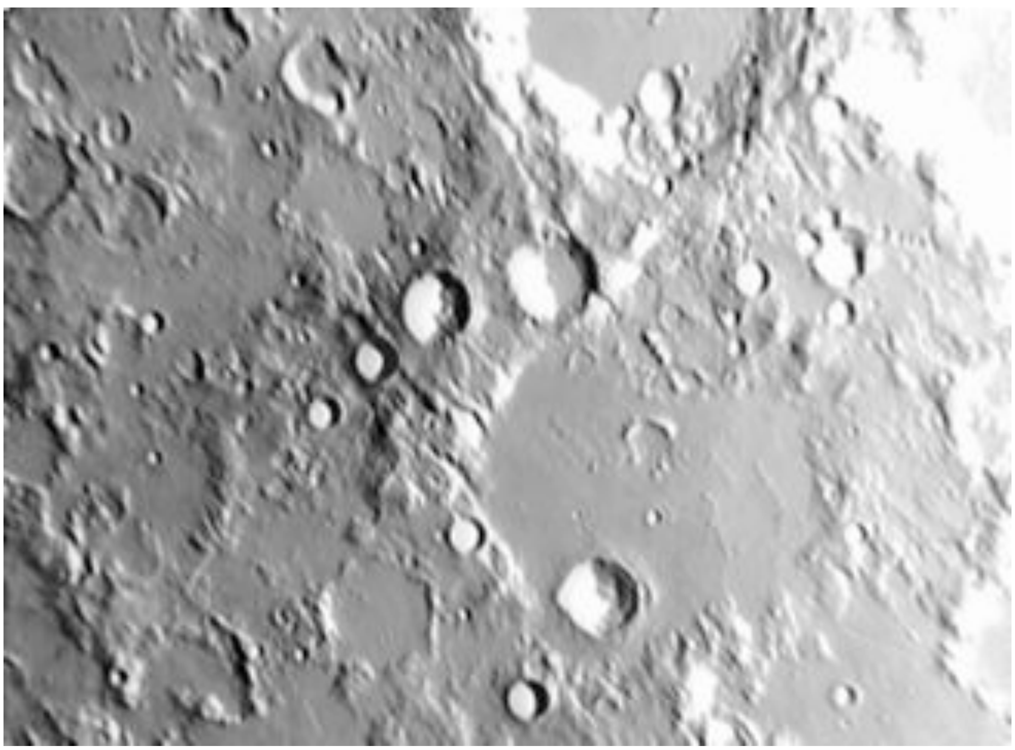
Eudoxus Region
Image Credit: Greg Konkel
Annotation: Tammy Plotner

1) Burg, 2) Barrow, 3) Grove, 4) Daniel, 5) Posidonius, 6) Apollo 17 Landing Area, 7) Plinius, 8) Bessel, 9) Menelaus, 10) Manilius, 11) Apennine Mountains, 12) Conon, 13) Palus Putredinus, 14) Mons Hadley, 15) Archimedes, 16) Autolycus, 17) Aristillus, 18) Mons Piton, 19) Cassini, 20) Caucasus Mountains, 21) Calippus, 22) Alexander, 23) Eudoxus, 24) Mare Serenitatis, 25) Linné, 26) Haemus Mountains.

Our first order of business for the evening will be to pick up a lunar club challenge that we haven't noted yet—Hipparchus.

Located just slightly south of the central point of the Moon and very near the terminator, this is not truly a crater—but a hexagonal mountain-walled plain. Spanning about 150 kilometers in diameter with walls around 3320 meters high, it is bordered just inside its northern wall by crater Horrocks. This deep appearing "well" is 30 kilometers in diameter and its rugged interior drops down an additional 2980 meters below the floor. To the south and just outside the edge of the plain is crater Halley. Slightly larger at 36 kilometers in diameter, this crater named for Sir Edmund is a little shallower at 2510 meters deep—but it has a very smooth floor. To the east you'll see a series of three small craters, the largest of which is Hind.

Now, relax! Tonight is the peak of the Kappa Cygnid meteor shower. Although the Moon will interfere early in the evening, wait until it has set and watch the area near Deneb. Discovered in the late 1800's, the Kappa Cygnids are often overlooked because the grander, more prolific Perseids tend to get more attention. Although the stream has been verified, peak dates and fall rates vary from year to year. The average fall rate is usually no more than 5 per hour, but it is not uncommon to see 12 or more per hour with many fireballs. The stream's duration is around 15 days. Clear skies!



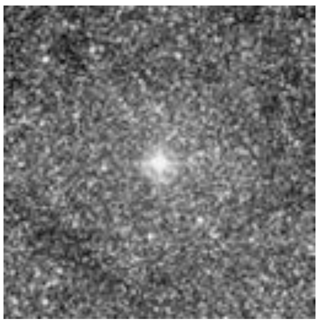
Hipparchus
Credit: Alan Chu

AUG 21
TUESDAY

When we begin our observations tonight, we'll start by having a look at another great study crater—Archimedes. You'll find it located in the Imbrium plain north of the Apennine Mountains and west of Autolycus.

Under this lighting, the bright ring of this class V walled plain extends 83 kilometers in diameter. Even though it looks to be quite shallow, it still has impressive 2150 meter high walls. To its south is a feature not often recognized—the Montes Archimedes. Though this relatively short range is well eroded, it still shows across 140 kilometers of lunar topography. Look for a shallow rima that extends southeast across Palus Putredinus towards the Apennines. Mark your challenge notes!

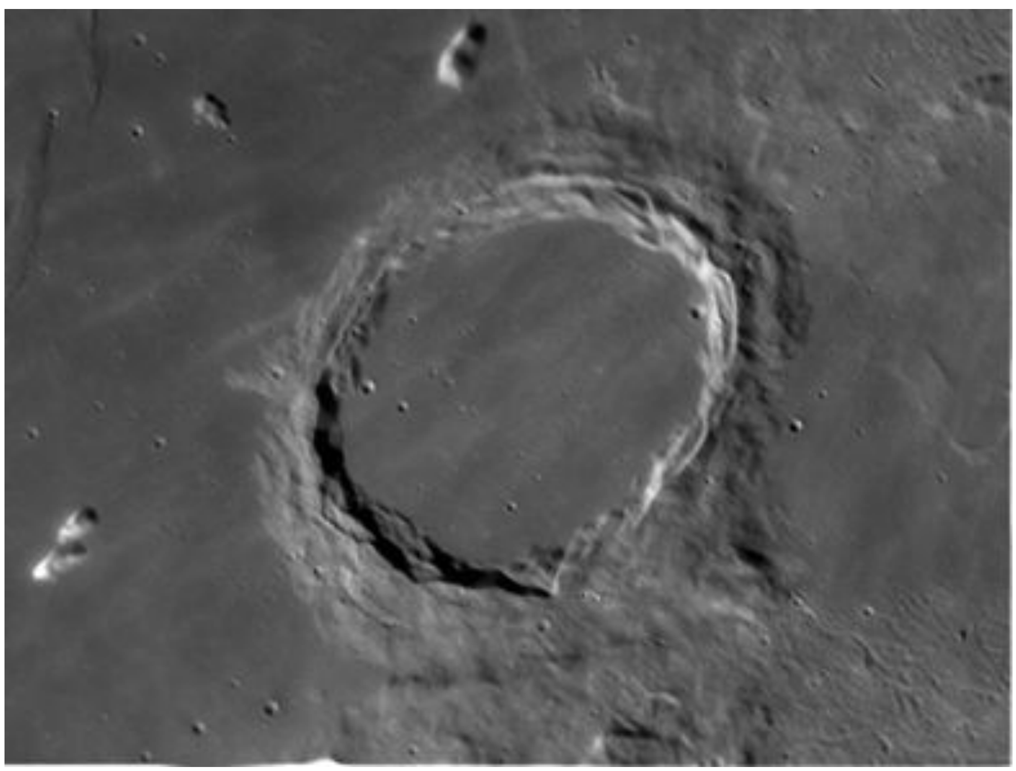
Now let's go have a look at a star buried in one of the spiral arms of our own galaxy—W Sagittarii...



W Sagittarii
Credit: Palomar Observatory, courtesy of Caltech

Located less than a fingerwidth north of Gamma, the tip of the "teapot spout," W is a Cepheid variable that's worth keeping an eye on. While its brightness only varies by less than a magnitude, it does so in less than 8 days! Normally holding close to a magnitude 4, nearby field stars will help you correctly assess when minimum and maximum occur. While it's difficult for a beginner to see such changes, watch it over a period of time. At maximum, it will be only slightly fainter than Gamma to the south. At minimum, it will be only slightly brighter than the stars to its northeast and southwest.

While you watch W go through its changes—think on this: not only is W a Cepheid variable (a standard for distance measurements), but it is also one that periodically changes its shape. Not enough? Then think twice... Because W is also a Cepheid binary. Still not enough? Then you might like to know that recent research points toward W having a third companion as well!



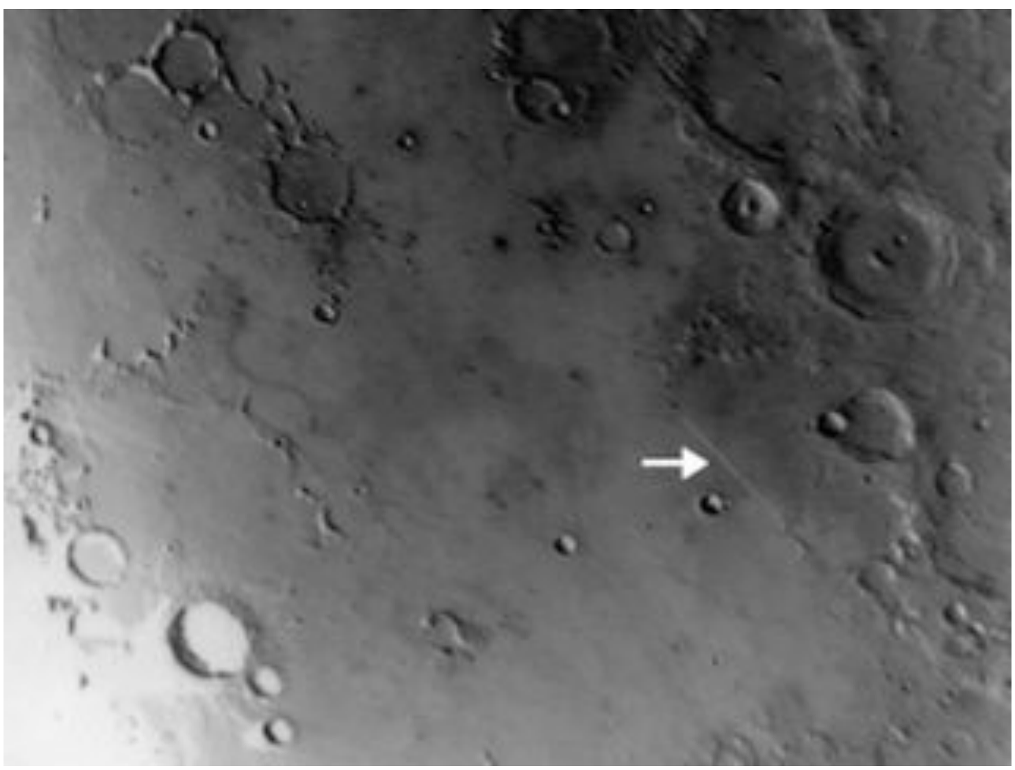
Archimedes
Credit: Wes Higgins

Tonight as the skies darken, look for Antares less than a degree north of moon. For some areas of the world, this could be an occultation event so be sure to check IOTA... And while you're watching, check out Jupiter about 5 degrees further to the north!

Tonight will be another opportunity to note a lunar challenge feature you may have missed earlier in the year—The Straight Wall. Begin in the lunar south where you can't miss the outstanding rings of craters Ptolemaeus, Alphonsus, Arzachel, Purbach and Walter descending from north to south. To the west, identify the beginnings of Mare Nubium. Look between Purbach and Walter for the small, bright ring of Thebit and further west and for a long, thin, dark "line" cutting across the mare. It is properly known as Rupes Recta—but more commonly called "The Straight Wall." It's one of the steepest slopes on the lunar surface and only visible when the lighting is just right. If you can't see it tonight, try again in 15 days when the sunlight changes the viewing angle!

Although it will be tough to locate with the unaided eye thanks to the Moon, let's take a closer look at one of the most unsung stars in this region of sky—Eta Sagittarii. This M-class giant star will show a wonderful color contrast to binoculars or scopes, being slightly more orange than the surrounding field. Located 149 light-years away, this irregular variable star is a source of infrared radiation and is a little larger than our own Sun—yet 585 times brighter. At around 3 billion years old, Eta has either expended its helium core or just begun to use it to fuse carbon and oxygen—creating an unstable star capable of changing its luminosity by about 4%. But have a closer look... For Eta is also a binary system with an 8th magnitude companion!

Eta Sagittarii
Credit: Palomar Observatory, courtesy of Caltech



Rupes Recta: The Straight Wall
Credit: Greg Konkel

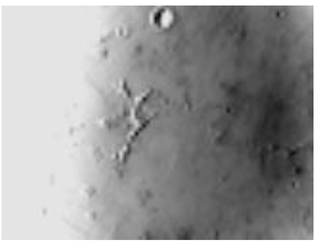
AUG 23
THURSDAY

Do you remember a few days ago in history when Lunar Orbiter 1 was launched? Well, on this day in history it made headlines as it sent back the very first photo of Earth seen from space!

Tonight let's do a little lunar orbiting of our own as we head to the western shore of Mare Cognitum and look along the terminator for the Montes Riphaeus—"The Mountains In The Middle of Nowhere." But are they really mountains? Let's take a look.

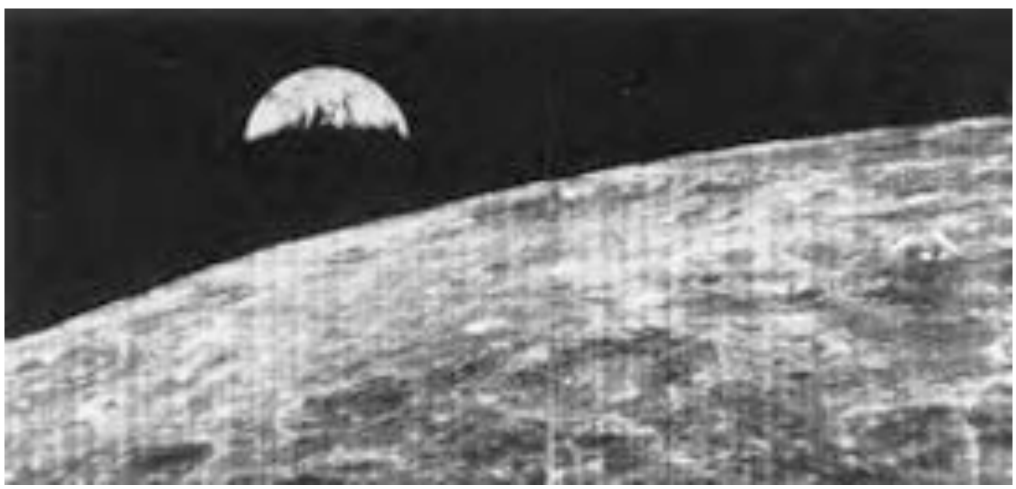
At the widest, this unusual range spans about 38 kilometers and runs for a distance of around 177 kilometers. Less impressive than most lunar mountain ranges, some peaks reach up to 1250 meters high, making these summits about the same height as our volcano Mt. Kilauea. While we are considering volcanic activity, consider that these peaks are all that is left of Mare Cognitum's walls after lava filled it in. At one time this may have been amongst the tallest of lunar features!

Now let's have a look at the brightest star in the "Archer"—Epsilon Sagittarii. Known as Kaus Australis, or the "Southern Bow," Epsilon holds a respectable magnitude 1.8 and is located around 120 light-years from Earth. This sparkling blue/white star is 250 times brighter than our own Sun. While a major challenge would be to spot Epsilon's 14th magnitude companion star located about 32" away, even the smallest of telescopes and most binoculars can try for the 7th magnitude visual companion widely spaced to the north-northwest.



Montes Riphaeus
Credit: Greg Konkel

Epsilon Sagittarii: Kaus Australis
Credit: Palomar Observatory, courtesy of Caltech

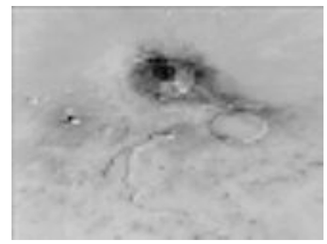


Lunar Orbiter's first photo
Credit: NASA

Today in 1966 from an Earth-orbiting platform, the Luna 11 mission was launched on a three day trip. After successfully achieving orbit, the mission went on to study many things, including lunar composition and nearby meteoroid streams.

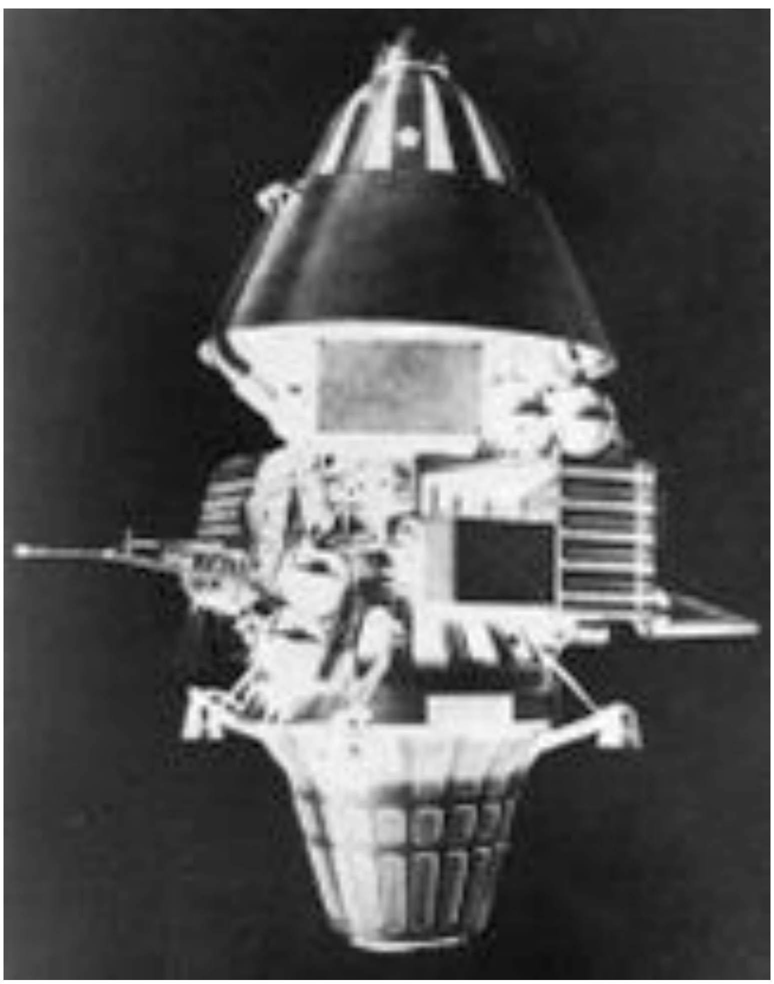
Tonight let's start our lunar observations with features that can be seen with both binoculars and telescopes. Just slightly north of center along the terminator, look for the bright point of Kepler. Watch as this feature develops a bright ray system in the coming days. To the north you will see equally bright Aristarchus—quite probably one of the youngest of the prominent features at around 50 million years old. It will also develop a ray system.

Now, grab your telescope and look west of Aristarchus for less prominent crater Herodotus. Just to the north you will see a fine white thread known as Vallis Schroteri—or Schroter's Valley. Winding its way across the Aristarchus plain, this feature is about 160 kilometers long, from 3 to 8 kilometers wide, and about 1 kilometer deep—but what is it?



Schroter's Valley
Credit: Wes Higgins

Schroter's Valley a prime example of a collapsed lava tube—created when molten rock flowed over the surface. This may have been from a major meteor strike, such as the formation of Aristarchus crater, or early volcanic activity. What is left is a long, narrow cave on the surface which only shows well when the lighting is correct. Like many sinuous rilles covering the surface, collapse has occurred. If intact tubes can be found on the lunar surface they could conceivably provide shelter for future settlers!



Luna 11
Credit: NASA

AUG 25
SATURDAY

Tonight we'll start our observations in the lunar southwest as we look along the terminator to identify challenge crater Schickard. Look for an elongated grey oval that's more than just another cool crater...

Named for Dutch mathematician and astronomer Wilhelm Schickard, this 227 kilometer diameter feature is a ringed plain and very old. At high power you'll see a variegated floor and dark areas near the walls—yet the center is creased by a lighter coloration. It is believed Schickard was formed by an early impact before Mare Nectaris formed. Its floor may have contained vents which allowed it to fill with lava during the Imbrium period. As it cooled and matured another impact event occurred nearby which formed the Orientale Basin and splashed material its way. But Schickard wasn't done evolving yet... Lava continued to flow and left even more dark evidence for us to observe. How do we know this is so? If you're able to resolve Schickard's tiny interior impacts, you'll see that far fewer of them occur over newer material. Older formations bear the scars of time and impact while younger features are fresh and unmarked!

Tonight is also the peak of the Northern Iota Aquarid meteor shower. While the Moon will totally interfere, you still might catch a bright streak!

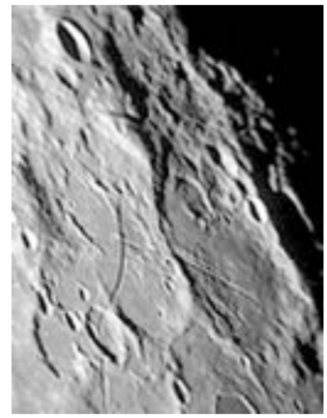
Schickard
Credit: Alan Chu

Tonight we'll continue our journey of lunar evolution as we have a look at another walled plain just south of Grimaldi.

Named for English naturalist Charles Darwin, this equally old feature bears the scars of the impact the created the Orientale Basin. Look carefully at the slopes in the northeast, for this may very well be material that was thrown there and left to slide back down to the crater floor. Spanning around 130 kilometers in diameter, Darwin's actual size is only diminished by the fact that we view it on a curve. Its northern and southern shores have almost completely eroded, yet evidence remains of its eastern margin broken by the Rima Darwin which stretches for 280 kilometers. Was there lava here as well? Yes. Evidence still exists in the form of a dome along Darwin's battered western edge.

On this date in 1981, Voyager 2 made a fly-by of Saturn. Eight years later in 1989, Voyager 2 flew by Neptune on this date. Why don't we make a "date" tonight to have a look at this distant blue world? You'll find it on the ecliptic plane east of the Moon. While large binoculars can pick up Neptune's very tiny blue orb, you'll need a telescope tonight to spot it through the lunar glare.

AUG 26
SUNDAY



Darwin
Credit: Alan Chu

Voyager 2 image of Neptune
Credit: NASA

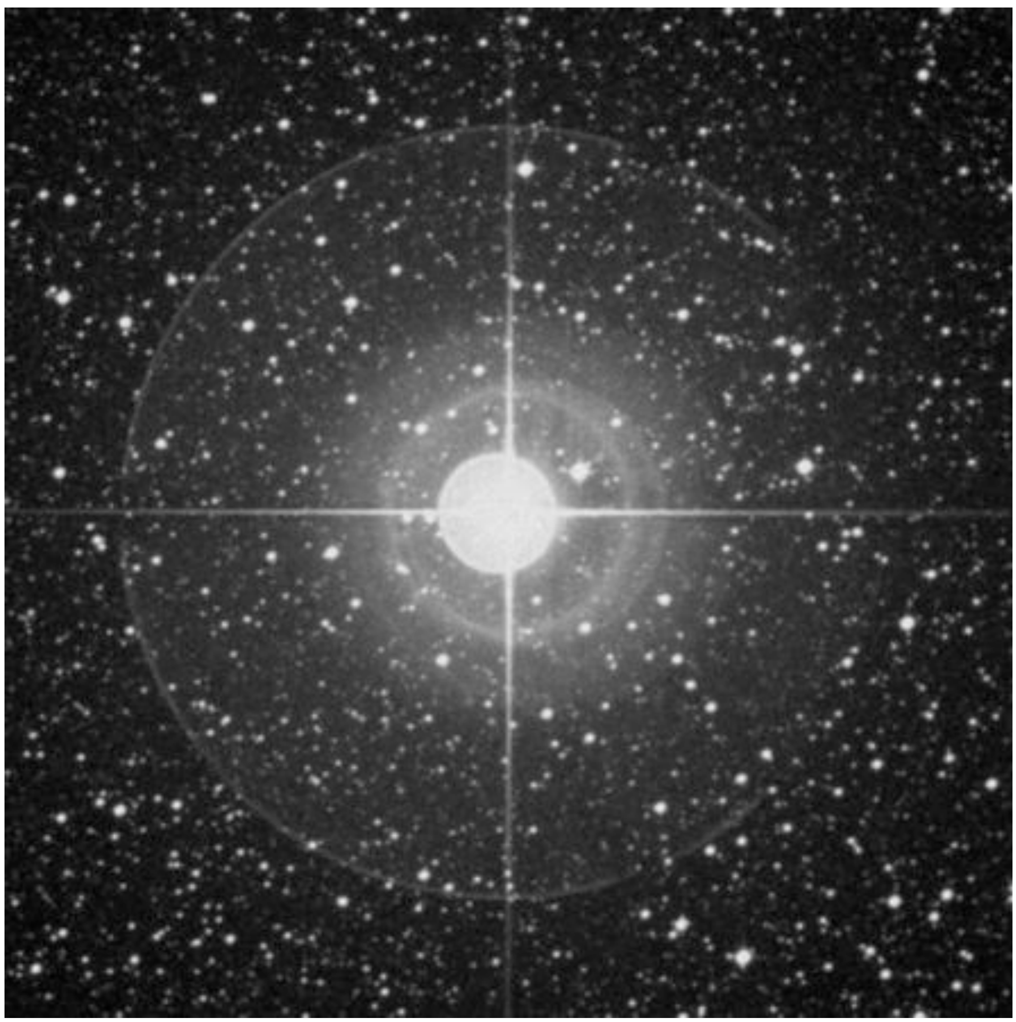
AUG 27
MONDAY

Nu Sagittarii: The Eye of the Archer
Credit: Palomar Observatory, courtesy of Caltech

While it's going to be very hard to ignore the presence of the Moon tonight, Neptune is a little more than a degree north, and there may be a visible occultation event. Be sure to check IOTA for the most up-to-date information.

Think having all this Moon around is the pits? Then let's venture to Zeta Sagittarii and have a look at Ascella—"The Armpit of the Centaur." While you'll find Zeta easily as the southern star in the handle of the teapot formation, what you won't find is an easy double. With almost identical magnitudes, Ascella is one of the most difficult of all binaries. Discovered by W. C. Winlock in 1867, the components of this pair orbit each other very quickly—in just a little more than 21 years. While they are about 140 light-years away, this gravitationally bound pair waltz no further apart than our own Sun and Uranus!

Too difficult? Then have a look at Nu Sagittarii—Ain al Rami, or the "Eye of the Archer." It's one of the earliest known double stars and was recorded by Ptolemy. While Nu 1 and Nu 2 are actually not physically related to one another, they are an easy split in binoculars. Eastern Nu 2 is a K type spectral giant that is around 270 light-years from our solar system. But take a very close look at the western Nu 1—while it appears almost as bright, this one is 1850 light-years away! As a bonus, power up in the telescope, because this is one very tight triple star system!



Zeta Sagittarii: Ascella
Credit: Palomar Observatory, courtesy of Caltech

AUG 28
TUESDAY

In 1789 on this day, Sir William Herschel discovered Saturn's moon Enceladus. But if Sir William were around tonight, he'd be napping the early evening hours away as the Moon heads quietly for the Earth's shadow and a total lunar eclipse is about to occur. For those living in the eastern portions of North and South America, the event will begin not long before dawn. The further west you live, the better your chances of observing totality, with the event in progress at moonrise for observers in far eastern Europe, New Zealand and Australia. No matter if you're staying out late, or getting up early, a total lunar eclipse is well worth watching!

One of the most breathtaking adventures you can undertake is to watch the Moon through a telescope during an eclipse, both at ingress and egress. Craters take on new dimensions and subtle detail as the shadow races across the surface. If you are lucky enough to see totality... Look at the stars around the Moon. What a wonder it is to behold that which is normally hidden by the light!

Try and judge the Danjon scale for yourself. An L4 is an orange moon with a blue shadow at the edge of the dark umbral cone. L3 is brick red with a grey rim. L2 is deep red, with the umbra very dark with a bright outer edge. L1 is a dark eclipse, where the Moon turns almost brown, while a rare L0 means the Moon becomes almost invisible.

Enjoy your eclipse experience and remember to try your hand at photography!

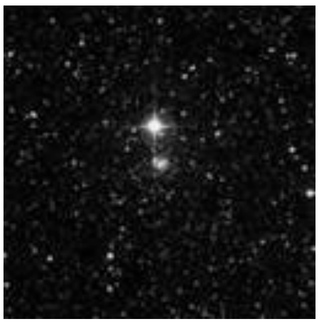
Total Lunar Eclipse
Credit: Alan Chu

AUG 29
WEDNESDAY

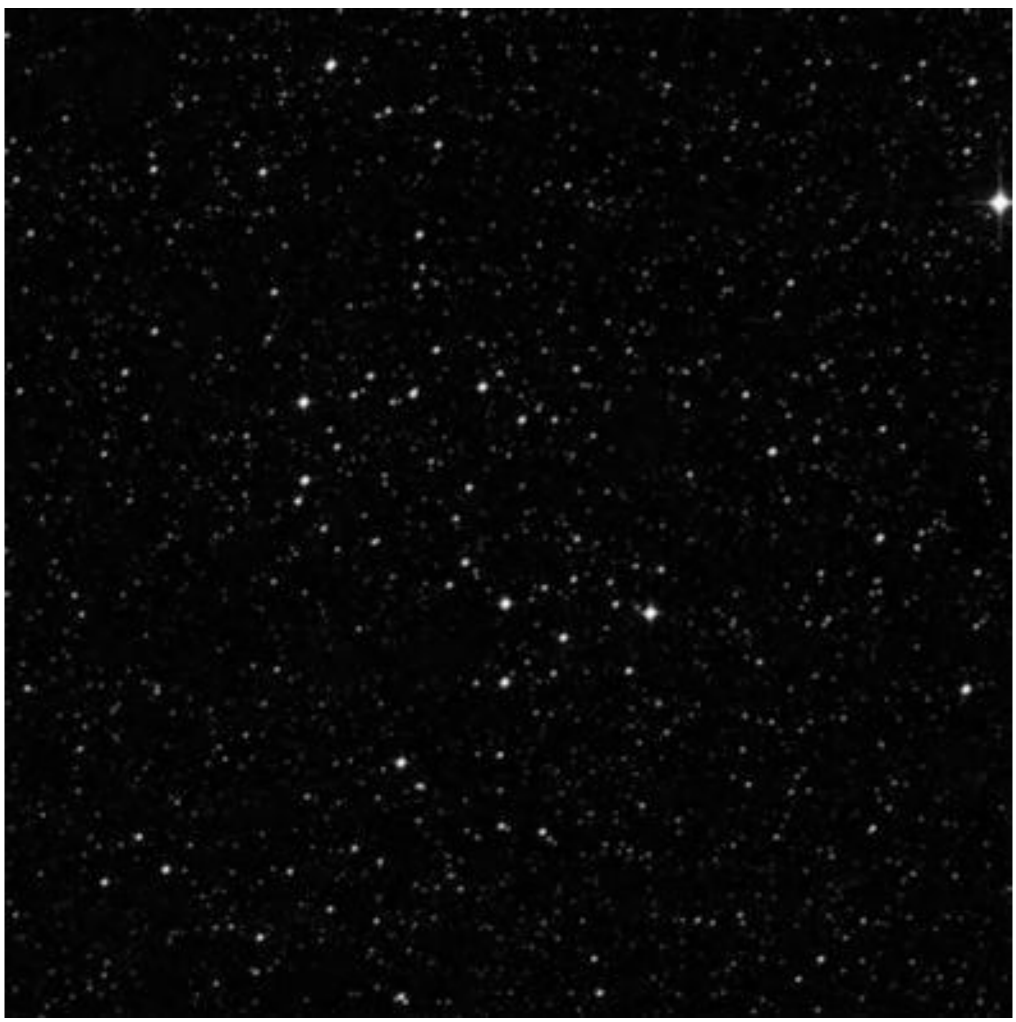
Tonight we'll hop about two fingerwidths north of Nu Sagittarii to have a look at an open cluster that's a bit more off the beaten path—NGC 6716. Comprised of around 75 genuine cluster members, this 100 million year old cluster will appear almost like a loose globular cluster, with brighter stars superimposed over the field of a mid-sized telescope in a distinctive horseshoe pattern. At magnitude 7.5 it's not only within range of larger binoculars, but part of challenge lists as well. Be sure not to confuse it with the far more open Collinder 394 about half a degree southwest. Like all Collinder clusters, it's a large, sparse open one that only contains a handful of stars in a V pattern.

If you're still feeling adventurous with a larger scope, drop back and take a much closer look at the Nu Sagittarii system. On the southern edge of eastern Nu 2's influence, you just might catch globular cluster NGC 6717. If not, keep trying because you need a Palomar globular for your studies! At very near magnitude 10, this loose, class VIII globular was discovered by Sir William Herschel on Aug 7th, 1784, and listed as H III.143. Although it will appear as nothing more than a faint, round unresolved area, it truly is a globular cluster. At one time a small cluster of stars was designated as IC 4802 with surrounding nebulosity—but tonight we'll log it as Palomar 9!

And if you still can't find Uranus? Try looking about 1.7 degrees south of the Moon after it rises...



NGC 6717
Credit: Palomar Observatory, courtesy of Caltech



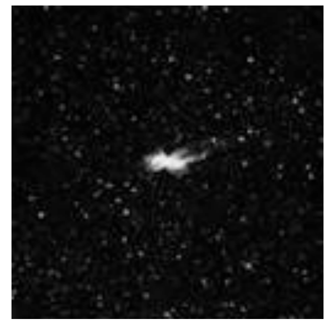
NGC 6716
Credit: Palomar Observatory, courtesy of Caltech

Today celebrates the Yohkoh Mission, launched in 1991. It was a joint effort of both Japan and the United States to monitor solar flares and the corona. While its initial mission was quite successful, on December 14, 2001 the signal was lost during a total eclipse. Unable to reposition the satellite back towards the Sun, the batteries discharged and Yohkoh became inoperable.

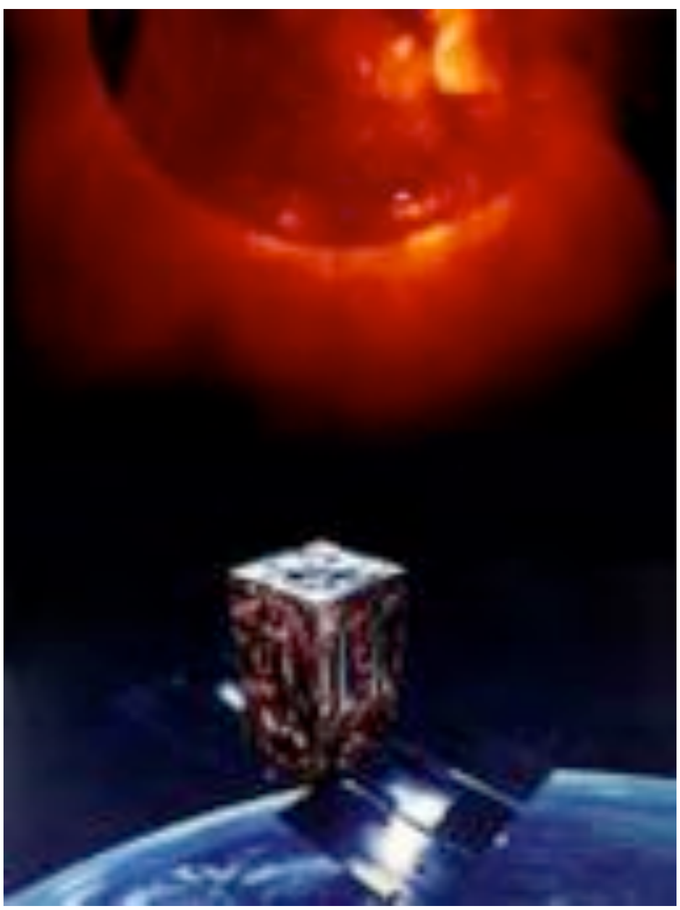
Before the Moon rises tonight, let's have a look at a very curious planetary nebula located around three fingerwidths (RA 17 13 44.21 Dec -37 06 15.9) west of Lambda Scorpii—NGC 6302, better known as the "Bug" nebula.

With a rough visual magnitude of 9.5, the Bug belongs to the telescope—but it's history as a very extreme planetary nebula belongs to all. At its center is a 10th magnitude star, one of the hottest known. Appearing in the telescope as a small bowtie, or figure-8 shape, huge amounts of dust exist—very special dust. Early studies showed it consisted of hydrocarbons, carbonates and iron. At one time, carbonates were believed associated with liquid water, and NGC 6302 is one of two such regions known is space to contain carbonates—perhaps in a crystalline form.

Ejected at high speed in a bi-polar outflow, further research has shown the presence of calcite and dolomite, causing scientists to rethink where carbonates might be formed. The processes that formed the Bug may have begun 10,000 years ago—meaning it may have by now stopped losing material. Hanging out about 4000 light-years from our own solar system, we'll never see NGC 6302 as well as the Hubble Telescope presents its beauty, but that won't stop you from enjoying one of the most fascinating of planetary nebulae!



NGC 6302: The Bug Nebula
Credit: Palomar Observatory, courtesy of Caltech



Yohkoh
Credit: NASA

Aug 31
FRIDAY

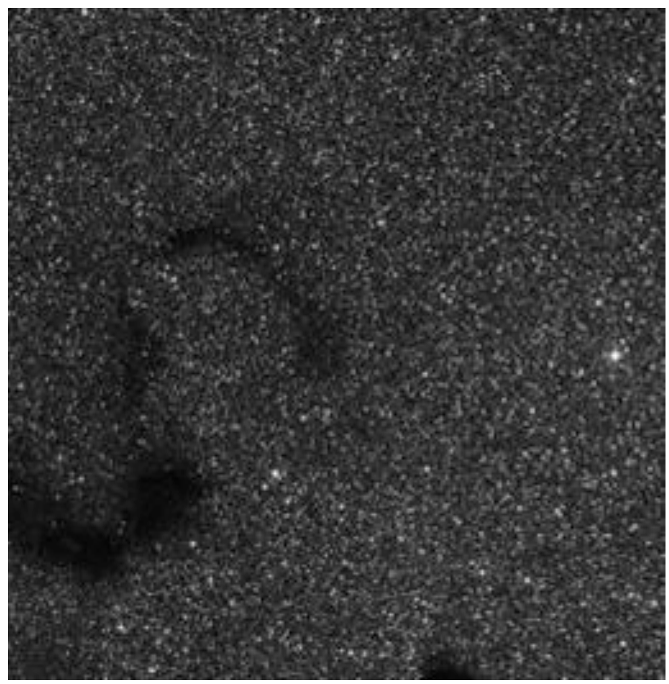
Tonight we will begin entering the stream of the Andromedid meteor shower, which peaks off and on for the next couple of months. For those of you in the northern hemisphere, look for the lazy "W" of Cassiopeia to the northeast. This is the radiant—or relative point of origin—for this meteor stream. At times, this shower has been known to be spectacular, but let's stick with an accepted fall rate of around 20 per hour. These are the offspring of Beila's Comet, one that split apart leaving radically different streams—much like 73/P Schwassman-Wachmann did last year. These meteors have a reputation for red fireballs with spectacular trains, so watch for them in the weeks ahead.

While we're waiting, let's head over to the dark side as we take a look at the Barnard 72 Dark Nebula (RA 17 23 02.00 Dec -23 33 48.0), located about a fingerwidth north of Theta Ophiuchi.

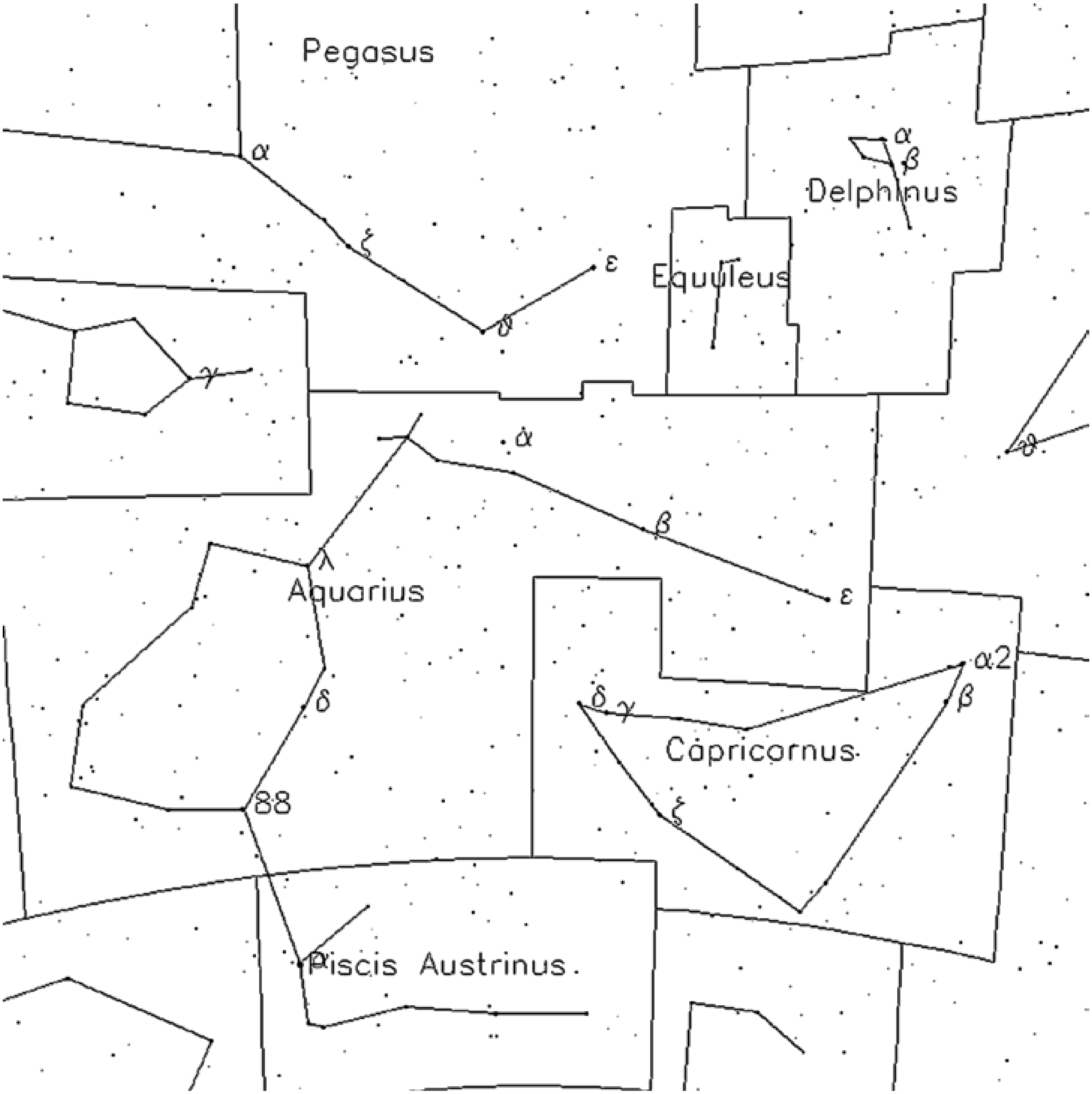
While sometimes dark nebulae are hard to visualize because they are simply an absence of stars, patient observers will soon learn to "see in the dark." The trained eye often realizes the presence of unresolved stars as a type of background "noise" that we simply take for granted—but not E.E. Barnard. He was sharp enough to realize that there were at least 182 places in the sky where these particular areas of nothingness existed, and he correctly assumed they were due to obscuring dark nebulae.

Unlike bright emission and reflection nebulae, these dark clouds are interstellar masses of dust and gas that remain unilluminated. We would probably not even realize they were there except for the fact that they eradicate star fields we know to be present! It is possible that one day they may form stars of their own, but until that time we can enjoy these objects as splendid mysteries—and one of the most fascinating of all is the "Snake."

Put in a wide field eyepiece and relax...It will come to you. Barnard 72 is only a few light-years in expanse and a relatively short 650 light-years away. If at first you don't see it, don't worry. Like many objects, spotting dark nebulae takes some practice.



B72: The Snake Nebula
Credit: Palomar Observatory, courtesy of Caltech


Pegasus
Delphinus
Equuleus
Aquarius
Capricornus
Piscis Austrinus
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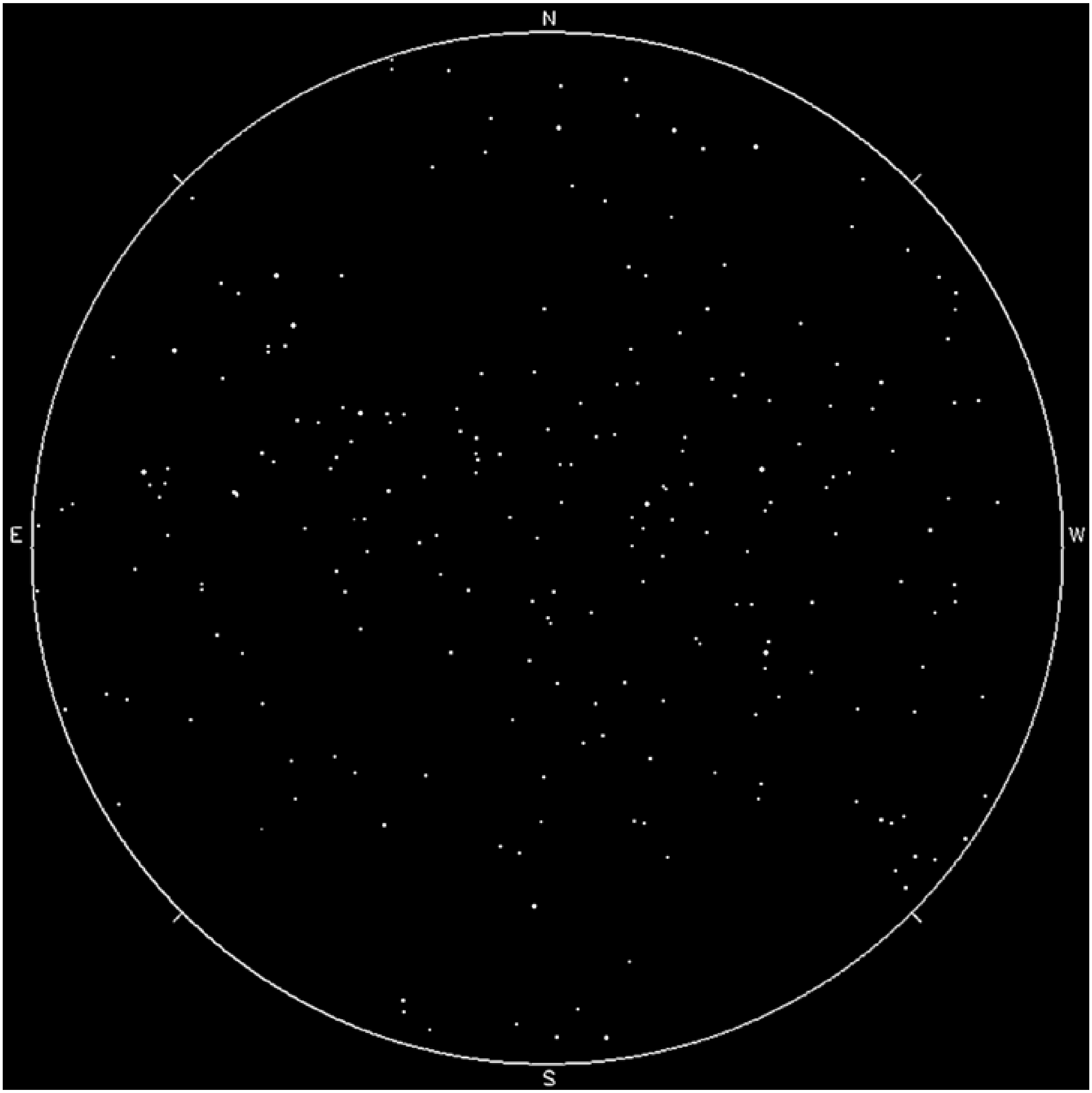
SEPTEMBER 2007



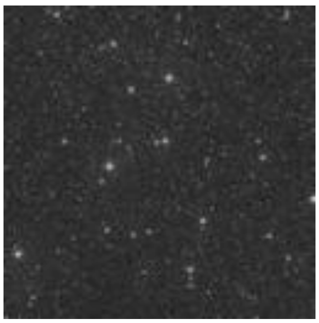
SEP 1
SATURDAY

On this day 1859, solar physicist Richard Carrington (who originally assigned sunspot rotation numbers) observed the first solar flare ever recorded. Naturally enough, an intense aurora followed the next day. 120 years later in 1979, Pioneer 11 made history as it flew by Saturn. And where is Saturn? Hanging out with the Sun!

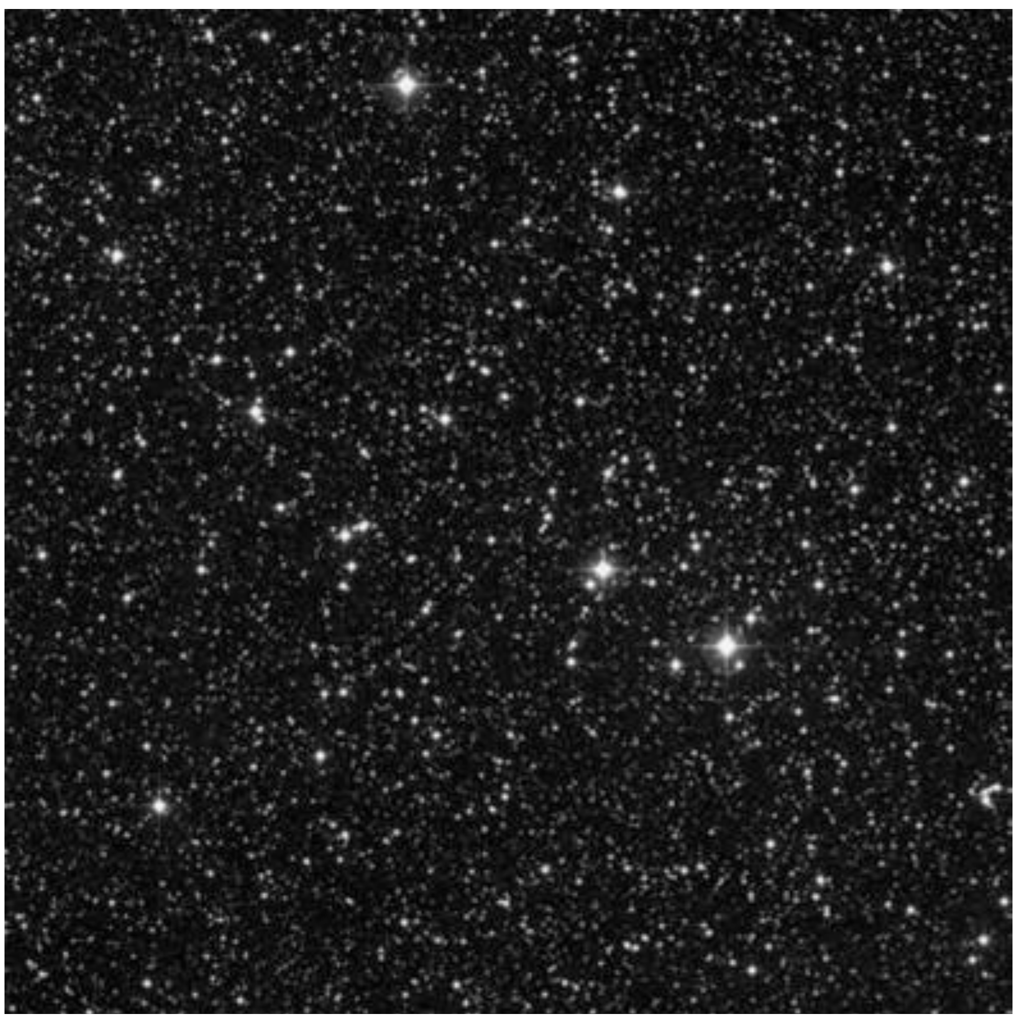
As the nights begin to cool and darken earlier for those in the north, it's time for us to fly with the "Swan" as the graceful arch of the Milky Way turns overhead. Tonight we'll start by taking a look at a bright star cluster that's equally great in either binoculars or telescope—M39.

Located about a fist's width northeast of Deneb (Alpha Cygni), you will easily see a couple of dozen stars in a triangular pattern. M39 is particularly beautiful because it will seem almost three dimensional against its backdrop of fainter stars. Younger than the Coma Berenices cluster, and older than the Pleiades, the estimated age of M39 is at least 230 million years. This loose, bright galactic cluster is around 800 light-years away. Its members are all main sequence stars and the brightest of them are beginning to evolve into giants.

For more of a challenge, try dropping about a degree south-southwest for NGC 7082—also known as H VII.52. While it is a less rich, less bright and far less studied open cluster, at magnitude 7.5 it is within range of binoculars, and is on many open cluster observing lists. With only a handful of bright stars to its credit, larger telescopes are needed to resolve out many of the fainter members. Be sure to mark your notes for both objects!



M39
Credit: Palomar Observatory, courtesy of Caltech



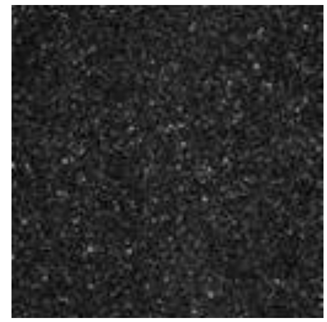
NGC 7082
Credit: Palomar Observatory, courtesy of Caltech

SEP 2
SUNDAY

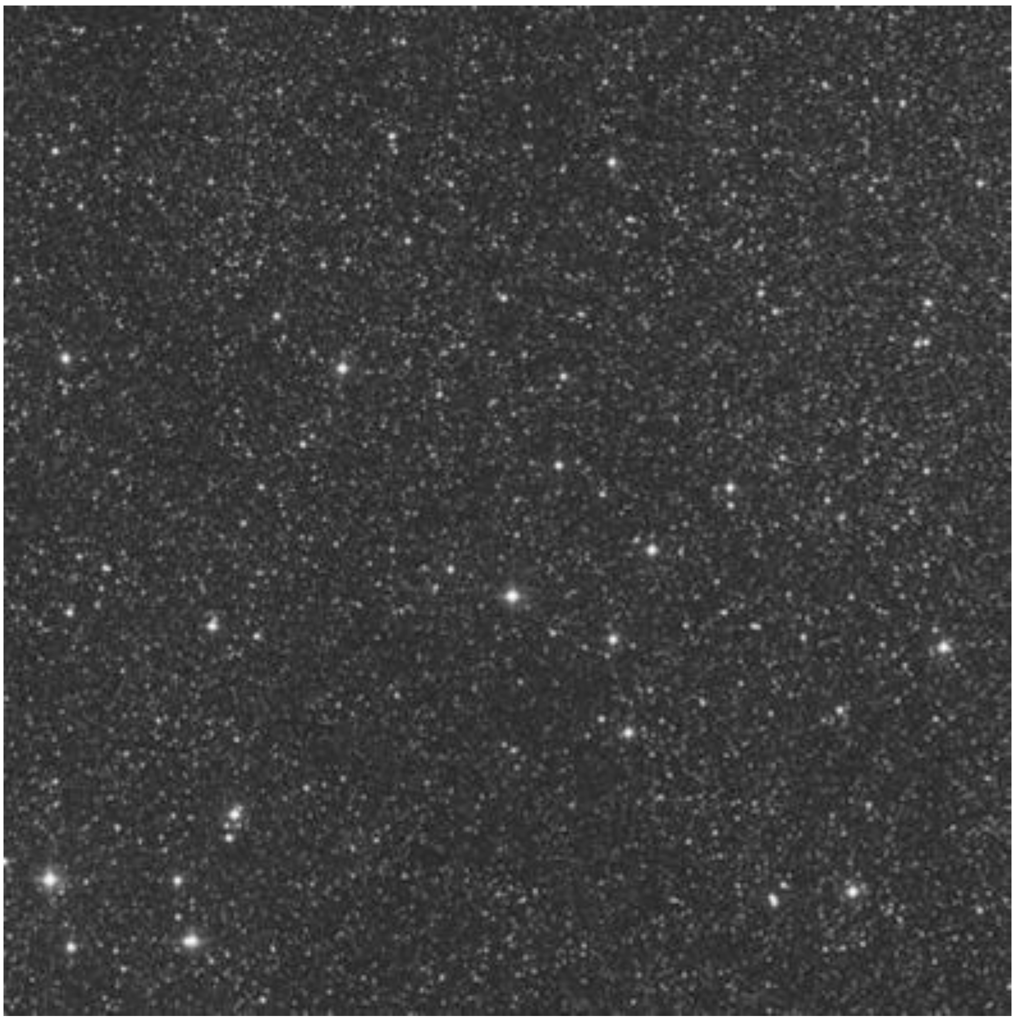
Tonight we'll hunt with the "Fox" as we head to Vulpecula to try two more open star cluster studies. The first can be done easily with large binoculars or a low power scope. It's a rich beauty that lies in the constellation of Vulpecula, but is more easily found by moving around 3 degrees southeast of Beta Cygni.

Known as Stock 1, this stellar swarm contains around 50 or so members of varying magnitudes that you will return to often. With a visual magnitude of near 5, loose associations of stars—like Stock clusters—are the subject of recent research. The latest information indicates that the members of this cluster are truly associated with one another.

A little more than a degree to the northeast is NGC 6815. While this slightly more compressed open cluster has no real status amongst deep sky objects, it is another one to add to your collection of things to do and see!

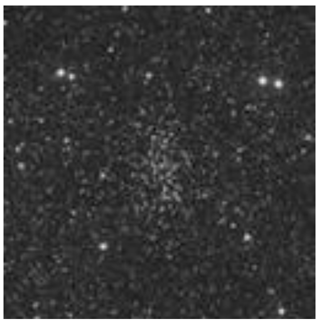


NGC 6815
Credit: Palomar Observatory, courtesy of Caltech



Partial Field of Stock 1
Credit: Palomar Observatory, courtesy of Caltech

SEP 3
MONDAY

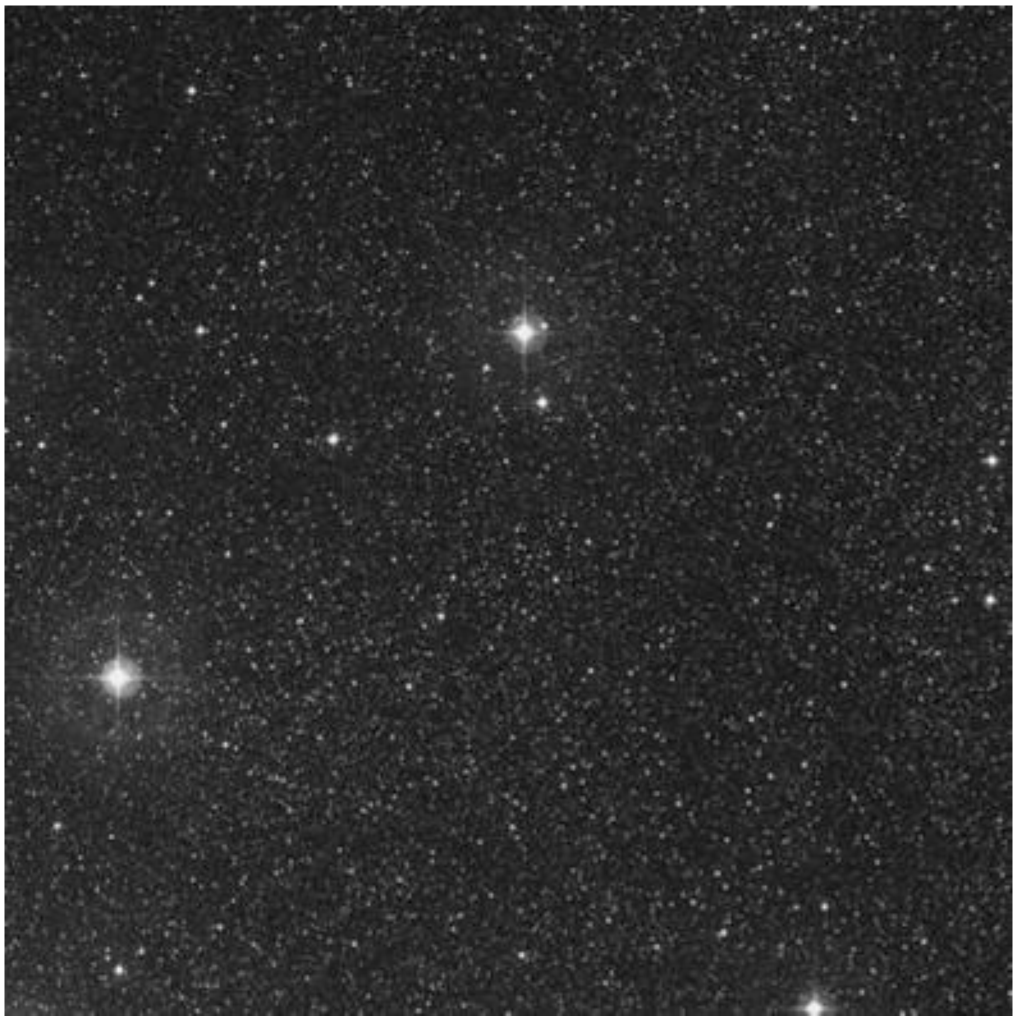


NGC 6802
Credit: Palomar Observatory, courtesy of Caltech

Tonight we'll start with an asterism known as the "Coat Hanger," but it is also known as Brocchi's Cluster, or Collinder 399. Let the colorful double star Beta Cygni—Albireo—be your guide as you move about 4 degrees to its south-southwest. You will know this cluster when you see it, because it really does look like a coat hanger! Enjoy its red stars.

First discovered by Al Sufi in 964 AD, this 3.5 magnitude collection of stars was again recorded by Hodierna. Thanks to its expansive size of more than 60 arc minutes, it escaped the catalogues of both Messier and Herschel. Only around a half dozen stars share the same proper motion, which may make it a cluster much like the Pleiades, but studies suggest it is merely an asterism...but one with two binary stars at its heart.

And for larger scopes? Fade east to the last prominent star in the cluster and power up. NGC 6802 awaits you! At near magnitude 9, Herschel VI.14 is a well compressed open cluster of faint members. The subject of ongoing research in stellar evolution, this 100,000 year old cluster is on many observing challenge lists!



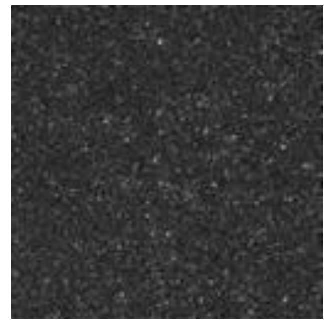
Center of Collinder 399
Credit: Palomar Observatory, courtesy of Caltech

Twenty-four hours ago in 1976, the Viking 2 lander successfully touched down on Mars. If you've been waiting on your opportunity to see the Red Planet again, you'll find it 5.8 degrees south of the Moon as the new day begins.

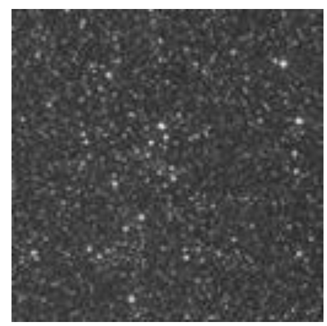
Tonight we'll start with the brightest star in Vulpecula—Alpha. Although it is not a true binary star, it is quite attractive in the telescope and an easy split for binoculars. Alpha itself is a 4.4 magnitude red giant which makes a nice color contrast with the unrelated yellow field star which is two magnitudes dimmer.

Now head around one half degree northwest for open cluster NGC 6800. Also known as Herschel VIII.21, this cluster is suitable for even smaller scopes but requires aperture to resolve completely. Discovered by Sir William in this month (10th) in 1784, you'll like this ring-like arrangement of stars!

Now drop 2.7 degrees southwest of Alpha for yet another open cluster—NGC 6793. Discovered by Herschel in 1789 and logged as catalog object VIII.81, you'll find a few more bright stars here. The challenge in this cluster is not so much being able to see it in a smaller telescope—but being able to discern a cluster from a starfield!



NGC 6800
Credit: Palomar Observatory, courtesy of Caltech



NGC 6793
Credit: Palomar Observatory, courtesy of Caltech

Alpha Vulpeculae
Credit: Palomar Observatory, courtesy of Caltech

SEP 5
WEDNESDAY

NGC 6823
Credit: Palomar Observatory, courtesy of Caltech

Tonight we'll return again to Vulpecula—but with a different goal in mind. What we're after requires dark skies—but can be seen in both binoculars and a small telescope. Once you've found Alpha, begin about two fingerwidths southeast and right on the galactic equator you'll find NGC 6823.

The first thing you will note is a fairly large, somewhat concentrated magnitude 7 open cluster. Resolved in larger telescopes, the viewer may note these stars are the hot, blue/white variety. For good reason. NGC 6823 only formed about 2 billion years ago. Although it is some 6000 light-years away and occupies around 50 light-years of space, it's sharing the field with something more—a very large emission/reflection nebula, NGC 6820.

In the outer reaches of the star cluster, new stars are being formed in masses of gas and dust as hot radiation is shed from the brightest of the stellar members of this pair. Fueled by emission, NGC 6820 isn't always an easy visual object—it is faint and covers almost four times as much area as the cluster. But trace the edges very carefully, since the borders are much more illuminated than the region of the central cluster. Take the time to really observe this one! Its processes are very much like those of the "Trapezium" area in the Orion nebula.

Be sure to mark your observing notes. NGC 6823 is Herschel VII.18 and NGC 6820 is also known as Marth 401!

NGC 6820
Credit: Adam Block/NOAO/AURA/NSF

Today celebrates the founding of the Astronomical and Astrophysical Society of America. Started in 1899, it is now known as the American Astronomical Society.

Tonight we are going to take a journey once again toward an area which has intrigued this author since I first laid eyes on it with a telescope. Some think it difficult to find, but there is a very simple trick. Look for the primary stars of Sagitta just to the west of bright Albireo. Make note of the distance between the two brightest and look exactly that distance north of the "tip of the arrow" and you'll find M27.

Discovered in 1764 by Messier in a 3.5 foot focal length telescope, I discovered this 48,000 year old planetary nebula for the first time in a 4" telescope. I was hooked immediately. Here before my eager eyes was a glowing green "apple core" which had a quality about it that I did not understand. It somehow moved... It pulsated. It appeared "living."

For many years I quested to understand the 850 light-year distant M27, but no one could answer my questions. I researched and learned it was made up of doubly ionized oxygen. I had hoped that perhaps there was a spectral reason to what I viewed year after year—but still no answer. Like all amateurs, I became the victim of "aperture fever" and I continued to study M27 with a 12" telescope, never realizing the answer was right there—I just hadn't powered up enough.

Several years later while studying at the Observatory, I was viewing through a friend's identical 12" telescope and, as chance would have it, he was using about twice the magnification that I normally used on the "Dumbbell." Imagine my total astonishment as I realized for the very first time that the faint central star had an even fainter companion that made it seem to wink! At smaller apertures or low power, this was not revealed. Still, the eye could "see" a movement within the nebula—the central, radiating star and its companion.

Do not sell the Dumbbell short. It can be seen as a small, unresolved area in common binoculars, easily picked out with larger binoculars as an irregular planetary nebula, and turns astounding with even the smallest of telescopes. In the words of Burnham, "The observer who spends a few moments in quiet contemplation of this nebula will be made aware of direct contact with cosmic things; even the radiation reaching us from the celestial depths is of a type unknown on Earth..."

M27 and SN 2005
Credit: R. Jay GaBany

SEP 7
FRIDAY

When skies are dark, it's time for us to head directly between the two southernmost stars in the constellation of Lyra and grab the "Ring." What summer would be complete without it?

First discovered by French astronomer Antoine Darquier in 1779, the Ring Nebula was cataloged later that year by Charles Messier as M57. In binoculars the Ring will appear as slightly larger than a star, yet it cannot be focused to a sharp point. To a modest telescope at even low power, M57 turns into a glowing donut against a wonderful stellar backdrop. The average accepted distance to this unusual structure is 1,400 light-years, and how you see the Ring on any given night is mostly attributable to conditions. As aperture and power increase, so do details, and it is not impossible to see braiding in the nebula's structure with scopes as small as eight inches on a fine night, or to pick up the star caught on the edge in even smaller apertures.

Like all planetary nebulae, seeing the central star is considered the ultimate of viewing. The central itself is a peculiar bluish dwarf which gives off a continuous spectrum and might very well be a variable. At times, this shy, near 15th magnitude star can be seen with ease with a 12" telescope, yet be elusive to 31" in aperture weeks later. No matter what details you may see, reach for the "Ring" tonight. You'll be glad you did.

M57: The Ring Nebula
Credit: C.F. Claver/WIYN/NOAO/AURA/NSF

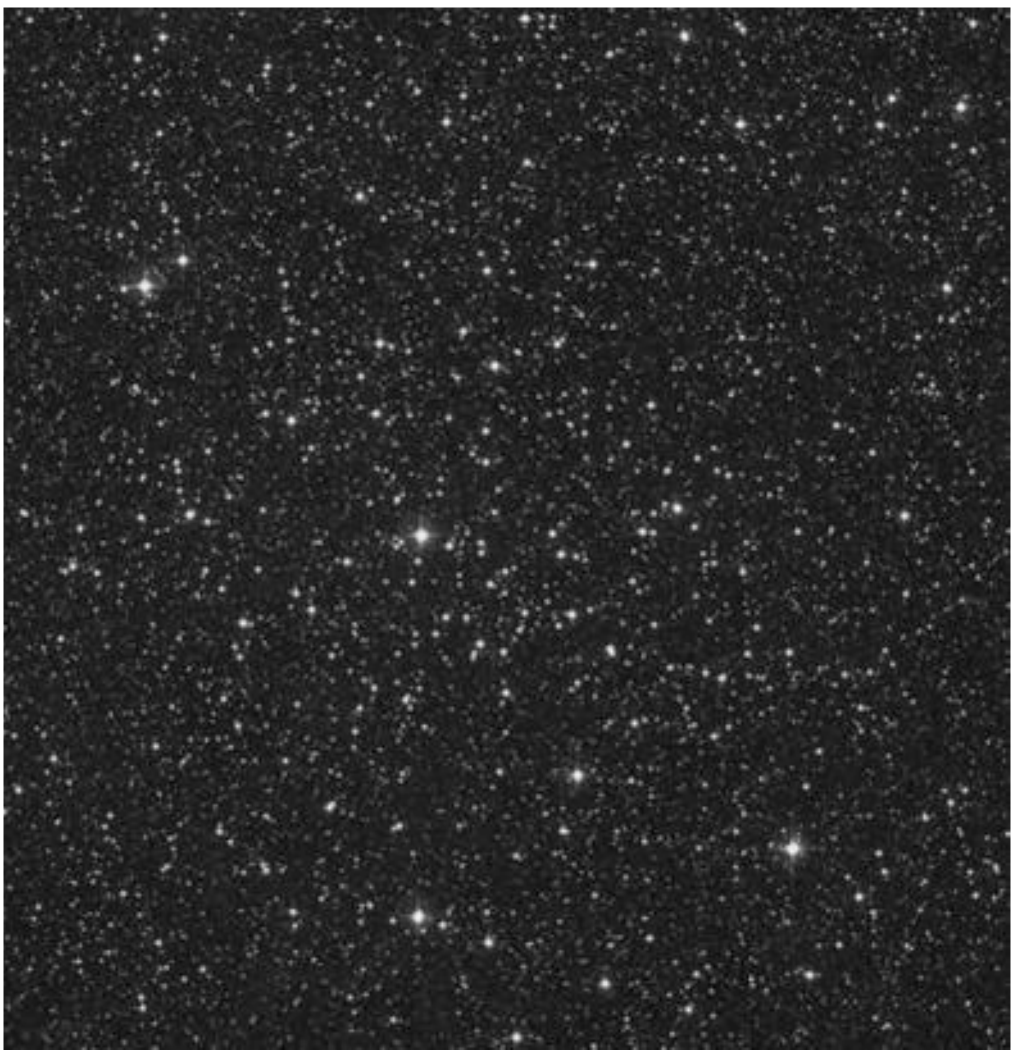
SEP 8
SATURDAY

Today in 1966, a legend was born as the television program, "Star Trek" premiered. Created by Gene Roddenberry, it was instrumental in inspiring several generations' interest in space, astronomy, and technology. The short-running series still airs in repeats, along with many movie and series sequels. May it continue to "live long and prosper."

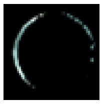
As your starry mission this evening, we'll continue our studies in Vulpecula with a spectacular open cluster—NGC 6940. At close to magnitude 6, you'll find this unsung symphony of stars around three fingerwidths southwest of Epsilon Cygni (RA 20 34 24.00 Dec +28 17 -0.0).

Discovered by Sir William Herschel on Oct 15, 1784, and logged as H VIII.23, this intermediate aged galactic cluster will blow your mind in larger aperture. Visible in binoculars, as size increases the field explodes into about 100 stars in a highly compressed, rich cloud. Although it is not an often visited cluster, it is part of many observing challenge lists. Use low power to get the full effect of this stunning starfield!

If you see a shooting star while you're out, it may belong to the Piscid meteor stream which will reach its peak tonight with an expected maximum of around 5 meteors per hour. This particular shower favors the southern hemisphere. While this branch of the Piscids is a rather unstudied, it is an unusual and diffuse stream that is active all month.



NGC 6940
Credit: Palomar Observatory, courtesy of Caltech



On this day in 1839, John Herschel made the very first glass plate photograph—and we're glad he did! The photo was of the famous 40-foot telescope of John's father, William Herschel. The scope had not been used in decades and was disassembled shortly after its photograph was taken.

So, have you ever wondered if Sir William had a bad night or ever made an error? Considering how much the technology of astronomy has changed in the over 200 years since he did his work—you'd be surprised at the uncanny knack Herschel had for making correct calls.

Tonight take the journey to Vulpecula in an area roughly between M27 and NGC 6940. We're looking for a small grouping of brighter stars and focus your attention (and telescope) on star 20. This is the region for a magnitude 6 open cluster within an open cluster known as NGC 6882 (RA 20 11 48.00 Dec +26 49 00.0) and NGC 6885 ((RA 20 12 00.00 Dec +26 29 -0.0). Check out the date, because they were discovered on September 9 and 10, 1784 by Sir William and logged as H VIII.20 and H VIII.22. His notes indicate the clusters to be north and south of each other, yet according to research his descriptions don't really precisely match the starfield.

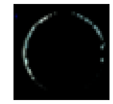
For many years, this was widely debated as an error—assuming the only true cluster (NGC 6885) was the one around star 20... Yet another, larger grouping does exist. Scientific research has proved that two distinct physical clusters of stars are paired together in this region. While errors and disagreements followed later over correctly listing both objects in the different catalogs, one fact remains. On this night 223 years ago? Herschel was right.

NGC 6882
Credit: Palomar Observatory, courtesy of Caltech

NGC 6885
Credit: Palomar Observatory, courtesy of Caltech

The Herschel Scope Photographic Plate (archival image)

Today is the birthday of James E. Keeler. Born in 1857, the American Keeler was a pioneer in the field of spectroscopy and astrophysics. In 1895, Keeler proved that different areas in Saturn's rings rotate at different velocities. This clearly showed that Saturn's rings were not solid, but were instead a collection of smaller particles in independent orbits.



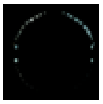
While we are studying some of the summer's finest objects, we'd be very remiss if we didn't look at another cosmic curiosity—"The Blinking Planetary." Located a couple of degrees east of visible star Theta Cygni, and in the same lower power field as 16 Cygni, it is formally known as NGC 6826.

Viewable in even small telescopes at mid to high power, you'll learn very quickly how its name came about. When you look directly at it, you can only see the central 9th magnitude star. Now, look away. Focus your attention on visual double 16 Cygni. See that? When you avert, the nebula itself is visible. This is actually a trick of the eye. The central portion of our vision is more sensitive to detail and will only see the central star. At the edge of our vision, we are more likely to see dim light, and the planetary nebula appears. Located around 2,000 light-years from our solar system, it doesn't matter if the "Blinking Planetary" is a trick of the eye or not... Because it's cool!

Also known as Herschel IV.73 and Caldwell object 16, this tiny planetary shows an abundance of carbon and dust pockets in its structure. It skyrocketed to fame when viewed by the Hubble Space Telescope which revealed the mysterious red "FLIERS," whose bow shocks point towards this planetary nebula—instead of away from it.

NGC 6826: The Blinking Planetary
Credit: Hubble Space Telescope/NASA

SEP 11
TUESDAY



Sir James Jeans
(widely used public image)

For viewers in South America, you're in for a partial solar eclipse on this Universal date. Be sure to check local information for precise times and viewing locations. Wishing you clear skies!

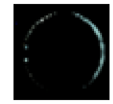
Today celebrates the birthday of Sir James Jeans. Born in 1877, English-born Jeans was an astronomical theoretician. During the beginning of the 20th century, Jeans worked out the fundamentals of the process of gravitational collapse. This was an important contribution to the understanding of the formation of solar systems, stars, and galaxies.

Tonight is New Moon and a great opportunity to have another look at all the things we've studied this week. However, I would encourage those of you with larger binoculars and telescopes to head for a dark sky location, because tonight we are going on a quest...the quest for the holy "Veil."

By no means is the Veil Nebula Complex an easy one. The brightest portion, NGC 6992, can be spotted in large binoculars and you can find it just slightly south of a central point between Epsilon and Zeta Cygni. NGC 6992 is much better in a 6" scope however, and low power is essential to see the long ghostly filaments which span more than a degree of sky. About two and a half degrees west-southwest, and incorporating star 52, is another long narrow ribbon of what may be classified as a supernova remnant. When aperture reaches the 12" range, so does the true breadth of this fascinating complex. It is possible to trace these long filaments across several fields of view. They sometimes dim and at other times widen, but like a surreal solar flare, you will not be able to tear your eyes away from this area. Another undesignated area lies between the two NGCs, and the whole 1,500 light-year distant area spans over two and a half degrees. Sometimes known as the Cygnus Loop, it's definitely one of late summer's finest objects.

The Veil Nebula
Credit: NOAO/AURA/NSF

SEP 12
WEDNESDAY

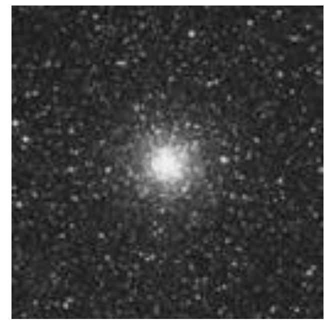


Today in 1959, the USSR's Luna 2 scored a mark as it became the first manmade object to hit the moon. The successful mission landed in the Paulus Putredinus area. Today also celebrates the 1966 Gemini 11 launch.

Tonight let's take the time to hunt down an often overlooked globular cluster—M56.

Located roughly midway between Beta Cygni and Gamma Lyrae (RA 19 15 35.50 Dec +30 11 04.2), this class X globular was discovered by Charles Messier in 1779 on the same night he discovered a comet, and was later resolved by Herschel. At magnitude 8 and small in size, it's a tough call for a beginner with binoculars, but is a very fine telescopic object. With a general distance of 33,000 light-years, this globular resolves well with larger scopes, but doesn't show as much more than a faint, round area with small aperture. However, the beauty of the chains of stars in the field makes it quite worth the visit!

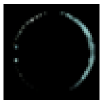
While you're there, look carefully: M56 is one of the very few objects for which the photometry of its variable stars was studied strictly with amateur telescopes. While one bright variable had been known previously, up to a dozen more have recently been discovered. Of those, six had their variability periods determined using CCD photography and telescopes just like yours!



M56
Credit: Palomar Observatory, courtesy of Caltech

Luna 2
Credit: NASA

SEP 13
THURSDAY



Today in 1922, the highest air temperature ever recorded at the surface of the Earth occurred. The measurement was taken in Libya and burned in at a blistering 136°F (58°C), but did you know that the temperatures in the sunlight on the Moon double that? Your first challenge for tonight will be to see if you can spot the slender crescent Moon right after sunset. If so, keep your binoculars on hand and look for Mercury about 2 degrees to the north. If you thought the surface of the Moon was a bit too warm for comfort, then know surface temperatures on the closest planet to the Sun can reach up to 800°F (427°C) at the equator during the day! As odd as it may sound, even that close to the Sun—Mercury could very well have ice deposits hidden below the surface at its poles.

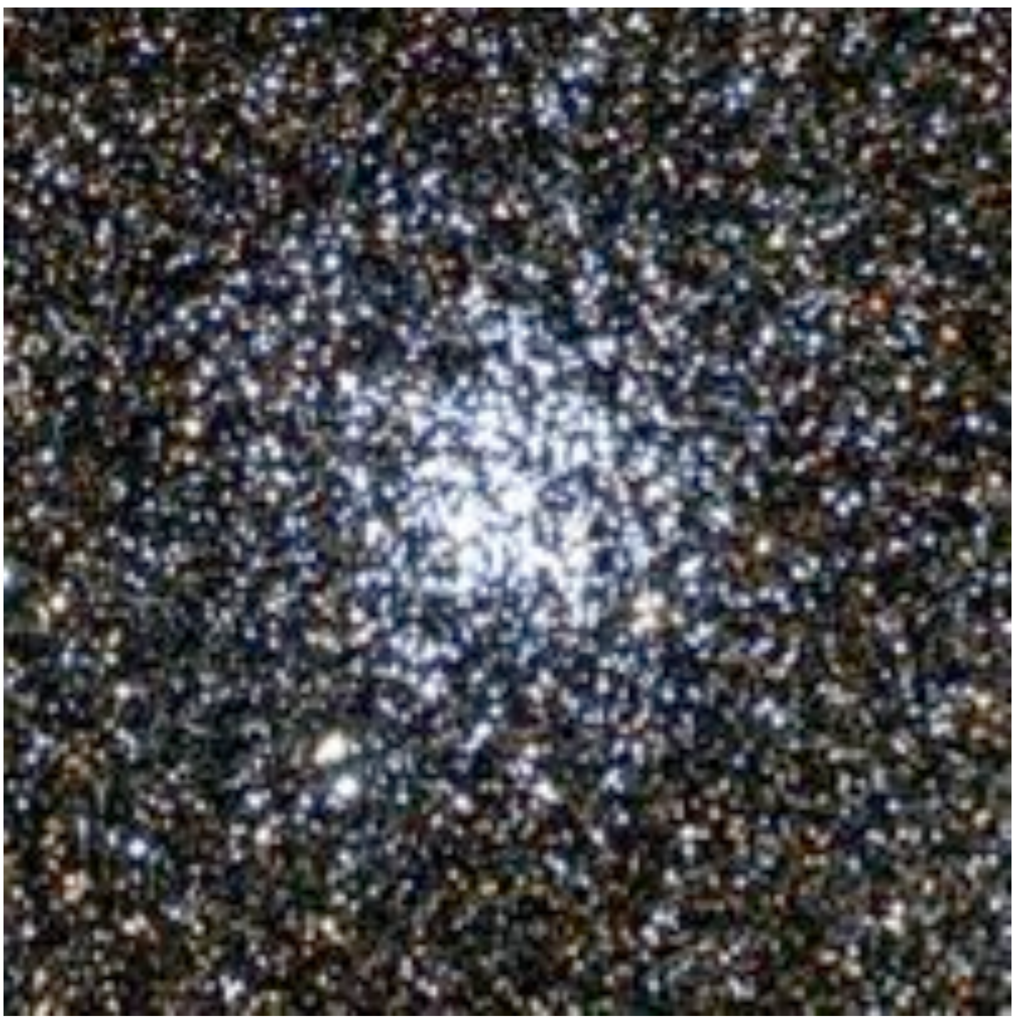
Tonight we'll move on to Aquila and look at the hot central star of an interesting planetary nebula—NGC 6804. You'll find it almost 4 degrees due west of Altair (RA 19 31 35.17 Dec +09 13 32.0). Discovered by Herschel and classed as open cluster H VI.38, it wasn't until Pease took a closer look that its planetary nature was discovered. Interacting with clouds of interstellar dust and gases, NGC 6804 is a planetary in decline, with its outer shell around magnitude 12 and the central star at about magnitude 13. While only larger telescopes will get a glimpse of the central, it's one of the hottest objects in space—with temperatures around 30,000°K!

NGC 6804
Credit: Palomar Observatory, courtesy of Caltech

Tonight as the Moon rises, look for the splendid appearance of Spica about 1.7 degrees to the north. Before it overpowers the sky, let's use this opportunity to have a look at one of the prettiest clusters in the night—M11.

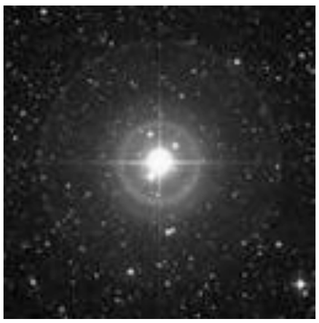
Discovered in 1681 by German astronomer Gottfried Kirch at the Berlin Observatory, M11 was later cataloged by Charles Messier in 1764 and first dubbed the "Wild Duck" by Admiral Smyth. To our modern telescopes and binoculars, there is little doubt as to how this rich galactic cluster earned its name—for it has a distinctive wedge-shaped pattern that closely resembles a flight of ducks. This fantastic open cluster of several thousand stars (about 500 of them are magnitude 14 or brighter) is approximately 250 million years old.

M11 is easily located by identifying Altair, the brightest star in Aquila. By counting two stars down the "body" of Aquila and stopping on Lambda, you will find your starhop guide. Near Lambda you will see three stars, the centermost is Eta Scuti. Now just aim! Even small binoculars will have no problem finding M11, but a telescope is required to start resolving individual stars. The larger the telescope's aperture the more stars will be revealed in this most concentrated of all open clusters!



M11: The Wild Duck Cluster
Credit: N. A. Sharp/REU Program/NOAO/AURA/NSF

SEP 15
SATURDAY

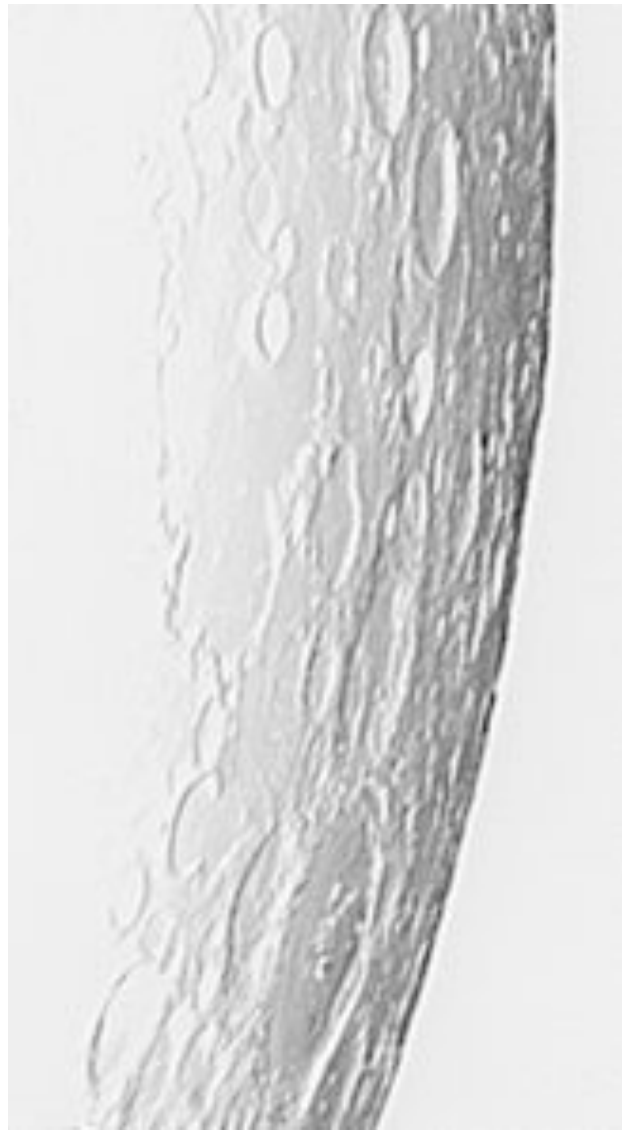


Beta Lyrae
Credit: Palomar Observatory, courtesy of Caltech

In 1991 the Upper Atmosphere Research Satellite (UARS) was launched from Space Shuttle Discovery. The successful mission lasted well beyond its life expectancy—sending back critical information about our ever-changing environment. After 14 years and 78,000 orbits, UARS remains a scientific triumph.

Tonight your lunar mission is to journey to the edge of the east limb and slightly south of central to identify crater Humboldt. Seen on the curve, this roughly 200 km wide crater holds a wealth of geographical details. Its flat, cracked floor has central peaks and a small mountain range, as well as radial rille structure. If libration and steadiness of skies are in your favor, power up and look for dark pyroclastic areas and a concentric inner crater.

Now, let's have a look at Beta and Gamma Lyrae, the lower two stars in the "Harp." Beta is actually a quick changing variable which drops to less than half the brightness of Gamma in around 12 days. For a few days the pair will seem of almost equal brightness and then you will notice the star closest to Vega fades away. Beta is one of the most unusual spectroscopic stars in the sky, and it is possible that its eclipsing binary companion may be the prototype of the "collapsar" (yep, a black hole!), rather than a true luminous body.



Crater Humboldt
Credit: Ricardo Borba

If you were unable to identify Humboldt last night, try again tonight with Petavius as your guide. Although we have studied Petavius before, now is your chance once again to mark your studies of the Petavius Wall. Look for unusual features, such as 57 kilometer diameter Wrottesley on Petavius' northwest wall, or 83 kilometer wide Hase to the south, with its deep interior impact... Or how about long, shallow Legendre and Phillips on Humboldt's west wall? If libration is good you might even spot the edge of Barnard on Humboldt's southeast edge!

While the Moon will dominate tonight's sky, we can still take a very unusual and beautiful journey to a bright and very colorful pair of stars known as Omicron 1 Cygni. Easily located about halfway between Alpha (Deneb) and Delta on the western side, this is a pure delight in binoculars or any size telescope. The striking gold color of 3.7 magnitude 31 Cygni (Omicron 1) is easily highlighted against the blue of its same-field companion, 5th magnitude 30 Cygni. Although this wide pairing is only an optical one, the K-type giant is a double star—an eclipsing variable around 150 times larger than or own Sun—and is surrounded by a gaseous corona more than double the size of the star itself. If you are using a scope, you can easily spot the blue tinted, 7th magnitude B star about one-third the distance between the two giants. Although our true pair are some two billion kilometers apart, they are oriented nearly edge-on from our point of view—allowing the smaller star to be totally eclipsed during each revolution. This total eclipse lasts for 63 days and happens about every 10.4 years, but don't stay up too late... We've still got five years to wait!

Petavius
Credit: Ricardo Borba

Omicron Cygni
Credit: Simone Bolzoni

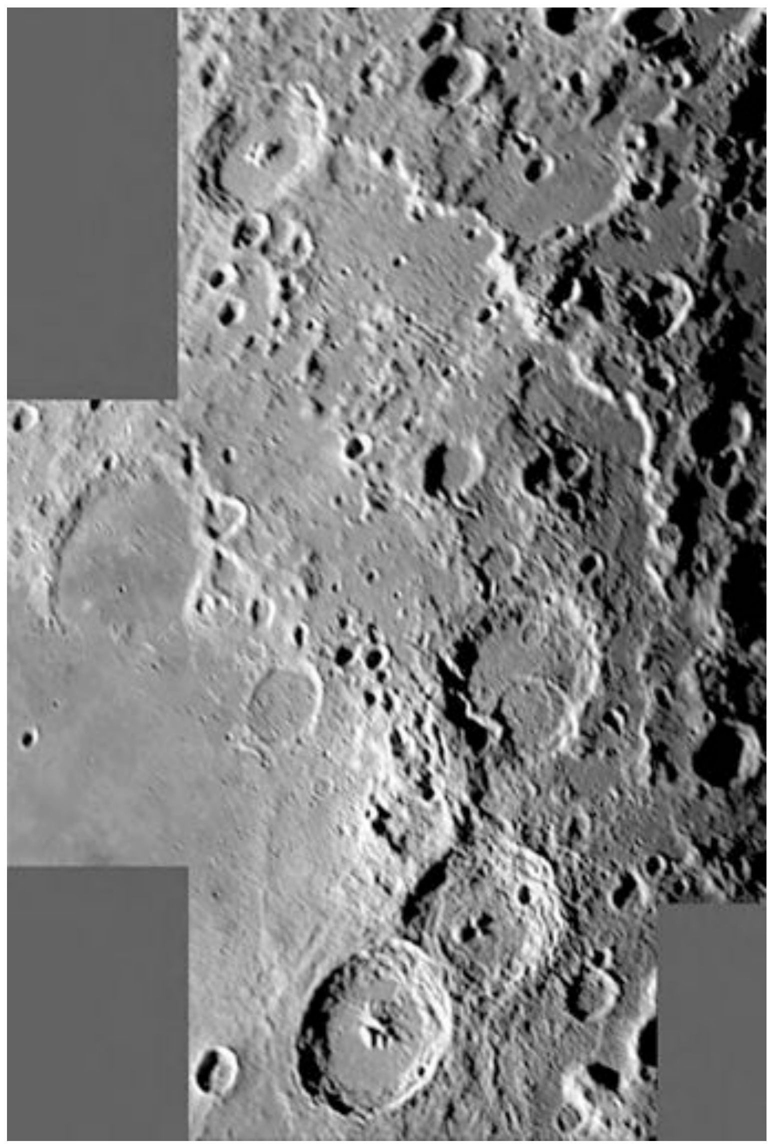
SEP 17
MONDAY

Epsilon 1 & 2 Lyrae
Credit: Palomar Observatory, courtesy of Caltech

Today in 1789, William Herschel discovered Saturn's moon Mimas. Tonight we'll discover our own Moon as we have a look at one of the last lunar challenges that occur during the first few days of the Moon's appearance—Piccolomini. You'll find it to the southwest of the shallow ring of Fracastorius on Mare Nectaris' southern shore.

Piccolomini is a standout lunar feature—mainly because it is a fairly fresh impact crater. Its walls have not yet been destroyed by later impacts and the interior is nicely terraced. Power up and look carefully at the northern interior wall where perhaps a rock slide has slipped towards the crater floor. While the floor itself is fairly featureless, the central peak is awesome. Rising up a minimum of two kilometers above the floor, it's even higher than the White Mountains in New Hampshire!

Now let's take a look at a double which has a close separation—Epsilon Lyrae. Known to most of us as the "Double Double," look about a finger width northeast of Vega. Even the slightest optical aid will reveal this tiny star as a pair, but the real treat is with a telescope—for each component is a double star! Both sets of stars appear as primarily white and both are very close to each other in magnitude. What is the lowest power that you can use to split them?



Piccolomini
Credit: Alan Chu

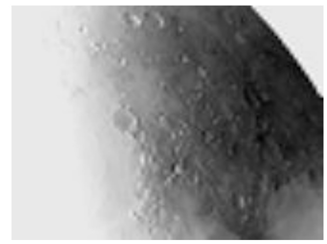
Tonight as the skies darken, look for the beautiful red Antares less than a degree north of the Moon. Such a close union might mean an occultation, so be sure to check IOTA! Also joining this celestial array is Jupiter just a few more degrees north.

Tonight we'll use a well-known lunar feature to help guide us to another challenge that is a little less easy to identify—crater Plinius. Starting with the grand visage of Posidonius, trace your way south past the ruined walls of Le Monnier and look for the long north/south wrinkle of Dorsa Smirnov running parallel to the terminator. Where it ends in the Promontorium Archerusia, look for the bright circle of Plinius.

Spanning approximately 43 kilometers, it is far from a prominent crater, yet will remain a very bright ring as the Moon grows full. Formed by an impact, its walls are bright and sharp with an irregular floor and jagged central peaks that will appear at times like two small impact craters.

It is near this rather inconspicuous feature that the remains of Ranger 6 lay forever preserved after "crash-landing" on February 2nd, 1964. Unfortunately, technical errors prevented Ranger 6 from transmitting lunar pictures. Not so Ranger 8! On a very successful mission to the same basic area, NASA received 7137 "postcards from the near side of the Moon" for 23 minutes before a very hard landing. On the "softer side," Surveyor 5 touched down near this area safely after two days of malfunctions on September 10, 1967. Incredibly, the tiny Surveyor 5 endured temperatures of up to 283 degrees F, but still spectrographically analyzed the area's soil and also managed to televise over 18,000 frames of "home movies" from its distant lunar location.

SEP 18
TUESDAY



Posidonius, Le Monnier, Serpentine Ridge and Crater Plinius
Credit: Greg Konkel

Surveyor 5: A Foot on the Moon
Credit: NASA

SEP 19

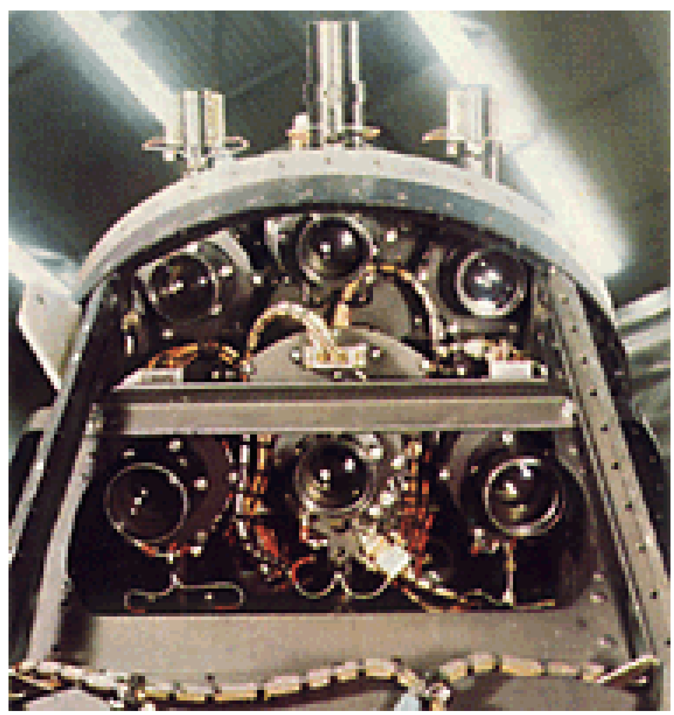
WEDNESDAY

On this day in 1848, William Boyd was watching Saturn—and discovered its moon Hyperion. Also today in 1988, Israel launched its first satellite. How long has it been since you've watched an ISS pass or an iridium flare? Both are terrific events that don't require any special equipment to be seen. Be sure to check with Heavens Above for accurate times and passes in your location and enjoy!

For binoculars and telescopes, the Moon will provide a piece of scenic history as we take an in-depth look at crater Albategnius. This huge, hexagonal mountain-walled plain will appear near the terminator about one-third the way north from the south limb. This 136 kilometer wide crater is approximately 4390 meters deep and the west wall will cast a black shadow on the dark floor. Albategnius is a very ancient formation, filled partially with lava at one point in its development, and is home to several wall craters like Klein (which will appear telescopically on its southwest wall). Albategnius holds more than just the distinction of being a prominent crater tonight—it holds a place in history. On May 9, 1962 Louis Smullin and Giorgio Fiocco of the Massachusetts Institute of technology aimed a red laser beam toward the lunar surface and Albategnius became the first lunar object to be illuminated and detected by a laser from Earth!

Ranger 9 Image of Lunar Surface
Credit: NASA

On March 24, 1965 Ranger 9 took this snapshot of Albategnius (in the lower right) from an altitude of approximately 2500 kilometers. Companion craters in the image are Ptolemaeus and Alphonsus, which will be revealed tomorrow night. Ranger 9 was designed by NASA for one purpose—to achieve a lunar impact trajectory and to send back high-resolution photographs and high-quality video images of the lunar surface. It carried no other scientific experiments, and its only destiny was to take pictures right up to the moment of final impact. It is interesting to note that Ranger 9 slammed into Alphonsus approximately 18.5 minutes after this photo was taken. They called that...a "hard landing."



Ranger 9's Vidicon Cameras
Credit: NASA

SEP 20
THURSDAY

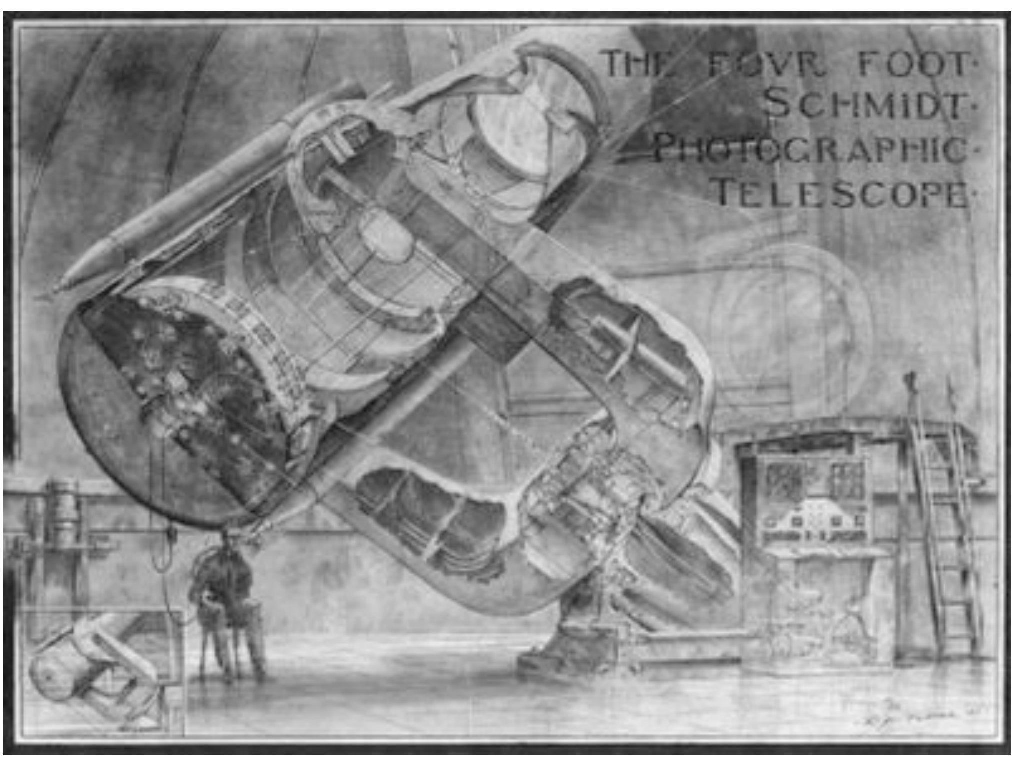
Let's walk upon the Moon this evening as we take a look at sunrise over one of the most often studied and mysterious of all craters—Plato. Located on the northern edge of Mare Imbrium and spanning 95 kilometers in diameter, Class IV Plato is simply a feature that all lunar observers check because of the many reports of unusual happenings. Over the years, mists, flashes of light, areas of brightness and darkness, and the appearance of small craters have become a part of Plato's lore.

On October 9, 1945 an observer sketched and reported "a minute, but brilliant flash of light" inside the western rim. Lunar Orbiter 4 photos later showed where a new impact may have occurred. While Plato's interior craterlets average between less than one and up to slightly more than two kilometers in diameter, many times they can be observed—and sometimes they cannot be seen at all under almost identical lighting conditions. No matter how many times you observe this crater, it is ever changing and very worthy of your attention!

Sunrise over Plato
Credit: Wes Higgins

Now let the Moon head west, because on this night in 1948, the 48" Schmidt telescope at Mt. Palomar was busy taking pictures. The first photographic plate was being exposed on a galaxy by the same man who ground and polished the corrector plate for this scope—Hendricks. His object of choice was reproduced as panel 18 in the Hubble Atlas of Galaxies and tonight we'll join his vision as we take a look at the fantastic M31—the Andromeda Galaxy.

Seasoned amateur astronomers can literally point to the sky and show you the location of M31, but perhaps you have never tried. Believe it or not, this is an easy galaxy to spot even under the moonlight. Simply identify the large diamond-shaped pattern of stars that is the "Great Square of Pegasus." The northernmost star is Alpha, and it is here we will begin our hop. Stay with the north chain of stars and look four finger-widths away for an easily seen star. The next along the chain is about three finger-widths away...And we're almost there. Two more finger-widths to the north and you will see a dimmer star that looks like it has something smudgy nearby. Point your binoculars there, because that's no cloud—it's the Andromeda Galaxy!



48" Schmidt Scope
Credit: Palomar Observatory, courtesy of Caltech

SEP 21
FRIDAY

Theta Cygni
Credit: Palomar Observatory, courtesy of Caltech

Tonight's featured lunar crater will be located on the south shore of Mare Imbrium right where the Apennine mountain range meets the terminator. Eratosthenes is unmistakable at 58 kilometers in diameter and 375 meters deep. Named after the ancient mathematician, geographer and astronomer Eratosthenes, this splendid Class I crater will display a bright west wall and a deep interior which contains its massive crater-capped central mountain reaching up to 3570 meters high! Extending like a tail, an 80 kilometer long mountain ridge angles away to the southwest. As beautiful as Eratosthenes appears tonight, it will fade away to total obscurity as the Moon becomes more Full. See if you can spot it in five days!

Now let's journey to a very pretty starfield as we head toward the western wingtip in Cygnus to have a look at Theta—also known as 13 Cygni. It is a beautiful main sequence star that is also considered by modern catalogs to be a double. For large telescopes, look for a faint (13th magnitude) companion to the west... But it's also a wonderful optical triple!

Also in the field with Theta to the southeast is the Mira-type variable R Cygni, which ranges in magnitude from around 7 to 14 in slightly less than 430 days. This pulsating red star has a really quite interesting history that can be found at AAVSO, and is circumpolar for far northern observers. Check it out!

Eratosthenes
Credit: Alan Chu

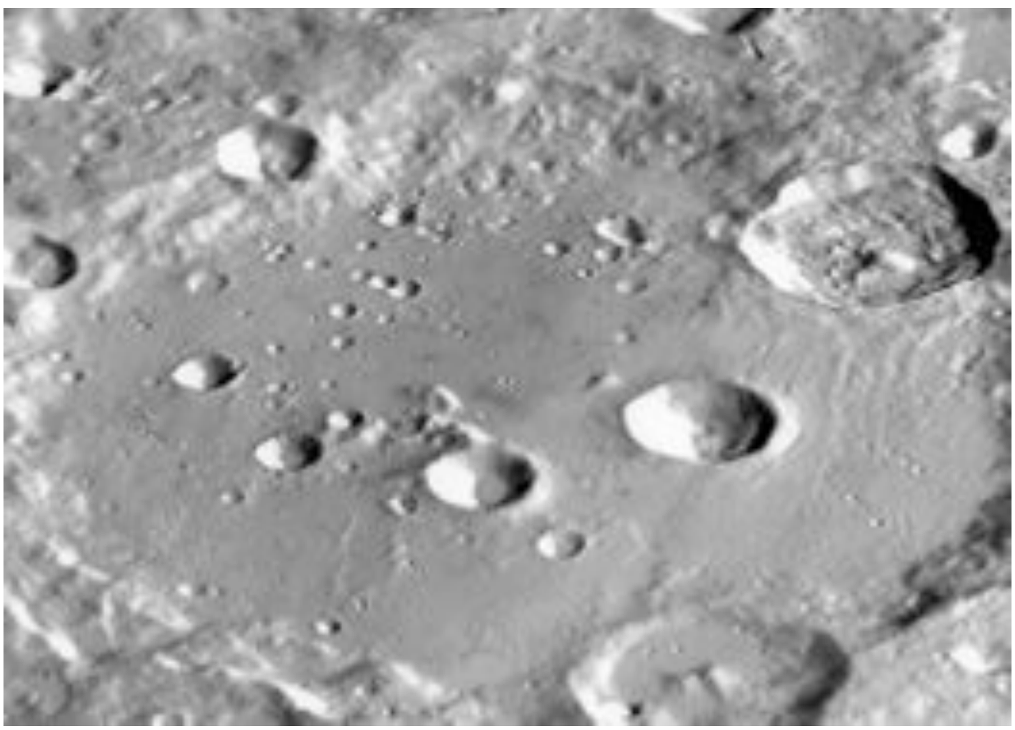
Tonight on the Moon, let's take an in-depth look at one of the most impressive of the southern lunar features—Clavius.

Although you cannot help but be drawn visually to this crater, let's start at the southern limb near the terminator and work our way up. Your first sighting will be the large and shallow dual rings of Casatus with its central crater and Klaproth adjoining it. Further north is Blancanus with its series of very small interior craters, but wait until you see Clavius. Caught on the southeast wall is Rutherford with its central peak and crater Porter on the northeast wall. Look between them for the deep depression labeled D. West of D you will also see three outstanding impacts: C, N and J; while CB resides between D and Porter. The southern and southwest walls are also home to many impacts, and look carefully at the floor for many, many more! It has been often used as a test of a telescope's resolving power to see just how many more craters you can find inside tremendous old Clavius. Power up and enjoy!

Now let's head for the northeast corner of the little parallelogram that is part of Lyra for easy unaided eye and binocular double Delta 1 and 2 Lyrae.

The westernmost Delta 1 is about 1100 light-years away and is a class B dwarf, but take a closer look at brighter Delta 2. This M-class giant is only 900 light-years away. Perhaps 75 million years ago, it, too, was a B class star, but it now has a dead helium core and it keeps on growing. While it is now a slight variable, it may in the future become a Mira-type. A closer look will show that it also has a true binary system nearby—a tightly matched 11th magnitude system. Oddly enough they are the same distance away as Delta-2 and are believed to be physically related.

Delta 1 and 2 Lyrae
Credit: Palomar Observatory, courtesy of Caltech



Clavius
Credit: Wes Higgins

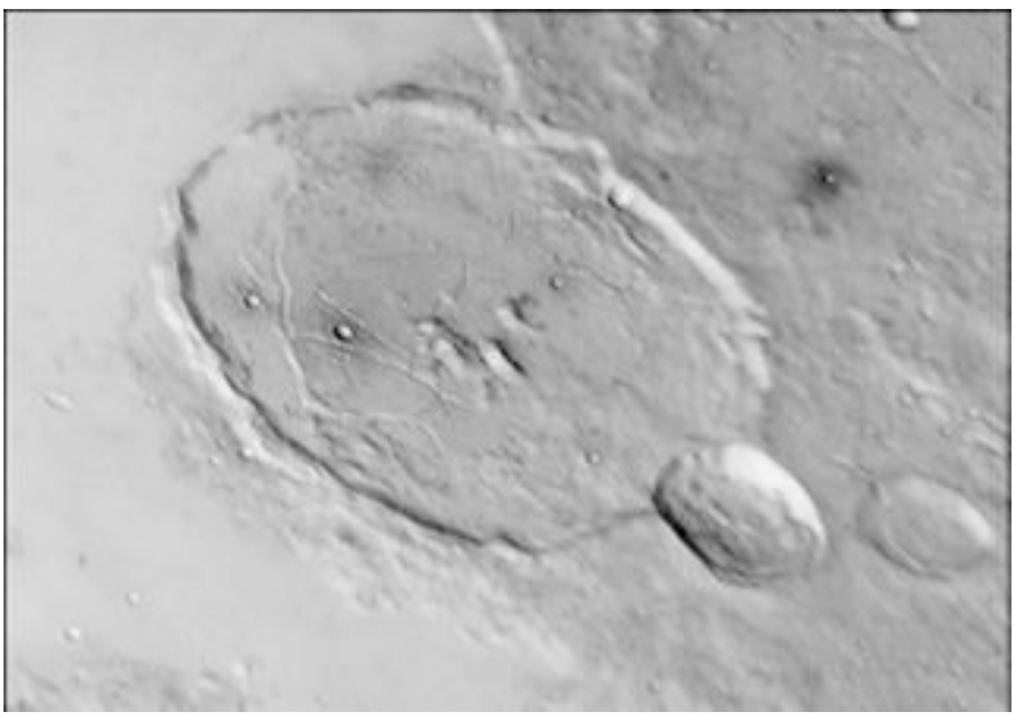
SEP 23
SUNDAY

Today is the Autumnal Equinox. This marks the first day of the fall season for the Northern Hemisphere and we astronomers welcome back earlier dark skies! On this day in 1846, Johann Galle of the Berlin Observatory makes a visual discovery. While at the telescope, Galle sees and identifies the planet Neptune for the first time in history. Would you like to try for Neptune? It's fairly easy—especially seeing as how it's only about a degree north of the Moon tonight! This could be an occultation event for some areas, so be sure to check IOTA!

Tonight exploring the Moon will be in order as one of the most graceful and recognizable lunar features will be prominent—Gassendi. As an ancient mountain-walled plain that sits proudly at the northern edge of Mare Humorum, Gassendi sports a bright ring and a triple central mountain peak that are within the range of binoculars.

Telescopic viewers will appreciate Gassendi at high power in order to see how its southern border has been eroded by lava flow. Also of note are the many rilles and ridges that exist inside the crater and the presence of the younger Gassendi A on the north wall. While viewing the Mare Humorum area, keep in mind that we are looking at an area about the size of the state of Arkansas. It is believed that a planetoid collision originally formed Mare Humorum. The incredible impact crushed the surface layers of the Moon resulting in a concentric "anticline" that can be traced out to twice the size of the original impact area. The floor of this huge crater then filled in with lava, and was once thought to have a greenish appearance but in recent years has more accurately been described as reddish. That's one mighty big crater!

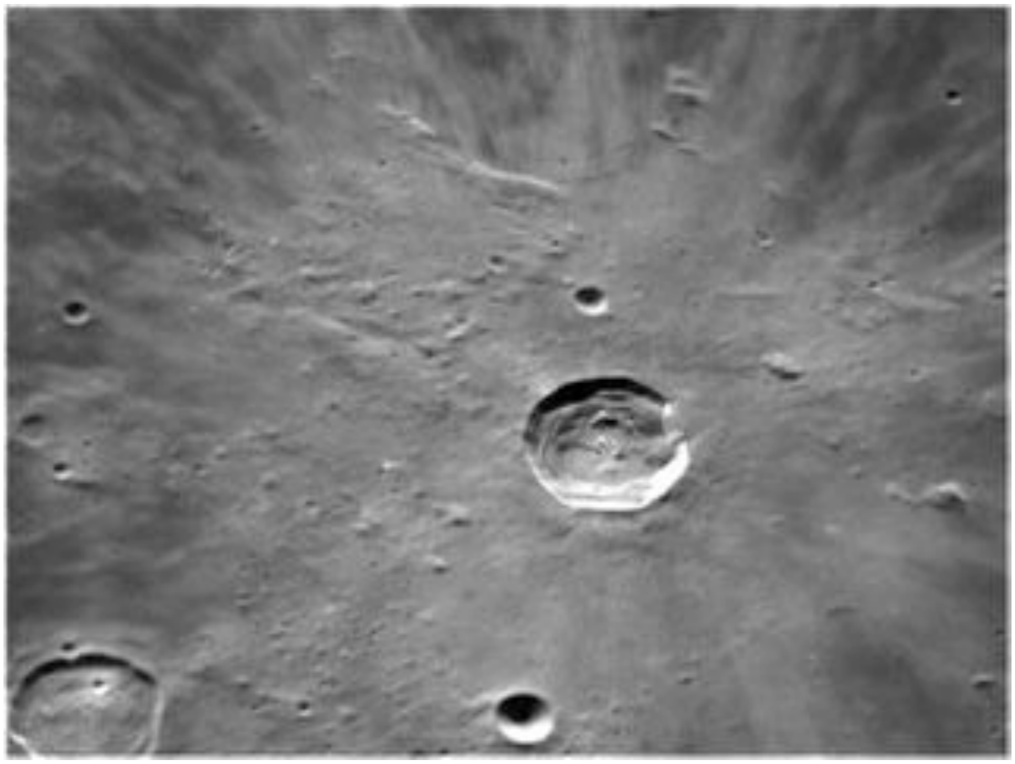
On this day in 1962, the prime time cartoon "The Jetsons" premiered. Think of all the technology this inspired as tonight we kick back to watch the Alpha Aurigid meteor shower. Relax, face northeast and look for the radiant near Capella. The fall rate is around 12 per hour, and they are fast and leave trails!



Gassendi
Credit: Wes Higgins

In 1970, the first unmanned, automated return of lunar material to the Earth occurred on this day when the Soviet's Luna 16 returned with three ounces of the Moon. Its landing site was eastern Mare Fecunditatis. Look just west of the bright patch of Langrenus.

Tonight our primary lunar study is crater Kepler. Look for it as a bright point, slightly lunar north of center near the terminator. Its home is the Oceanus Procellarum—a sprawling dark mare composed primarily of dark minerals of low reflectivity (albedo) such as iron and magnesium. Bright, young Kepler will display a wonderfully developed ray system. The crater rim is very bright, consisting mostly of a pale rock called anorthosite. The "lines" extending from Kepler are fragments that were splashed out and flung across the lunar surface when the impact occurred. The region is also home to features known as "domes"—seen between the crater and the Carpathian Mountains. So unique is Kepler's geological formation that it became the first crater mapped by U.S. Geological Survey in 1962.



Kepler
Credit: Wes Higgins

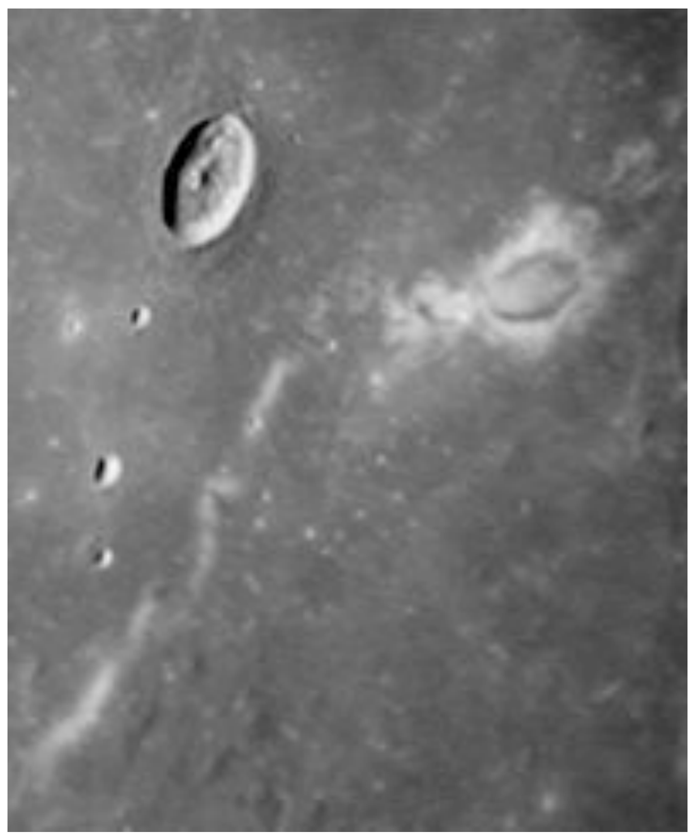
SEP 25
TUESDAY

Tonight Uranus will be a little less than two degrees south of the Moon, but we're going to have a look at a lunar feature that goes beyond simply incredible—it's downright weird. Start your journey by identifying Kepler and head due west across Oceanus Procellarum until you encounter the bright ring of crater Reiner. Spanning 30 kilometers, this crater isn't anything in particular—just shallow-looking walls with a little hummock in the center. But, look further west and a little more north for an anomaly—Reiner Gamma.

Well, it's bright. It's slightly eye-shaped. But what exactly is it? Possessing no real elevation or depth above the lunar surface, Reiner Gamma could very well be an extremely young feature caused by a comet. Only three other such features exist—two on the lunar far side and one on Mercury. They are high albedo surface deposits with magnetic properties. Unlike a lunar ray of material ejected from below the surface, Reiner Gamma can be spotted during the daylight hours—when ray systems disappear. And, unlike other lunar formations, it never casts a shadow.

Reiner Gamma also causes a magnetic deviation on a barren world that has no magnetic field. This has many proposed origins, such as solar storms, volcanic gaseous activity, or even seismic waves. But, one of the best explanations for its presence is a cometary strike. It is believed that a split-nucleus comet, or cometary fragments, once impacted the area and the swirl of gases from the high velocity debris may have somehow changed the regolith. On the other hand, ejecta from an impact could have formed around a magnetic "hot spot," much like a magnet attracts iron filings.

No matter which theory is correct, the simple act of viewing Reiner Gamma and realizing that it is different from all other features on the Moon's earthward facing side makes this journey worth the time!



Reiner and Reiner Gamma
Credit: Alan Chu

SEP 26
WEDNESDAY

This is the Universal date the Moon will become Full and it will be the closest to the Autumnal Equinox. Because its orbit is more nearly parallel to the eastern horizon, it will rise at dusk for the next several nights in a row. On the average, the Moon rises about 50 minutes later each night, but at this time of year it's around 20 minutes later for mid-northern latitudes and even less farther north. Because of this added light, the name "Harvest Moon" came about because it allowed farmers more time to work in the fields.

Often times we perceive the Harvest Moon as being more orange than at any other time of the year. The reason is not only scientific enough—but true. Coloration is caused by the scattering of the light by particles in our atmosphere. When the Moon is low, like now, we get more of that scattering effect and it truly does appear more orange. The very act of harvesting itself produces more dust and often times that coloration will last the whole night through. And we all know the size is only an "illusion"...

So, instead of cursing the Moon for hiding the deep sky gems tonight, enjoy it for what it is...a wonderful natural phenomenon that doesn't even require a telescope!

And if you'd like to visit another object that only requires eyes, then look no further than Eta Aquilae one fist-width due south of Altair...

Discovered by Pigot in 1784, this Cepheid-class variable has a precision rate of change of over a magnitude in a period of 7.17644 days. During this time it will reach of maximum of magnitude 3.7 and decline slowly over 5 days to a minimum of 4.5... Yet it only takes two days to brighten again! This period of expansion and contraction makes Eta very unique. To help gauge these changes, compare Eta to Beta on Altair's same southeast side. When Eta is at maximum, they will be about equal in brightness.

"Harvest Moon Rising"
(by the incredible and inspiring artist Duane Hilton)
Credit: NASA

SEP 27
THURSDAY

Tonight we'll begin with an easy double star and make our way towards a more difficult one. Beautiful, bright and colorful, Beta Cygni is an excellent example of an easily split double star. As the second brightest star in the constellation of Cygnus, Albireo lies roughly in the center of the "Summer Triangle" making it a relatively simple target for even urban telescopes.

Albireo's primary (or brightest) star is around magnitude 4 and has a striking orangish color. Its secondary (or B) star is slightly fainter at a bit less than magnitude 5, and often appears to most as blue, almost violet. The pair's wide separation of 34" makes Beta Cygni an easy split for all telescopes at modest power, and even for larger binoculars. At approximately 410 light-years away, this colorful pair shows a visual separation of about 4400 AU, or around 660 billion kilometers. As Burnham noted, "It is worth contemplating, in any case, the fact that at least 55 solar systems could be lined up, edge-to-edge, across the space that separates the components of this famous double!"

Now let's have a look at Delta. Located around 270 light-years away, Delta is known to be a more difficult binary star. Its duplicity was discovered by F. Struve in 1830, and it is a very tough test for smaller optics. Located no more than 220 AU away from the magnitude 3 parent star, the companion orbits anywhere from 300 to 540 years and is often rated as dim as 8th magnitude. If skies aren't steady enough to split it tonight, try again! Both Beta and Delta are on many challenge lists.

Delta Cygni
Credit: Palomar Observatory, courtesy of Caltech

Beta Cygni: Albireo
Credit: University of Nebraska-Lincoln

Tonight we'll have a look at the central star of the "Northern Cross"—Gamma Cygni. Also known as Sadr, this beautiful main sequence star lies at the northern edge of the "Great Rift." Surrounded by a field of nebulosity known as IC 1310, second magnitude Gamma is very slowly approaching us, but still maintains an average distance of about 750 light-years. It is here in the rich, starry fields that the great dust cloud begins its stretch toward southern Centaurus—dividing the Milky Way into two streams. The dark region extending north of Gamma towards Deneb is often referred to as the "Northern Coalsack," but its true designation is Lynds 906.

If you take a very close look at Sadr, you will find it has a well-separated 10th magnitude companion star, which is probably not related—yet in 1876, S.W. Burnham found that it itself is a very close double. Just to its north is NGC 6910, a roughly 6th magnitude open cluster which displays a nice concentration in a small telescope. To the west is Collinder 419, another bright gathering that is nicely concentrated. South is Dolidze 43, a widely spaced group with two brighter stars on its southern perimeter. East is Dolidze 10, which is far richer in stars of various magnitudes and contains at least three binary systems.

Whether you use binoculars or telescopes, chances are you won't see much nebulosity in this region—but the sheer population of stars and objects in this area makes a visit with Sadr worthy of your time!

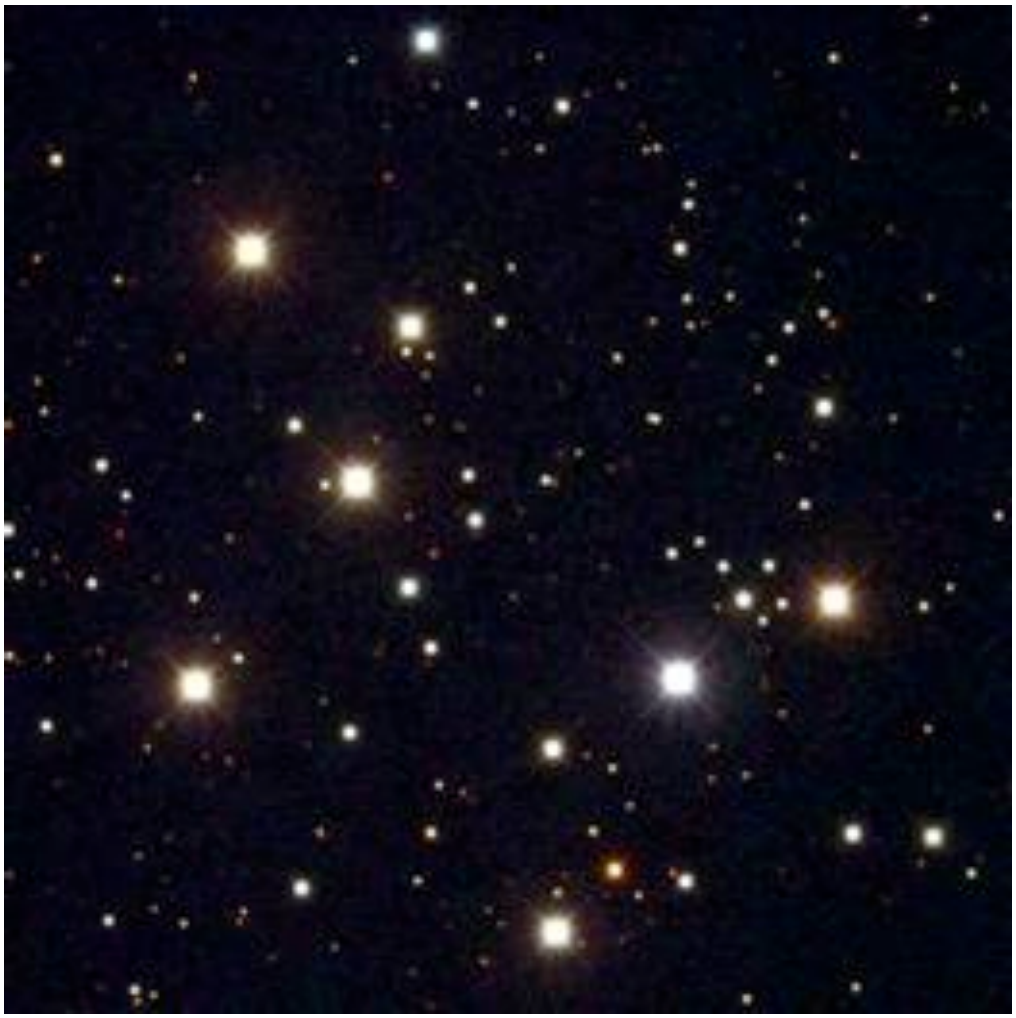
Gamma Cygni Region
Credit: Teresa Hawes, Phillip Darling and Adam Block/NOAO/AURA/NSF

SEP 29
SATURDAY

Tonight let's head about a fingerwidth south of Gamma Cygni to have a look at an open cluster well suited for all optics—M29.

Discovered in 1764 by Charles Messier, this type D cluster has an overall brightness of about magnitude 7, but isn't exactly rich in stars. Hanging out anywhere from 6000 to 7200 light-years away, one would assume this to be a very rich cluster and it may very well have hundreds of stars—but their light is blocked by a dust cloud a thousand times more dense than average.

Approaching us at around 28 kilometers per second, this loose grouping could be as old as 10 million years and appears much like a miniature of the constellation of Ursa Major at low powers. Even though it isn't the most spectacular in star-rich Cygnus, it is another Messier object to add to your list!

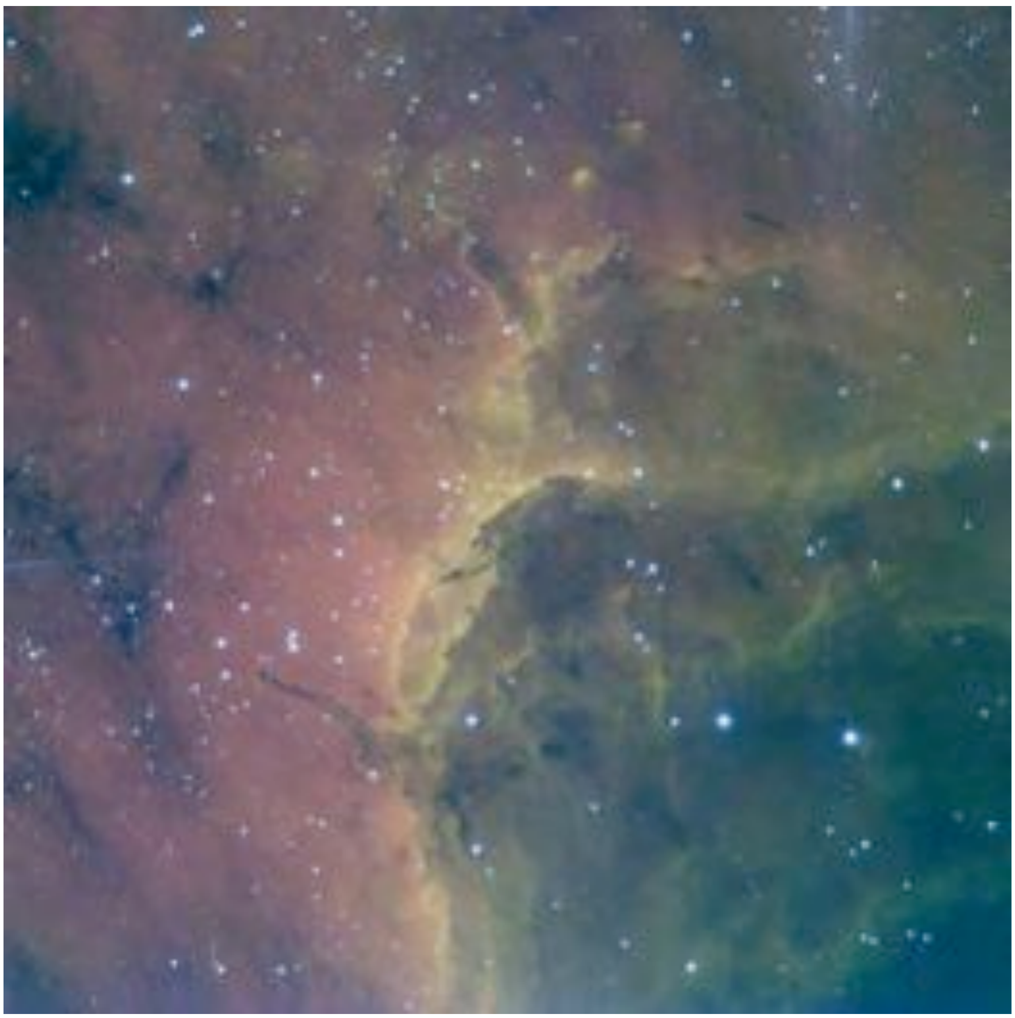


M29
Credit: Hilary Mathis/NOAO/AURA/NSF

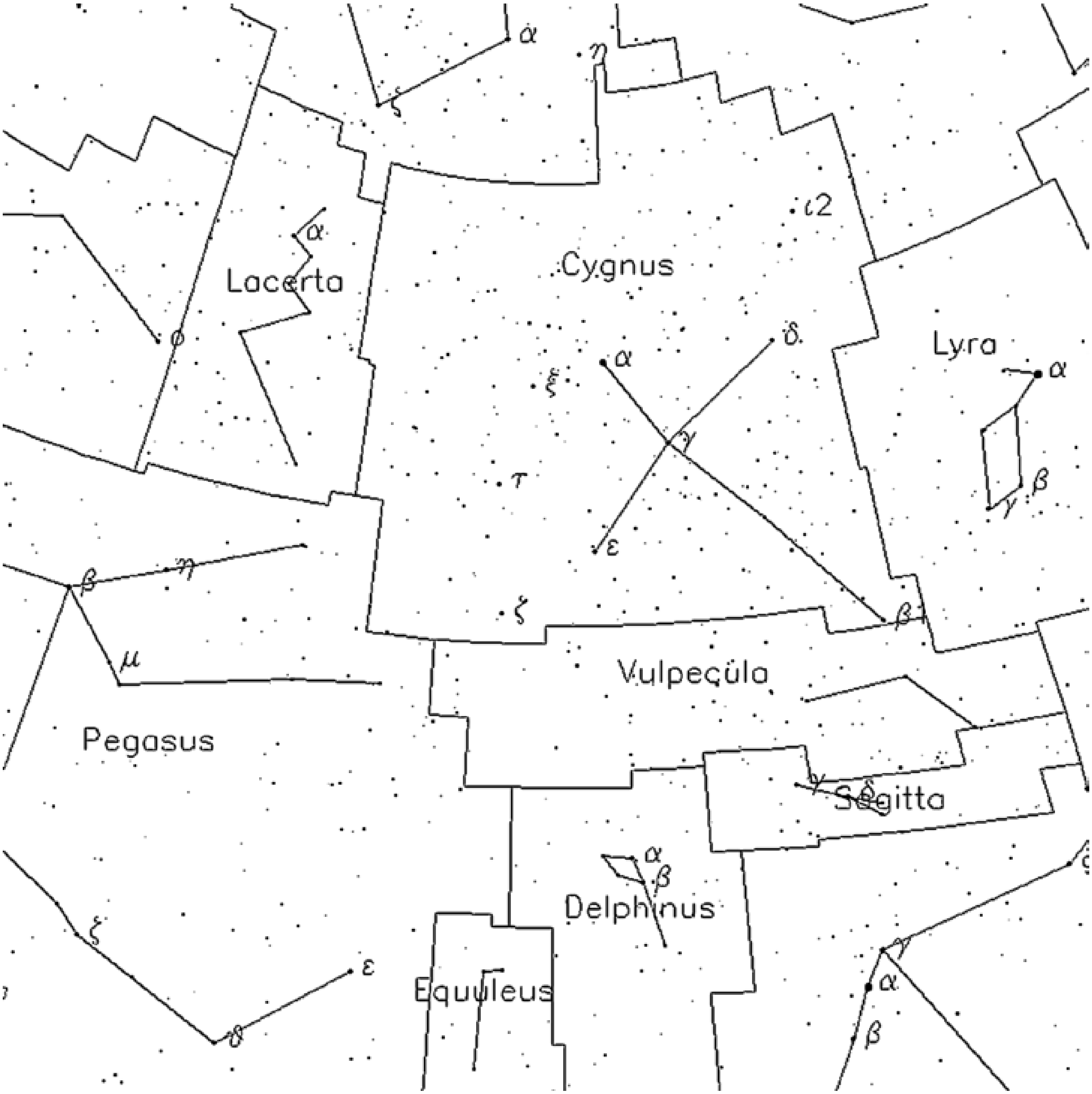
Today in 1880, Henry Draper must have been up very early indeed when he took the first photo of the Great Orion Nebula (M42). Although you might not wish to set up equipment before dawn, you can still use a pair of binoculars to view this awesome nebula! You'll find Orion high in the southeast for the Northern Hemisphere, and M42 in the center of the "sword" that hangs below its bright "belt" of three stars.

Tonight before the Moon rises and we leave Cygnus for the year, try your luck with IC 5070, also known as the "Pelican Nebula." You'll find it just about a degree southeast of Deneb and surrounding the binary star 56 Cygni.

Located around 2000 light-years away, the Pelican is an extension of the elusive North American Nebula, NGC 7000. Given its great expanse and faintness, catching the Pelican does require clean skies, but it can be spotted best with large binoculars. As part of this huge star forming region, look for the obscuring dark dust cloud Lynds 935 to help you distinguish the nebula's edges. Although it is every bit as close as the Orion Nebula, this star hatchery isn't quite as easy!



IC 5070: The Pelican Nebula
Credit: John Balley (U. Colorado)/NOAO/AURA/NSF


Cygnus
Lacerta
Lyra
Vulpecula
Pegasus
Sagitta
Delphinus
Equuleus

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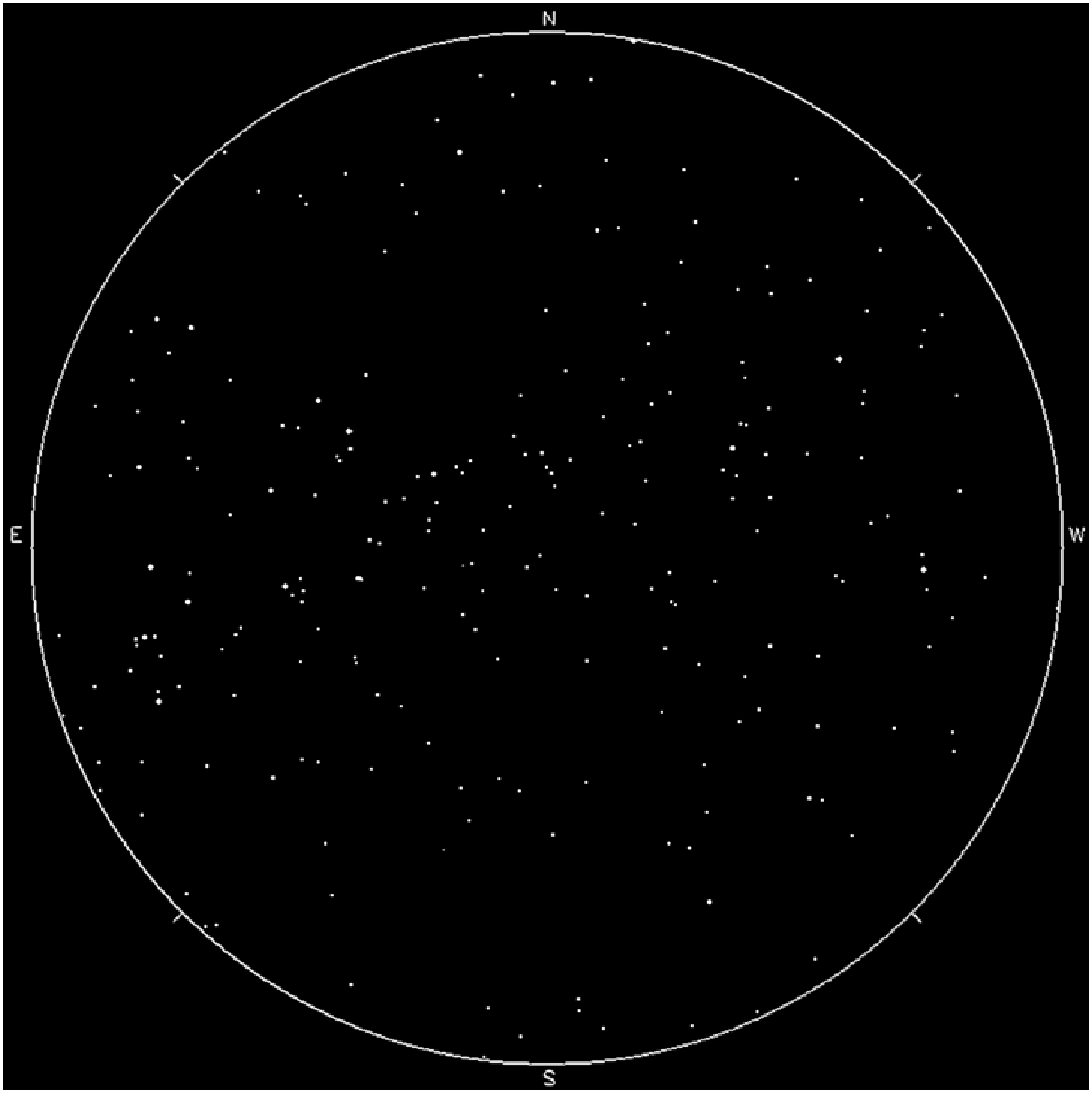


Oct 1
MONDAY

In 1897, the world's largest refractor (40") debuted at the dedication of the University of Chicago's Yerkes Observatory. The immense telescope was 64 feet long and weighed 6 tons. Also today in 1958, NASA was established by an act of Congress. More? In 1962, the 300 foot radio telescope of the National Radio Astronomy Observatory (NRAO) went live at Green Bank, West Virginia. It held its place as the world's second largest radio scope until it collapsed in 1988. (It was rebuilt as a 100 meter dish in 2000.)

Although first light for the 40" was Jupiter, E. E. Barnard later discovered the third companion star to Vega using the Yerkes refractor. First "light" studies at Green Bank were a radio source galaxy and pulsar for NRAO. Tonight we're going to turn our attention toward Pegasus and the incredible M15. Although we don't have that much aperture to study with tonight, we can still get a very satisfactory look at M15 through any size binoculars or telescope.

You can find it easily just about two fingerwidths northwest of red Epsilon Pegasi (Enif). Shining brightly at magnitude 6.4, low power users will find it a delightfully tight ball of stars, but scope users will find it quite unique. As resolution begins, sharp-eyed observers will note the presence of a planetary nebula—Pease 1. This famous X-ray source you have just seen with your eyes may have supernovae remnants buried deep inside...

40" refractor at Yerkes
(widely used public image)

300-foot Radio Telescope
at Green Bank
Credit: NRAO/AUI/NSF

M15
Credit: NOAO/AURA/NSF

If you're up before dawn this morning, take a look at the Moon. You'll find the "Red Planet"—Mars—less than a fistwidth south!

Tonight's destination is not an easy one, but if you have a 6" or larger scope, you'll fall in love at first sight! Let's head for Eta Pegasi and slightly more than four degrees north-northeast for NGC 7331.

This beautiful, 10th magnitude, tilted spiral galaxy is very much how our own Milky Way would appear if we could travel 50 million light-years away and look back. Very similar in structure to both our own Milky Way and the Great Andromeda Galaxy, this particular galaxy gains more and more interest as scope size increases—yet it can be spotted with larger binoculars. At around 8" in aperture, a bright core appears and the beginnings of wispy arms. In the 10" to 12" range, spiral patterns begin to emerge and with good seeing conditions, you can see "patchiness" in structure as nebulous areas are revealed, and the western half is deeply outlined with a dark dustlane. But hang on...

Because the best is yet to come!

NGC 7331
Credit: NOAO/AURA/NSF

OCT 3
WEDNESDAY

Tonight return to NGC 7331 with all the aperture you have. What we are about to look at is truly a challenge and requires dark skies, optimal position and excellent conditions. Now breathe the scope about one half a degree south-southwest and behold one of the most famous galaxy clusters in the night.

In 1877, French astronomer Edouard Stephan was using the first telescope designed with a coated mirror when he discovered something a bit more with NGC 7331. He found a group of nearby galaxies! This faint gathering of five is now known as "Stephan's Quintet" and its members are no further apart than the diameter of our own Milky Way galaxy.

Visually in a large scope, these members are all rather faint, but their proximity is what makes them such a curiosity. The Quintet is made up of five galaxies numbered NGC 7317, 7318, 7318A, 7318B, 7319 and the largest is 7320. Even with a 12.5" telescope, this author has never seen them as much more than tiny, barely-there objects that look like ghosts of rice grains on a dinner plate. So why bother? Because I've seen them with large aperture...

What our backyard equipment can never reveal is what else exists within this area—more than 100 star clusters and several dwarf galaxies. Some 100 million years ago, the galaxies collided and left long streamers of their materials which created star forming regions of their own, and this tidal pull keeps them connected. The stars within the galaxies themselves are nearly a billion years old, but between them lie much younger ones. Although we cannot see them, you can make out the soft sheen of the galactic nuclei of our interacting group.

Enjoy their faint mystery!

Stephan's Quintet
Credit: Gemini Observatory/Travis Rector/University of Anchorage Alaska

Today in 1957, the USSR's Sputnik 1 made space history as it became the first manmade object to orbit the earth. The Earth's first artificial satellite was tiny, roughly the size of a basketball, and weighed no more than the average man. Every 98 minutes it swung around Earth in its elliptical orbit…and changed everything. It was the beginning of the "Space Race." Many of us old enough to remember Sputnik's grand passes will also recall just how inspiring it was. Take the time with your children or grandchildren to check heavens-above.com for visible passes of the ISS and think about how much our world has changed in just 50 years!

Tonight we're headed towards the southwest corner star of the Great Square of Pegasus—Alpha. Our goal will be 11th magnitude NGC 7479 located about 3 degrees south (RA 23:04.9 Dec +12:19).

Discovered by Sir William Herschel in 1784 and cataloged as H I.55, this barred spiral galaxy can be spotted in average telescopes and comes to beautiful life with larger aperture. Also known as Caldwell 44 on Sir Patrick Moore's observing list, what makes this galaxy special is its delicate "S" shape. Smaller scopes will easily see the central bar structure of this 105 million light-year distant island universe, and as aperture increases, the western arm will become more dominant. This arm itself is a wonderful mystery—containing more mass than it should and a turbulent structure. It is believed that perhaps a minor merger may have at one time occurred, yet no evidence of a companion galaxy can be found.

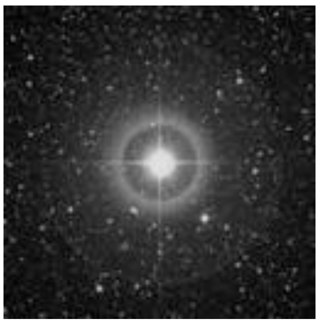
Sputnik 1
Credit: NASA

On July 27, 1990, a supernova occurred near NGC 7479's nucleus and reached a magnitude of 16. When observed in the radio band, there is a polarized jet near the bright nucleus that is unlike any other structure known. If at first you do not see a great deal of detail, relax... Allow your mind and eye time to look carefully. Even with telescopes as small as 8-10" structure can easily be seen. The central bar becomes "clumpy" and this well-studied Seyfert region is home to an abundance of molecular gas and forming stars.

Enjoy this incredible galaxy...

NGC 7479
Credit: Palomar Observatory, courtesy of Caltech

OCT 5
FRIDAY



Eta Aquilae
Credit: Palomar Observatory, courtesy of Caltech

Today marks the birthdate of Robert Goddard. Born 1882, Goddard is known as the father of modern rocketry—and with good reason.

In 1907, Goddard came into the public eye as a cloud of smoke erupted from the basement of the physics building in Worcester Polytechnic Institute where he had just fired a powder rocket. By 1914, he had patented the use of liquid rocket fuel and two- or three-stage solid fuel rockets. His work continued as he sought methods of putting equipment ever higher, and by 1920 he had envisioned his rockets reaching the Moon. Among his many achievements, he proved that a rocket would work in a vacuum, and by 1926 the first scientific equipment went along for the ride. By 1932, Goddard was guiding those flights and by 1937 had the motors pivoting on gimbals and controlled gyroscopically. His lifetime of work went pretty much unnoticed until the dawn of the Space Age, but in 1959 (14 years after his death) he received his acclaim at last as NASA's Goddard Space Flight Center was established in his memory.

Today in 1923, Edwin Hubble was also busy as he discovered the first Cepheid variable in M31—the Andromeda Galaxy. Hubble's discovery was crucial in proving that objects once classed as "spiral nebulae" were actually independent and external stellar systems like our own Milky Way.

Tonight let's look at a Cepheid variable as we head towards Eta Aquilae, almost a fistwidth due south of bright Altair.

Discovered by Edward Pigott in 1784, Eta is a Cepheid variable star around 1200 light-years away, but its beauty can be followed easily with the unaided eye. Ranging almost a full magnitude in a period of slightly over 7 days, this yellow supergiant is 3000 times brighter than our own Sun and around 60 times larger. Watch over the days as it takes about 48 hours to achieve maximum brightness and rivals nearby Beta—then falls slowly over the next 5 days.

Robert Goddard
Credit: NASA

While time and the stars appear to stand still and astronomical twilight begins earlier each night, let's take one last look at the exiting constellation of Sagittarius. Our study for this evening is strictly a telescopic challenge for skilled observers. Set your sights about 2 degrees northeast of easy double 54 Sagittarii and around 7 degrees west of Beta Capricorni (RA 19 44 57.80 Dec -14 48 11.0) and let's have a look at NGC 6822.

Often referred to as "Barnard's Galaxy," for its discoverer (E. E. Barnard—1884), this unusual customer is actually a member of our local galaxy group. For the 4" to 6" telescope, this 11th magnitude, 1.7 million light-year distant object will not be easy, but it can be achieved with good conditions. Lower power is essential in even larger scopes, and those into the 12" to 16" range will see NGC 6822 burst into stunning resolution. This author has found that "Barnard's Galaxy" almost appears like an open cluster overlaid with nebulosity, but the experienced eye will clearly see that the "shine" behind the stars is galactic in nature. It's a very clumpy and unusual galaxy—one that I think you will very much enjoy. Be sure to look for small, pale blue, 10th magnitude planetary nebula NGC 6818 in the same field to the north-northwest. This pair rocks!

NGC 6822
Credit: Palomar Observatory, courtesy of Caltech

Oct 7
Sunday

Today celebrates the birthday of Niels Bohr. Born 1885, Bohr was a pioneer Danish atomic physicist. If Niels were alive today, he'd be out early looking at the beautiful sight of Saturn, Venus and Regulus and the crescent Moon grouping together and gracing the predawn skies. It's worth getting up for! For some lucky viewers, Regulus is so close to the Moon that it could be an occultation event. Be sure to check IOTA.

Now let's get some practice in Capricornus as tonight we'll take on a more challenging target with confidence. Locate the centermost bright star in the northern half of the constellation—Theta—because we're headed for the "Saturn Nebula."

Three finger-widths north of Theta you will see dimmer Nu, and only one finger-width west is NGC 7009 (RA 21 04 10.88 Dec -11 21 48.3). This wonderful blue planetary is around 8th magnitude and achievable in small scopes and large binoculars. NGC 7009 was the first discovery of Sir William Herschel on September 7, 1782—the night he started his sky survey—and he cataloged it as H IV.1. Sir William's original notes describe it as: "very bright nearly round planetary, not well-defined disk."

When viewed by Lord Rosse in the 1840s, he gave it the nickname Saturn Nebula, and it is considered one of the nine Struve rare celestial objects. Also known as Bennett 127 and Caldwell 55, it is generally believed to be around 2400 light-years away—but not so far that it doesn't make about every list known as an all time great!

Even at moderate magnification, you will see the elliptical shape which gave rise to its moniker. With larger scopes, those "ring like" projections become even clearer as the 11th magnitude central star becomes apparent. No matter which aperture you choose, this challenging object is well worth the hunt. You can do it!

Niels Bohr
(widely used public image)

NGC 7009: The Saturn Nebula
Credit: Brad Ehrhorn/NOAO Outreach Photography

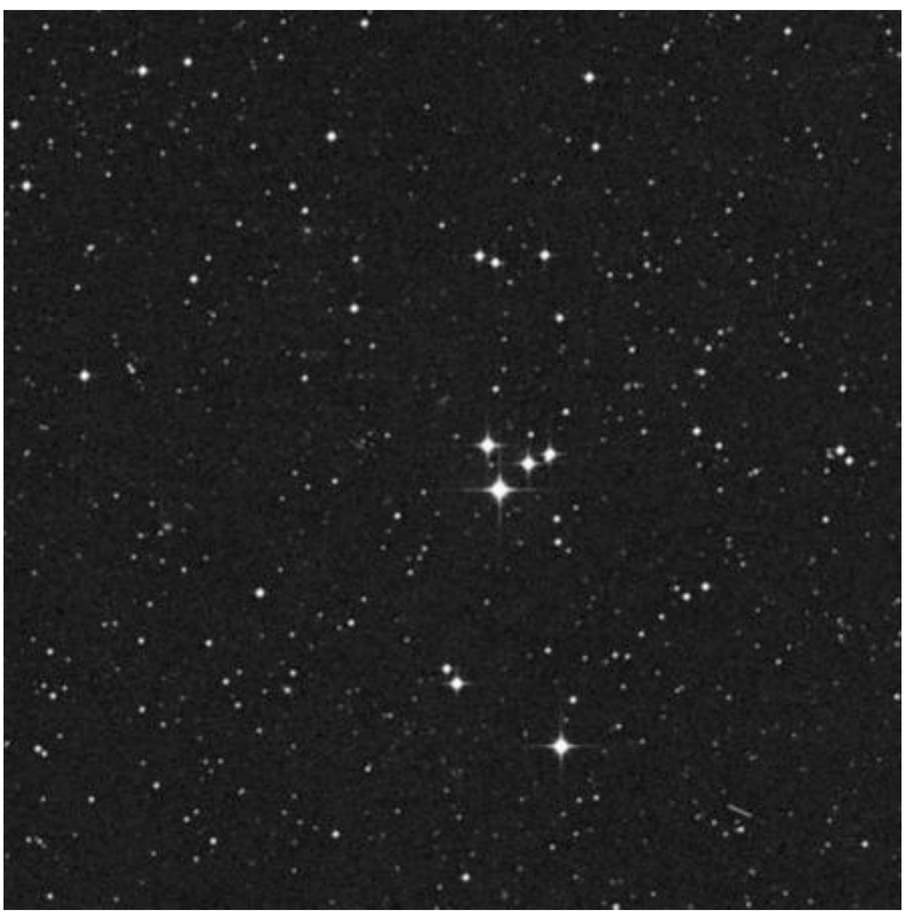
Today marks the birthday of Ejnar Hertzsprung. Born 1873, Hertzsprung was a Danish astronomer who first proved the existence of giant and dwarf stars in the early 1900s. His discoveries included the relationship between color and luminosity, which wasn't truly recognized until it was recovered by Henry Russell. Now it is a familiar part of all our studies as the Hertzsprung-Russell diagram. His use of absolute magnitudes will come into play tonight as we have a look at the age-old mystery of M73.

Located about three fingerwidths north-northwest of Theta Capricorni (RA 58.9 Dec -12 38), this 9th magnitude open cluster consisting of four stars was discovered by Charles Messier on October 4, 1780. He described it as a "Cluster of three or four small stars, which resembles a nebula at first glance..." Hotly debated as to whether or not the grouping is a genuine cluster or simply an asterism, it was also included in J. Herschel's catalog (GC 4617) and given the NGC 6994 designation by Dreyer. In 1931 Collinder cataloged M73 as Cr 426, with an estimated distance of 12,000 light-years. Still, the debate about its authenticity as a physically related group continued.

At least two stars show the same proper motion, leading scientists to believe M73 may be the remnant of a much older and now dispersed cluster—or simply two related stars. Of the 140 stars investigated in the region, 24 may be real members, including those in Messier's original observation. Thanks to the work of Hertzsprung and Russell, these candidates fall within the color-magnitude diagram of a 2 to 3 billion year old cluster with Messier's suspect four being evolved giants.

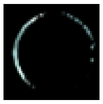
The most recent data indicates M73 may simply be an asterism—sharing no common proper motion, but until more studies are undertaken you can enjoy this unusual Messier in even a small telescope!

Ejnar Hertzsprung
(widely used public image)



M73
Credit: Palomar Observatory, courtesy of Caltech

OCT 9
TUESDAY



Tonight is the peak of the Draconid meteor shower whose radiant is near the westering constellation of Hercules. This particular shower can be quite impressive when comet Giacobini-Zinner passes near Earth. When this happens, the fall rate jumps to 200 per hour and has even been known to reach 1000. So what am I going to tell you about this year? Comet Giacobini-Zinner reached perihelion on July 2nd of 2005, passing with 8 million kilometers of Earth, but has now greatly distanced itself from our solar system. Chances are the Draconids will only produce around 3 to 5 per hour, but no one knows for sure!

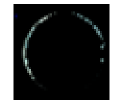
While we're out, let's take the time to have a peek at M72, just about a degree and a half west (RA 20 53.5 Dec -12 32) of last night's target M73.

Originally found by Méchain on the night of August 29-30, 1780, this class IX globular cluster is one of the faintest and most remote of the Messiers, and Charles didn't catalog it until over a month after its discovery. At around magnitude 9, this 53,000 light-year distant globular will be not much more than a faint round smudge in smaller aperture, but will take on a modicum of resolution in larger telescopes. Well beyond the galactic center and heading toward us at 255 kilometers per second, M72 is home to 42 variables and the average magnitude of its members is around 15. While mid-sized scopes will pick up a graininess in the texture of this globular, notice how evenly the light is distributed, with little evidence of a core region. Be sure to write down your observations!

M72
Credit: Palomar Observatory, courtesy of Caltech

OCT 10
WEDNESDAY

Today in 1846, William Lassell was busy at his scope as he made a new discovery—Neptune's moon Triton! Although our everyday equipment can't "see" Triton, we can still have a look at Neptune which is also hanging out in tonight's study constellation of Capricornus. Try checking astronomy periodicals or many great on-line sites for accurate locator charts.



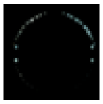
Tonight let's head to the eastern portion of Capricornus and start by identifying Zeta about a fistwidth southwest of the eastern corner star—Delta. Now look southeast about 2 fingerwidths and identify 5th magnitude star 41. About one half degree west is our target globular for the evening, M30.

William Lassell
(widely used public image)

At near magnitude 8, this class V globular cluster is well suited to even binoculars and becomes spectacular in a telescope. Originally discovered by Messier in August 1764 and resolved by William Herschel in 1783, some of M30's most attractive features are the branches of stars which seem to radiate from its concentrated core region. Estimated to be around 26,000 light-years away, you'll find it fairly well resolved in large aperture, but take time to really look. The dense central region may have already undergone core collapse—yet as close as these stars are, very few have collided to form x-ray binaries. For the smaller scope, notice how well M30's red giants resolve and be sure to mark your notes!

M30
Credit: REU Program/NOAO/AURA/NSF

OCT 11
THURSDAY



Tonight is officially New Moon and time for a telescopic challenge—a compact galaxy group. You'll find it less than half a degree southeast of stellar pair 4 and 5 Aquarii (RA 20 52 26.00 Dec -05 46 19.1).

Known as Hickson 88, this grouping of four faint spiral galaxies is estimated to be around 240 million light-years away and is by no means an easy object—yet the galactic cores can just be glimpsed with mid-sized scopes from a very dark site. Requiring around 12.5" to study, you'll find the brightest of these to be northernmost NGC 6978 and NGC 6977. While little detail can be seen in the average large backyard scope, NGC 6978 shows some evidence of being a barred spiral, while NGC 6977 shows the even appearance of a face-on. Further south, NGC 6976 is much smaller and considerably fainter. It is usually caught while averting and studying the neighborhood. The southernmost galaxy is NGC 6975, whose slender, edge-on appearance makes it much harder to catch.

Although these four galaxies seem to be in close proximity to one another, no current data suggests any interaction between them. While such a faint galaxy grouping is not for everyone, it's a challenge worthy of seasoned astronomer with a large scope! Enjoy...

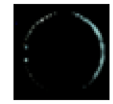
Hickson 88
Credit: Palomar Observatory, courtesy of Caltech

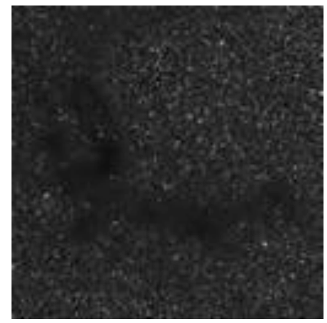
Today in 1891, the Astronomical Society of France was established. Exactly one year later in 1892, astronomy great E. E. Barnard was hard at work using the new tool of photography and became the first to discover a comet—1892 V—in this way!

Not only did Barnard use photography for comets, but his main interest of study was details within the Milky Way. Tonight let us take out binoculars or a telescope at the widest possible field of view and have a look at two such regions in the westering Aquila—The "Double Dark Nebula."

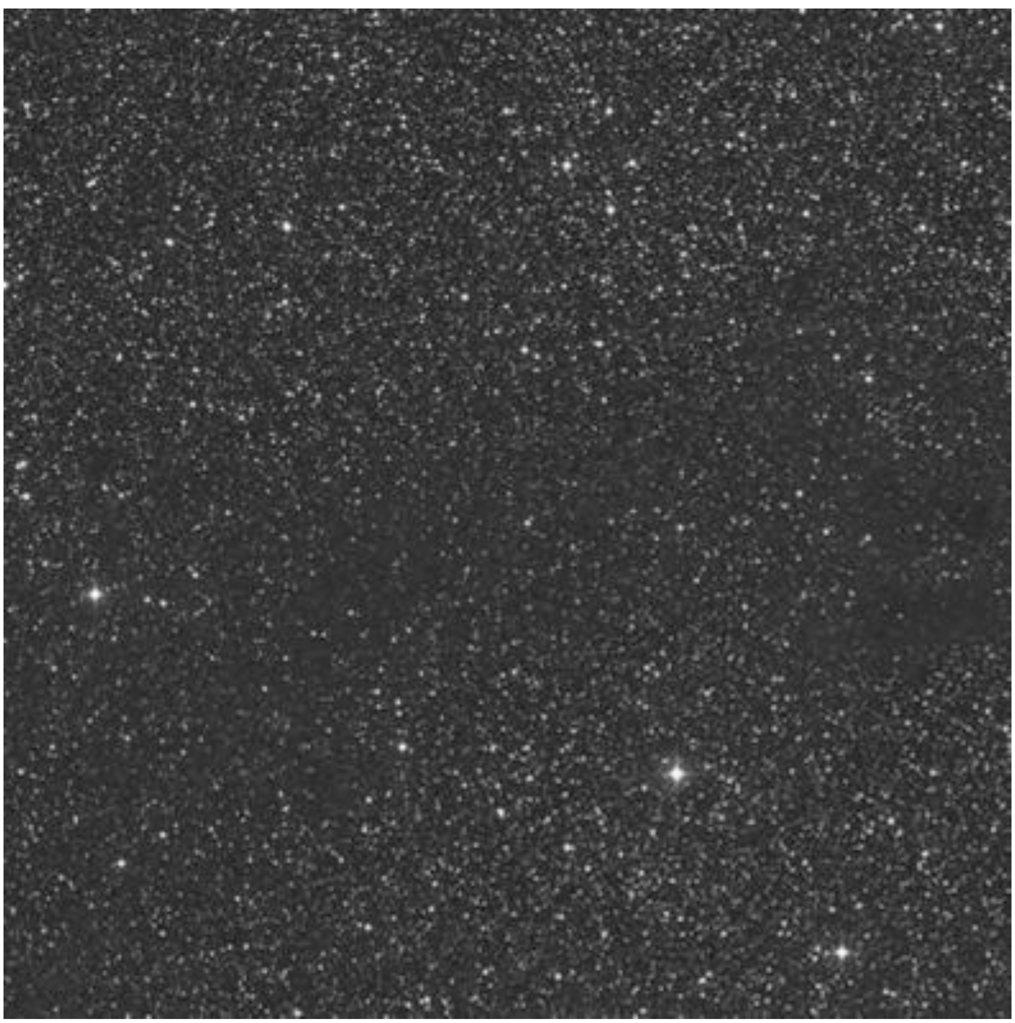
Just northeast of Altair is bright star Gamma Aquilae, and about a fingerwidth west is a pair of Barnard discoveries: B142 and B143—two glorious absences of stars known as interstellar dust clouds. B143 is no more than a half degree in size and will simply look like a blank area shaped like a horseshoe, with its extensions point toward the west. Just south is B142, an elongated comma shape, which seems to underline its companion.

Located anywhere from 1000 to 3000 light-years away, these non-luminous clouds of gas and dust are a very fine example of Barnard's passion. Do not be upset if you don't see them on your first attempt—for the chances are if you are seeing "nothing," you are looking in the right place!



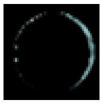


Barnard 143
Credit: Palomar Observatory, courtesy of Caltech



Barnard 142
Credit: Palomar Observatory, courtesy of Caltech

OCT 13
SATURDAY



Today marks the founding of the British Interplanetary Society in 1933. "From imagination to reality," the BIS is the world's oldest established organization devoted solely to supporting and promoting the exploration of space and astronautics.

Tonight we'll do them proud as we have a look at the mighty M2. You'll find it located about three fingerwidths north-northeast of Beta Aquarii (RA 33.5 Dec 00 49).

At slightly dimmer than 6th magnitude, this outstanding globular cluster is just inside that region where it can't quite be viewed unaided, but even the smallest of binoculars will pick it out of a relatively starless field with ease. Holding a Class II designation, it was first discovered by Maraldi on September 11, 1746 and rediscovered independently by Messier exactly 14 years later. At a distance of roughly 37,500 light-years, it is estimated to contain in the neighborhood of 150,000 stars.

Even a small telescope will reveal M2's rich and concentrated core region and slight ellipticity. Not bad for a 13 billion year old group of stars! As aperture increases, some of the brightest stars will begin to resolve, and in larger telescopes it will approach total resolution. You might well note a dark area in the northeastern section, and several more located throughout the splendid field. Feast your eyes on one of the finest in the skies!

M2
Credit: Doug Williams/REU Program/NOAO/AURA/NSF

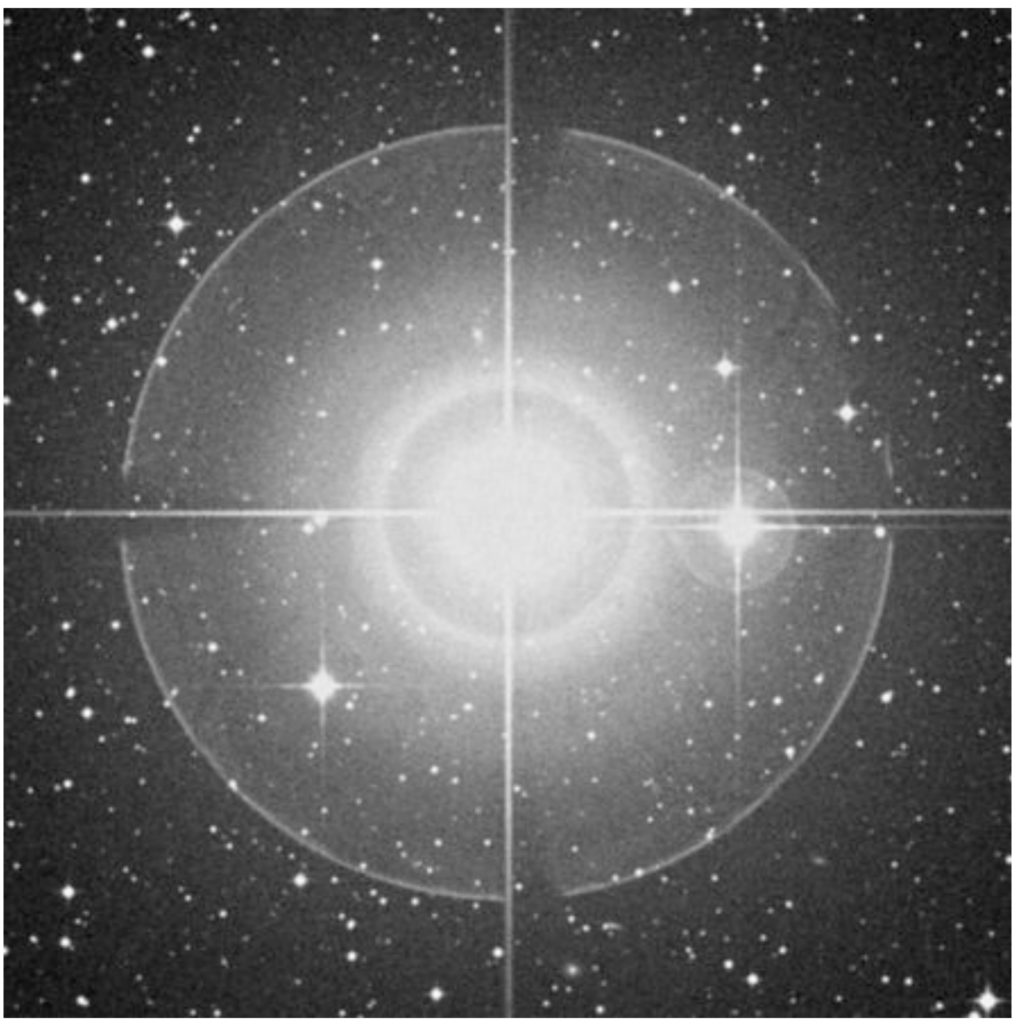
OCT 14
SUNDAY

Before dawn this morning, be sure to step outside and look at the splendid pairing of Venus and Saturn. The two bright planets will be separated by less than three degrees and present a wonderful photographic opportunity!

As the skies darken tonight, have a look at the Moon! If the lunar terminator has not advanced too far at your viewing time, have a look at the southeast shoreline of Mare Crisium for Agarum Promontorium. Look at how boldly it progresses northward across the dark plain before it disappears beneath the once molten lava. There were times in the past when great lunar observers had noted a mist-like appearance in this area—another transient lunar phenomenon.

Now let's give deep sky a rest as we travel to the northwest corner of Capricornus and have a look just south of Alpha at beautiful Beta.

Named Dabih, this lovely white 3rd magnitude star has a very easily to split 6th magnitude companion which will appear slightly blue. Over 100 times brighter than our own Sun, the primary star is also a spectroscopic triple—one whose unseen companions orbit in a little over 8 days and 1374 days. Oddly enough the B star is also a very tight binary as well—yet the two major stars of this system are separated by about a trillion miles! If you have a large aperture telescope—power up. According to T. W. Webb, a 13th magnitude unrelated double is also found in between the two brighter stars. No matter if you chose binoculars or a telescope, I'm sure you'll find the 150 light-year trip worth your time to add to your doubles list!



Beta Capricorni
Credit: Palomar Observatory, courtesy of Caltech

OCT 15
MONDAY

As the evening begins, be sure to at least walk out and look at the Moon. For many observers, bright red Antares will be only around a half degree north of the waxing crescent. Of course, you know that a brush this close could mean an occultation for your area! Be sure to check IOTA for visibility locations and times. No special equipment is needed to check out a lunar occultation, but thanks to an historic observation of just such an event, Antares' companion star was discovered by Professor Johannes Burg in Vienna on April 13, 1819!

Today in 1963 marks the first detection of an interstellar molecule. This discovery was made by Sander Weinreb (with Barrett, Meeks, and Henry) on the MIT Millstone Hill 84-foot dish. The discovery was made possible by new correlation receiver technology, and picked up a hydroxyl molecule in an absorption band. By using the radio galaxy Cas A as a background continuum source, the detection occurred at 1667.46 MHz and again at 1665.34 MHz. By the dawn of 2000, nearly 200 different interstellar molecules had been identified and many of these are classified as organic.

Tonight let's have a look at a radio source as we visit a pulsar located almost midway between Theta and Beta Capricorni—PSR2045+16.

While pulsars aren't truly visible objects, there is still something undeniably cool about locating the field in which a rotating neutron star is sending out staccato pulses of radio waves anywhere between .001 and 4 seconds apart. If you have bright star 19 in the binocular field, then you know you're in the right area for many radio sources, including many nearby quasars... Just imagine the possibilities!

19 Capricorni
Credit: Palomar Observatory, courtesy of Caltech

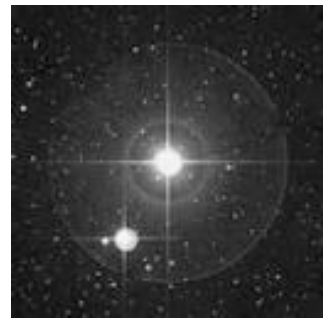
OCT 16
TUESDAY

Do you remember Professor Burg who discovered Antares' companion during an occultation? Then tonight let's have a look at the crater named for him as we begin by using past study crater Posidonius as our guide.

If you walk along the terminator to the northwest, you'll see the punctuation of 40 kilometer-wide Burg just emerging from the shadows. While it doesn't appear to be a grand crater like Posidonius, it has a redeeming feature: it's deep—real deep. If Burg were filled with water here on Earth, it would require a deep submergence vehicle like ALVIN to reach its 3680 meter floor! This class II crater stands fairly alone on an expanse of lunarscape known as Lacus Mortis. If the terminator has advanced enough at your time of viewing, you may be able to see this walled plain's western boundary peeking out of the shadows.

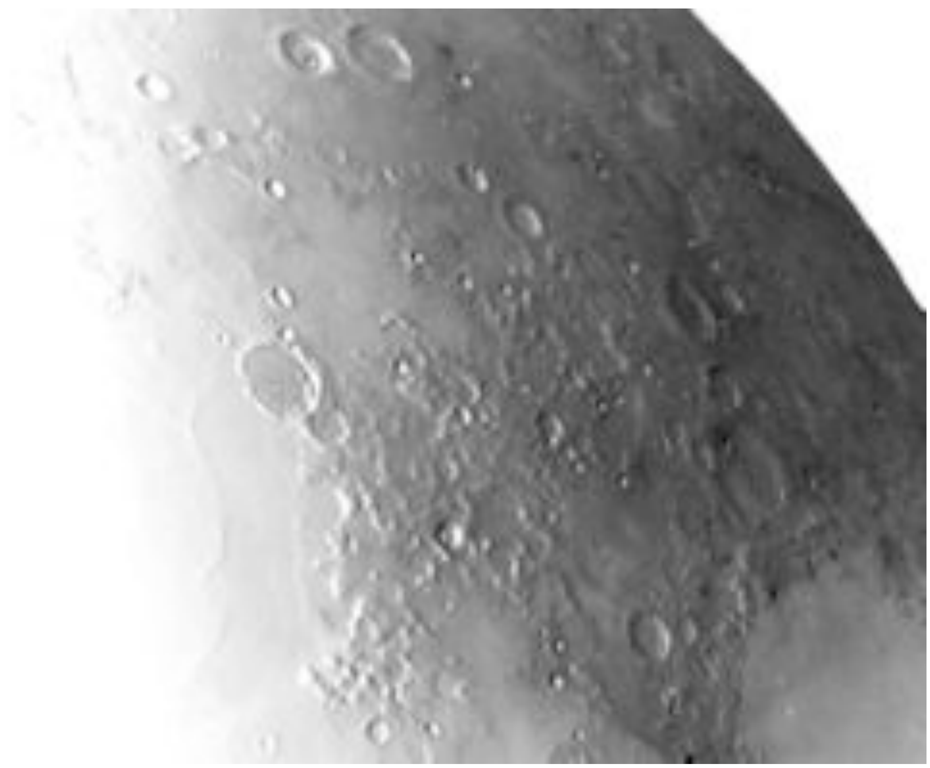
Now let's drop south-southeast of Beta Capricorni to have a look at a pair of doubles—Rho and Pi.

Northernmost Pi is a multiple system slightly less than 100 light-years away, with each discernable member also being a spectroscopic double. Separated by about an eighth of a light-year, look for a 5th magnitude yellow/white giant with a very close 9th magnitude companion. Further south is Pi, a triple star system which has a traditional name—Okul. Located around 670 light-years away, look for a bright blue/white 5th magnitude primary that is also a spectroscopic double—and its much easier C component, which is around magnitude 8.



Rho Capricorni
Credit: Palomar Observatory, courtesy of Caltech

Pi Capricorni
Credit: Palomar Observatory, courtesy of Caltech



Crater Burg on the northern terminator
Credit: Greg Konkel

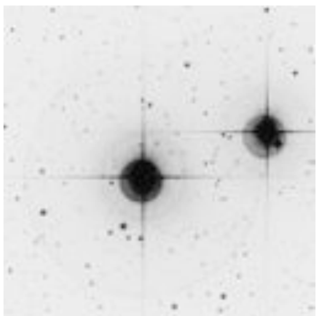
OCT 17
WEDNESDAY

Tonight let's start with the Moon and explore a binocular curiosity.

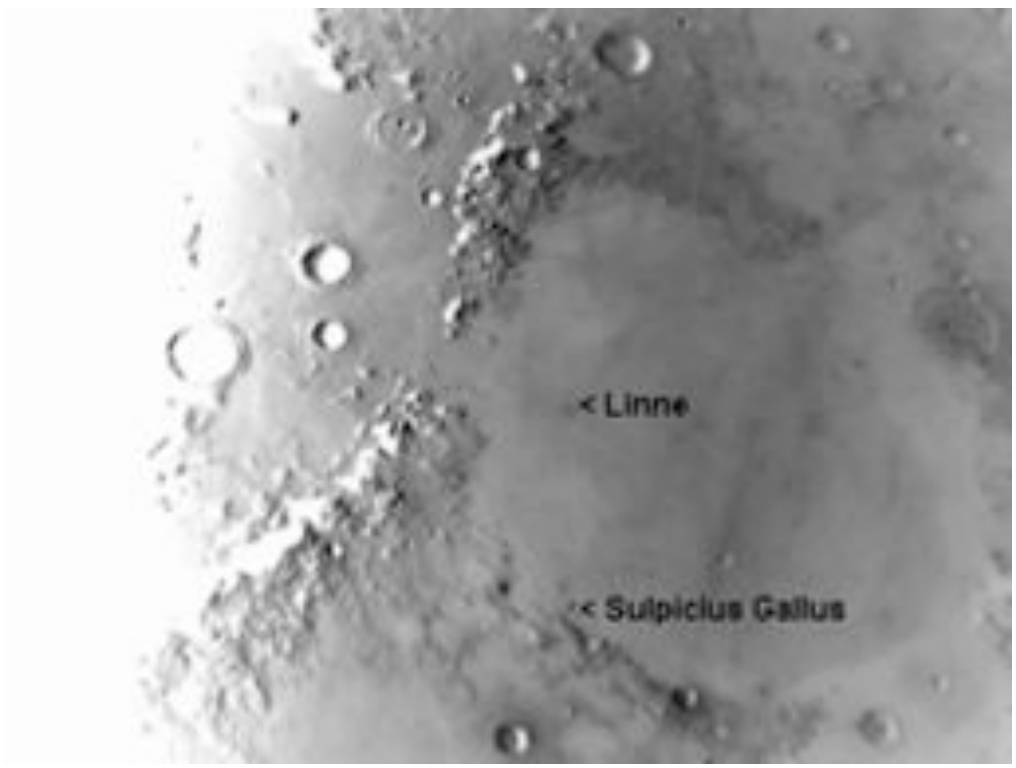
Look on the northeast shore of Mare Serenitatis for the bright ring of Posidonius, which contains several equally bright points both around and within it. Now look at Mare Crisium and get a feel for its size. A little more than one Crisium's length west of Posidonius you'll meet Aristotle and Eudoxus. Drop a similar length south and you will be at the tiny, bright crater Linne on the expanse of Mare Serenitatis. So what's so cool about this little white dot? With only binoculars you are resolving a crater that is one mile wide, in a seven mile wide patch of bright ejecta from close to a quarter of a million miles away!

Now point those binoculars towards the northwestern corner of Capricornus and have a look a spectacular Alpha!

Although the Alpha 1 and 2 pairing is strictly a visual binary, that won't stop you from enjoying their slightly yellow and orange colors. Collectively they are named Al Giedi, and the brighter of the pair is Alpha 2 at about 100 light-years distant; while Alpha 1 is around five times further away. Now power up with a telescope and you'll find that both stars are also visual doubles! While the companion stars to both are around the same magnitude, you'll find that Alpha 2 is separated by three times as much distance. Be sure to mark your observation lists and enjoy!



Alpha Capricorni
Credit: Palomar Observatory, courtesy of Caltech



Crater Linne
Credit: Greg Konkel Annotations: Tammy Plotner

OCT 18
THURSDAY

Today in 1959, Soviet Luna 3 began returning the first photographs of the Moon's far side. Also today—but in 1967—the Soviets again made history as Venera 4 became the first spacecraft to probe Venus' atmosphere. If you're up before dawn, be sure to have a look at brilliant Venus pairing with the solemn Saturn. You'll find them just a few fingerwidths apart!

Tonight let's walk on the Moon and check off a few more features on your lunar list! Look for the prominent pair of Aristillus and Autolycus caught just east of the Apennine Mountain range. If you haven't logged the shallow Archimedes, tonight is your chance. Take the time to closely inspect the differing lava flow patterns on the floor of Palus Putredinus—and you can't miss the bright ring of Manilius!

When we're done? Let's go have a look at Gamma Aquilae just for the heck of it. Just northwest of bright Altair, Gamma has the very cool name of Tarazed and is believed to be over 300 light-years away. This K3 type giant will show just a slightly yellow coloration—but what really makes this one special is the low power field!

Gamma Aquilae
Credit: Palomar Observatory, courtesy of Caltech

Moon Walk
Credit: Roger Warner

OCT 19
FRIDAY

Our lunar mission for tonight is to move south past the crater rings of Ptolemaeus, Alphonsus, Arzachel and Purbach until we end up at the spectacular crater Walter. Named for Dutch astronomer Bernhard Walter, this 132 by 140 kilometer-wide lunar feature offers up amazing details at high power. Perhaps amongst the most fascinating is to take the time to study the differing levels, which drop to a maximum of 4130 meters below the surface. Multiple interior strikes abound, but the most fascinating of all is the wall crater Nonius. Spanning 70 kilometers, Nonius would also appear to have a double strike of its own—one that's 2990 meters deep!

Now, let's go have a look at the northeastern corner of Capricornus as we learn about Delta…

Its proper name is Deneb Algedi and this nearly 3rd magnitude star is a stunning blue/ white. Curiously enough, it's a rather close star—only about 50 light-years from Earth. Hovering so close to it that we cannot even correctly assess its spectral type is a binary companion whose eclipsing orbit causes Delta to be a very slight variable—with a period of just about one day. In its own way, Delta is rather historic... For it was only 4 degrees north of this star that Uranus was first sighted by Galle in 1846!

Delta Capricorni
Credit: Palomar Observatory, courtesy of Caltech

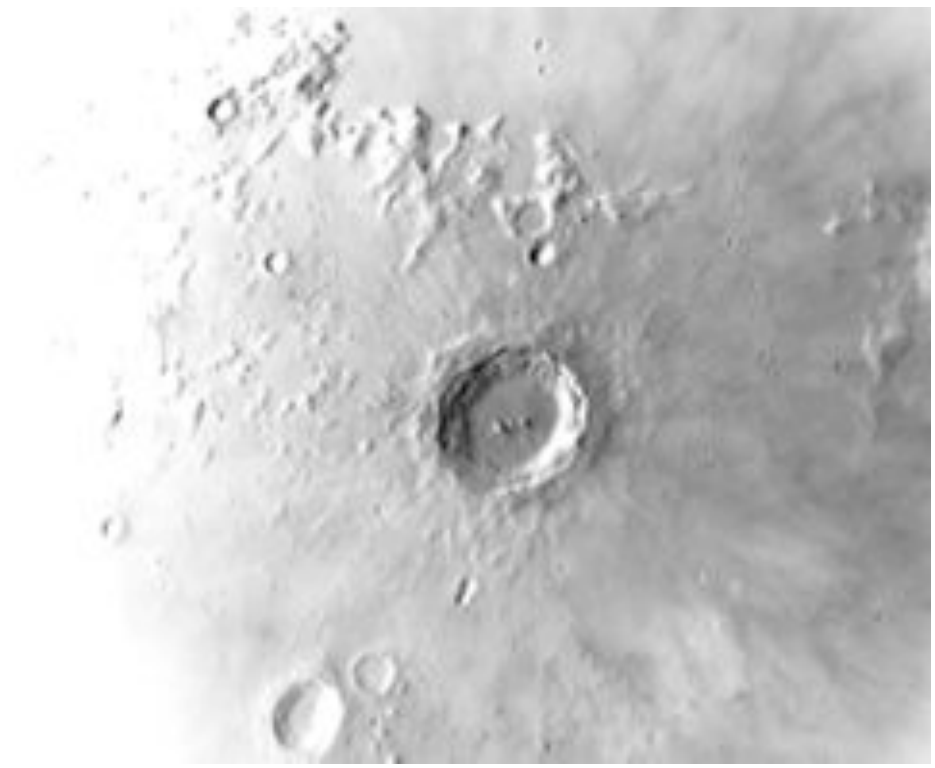
Walter
Credit: Wes Higgins

It's bold. It's beautiful. You've looked at it hundreds of times...and tonight? It's Copernicus...

While Copernicus is not the oldest, deepest, largest, or brightest crater on the Moon, it certainly is one of the most detailed. Visible in binoculars toward Plato and near the terminator, this youthful crater gives a highly etched appearance. Its location in a fairly smooth plain near the center of the Moon's disc, and its prominent "splash" ray system, all combine to make Copernicus visually stunning in a small telescope.

Spanning 100 kilometers in diameter, with 23 kilometer thick walls, the "Mighty One" is most definitely an impact crater that left its impression down to 3840 meters below the surface. Geologist Gene Shoemaker cited many features of Copernicus which mirror our own terrestrial impact features. Many of these Copernican features could have been caused by a large meteoritic body...a body about the size of Comet Halley's nucleus. No matter what optical aid you use, mid-placed Copernicus simply rocks!

Now we are slipping into the stream of Comet Halley and into one of the finest meteor showers of the year. If skies are clear tonight, this would be the perfect chance to begin your observations of the Orionid meteor shower. But go to bed early... And wait for the Moon to set!



Copernicus
Credit: Greg Konkel

OCT 21
SUNDAY

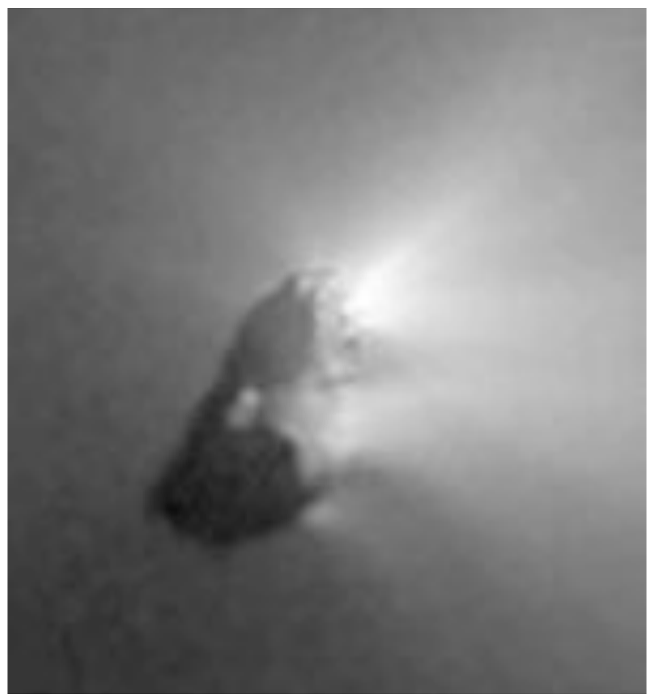
Be sure to be outdoors before dawn to enjoy one of the year's most reliable meteor showers. The offspring of Comet Halley will grace the early morning hours as they return once again as the Orionid meteor shower. This dependable shower produces an average of 10-20 meteors per hour at maximum and the best activity begins before local midnight on the 20th, and reaches its best as Orion stands high to the south at about two hours before local dawn on the 21st. With the Moon nearly out of the picture, this is gonna be great!

Although Comet Halley has long since departed our Solar System, the debris left from its trail still remain scattered in Earth's orbital path around the Sun, allowing us to predict when this meteor shower will occur. We first enter the "stream" at the beginning of October and do not leave it until the beginning of November, making your chances of "catching a falling star" even greater! These meteors are very fast, and although they are faint, it is still possible to see an occasional fireball that leaves a persistent trail.

For best success, try to get away from city lights. Facing south-southeast, simply relax and enjoy the stars of the winter Milky Way. The radiant, or apparent point of origin, for this shower will be near the red giant Alpha Orionis (Betelguese), but meteors may occur from any point in the sky. You will make your meteor watching experience much more comfortable if you take along a lawn chair, a blanket and a thermos of your favorite beverage.

Clouded out? Don't despair. You don't always need your eyes or perfect weather to meteor watch. By tuning an FM radio to the lowest frequency possible that does not receive a clear signal, you can practice radio meteor listening! An outdoor FM antenna pointed at the zenith and connected to your receiver will increase your chances, but it's not necessary. Simply turn up the static and listen. Those hums, whistles, beeps, bongs, and occasional snatches of signals are our own radio signals being reflected off the meteor's ion trail!

Pretty cool, huh?

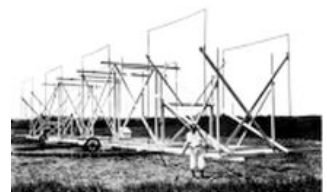


Comet Halley's Nucleus
Credit: NASA

OCT 22
MONDAY

Something very special happened today in 2136 B.C. There was a solar eclipse, and for the very first time it was seen and recorded by Chinese astronomers. And probably a very good thing because in those days the royal astronomers were executed for failure to predict! Today is also the birthday of Karl Jansky. Born in 1905, Jansky was an American physicist as well as an electrical engineer. One of his pioneer discoveries was non-Earth-based radio waves at 20.5 MHz, a detection he made while investigating noise sources during 1931 and 1932. And, in 1975, Soviet Venera 9 was busy sending Earth the very first look at Venus' surface. If you are up before dawn this morning, why not take a moment to have a look at Venus yourself. Can you tell what phase it is in through the telescope?

Also today in 1966 Luna 12 was launched towards the Moon—as so shall we be. Tonight we'll let Gassendi be our guide as we head north to examine the ruins of crater Letronne. Sitting on a broad peninsula on the south edge of Oceanus Procellarum, this class V crater once spanned 118 kilometers. Thanks to the lava flows which formed Procellarum, virtually the entire northern third of the crater was submerged beneath the flow, leaving the remaining scant walls to rise no more than a thousand meters above the surface. While that might seem shallow, that's as high as El Capitan in Yosemite!



Karl Jansky and his antenna
(widely used public image)

Apollo 16 image of Letronne
Credit: NASA

OCT 23
TUESDAY

Fomalhaut
Credit: Palomar Observatory, courtesy of Caltech

Tonight the Moon itself will be our starting point as we look for the planet Uranus less than 2 degrees south. Fix its position in your memory, because it will play a role in just 24 hours.

If you journey to the Moon tonight, you might return to the southern quadrant along the terminator to have a look at 227 kilometer diameter crater Schickard. Seen on the oblique, this great crater's floor is so humped in the middle that you could stand there and not see the crater walls! Be sure to note Schickard for your lunar challenge studies.

After having looked at the Moon, take the time out to view a bright southern star—Fomalhaut. Also known as "The Lonely One," Alpha Piscis Austrini seems to sit in a rather empty area in the southern skies, some 23 light-years away. At magnitude 1, this main sequence A3 giant is the southern-most visible star of its type for northern hemisphere viewers, and it is the 18th brightest star in the sky. "The Lonely One" is about twice the diameter of our own Sun, but 14 times more luminous! Just a little visual aid is all that it takes to reveal its optical companion...

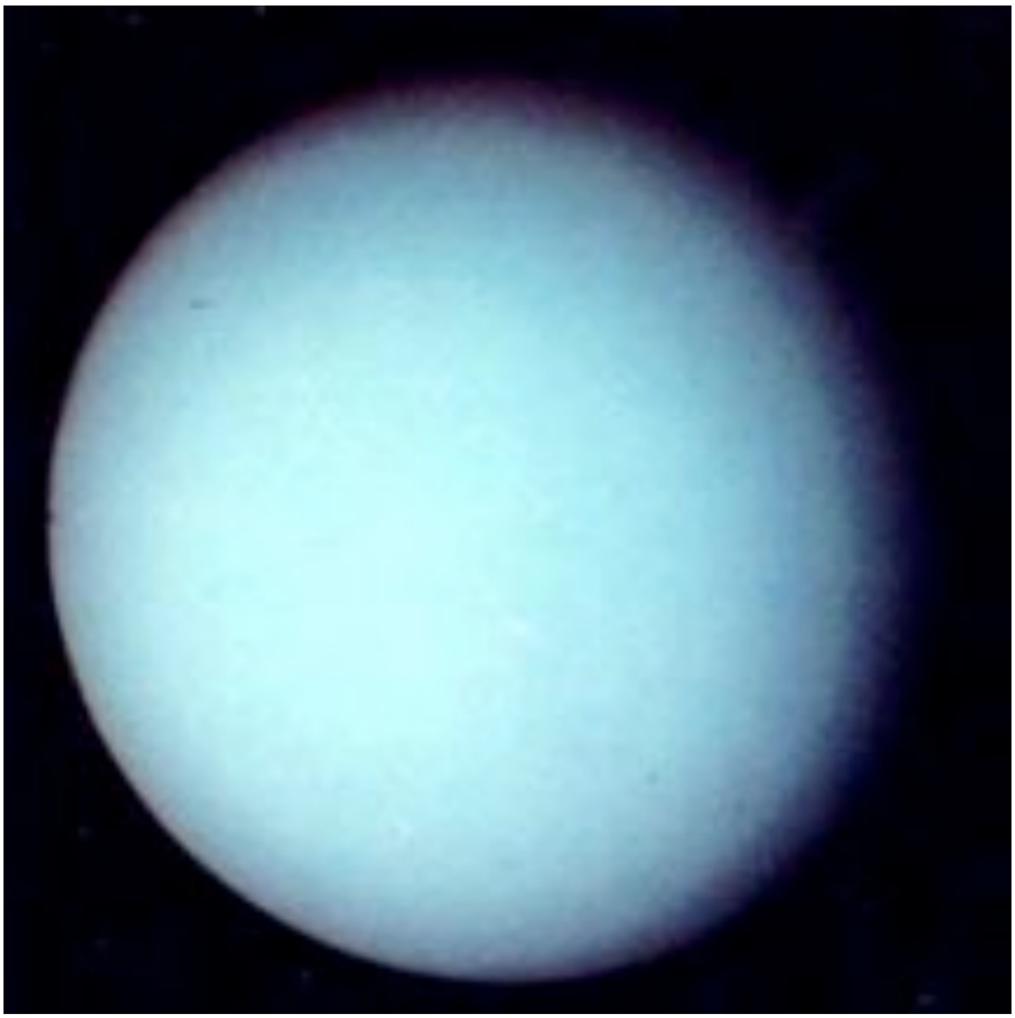
Schickard
Credit: Alan Chu

OCT 24
WEDNESDAY

Today in 1851, a busy astronomer was at the eyepiece as William Lassell discovered Uranus' moons Ariel and Umbriel. Although this is far beyond backyard equipment, we can have a look at that distant world, as we find Uranus just where we left it last night—only a bit further away from the Moon's influence.

While Uranus' small, blue/green disc isn't exactly the most exciting thing to see in a small telescope or binoculars, the very thought that we are looking at a planet that's over 18 times further from the Sun than we are is pretty impressive! Usually holding close to a magnitude 6, we watch as the tilted planet orbits our nearest star once every 84 years. Its atmosphere is composed of hydrogen, helium and methane, yet pressure causes about a third of this distant planet to behave as a liquid. Larger telescopes may be able to discern a few of Uranus' moons, for Titania (the brightest) is around magnitude 14.

Rendition of Lassell's telescope
(widely used public image)



True color image of Uranus
Credit: NASA

OCT 25
THURSDAY

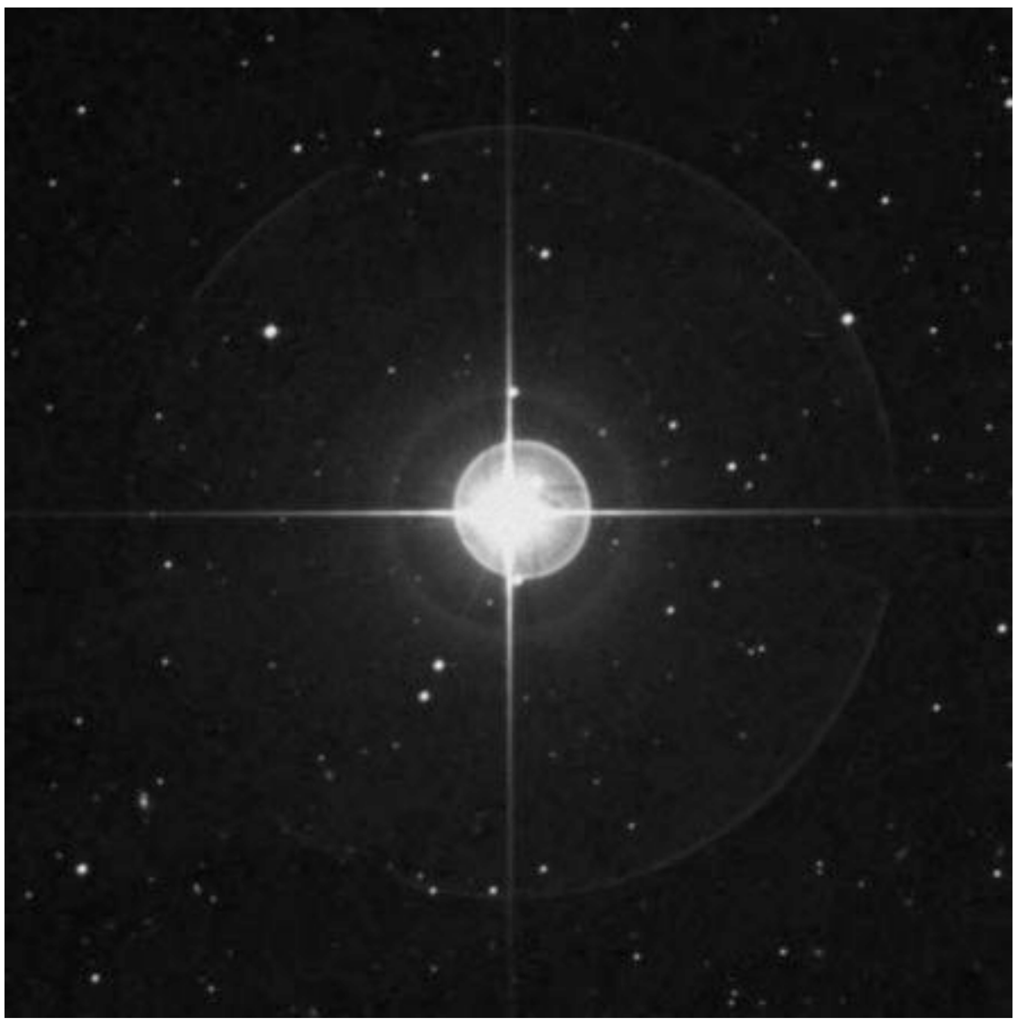
Henry Norris Russell
(widely used public image)

And who was watching the planets in 1671? None other than Giovanni Cassini—because he'd just discovered Saturn's moon Iapetus. If you're up before dawn this morning, have a look at Saturn for yourself. Iapetus usually holds around a magnitude of 12, and orbits well outside of bright Titan's path.

Today is the birthday of Henry Norris Russell. Born in 1877, Russell was the American leader in establishing the modern field of astrophysics. As the namesake for the American Astronomical Society's highest award (for lifetime contributions to the field), Mr. Russell is the "R" in HR diagrams, along with Mr. Hertzsprung. This work was first used in a 1914 paper, published by Russell.

Tonight let's have a look at a star that resides right in the middle of the HR diagram as we have a look Beta Aquarii.

Named Sadal Suud ("Luck of Lucks"), this star of spectral type G is around 1030 light-years distant from our solar system and shines 5800 times brighter than our own Sun. The main sequence beauty also has two 11th magnitude optical companions. The one closest to Sadal Suud was discovered by John Herschel in 1828, while the further star was reported by S.W. Burnham in 1879.



Beta Aquarii
Credit: Palomar Observatory, courtesy of Caltech

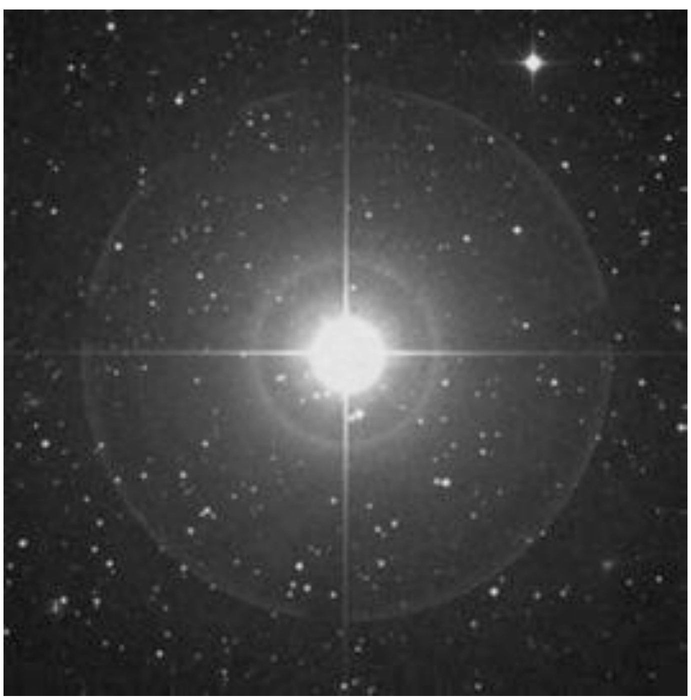
It's big. It's bright. It's the Full Moon just before Halloween! For the next five days, let's take a look at some of the "spookiest" objects in the night sky...

This evening we are once again going to study a single star, which will help you become acquainted with the constellation of Perseus. Its formal name is Beta Persei and it is the most famous of all eclipsing variable stars. Tonight, let's identify Algol and learn all about the "Demon Star."

Ancient history has given this star many names. Associated with the mythological figure Perseus, Beta was considered to be the head of Medusa the Gorgon, and was known to the Hebrews as Rosh ha Satan or "Satan's Head." 17th century maps labeled Beta as Caput Larvae, or the "Specter's Head," but it is from the Arabic culture that the star was formally named. They knew it as Al Ra's al Ghul, or the "Demon's Head," and we know it as Algol. Because these medieval astronomers and astrologers associated Algol with danger and misfortune, we are led to believe that Beta's strange visual variable properties were noted throughout history.

Italian astronomer Geminiano Montanari was the first to record that Algol occasionally "faded," and its methodical timing was cataloged by John Goodricke in 1782, who surmised that it was being partially eclipsed by a dark companion orbiting it. Thus was born the theory of the "eclipsing binary" and this was proved spectroscopically in 1889 by H. C. Vogel. At 93 light-years away, Algol is the nearest eclipsing binary of its kind, and is treasured by the amateur astronomer because it requires no special equipment to easily follow its stages. Normally Beta Persei holds a magnitude of 2.1, but approximately every three days it dims to magnitude 3.4 and gradually brightens again. The entire eclipse only lasts about 10 hours!

Although Algol is known to have two additional spectroscopic companions, the true beauty of watching this variable star is not telescopic—but visual. The constellation of Perseus is well placed this month for most observers and appears like a glittering chain of stars that lie between Cassiopeia and Andromeda. To help further assist you, re-locate last week's study star, Gamma Andromedae (Almach) east of Algol. Almach's visual brightness is about the same as Algol's at maximum.



Beta Persei: Algol
Credit: Palomar Observatory, courtesy of Caltech

OCT 27
SATURDAY

Now we need a jack-o-lantern...

Asteroid Vesta is considered to be a minor planet since its approximate diameter is 525 km (326 miles), making it slightly smaller in size than the state of Arizona. Vesta was discovered on March 29, 1807 by Heinrich Olbers and it was the fourth such "minor planet" to be identified. Olbers' discovery was fairly easy because Vesta is the only asteroid bright enough at times to be seen unaided from Earth. Why? Orbiting the Sun every 3.6 years and rotating on its axis in 5.24 hours, Vesta has an albedo (or surface reflectivity) of 42%. Although it is about 220 million miles away, pumpkin-shaped Vesta is the brightest asteroid in our solar system because it has a unique geological surface. Spectroscopic studies show it to be basaltic, which means lava once flowed on the surface. (Very interesting, since most asteroids were once thought to be rocky fragments left-over from our forming solar system!)

Studies by the Hubble telescope have confirmed this, as well as shown a large meteoric impact crater which exposed Vesta's olivine mantle. Debris from Vesta's collision then set sail away from the parent asteroid. Some of the debris remained within the asteroid belt near Vesta to become asteroids themselves with the same spectral pyroxene signature, but some escaped through the "Kirkwood Gap" created by Jupiter's gravitational pull. This allowed these small fragments to be kicked into an orbit that would eventually bring them "down to Earth." Did one make it? Of course! In 1960 a piece of Vesta fell to Earth and was recovered in Australia. Thanks to Vesta's unique properties, the meteorite was definitely classified as once being a part of our third largest asteroid. Now, that we've learned about Vesta, let's talk about what we can see from our own backyards.

As you can discern from the image, even the Hubble Space Telescope doesn't give incredible views of this bright asteroid. What we will be able to see in our telescopes and binoculars will closely resemble a roughly magnitude 7 "star," and it is for that reason that I strongly encourage you to visit Heavens Above, follow the instructions and print yourself a detailed map of the area. When you locate the proper stars and the asteroid's probable location, mark physically on the map Vesta's position. Keeping the same map, return to the area a night or two later and see how Vesta has moved since your original mark. Since Vesta will stay located in the same area for awhile, your observations need not be on a particular night, but once you learn how to observe an asteroid and watch it move—you'll be back for more!

Asteroid Vesta
Credit: NASA

OCT 28
SUNDAY

Today in 1971, Great Britain launched its first satellite—Prospero.

One of the scariest movies in a long time was the "Ring"… Let's find one! Tonight's dark sky object is a difficult one for northern observers and is truly a challenge. Around a handspan south of Zeta Aquarii and just a bit west of finderscope star Upsilon is a remarkably large area of nebulosity that is very well suited to large binoculars, rich field telescopes and wide field eyepieces. Are you ready to walk into the "Helix?"

Known as NGC 7293, this faint planetary nebula "ring" structure is around half the size of the full Moon. While its total magnitude of 6.5 and large size should indicate an easy find, the "Helix" is anything but easy because of its low surface brightness. Binoculars will show it as a large, round, hazy spot while small telescopes with good seeing conditions will have a chance to outshine larger ones by using lower power eyepieces to pick up the braided ring structure.

As one of the very closest of planetary nebulae, NGC 7393 is very similar in structure to the more famous Ring—M57. It is a spherical shell of gas lighted by an extremely hot, tiny central star that's only around 2% of our own Sun's diameter—yet exceeds Sol in surface temperature by over 100,000 Kelvin. Can you resolve it? Best of luck!

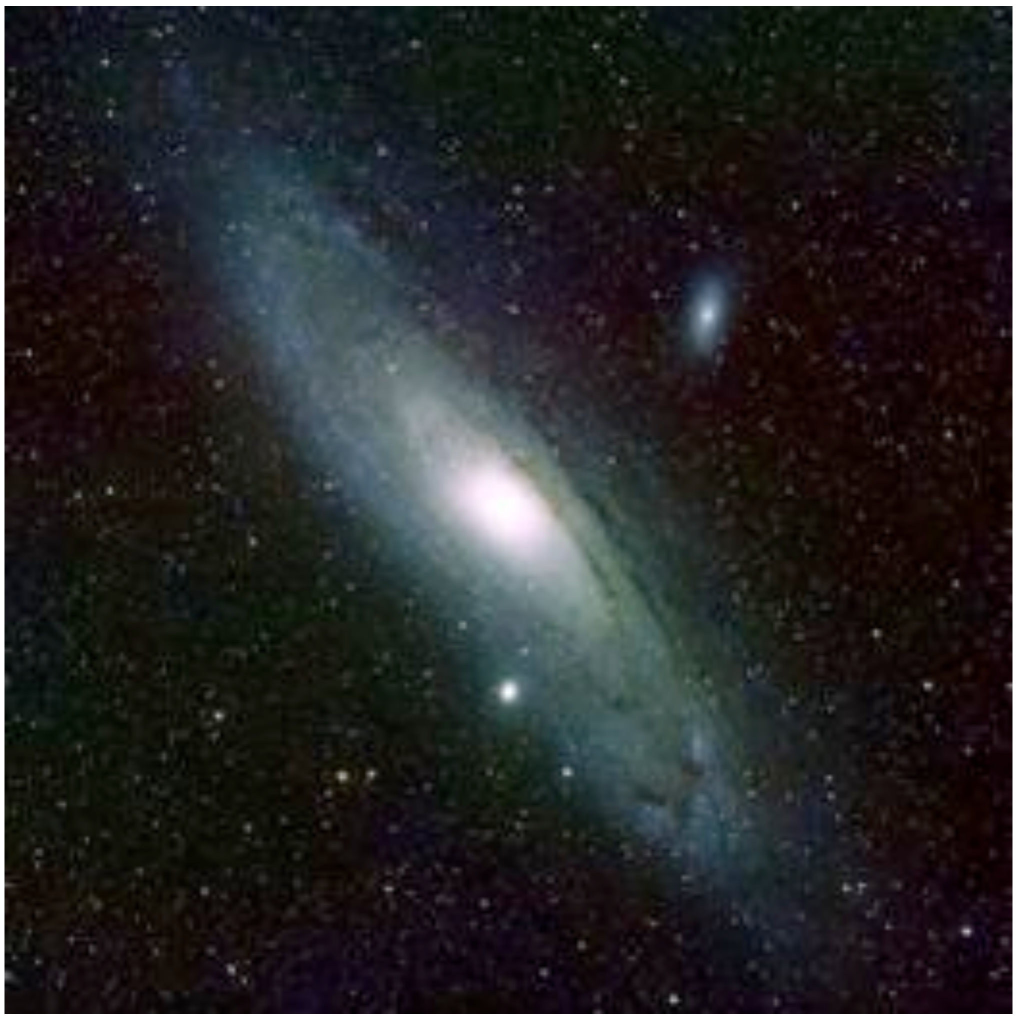
NGC 7392: The Helix Nebula
Credit: R. Jay GaBany

OCT 29
MONDAY

On this night in 1749, the French astronomer Le Gentil was at the eyepiece of an 18' focal length telescope. His object of choice was the Andromeda Galaxy, which he believed to be a nebula. Little did he know at the time that his descriptive notes also included M32, a satellite galaxy of M31. It was the first small galaxy discovered, and it would be another 175 years before these were recognized as such by Edwin Hubble.

Tonight, take the time to view the Andromeda Galaxy for yourself. Located just about a degree west of Nu Andromeda, this ghost set against the starry night was known as far back as 905 AD, and was referred to as the "Little Cloud." Located about 2.2 million light-years from our solar system, this expansive member of our Local Galaxy Group has delighted observers of all ages throughout the years. No matter if you view with just your eyes, a pair of binoculars or a large telescope, M31 still remains one of the most spectacular galaxies in the night.

"Boo" tiful...



M31/32/110: The Andromeda Galaxy and Companions
Credit: Bill Schoenig and Vanessa Harvey/REU Program/NOAO/AURA/NSF

Today in 1981 Venera 13 was launched on its way toward Venus—did you catch the bright planet before dawn?

What Halloween celebration would be complete without a black cat? Tonight let's cruise Draco "The Dragon" in search of the "Cat's Eye"...

Located about halfway between Delta and Zeta Draconis is one of the brightest planetary nebulae in the night—8.8 magnitude NGC 6543. Around three thousand light-years away, it was one of the first planetary nebulae to be studied spectroscopically and the resulting emission lines proved that the phenomenon was actually a shell of gas emitted from a dying star—a fate that awaits our own Sun.

While a small telescope will never reveal NGC 6543 as gloriously as a Hubble image, you can expect even in a small telescope or binoculars to make out a small, blue/green glowing object. Large aperture telescopes and good sky conditions are needed to reveal some of the braided structure seen within this bright object. No matter how you view it, the "Cat's Eye" belongs on the list of spooky objects!

NGC 6543: The Cat's Eye
Credit: Hubble Heritage Team

OCT 31
WEDNESDAY

Happy Halloween! Many cultures around the world celebrate this day with a custom known as "Trick or Treat." Tonight instead of tricking your little ghouls and goblins, why not treat them to a sweet view through your telescope or binoculars?

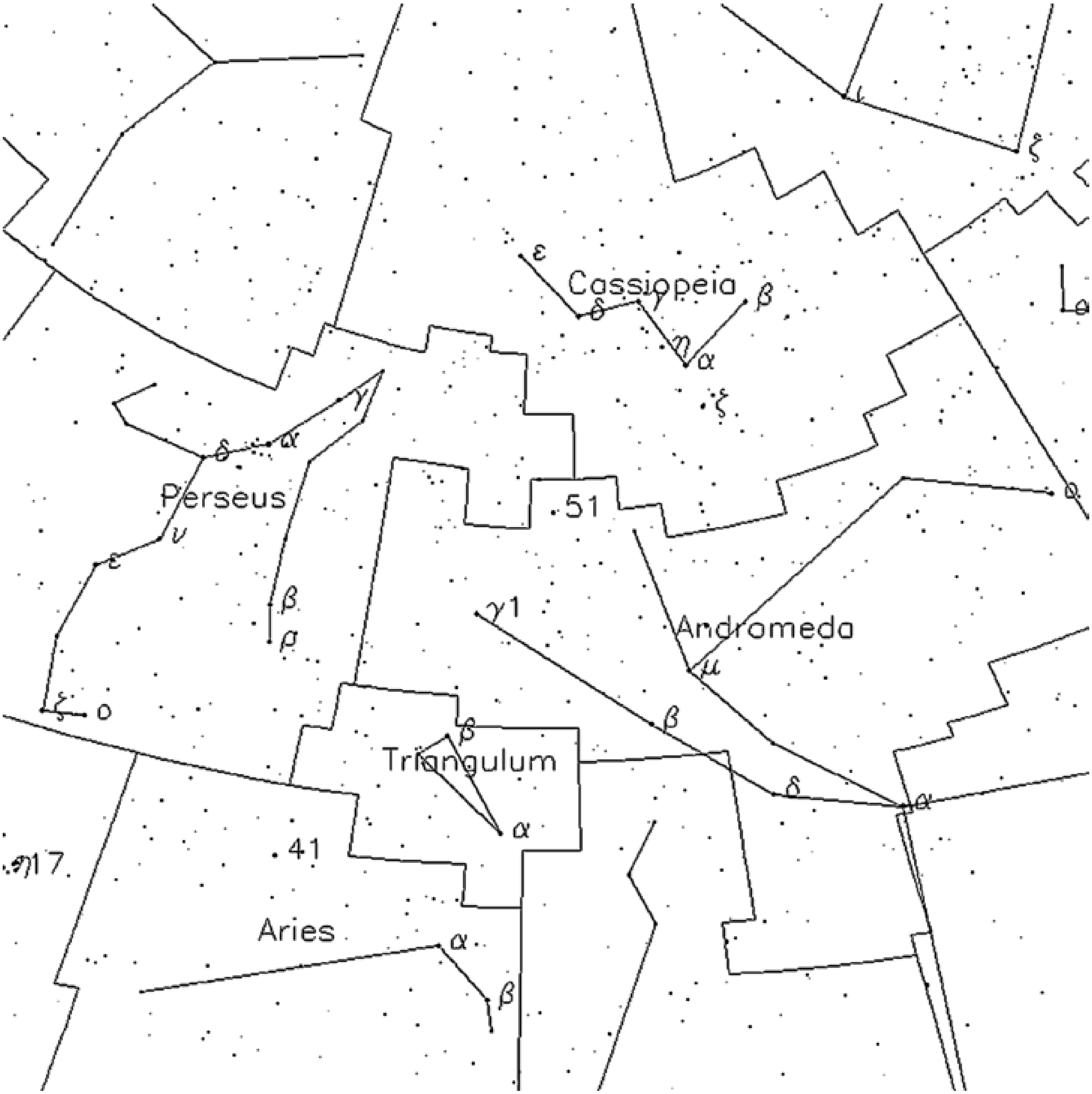
So far we've collected a demon, a pumpkin, a galactic ghost, and the eye of the cat... And what Halloween would be complete without a witch! Easily found from a modestly dark site with the unaided eye, the Pleiades can be spotted well above the northeastern horizon within a couple of hours of nightfall. To average skies, many of the 7 bright components will resolve easily without the use of optical aid, but to telescopes and binoculars? M45 is stunning...

First let's explore a bit of history. The recognition of the Pleiades dates back to antiquity and its stars are known by many names in many cultures. The Greeks and Romans referred to them as the "Starry Seven," the "Net of Stars," "The Seven Virgins," "The Daughters of Pleione," and even "The Children of Atlas." The Egyptians referred to them as "The Stars of Athyr," the Germans as "Siebengestiren" (the Seven Stars), the Russians as "Baba" after Baba Yaga, the witch who flew through the skies on her fiery broom. The Japanese call them "Subaru," Norsemen saw them as packs of dogs and the Tonganese as "Matarii" (the Little Eyes). American Indians viewed the Pleiades as seven maidens placed high upon a tower to protect them from the claws of giant bears, and even Tolkien immortalized the stargroup in "The Hobbit" as "Remmirath." The Pleiades have even been mentioned in the Bible! So, you see, no matter where we look in our "starry" history, this cluster of seven bright stars has been part of it. But, let's have some Halloween fun!

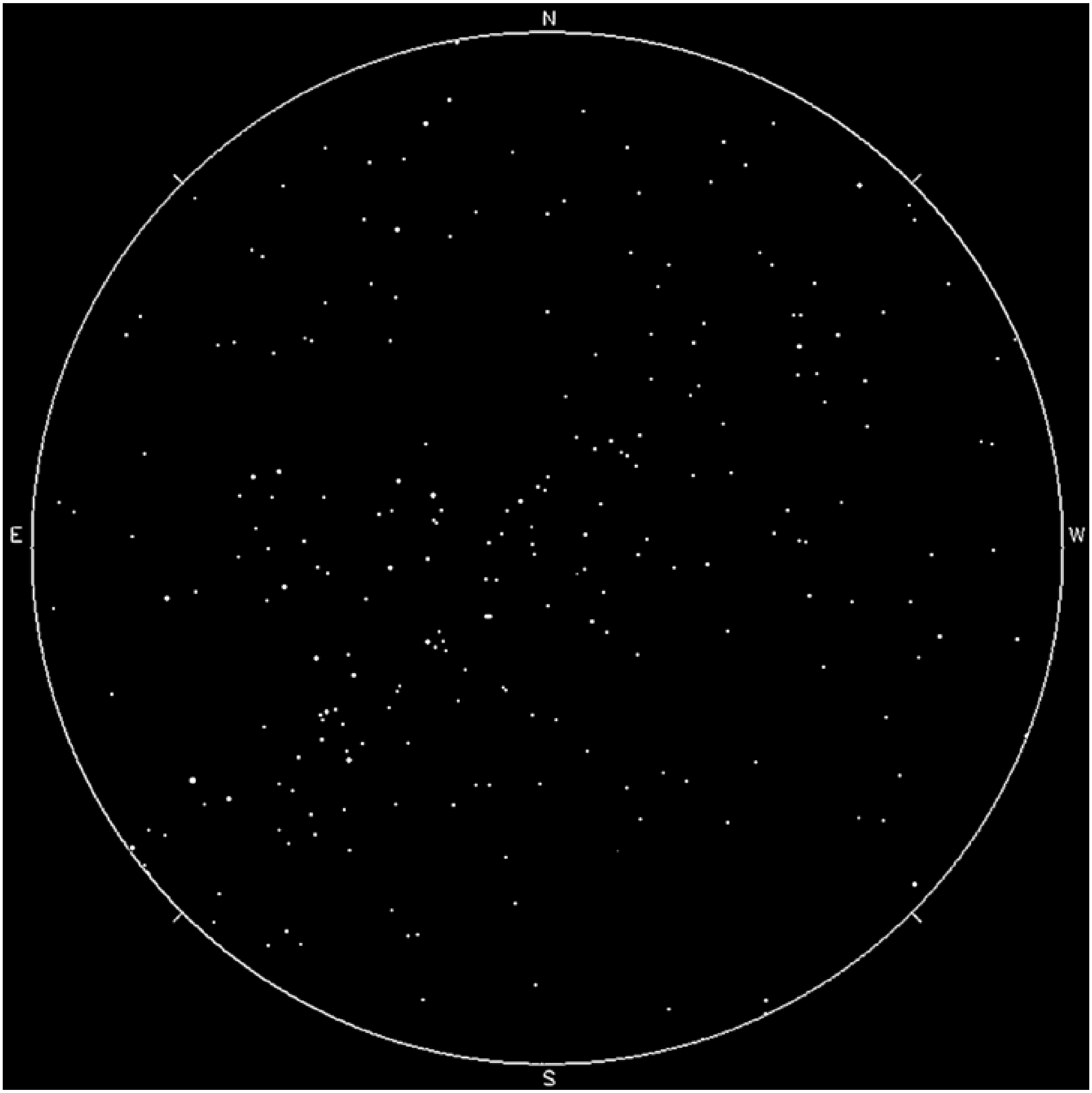
The date of the Pleiades culmination (its highest point in the sky) has been celebrated through its rich history by being marked with various festivals and ancient rites—but there is one particular rite that really fits this occasion! What could be more spooky on this date than to imagine a group of Druids celebrating the Pleiades' midnight "high" with Black Sabbath? This night of "unholy revelry" is still observed in the modern world as "All Hallow's Eve" or more commonly as Halloween. Although the actual date of the Pleiades midnight culmination is now on November 21 instead of October 31, why break with tradition? Thanks to its nebulous regions, M45 looks wonderfully like a "ghost" haunting the starry skies.

Treat yourself and your loved ones to the "scariest" object in the night. Binoculars give an incredible view of the entire region, revealing far more stars than are visible with the naked eye. Small telescopes at lowest power will enjoy M45's rich, icy-blue stars and fog-like nebulosity. Larger telescopes and higher power reveal many pairs of double stars buried within its silver folds. No matter what you choose, the Pleiades definitely rock!

M45: The Pleiades
Credit: Royal Observatory Edinburgh/Anglo-Australian Observatory
Photographed from UK Schmidt plates by David Malin


Cassiopeia
Perseus
51
Andromeda
Triangulum
41
Aries
17

NOVEMBER 2007

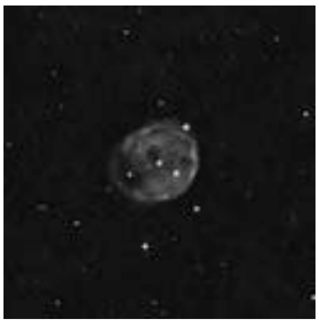


NOV 1
THURSDAY

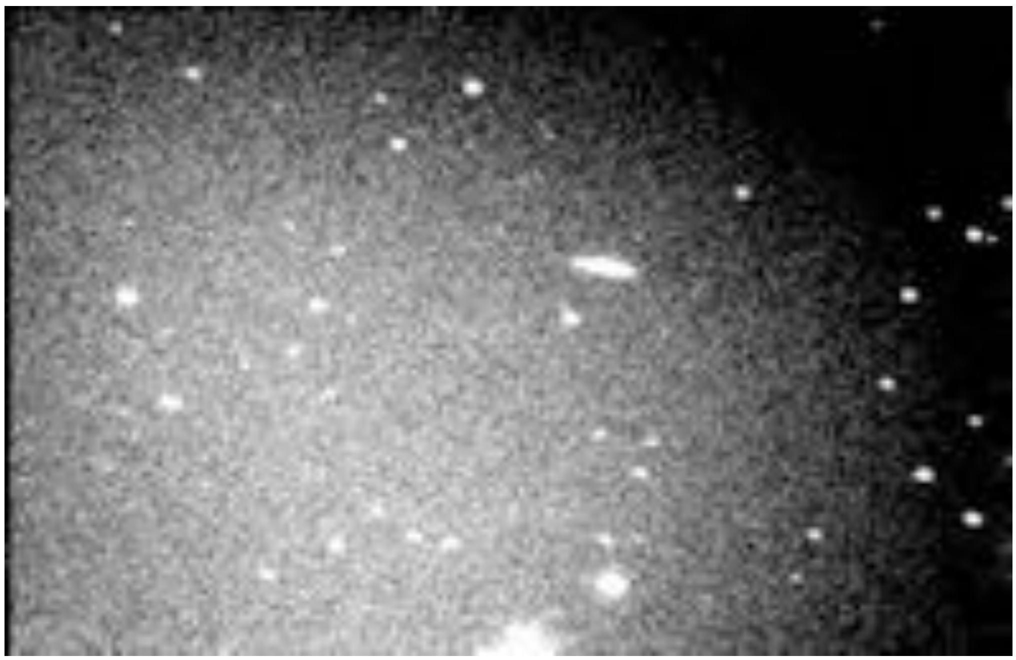
On this day in 1977, Charles Kowal made a wild discovery—Chiron. This represented the first discovery of a multitude of tiny, icy bodies that lie in the outer reaches of our solar system. Collectively known as Centaurs, they reside in unstable orbits between Jupiter and Neptune and are almost certainly "refugees"" from the Kuiper Belt

Tonight let's go for something small, but white-hot as we head for a dwarf star and planetary nebula, NGC 246. You'll find it just a bit more than a fistwidth north-northeast of Beta Ceti (RA 00 47 03.34 Dec -11 52 18.9).

First discovered by Sir William Herschel and cataloged as object V.25, this 8th magnitude planetary nebula has a wonderful patchy, diffuse structure that envelops four stars. Around 1600 light-years away, the nebulosity you can see around the exterior edges was once the outer atmosphere of a star much like our own Sun. At the center of the nebula lies the responsible star—the fainter member of a binary system. While it is now in the process of becoming a white dwarf, we can still enjoy the product of this expanding shell of gas that is often called the "Skull Nebula."



NGC 246
Credit: Palomar Observatory, courtesy of Caltech



Chiron
Credit: NASA

Today celebrates the birth of an astronomy legend—Harlow Shapely. Born in 1885, the American-born Shapley paved the way in determining distances to stars, clusters, and the center of our Milky Way galaxy. Among his many achievements, Shapely was also the Harvard College Observatory director for many years. Today in 1917 also represents the night first light was seen through the Mt. Wilson 100" telescope.

Of course, Dr. Shapley spent his fair share of time on the Hooker telescope as well. One of his many points of study was globular clusters, their distance, and their relationship to the halo structure of our galaxy. Tonight let's have a look at a very unusual little globular located about a fistwidth south-southeast of Beta Ceti and just a couple of degrees north-northwest of Alpha Sculptor (RA 00:52:47.5 Dec -26:35:24), as we have a look at NGC 288.

Discovered by William Herschel on October 27, 1785, and cataloged by him as H VI.20, the class X globular cluster blew apart scientific thinking in the late 1980's as a study of perimeter globulars showed it to be more than 3 million years older than similar globulars—thanks to the color magnitude diagrams of Hertzsprung and Russell. By identifying both its blue and red branches, it was shown that many of NGC 288's stars are being stripped away by tidal forces and contributing to the formation of the Milky Way's halo structure. In 1997, three additional variable stars were discovered in this cluster.

At magnitude 8, this small globular is easy for southern observers, but faint for northern ones. If you are using binoculars, be sure to look for the equally bright spiral galaxy NGC 253 to the globular's north.

Harlow Shapley
(widely used public image)

NGC 288

Nov 3
SATURDAY

Laika
(widely used public image)

On this day in 1955, one of the few documented cases of a person being hit by a meteorite occurred. What are the odds on that?

1957 the Russian space program launched its first "live" astronaut into space—Laika. Carried on board Sputnik 2, our canine hero was the first living creature to reach orbit. The speedily developed Sputnik 2 was designed with sensors to transmit the ambient pressure, breathing patterns and heartbeat of its passenger, and also had a television camera on board to monitor its occupant. The craft also studied ultraviolet and x-ray radiation to further assess the impact of space flight upon live occupants. Unfortunately, the technology of the time offered no way to return Laika to Earth, so she perished in space. On April 14, 1958, Laika and Sputnik 2 returned to Earth in a fiery re-entry after 2,570 orbits.

Since we've got the scope out, let's go have another look at that galaxy we spied last night!

Discovered by Caroline Herschel on September 23, 1783, NGC 253 (RA 00 47.6 Dec -25 17) is the brightest member of a concentration of galaxies known as the Sculptor Group, near to our own local group and the brightest of all outside it. Cataloged as both H V.1 and Bennett 4, this 7th magnitude beauty is also known as Caldwell 65, and due to both its brightness and oblique angle is often called the "Silver Dollar Galaxy." As part of the SAC 110 best NGCs, you can even spot this one if you don't live in the Southern Hemisphere. At around 10 million light-years away, this very dusty, star-forming Seyfert galaxy rocks in even a modest telescope!

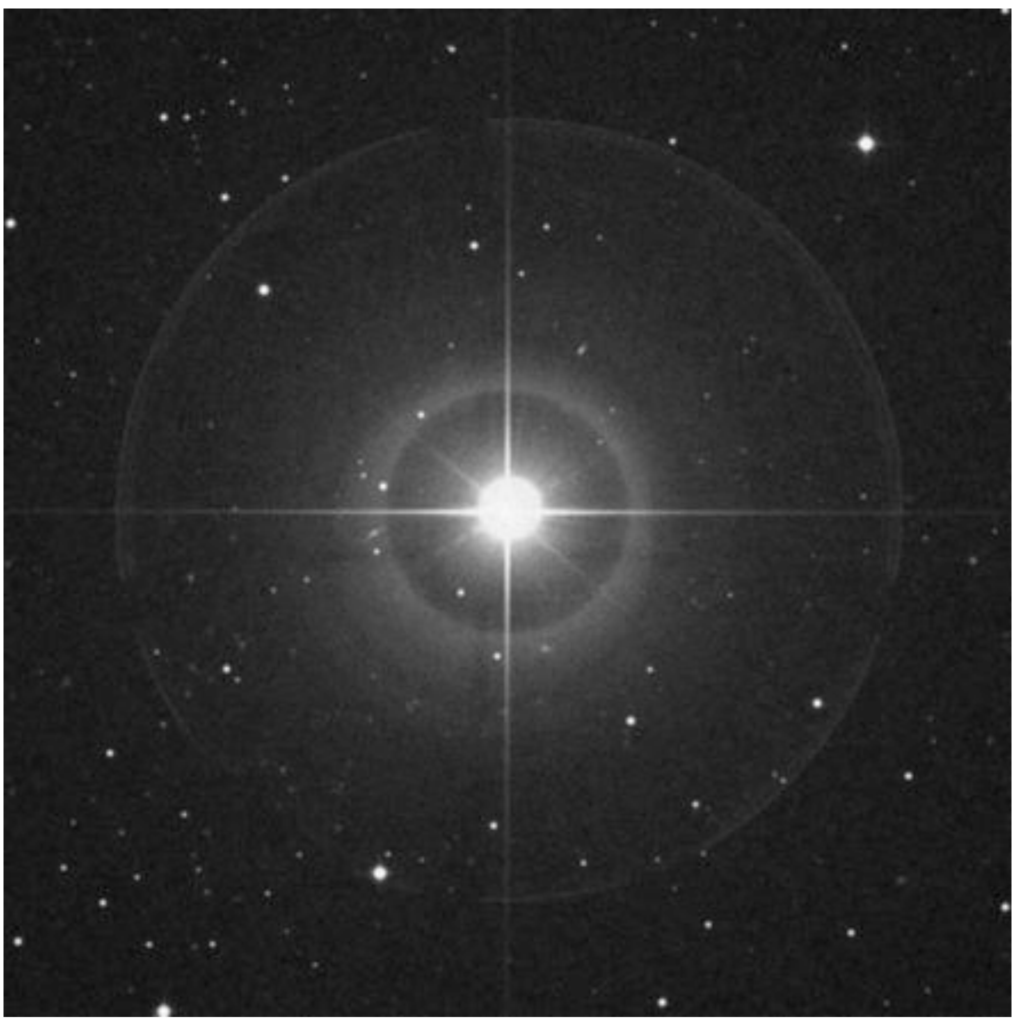
NGC 253: The Silver Dollar Galaxy
Credit: R. Jay GaBany

This morning will be the peak of the Southern Taurid meteor shower. Already making headlines around the world for producing fireballs, the Taurids will be best visible in the early morning hours as soon as the Moon is far west.. The radiant for this shower is, of course, the constellation of Taurus and red giant Aldeberan, but did you know the Taurids are divided into two streams?

It is surmised that the original parent comet shattered as it passed our Sun around 20,000 to 30,000 years ago. The larger "chunk" continued orbiting and is known as periodic comet Encke. The remaining debris field turned into smaller asteroids, meteors and larger fragments that often pass through our atmosphere creating the astounding "fireballs" known as bolides. Although the fall rate for this particular shower is rather low at 7 per hour, these slow traveling meteors (27 km or 17 miles per second) are usually very bright and appear to almost "trundle" across the sky. With the chances high all week of seeing a bolide, this makes a bit of quiet contemplation under the stars worthy of a morning walk. Be sure to look at how close Saturn is to the Moon!

For unaided eye or binocular observers—or those who just wish something a bit "different" tonight—have a look at 19 Pisces. You'll find it as the easternmost star in the small "circlet" just south of the Great Square of Pegasus.

Also known as TX, you'll find this one quite delightful for its strong red color. TX is a cool giant star which varies slightly in magnitude on an irregular basis. This carbon star is located anywhere from 400 to 1000 light-years away and rivals even R Leporis' crimson beauty.



19 Pisces
Credit: Palomar Observatory, courtesy of Caltech

NOV 5
MONDAY

Fred Whipple
(widely used public image)

If you're out looking for meteors this morning—and even if you're not—take a look at the sweet pairing of the Moon and Venus. Take out a scope! Which has the larger crescent visible?

Today in 1906, a man named Fred Whipple was born. If that name doesn't ring a bell for you—it should. Thanks to Dr. Whipple's work we have a clearer understanding of the orbital mechanics of comets and their relation to meteoroid streams. Not only that, but he founded the SAO observatory in Arizona, discovered six comets, made invaluable contributions to research in the upper atmosphere, and was the first to call a comet a "dirty snowball." His guess about the outgassing properties of comets was proved true when the first flyby of Comet Halley was made!

To honor Dr. Whipple a bit, let's have a look at a beautiful optical pair/multiple system as we journey to the southernmost star in the "Circlet"—Kappa Piscium.

Easily split in even binoculars, this lovely green and violet combination of stars may have once belonged to the Pleiades group. 5th magnitude Kappa is a chromium star—one with unusual spectral iron properties—which rotates completely in around 48 hours. It shows lines of uranium, and the possibility of a very rare element known as holmium. Both the uranium and osmium content could be the result of a supernova explosion in a nearby star.

Enjoy this colorful pair tonight!

Kappa Piscium
Credit: Palomar Observatory, courtesy of Caltech

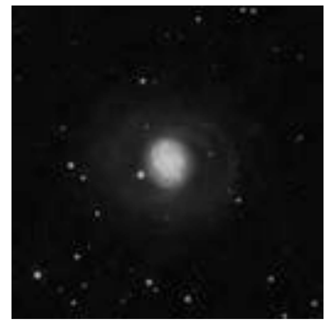
NOV 6
TUESDAY

Tonight let's head less than a degree south-southeast of Delta Ceti (RA 02 43 40.83 Dec -00 00 48.4) to have a look at a galaxy grouping that features the magnificent M77.

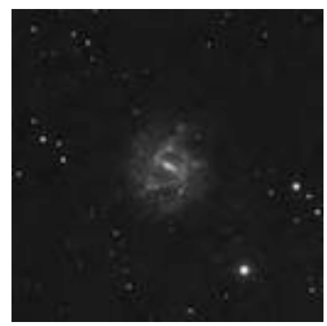
Discovered on October 29, 1780 by Pierre Méchain, Messier cataloged it as #77 around six weeks later as a "nebulous cluster"—an accurate description for a small telescope. It wasn't until 1850 when Lord Rosse uncovered its spiral nature that we began to view it as the grand structure seen in today's modern telescopes.

Around 47 million light-years away, larger instruments will reveal its wide spiral arms where the older stars call home, and the concentrated core region where gigantic gas clouds move rapidly and new stars are being formed—a core which contains such a massive energy source that it emits spectrum of radio waves. After decades of study, the highly active nucleus of this Seyfert galaxy is known to have a mass equaling 10 million suns and a 5 light-year wide disc which rotates around it, which has intense star forming regions. This is one of the brightest known, and was cataloged by Arp as number 37 on his list of peculiar galaxies.

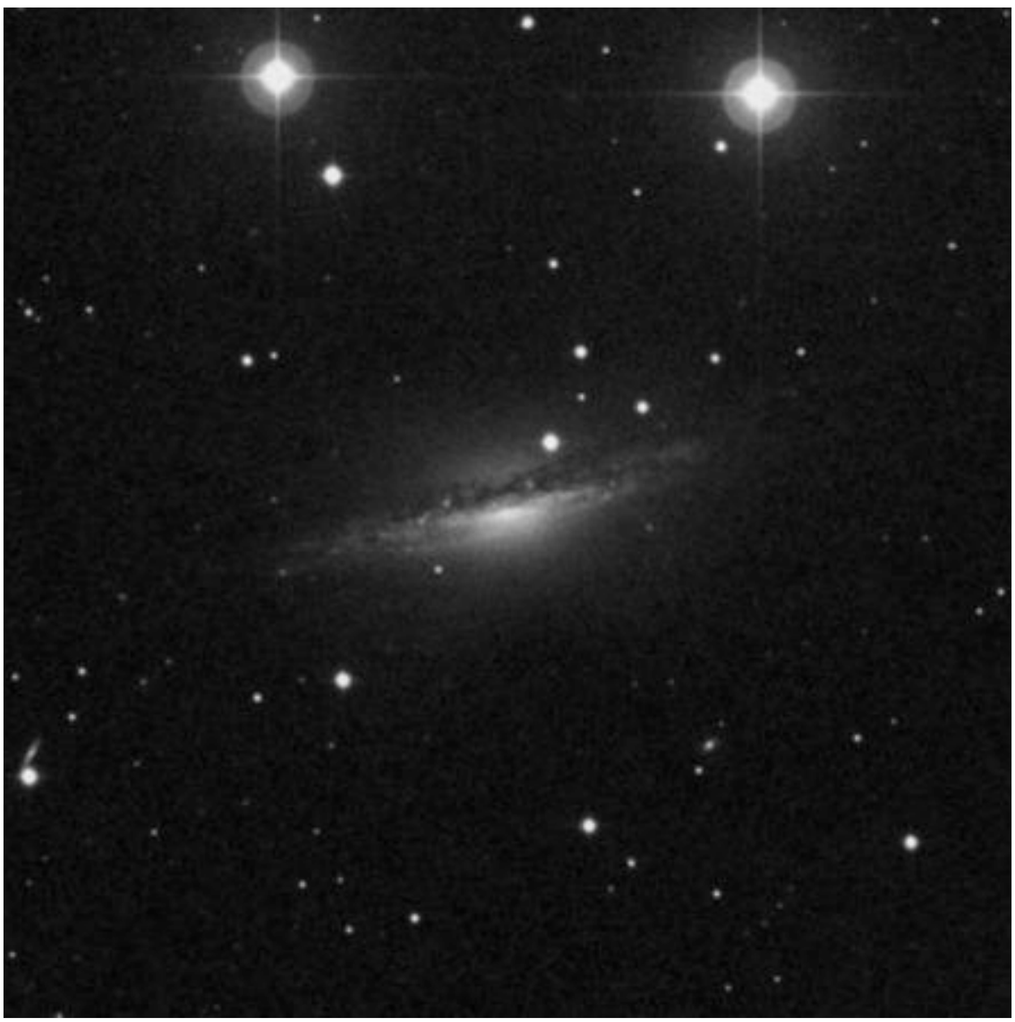
While even binoculars can spot the core, and modest scopes can reveal M77's glory, larger telescopes will also spy 10th magnitude, edge-on NGC 1055 about half a degree north-northwest and 11th magnitude, face-on NGC 1073 about a degree north-northeast. Enjoy them tonight!



M77
Credit: Palomar Observatory, courtesy of Caltech

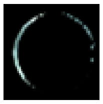


NGC 1073
Credit: Palomar Observatory, courtesy of Caltech



NGC 1055
Credit: Palomar Observatory, courtesy of Caltech

NOV 7
WEDNESDAY



Today in 1966, Lunar Orbiter 2 was launched. 30 years later on this same date, the Mars Global Surveyor left on its journey. Tonight let's journey back to the area around M77—because we've got more to explore!

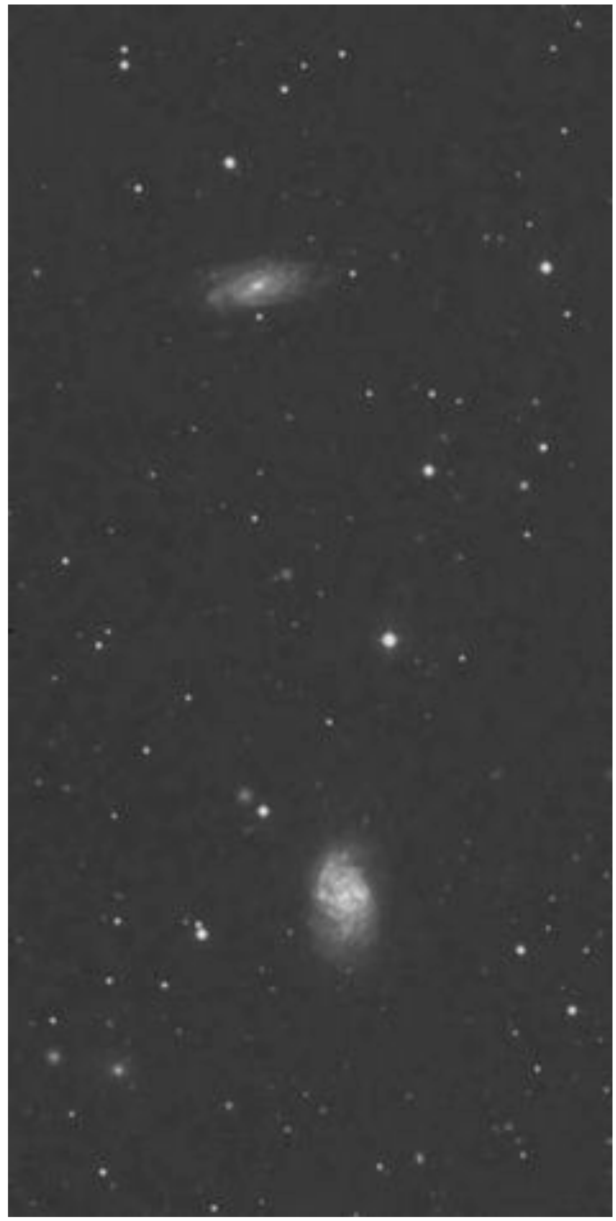
Let's start with Delta Ceti and head north about a degree for NGC 1032 (RA 02 39 23.74 Dec +01 05 37.7). Discovered in 1783 by Sir William Herschel and cataloged as H II.5, this 13th magnitude edge-on galaxy isn't for the smaller scope, but that doesn't mean it's not interesting. Possessing a bright core region and an almost stellar nucleus, this superb galaxy was home to a supernova event in 2005!

NGC 1032
Credit: Palomar Observatory, courtesy of Caltech

Now, have a look at M77 again and head less than two degrees east for a pair of north/south oriented galaxies—NGC 1090 and NGC 1087 (RA 02 46 33.70 Dec -00 1 4 49.0). At around 120 million light-years away, northern NGC 1090 (H II.465) is also a supernova candidate, with events being reported in both 1962 and 1971. At close to magnitude 13, this barred spiral isn't easy, but it can be spotted with aversion and a mid-sized telescope.

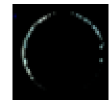
About 15' south is NGC 1087. Although the pair seem quite close—no interaction between them has been detected. At magnitude 11, smaller scopes stand a much better chance a picking out 1087's faint, round glow... while large scopes will get a sense of tightly wound spiral arms around Herschel II.466. Its barred structure is quite curious—far smaller than what is known to be common in this type of structure, but still a grand star forming region. A region that held a supernova event in 1995!

Check out this active group tonight...



NGC 1090/1087
Credit: Palomar Observatory, courtesy of Caltech

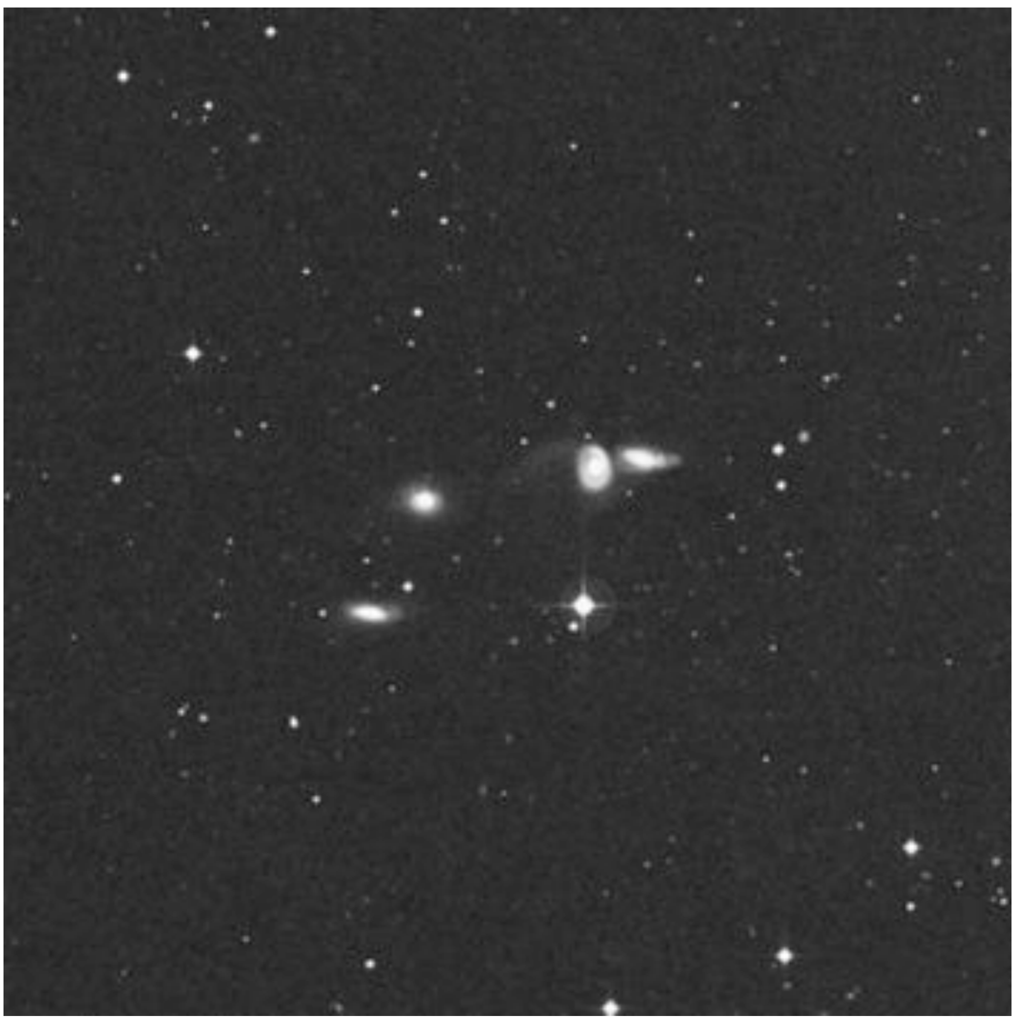
Nov 8
Thursday



Born on this day in 1656, the great Edmund Halley made his mark on history as he became best known for determining the orbital period of the comet which bears his name. English scientist Halley had many talents however, and in 1718 discovered that what were referred to as "fixed stars," actually displayed proper motion! If it were not for Halley, Sir Isaac Newton may never have published his now famous work on the laws of gravity and motion. If Halley were alive today, you could bet that he'd have a big scope aimed about 4 degrees east of the Zeta and Chi pairing in Cetus to have a look at Hickson Compact Galaxy Group 16 (RA 02 09 31.71 Dec -10 08 59.7).

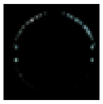
Consisting of four faint, small galaxies designated as NGC 835, NGC 833, NGC 838 and NGC 839 clustered around a 9th magnitude star, these aren't for a small scope—but are a true challenge for a seasoned observer. Groups of galaxies such as Hickson 16 are believed to be some of the very oldest things in our Universe—and this particular one has a reputation of having an extremely large amount of starburst activity that is close enough for scientists to study. They were all cataloged by William Herschel in this month (on the 28th) in 1785. The northernmost, NGC 833, is known as HII.482, roughly magnitude 13, followed by NGC 835 (HII.483) which holds a magnitude 12. Next in line is NGC 838 (HII.484) at close to magnitude 13, followed southernmost by NGC 839 (HII.485) at magnitude 13. Not easy... But this beautiful crescent of four is worth the effort!

Edmund Halley
(widely used public image)



Hickson 16
Credit: Palomar Observatory, courtesy of Caltech

Nov 9
FRIDAY

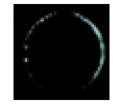


Today is the birthdate of Carl Sagan. Born in 1934, Sagan was an American planetologist, exobiologist, popularizer of science and astronomy, and novelist. His influential work and enthusiasm inspired us all. If Carl were with us on this New Moon night, he would encourage amateurs of every level of astronomical ability! So let us embark to honor his memory with an optical pairing of stars known as Zeta and Chi Ceti, a little more than a fistwidth northeast of bright Beta. Now have a look with binoculars or small scopes because you'll find that each has their own optical companion!

And northeast we continue with the largest of telescopes to investigate a galaxy cluster known as Abell 194 (RA 01 26 01.30 Dec -01 22 02.0). Over 100 galaxies have been found in this area and most of them are around 265 million light-years away. The brightest is NGC 547 and the pairing of NGC 547/545, which may be interacting with the elliptical NGC 541. Other viewable members include NGCs 548, 543, 535, 530, 519, 538, and 557, as well as far more southern 564, 560 and 558, just north of another optical double. No matter what you chose to look at tonight, as Dr. Sagan would say: "We are all star stuff."

Carl Sagan
(widely used public image)

Abell 194
Credit: Palomar Observatory, courtesy of Caltech



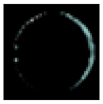
Tonight let's have a look at one of the most elusive Messiers of all as we head about two fingerwidths northeast of Eta Pisces in search of M74 (RA 01 36.7 Dec +15 47).

Discovered at the end of September 1780 by Méchain, M74 is a real challenge to smaller backyard telescopes—even at magnitude 9. This near perfect presentation of a face-on spiral galaxy has low surface brightness, and it takes really optimal conditions to spot much more than its central region. Located about 30 to 40 million light-years away, M74 is roughly the size as the Milky Way, yet contains no central bar. Its tightly wound spiral arms contain clusters of young blue stars and traces of nebulous star forming regions that can be seen in photos, yet little more than some vague concentrations in structure are all that can be noted visually even in a large scope. Yet, if sky conditions are great, even a small telescope can see details! Add the slightest bit of light pollution and even the biggest scopes will have problems locating it.

Don't be disappointed if all you see is a bright nucleus surrounded by a small hazy glow—just try again another time. Who knows what might happen? A supernova was discovered in 2002 by a returning amateur and again in 2003 from the southern hemisphere. When it comes to M74, this is the very best time of year to try with a smaller scope!

M74
Credit: R. Jay GaBany

NOV 11
SUNDAY



Vesto Slipher
(widely used public image)

Heads up! Tonight Antares will be within a half degree of the very young crescent Moon. For some observers, this could be an occultation, so be sure to check IOTA information.

A true observer was born on this day 1875. His name was Vesto Slipher, who spent some very quality time with the 60" and 100" telescopes on Mt. Wilson. Slipher was the first to photograph galaxy spectra and measure their redshifts, which led to the discovery of the expansion of the universe by Edwin Hubble.

On this night in 1572, the incomparable Tycho Brahe set out to record a bright new star. Today we realize he was looking at a supernova! "Visible" now as a supernova remnant only at very long wavelengths in the constellation of Cassiopeia, if you are good with your finderscope, you can still view it as a 7th magnitude star. Using Gamma, Alpha and Beta as your visual starting point, use binoculars to locate Kappa just north of this trio. Small Kappa will also be part of a configuration of stars which will look much like our starting point, only much dimmer. From Kappa, you will see a line of stars heading northwest. The very first in this series of 7th magnitude stars is SN 1572 (RA 00 25 08.07 Dec +64 09 55.7). According to Tycho's report from Burnham's Celestial Handbook:

"On the 11th day of November in the evening after sunset, I was contemplating the stars in a clear sky. I noticed that a new and unusual star, surpassing the other stars in brilliancy, was shining almost directly above my head; and since I had, from boyhood, known all the stars of the heavens perfectly, it was quite evident to me that there had never been any star in that place of the sky, even the smallest, to say nothing of a star so conspicuous and bright as this. I was so astonished of this sight that I was not ashamed to doubt the trustworthyness of my own eyes. But when I observed that others, on having the place pointed out to them, could see that there was really a star there, I had no further doubts. A miracle indeed, one that has never been previously seen before our time, in any age since the beginning of the world."

So bright was the event, that it rivaled Jupiter at the time and soon surpassed Venus—being visible during the day for nearly two weeks. It had faded by the end of November, slowly changing color to red when it passed away from strong visibility almost 16 months later. We'll be forever glad it wasn't cloudy at the time, for the event inspired Tycho Brahe to dedicate his life to astronomy... And who'd blame him?!

Field of SN 1572
Credit: Palomar Observatory, courtesy of Caltech

Can you spot the thin crescent of the Moon on the western horizon at sunset? Let Jupiter help you. Look for the slim appearance of Selene about 3 fingerwidths south.

Wouldn't we all have loved to have been there in 1949 when the first scientific observations were made with the Palomar 5-meter (200-inch) telescope? Or to have seen what Voyager I saw as it made its closest approach to Saturn on this date in 1980? To watch Space Shuttle Columbia launch in 1981? Or even better, to have been around in 1833—the night of the Great Leonid Meteor Shower! But this is here and now, so let's make our own mark on the night sky as we view the Moon.

This evening have a look at the lunar surface and the southeast shoreline of Mare Crisium for Agarum Promontorium. To a small telescope it will look like a bright peninsula extending northward across the dark plain of Crisium's interior, eventually disappearing beneath the ancient lava flow. Small crater Fahrenheit can be spotted at high power to the west of Agarum, and it is just southeast of there that Luna 24 landed. If you continue south of Agarum along the shoreline of Crisium you will encounter 15 kilometer high Mons Usov. To its west is a gentle rille known as Dorsum Termier - where the Luna 15 mission remains lie. Can you spot 23 kilometer wide Shapely further south?

While skies are fairly dark be sure to keep watch for members of the Pegasid meteor shower—the radiant is roughly near the Great Square. This stream endures from mid-October until late November, and used to be quite spectacular. Watch for the peak on November 17.

3 Day Moon
Credit: Ricardo Borba

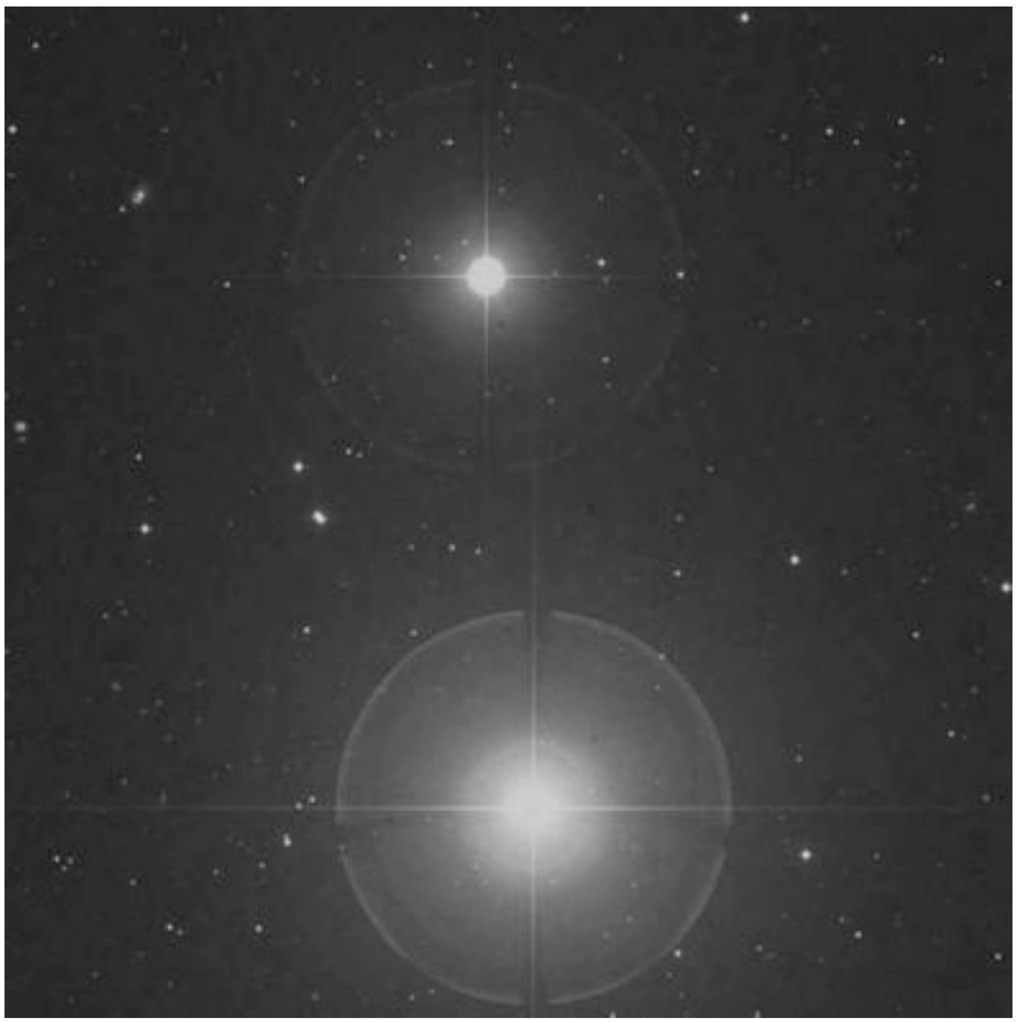
NOV 13
TUESDAY

James Clerk Maxwell
(widely used public image)

Today is the birthday of James Clerk Maxwell. Born in 1831, Maxwell was a leading English theoretician on electromagnetism and the nature of light.

Tonight when you've explored the lunar surface on your own, let's take a journey of 150 light-years as we honor Maxwell's theories of electricity and magnetism as we take a look at a star that is in nuclear decay—Alpha Ceti.

Its name is Menkar, and this second magnitude orange giant is slowly using up its nuclear fuel and gaining mass. According to Maxwell's theories of the electromagnetic and weak nuclear forces, W bosons must exist in such circumstances—this was an extremely advanced line of thinking for the time. Without getting deep into the physics, simply enjoy reddish Alpha for the beauty that it is. Even small telescopes will reveal its 5th magnitude optical partner 93 Ceti to the north. It's only another 350 light-years further away! You'll be glad you took the time to look this one up, because the wide separation and color contrast of the pair make this tribute to Maxwell worth your time!



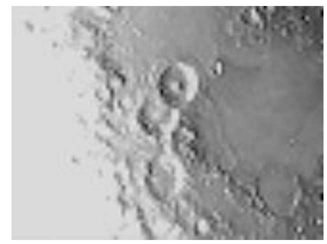
Alpha Ceti: Menkar
Credit: Palomar Observatory, courtesy of Caltech

Nov 14
WEDNESDAY

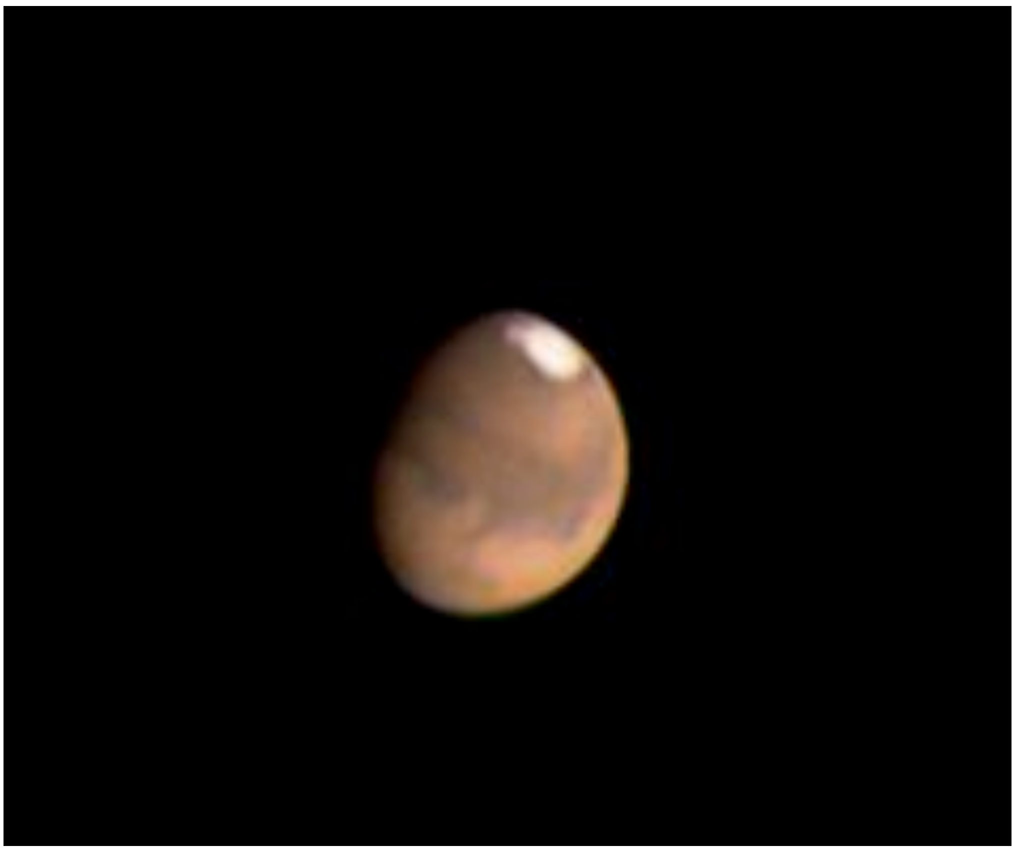
Up before dawn this morning? Take the time to look on the eastern horizon and see if you can still spot Mercury!

This evening on the Moon we will be returning to familiar features Theophilus, Cyrillus and Catharina. Why not take the time to really power up on them and look closely? Curving away just to the southwest of Catharina on the terminator is another lunar challenge feature, Rupes Altai, or the Altai Scarp. Look for smaller craters beginning to emerge, such as Kant to the northwest, Ibn-Rushd just northwest of Cyrillus and Tacitus to the west.

On this day in 1971, Mariner 9 became the first space probe to orbit Mars. Why not wait until the Red Planet rises above the atmosphere's influence and have a look at it as well? Right now (and until the end of the year) is one of the best times to view Mars at a reasonable hour. Enjoy!



Theophilus, Cyrillus, Catharina
and the Altai Scarp
Credit: Ricardo Borba



Mars
Credit: Wes Higgins

NOV 15
THURSDAY

Sir William Herschel
(widely used public image)

Today marks a very special birthday in history. On this day in 1738, my personal hero William Herschel was born. Among this British astronomer and musician's many accomplishments, Herschel was credited with the discovery of the planet Uranus in 1781, the motion of the Sun in the Milky Way in 1785, Castor's binary companion in 1804; and he was the first to record infrared radiation. Herschel was well known as the discoverer of many clusters, nebulae, and galaxies. This came through his countless nights studying the sky and writing catalogs whose information we still use today. Just look at how many we've logged this year! Tonight let's look towards Cassiopeia as we remember this great astronomer...

Almost everyone is familiar with the legend of Cassiopeia and how the Queen came to be bound in her chair, destined for an eternity to turn over and over in the sky, but did you know that Cassiopeia holds a wealth of double stars and galactic clusters? Seasoned sky watchers have long been familiar with this constellation's many delights, but let's remember that not everyone knows them all, and tonight let's begin our exploration of this Cassiopeia with two of its primary stars.

Looking much like a flattened "W," its southern-most bright star is Alpha. Also known as Schedar, this magnitude 2.2 spectral type K star was once suspected of being a variable, but no changes have been detected in modern times. Binoculars will reveal its orange/yellow coloring, but a telescope is needed to bring out its unique features. In 1781, Herschel discovered a 9th magnitude companion star and our modern optics easily separate the blue/white component's distance of 63". A second, even fainter companion at 38" is mentioned in the list of double stars and even a third at 14th magnitude was spotted by S.W. Burnham in 1889. All three stars are optical companions only, but make 150 to 200 light-year distant Schedar a delight to view!

Just north of Alpha is the next destination for tonight...Eta Cassiopeiae. Discovered by Herschel in August of 1779, Eta is quite possibly one of the most well-known of binary stars. The 3.5 magnitude primary star is a spectral type G, meaning it has a yellowish color much like our own Sun. It is about 10% larger than Sol and about 25% brighter. The 7.5 magnitude secondary (or B star) is very definitely a K-type: metal poor, and distinctively red. In comparison, it is half the mass of our Sun, crammed into about a quarter of its volume and is around 25 times dimmer. In the eyepiece, the B star will angle off to the northwest, providing a wonderful and colorful look at one of the season's finest!

Alpha Cassiopeiae
Credit: Palomar Observatory, courtesy of Caltech

Eta Casseopeia
Credit: Palomar Observatory, courtesy of Caltech

NOV 16
FRIDAY

Today in 1974, there was a party at Arecibo, Puerto Rico, as the new surface of the giant 1000-foot radio telescope was dedicated. At this time, a quick radio message was released in the direction of the globular cluster M13.

To give you a rough idea of how large craters really are on the Moon, take a look at Sacrobosco tonight—just west of the Theophilus, Cyrillus and Catharina trio. When you've located it, power up. As huge as the Arecibo dish looks, it would take 91 of them lined side by side to reach from edge to edge of Sacrobosco's largest interior crater. Can you imagine the possibilities if we could use a lunar crater to house an even larger radio telescope?!

Now wait for the Moon to set, because the annual Leonid meteor shower is underway. For those of you seeking a definitive date and time, it isn't always possible. The meteor shower itself belongs to the debris shed by comet 55/P Tempel-Tuttle as it passes our Sun in its 33.2 year orbital period. Although it was once assumed that we would merely add around 33 years to each observed "shower," we later came to realize that the debris formed a cloud that lagged behind the comet and dispersed irregularly. With each successive pass of Tempel-Tuttle, new filaments of debris were left in space along with the old ones, creating different "streams" that the orbiting Earth passes through at varying times, which makes blanket predictions unreliable at best.

Sacrobosco
Credit: Wes Higgins

Arecibo
(widely used image)

Nov 17
SATURDAY

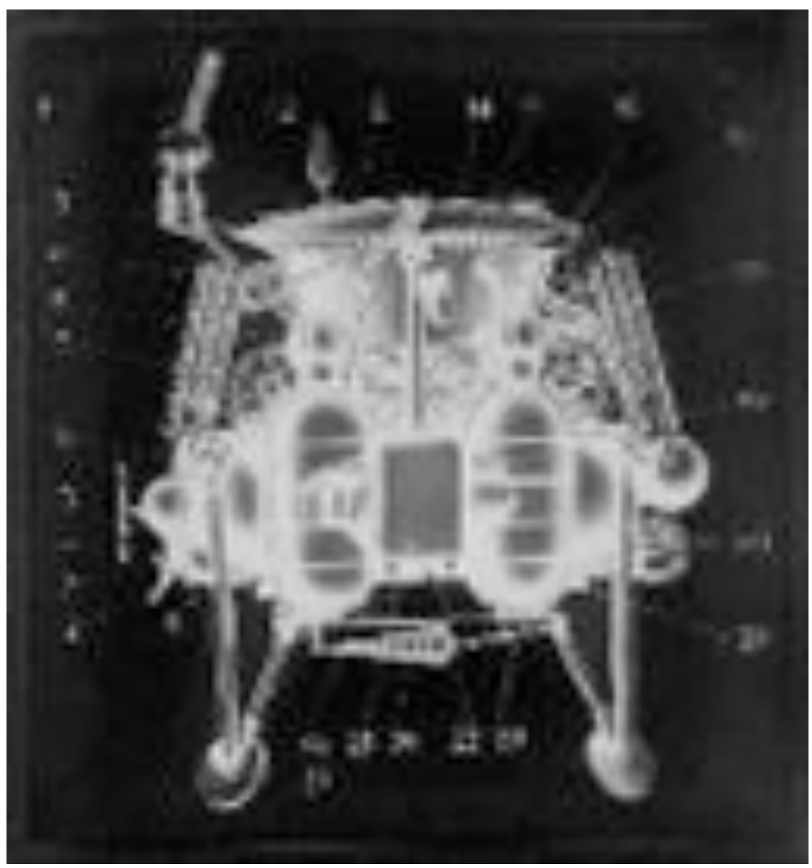
Leonid Meteor Shower
Credit: NASA

If you didn't stay up late, then get up early this morning to catch the Leonids. Each year during November, we pass through the filaments of debris—both old and new—and the chances of impacting a particular stream from any one particular year of Tempel-Tuttle's orbit becomes a matter of mathematical estimates. We know when it passed... We know where it passed... But will we encounter it and to what degree?

Traditional dates for the peak of the Leonid meteor shower occur as early as the morning of November 17 and as late as November 19, but what about this year? On November 8, 2005 the Earth passed through an ancient stream shed in 1001. Predictions ran high for viewers in Asia, but the actual event resulted in a dud. There is no doubt that we crossed through that stream, but its probability of dissipation is impossible to calculate. Debris trails left by the comet in 1333 and 1733 look the most promising for this year, but we simply don't know.

We may never know precisely where and when the Leonids might strike, but we do know that a good time to look for this activity is well before dawn on November 17, 18 and 19th. With the Moon mostly out of the way, wait until the radiant constellation of Leo rises and the chances are good of spotting one of the offspring of periodic comet Tempel-Tuttle. Your chances increase significantly by traveling a dark sky location, but remember to dress warmly and provide for your viewing comfort.

On this day in 1970, the long running Soviet mission Luna 17 successfully landed on the Moon. Its Lunokhod 1 rover became the first wheeled vehicle on the Moon. Lunokhod was designed to function three lunar days but actually operated for eleven. The machinations of Lunokhod officially stopped on October 4, 1971, the anniversary of Sputnik 1. Lunokhod had traversed 10,540 meters, transmitted more than 20,000 television pictures, over 200 television panoramas and performed more than 500 lunar soil tests. We'll take a look at its landing site in the days ahead. *Spaseba!*



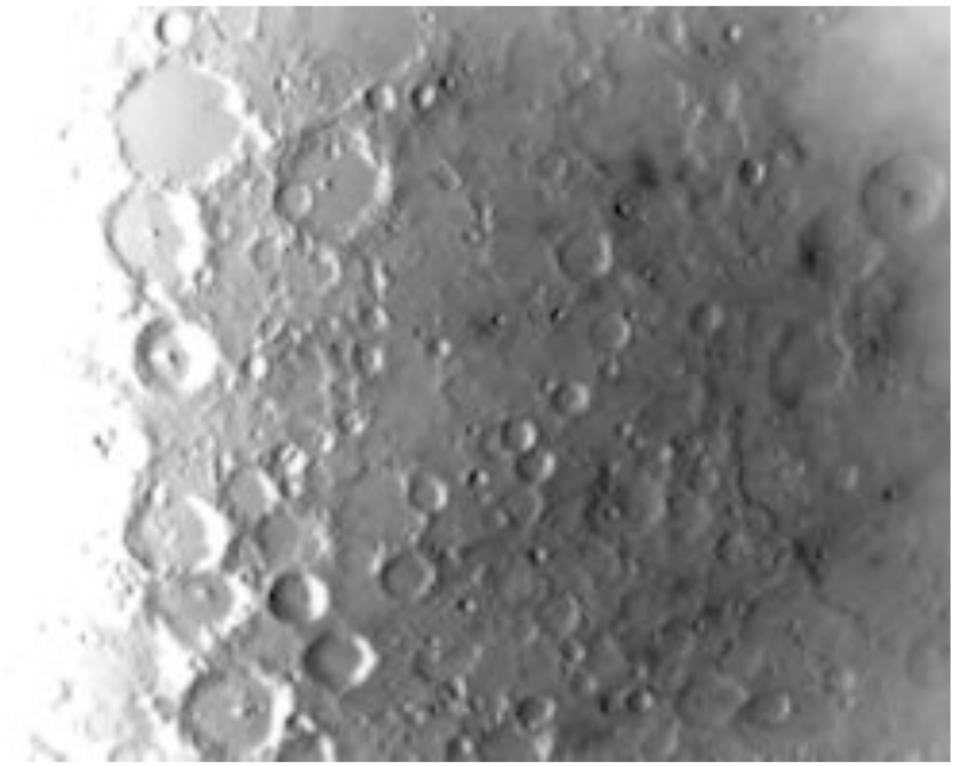
Luna 17
Credit: NASA

Nov 18
Sunday

If you got clouded out of the Leonids yesterday morning, there is no harm in trying again before dawn! The meteor stream varies, and your chances are still quite good of catching one of these bright meteors.

Tonight let's head toward the lunar surface as we have a look at a series of lunar club challenges you may not have logged yet. Just slight below central towards lunar south, look for a series of rings which grow smaller as they progress. Once again, these are Ptolemaeus, Alphonsus and Arzachel. But, focus your attention on the largest of these, and in particular the small crater caught on its northern edge.

Named for Sir William himself, crater Herschel spans 41 kilometers wide and drops to a depth of 3770 kilometers below the surface. While you're journeying, look for small Ammonius caught in Ptolemaeus' interior. Further south, see if you can catch Alphonsus' bright central peak. Ranger 9's remains lay just northeast of there!

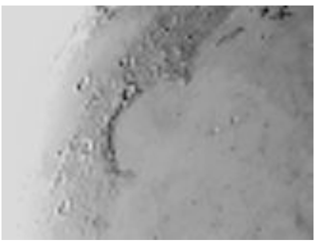


Ptolemaeus, Alphonsus and Arzachel
Credit: Greg Konkel

Nov 19
MONDAY

Even if you only use binoculars tonight, you can't miss the beautiful C-shape of Sinus Iridium as it comes into view on the lunar surface. As we have learned, the mountains that ring it are called the Juras, and the crater punctuating them is named Bianchini. Do you remember what the bright tips of the opening into the "Bay of Rainbows" are called? That's right: Promontorium LaPlace to the northeast and Promontorium Heraclides to the southwest. Now take a good look at Heraclides... Just south of here is where Luna 17 landed, leaving the Lunokhod rover to explore!

Now turn your eyes or binoculars just west of bright Aldebaran and have a look at the Hyades Star Cluster. While Aldebaran appears to be part of this large, V-shaped group, it is not an actual member. The Hyades cluster is one of the nearest galactic clusters, and it is roughly 130 light-years away in the center. This moving group of stars is drifting slowly away towards Orion, and in another 50 million years it will require a telescope to view!



Sinus Iridium
Credit: Ricardo Borba

The Hyades Star Cluster
Credit: NASA

Today celebrates another significant astronomer's birth—Edwin Hubble. Born 1889, Hubble became the first American astronomer to identify Cepheid variables in M31—which in turn established the extragalactic nature of the spiral nebulae. Continuing with the work of Carl Wirtz, and using Vesto Slipher's redshifts, Hubble then could calculate the velocity-distance relation for galaxies. This has become known as "Hubble's Law" and demonstrates the expansion of our Universe.

Tonight we're going to ignore the Moon and head just a little more than a fistwidth west of the westernmost bright star in Cassiopeia to have a look at Delta Cephei (RA 22 29 10.27 Dec +58 24 54.7). This is the most famous of all variable stars and the granddaddy of all Cepheids. Discovered in 1784 by John Goodricke, its changes in magnitude are not due to a revolving companion—but rather the pulsations of the star itself.

Edwin Hubble
(widely used public image)

Ranging over almost a full magnitude in 5 days, 8 hours and 48 minutes precisely, Delta's changes can easily be followed by comparing it to nearby Zeta and Epsilon. When it is its dimmest, it will brighten rapidly in a period of about 36 hours—yet take 4 days to slowly dim again. Take time out of your busy night to watch Delta change and change again. It's only 1000 light-years away, and doesn't even require a telescope! (But even binoculars will show its optical companion...)

Delta Cephei
Credit: Palomar Observatory, courtesy of Caltech

Nov 21
Wednesday

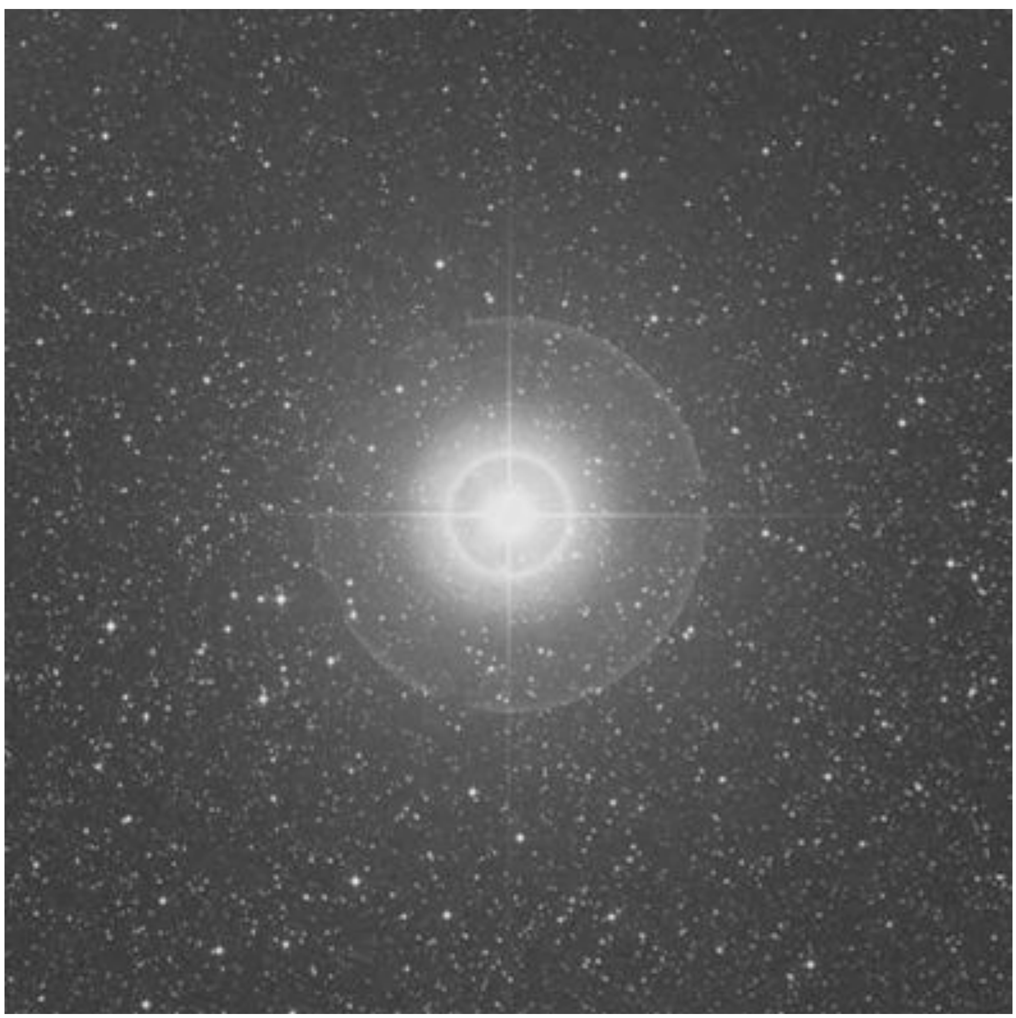
Tonight the gibbous Moon will dominate the sky. If you haven't had a chance to log some features like Copernicus, Gassendi, Tycho and Plato—be sure to pick them up before the glare overpowers them. While you're there, be sure to look for "the Man in the Moon!"

Now, let's continue our stellar studies with the central-most star in the lazy "W" of Cassiopeia—Gamma...

At the beginning of the 20th century, the light from Gamma appeared to be steady, but in the mid-1930s it took an unexpected rise in brightness. In less than 2 years it jumped by a magnitude! Then, just as unexpectedly, it dropped back down again in roughly the same amount of time. A performance it repeated some 40 years later!

Gamma Cassiopeiae isn't quite a giant and is still fairly young on the evolutionary scale. Spectral studies show violent changes and variations in the star's structure. After its first recorded episode, it ejected a shell of gas which expanded Gamma's size by over 200%—yet it doesn't appear to be a candidate for a nova event.

The best estimate now is that Gamma is around 100 light-years away and approaching us a very slow rate. If conditions are good, you might be able to telescopically pick up its disparate 11th magnitude visual companion, discovered by Burnham in 1888. It shares the same proper motion—but doesn't orbit this unusual variable star. For those who like a challenge, visit Gamma again on a dark night! Its shell left two bright (and difficult!) nebulae, IC 59 and IC 63, to which we will return at the end of the month…

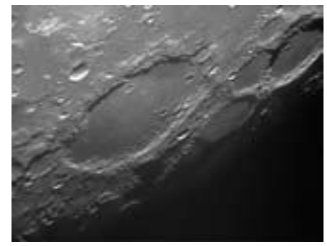


Gamma Cassiopeiae
Credit: Palomar Observatory, courtesy of Caltech

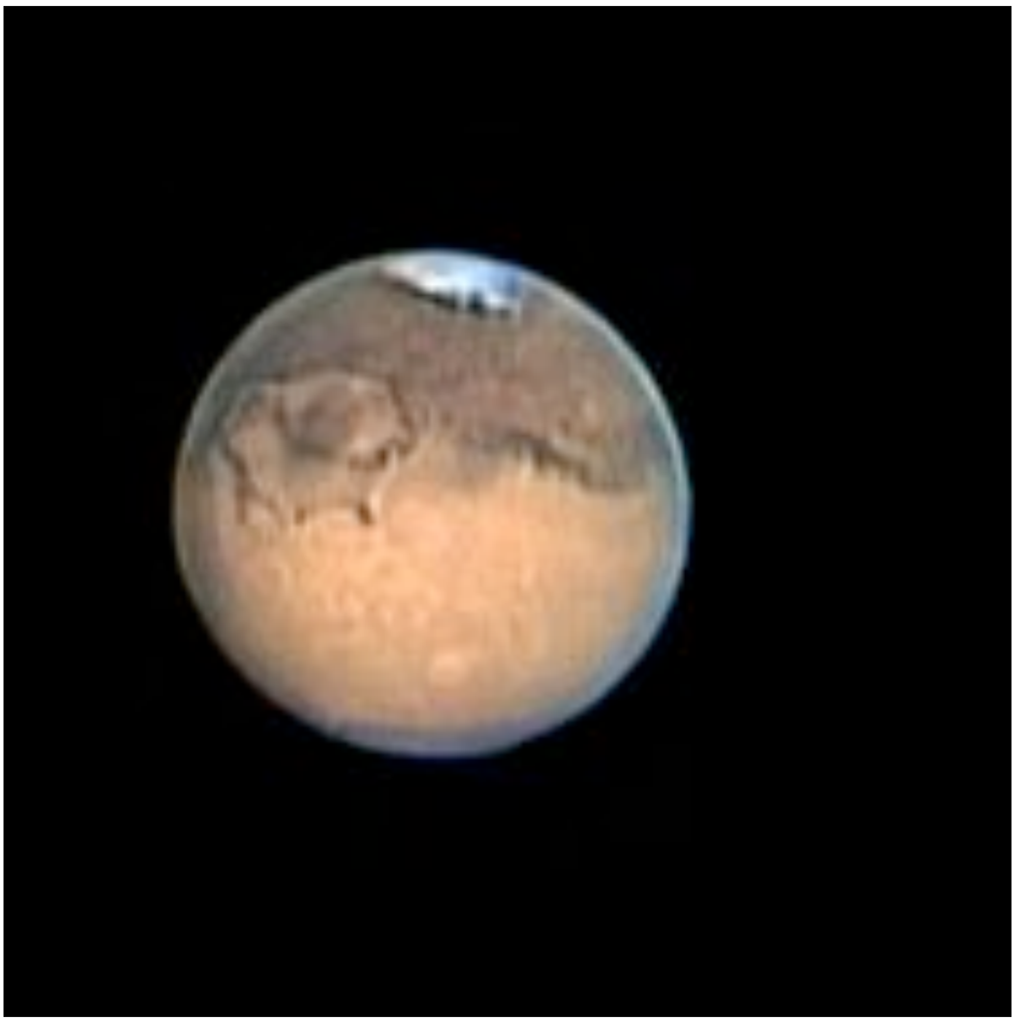
As our observing year draws to a close, let's take another look at a feature you might have missed - Wargentin. Located in the southwest quadrant on the terminator just south of the larger crater Schickard, we return again because Wargentin is one of the Moon's most well-known curiosities. Able to be captured in binoculars, but best seen through a telescope at high power, really take a look at what was once a normal small crater! Unlike most craters, Wargentin's walls were solid - able to contain the lava which eventually filled it to a height of 84 meters above the lunar surface.

While at first you might not notice, compare it to nearby Nasmyth and Phocylides. While both of these craters go below the surface, they also contain interior strikes - Wargentin has none! Except for a gentle, unnamed rille across its elevated surface, Wargentin is smooth.

While we still have about a month until it reaches opposition, the "Red Planet" is always worthy of a little attention. While Mars isn't at its closest right now, this will be the only time this year that we can view it in the evening. Catch it now—before the Moon catches up with it in the days ahead!



Schickard and Wargentin
Credit: Roger Warner

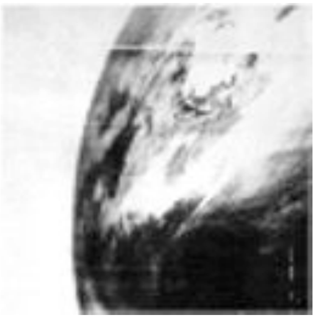


Mars
Credit: Wes Higgins

Nov 23
FRIDAY

Tonight in 1885, the very first photograph of a meteor shower was taken. Also, the weather satellite TIROS II was launched on this day in 1960. Carried to orbit by a three-stage Delta rocket, the "Television Infrared Observation Satellite" was about the size of a barrel, testing experimental television techniques and infrared equipment. Operating for 376 days, Tiros II sent back thousands of pictures of Earth's cloud cover and was successful in its experiments to control the orientation of the satellite spin and its infrared sensors. Oddly enough, a similar mission—Meteosat 1—also became the first satellite put into orbit by the European Space Agency, in 1977 on this day. Where is all this leading? Why not try observing satellites on your own! Thanks to wonderful on-line tools from NASA you can be alerted by e-mail whenever a bright satellite makes a pass for your specific area. It's fun!

Now, let's explore tonight's lunar feature—Galileo. It is a challenge for binoculars to spot this feature, but telescopes of any size capable of higher power will find it easily on the terminator in the west-northwest section of the Moon. Set in the smooth sands of Oceanus Procellarum, Galileo is a very tiny, eye-shaped crater and has a soft rille that accompanies it. It was named for the very man who first viewed and contemplated the Moon through a telescope. No matter what lunar resource you choose to follow, all agree that giving such an insignificant crater a great name like Galileo is unthinkable! For those of you familiar with some of the outstanding lunar features, read any good account of Galileo's life and just look at how many spectacular craters were named for people he supported! We cannot change the names of lunar cartography, but we can remember Galileo's many accomplishments each time we view this crater…



TIROS Image of Earth
Credit: NASA

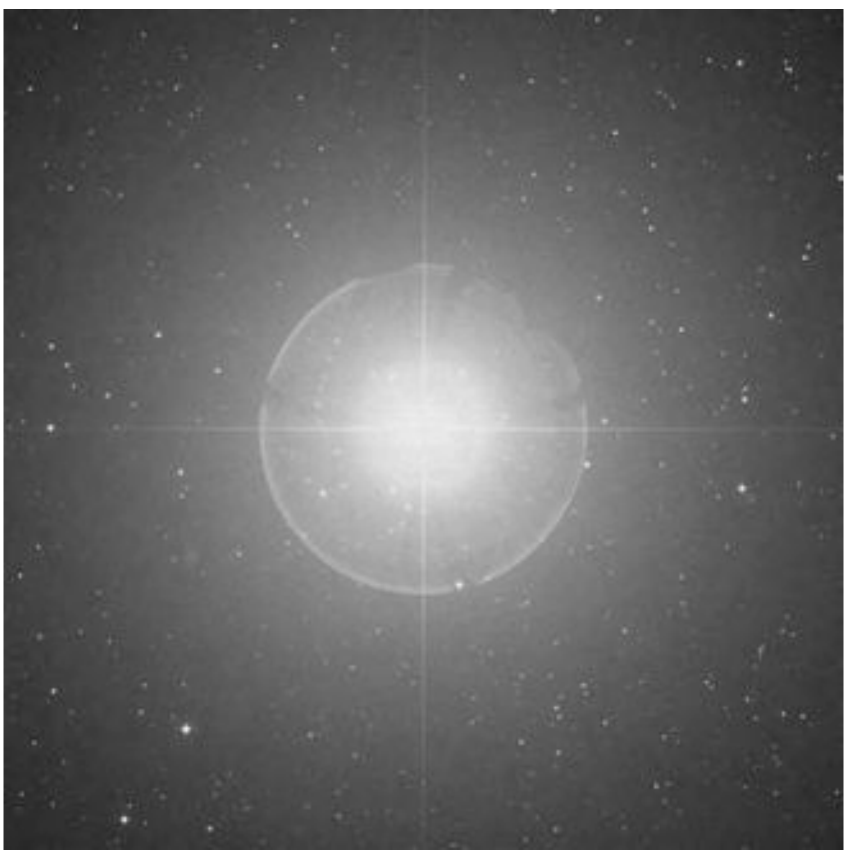
"A Galileo Moon"
Credit: Roger Warner

Tonight it is Full "Frost Moon" and there is little doubt about how its name came to be! For those of you interested in viewing lunar features tonight, libration could be favorable to study a collection of shallow, dark craters known as Mare Australe. Located on the southeastern limb, this large binocular and telescopic object is well-worth looking for because it's a challenge that isn't always visible.

Ready to aim for a bullseye? Then head for the bright, reddish star Aldebaran. Set your eyes, scopes or binoculars there and let's look into the "eye" of the Bull.

Known to the Arabs as Al Dabaran, or "the Follower," Alpha Tauri took its name for the fact that it appears to follow the Pleiades across the sky. In Latin it was Stella Dominatrix, yet the old English knew it as Oculus Tauri, or very literally the "eye of Taurus." No matter which source of ancient astronomy lore we explore, there are references to Aldeberan.

As the 13th brightest star in the sky, it almost appears from Earth to be a member of the V-shaped Hyades star cluster, but its association is merely coincidental, since it is about twice as close to us as the cluster. In reality, Aldeberan is on the small end as far as K5 stars go, and like many other orange giants could possibly be a variable. Aldeberan is also known to have five close companions, but they are faint and very difficult to observe with backyard equipment. At a distance of approximately 68 light-years, Alpha is only about 40 times larger than our own Sun and approximately 125 times brighter. To get a grasp on that size, think of it as being about the same size as the area Earth's orbit! Because of its position along the ecliptic, Aldeberan is one of the very few stars of first magnitude that can be occulted by the Moon.



Aldeberan
Credit: Palomar Observatory, courtesy of Caltech

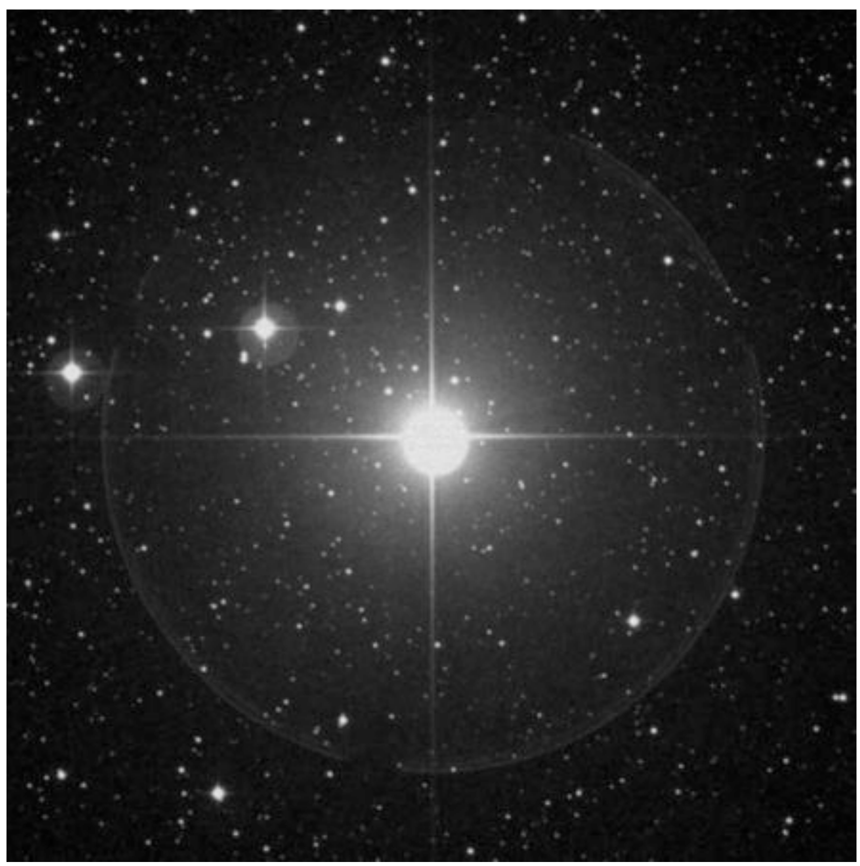
Nov 25
SUNDAY

While Cassiopeia is in prime position for most northern observers, let's return tonight for some additional studies. Starting with Delta, let's hop to the northeast corner of our "flattened W" and identify 520 light-year distant Epsilon. For larger telescopes only, it will be a challenge to find this 12" diameter, magnitude 13.5 planetary nebula I.1747 in the same field as magnitude 3.3 Epsilon!

Using both Delta and Epsilon as our "guide stars" let's draw an imaginary line between the pair extending from southwest to northeast and continue the same distance until you stop at visible Iota. Now go to the eyepiece...

As a quadruple system, Iota will require a telescope and a night of steady seeing to split its three visible components. Approximately 160 light-years away, this challenging system will show little or no color to smaller telescopes, but to large aperture, the primary may appear slightly yellow and the companion stars a faint blue. At high magnification, the 8.2 magnitude "C" star will easily break away from the 4.5 primary, 7.2" to the east-southeast. But look closely at that primary: hugging in very close (2.3") to the west-southwest and looking like a bump on its side is the B star!

Dropping back to the lowest of powers, place Iota to the southwest edge of the eyepiece. It's time to study two incredibly interesting stars that should appear in the same field of view to the northeast. When both of these stars are at their maximum, they are easily the brightest of stars in the field. Their names are SU (southernmost) and RZ (northernmost) Cassiopeiae and both are unique! SU is a pulsing Cepheid variable located about 1000 light-years away and will show a distinctive red coloration. RZ is a rapidly eclipsing binary that can change from magnitude 6.4 to magnitude 7.8 in less than two hours. Wow!



Iota Cassiopeiae
Credit: Palomar Observatory, courtesy of Caltech

Today in 1965 marked the launch of the first French satellite—Asterix 1. Today is also the seventh anniversary of the discovery of the meteorites SAU 005 & 008: the "Mars Meteorites." These meteorites are known to be of Martian origin because of gases preserved in the glassy material of their interior. They were hurled into space some 600,000 years ago when a probable asteroid impact on Mars tossed them high enough to escape the planet's gravity, and they were captured by our gravity these many thousands of years later. They are just two of the 32 meteorites found on Earth which have been positively determined from their chemical compositions to be of Martian origin.

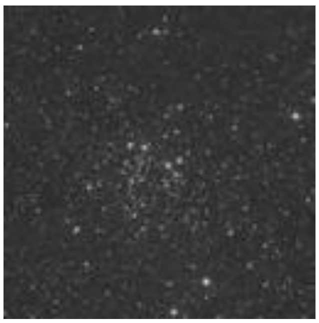
Thanks to just a slightly later rise of the Moon, let's return again to Cassiopeia and start at the central-most bright star, Gamma. Four degrees southeast is our marker for this starhop, Phi Cassiopeiae. By aiming binoculars or telescopes at this star, it is very easy to locate an interesting open cluster, NGC 457, because they will be in the same field of view.

This bright and splendid galactic cluster has received a variety of names over the years because of its uncanny resemblance to a figure. Some call it an "Angel," others see it as the "Zuni Thunderbird;" I've heard it called the "Owl" and the "Dragonfly," but perhaps my favorite is the "E.T. Cluster," As you view it, you can see why! Bright Phi and HD 7902 appear like "eyes" in the dark and the dozens of stars that make up the "body" appear like outstretched "arms" or "wings." (For E.T. fans? Check out the red "heart" in the center.)

All this is very fanciful, but what is NGC 457, really? Both Phi and HD 7902 may not be true members of the cluster. If 5th magnitude Phi were actually part of this grouping, it would have to have a distance of approximately 9300 light-years, making it the most luminous star in the sky, far outshining even Rigel! To get a rough of idea of what that means, if we were to view our own Sun from this far away, it would be no more than magnitude 17.5. The fainter members of NGC 457 comprise a relatively young star cluster that spans about 30 light-years. Most of the stars are only about 10 million years old, yet there is an 8.6 magnitude red supergiant in the center. No matter what you call it, NGC 457 is an entertaining and bright cluster that you will find yourself returning to again and again. Enjoy!

NGC 457
Credit: NOAO/AURA/NSF

NOV 27
TUESDAY



NGC 663
Credit: Palomar Observatory, courtesy of Caltech

Tonight let's take advantage of early dark and venture further into Cassiopeia. Returning to Gamma, we will move towards the southeast and identify Delta. Also known as Ruchbah, this long-term and very slight variable star is about 45 light-years away, but we are going to use it as our marker as we head just one degree northeast and discover M103.

As the last object in the original Messier catalog, M103 (NGC 581) was actually credited to Méchain in 1781. Easily spotted in binoculars and small scopes, this rich open cluster is around magnitude 7, making it a prime study object. At about 8000 light-years away and spanning approximately 15 light-years, M103 offers up superb views in a variety of magnitudes and colors, with a notable red in the south and a pleasing yellow and blue double to the northwest.

Viewers with telescopes and larger binoculars are encouraged to move about a degree and half east of M103 to view a small and challenging chain of open clusters, NGCs 654, 663 and 659! Surprisingly larger than M103, NGC 663 is a lovely fan-shaped concentration of stars with about 15 or so members that resolve easily to smaller aperture. For the telescope, head north for NGC 654, (difficult, but not impossible to even a 114mm scope) which has a bright star on its southern border. South of NGC 663 is NGC 659 which is definitely a challenge for small scopes, but its presence will be revealed just northeast of two conspicuous stars in the field of view.

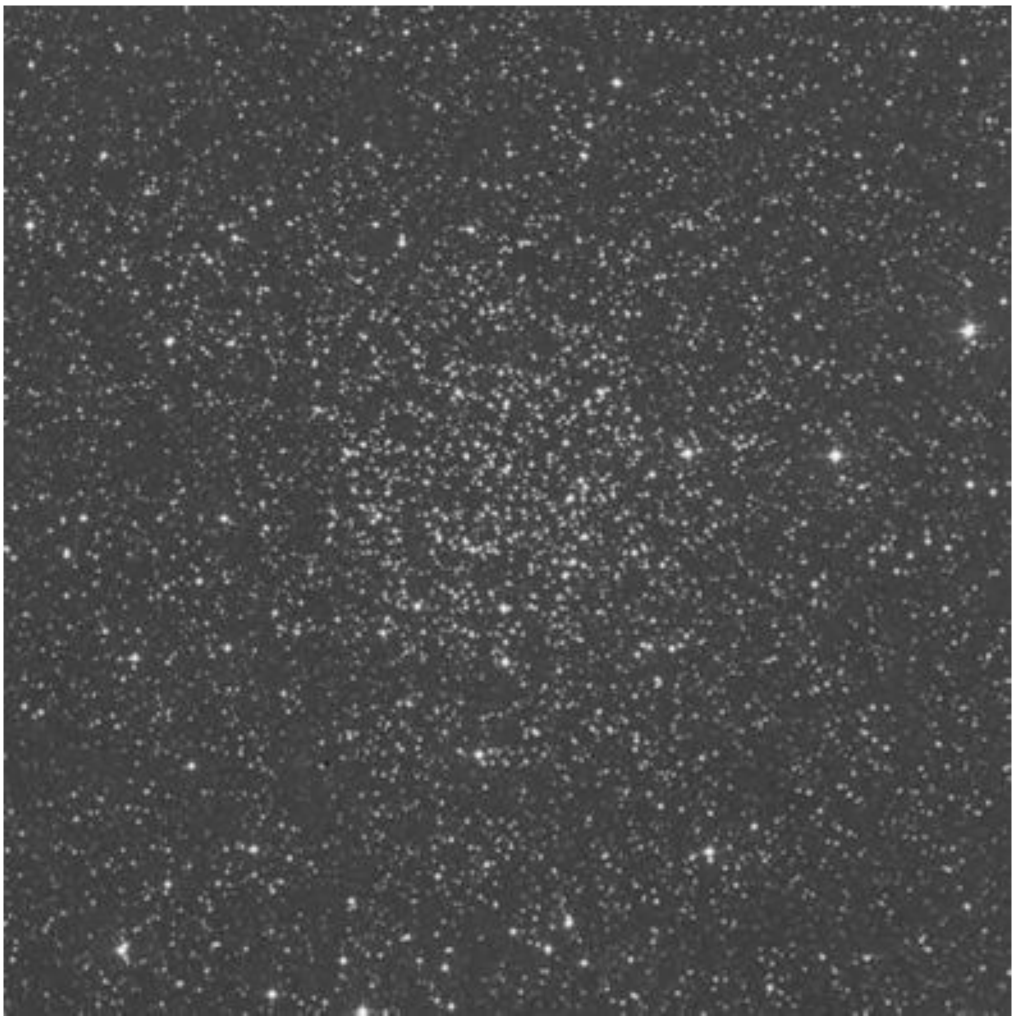
If you are out when the Moon rises tonight, enjoy seeing Mars very nearby—less than 2 degrees away! And speaking of degrees, today is also the birthday of Anders Celsius—born in 1701.

M103
Credit: NOAO/AURA/NSF

Once again utilizing early darkness, let's go back to Cassiopeia. Remembering Alpha's position as the westernmost star, go there with your finderscope or binoculars and locate bright Sigma and Rho (each has a dimmer companion). They will appear to the southwest of Alpha. It is between these two stars that you will find NGC 7789 (RA 23 57 24.00 Dec +56 42 30.0).

Absolutely one of the finest of rich galactic opens bordering on a loose globular, NGC 7789 has a population of about 1000 stars and spans a mind-boggling 40 light-years. At well over a billion years old, the stars in this 5000 light-year distant galactic cluster have already evolved into red-giants or super-giants. Discovered by Caroline Herschel in the 18th century, this huge cloud of stars has an average magnitude of 10, making it a great large binocular object, a superb small telescope target, and a total fantasy of resolution for larger instruments.

Tonight in 1659, Christian Huygens was busy at the eyepiece—but he wasn't studying Saturn. This was the first time any astronomer had seen dark markings on Mars!



NGC 7789
Credit: Palomar Observatory, courtesy of Caltech

Nov 29
THURSDAY

Today in 1961, Mercury 5 launched Enos the Chimp into fame!

With a short time until the Moon rises tonight, why not journey with me once again to Cassiopeia? We will start our studies with the western-most of the bright stars—Beta. Also known as "Caph," Beta Cassiopeiae is approximately 45 light-years away and is known to be a rapid variable. Viewers with larger telescopes are challenged to find the 14th magnitude optical companion to Caph at about 23" in separation. Tonight, using our previous study stars Alpha and Beta, we are going to learn to locate a Messier object with ease! By drawing an imaginary line between Alpha and Beta, we extend that line the same distance and angle beyond Beta and find M52.

Found on September 7, 1774 by Charles Messier, this magnitude 7 galactic cluster is easily seen in both binoculars and small telescopes. Comprised of roughly 200 members, this open cluster is roughly 3,000 light-years distant and spans approximately 10-15 light-years. Containing stars of several different magnitudes, larger telescopes will easily perceive blue components as well as orange and yellow. Also known as NGC 7654, M52 is a young, very compressed cluster whose approximate age is about the same as the Pleiades.

For those with large telescopes wanting a challenge? Try spotting a faint patch of nebulosity just 36' to the southwest. This is NGC 7635, more commonly known as the "Bubble Nebula." Best of luck!

M52 and the Bubble Nebula
Credit: N. A. Sharp/REU Program/NOAO/AURA/NSF

NOV 30
FRIDAY

If you are up before dawn, Look for bright Venus and cool, blue Spica less than a fistwidth apart—and look for the Moon and Regulus! Less than half a degree of separation means a possible occultation event, so be sure to check IOTA information. Just as a curiosity, on this day in 1954, Elizabeth Hodges was struck by a five kilogram meteorite in Alabama. Duck!

Tonight we will haunt Cassiopeia one last time—with studies for the seasoned observer. Our first challenge of the evening will be to return to Gamma where we will locate two patches of nebulosity in the same field of view. IC 59 and IC 63 are challenging because of the bright influence of the star, but by moving the star to the edge of the field of view you may be able to locate these two splendid small nebulae. If you do not have success with this pair, why not move on to Alpha? About one and a half degrees due east, you will find a small collection of finderscope stars that mark the area of NGC 281 (RA 00 52 25.10 Dec +56 33 54.0). This distinctive cloud of stars and ghostly nebulae make this NGC object a fine challenge!

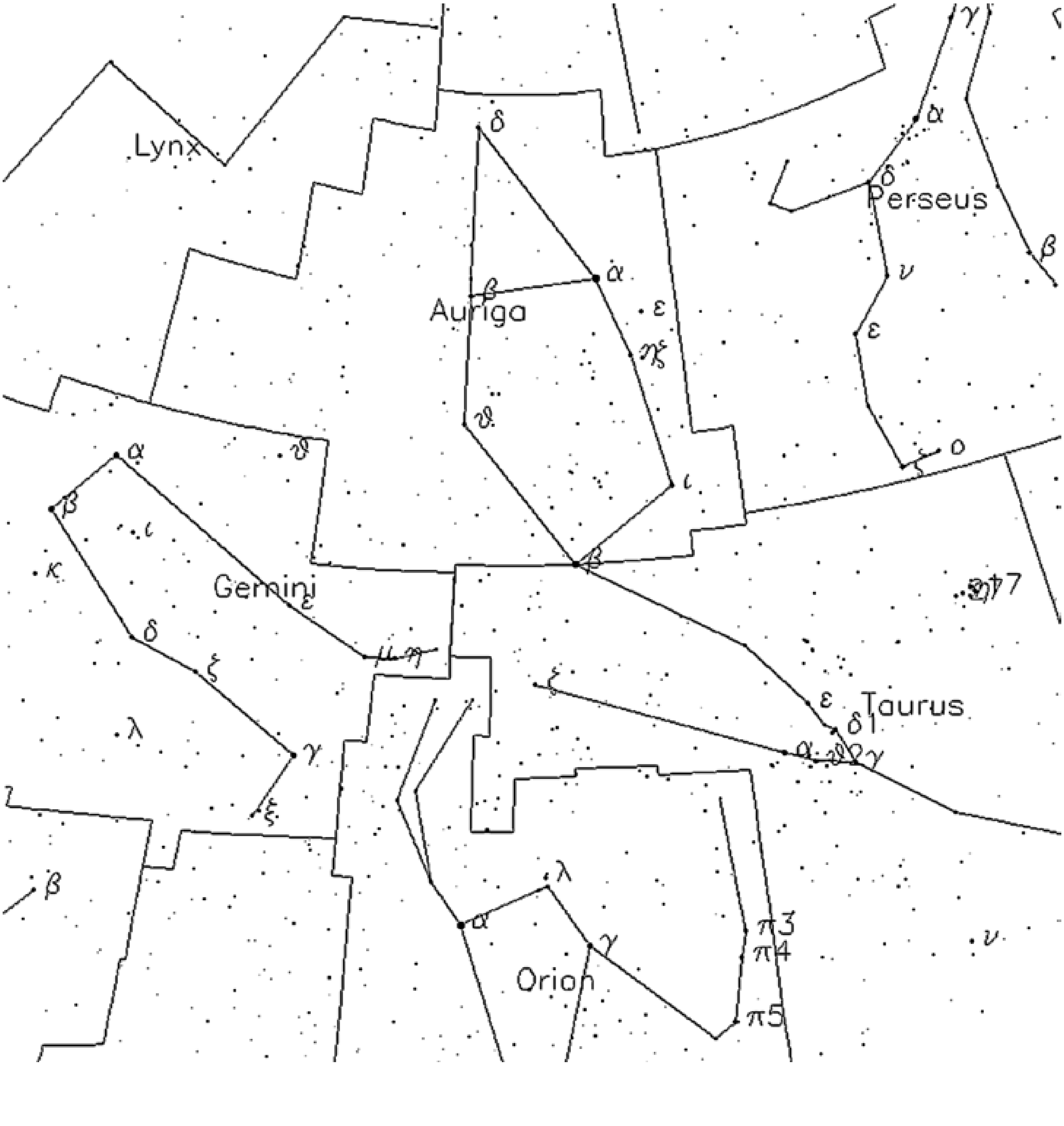
The last things we will study are two small elliptical galaxies that are achievable in mid-sized scopes. Locate Omicron Cassiopeiae about 7 degrees north of M31 and discover a close galactic pair that is associated with the Andromeda group—NGC 185 (RA 00 38 57.40 Dec +48 20 14.4) and NGC 147 (RA 00 33 11.79 Dec +48 30 24.8).

The constellation of Cassiopeia contains many, many more fine star clusters, and nebulae—and even more galaxies. For the casual observer, simply tracing over the rich star fields with binoculars is a true pleasure, for there are many bright asterisms best enjoyed at low power. Scopists will return to "rock with the Queen" year after year for its many challenging treasures. Enjoy it tonight!

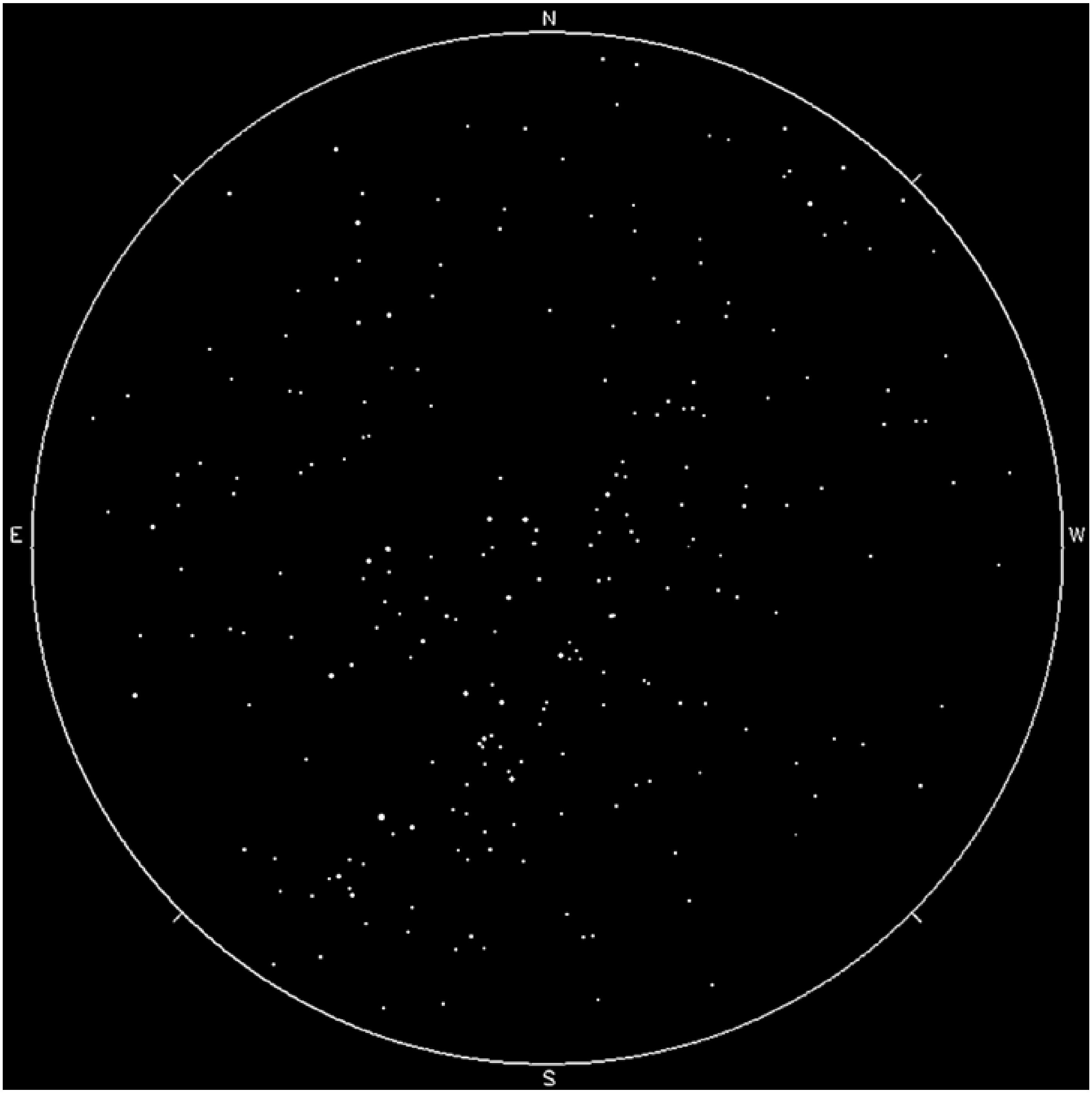
NGC 185
Credit: Palomar Observatory,

NGC 147
Credit: Palomar Observatory, courtesy of Caltech

NGC 281
Credit: Palomar Observatory, courtesy of Caltech


Lynx
Auriga
Perseus
Gemini
Taurus
Orion
π3
π4
π5
δ1

DECEMBER 2007



DEC 1
SATURDAY

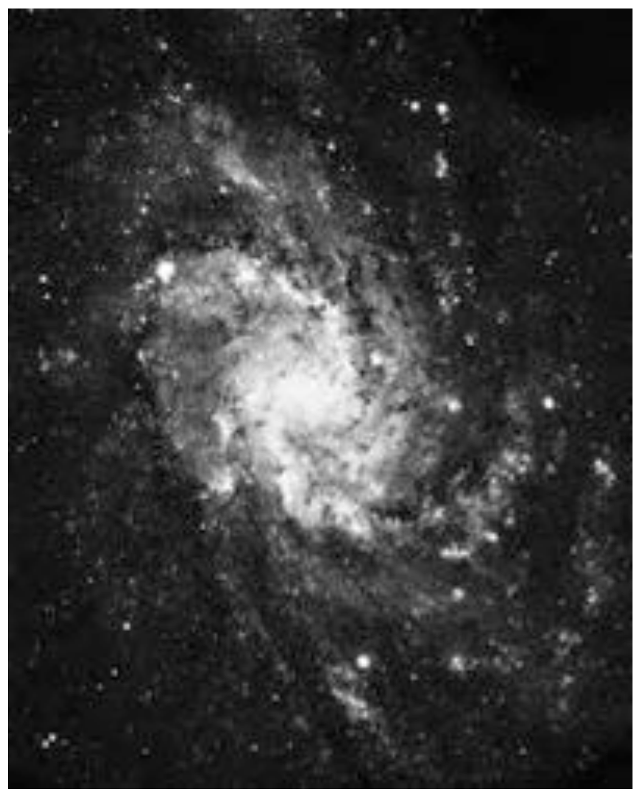
Born today in 1811 was Benjamin (Don Benito) Wilson. He was the namesake of Mt. Wilson, California—home to what once were the largest telescopes in the world—the 60" Hale and the 100" Hooker. Later, three solar telescopes were added on the mountain—two of which are still in use—as well as the CHARA array and active interferometers. It was here that Edwin Hubble first realized the "nebulae" were distant galaxies and discovered Cepheid variables in them. As we approach the end of our SkyWatching year together, let us pretend the skies are still as dark as they were on Mt. Wilson as we aim our binoculars and telescopes towards one of the most elusive galaxies of all—M33.

Located about one-third the distance between Alpha Triangulum and Beta Andromedae (RA 01 33.9 Dec +30 39), this member of our Local Group was probably first seen by Hodierna, but was recovered independently by Messier some 110 years later. Right on the edge of visibility unaided, M33 spans about 4 full moon widths of sky, making it a beautiful binocular object and a prime view in a low power telescope.

Edwin Hubble working
at the Hooker Telescope
(widely used public image)

Smaller than the Milky Way and the Andromeda Galaxy, the Triangulum galaxy is about average in size, but anything but average to study. So impressed was Herschel that he gave it its own designation of H V.17 after having cataloged one of its bright star forming regions as H III.150! In 1926, Hubble also studied M33 at Mt. Wilson with the Hooker telescope during his work with Cepheid variables. Larger telescopes often "can't see" M33 with good reason—it overfills the field of view—but what a view! Not only did Herschel discover a region much like our own Orion Nebula, but the entire galaxy contains many NGC and IC objects (even globular clusters) that can be seen with a larger scope.

Although M33 might be 3 million light-years away, tonight it's as close as your own dark sky site...



M33: The Triangulum Galaxy
Credit: NOAO/AURA/NSF

If you are awake before dawn, enjoy the beauty of Saturn and the Moon as they dance along the ecliptic plane together. For most viewers, the tranquil pair will only be about a fingerwidth apart. Today in 1934, the largest mirror in telescope history began its life as the blank for the 200" telescope was cast in Corning, NY.

The 200" would play another important role as Edwin Hubble continued on at Palomar Observatory. Thanks to his work there, we now understand "Hubble's Law"—the expansion of the Universe. Tonight let us honor that great mind as we take a look at a galaxy that's receding from us—NGC 1300.

Located about a thumb's width north of Tau4 Eridani (RA 03 19.7 Dec -19 25), this is probably the most incredible barred spiral you will ever encounter. At magnitude 10, it will require at least a 4.5" telescope in northern latitudes, but can probably be spotted with binoculars in the far south.

At 75 million light-years away, NGC 1300's central bar alone is larger than the Milky Way, and this galaxy has been intensively studied because the manner of its formation was so similar that of to our own. Although it is so distant, it is seen face-on—allowing us a look at how this formation occurs without looking through the gas and dust which block our own central view. Enjoy this one's fantastic structure!

NGC 1300
Credit: Hilary Mathis/NOAO/AURA/NSF

Today in 1971, the Soviet Mars 3 became the first spacecraft to make a soft landing on the red planet, and two years later on this same date the Pioneer 10 mission became the first spacecraft to fly by Jupiter. One year later on this same date? Pioneer 11 did the same thing!

Tonight let's familiarize ourselves with the vague constellation of Fornax. Its three brightest stars form a shallow V just south of the Cetus/Eridanus border and span less than a handwidth of sky. Although it's on the low side for northern observers, there is a wealth of sky objects in this area.

Try having a look at the easternmost star—40-light-year distant Alpha. At magnitude 4, it is not easy, but what you'll find there is quite beautiful. For binoculars, you'll see a delightful cluster of stars around this long-term binary—but telescopes will enjoy it as a great golden double star! First measured by John Herschel in 1835, the distance between the pair has narrowed and widened over the last 172 years and it is suspected its orbital period may be 314 years. While the 7th magnitude secondary can be spotted with a small scope—watch out—because it may also be a variable which drops by as much as a full magnitude!

Alpha Fornacis
Credit: Palomar Observatory, courtesy of Caltech

Today in 1978, the Pioneer/Venus Orbiter became the first spacecraft to orbit Venus. And in 1996, the Mars Pathfinder mission was launched!

For larger telescopes, set sail for Beta Fornacis tonight and head 3 degrees southwest (RA 02 39 42.5 Dec -34 16 08.0) for a real curiosity—NGC 1049.

At magnitude 13, this globular cluster is a challenge for even large scopes—and with good reason. It isn't in our galaxy. This globular cluster is a member of the Fornax Dwarf Galaxy—a one degree span that's so large it was difficult to recognize as extra-galactic—or at least it was until the great Harlow Shapely figured it out!

NGC 1049 was first discovered and cataloged by John Herschel in 1847, only to be reclassified as "Hodge 3" in a 1961 study of the system's five globular clusters by Paul Hodge. Since that time, yet another globular has been discovered! Good luck...

NGC 1049
Credit: Palomar Observatory, courtesy of Caltech

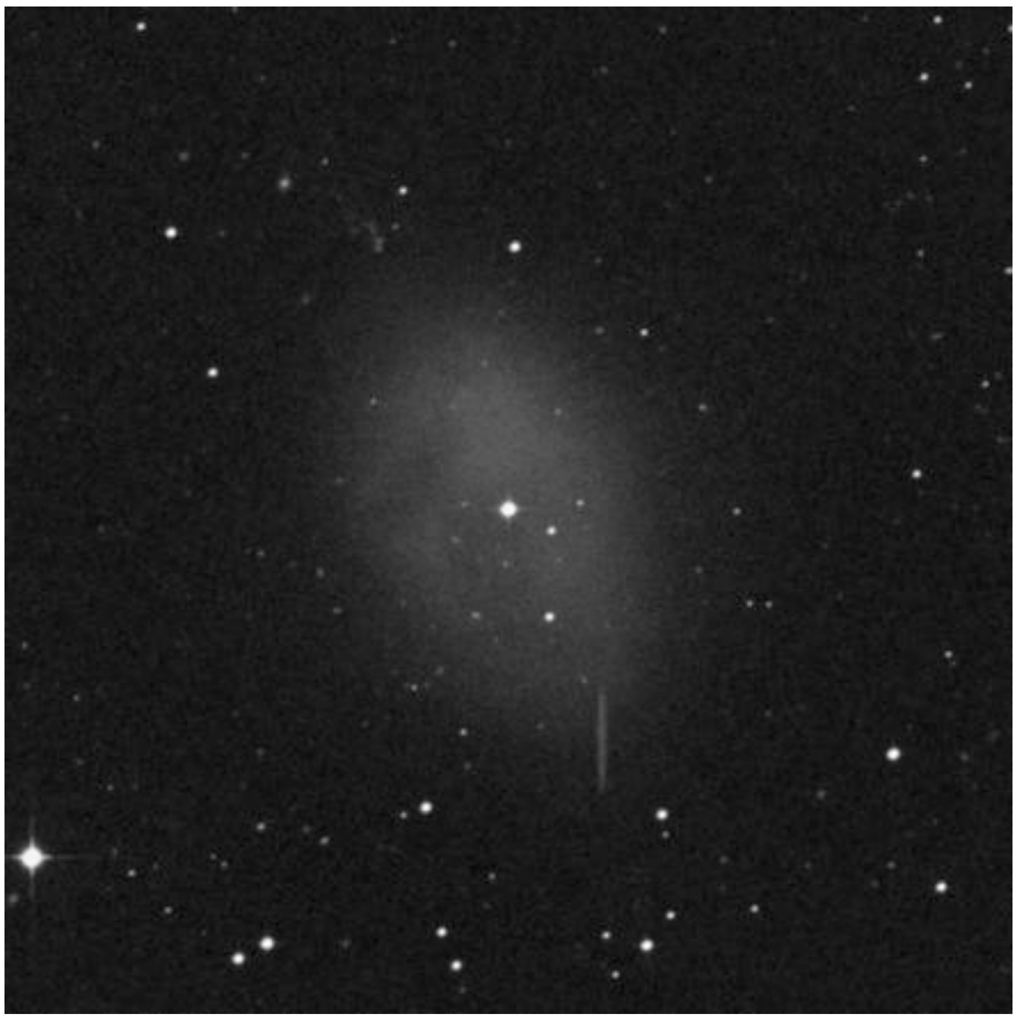
DEC 5
WEDNESDAY

Up before dawn? Then check out the skies because the stars of spring are returning! Let the waning Moon be your guide as it and Spica are only about two degrees apart!

How about something a little more suited to the mid-sized scope tonight? Set your sights on Alpha Fornacis and let's head about 3 fingerwidths northeast (RA 03 33 14.65 Dec -25 52 18.0) for NGC 1360.

In a 6" telescope, you'll find the 11th magnitude central spectroscopic double star of this planetary nebula to be very easy—but be sure to avert because the nebula itself is very elongated. Like most of my favorite things, this planetary is a rule-breaker since it doesn't have an obvious shell structure. But why? Rather than believe it is not a true planetary by nature, studies have shown that it could quite possibly be a very highly evolved one—an evolution which has allowed its gases to begin to mix with the interstellar medium.

Although faint and diffuse for northern observers, those in the south will recognize this as Bennett 15!



NGC 1360
Credit: Palomar Observatory, courtesy of Caltech

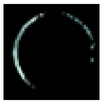
For northern observers clamoring for brighter stellar action, look no further tonight than the incredible "Double Cluster" about four fingerwidths southeast of Delta Cassiopeiae. At a dark sky site, this incredible pair is easily located visually and stunning in any size binoculars and telescopes.

As part of the constellation of Perseus, this double delight is around 7000 light-years away and less than 100 light-years separates the pair. While open clusters in this area are not really a rarity, what makes the "Double Cluster" so inviting is the large amount of bright stars within each of them.

Well known since the very beginnings of astronomy, take the time to have a close look at both Chi (NGC 884) and H Persei very carefully. Note how many colorful stars you see, and the vast array of double, multiple and variable systems!

NGC 884/869: The Double Cluster
Credit: N. A. Sharp/NOAO/AURA/NSF

DEC 7
FRIDAY



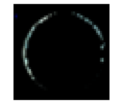
Today is the birthday of Gerard Kuiper. Born 1905, Kuiper was a Dutch-born American planetary scientist who discovered moons of both Uranus and Neptune. He was the first to know that Titan had an atmosphere, and he studied the origins of comets and the solar system.

Tonight let's honor his achievements as we have a look at another bright open cluster known by many names: Herschel VII.32, Melotte 12, Collinder 23, and NGC 752. You'll find it three fingerwidths south (RA 01 57.8 Dec +37 41) of Gamma Andromedae...

Under dark skies, this 5.7 magnitude cluster can just be spotted with the unaided eye, is revealed in the smallest of binoculars, and can be completely resolved with a telescope. Chances are it was first discovered by Hodierna over 350 years ago, but it was not cataloged until Sir William gave it a designation in 1786. But give credit where credit is due... For it was Caroline Herschel who observed it on September 28, 1783!

Containing literally scores of stars, galactic cluster NGC 752 could be well over a billion years old, strung out in chains and knots in an X pattern of a rich field. Take a close look at the southern edge for orange star 56: while it is a true binary star, the companion you see is merely optical. Enjoy this unsung symphony of stars tonight!

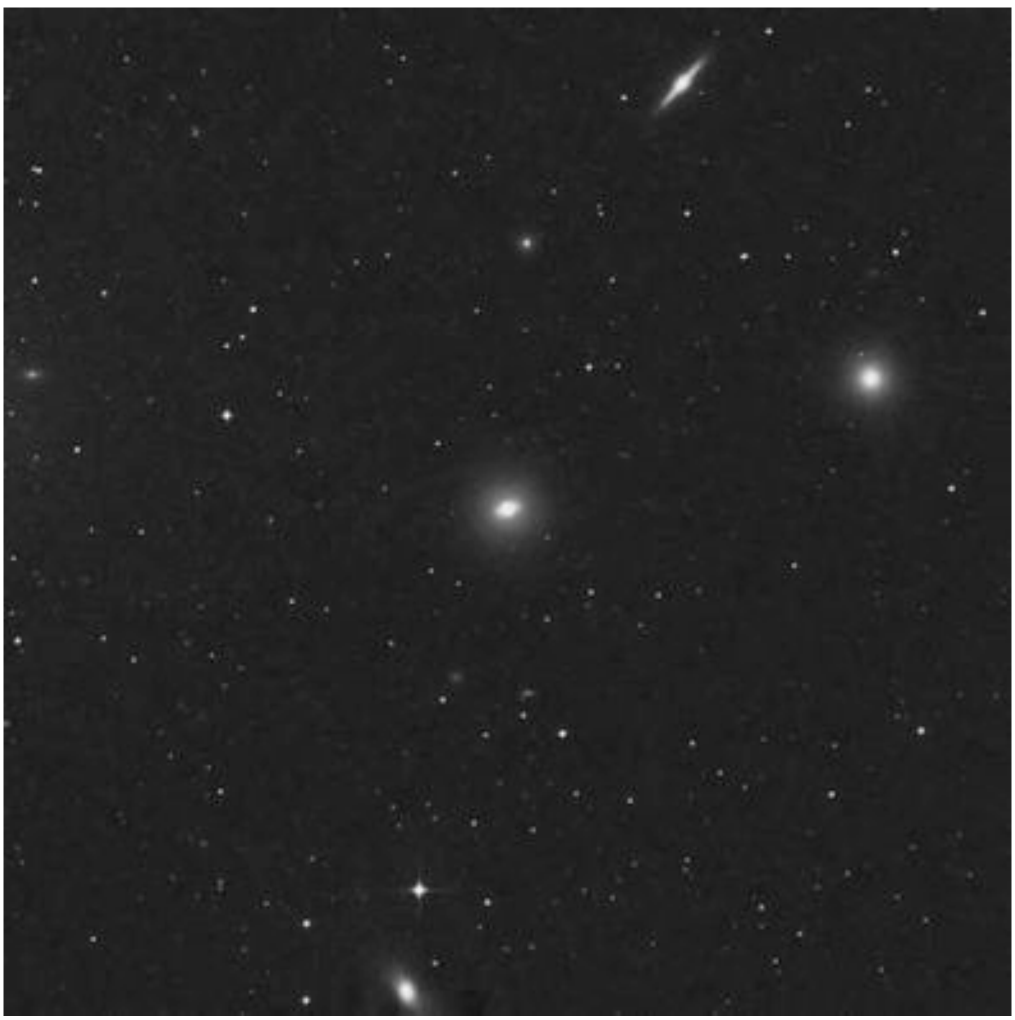
NGC 752
Credit: Palomar Observatory, courtesy of Caltech



Today in history (1908) marks "first light" for the 60" Hale Telescope at Mt. Wilson Observatory. Not only was it the largest telescope of the time, but it ended up being one of the most productive of all. Almost 100 years later, the 60" Hale is still in service as a public outreach instrument. If we could use the 60" tonight to study, where would we go? My choice would be the Fornax Galaxy Cluster!

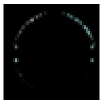
Containing around 20 galaxies brighter than 13th magnitude in a one degree field, here is where a galaxy hunter's paradise begins! About a degree and a half north of Tau Fornacis is the large, bright and round spiral NGC 1398. A little more than a degree west-northwest is the easy ring of the planetary nebula NGC 1360. Look for the concentrated core and dark dustlane of NGC 1371 a degree north-northeast—or the round NGC 1385 which accompanies it. Why not visit Bennett 10 or Caldwell 67 as we take a look at NGC 1097 about 6 degrees west-southwest of Alpha? This one is bright enough to be caught with binoculars!

Telescopes will love NGC 1365 at the heart of the cluster proper. This great barred spiral gives an awesome view in even the smallest of scopes. As you slide north, you will encounter a host of galaxies, NGCs 1386, 1389, 1404, 1387, 1399, 1379, 1374, 1381 and 1380. There are galaxies everywhere! But, if you lose track? Remember the brightest of these are two ellipticals—1399 and 1404. Have fun!



A 30 arc minute view of the Fornax Cluster centered on NGC 1387
Credit: Palomar Observatory, courtesy of Caltech

DEC 9
SUNDAY

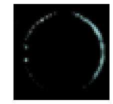


Southern Hemisphere viewers, you're in luck again on a New Moon night! This is the maximum of the Puppid-Velid meteor shower. With an average fall rate of about 10 per hour, this particular meteor shower could also be visible to those far enough south to see the constellation of Puppis. Very little is known about this shower except that the streams and radiants are very tightly bound together. Since studies of the Puppid-Velids are just beginning, why not take the opportunity to watch? Viewing will be possible all night long and although most of the meteors are faint, this one is known to produce an occasional fireball.

Since we're favoring the south tonight, let's set northern observers toward a galaxy cluster—Abell 347—located almost directly between Gamma Andromedae and M34. Here you will find a grouping of at least a dozen galaxies that can be fitted into a wide field view. Let's tour a few...

The brightest and largest is NGC 910, a round elliptical with a concentrated nucleus. To the northwest you can catch faint, edge-on NGC 898. NGC 912 is northeast of NGC 910, and you'll find it quite faint and very small. NGC 911 to the north is slightly brighter, rounder, and has a substantial core region. NGC 909 further north is fainter, yet similar in appearance. Fainter yet is more northern NGC 906, which shows as nothing more than a round contrast change. Northeast is NGC 914, which appears almost as a stellar point with a very small haze around it. To the southeast is NGC 923 which is just barely visible with wide aversion as a round contrast change. Enjoy this Abell quest!

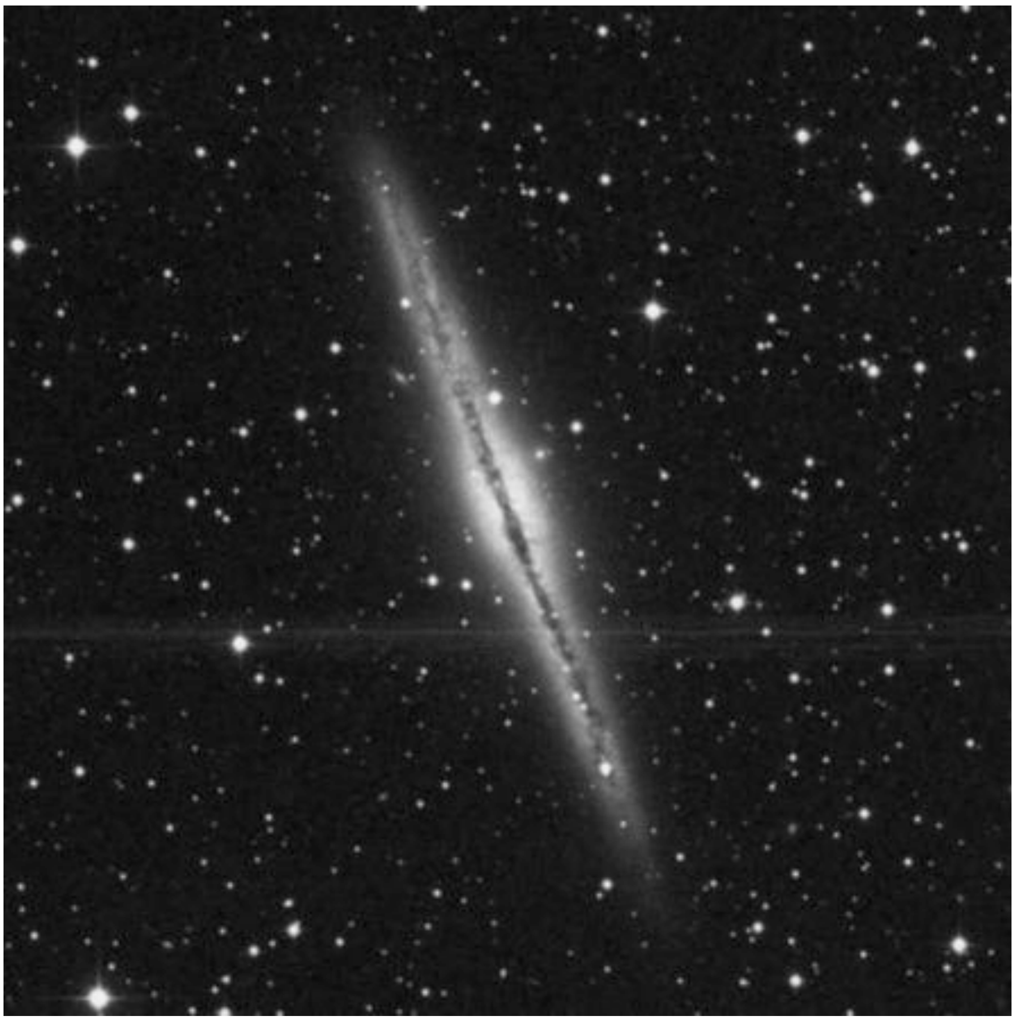
Abell 347
Credit: Palomar Observatory, courtesy of Caltech



If you are out stargazing until the morning hours, look for the peak of the Monocerid meteor shower. Its fall rate is around one per hour and its radiant point is near Gemini.

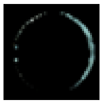
Tonight let's go north for a mid-size scope challenge about two fingerwidths east-northeast of the beautiful double star Gamma Andromedae (RA 02 22 32.90 Dec +43 20 45.8).

The 12th magnitude NGC 891 is a perfect example of a spiral galaxy seen edge-on. To the mid-sized scope, it will appear as a pencil-slim scratch of light, but larger telescopes will be able to make out a fine, dark dust lane upon aversion. Discovered by Caroline Herschel in 1783, NGC 891 contained a magnitude 14 supernova event recorded on August 21, 1986. Often considered a "missed Messier," you can add this one to your Caldwell list as number 23!



NGC 891
Credit: Palomar Observatory, courtesy of Caltech

DEC 11
TUESDAY



Annie Jump Cannon
(widely used public image)

On this date in 1863, Annie Jump Cannon was born. She was a United States astronomer who created the modern system for classifying stars by their spectra. Why not celebrate this achievement by coming along with me and viewing some very specific stars that have unusual visual spectral qualities! Let's grab a star chart, brush up on our Greek letters and start first with Mu Cephei.

Nicknamed the "Garnet Star," this is perhaps one of the reddest stars visible to the unaided eye. At around 1200 light-years away, this spectral type M2 star will show a delightful blue/purple "flash." If you still don't perceive color, try comparing Mu to its bright neighbor Alpha, a spectral type A7, or "white," star. Perhaps you'd like something a bit more off the beaten path? Then head for S Cephei about halfway between Kappa and Gamma toward the pole. Its intense shade of red makes this magnitude 10 star an incredibly worthwhile hunt.

To see an example of a B spectrum star, look no further than the Pleiades...All the components are blue white. Want to taste an "orange?" Then look again at Aldeberan, or Alpha Tauri, and say hello to a K spectrum star. Now that I have your curiosity aroused, would you like to see what our own Sun would look like? Then choose Alpha Aurigae, better known as Capella, and discover a spectral class G star that's only 160 times brighter than the one that holds our solar system together! If you're enjoying the game, then have a look at a star with one of the most unusual spectra of all—Theta Aurigae. Theta is actually a B class, or a blue/white, but instead of having strong lines in the helium, it has an abnormal concentration of silicon, making this incredibly unusual double star seem to glitter like a "black diamond."

Still no luck in seeing color? Don't worry. It does take a bit of practice! The cones in our eyes are the color receptors and when we go out in the dark, the color-blind rods take over. By intensifying the starlight with either a telescope or binoculars, we can usually excite the cones in our dark-adapted eyes to pick up on color.

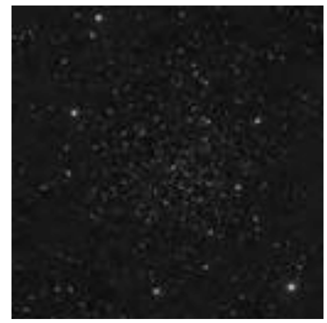
Tonight is also the peak of the Sigma Hydrid meteor stream. Its radiant is near the head of the Serpent and the fall rate is also 12 per hour—but these are fast!

DEC 12
WEDNESDAY

Today in 1961, OSCAR-1 was launched. The project started in 1960; the name stands for Orbital Satellite Carrying Amateur Radio. OSCAR-1 operated in orbit for 22 days, transmitting a signal in Morse Code—the simple greeting "Hi." The success of the mission helped to promote interest in amateur radio which still continues to this day!

Tonight before the Moon interferes with fainter studies, let's head far north for one of the oldest galactic clusters in our visible sky—NGC 188.

Hovering near Polaris (RA 00 44.5 Dec +85 20) this circumpolar open cluster also goes by other names: Collinder 1 and Melotte 2. Discovered by John Herschel on November 3, 1831, this 8th magnitude collection of faint stars will require a telescope to resolve its 120 members. At one time, it was believed to be as old as 24 billion years, later updated to 12 billion; but it is now considered to be around 5 billion years old. No matter how old it may truly be, it is one of the time-honored great studies and is also number one on the Caldwell list!



NGC 188
Credit: Palomar Observatory, courtesy of Caltech

OSCAR-1
(archival image)

DEC 13
THURSDAY

Geminid MeteorCredit: NASA

Today in 1920, the first stellar diameter was measured by Francis Pease with an interferometer at Mt. Wilson. His target? Betelgeuse!

Tonight will being be one of the most hauntingly beautiful and most mysterious displays of celestial fireworks all year—the Geminid meteor shower. First noted in 1862 by Robert P. Greg in England, and B. V. Marsh and Prof. Alex C. Twining of the United States in independent studies, the annual appearance of the Geminid stream was weak initially, producing no more than a few per hour, but it has grown in intensity during the last century and a half. By 1877 astronomers realized a new annual shower was occurring with an hourly rate of about 14. At the turn of the century, it had increased to over 20, and by the 1930s up to 70 per hour. Only eight years ago observers recorded an outstanding 110 per hour during a moonless night... And our Moon will soon set!

So why are the Geminids such a mystery? Most meteor showers are historic—documented and recorded for hundred of years—and we know them as being cometary debris. When astronomers first began looking for the Geminids' parent comet, they found none. It wasn't until October 11, 1983 that Simon Green and John K. Davies, using data from NASA's Infrared Astronomical Satellite, detected an orbital object (confirmed the next night by Charles Kowal) that matched the Geminid meteoroid stream. But this was no comet, it was an asteroid.

Originally designated as 1983 TB, but later renamed 3200 Phaethon, this apparently rocky solar system member has a highly elliptical orbit that places it within 0.15 AU of the Sun about every year and half. But asteroids can't fragment like a comet—or can they? The original hypothesis was that since Phaethon's orbit passes through the asteroid belt, it may have collided with other asteroids creating rocky debris. This sounded good, but the more we studied the more we realized the meteoroid "path" occurred when Phaethon neared the Sun. So now our asteroid is behaving like a comet, yet it doesn't develop a tail.

So what exactly is this "thing?" Well, we do know that 3200 Phaethon orbits like a comet, yet has the spectral signature of an asteroid. By studying photographs of the meteor showers, scientists have determined that the meteors are denser than cometary material and not as dense as asteroid fragments. This leads us to believe that Phaethon is probably an extinct comet that has gathered a thick layer of interplanetary dust during its travels, yet retains the ice-like nucleus. Until we are able to take physical samples of this "mystery," we may never fully understand what Phaethon is, but we can fully appreciate the annual display it produces!

Thanks to the wide path of the stream, folks the world over get an opportunity to enjoy the show. The traditional peak time is tonight as soon as the constellation of Gemini appears around mid-evening. The radiant for the shower is right around bright star Castor, but meteors can originate from many points in the sky. From around 2 am tonight until dawn (when our local sky window is aimed directly into the stream) it's possible to see about one "shooting star" every 30 seconds.

The most successful of observing nights are ones where you are comfortable, so be sure to use a reclining chair or pad the ground while looking up. Please get away from light sources when possible—it will triple the amount of meteors you see. Enjoy the incredible and mysterious Geminids!

DEC 14
FRIDAY

Today was a very busy day in astronomy history. Tycho Brahe was born in 1546. Brahe was a Danish pre-telescopic astronomer who established the first modern observatory in 1582 and gave Kepler his first job in the field. In 1962, Mariner 2 made a flyby of Venus and became the first successful interplanetary probe. As we begin our evening on the Moon, be sure to check with IOTA for a possible occultation event in your area. Neptune is less than a degree away to the north!

On this day in 1972, the last humans (so far) to have walked on the lunar surface returned to Earth. Eugene Cernan left the final bootprint at Taurus-Littrow and called it the "end of the beginning." As we reach the end of our observing year, let this only be the beginning for you as we look to that distant orb to seek out the Apollo 17 landing area.

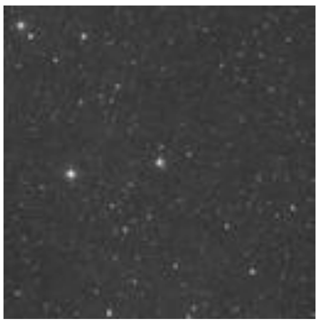
You have learned so much over the last 12 months! Even if the terminator has not progressed as far as the illustration shows, you should know the approximate location of Posidonius on the surface and recognize Mare Crisium and the Taurus Mountains to its east as well as the small, grey expanse of Sinus Amoris between them. Littrow is on its western shore, and although it is rather small with a 31 kilometer diameter, Mons Vitruvius will shine like a beacon to the south.

Enjoy your Moon walk!

Tycho Brahe
Credit: NASA

Apollo 17 landing area
Image Credit: Ricardo Borba
Annotation: Tammy Plotner

DEC 15
SATURDAY

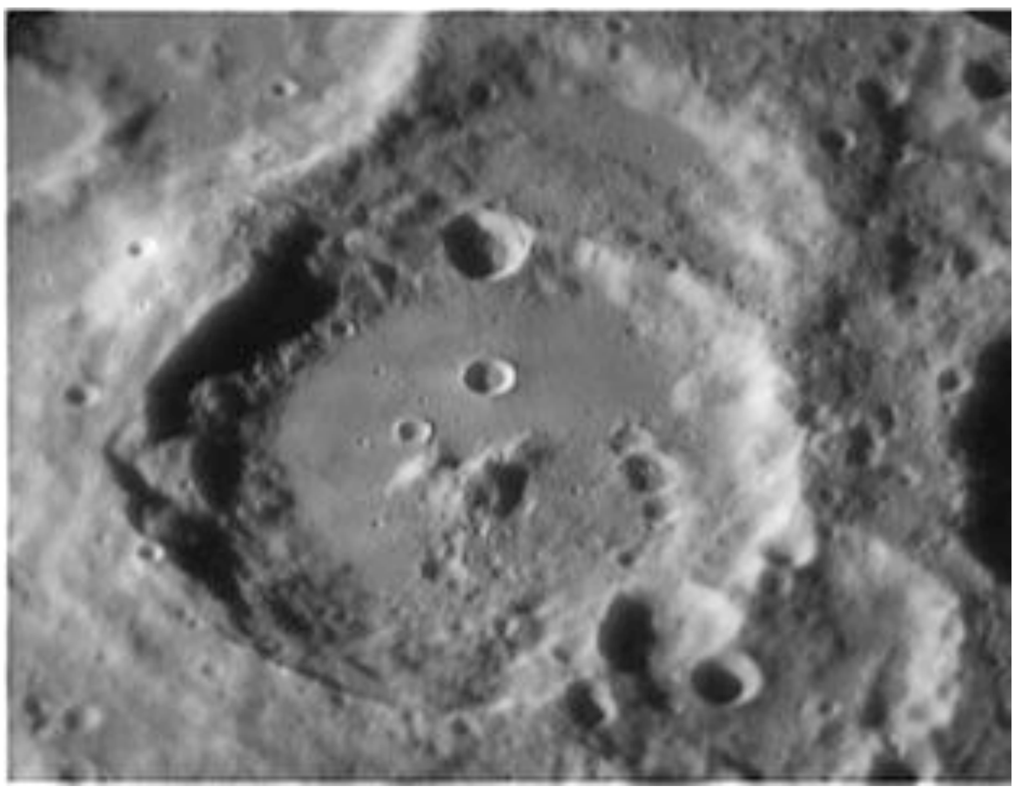


AR Aurigae
Credit: Palomar Observatory, courtesy of Caltech

Today in 1970, the Soviet spacecraft Venera 7 registered a first as it made a successful soft landing on Venus, and so went into the history books as the first craft to land on another planet. You can catch Venus yourself in the pre-dawn skies!

Tonight, one of the most outstanding features on the lunar surface will be the southern crater Maurolycus. Although we have visited it before, look again! At an overall diameter of 114 kilometers, this double impact crater sinks below the surface to a depth of 4730 meters and displays a wonderful multiple mountain-peaked center. If you have not collected Gemma Frisius for your studies, you will find it just north of this grand crater, looking much like a "paw print" at low power.

Now let's travel 398 light-years away as we have a look at AR Aurigae—the centermost star in a brilliant collection. It is about one-third the distance from southern Beta to northern Alpha (Capella). AR is an eclipsing binary which consists of two main sequence white dwarf stars. About every 4.1 days, this pair will make a slight magnitude drop. While both are chemically peculiar, neither fills its Roche Lobe—meaning they are not stripping material from each other to cause these unusual abundances. Recent studies have shown the possibility of a third, unseen companion! But even binoculars will see that AR resides in a great field of stars and is worth a little of your time...



Maurolycus
Credit: Wes Higgins

With only nine days left until the holiday, astronomers have recently discovered a unique feature on the lunar surface. While accepted for many years to be a natural feature of selenography, modern photography coupled with today's high powered telescopes have discovered an area near the lunar North Pole that's being used as a runway by a man in a red suit piloting an unusual spacecraft. Be sure to spark the imaginations in your young viewers as you show them the Alpine Valley!

Today we celebrate the birthday of Edward Emerson (E. E.) Barnard. Born in 1857, Barnard was an American observational astronomer and an absolute legend. He led a very colorful life in astronomy, and his sharp skills have led to a multitude of discoveries. His life was a very fascinating one: Barnard was often known to simply set the scope on one point in the sky and just watch for new objects as the field moved! Tonight let's take a look at a bright star that has Barnard's touch, as we explore Beta Aurigae—Menkalinan.

First identified as a spectroscopic binary by A. Maury in 1890, Beta itself is part of a moving group of stars that includes Sirius, and is an Algol-type variable. While you won't see changes as dramatic as those of the "Demon Star," it has a precise drop of 0.09 magnitude every 3.96 days. This system contains almost identical stars which are more than two and a half times the size of our Sun, but they orbit each other at a distance of less than 0.1 AU! While Menkalinan's 10th magnitude optical companion was first spotted by Sir William Herschel in 1783, only E. E. Barnard noticed the 14th magnitude true tertiary to this incredible multiple system!

E. E. Barnard at the 36" Scope
Credit: UCO/Lick Observatory
(archival image)

Beta Aurigae
Credit: Palomar Observatory,
courtesy of Caltech

Santa's Landing Strip
Credit: Wes Higgins

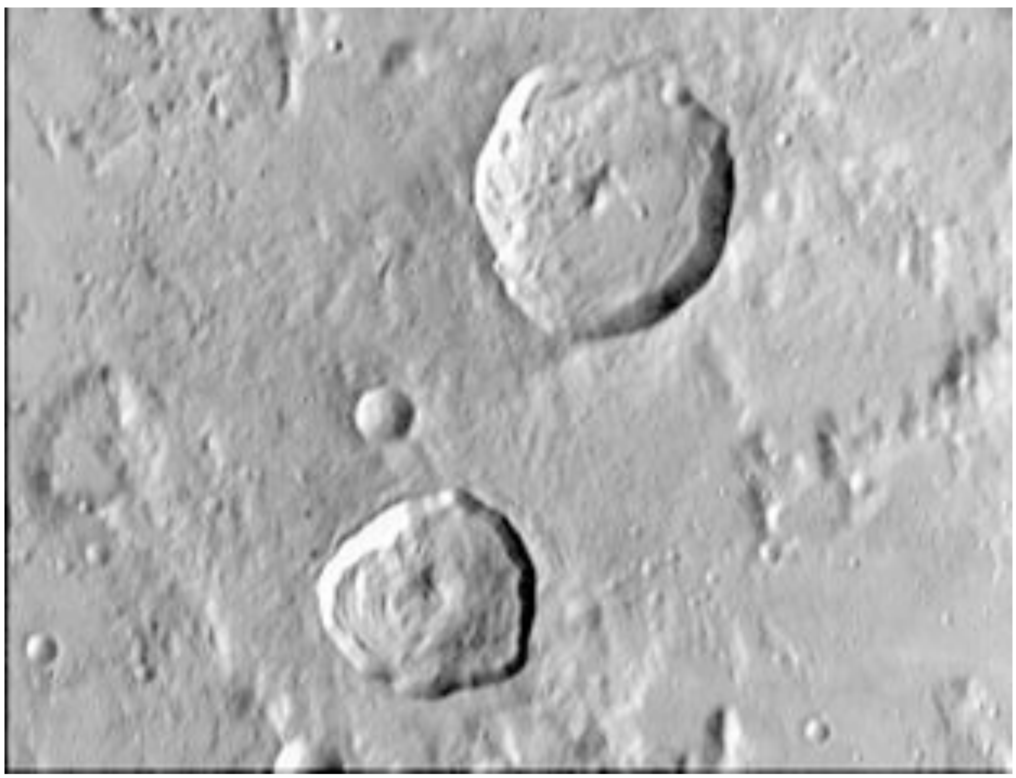
DEC 17
MONDAY

RT Aurigae
Credit: Palomar Observatory, courtesy of Caltech

Tonight there are craters galore to explore: Plato, Aristotle, Eudoxus, Archimedes... But let's head to the north of Sinus Medii and have a look at a pair we've not yet encountered on our lunar travels—Agrippa and Godin. The larger of the two, Agrippa, measures around 46 kilometers in diameter and drops to a depth of 3070 meters. To the south is Godin, which is somewhat smaller at 35 kilometers in diameter, but a bit deeper at 3200 meters. Note how Godin's interior slopes towards its central peak.

With deep sky studies improbable for the next few days, why don't we try taking a look at another interesting variable star? RT (star 48) Aurigae is a bright Cepheid that is located roughly halfway between Epsilon Geminorum and Theta Aurigae. This perfect example of a pulsating star follows a precise timetable of 3.728 days and fluxes by close to one magnitude.

Located 1600 light-years away, RT was first discovered in 1905 by T. H. Astbury of the British Astronomical Association. Like all Cepheids, it expands and contracts rhythmically—for reasons science is not completely sure of. Yet, we do know that it takes about 1.5 days for it to expand to its largest and brightest and 2.5 days for it to contract, cool, and dim.



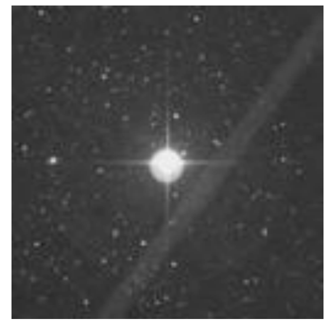
Agrippa and Godin
Credit: Wes Higgins

Tonight on the south shore of the emerging Mare Nubium, look for ancient craters Pitatus and Hesiodus right on the terminator. During this phase, something wonderful can happen! If you are at the right place at the right time, sunlight will shine briefly through a break in Hesiodus' wall and cast an incredible ray across the lunar surface! If you don't catch it, you can still enjoy one of the few concentric craters on the Moon.

Want a challenging double this evening? Then let's have a look at Theta Aurigae located on the east side of the pentagonal shape of this constellation.

Located about 110 light-years away, 2.7 magnitude Theta is a four star system, whose members range in magnitude from 2.7 to 10.7. Suited even to a small telescope, the brightest member—Theta B—is itself a binary at magnitude 7.2, and was first recorded by Otto Struve in 1871. The pair moves quite slowly, and may take as long as 800 years to orbit each other at their separation of about 110 AU. The furthest member of this system was also noted by Struve as far back as 1852, but it is not a true member—the separation only occurring thanks to Theta's own proper motion.

While you are there, be sure to note Theta's unusual color. While it will appear "white," look closely at the diffraction caused by our own atmosphere which acts much like a prism...You'll notice a lot more purple and blue around this star than many others of the same spectral type. Why? Theta is a silicon star!



Theta Aurigae
Credit: Palomar Observatory, courtesy of Caltech

Pitatus and Hesiodus
Credit: Wes Higgins

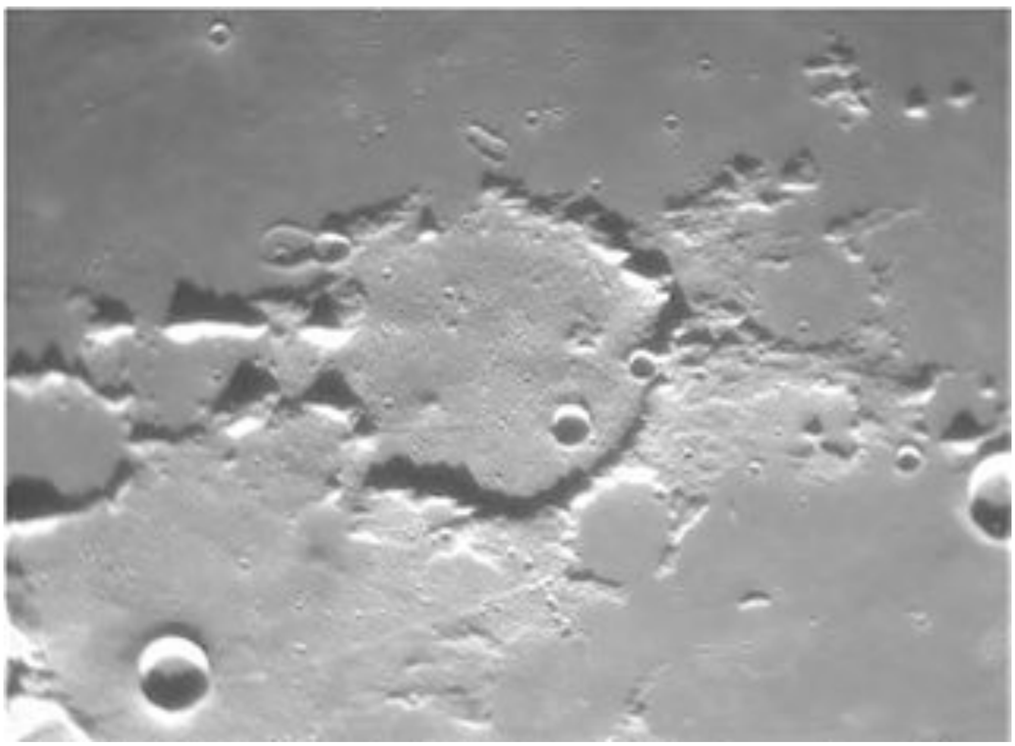
DEC 19
WEDNESDAY

While the mighty Copernicus on the terminator will draw the eye like no other crater tonight, it's time to pick up another study which you may not have logged—Crater Davy. You will find it just west of the large ring of Ptolemaeus on the northeastern edge of Mare Nubium. It will appear as a small, bright ring, with the large crater Davy A on its southern border. Now skip across the grey sands of Nubium further west and let's take a look at the crater on the peninsula-like feature Guericke. Named for Dutch physicist Otto von Guericke, this 58 kilometer diameter crater has all but eroded away. Look for a break in its eastern wall and notice how lava flow has eradicated the north!

Now, for apparently no good reason, let's head for Alpha Persei (Mirfak). While there's nothing particularly interesting about this 570 light-year distant star, what is incredible is the field in which it resides! Take a look at lowest power with a rich field telescope or binoculars and be prepared to be blown away...

This is the Alpha Persei moving group—a fantastic field of main sequence stars that contains a little over 100 members. Even though it will take 90,000 years before any perceptible change is seen in this bright collection, they are happily moving at a pace of about 16 kilometers per second towards Beta Tauri! Enjoy this fine group also known as Melotte 20...

Melotte 20
Credit: T. Credner and S. Kohl at allthesky.com



Guericke
Credit: Wes Higgins

Tonight is the peak of the Delta Arietid meteor shower. While most showers are best after midnight, this is an early evening shower that must be viewed before the radiant sets. The fall rate is modest—about 12 per hour.

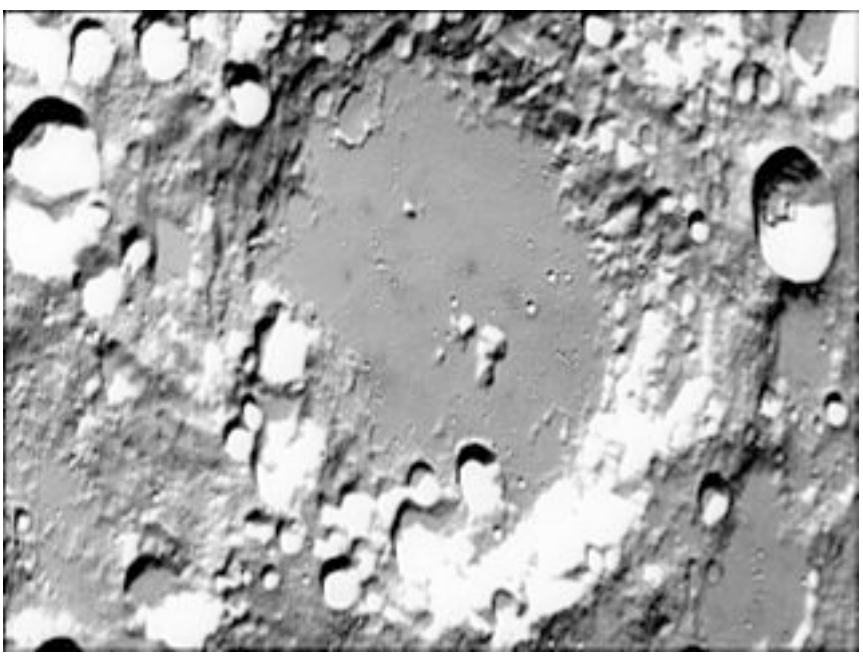
On the lunar surface, we're going to head to the deep south as we pick up one of the last of our lunar studies—Longomontanus. Named for the Danish Astronomer Christian Longomontanus (an assistant to Tycho Brahe), this wonderland of details stretches around 145 kilometers across the surface. Look for a great collection of interior craters along its northwest interior wall and note how it has eradicated a much older crater which still shows an edge to the east.

Today marks the founding of Mt. Wilson Solar Observatory. It officially opened its doors in 1904. We also celebrate the birth of Walter S. Adams on this date. Born in 1876, Adams was the astronomer at Mt. Wilson who revealed the nature of Sirius B, the first known white dwarf star. Sirius B was first seen by Alvan Clark in 1862 and most recently, the Hubble Space Telescope precisely measured the mass of B for the first time. While Sirius is far too low at an early hour to study its white dwarf, we can have a look at a similar star when we view Omicron 2 Eridani located roughly a handspan west of Rigel. As the southernmost of the Omicron pair, it is sometimes known as 40 Eridani, and you'll find it to be an interesting multiple star system that's very worthy of your time.

Discovered by William Herschel in 1783, this 16 light-year distant system is the eighth nearest of the unaided visible stars. Well spaced from the primary, the companion star is also a double for high powers and will reveal a red dwarf discovered by Otto Struve. Now, look closely at the 9th magnitude B star. This is the only white dwarf that can be considered "easy" for the backyard telescope. Its diameter is only about twice the size of Earth and its mass is about that of our Sun. Power up and locate the 11th magnitude companion...for it's one of the least massive stars known! And this white dwarf may be the smallest stellar object visible in an amateur telescope—it would be like spotting a tennis ball...on the moon!

Walter Adams
Credit: Yerkes Observatory, University of Chicago

40 Eridani
Credit: Palomar Observatory, courtesy of Caltech



Longomontanus
Credit: Wes Higgins

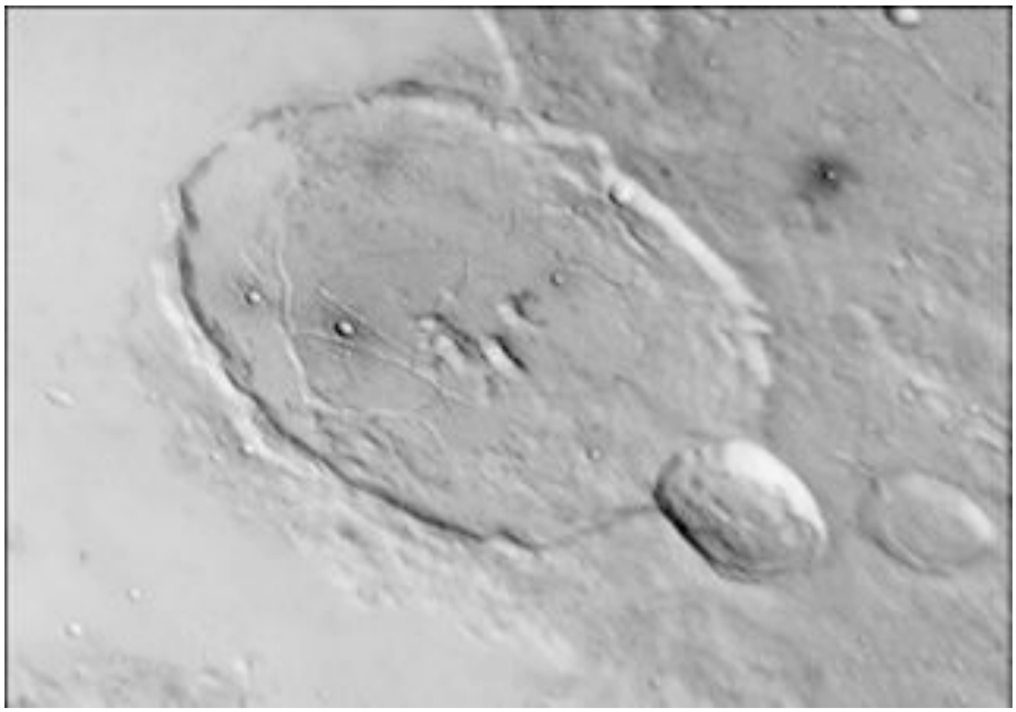
DEC 21
FRIDAY

Ah, yes... Is there any more beautiful crater on the Moon than graceful Gassendi? While we have visited it before, take the time to power up and enjoy its features. Look for rimae which crisscross the shallow floor, and the strong A crater which mars its northern wall. How many of its interior features can you resolve?

While we're out, let's have a look at one of the best known double stars in the night—Gamma Arietis (RA 01 53 31.81 Dec +19 17 37.9).

Also known as Mesarthim, this combined magnitude 4 beauty was unintentionally discovered in 1664 by Robert Hooke who was following a comet. While no real change has been spotted in the more than 343 years since that time, there has been a slight difference detected in the components' radial velocities. Roughly 160 light-years away, you'll enjoy this almost matched-magnitude pair of white stars—but look carefully: in 1878, S.W. Burnham found a third star nearby that might not be a physical member, but is also a double!

Gamma Arietis: Mesarthim
Credit: Palomar Observatory, courtesy of Caltech



Gassendi
Credit: Wes Higgins

Up early? Fantastic! In the pre-dawn hours of this morning, I have a treat for you—the Ursid meteor shower! Cruising around the Sun about every thirteen and a half years, Comet 8P/Tuttle sheds a little skin. Although it never passes inside of Earth's orbit, some six years later we pass through its debris stream. Not so unusual? Then think again, because it takes as much as six centuries before the meteoroid trail is affected enough by Jupiter's gravitation to deflect the stream into our atmosphere.

With little interference from the Moon while watching this circumpolar meteor shower, the hours before dawn could see activity of up to 12 per hour. By keeping watch on the constellation of Ursa Major, you just might spot one of these slow moving, 600 year old travelers that make their path only halfway between us and Selene!

Today marks Winter Solstice—for the northern hemisphere, the shortest day and the longest night of the year—and the point when the Sun is furthest south. Now is a wonderful time to demonstrate for yourself our own movements by choosing a "solstice marker." Anything from a fence post to a stick in the ground will suffice! Simply measure the shadow when the Sun reaches the zenith and repeat your experiment in the weeks ahead and watch as the shadow grows shorter...and the days grow longer!

And be sure to look at the Moon tonight as well, for it is at perigee—its closest point to the Earth. While you might hear a tall tale or two about it being brighter than normal since it is also close to Full, judge for yourself! And be sure to look for signs of libration while you're there...

Analemma
Credit: Credit: Vasilij Rumyantsev (Crimean Astrophysical Observatory)/NASA

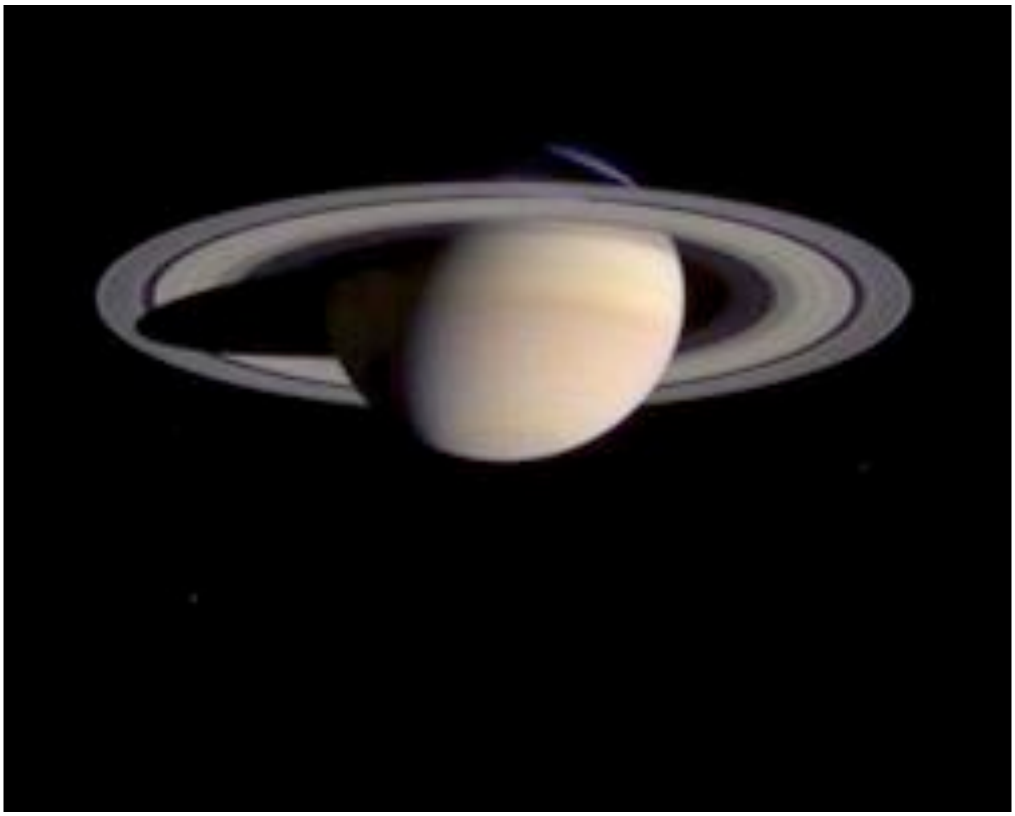
DEC 23
SUNDAY

Alpha Ceti: Menkar
Credit: Palomar Observatory, courtesy of Caltech

While the Moon will command tonight's skies, we can still have a look at a tremendous star as we head 150 light-years away to Menkar...

Better known as Alpha Ceti, you'll find this nearly second magnitude giant orange beauty just west of Orion's "bow" (RA 03 02 16.77 Dec +04 05 23.0). With even a small telescope, you will also see 5th magnitude 93 Ceti in the eyepiece as well! Although they are not a true physical pair (the blue 93 is 350 light-years further away), they make a wonderful color contrast which is well worth your time. Just think... If 93 were as close as Menkar, it would be 250% brighter. But up the magnification and see if you can spot another true double in the field!

Tonight in 1672, astronomer Giovanni Cassini discovered Saturn's moon Rhea. Although you will have to wait until a little later in the evening to catch the ringed planet, why not try your hand at finding Rhea as well? A well-collimated scope as small as 4.5" is perfectly capable of seeing Tethys, Rhea and Dione as they orbit very nearly to the edges of the ring system. All it requires is steady skies and a little magnification!

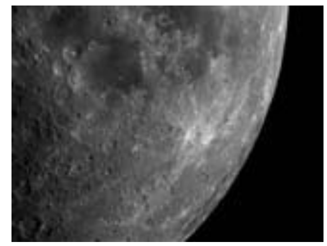


Saturn
Credit: JPL/NASA

DEC 24
MONDAY

'Twas the night before Christmas in a sky filled with stars... And low on the horizon are the Yule Moon and Mars! That's right. It's the Full Yule Moon, and arriving at the same time Mars reaches opposition. For many viewers, the spectacular pair will rise with Mars less than a degree south of Luna... But a pairing this close means a few lucky observers could be in for an occultation event! Be sure to check IOTA for possible times and locations.

Today in 1968, Apollo 8 became the first manned spacecraft to orbit the Moon. Let's celebrate that by having a look at the lunar surface. On the eastern limb we see the bright splash ray patterns surrounding ancient Furnerius—yet the rays themselves emanate from much younger crater Furnerius A. All over the surface, we see small points light up and the testament to the Moon's violent past written in its scarred lines. Take a look now at the western limb... For the sunrise is about to advance around it.



Furnerius
Credit: Roger Warner

Until this date, no man had seen with his own eyes what lay beyond. Frank Borman, James Lovell and William Anders were to become the first to directly view the "dark side" and the first to witness earthrise over the Moon. As the days ahead bring the terminator around to the eastern limb, let your mind take flight to the distant orb and enjoy its landscape as the shadows take on new angles and old features become new again.

"And from the crew of Apollo 8, we close, with good night, good luck, a Merry Christmas, and God bless all of you, all of you on the good Earth." (Astronaut Frank Borman)

"Earthrise"
Credit: Apollo 8/NASA

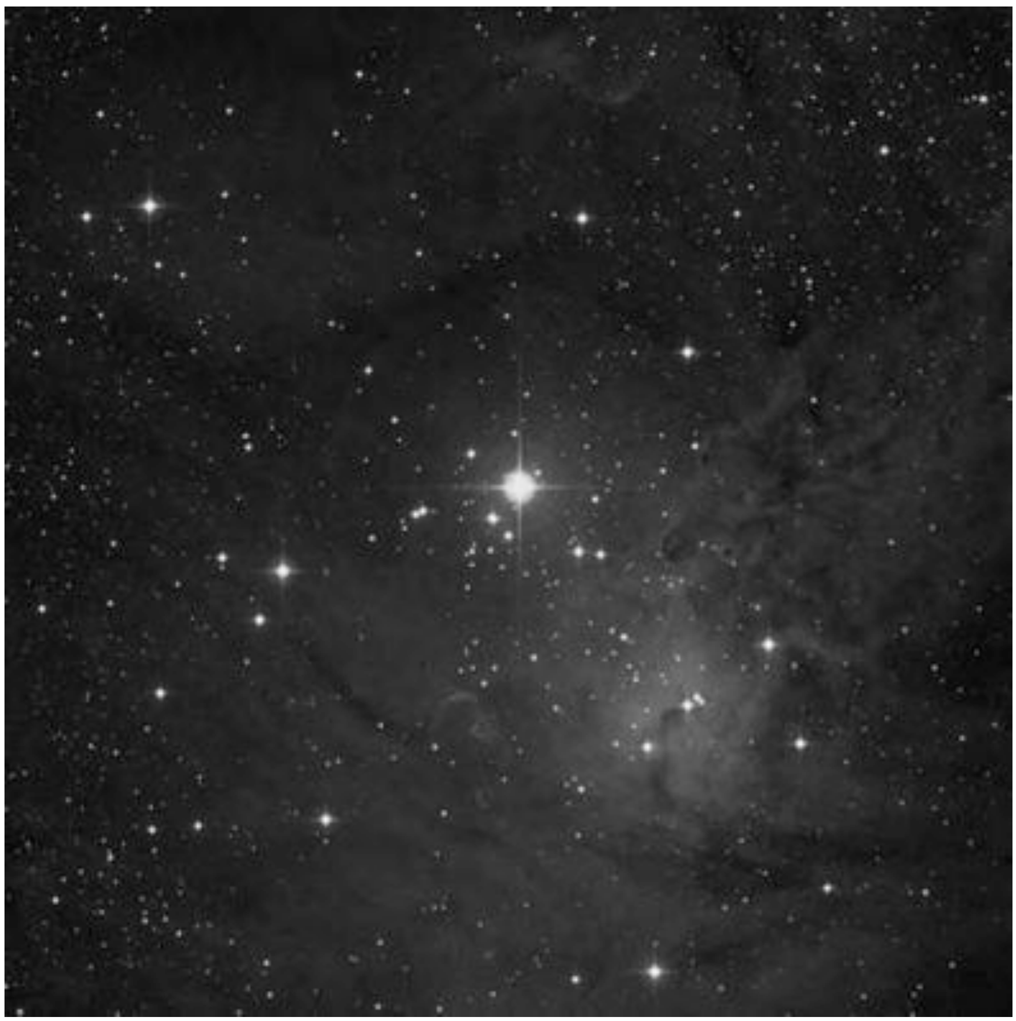
DEC 25
TUESDAY

Sir Isaac Newton
(widely used public image)

Wishing you all the very best for the Christmas season! Like a present, Sir Isaac Newton was born on this day 1642—Newton was the British "inventor" of calculus and a huge amount of what we now consider modern classical physics. Even young children are aware of his simple laws of motion and gravity. It wasn't until the time of Einstein until things changed!

In keeping with the season, tonight's astronomical object is a celebration of both starlight and asterism. Located 10 degrees east of Betelgeuse (RA 06 41 00.00 Dec +09 53 -0.0), NGC 2264 will be a challenging object thanks to the Moon. Also known as the "Christmas Tree Cluster," this bright asterism of approximately 20 bright stars and over 100 fainter ones is embroiled in a faint nebula that will be lost to bright skies, leaving only the delightful Christmas tree shape adorned with stars.

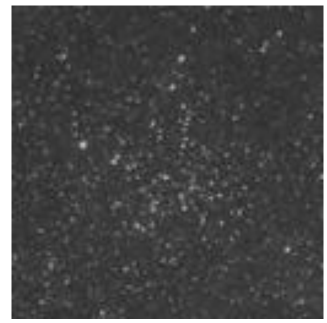
The very brightest of these stars, S Monocerotis, is 5th magnitude and will show clearly in the finderscope, and will be seen as a double at magnification. Steady skies will reveal that the "star" at the top of our "tree" is also a visual double. Many of the stars will also appear to have companions, as well as tints of silver as gold. The visual effect of this splendid open cluster is well worth the challenge it presents. Happy Holidays!



NGC 2264: The Christmas Tree Cluster
Credit: Palomar Observatory, courtesy of Caltech

Is it gone yet? Nope. The Moon will rise a little later this evening, but we're going to run ahead of it tonight and enjoy some studies in Auriga! Looking roughly like a pentagon in shape, start by identifying the brightest of these stars—Capella. Due south of it is the second brightest star, El Nath. By aiming binoculars at El Nath, go north about one-third the distance between the two and enjoy all the stars!

You will note two very conspicuous clusters of stars in this area, and so did Le Gentil in 1749. Binoculars will reveal the pair in the same field, as will telescopes using lowest power. The dimmest of these is M38, and it will appear vaguely cruciform in shape. At roughly 4200 light-years away, larger aperture will be needed to resolve the 100 or so fainter members. About two and a half degrees to the southeast you will see the much brighter M36. More easily resolved in binoculars and small scopes, this "jewel box" galactic cluster is quite young—and about 100 light-years closer!



M38
Credit: Palomar Observatory, courtesy of Caltech

M36
Credit: Palomar Observatory, courtesy of Caltech

DEC 27
THURSDAY

Johannes Kepler
(widely used public image)

Born today in 1571 was Johannes Kepler—Danish astronomer and assistant to Tycho Brahe. Kepler used Brahe's copious notes of Mars' positions to help formulate his three laws of planetary motion. These laws are still in use today.

Is it gone yet? No. The Moon will be along shortly, but we still have time to set our sights about halfway between Theta Aurigae and El Nath. Our study object will be the open cluster M37. Apparently discovered by Messier himself in 1764, this galactic cluster will appear almost nebula-like to binoculars and very small telescopes—but comes to perfect resolution with larger instruments.

At around 4700 light-years away, and spanning a massive 25 light-years, M37 is often billed as the finest of the three Aurigan opens for bigger scopes. Offering beautiful resolvability, this one contains around 150 members down to magnitude 12, and has a total population in excess of 500.

What makes it unique? As you view, you will note the presence of several red giants. For the most part, open clusters are comprised of stars that are all about the same age, but the brightest star in M37 appears orange in color and not blue! So what exactly is going on in here? Apparently some of these big, bright stars have evolved much faster—consuming their fuel at an incredible rate. Other stars in this cluster are still quite young on a cosmic scale, yet they all left the "nursery" at the same time! In theory, this allows us to judge the relative age of open clusters. For example, M36 is around 30 million years old and M38 about 40, but the presence of the red giants in M37 puts its estimated age at 150 million years! Just awesome...

M37
Credit: NOAO/AURA/NSF

Today we celebrate the birth of Arthur S. Eddington. Born in 1882, Eddington was a British theoretical astrophysicist whose work was fundamental to interpreting and explaining stellar nature. He also coined the phrase "expanding universe" to refer to the mutual recession of the galaxies.

Is it gone yet? Not yet... But before the Moon rises tonight, let's enjoy the early dark skies and go to our maps west of M36 and M38 to identify AE Aurigae. As an unusual variable, AE is normally around 6th magnitude and resides approximately 1600 light-years distant. The beauty in this region is not particularly the star itself but the faint nebula in which it resides. Known as IC 405, this is an area of mostly dust and very little gas. What makes this view so entertaining is that we are looking at a "runaway" star.

It is believed that AE originated in the M42 region in Orion. Cruising along at a very respectable speed of 130 kilometers per second, AE flew the "stellar nest" some 2.7 million years ago! Although IC 405 is not directly related to AE, there is evidence within the nebula that areas have been cleared of their dust by the rapid northward motion of the star. AE's hot, blue illumination and high energy photons fuel what little gas is contained within the region, and its light reflects off the surrounding dust as well. Although we cannot "see" with our eyes like a photograph, together this pair makes an outstanding view for the small backyard telescope, and it is known as "The Flaming Star."

And when the Moon rises? Look for Regulus less than one half degree to its north and Saturn another two degrees further. This could be an occultation of Regulus, so be sure to check IOTA!

Arthur Eddington
Credit: American Institute of Physics Niels Bohr Library

AE Aurigae: The Flaming Star
Credit: T. A. Rector and B. A. Wolpa/NOAO/AURA/NSF

DEC 29
SATURDAY

If you're up before dawn this morning, take the time to step outside and view the simple beauty of the ecliptic plane. To the west, Mars hangs just above the horizon with Saturn not far above it. The Moon dances high overhead and Venus shines just before the rising Sun. In a matter of weeks, Jupiter will return again to the morning skies!

Is it gone yet? Not yet. Since the Moon won't begin to interfere for quite a while after the skies turn dark, this would be a great opportunity to locate an easy Messier object—M34. If you remember our previous study stars Almach and Algol, you're halfway there. Draw an imaginary line between them and look with your binoculars or finder scope just a shade north of center.

In binoculars, M34 will show around a dozen fainter stars clustered together, and perhaps a dozen more scattered around the field. Small telescopes at low power will appreciate M34 for its resolvability and the distinctive orange star in the center. Larger aperture scopes will need to stay at lowest power to appreciate the 18 light-year span of this 100 million year old cluster, but take the time to power up and study. You will find many challenging doubles inside!

M34
Credit: REU Program/NOAO/AURA/NSF

Is it gone yet? Not quite! The Moon will be along much later, but not before we've had an opportunity to head for another northern gem, M76.

Located in western Perseus just slightly less than one degree north-northwest of Phi, M76 is often referred to as "The Little Dumbbell." Originally discovered by Messier's assistant Méchain in September of 1780, Charles didn't get around to cataloging it for another six weeks. What a shame it took him so long to view this fine planetary nebula! Its central star is one of the hottest known, but its resemblance to M27 is what makes it so fascinating.

Looking very much like a miniaturization of the much larger M27, M76 is rather faint at magnitude 11, but is quite achievable in scopes of 114mm in aperture or larger. It is small, but its irregular shape makes this planetary nebula a real "class act!"

For our Southern Hemisphere friends, get thee out there and view Eta Carinae! First recorded by Halley in 1677, this nebular variable star left even the great Sir John Herschel at a loss to describe its true beauty and complexities. This "slow nova" is filled with all the wonders that we "northerners" can only dream about...

Eta Carinae
Credit: NOAO/AURA/NSF

M76: The Little Dumbbell
Credit: N. A. Sharp/NOAO/AURA/NSF

DEC 31
MONDAY

Robert Aitken
Credit: Mary Lea Shane Archives/
Lick Observatory

Today is the birthday of Robert G. Aitken. Born in 1864, Aitken was a prolific American observer who discovered and catalogued more than 3100 double and binary stars. Just look at what a prolific observer YOU have become in just a year!

Is it gone yet? No. The Moon will be around much later tonight, but the year 2007 is just about ended. Try celebrating in a unique and inspiring way! Go observing...

In the hours before midnight, you could take a cosmic journey that spans millions of light-years. In the northern hemisphere, visit with the Andromeda Galaxy again—or the Small and Large Magellanic Clouds if you live in the South. Feast your eyes on vast and wondrous displays of stars like the "Double Cluster" in Perseus, or the "Jewel Box"—the Kappa Crucis star cluster. Rejoice in the birth of new stars by voyaging to M42—the Orion Nebula... And remember the old by returning to M1—the Crab Nebula. Take delight in the movements of our own solar system by watching Mars rise, or peeking in on Saturn's rings as it follows behind. Perhaps the ISS will make a pass over your area tonight, or maybe only a single star will shine through your cloudy sky. It may be something as spectacular as watching a meteor go down in a blaze of glory, or as quiet and contemplative as watching the Moon rise as the year ends.

Now take a moment to look up at the stars and think about all the billions of years that they have been in the making and all the time that it has taken for the light to reach us. Salute! Our observing year has been wonderful together... And I'll look for you under the stars! I hope you'll join me again when 2008 begins as "The Night Sky Companion."

May all your journeys be at light speed!

Comet Hale Bopp
Credit: Jason Shinn

RESOURCES

While there are many great resources out there to help you along your way to enjoying the hobby of astronomy, here are a few I think you'll find very useful!

www.lunar-occultations.com

This is the International Occultation and Timing Association (IOTA) site. The accurate information they provide for viewers around the globe will prove invaluable.

www.heavens-above.com

This site is easy to use, concise, and offers perfect information and charts for viewing satellites, asteroids and bright comets.

www.spaceweather.com

Space Weather will keep you up-to-date on solar and auroral events and many other things. This is definitely a good tool!

www.astroleague.org

The Astronomical League website offers many fine observing programs for the amateur astronomer, and offers a wealth of resources including links to current information on comets.

www.fourmilab.ch/yoursky

Your Sky is a wonderful interactive planetarium tool that allows you to create customized maps and sky views specific to your location.

www.skyandtelescope.com

Sky and Telescope magazine offers terrific on-line tips, charts and information, as well as many articles for the amateur astronomer.

www.astronomy.com

Astronomy magazine also has on-line resources, observing tips and more.

www.lpl.arizona.edu/alpo

The Association of Lunar and Planetary Observers (ALPO) has a comprehensive, educational, and very useful website.

www.aavso.org

The American Association of Variable Star Observers (AAVSO) will offer you the kind of information you need to study variable stars.

www.lunarrepublic.com

Lunar Republic offers up some of the very finest on-line reference materials available.

www.universetoday.com

Universe Today offers the best in up-to-date space science news!

Although there are many more terrific websites out there, I think you'll find the ones listed here some of your most often used "tools."

Clear Skies!

ABOUT THE AUTHOR

Born before the great "Space Race," Tammy's parents encouraged her interests. From those early missions, a love was born of watching celestial phenomena - be it a pass of Sputnik, a meteor shower, or a solar eclipse. She purchased her first telescope to view Comet Halley and when she and her family moved to dark, rural Ohio, astronomy turned into a passion.

For 20 years, the fleet of telescopes grew along with the desire to study and report. Graduating from handwritten journals to on-line reports that span more than seven years, her desire to share her experience and knowledge with other beginners and amateurs led her down many starry roads…and into public outreach.

Tammy is currently the President of the Richland Astronomical Society at Warren Rupp Observatory where she also serves as the Education Director and a Board member. She is also a member of the Astronomy for Youth team and served on the board. Tammy is a member of the Astronomical League webmaster team, an is AlCor representative, serves as a NASA "Space Place" editor, and is heavily involved with the Night Sky Network and Astronomical League Outreach.

Her credits include many observing awards from the Astronomical League and reporting for the Lunar Transient Phenomena Research team, as well as several other observing organizations. As a freelance writer, she has had success in various periodicals, but is probably best known for the long running column on Universe Today - "What's Up", the "365 Days" book and "Beginner's Guide To Astronomy" series. Tammy has traveled all over the United States giving astronomy outreach programs. You'll find her at schools, colleges, libraries, state parks, at the Observatory, and right here in her own backyard - doing what she loves best.

Traveling at light speed...

ACKNOWLEDGEMENTS

When one has weighed the Sun in balance, and measured the steps of the Moon, and mapped out the seven heavens, there still remains oneself. Who can calculate the orbit of his own soul?

NGC1579
Credit: R. Jay GaBany

We are all on our backs in the gutter, only some of us are looking at the stars.
– Oscar Wilde

Throughout the years, it has been my great pleasure and privilege to know many professional and amateur astronomers. I have been inspired by countless books, magazines and programs—and spent years of starry nights at the eyepiece in study. It is a combination of all of these things that makes this book what it is.

And makes me who I am.

For all of you out there? I thank you. Your support and kind words have made a dream come true. Now let's thank the people that made it come about...

Ricardo Borba

Ricardo Borba is an amateur astronomer living in Ottawa, Ontario and a member of the Royal Astronomical Society of Canada. Between observing sessions he is an Application Software Engineer at Natural Convergence and his photographic skills are becoming highly acclaimed as they are featured in various publications.

www.borba.com

Fraser Cain

Fraser is the publisher of Universe Today, a popular Internet website dedicated to news about astronomy and space exploration. The site receives over 600,000 page views a month, and the newsletter edition goes out to 26,000 subscribers every weekday. An accomplished writer, he has written three published books (GURPS Supporting Cast, Creatures of Earthdawn, Double Exposure), and several magazine articles. Fraser grew up on Hornby Island, a small rock off the coast Western Canada with incredibly dark skies—ideal for amateur astronomy. He currently lives in Courtenay, BC, a small city on Vancouver Island.

I would personally like to thank Fraser for his idea and encouragement to take what had been a weekly column and create a successful book which was downloaded in excess of 500,000 times last year. Fraser's vision continued into 2007 and his faith to turn in a virtual "nobody" into a writer will forever be appreciated.

www.universetoday.com

Alan Chu

As a resident of Hong Kong, Alan might joke that the Moon is all he has to observe due to light pollution, but Alan's work is no laughing matter. He has produced one of the finest amateur Photographic Atlas of the Moon available and it is a great honor to include his fine photography in these pages.

www.alanchuhk.com/

John Cudworth

As an amateur astronomer in the New England area, John has a passion for photography and his work includes many outstanding sky shots.

R. Jay GaBany

Born at the dawn of the space age, R Jay GaBany has grown up and matured during a time when mankind's fascination with the great mysteries beyond our home planet has surged. His interest in astronomy started at an early age, sparked by the Apollo Moon Landing program. When Neil Armstrong and Buzz Aldrin were bouncing on the lunar surface, Jay was in his back yard observing the moon through his first small refractor. But it was Carl Sagan's vision that ignited his adult enthusiasm for astronomy when Cosmos debuted, and shortly thereafter he acquired his first 8-inch Schmidt-Cassegrain telescope.

Many other telescopes followed, as did two years learning how to image with a 35mm camera in time for the passing of Halley's Comet in 1986. Family, kids, career and expenses, however, turned him into a spectator when amateur astronomy migrated from film to CCD imagery during the 1990's. Moving from Connecticut to San Jose, California, Jay began designing web-based travel reservation systems during the day but at night began taking deep space pictures, inspired by the work of Robert Gendler. Learning to produce images of the night sky with a CCD camera proved to be the most challenging, rewarding and addictive activity he had ever undertaken. Today, images are taken both from his light-polluted backyard using a portable 12 inch telescope and remotely, using Internet control, with a 20 inch reflector from a dark location in the south-central mountains of New Mexico.

www.cosmotography.com

Greg Gerhart

As an amateur astronomer at both Warren Rupp Observatory and Astronomy for Youth, Greg's keen interest in the night sky has led him to be one of the most prolific of observers and his tireless outreach efforts are to be highly commended.

Geophysical Institute

Located at the University of Alaska, Fairbanks, there is no finer site available to the amateur to explore aurora.

www.gi.alaska.edu/

Wes Higgins

Wes' interest in space and astronomy started when he was in the second grade while watching the first US manned space shot on television. He continued to follow with great interest the NASA space programs all the way thorough the Apollo moon landings. While growing up, he yearned for a telescope, but the thought lay dormant through college, marriage and starting his own business. Eight years ago I his dream came true and as he says, "I am sure that for the rest of my life I will be out observing and imaging every chance I get."

http://higginsandsons.com/astro/

International Occultation Timing Association—IOTA

World renowned for their accuracy, the IOTA team provides perfect information for any occultation or grazing event—be it by the Moon, a planet or an asteroid! My appreciation goes to Dr. David Dunham and Derek Breit for providing a forward look into the year 2007. The planetary position information used in this book was calculated using IOTA's OCCULT 3.0 software.

www.lunar-occultations.com

Greg Konkel

Greg has many interests and two of those that occupy a great deal of his time are astronomy and photography. Having recently made the transition from film to digital cameras, he's enthused about the potential of this new technology and has focused his attention lately on integrating these two interests. The purpose of his web site is twofold…to, hopefully, make a contribution regarding the technical issues surrounding digital astrophotography, and to share some of the best images he's acquired—both astronomical and general photographic.

www.nwgis.com/greg

David Malin

From the Royal Observatory Edinburgh/Anglo-Australian Observatory, no one has produced finer or more inspiring images of the heavens than Mr. David Malin. Although retired, David's work continues to be amongst the best ever achieved. It is an honor to be able to include it here.

www.davidmalin.com

Terry Mann

Terry Mann is President of the Astronomical League, a JPL Solar System Ambassador and served as President and Vice-President of the Miami Valley Astronomical Society. She has received the R. G. Wright Award, the Kepler Award and an Award from the Ohio House of Representatives for her dedicated research and study of the Solar System. She has written articles for the Astronomical League's newsletter, the REFLECTOR, local newspapers, and her astrophotography has appeared in local art galleries, newspapers, and TV newscasts. Her service and dedication to astronomy outreach is beyond compare.

National Aeronautics and Space Administration (NASA)

NASA explores. NASA discovers. NASA seeks to understand. But, most of all, NASA shares. We would like to thank those good folks for providing all the wonderful resources available to amateur astronomers and to express my personal thanks for the use of many archival photographs, illustrations and other materials seen here.

NOAO/AURA/NSF

The National Optical Astronomy Observatory was formed in 1982 to consolidate all AURA-managed ground-based astronomical observatories (Kitt Peak National Observatory, Cerro Tololo Inter-American Observatory, and the National Solar Observatory with facilities at Sacramento Peak, New Mexico and Kitt Peak, Arizona) under a single Director. Today, the National Solar Observatory has its own director. NOAO is funded by the National Science Foundation and operated by the Association of Universities for Research in Astronomy, Inc. NOAO has its headquarters in Tucson, AZ.

NOAO also represents the US astronomical community in the International Gemini Project through its new NOAO Gemini Science Center. NOAO's purpose is to provide the best ground-based astronomical telescopes to the nation's astronomers, to promote public understanding and support of science, and to help advance all aspects of US astronomy. As a national facility, NOAO telescopes are open to all astronomers regardless of institutional affiliation.

Association of Universities for Research in Astronomy, Inc. (AURA) is a consortium of universities, and educational and other non-profit institutions, that operates world-class astronomical observatories that we term "centers." Our members are 32 U.S. institutions and 7 international affiliates. We view ourselves as acting on behalf of the science communities that are served by our centers, and as trustees and advocates for the centers' missions.

Their mission statement: "To promote excellence in astronomical research by providing access to state-of-the-art facilities."

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science…" They are the funding source for approximately 20 percent of all federally supported basic research conducted by America's colleges and universities. In many fields such as mathematics, computer science and the social sciences,

NSF's task of identifying and funding work at the frontiers of science and engineering is not a "top-down" process. NSF operates from the "bottom up," keeping close track of research around the United States and the world, maintaining constant contact with the research community to identify ever-moving horizons of inquiry, monitoring which areas are most likely to result in spectacular progress and choosing the most promising people to conduct the research. It is through the wonderful work of these organizations and the people involved in them that you see many of the outstanding photographs in the pages.

Gary Nugent

I would like to thank Gary for the use of the small lunar phase graphics you see on each page. These are from his program Lunar Phase Pro.

lunarphasepro.nightskyobserver.com/

Palomar Observatory/Caltech

I cannot adequately express my gratitude towards Palomar Observatory and Caltech for the use of the POSS II Sky Survey images that you see in hundreds of places throughout this book. Although amateur photography has come a long way over the years, no one can surpass this huge database of images. I would also like to thank Linda Bustos for helping me obtain permission to use and present them to you. May their use as illustrations inspire you, as much as their research has inspired me. My many, many thanks...

Jason Shinn

Jason Shinn has been an amateur astronomer for more than 20 years. An active member of the Astronomy Club of Akron, he has recently joined the Society of Amateur Radio

Astronomers (SARA) and is an active participant in the NASA Radio Jove Project, as well as a director of the Hoover Price Planetarium.

Ken Vogt

There is no one to whom I owe a deeper debt of gratitude that Ken. By conventional standards, he swears his life has not been that successful—but he's far more talented than he will speak of. Living modestly in southern Indiana, he was able to retire from various menial employments in 1991 at age 45—but he's far from "retired."

Since that time, Ken pursued his love of music (playing keyboards tolerably badly) and computers; although the bright sky in his home town has prevented any serious sky watching. Ken is also a passionate advocate of Distributed Computing, helping out with the creation of the BAUT BOINC team for projects like Einstein@Home. As he says: "At this stage of life, I'm very happy to help out around the Internet in any way I can."

Ken's "help" has been critical to the publication of this book. He graciously volunteered his time in several ways, and his encouragement through some rough times has been instrumental in its completion. He is truly one of the brightest "stars" in my night sky.

John Walker

I would also like to thank John Walker, the developer of the "Your Sky" program. It was used to generate the monthly All Sky charts and the constellation charts you see here.

www.fourmilab.ch/yoursky/

Roger Warner

Roger Warner lives in the UK within a town called Basildon, located in the county of Essex. Both father and grandfather, his interest in astronomy began seven years ago, but the last two years have been dedicated to learning the art of imaging, The Moon and planets were his beginnings—taken with a low cost camera, which is still used to this day.

The Moon became Roger's huge challenge—waiting for the moment of good seeing and grabbing those hidden secrets within. He began to get in close to capture those jaw dropping pictures of the Moons craters, valleys and mountains. With the introduction of a modified webcam, he soon moved on to deep sky—learning the process all over again. His greatest wish is that the images he has produced will inspire others "to progress as well in this wonderful hobby."

www.lupas.pwp.blueyonder.co.uk/rwnewastro/lunar.htm

My deepest appreciation goes once again to all of these fine folks and astronomers. May we all shine on...

~Tammy

Go outside and look up...

What's Up 2007: 365 Days of Skywatching presents the highlights you can see in the night sky for every day in 2007. With a small telescope, binoculars, and sometimes just your eyes, you'll track down features on the Moon, planets, meteor showers, bright and double stars, open and globular clusters, and distant galaxies.

Astronomer Tammy Plotner is your guide to the wonders of the night sky.

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Front Cover Photo Credit: R. Jay GaBany
Rear Cover Photo Credit: Greg Konkel