

StarDate™

JANUARY/FEBRUARY 2013

\$5

MESSIER'S WONDERS
A DEEP-SKY LEGACY



THE UNIVERSITY OF TEXAS AT AUSTIN MCDONALD OBSERVATORY

StarDate

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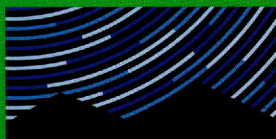
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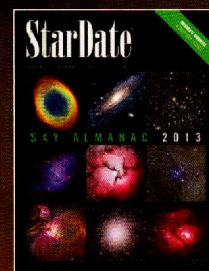
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Venus shines through a Texas evening twilight.

Coming Up in March/April

In our next issue, bone up on the different types of exploding stars called supernovae, and find out why they matter. And get the latest scoop on astronomers' efforts to decode the atmospheres of extrasolar planets to find signs of life on other worlds.



On the Cover

This array depicts some of the deep-sky wonders cataloged by Charles Messier in the 18th century. Many of these objects are visible to the unaided eye, while others require nothing more than binoculars. Learn more about the Messier objects throughout this issue.

SKY ALMANAC 2013

CHARLES MESSIER'S DEEP-SKY LEGACY

Charles Messier compiled history's most famous astronomical catalog not to guide his fellow astronomers to new wonders in the heavens, but to help them avoid them.

Like many astronomers, Messier scoured the skies for comets. In part, that's because his interest in astronomy was fired by a spectacular comet in 1744, when Messier was just 14 years old, that sprouted six tails. But comets offered one of the few chances to study something new. Through the telescopes of the late 18th century, the stars were simply never-changing points of light, the planets indistinct orbs. Comets, however, appeared and disappeared at whim, so they were about the only objects in the night sky that offered something new. Nobility, industrialists, and even governments offered medals and cash prizes for comet discoveries, making them even more appealing.

As Messier studied the sky, though, he kept finding fuzzy blobs of light that were neither stars nor comets. His telescopes revealed little detail, so in 1758 he began cataloging them. In 1774 he published a catalog of 45 of these objects, and in 1784, an expanded list of 103; another seven were added long after his death. The catalog was intended to keep his fellow comet-hunters from wasting time by ruling out these comet-like objects.

Today, though, we realize that Messier's catalog offers some of the most fascinating deep-sky objects, from star clusters and the remains of dead stars to the Andromeda galaxy (Messier 31), at a distance of 2.5 million light-years.

Many Messier objects are bright enough to see with the unaided eye, while others require nothing more than binoculars. They are sprinkled across the sky, which means they are sprinkled through the seasons. So with our Almanac as a guide, ignore Messier's intent and hunt down his famous quarry — blobs of light that are far more interesting than Messier ever realized.



Text by Damond Benningfield

OVERVIEW

Venus, Jupiter, Mars, and Saturn are all in view as the year starts, with Jupiter dominating the sky for much of the night. Mars drops from view in early evening, with Saturn and Venus in view only in the early morning hours. January's skies offer some of the most spectacular stellar cartography of all, with brilliant Orion, Taurus, Canis Major, and others sparkling through much of the night. Fomalhaut, the lonely "autumn star," disappears in the southwest around month's end.

HIGHLIGHTS

1 Earth is at perihelion, its closest approach to the Sun for the year, at a distance of about 91.5 million miles (147 million km), or about 1.5 million miles (2.4 million km) closer than average.

1 Regulus, the bright heart of Leo, perches directly above the Moon at first light.

2 The Quadrantid meteor shower is at its peak tonight.

5/6 Spica, the leading light of Virgo, rises to the lower left of the Moon in the wee hours of the 5th, and well above the Moon on the 6th. The duo is high in the south at first light.

8/9 Antares, the bright orange center of Scorpius, is well below the Moon at first light on the 8th, and close to the Moon's right on the 9th. Venus, the brilliant "morning star," is far to their lower left.

10 Venus is close to the right of the Moon as the sky begins to brighten this morning. They are quite low in the sky, so you need a clear horizon to spot them.

12 Mars stands to the upper left of the Moon as darkness begins to fall this evening. Both set shortly after the sky grows fully dark.

FEATURED EVENT

21 Jupiter stands just to the left of the Moon as night falls.

27/28 Regulus rises well to the lower left of the Moon on the evening of the 27th, and to the upper right of the Moon on the 28th.

JANUARY

Su	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Named for Janus, the Roman god of gates and doors, beginnings and endings

JANUARY

A view of the Great Red Spot and other cloud features from the Cassini spacecraft, 2001.

FEATURED EVENT

Painterly Planet

Art and science intersect in beautiful fashion in the cloud tops of Jupiter, the largest planet in the solar system.

The planet is beautiful enough just to the unaided eye. On the night of January 21, in fact, it looks better than average because it stands just above the gibbous Moon in the evening sky. Jupiter looks like a brilliant cream-colored star, outshining all the other planets and stars in the sky at that hour.

Close-up images from spacecraft at Jupiter reveal even greater beauty, though, including streamers and curls of soft color that look like the bold brushstrokes of an Impressionist painter.

Jupiter is a ball of gas that's almost 11 times wider than Earth. Its thick atmosphere is topped by clouds of water, ammonia, sulfur, and other compounds. The giant planet spins on its axis once every 10 hours, stretching the clouds into globe-circling bands that are visible through even small telescopes.

Those bands are quite dynamic. Strong winds, rapidly rising clouds, and the interplay of adjoining bands create swirls, streamers, pinwheels, and other beautiful shapes. Different mixtures of chemicals color the cloud tops in shades of white, blue, tan, and orange. The white and blue clouds, in fact, are likely made of water. They reside in a lower level of the atmosphere, making them harder to see than their warmer-colored cousins. These clouds produce giant thunderstorms, with lightning that may be a thousand times more powerful than anything on Earth.

In fact, many of Jupiter's artistic creations are really storm systems that are thousands of miles across. The largest of all, the Great Red Spot, is twice as wide as Earth. It, too, has a painterly look, with spiraling bands that resemble the sky in Vincent Van Gogh's "Starry Night." Yet these broad brushstrokes are painted in the sky of a giant, dynamic world.

FEATURED MESSIER OBJECT

M42: Star Factory

Stars are like members of large broods of chicks. They are born in groups that stay close together for a while before each member heads off on its own.

A “nest” of newly hatched stars highlights Orion’s Sword, a lineup of objects below the constellation’s three-star Belt. At a distance of just 1,350 light-years, the Orion Nebula, object number 42 on Messier’s list, is the closest stellar nursery to Earth, and the only one that is easily visible to the unaided eye.

M42 is part of a giant complex of clouds of interstellar gas and dust. Pockets of this material are collapsing to give birth to new stars. Hubble Space Telescope images reveal about 3,000 stars in the Orion Nebula alone.

The visible nebula is a bubble of turbulent gas that is energized by the Trapezium, a cluster of hot, bright stars at its center. Ultraviolet energy from the stars strips electrons from atoms in the nebula. When the electrons link up with new atoms, the atoms emit light.

The process of starbirth continues today, with several hundred dense blobs of gas and dust collapsing to make new stars. In addition, planetary systems appear to be taking shape around many of the newborn stars. Not all of them will survive the birth process, though, because radiation from the cluster’s hot young stars is eroding the planet-making materials around many of the stars.

M42 is the bright, fuzzy blob at bottom center of Orion.

In about 100,000 years or so, as hot stars blow away the last wisps of gas and dust, the nebula will disappear, leaving behind a brilliant star cluster. That, too, eventually will disappear. Over tens of millions of years, most of the cluster’s stars will leave the nest and head into the galaxy alone.



Moon phase times are for the Central Time Zone.

The full Moon of January is known as the Old Moon, Moon After Yule, or Wolf Moon.

PERIGEE
January 10

APOGEE
January 22

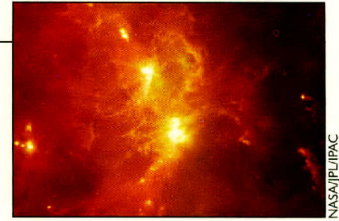
Apogee is the Moon’s greatest distance from Earth, perigee is the smallest. The average distance is 239,000 miles (383,000 km), but the distance can vary by almost 30,000 miles (48,000 km).

ANNIVERSARIES

30 Years Ago

The Infrared Astronomical Satellite (IRAS) launched on January 25, 1983. During 10 months of observations, it cataloged about 500,000 infrared sources — more than twice as many as were known before the mission.

Infrared wavelengths are too long to see with the human eye. They are produced by relatively cool clouds of dust in such objects as stellar nurseries, galaxies, and comets. IRAS was the first infrared satellite.



IRAS infrared view of Orion, including M42 (bottom center).

NASA/JPL/IRAC

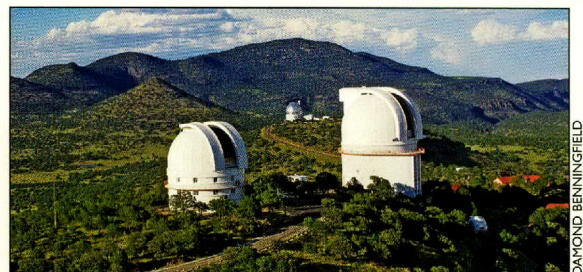
EXPLORATIONS

Ongoing

In addition to the major milestones sprinkled throughout this issue, many spacecraft are continuing to explore the worlds of the solar system. Here are the leading examples. (Spacecraft in transit are not included.)

Mission	Target	Arrival
Lunar Reconnaissance Orbiter	Moon	2009
MESSENGER	Mercury	2011
Venus Express	Venus	2006
Mars Odyssey	Mars	2001
Mars Express	Mars	2003
Opportunity Rover	Mars	2004
Mars Reconnaissance Orbiter	Mars	2006
Curiosity Rover	Mars	2012
Cassini	Saturn	2004

EVENTS



DAMON BENNINGFIELD

Year-Round

McDonald Observatory offers star parties every Tuesday, Friday, and Saturday night. Daily events include solar viewing and observatory tours, while other special events include lunar viewing and twilight programs.

mcdonaldobservatory.org

OVERVIEW

The cold February evenings offer some of the brightest stars in the entire night sky. Sirius, the brightest of all, climbs across the south, trailing below and behind beautiful Orion. Taurus, the bull, looks down on them. From the southern United States the second-brightest star, Canopus, huddles below Sirius. And brilliant Capella lords over them all from high overhead. Among the planets, only dazzling Jupiter puts in a good showing this month, although Mercury just peeks into view in the west for a few evenings around mid-month.

HIGHLIGHTS

- 1** Spica, the brightest star of Virgo, stands to the left of the Moon at first light.
- 2** Spica is to the right or upper right of the Moon at first light, with the brighter planet Saturn farther to the left or upper left of the Moon.
- 3** The golden planet Saturn stands above the Moon at dawn.
- 5** Antares, the brightest star of Scorpius, huddles to the lower right of the Moon at first light. The star shows a distinctly orange hue.
- 17** Mercury, the closest planet to the Sun, puts in a brief appearance in the evening sky. It is low in the west shortly after sunset. Although it looks like a fairly bright star, it can be tough to spot through the glare of twilight.
- 17/18** Jupiter, which looks like a brilliant cream-colored star, is to the upper left of the Moon at nightfall on the 17th, and to the upper right of the Moon on the 18th. Orange Aldebaran, the “eye” of Taurus, looks on from a little lower in the sky.
- 24** Regulus, the brightest star of Leo, is to the left of the Moon at nightfall.

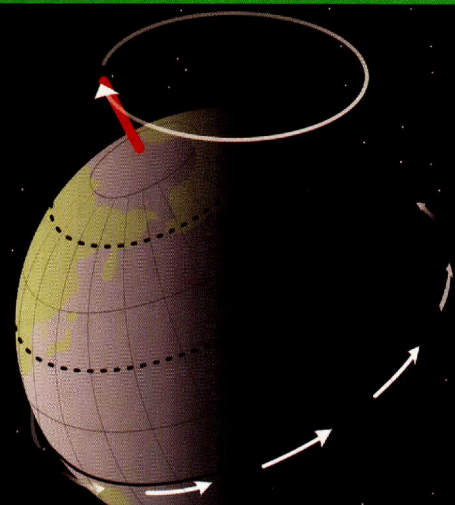
FEATURED EVENT

- 28** Spica huddles quite close to the Moon as they climb into good view by late evening.

FEBRUARY

Su	M	T	W	Th	F	Sa
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24	25	26	27	28		

FEBRUARY



Hipparchos discovered that Earth's axis moves, an effect called precession.

NASA

FEATURED EVENT

Spinning Through the Stars

You don't need big telescopes or electronic instruments to learn about the universe. Sometimes, you can learn a great deal with little more than your eyes alone.

In 127 BC, for example, the Greek astronomer Hipparchus learned that the stars shift position relative to the Sun from year to year. He did so by measuring the position of Spica, the brightest star of the constellation Virgo. It stages a dazzlingly close encounter with the Moon on the night of February 28, as the Moon passes just a fraction of a degree from the bright star.

During a lunar eclipse, Hipparchus measured the angle from Spica to the middle of the Moon, which in turn allowed him to calculate Spica's position relative to the Sun. By comparing that position with records of another eclipse about 150 years earlier, he determined that the star had moved about two degrees, which is roughly the width of a finger held at arm's length, over that period. Hipparchus realized that the entire celestial sphere — the background of fixed stars — rotated with respect to the Sun.

That rotation is known as the precession of the equinoxes. It's caused not by the stars, though, but by Earth. Our planet “wobbles” on its axis like a spinning gyroscope that's running down. As it does so, the stars appear to shift position relative to the Sun. It takes about 26,000 years to complete one full wobble and have the stars return to their starting positions.

Precession was an important discovery because it showed that the heavens can change, setting the intellectual stage for future discoveries about the universe and our place in it.

Named for Februus, the Roman god of purification

FEATURED MESSIER OBJECT

M44: *The Beehive*

Cancer, the crab, is famed for its position in the zodiac. Yet other than its location, there's not much to recommend it. The outline of the crab itself is not all that crab-like, and even its brightest stars are mere pinpricks that are difficult to see from light-polluted cities and suburbs.

Cancer's only real highlight is a star cluster that Messier listed as the 44th object in his catalog. It buzzes with so many tightly packed stars that it's known as the Beehive. That appearance isn't deceiving, because M44 is one of the busiest star clusters in our region of the galaxy, with perhaps a thousand stars or more.

The cluster is around 600 light-years away, and probably about 600 million years old. Astronomers deduce its age by determining the types of stars it contains — and the types it does not. Missing from the cluster are the hottest, brightest, and most massive classes of stars. Such stars burn through their nuclear fuel in a hurry, so they disappear in tens or hundreds of millions of years, placing a lower limit on the cluster's age.

Most of the cluster's current members are the faint cosmic embers known as red dwarfs, while about a third are somewhat like the Sun. Only a handful of its stars are much brighter and more massive than the Sun, and these will burn out fairly soon on the astronomical time scale.

M44 stands about a third of the way up the eastern sky as darkness falls on February evenings, and climbs high across the sky later on. To the eye alone it looks like a small hazy patch of light sprinkled with a few little stars. Binoculars reveal dozens of stars, which span a region about three times the width of the Moon, adding sparkle to the otherwise drab crab.



The sprinkling of stars known as the Beehive.

TOM BASH, JOHN FOX/ADAM BLOCK/NOAO/AURA/NSF



3

7:56 am



10

1:20 am



17

2:31 pm



25

2:26 pm

Moon phase times are for the Central Time Zone.

The full Moon of February is known as the Snow Moon, Wolf Moon, or Hunger Moon.

PERIGEE

February 7

APOGEE

February 19

ANNIVERSARIES

10 Years Ago

An international team of seven astronauts perished when space shuttle Columbia disintegrated during reentry at the end of a 16-day flight on February 1, 2003. Mission STS-107 was doomed during launch, when a large chunk of foam broke off the shuttle's external fuel tank and punched a hole in one of Columbia's wings. The hole allowed searing gases to enter the wing during reentry, melting the wing supports and destroying the spacecraft, which flew the first shuttle mission in 1981.



The STS-107 crew floats inside Columbia.

SKY WATCH

A big space rock will sweep about 20,000 miles above Earth's surface on February 15. No other asteroid known as of late 2012 will pass closer to our planet this year. It should be bright enough to see with binoculars, although not the naked eye.

A Spanish asteroid-hunting telescope discovered 2012 DA14 on February 23, 2012. Observations show that it is roughly 150 feet in diameter, which would fill about two percent of the interior space of Dallas Cowboys Stadium. Because it is moving so rapidly, however, an impact with Earth could cause significant damage. In fact, a similar-sized object probably caused the 1908 Tunguska explosion in Russia, which flattened hundreds of square miles of forest.

Astronomers have discovered about 9,000 asteroids with orbits that bring them close to Earth, with roughly 1,500 on paths that could potentially threaten the planet. A recent estimate suggests that another 3,000 or more potentially hazardous asteroids could still await discovery.

OVERVIEW

The warmer nights of spring bring a panoply of new stars and constellations for skywatchers to enjoy. Leo is in good view by nightfall, climbing straight up from the eastern horizon, led by his bright "heart," the star Regulus. Virgo follows the lion a couple of hours later. Auriga, the charioteer, is to the maiden's left, marked by yellow-orange Arcturus, one of the brightest stars in the night sky. The brilliant planet Jupiter dominates the evening sky, with the orange "eye" of Taurus close by.

HIGHLIGHTS

- 1 Spica, the brightest star of Virgo, is close to the right of the Moon at first light.
- 2 The planet Saturn, which looks like a bright golden star, stands just above the Moon at dawn.
- 4 Antares, the bright orange heart of Scorpius, huddles below the Moon in the pre-dawn sky.
- 9 Comet C/2011 L4 (PANSTARRS) is expected to shine at its brightest. (See details at far right.)
- 17 Dazzling Jupiter is close to the upper right of the Moon at nightfall, with the orange star Aldebaran a little farther to the lower left of the Moon.

FEATURED EVENT

- 20** Spring arrives in the northern hemisphere with the vernal equinox at 6:02 a.m. CDT.
- 23/24** The Moon swings by Regulus, the heart of Leo. Regulus is to the lower left of the Moon as darkness falls on the 23rd, and about the same distance above the Moon on the 24th.
- 28** Spica is to the upper right of the Moon, with the planet Saturn about the same distance to the lower left of the Moon late this evening. They are high in the sky at first light on the 29th, with Saturn to the upper left of the Moon and Spica farther to the right.
- 30** Saturn stands above the Moon as they climb skyward in the wee hours of the morning.

MARCH

Su	M	T	W	Th	F	Sa
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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

MARCH

Named for Mars, the Roman god of war

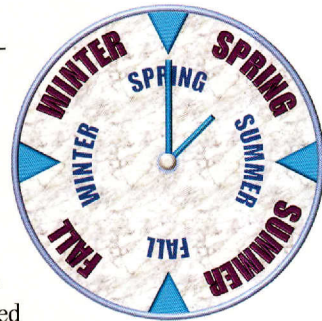
FEATURED EVENT

Calendar Confusion

The Sun crosses the celestial equator heading from south to north on the morning of March 20. This moment, known as the vernal equinox, marks the beginning of spring in the northern hemisphere.

Every year, though, our StarDate radio broadcasts about the changing seasons bring protests from listeners. Some contend that the equinoxes and solstices mark the middle of the seasons, not the beginning, while others argue that these dates have no connection to the seasons at all.

Many cultures have created their own calendars. Some, such as the Chinese, Jewish, and Muslim calendars, are based on the cycles of the Moon. They quickly slip out of phase with the seasons, so in some, extra days are added to bring calendar and seasons into rough alignment.



The modern western calendar evolved from the calendar of ancient Rome. Originally, the year began at the March equinox. In 46 B.C., Julius Caesar instituted the basic version of the calendar that's in use today, with 12 months and a start date of January 1. (The calendar has been tweaked a few times since, particularly to revise the number of leap days.)

Even so, there was no standard for the beginning and ending dates for the seasons. Some used the equinoxes and solstices, while others used these dates as mid-points. In Britain, for example, the June solstice was Mid-Summer's Day. In this system, the seasons changed roughly half-way between the solstices and equinoxes, on the cross-quarter days.

Over time, though, many cultures adopted the solstice-and-equinox system of delineating the seasons. These events are based on the precise position of the Sun in the sky, so they are easily predicted.

The official timekeeping organization in the United States, the U.S. Naval Observatory, reckons the seasons along these astronomical events, so spring officially begins at the moment of the vernal equinox.

There are many other ways to designate the seasons and even the year, of course. The school year begins around September 1, for example, while the federal government's fiscal year begins October 1. Each of these systems has its own calendar and seasons. But the astronomical seasons begin and end with the solstices and equinoxes.

FEATURED MESSIER OBJECT

M51: Galactic Whirlybird

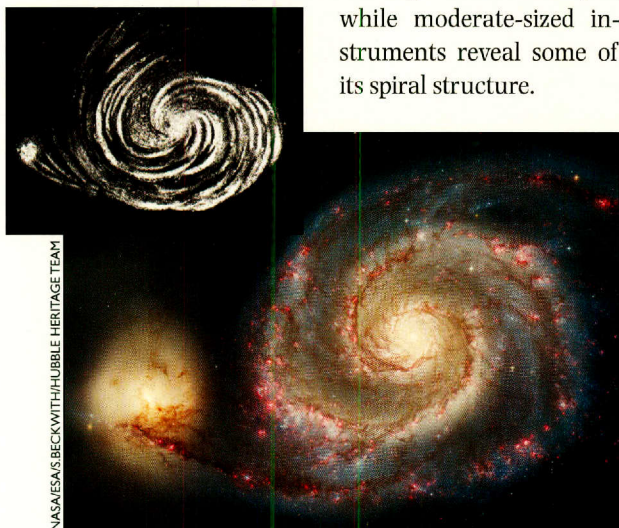
Charles Messier compiled his catalog to help his fellow astronomers discover more comets. But it was while watching a comet that Messier discovered the 51st object on his list. He found it in October 1773, and described it as “a very faint nebula, without stars.” Modern telescopes reveal a far more detailed picture: one of the most spectacular spiral galaxies in the universe, known as the Whirlpool.

M51 actually consists of two separate galaxies that have sideswiped each other over the last few hundred million years. This encounter has helped create the beautiful spiral structure in the larger of the two galaxies. The gravity of the smaller galaxy, which looks like a small knot of stars at the end of one of the larger galaxy arms, has created waves that sweep around the galaxy. These waves compress giant clouds of gas and dust, triggering the birth of new stars. These hot, bright stars outline the spiral arms.

M51 was the first galaxy in which anyone detected a spiral structure. In 1854, Lord Rosse, using what was then the world’s largest telescope, painted the object’s beautiful spiral arms. At the time, most astronomers thought the small, puffy blobs of light known as nebulae were all inside the Milky Way galaxy. Observations like Rosse’s helped foment the idea that some of these objects were actually distant galaxies of stars.

Estimates of M51’s distance center around 26 million light-years, although they vary by millions of light-years.

M51 is in the northern constellation Ursa Major, not far from the star at the tip of the Big Dipper’s handle. It is easily visible through small telescopes, while moderate-sized instruments reveal some of its spiral structure.



A modern view of M51, with Lord Rosse’s painting (inset), which was the first to show spiral structure in a galaxy.



Moon phase times are for the Central Time Zone.

Daylight Saving Time begins March 10

The full Moon of March is known as the Lenten Moon, Sap Moon, or Worm Moon.

PERIGEE
March 5

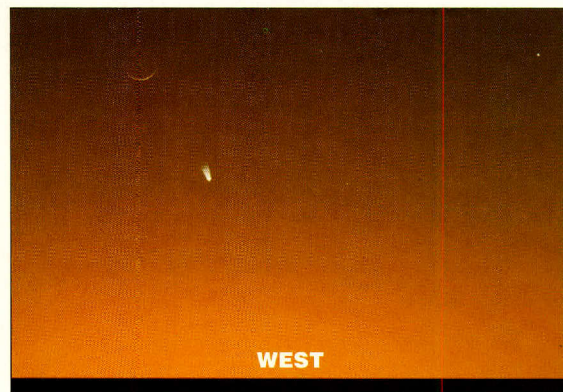
APOGEE
March 18

ANNIVERSARIES

40 Years Ago

A small meteorite punched a hole in a metal carport roof in San Juan Capistrano, California, in the wee hours of March 15, 1973. The owner, Jack Scurlock, picked up a two-ounce fragment later that day, and a smaller piece was discovered in the roof gutter about a month later. Scientists quickly examined the meteorite and determined that it was a piece of a rocky asteroid.

SKY WATCH



This diagram shows the comet’s location on the evening of March 13, although how large and bright it will appear are still unknown.

C/2011 L4 (PANSTARRS)

A comet that was discovered in 2011 while still in the deep freeze of the outer solar system should thaw enough to put on a pretty good show in March as viewed from the latitudes of the United States. Known by the catalog designation C/2011 L4 (PANSTARRS), the comet was discovered by a robotic telescope that scans the skies for asteroids and comets. The comet will pass closest to Earth on March 5 (at a healthy 100 million miles, so no reason to fret!), and to the Sun on March 10. By then, it will be pulling away from the Sun as seen in the western evening sky.

As of late 2012, astronomers were estimating a peak magnitude of about 0.5, which is brighter than all but a few stars and planets. The comet’s light will be spread out over a wider area, however, making it more difficult to see. It will climb farther from the Sun over the following nights, but it will grow fainter as well. Even if it isn’t visible to the unaided eye it will be a good sight through binoculars. We will post updates in March on StarDate Online.

OVERVIEW

The favorite constellations of the season spring into view in the early evening sky this month. Leo is well up in the east at nightfall, with Regulus, the bright star that marks his heart, leading the way. A curved pattern known as the Sickle, which outlines the lion's head and mane, is to the left of Regulus. Virgo is low in the sky at nightfall but quickly climbs to prominence, highlighted by the star Spica. The brilliant planet Jupiter is sliding down toward the western horizon, near the face of Taurus, the bull, while fainter Saturn puts on its best showing of the year late in the month, shining throughout the night.

HIGHLIGHTS

- 13** Aldebaran, the orange eye of Taurus, the bull, is to the upper left of the Moon this evening, with brilliant Jupiter well above them.
- 14** Jupiter, the largest planet in the solar system, stands close to the lower right of the Moon this evening.
- 20** Regulus, the leading light of Leo, perches to the upper left of the Moon at nightfall.
- 21** The Lyrid meteor shower should be at its best tonight.
- 24** Spica, the brightest star of Virgo, stands just above the Moon at nightfall, with the bright planet Saturn to their lower left.
- 25** Golden Saturn poses to the upper left of the Moon early this evening. They remain close together as they sail across the sky during the night.
- 28** Antares, the luminary of Scorpius, is the bright orange star below the Moon at first light.

FEATURED EVENT

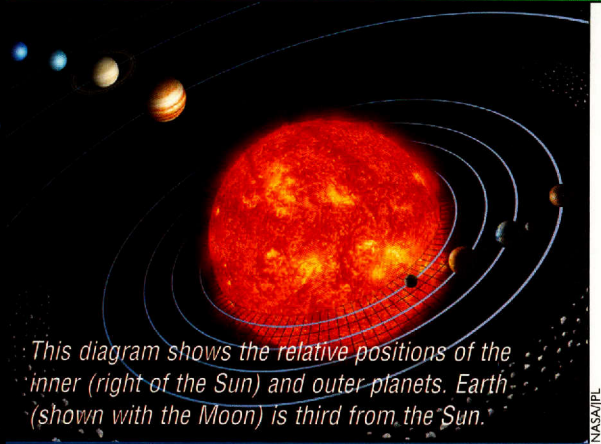
28 Saturn, the second-largest planet in the solar system, is at its best for the year. It rises around sunset and shines all night in Virgo, with the constellation's brightest star, Spica, to the right of Saturn. Saturn looks like a bright golden star.

APRIL

Su	M	T	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

APRIL

From the Latin name Aprilis, which may come from a word meaning "to open," which describes the season in which trees and flowers begin to bloom, or from Aphrodite, the Greek goddess of love and beauty



This diagram shows the relative positions of the inner (right of the Sun) and outer planets. Earth (shown with the Moon) is third from the Sun.

FEATURED EVENT

Superior Beauty

Not to judge our own Earth too harshly, but Saturn is a superior planet. That's not because it's bigger than Earth (it's about 9.5 times Earth's diameter), because it has more moons (more than 60 and counting), or because its rings make it the beauty of the solar system. Instead, it's because Saturn orbits the Sun outside Earth's own orbit, which in astronomical parlance qualifies it as a "superior" planet.

The effect of that superiority is on display in late April and early May, as Saturn reaches opposition, when it lines up opposite the Sun in our sky. The planet remains in view all night, sliding about half way up the southern sky after midnight. Saturn is also brightest for the year, shining like a brilliant golden star.

Earth is the third planet from the Sun, so only two planets are inferior to it: Mercury and Venus. Since their orbits are inside Earth's, neither planet strays far from the Sun in our sky; at best, each is in view for a few hours after sunset or before sunrise.

The other five planets in the solar system are superior, although only Saturn, Jupiter, and Mars are easily visible to the unaided eye. These planets can loop "behind" Earth, lining up opposite the Sun and remaining in view throughout the night. They are closest to Earth around the time of opposition as well, so they shine brightest then.

Saturn is so far from the Sun that it takes the planet almost 30 years to complete a full circle through the background of stars. At that pace, it comes to opposition about every 12.5 months (compared to 13 months for Jupiter and 26 months for much closer Mars).

At opposition, Saturn is still 800 million miles (1.3 million km) from Earth. Yet its superior size, combined with its "superior" location, help make the giant planet one of the skywatching treats of spring.

FEATURED MESSIER OBJECT

M87: Dull Deception

Based on appearance alone, M87 is one of the dull-est objects in Messier's catalog. The giant elliptical galaxy looks like a fuzzy rugby ball, with a bright concentration of stars in its center that fades to a dim glow at the edges.

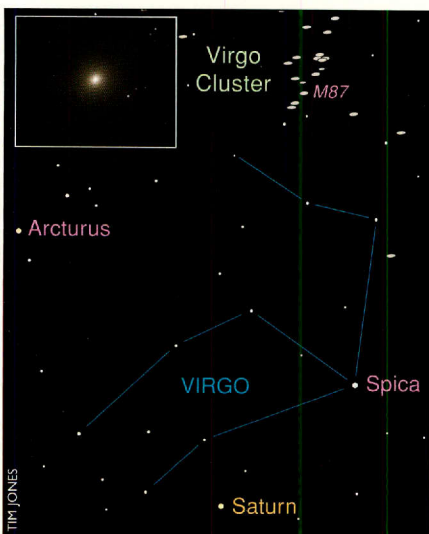
Modern observations, however, show that M87 is an amazing beast, defined by a staggering set of numbers. The galaxy spans one million light-years or more and is home to more than one trillion stars, both of which are several times greater than the Milky Way. Moreover, its core is dominated by a black hole that is more than a thousand times as massive as the one at the heart of the Milky Way, making it one of the heaviest black holes yet measured.

Such giant elliptical galaxies typically form from the mergers of several smaller galaxies. That scenario makes sense because M87 sits at the center of the Virgo Cluster, a crowded galactic cluster in the constellation Virgo. The cluster's galaxies frequently interact with each other, and some of the larger galaxies gobble up the smaller ones.

The mergers that built M87 also built up its central black hole. As the galaxies came together, their central black holes merged to make a bigger one. Even though M87 is about 60 million light-years away, its black hole is so large — about three times the diameter of Pluto's orbit around the Sun — that

astronomers may one day be able to take a picture of its event horizon, which is the point of no return for any matter and energy that enter the black hole. That would offer the final confirmation that black holes exist.

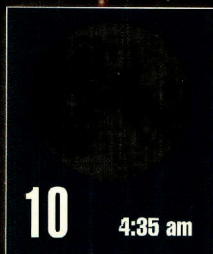
Virgo climbs the eastern sky on April evenings, highlighted by its brightest star, Spica. M87 is high above Spica, and is visible through small telescopes. Many other galaxies of the Virgo cluster dapple the space around M87.



This view is looking east in early evening. Inset: M87.



2 11:37 pm



10 4:35 am



18 7:31 am



25 2:57 pm

Moon phase times are for the Central Time Zone.

The full Moon of April is known as the Egg Moon or Grass Moon.

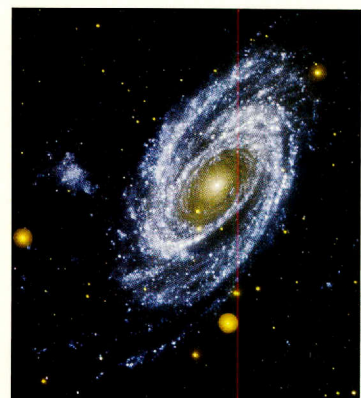
APOGEE
April 15

PERIGEE
April 27

ANNIVERSARIES

10 Years Ago

NASA launched GALEX (Galaxy Evolution Explorer), a small space telescope designed to study galaxies at ultraviolet wavelengths, on April 28, 2003. Ultraviolet energy, which is blocked by Earth's atmosphere, gives astronomers a good look at young stars, hot gas clouds, and other energetic objects inside galaxies. In 2012 NASA



GALEX image of Messier 81, a spiral galaxy in Ursa Major.

turned the spacecraft over to the California Institute of Technology, which is using private funding to continue scientific observations.

SKY WATCH

This Year's Meteor Showers

Shower	Peak	Moon
Quadrantids	Night of January 2	In view most of the night
Lyrids	Night of April 21	In view most of the night
Eta Aquarids	Night of May 5	Early morning crescent
Perseids	Nights of August 11/12	Sets after midnight
Orionids	Night of October 21	In view most of the night
Leonids	Night of November 16	Full
Geminids	Nights of December 12/13	In view most of the night

These times are approximate; actual times may vary.

EVENTS

20 Astronomy Day

A nationwide celebration of astronomy in which museums, astronomy clubs, libraries, universities, and many other groups host star parties, lectures, and other events for general audiences. Many events are held at shopping malls or other convenient locations.

astroleague.org/al/astroday/astroday.html

OVERVIEW

Venus returns to evening skies this month, shining as the “evening star” quite low in the west at nightfall by month’s end. By that time, its only rival in the night sky, brilliant Jupiter, is dropping toward the Sun and getting ready to exit the evening sky. In the meantime, one of the signature constellations of summer, Scorpius, skitters into view in late evening, preceded by the scorpion’s long-lost claws, the stars of Libra, the balance scales.

HIGHLIGHTS

11/12 The bright planet Jupiter stands above the Moon at nightfall on the 11th, and to the lower right of the Moon on the 12th. They are quite low in the sky, and set soon after darkness falls.

17/18 Regulus, the heart of Leo, is above the Moon on the evening of the 17th, and farther to its upper right on the 18th.

21/22 Spica, the leading light of Virgo, stands close to the lower left of the Moon on the evening of the 21st, with golden Saturn farther along the same line. On the 22nd, the Moon has moved down to pose almost side by side with Saturn.

24/25 Antares, the orange heart of the scorpion, is below the Moon as they rise in late evening on the 24th, and about the same distance to the right of the Moon the following night.

FEATURED EVENT

25-30 Venus and Jupiter sweep past each other over several evenings. Fainter Mercury joins the show, moving up and away from the other two in a hurry.

MAY

Su	M	T	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

MAY

Named for Maia, a goddess of spring from Italy before the time of the Roman Empire

FEATURED EVENT

Long-Distance Headlights

Venus and Jupiter, the two brightest objects in the night sky after the Moon, line up like the lights of a low-flying UFO for a few nights in late May. One of them is moving up and away from the Sun while the other is dropping back toward the Sun, so the UFO will appear to tip at a different angle each night as the two planets glide past each other.

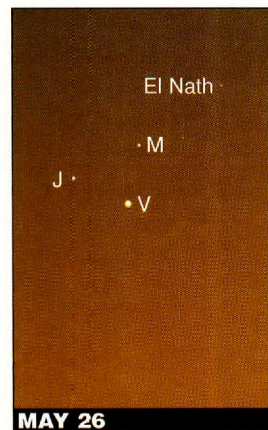
Although they are quite low in the western sky as darkness begins to fall, Venus and Jupiter are so bright that, with a clear horizon, you won’t have any trouble spotting them. In fact, they really do shine so brightly that you might mistake them for one or two approaching airplanes with their landing lights turned on.

That brilliant display will help you find a planet that is easy to overlook: Mercury. The little world sweeps up and past Venus and Jupiter in a hurry, but its proximity to them will make it stand out.

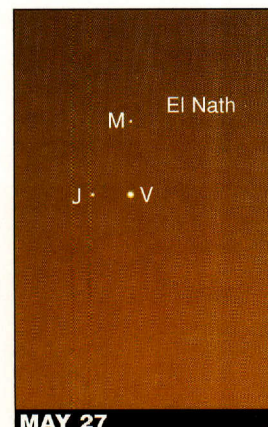
Mercury is the closest planet to the Sun, so it seldom wanders far from the Sun in our sky. Because of that, it’s seldom in view for more than an hour or so after nightfall or before dawn.

Jupiter is well up in the west at nightfall to begin the month, but drops lower in the sky each evening. Venus is so low in early May that it’s all but impossible to see. As the month progresses, however, it climbs a little higher. And Mercury whisks into view by around the 20th.

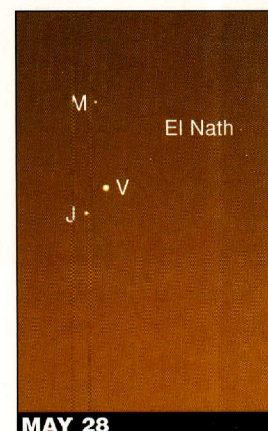
The three planets cluster closest together on the 25th and 26th, with Venus and Jupiter standing side by side on the 27th. After that, Venus and Mercury will continue to climb higher into the evening sky, while Jupiter drops inexorably toward the Sun. Venus will reign as the “evening star” for the rest of the year.



MAY 26



MAY 27



MAY 28

M: Mercury; V: Venus; J: Jupiter

FEATURED MESSIER OBJECT

M13: Ancient Stellar City

An ancient “city” of stars passes high overhead on spring and summer evenings, a globular cluster known as M13, the Hercules Cluster. It’s a faint, fuzzy point of light in the constellation Hercules. Under dark, moonless skies, it is just visible to the unaided eye. Edmond Halley, best known as the namesake of Halley’s Comet, discovered the cluster in 1714, and Charles Messier added it to his catalog a half-century later.

M13 is about 25,000 light-years away, and it contains hundreds of thousands of stars. They are crammed into a region that is only about 100 to 150 light-years across, however, so the cluster contains hundreds of times more stars than are found in a similar volume of space around the Sun.



Most of the stars in globular clusters are red and faint, which is a strong indication that they are among the galaxy’s oldest stars.

In fact, the stars in M13 are probably at least 12 billion years old — close to three times the age of the Sun and about as old as the Milky Way galaxy itself.

Hubble Space Telescope view of M13

The stars in globulars are also different from the Sun in another way: They contain far fewer heavy elements. The Big Bang created hydrogen and helium, but almost nothing heavier than those simple elements. Everything else, from carbon and oxygen to gold and uranium, was created by stars. As stars die, they expel some of these elements into space, where they can be incorporated into new stars — like the Sun.

M13’s stars, however, were born before most of the heavy elements found in the universe today were formed. So almost all of the heavy elements they contain are elements that the stars of M13 created on their own, forged in the hearts of stars over the last 12 billion years.



Moon phase times are for the Central Time Zone.

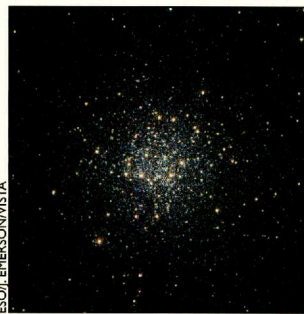
The full Moon of May is known as the Milk Moon, Flower Moon, or Corn Moon.

APOGEE
May 13

PERIGEE
May 25

ANNIVERSARIES

300 Years Ago



Lacaille discovered this globular cluster, later cataloged as M55 by Charles Messier, during an expedition to South Africa in 1752.

Nicolas Louis de Lacaille was born May 15, 1713. Among other accomplishments, the French astronomer compiled the most extensive catalog of southern-hemisphere stars to date, and created 14 new southern constellations.



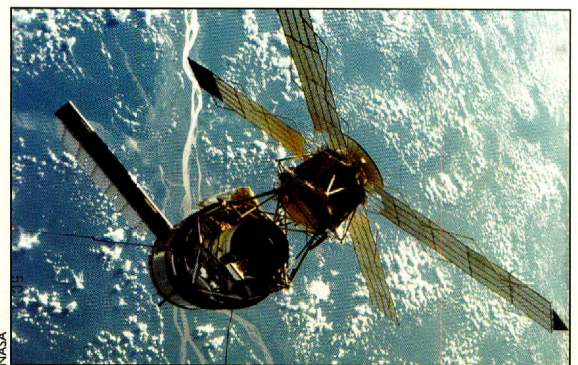
Leroy Gordon Cooper Jr.

50 Years Ago

America’s first manned space project came to an end when Gordon Cooper completed the 33-hour flight aboard the Mercury capsule Faith 7 on May 16, 1963. Mercury proved that astronauts could live and work in space, providing the first steps on the path to the Moon.

40 Years Ago

The United States launched its first space station, Skylab, on May 14, 1973. Despite a launch mishap that ripped off one of its solar panels and a meteorite shield, three crews of astronauts visited the station over the following 21 months, with the final crew setting a record of 84 days in space. Skylab plunged back to Earth in 1979.



Skylab in orbit

EVENTS

5-12 Texas Star Party
Fort Davis, Texas

texasstarparty.org

OVERVIEW

June offers warm nights for watching the sky, but a limited amount of time to enjoy the view, with the longest days and shortest nights of the year. Even so, there's plenty to look at, with Leo diving toward the western horizon at nightfall and the Summer Triangle climbing into view in the eastern sky. It crowns the sky in the wee hours of the morning, with its brightest star, Vega, passing directly overhead. Vega is the second-brightest star visible from mid-northern latitudes on summer evenings, only a few percent behind yellow-orange Arcturus, which is high in the south at nightfall.

HIGHLIGHTS

FEATURED EVENT

10/11 The crescent Moon sweeps past the two innermost planets, Venus and Mercury, in the early evening sky.

13/14 Regulus, the brightest star of Leo, is high above the Moon on the evening of the 13th, and closer to the upper right of the Moon on the 14th. The lion's head and mane, formed by a curving star pattern known as the Sickle, stretch above Regulus.

18/19 The star Spica is close to the right of the Moon as night falls on the 18th, with the planet Saturn to the upper left of the Moon. Saturn is close to the upper right of the Moon on the 19th, with Spica far to their right.

21 Summer arrives in the northern hemisphere at 12:04 a.m. CDT, which is the moment of summer solstice. The Sun stands farthest north in the sky on the June solstice, providing the longest days of the year north of the equator.

21 Antares, the bright orange heart of Scorpius, is close to the lower right of the Moon as night falls.

JUNE

Su	M	T	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

JUNE

Named for Juno, the patron goddess of Rome and wife of Jupiter, king of the Roman gods



View of a crescent Mercury from the MESSENGER spacecraft

NASA/JHUAPL/CARNegie INSTITUTION OF WASHINGTON

FEATURED EVENT

Getting to Know a Neighbor

Some planets are hard to overlook. The best example is Venus, which reigns as either the morning or evening star. It outshines everything else in the night sky except the Moon, so there is no way to miss it.

Others, such as Mercury, are more bashful. It is one of our closest planetary neighbors (only Venus and Mars ever pass closer to Earth), and it sometimes outshines all but a handful of other planets and stars. Yet it's the closest planet to the Sun, so it never moves far from the Sun in our sky. At best, it's visible for an hour or two before sunrise or after sunset.

One of those viewing windows comes this month. Early in the month, Mercury is low in the western sky as night begins to fall, above brighter Venus and Jupiter. It's only a few percent as bright as those other worlds, but the close lineup of the three planets will help you pick it out.

Another alignment on the 10th and 11th also points the way. On the 10th, Venus and the crescent Moon line up roughly parallel to the horizon, with Mercury standing above them, creating a triangle. The Moon stands far to the upper right of the two planets the next evening, but still close enough to draw your attention to Mercury.

After that, Venus and Mercury head in opposite directions, with Venus climbing a little higher in the sky each evening and Mercury dropping back toward the Sun. They will stand side by side on the evening of the 18th, with Mercury to the left of Venus. By then Mercury will be only about a third as bright as it was at the start of the month.

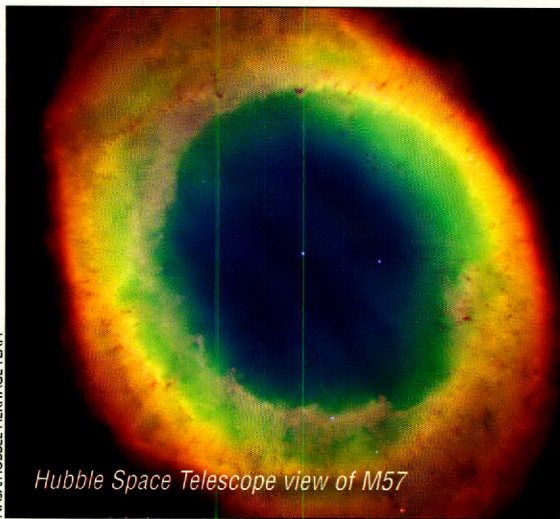
By month's end, Mercury will drop so low into the twilight that it will be all but impossible to see without binoculars, completing its best showing of the year.

FEATURED MESSIER OBJECT

M57: *Blowing Bubbles*

For most of its long life, a star like the Sun looks a bit boring — a big, round ball of gas with occasional dark spots or bright flares to break the monotony. In the final stages of life, though, it blossoms like a butterfly emerging from its cocoon. It can look like a ring, a box kite, an egg, a cat's eye, or many other fantastic shapes, all colored in shades of red, green, and other vivid hues. Known as a planetary nebula, it lasts perhaps a few thousand years before it fades into the galaxy, leaving only the star's hot but tiny corpse, a white dwarf.

French astronomer Antoine Darquier de Pellepoix discovered the first planetary nebula in January 1779. Charles Messier discovered it on his own a few weeks later, and made it the 57th object in his catalog. Today, it's better known as the Ring Nebula. It's in the constellation Lyra, which sails high across the sky on summer nights. Although too faint to see with the eye alone, M57 is a favorite target for small telescopes.



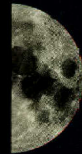
Hubble Space Telescope view of M57

As a Sun-like star ends its life, it can no longer produce nuclear energy in its core. The core collapses, while the star's outer layers are blown into space. Ultraviolet energy from the hot white dwarf causes this gas to glow. Hydrogen glows red, while oxygen and nitrogen glow green.

M57 spans about one light-year. Based on how fast it is expanding, astronomers estimate the star's outer layers began blowing off into space about 1,600 years ago as seen from Earth. The nebula continues to expand today, and will someday become so thinly spread that it will no longer be visible. Eventually, some of its oxygen, nitrogen, and other elements may be incorporated into new stars and planets, continuing the cycle of life and death in the stars.

NASA/HUBBLE HERITAGE TEAM

8 10:56 am



16 12:24 pm



23 6:32 am



29 11:54 pm

Moon phase times are for the Central Time Zone.

The full Moon of June is known as the Flower Moon, Strawberry Moon, Rose Moon, or Honey Moon.

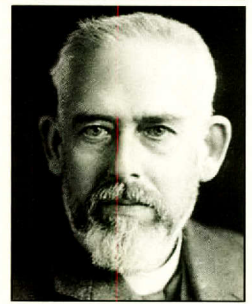
APOGEE
June 9

PERIGEE
June 23

ANNIVERSARIES

150 Years Ago

Few astronomers have discovered more objects than Maximilian Franz Joseph Cornelius Wolf, who was born in Germany on June 21, 1863. His list of discoveries includes thousands of galaxies and nebulae and hundreds of asteroids, including the first of the Trojans, a group of asteroids that share Jupiter's orbit around the Sun. He also discovered the third-closest star system to the Sun, Wolf 359, a popular setting for science-fiction writers. Wolf's observations also showed that what are now known as galaxies are agglomerations of stars and not clouds of gas.



Maximilian Wolf



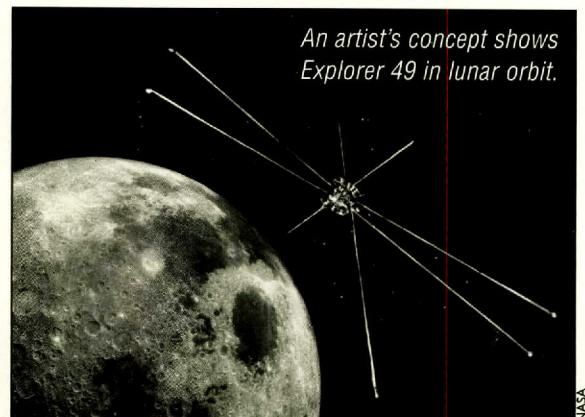
Valentina Tereshkova

50 Years Ago

The Soviet Union launched the first woman into space on June 16, 1963. Valentina Tereshkova piloted her Vostok 6 capsule for 48 orbits around Earth.

40 Years Ago

A new way to study the universe in radio waves began June 15, 1973, when Explorer 49 entered lunar orbit. The spacecraft used the Moon's bulk to block out interference from terrestrial radio sources. Although its radio antennas did not fully unfurl, they still spanned about 600 feet, allowing the craft to study the radio emissions of the Sun, Jupiter, and sources in and beyond the Milky Way galaxy.



An artist's concept shows Explorer 49 in lunar orbit.

NASA

OVERVIEW

Scorpius and Sagittarius highlight the July sky, scooting low across the south during the night. Bright orange Antares highlights the scorpion's hook-shaped body, with teapot-shaped Sagittarius to its left. Under dark skies, the Milky Way rises from the teapot's spout like steam. Meanwhile, the Big Dipper stands high in the north and northwest during the evening, looking especially dipper-like, with its handle to the upper left and bowl at the lower right. And the brilliant Summer Triangle is in good view in the east by mid-evening and climbs high overhead in the wee hours of the morning.

HIGHLIGHTS

5 Aldebaran, the brightest star of Taurus, stands close to the right of the Moon at first light.

5 Earth is at aphelion, its farthest point from the Sun for the year, about 1.5 million miles (2.4 million km) farther than the average distance of 93 million miles (150 million km).

10 Venus, the "evening star," blazes to the upper right of the Moon as darkness falls, with the star Regulus to their upper left.

11 Regulus is close to the upper right of the Moon, with Venus well to their right or lower right.

FEATURED EVENT

15 Spica and the Moon pass within a fraction of a degree of each other this evening. From Hawaii, the Moon will briefly pass in front of the star, blocking it from view.

16 The planet Saturn glows to the upper right of the Moon at nightfall, with Spica well to their right.

18/19 Antares, the heart of the scorpion, stands close to the lower left of the Moon at nightfall on the 18th, and farther to the lower right of the Moon on the 19th.

21 Venus passes Regulus. They are quite low in the west at sunset, with Regulus close to the lower left of the dazzling "evening star."

FEATURED EVENT

Lining Up the Moon

The first-quarter Moon acts as a pointer on the night of July 15, with the line separating night from day taking aim at Spica, the brightest star of Virgo. As seen from the continental United States, the Moon will pass just a fraction of a degree from the star in early to late evening, depending on your time zone. As it passes, the straight line separating night from day, the terminator, will point directly toward Spica.

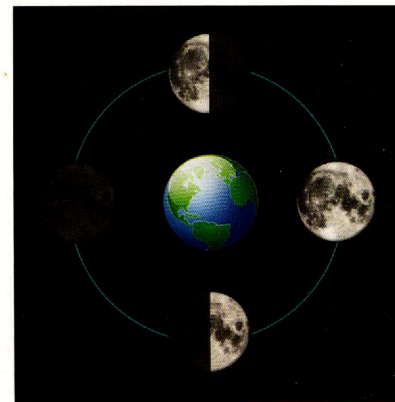
The "first-quarter" and "last-quarter" names can be confusing to those who don't know the convention for naming lunar phases. At a "quarter" phase, sunlight illuminates exactly one-half of the lunar hemisphere that faces Earth, so half of the lunar disk is bright, the other half is dark. That leads many to describe it as a "half" Moon. Based strictly on appearance, that's correct.

However, the names of the four main lunar phases are based not on the Moon's appearance but on its location relative to the Sun.

In this system, the Moon's 29.5-day cycle begins at new Moon, when the Moon crosses between Earth and Sun. The side that faces Earth is in darkness, and the Moon is too close to the Sun to view. About a week later, the Moon lines up at a right angle to Earth and the Sun, so sunlight illuminates half of the lunar disk. Because the Moon is one-quarter of the way through its cycle, however, that phase is known as first quarter.

A week later, the Moon lines up opposite the Sun, so it is fully bathed in sunlight – hence the name "full" Moon. And one week later still, the Moon is back to a right-angle alignment, half in sunlight, half in shadow, described as last quarter.

This system gives us two ways to describe the Moon: one based on its motion around Earth, the other based on its appearance. However you describe it, be sure to watch the Moon on the night of the 15th as it points the way to a bright star.



This diagram shows the Moon's cycle of phases as seen from Earth. The phases run counterclockwise, beginning with new (left), then first quarter, full, and last quarter.

JULY

JULY

Su	M	T	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Named for Julius Caesar

FEATURED MESSIER OBJECT

M6, 7, 8, 20: Summer Delights

Summer evenings feature hook-shaped Scorpius and teapot-shaped Sagittarius scooting low across the south. This region boasts several Messier objects, including the star clusters M6 and M7.

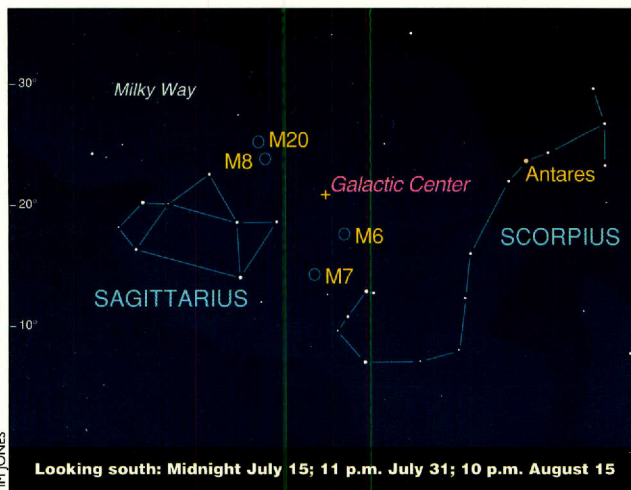
M7 is the brighter of the two. It is almost 1,000 light-years away, and its several hundred stars all are about 200 million to 300 million years old. Several of its stars are nearing the ends of their lives, so they have puffed up to gigantic proportions, helping M7 stand out.

M6 is farther than M7, so it doesn't look as big or bright, so you need dark skies to see it without optical aid. Through binoculars or a telescope, the cluster's colorful stars form a pattern that resembles the outline of a butterfly.

The "steam" above the teapot's spout includes two nebulae that are giving birth to new star clusters: M8 (the Lagoon Nebula) and M20 (the Trifid Nebula).

The Lagoon has given birth to scores of stars, with more taking shape even now. Through binoculars or a small telescope, it looks like a hazy oval of light. Photographs show a reddish-pink glow, which is the color of hydrogen atoms being zapped by the radiation of young stars.

The Trifid is also a hot-pink stellar nursery, but dark lanes of dust across its center make it look like three different blobs, while a nearby dust cloud reflects the light of the Trifid's stars, so it glows blue instead of pink.



Looking south: Midnight July 15; 11 p.m. July 31; 10 p.m. August 15

8

2:14 am

15

10:18 pm

22

1:16 pm

29

12:43 pm

Moon phase times are for the Central Time Zone.

The full Moon of July is known as the Hay Moon or Thunder Moon.

APOGEE

July 6

PERIGEE

July 21

ANNIVERSARIES

75 Years Ago

Using the 100-inch telescope at Mount Wilson, California, Seth Barnes Nicholson discovered the 10th and 11th moons of Jupiter on the nights of July 6 and July 30, 1938, respectively. Since named Lysithea and Carme, both moons may be fragments of asteroids that were captured by Jupiter and later shattered by collisions. Each is essentially a giant boulder orbiting far above Jupiter's cloudtops.

RESOURCES

Online

StarDate Online

Daily skywatching tips, lunar phases, guides for getting started, and other skywatching resources.



stardate.org

U.S. Naval Observatory

Custom sunrise/sunset and moonrise/moonset charts, eclipse information, rising and setting information for planets and bright stars, and other data for any location on Earth.

www.usno.navy.mil/USNO/astronomical-applications

SpaceWeather

Updates on solar flares, photo galleries of the latest meteor showers, news about major skywatching events, information on where to see the northern lights.

spaceweather.com

Meteor Shower Calendar

The International Meteor Organization provides starmaps, explanations, and other details on meteor showers.

www.imo.net/calendar/2013

NASA Eclipse Web Site

Charts, tables, and much more on lunar and solar eclipses for 2013 and beyond.

eclipse.gsfc.nasa.gov

Radio

StarDate provides regular skywatching updates, research findings, and more about astronomy seven days a week.

stardate.org/radio

Publications

Observer's Handbook 2013, edited by Patrick Kelly

A detailed look at upcoming astronomical events plus an extensive reference section.

rasc.ca/handbook

Astronomical Calendar 2013, by Guy Ottewell

An over-sized reference with detailed star charts, meteor shower details, planet viewing, and much more.

universalworkshop.com

OVERVIEW

Three of the five planets that are easily visible to the unaided eye congregate in the eastern sky at dawn as the month begins. Dazzling Jupiter stands highest in the sky, with fainter Mars close below it as the month begins and Mercury below Mars. Jupiter and Mars pull higher into the sky each morning, while Mars begins to dive back toward the Sun by mid-month. Scorpius and Sagittarius continue to beckon in the south for much of the night, while the Summer Triangle climbs higher at each nightfall.

HIGHLIGHTS

1 Aldebaran, the eye of Taurus, the bull, snuggles to the lower right of the Moon at first light.

FEATURED EVENT

3-5 The Moon slides past three planets at first light on these mornings: brilliant Jupiter, and fainter Mars and Mercury lower in the sky.

9/10 Venus, the brilliant “evening star,” stands close to the upper right of the crescent Moon shortly after sunset on the 9th, and farther to the right of the Moon on the 10th.

11 Spica, the brightest star of Virgo, is close to the upper left of the Moon this evening.

11/12 The Perseid meteor shower peaks on these nights. At its best, under dark skies, you might see a score or so “shooting stars” per hour. The Moon sets by late evening.

12 The planet Saturn, which shines like a golden star, is just above the Moon at nightfall.

14/15 Antares, the heart of Scorpius, is to the lower left of the Moon at nightfall on the 14th, and about the same distance to the lower right of the Moon on the 15th.

28/29 Aldebaran, the orange eye of Taurus, is to the lower left of the Moon at first light on the 28th, and farther to the upper right of the Moon on the 29th.

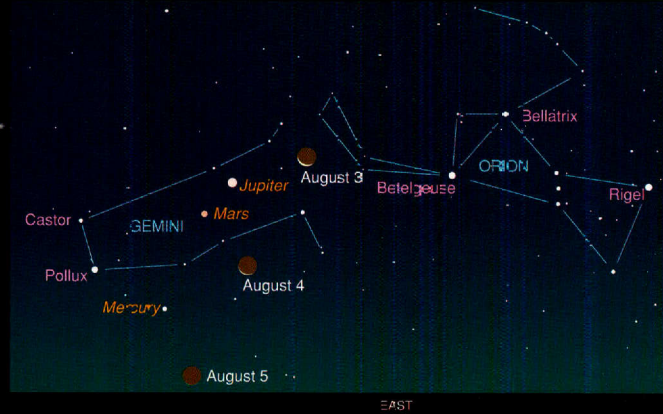
31 Brilliant Jupiter perches to the left of the Moon at first light.

AUGUST

Su	M	T	W	Th	F	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

AUGUST

Named for Augustus
Caesar



FEATURED EVENT

Staging a Planetary Scene

All the sky's a stage, and the planets are merely players. They move against the backdrop of the unmoving stars, pacing from one constellation to another, looping back across the giant spotlight of the Sun, sometimes gathering in a small corner of the sky.

Such is the case early this month, when the planets Jupiter, Mars, and Mercury congregate in the eastern sky shortly before the light through your window breaks. Jupiter steals the show, outshining all the other stars and planets in the sky at that hour. Mars begins the month close below Jupiter, with faint little Mercury not far above the horizon. The crescent Moon takes center stage on the mornings of the 3rd through the 5th, sweeping past the three planets before exiting in the Sun's glare.

The Moon and planets move across the starry background because they are much closer to us than the stars. So as Earth and the other bodies follow their orbits around the Sun, our viewing angle to them changes.

It took millennia for astronomers to understand that arrangement. They first thought that the Sun, Moon, planets, and stars all circled around Earth. The odd motions of the planets, which sometimes reverse direction against the background of stars, presented challenges, which required odd manipulations of their motions.

Nicolaus Copernicus deduced the true configuration in the 16th century, but he could not work out the mathematics of some of the planetary motions. That final proof came from Johannes Kepler, in the 17th century, who formulated the laws of planetary motion that explain how the planets, including Earth, orbit the Sun — drawing a new map of the stage known as the night sky.

FEATURED MESSIER OBJECT

M24, 16: *Padding and Pillars*

Charles Messier compiled his catalog to help fellow astronomers not mistake “fixed” star clusters and nebulae for cometary interlopers. Yet a few of his objects are so large, bright, and well known that there was little chance of anyone misidentifying them. Some historians, in fact, believe he added a few objects just to pad the catalog a bit.

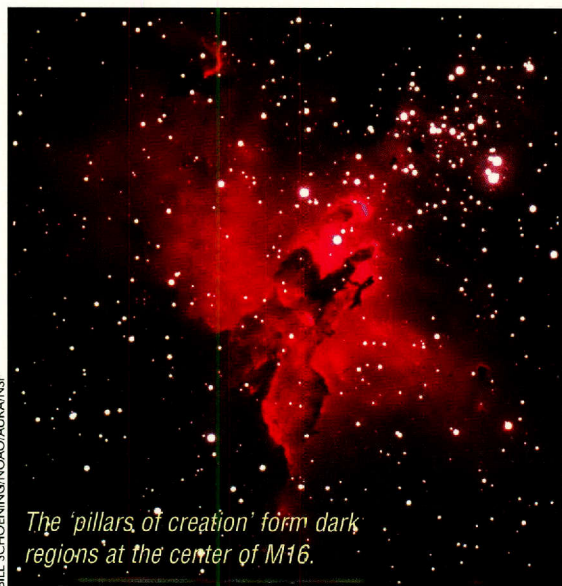
One of those objects is M24, which is also known as the Sagittarius Star Cloud. It spans an area about three times the diameter of the full Moon, amid the hazy band of the Milky Way. It’s not an individual object at all, but a wide field of stars that is not blocked from view by dark clouds of interstellar dust. The stars in M24 form many different clusters, groups, and streams, so they are unrelated. Still, M24 is a bright highlight in the Milky Way.



The central region of M24

VANESSA HARVEY/REU PROGRAM/NOAO

M16, the Eagle Nebula, stands close above M24. The giant nebula contains hundreds of young stars that are surrounded by vast clouds of gas and dust. The radiation of the youngest, hottest stars has sculpted some of the nebula’s gas and dust into tall columns that envelop nascent stars. A Hubble Space Telescope photo made these columns famous as the Pillars of Creation.



The ‘pillars of creation’ form dark regions at the center of M16.

BILL SHOENING/NOAO/AURA/NSF

6

4:51 pm

14

5:56 am

20

8:45 pm

28

4:35 am

Moon phase times are for the Central Time Zone.

The full Moon of August is known as the Grain Moon, or Green Corn Moon.

APOGEE

August 3

PERIGEE

August 18

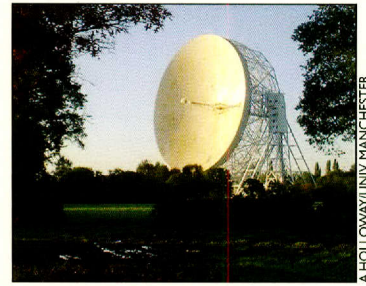
APOGEE

August 30

ANNIVERSARIES

100 Years Ago

Alfred Charles Bernard Lovell, a pioneer in radio astronomy, was born August 31, 1913, in England. He began studying cosmic rays in the 1930s, then developed aerial radar systems during World War II. After the war, he applied some of that technology to cosmic-ray studies, which led to the establishment of Jodrell Bank Observatory, one of the world’s first radio astronomy observatories. Its largest telescope is named in Lovell’s honor. Lovell died in August 2012, a few weeks shy of his 99th birthday.



A.HOLLOWAY/UNIV. MANCHESTER

The Lovell Telescope

10 Years Ago

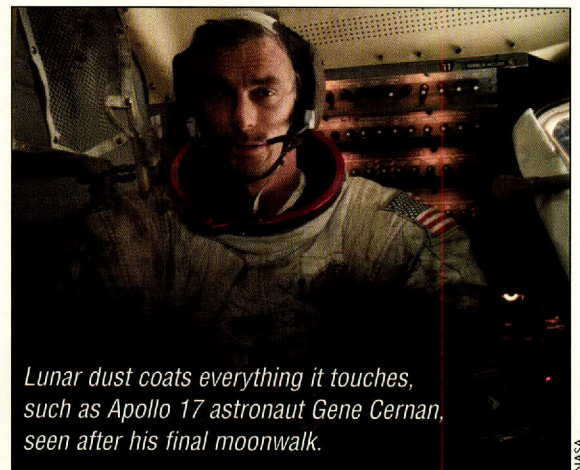
NASA launched the last of its Great Observatories, Spitzer Space Telescope, on August 25, 2003. The telescope was designed to study the universe at infrared wavelengths, which are produced by relatively cool objects, such as stellar nurseries and the failed stars known as brown dwarfs. The telescope continues to operate today, although it has depleted the coolant needed to see many infrared wavelengths.



NASA/PI/CALTECH

Spitzer view of Messier 100

EXPLORATIONS



NASA

Lunar dust coats everything it touches, such as Apollo 17 astronaut Gene Cernan, seen after his final moonwalk.

12 The next lunar mission is scheduled for launch from NASA’s Wallops Flight Facility in Virginia. From lunar orbit, LADEE (Lunar Atmosphere and Dust Environment Explorer) will study the Moon’s surface environment, particularly the powdery dust that coats it. The dust could prove harmful to future human explorers.

OVERVIEW

There's plenty to enjoy during the longer, cooler nights of late summer and early fall. Venus, the "evening star," creeps past two bright companions, the star Spica and the planet Saturn. The Milky Way arches high overhead during the evening, putting on a grand display from sites with dark skies. At the same time, the Big Dipper is at its most dipper-like, in the northwest, with its bowl to the lower right of the handle.

HIGHLIGHTS

- 1** Brilliant Jupiter stands directly above the Moon at first light, with much fainter Mars about the same distance to the lower left of the Moon and the star Procyon to the lower right of the Moon.
- 2** Little orange Mars is to the upper left of the Moon at first light.
- 5** The star Spica is quite close to the lower left of Venus, the "evening star," in the west as night falls. Venus will move away from Virgo's leading light over the next few nights.
- 8** Venus is close to the right of the Moon at nightfall, with Spica to their lower right and golden Saturn farther to their upper left.
- 9** Saturn is to the right of the Moon at nightfall, with brilliant Venus to their lower right.
- 11** Antares, the orange "heart" of Scorpius, stands below the Moon this evening.
- 16** Saturn is directly above Venus as night begins to fall. Venus will pass Saturn over the next few nights.

FEATURED EVENT

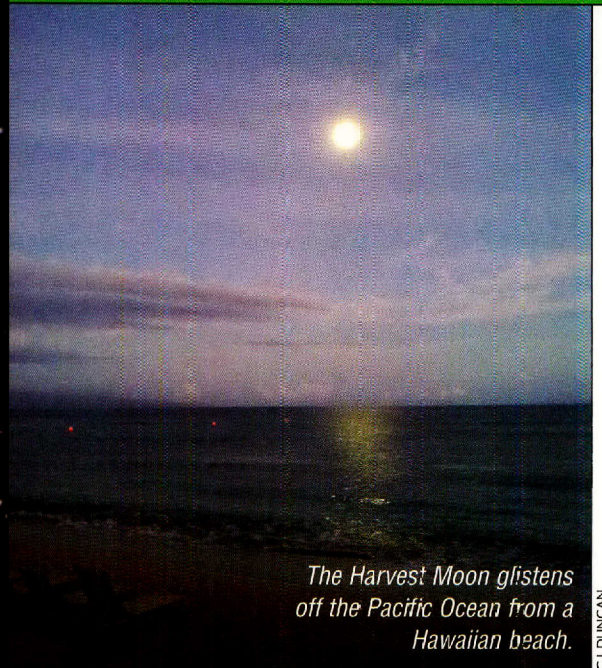
- 19** The Moon is full today. As the full Moon closest to the autumnal equinox, it is the Harvest Moon.
- 22** The autumnal equinox is at 3:44 p.m. CDT, marking the beginning of autumn in the northern hemisphere.

SEPTEMBER

Su	M	T	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

SEPTEMBER

Name means 'seventh month,' from the time when the year began in March



The Harvest Moon glisters off the Pacific Ocean from a Hawaiian beach.

CJ DUNCAN

FEATURED EVENT

Fields of Moonbeams

Full Moons have a poetic roll call of names, from Wolf Moon to Rose Moon to Honey Moon. None is more evocative, however, than September's full Moon, which is known as the Harvest Moon — the full Moon closest to the autumnal equinox. This year, the Moon is full on the morning of September 19 as clocked from the United States, so the nights of the 18th and 19th will double as Harvest Moon nights.

For the farmers of yore, no full Moon was more welcome than this one. Its brilliant glow lit the fields, allowing farmers to gather their crops well into the night.

It was especially helpful at high latitudes, because it rises at about the same time each night for several nights in a row. Over the course of a year, the Moon rises an average of 48 minutes later each night. Depending on the precise geometry, the interval can range from a few minutes to much more than an hour.

At this time of year, as you go farther north, the interval between rising times gets smaller and smaller. From the latitude of Seattle, for example, the Moon rises only about 20 minutes later for each of the few nights around the full Moon. And from even farther north — from around Anchorage, for example — the difference is even smaller. That provides a lot of extra moonlight to illuminate the fields.

The Moon makes up the time around the next new Moon, when it rises almost an hour and a half later each night, balancing the books on the amount of moonlight.

FEATURED MESSIER OBJECT

M31: A Galaxy Far, Far Away

Most of the stars visible to the unaided eye are no more than a few hundred light-years away. Those are unimaginable distances on the human scale, but mere hops on the astronomical scale.

The distance to one object that parades across autumn skies, though, is more like a leap than a hop. M31, the Andromeda galaxy, is about 2.5 million light-years away, making it the remotest object that is readily visible to the unaided eye.

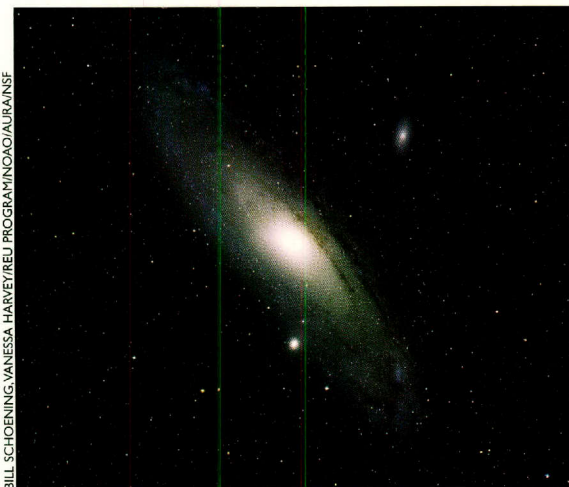
A light-year is the distance that light travels in one year, about 5.9 trillion miles (9.4 trillion km). The fastest spacecraft ever launched from Earth would take tens of billions of years to cover such the vast distance to M31 — several times longer than the age of the universe.

M31 is visible to us because its light is the combined glow of hundreds of billions of stars. The galaxy is a near twin to our own, with roughly the same size and mass and a similar spiral structure.

M31 and the Milky Way are the largest members of the Local Group, a collection of about three dozen galaxies that travel through the universe together, bound by their mutual gravitational pull. Most of the smaller galaxies orbit one of the two giants.

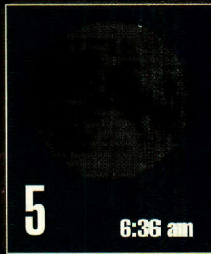
Several billion years from now, M31 and the Milky Way will collide and merge. That will trigger the birth of many new stars, while hurling many existing stars into intergalactic space. When things settle down, the combined galaxies will form a giant elliptical — a galaxy shaped like a fuzzy football, with the combined might of close to one trillion stars.

In the interim, M31 will grow larger and brighter in Earth's night sky as the distance to this remote neighbor slowly closes.



BILL SCHOENING, VANESSA HARVEY/REU PROGRAM/NOAO/JUR/INSE

M31 and two of its small attendant galaxies



Moon phase times are for the Central Time Zone.

The full Moon of September is known as the Harvest Moon, Fruit Moon, or Corn Moon.

PERIGEE
September 15

APOGEE
September 27

ANNIVERSARIES

50 Years Ago

The first McDonald Observatory director hired by the Observatory's owner, the University of Texas, began work on September 1, 1963. Harlan J. Smith also doubled as chairman of the newly established astronomy department on the Austin campus. Although McDonald was established in the 1930s, Texas had no astronomy program and no money to use the facility, so it signed a 30-year contract with the University of Chicago to operate it. The agreement expired in 1962. One of Smith's first accomplishments was to build a new 107-inch telescope, which at the time was the world's third-largest. Today, the telescope bears Smith's name.

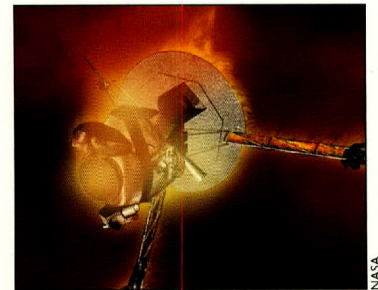


Harlan J. Smith

DAYMOND BENNINGFIELD

10 Years Ago

The Galileo mission to Jupiter came to a spectacular end on September 21, 2003, when the spacecraft plunged into Jupiter's atmosphere. Galileo had arrived at Jupiter eight years earlier, dropping a probe into the atmosphere to measure conditions there. Galileo provided new views of Jupiter and its moons and dark rings, although its effectiveness was limited by a balky radio antenna that never properly deployed, drastically reducing the amount of data it could transmit to Earth. Galileo was intentionally crashed into Jupiter to prevent it from striking the watery moon Europa and potentially contaminating it with microscopic life from Earth.



Artist's concept of Galileo entering the Jovian atmosphere

NASA

OVERVIEW

A pair of eye-catching conjunctions highlights the mid-month skies. Venus and Antares team up low in the southwest at sunset, while Mars and Regulus get together in the east before dawn. A string of constellations that represent the Celestial Sea line up low across the south in mid- to late evening: Capricornus, Aquarius, Pisces, Cetus, and Piscis Austrinus. Eridanus, the river, joins them by around midnight.

HIGHLIGHTS

1 The Moon, Mars, and Regulus, the heart of Leo, form a tall triangle in the dawn sky. Regulus is to the left of the Moon, with Mars above them.

2 Regulus and Mars line up above the Moon at first light.

FEATURED EVENT

3 The planet Uranus is at opposition, lining up opposite the Sun.

7 Venus, the “evening star,” poses just to the left of the Moon shortly after sunset.

8 Venus is to the lower right of the Moon in early evening, with the orange star Antares, the heart of Scorpius, about the same distance to the lower left of the Moon.

14-16 Mars scoots past Regulus in the early morning sky. Orange Mars is a bit to the upper left of the brighter star on the 14th, roughly even with it on the 15th, and to its lower left on the 16th.

15-17 The dazzling planet Venus sweeps over the top of Antares, the brightest star of Scorpius.

18 The Moon passes through Earth’s outer shadow this evening. The eclipse is so faint, however, that it is tough to see.

21 Aldebaran, the orange eye of Taurus, rises just below the Moon in mid-evening.

25/26 Jupiter stands to the upper left of the Moon at first light on the 25th, and farther to the upper right of the Moon on the 26th.

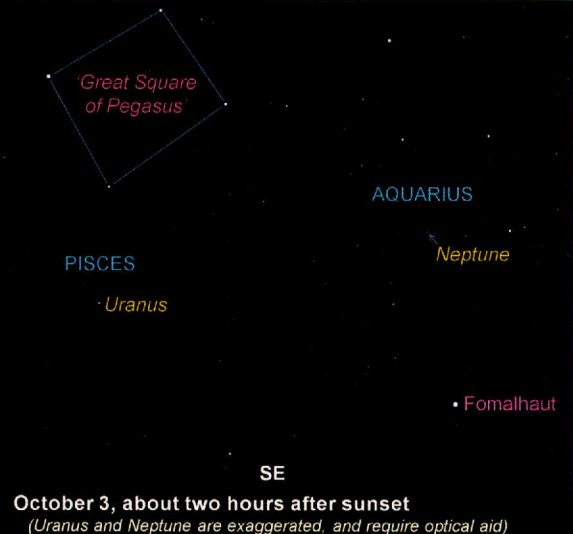
29 The Moon, Mars, and Regulus form a tall triangle in the early morning sky. Mars is to the left of the Moon, with Regulus above them.

OCTOBER

Su	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

8 E E B O O T O O O

Name means ‘eighth month,’ from the time when the year began in March



FEATURED EVENT

Giant Planets, Tiny Profiles

Uranus is the third-largest planet in the solar system, at about four times Earth’s diameter, with fourth-ranked Neptune only slightly smaller. Yet such is the solar system’s scale that these two giants are barely known and almost never seen.

Uranus, for example, puts on its best showing of the year in early October. It rises at sunset and remains in view all night, and it shines brightest for the year as well. Yet at a distance of about 1.8 billion miles (2.8 billion km), it remains so faint that you need binoculars or a telescope to see it, near the border between the relatively faint constellations Pisces and Cetus.

Under ideal conditions, Uranus can be barely visible to the unaided eye. Seeing it requires dark skies, great vision, and good knowledge of the night sky, however, so few have ever cast their own eyes upon it. As a result, it wasn’t officially discovered until 1781.

Neptune is a billion miles farther than Uranus, so it never brightens enough to see without optical aid. It wasn’t discovered until 1846.

Recent reviews of astronomical records suggest that several astronomers may have seen Neptune earlier, beginning with Galileo Galilei, who made the first detailed telescopic observations of the night sky in the early 17th century. His notebooks record a tiny star passing near Jupiter and its moons in December 1612 and January 1613. Galileo thought it was a true star, so he paid it little attention. Had he followed it for a few weeks longer, he might have realized that it was a planet, adding the discovery of this distant world to his already impressive resume.

Neptune was at opposition in late August, and is in Aquarius. While Uranus is a fairly easy target for binoculars, Neptune is best seen with a telescope.

FEATURED MESSIER OBJECT

M45: Counting Sisters

Like several other objects in Charles Messier's catalog, there was no chance Messier's colleagues would mistake the Pleiades for a passing comet because it was one of the most famous objects in the night sky. Even so, Messier included it as the 45th object in his catalog, and today it's perhaps the most famous. It is a cluster of several hundred stars that lie more than 400 light-years from Earth. The cluster's brightest members form a tiny dipper shape, which many confuse with the Little Dipper.

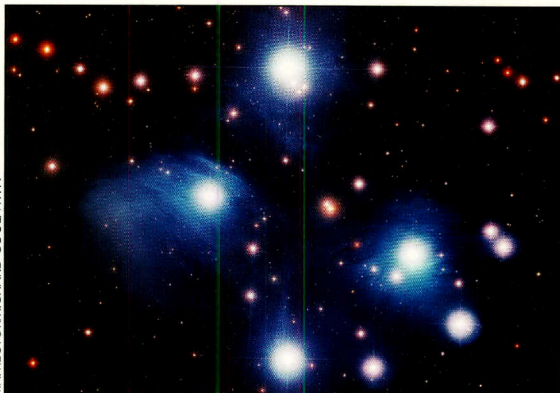
In mythology, the Pleiades represented the Seven Sisters. That's a bit of a puzzler, though, because few skywatchers see exactly seven stars when they look at it. Most see six, while a few see nine or more.

The exact number visible on a given night can be an indication not only of the viewer's eyesight, but of the sky conditions. That made the Pleiades a key object in forecasting the weather.

In ancient Greece, for example, sailors often studied the Pleiades before heading out to sea. If the cluster looked bright and clear, with all of its stars shining sharply, it was a harbinger of good weather. If it was obscured by high, thin clouds, then it was a sign of stormy weather and a good time to stay home.

Villagers in the Andes Mountains of South America used the Pleiades to decide when to plant crops. Good visibility at the start of the planting season meant early and abundant rains, so villagers planted early, but poor visibility meant poor rains, so planting started later. Recent studies have shown that the Pleiades was especially good at forecasting El Niño, which had a major impact on the rains.

At mid-month, M45 climbs into good view in the east by about 9 or 10 p.m. The cluster, which represents the shoulder of Taurus, the bull, stands directly above the bull's orange eye, the star Aldebaran.



A long-exposure image shows wispy dust clouds reflecting the light of the brightest members of M45.

TA. RECTOR/RICHARD COOL/WYNN

4 7:35 pm



11 6:02 pm



18 6:38 pm



26 6:40 pm

Moon phase times are for the Central Time Zone.

The full Moon of October is known as the Hunter's Moon or Dying Grass Moon.

PERIGEE
October 10

APOGEE
October 25

ANNIVERSARIES

75 Years Ago

Martians destroy the world in the radio broadcast of "War of the Worlds" on October 30, 1938. The CBS drama, presented by Orson Welles and his Mercury Theater, began with a series of "news bulletins," interspersed with dance music, describing a Martian invasion at Groves Mill, New Jersey. Although the second half of the show was a conventional narrative, describing events well after the faux invasion, the broadcast caused a nationwide panic.



Orson Welles directs the Mercury Theater; reaction to the broadcast

EXPLORATIONS

9 The Jupiter-bound Juno spacecraft will fly about 300 miles (500 km) above Earth, using the planet's gravity to boost its speed by more than 16,300 mph (26,000 kph). Launched in August 2011, Juno will arrive at Jupiter on July 4, 2016. The craft will measure Jupiter's gravitational and magnetic fields to help scientists map its structure and composition.

EVENTS

13 Astronomy Day

A twice-yearly nationwide celebration of astronomy in which museums, astronomy clubs, libraries, universities, and many other groups host star parties, lectures, and other events for general audiences. Many events are held at shopping malls or other convenient locations.

astroeague.org/al/astroday/astroday.html

OVERVIEW

One of the most popular stories from ancient mythology is told in a group of constellations that highlight November's sky. Andromeda, the princess, was rescued by Perseus from the sea monster Cetus. She had been chained at the edge of the sea on orders from her father, king Cepheus, after her mother, Cassiopeia, angered the gods with her vanity. These five characters stretch from north to southeast in the evening sky.

HIGHLIGHTS

3 A total solar eclipse will be visible across a narrow strip of Africa. The far northeastern United States will see a partial eclipse at sunrise.

5/6 Venus, the "evening star," is well to the left of the Moon as night falls on the 5th, and closer to the lower left of the Moon on the 6th.

18 Venus passes just a fraction of a degree from Nunki, the star at the top left edge of the "handle" of teapot-shaped Sagittarius.

18 Aldebaran, the eye of Taurus, is close to the upper right of the Moon as they climb into view shortly after nightfall.

20/21 Brilliant Jupiter is to the lower left of the Moon as they rise in mid-evening on the 20th, and closer to the upper left of the Moon on the 21st.

25/26 The planets Mercury and Saturn swap places in the dawn sky. Saturn is to the lower left of brighter Mercury on the 25th, but directly above Mercury on the 26th.

25-27 The Moon glides past Regulus and Mars. Regulus is close above the Moon at first light on the 25th. The next morning, Regulus is to the upper right of the Moon with Mars closer to the left. And on the 27th, Mars is close to the upper left of the Moon, with Regulus far to their upper right.

FEATURED EVENT

28 Comet C/2012 S1 (ISON) will pass closest to the Sun.

29 Spica, the brightest star of Virgo, is very close below or to the lower left of the Moon at first light.

NOVEMBER

Su	M	T	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

NOVEMBER

Name means 'ninth month,' from the time when the year began in March

Comet Lovejoy slashes the skies above Chile in late 2011. Skywatchers are hoping for a similar performance from ISON.

FEATURED EVENT

A Historic Performance?

First, a disclaimer. Comets are the most fickle of astronomical objects, frequently disappointing after predictions of never-before-seen grandeur. So if the predictions for a great display by Comet C/2012 S1 (ISON) prove false, don't say we didn't warn you.

On the other hand, the prospect of one of the most spectacular cometary displays of the last century is worth talking up. The astronomers who discovered the comet say it could be a stunner, shining not only in the night skies of November and December, but perhaps even in the daytime sky as well.

The comet, which was discovered by Russian astronomers in September 2012, will pass closest to the Sun on November 28, at a distance of just 800,000 miles (1.2 million km), which is roughly three times the distance from Earth to the Moon. At that close range, the Sun's energy should vaporize much of the comet's icy surface layers, releasing vast amounts of gas and dust into space. The material will form a wide, glowing halo around the comet's small nucleus. The Sun's radiation and the solar wind will push much of that material away from the comet, forming a long tail.

At best, the comet could shine brighter than most of the stars and planets in the night sky, and its tail could stretch across much of the sky. It could even remain visible in the daytime.

If the predictions hold true, the comet will be visible in the evening sky in late November, and in both evening and morning skies in December.

Then again, maybe not. Some comets that pass so close to the Sun disintegrate, leaving nothing but a big cloud of gas and dust that rapidly vanishes. If that happens to ISON, it could end up like many of its highly anticipated predecessors: a dud.

FEATURED MESSIER OBJECT

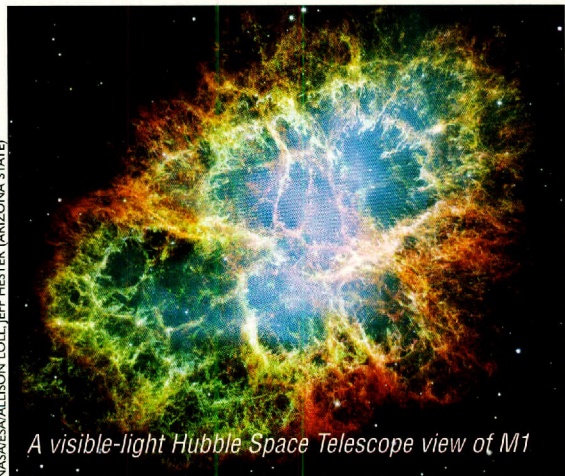
M1: Saving the Best for First

The first object in Charles Messier's catalog may also be the most interesting. M1, the Crab Nebula, represents the shattered remains of a supernova, with the star's dense "corpse" at the nebula's center.

In 1758, Messier was observing a comet between the horns of Taurus, the bull, when he saw another comet-like object nearby. He described it as an elongated whitish object, although it was "more vivid" than a comet. The discovery spurred Messier to create his catalog as a service to other comet hunters.

Since then, each new discovery has painted a more thrilling picture of M1. Together, they suggest that a star roughly 10 times as massive as the Sun exploded in the year 1054 as seen from Earth. Skywatchers in China and elsewhere recorded the explosion as a "guest star," which was visible during daytime for several weeks, and during the night for almost two years.

The explosion was triggered by the collapse of the star's core, which formed an ultra-dense neutron star. It is roughly twice as massive as the Sun, but only about 20 miles (30 km) in diameter, so a teaspoon of its matter would weigh as much as 100 million African elephants. The neutron star spins 30 times per second, beaming pulses of radio energy into space, so it's also known as a pulsar.



A visible-light Hubble Space Telescope view of M1

The star's outer layers exploded as a supernova, blasting enough material into space to make several stars as massive as the Sun. The debris is rich in such elements as oxygen, iron, and carbon, which were created in the star's core or in the explosion itself. The nebula spans about a dozen light-years, and it is continuing to expand into space at several million miles per hour. Over the eons, the nebula's gas and dust will spread out even more, providing raw materials for new stars and planets.

NASA/ESA/LISSON LOUL, JEFF HESTER (ARIZONA STATE)

3

6:50 am

9

11:57 pm

17

9:16 am

25

1:28 pm

Moon phase times are for the Central Time Zone.

Daylight Saving Time ends November 4.

The full Moon of November is known as the Frost Moon or Snow Moon.

PERIGEE

November 6

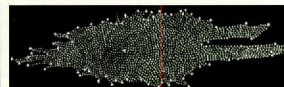
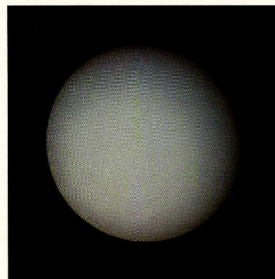
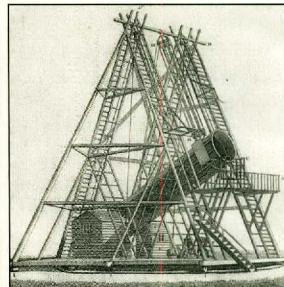
APOGEE

November 22

ANNIVERSARIES

275 Years Ago

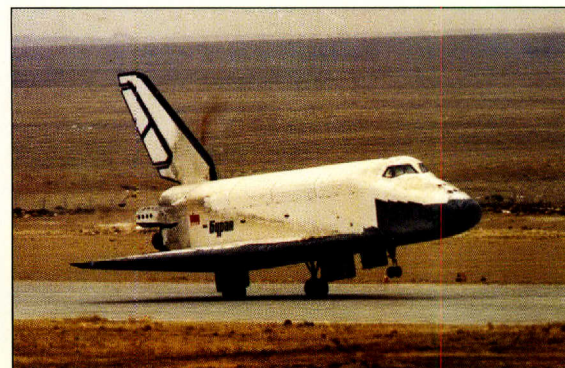
William Herschel, one of the most celebrated astronomers in history, was born November 15, 1738, in Hanover. He began as a composer and musician (which he continued for much of his life), but soon turned to mathematics and astronomy. Herschel designed and built telescopes, and with the aid of his sister, Caroline, compiled catalogs of double stars and deep-sky objects. He also discovered that the solar system moves through space, and posited (correctly) that the Milky Way is shaped like a lens. Herschel is best known, however, for discovering the planet Uranus, in 1781, and infrared radiation, in 1800.



Clockwise from top left: Herschel, his 40-foot telescope, his sketch of the Milky Way, the planet Uranus

25 Years Ago

The Soviet Union's first space shuttle, Buran ("snowstorm"), made its only trip to space on November 15, 1988. The unmanned shuttle orbited Earth twice before landing at its launch site in Kazakhstan. The Soviets canceled the program before shuttles could carry cosmonauts to space. Buran was destroyed in 2002 when its hangar roof collapsed.



Buran touches down after its only space flight.

RSC ENERGIA

OVERVIEW

Each of the five planets visible to the unaided eye puts in an appearance this month. Mercury quickly vanishes after putting in a brief showing quite low in the dawn sky as December begins, but the other four are in view for at least a couple of hours per night. The constellations of winter begin to take center stage, with Orion in the east in early evening, and Sirius, the brightest star in the night sky, climbing skyward by mid-evening.

HIGHLIGHTS

1 The planet Saturn stands above the Moon and the planet Mercury, which is to the Moon's lower left, 30 to 40 minutes before sunrise. You may need binoculars to spot them.

FEATURED EVENT

4/5 Venus is close to the upper left of the Moon in early evening on the 4th and closer to its lower left on the 5th. Venus is also at its brightest for its current "evening-star" appearance.

15 Aldebaran, the eye of Taurus, is quite close to the lower right of the Moon as they climb into view in early evening.

18 Jupiter dazzles close to the left of the Moon as they rise in early evening on the 18th. It is above the Moon on the 19th, with the star Procyon about the same distance to the right of the Moon.

21 Winter arrives in the northern hemisphere at 11:11 a.m. CST, the moment of the winter solstice.

21/22 Regulus is to the lower left of the Moon as they rise in late evening on the 21st, and above the Moon on the 22nd.

25 Orange Mars, which is growing brighter, stands to the left of the Moon at first light.

26/27 Mars is to the upper right of the Moon and Spica is closer to the lower left of the Moon at first light on the 26th, with Spica to the upper right of the Moon on the 27th.

28/29 Saturn perches to the lower left of the Moon at first light on the 28th, and upper right on the 29th.

DECEMBER

Su	M	T	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

DECEMBER

Name means 'tenth month,' from the time when the year began in March

These images show Venus' cycle of phases, and its relative size as seen from Earth at each phase.

FEATURED EVENT

Phasing in the Evening Star

In all the night sky, only the Moon outshines Venus, and the planet is at its brilliant best this month. It is low in the southwest as night falls. The Moon barges past it on the 4th and 5th, about the time Venus reaches its peak brightness for the entire year.

Like the Moon, Venus shows phases as seen from Earth, so we see Venus as anywhere from almost full to almost new (at its "full" and "new" phases, Venus is too near the Sun in our sky to view). While the Moon maintains a relatively constant distance from Earth, though, Venus' distance changes dramatically. The combination of phase and distance causes the planet's brightness to vary by roughly a factor of three.

This month, Venus appears as a thin crescent, which would suggest that it will be faint, as a crescent Moon is. However, Venus is nearing its closest approach to Earth, so its crescent covers a fairly large area. In addition, we receive the greatest amount of light from each square mile of Venus' surface when the planet is closest. Venus will reach a peak magnitude of -4.9 on the scale astronomers use to determine brightness (negative numbers are brighter than positive ones). By comparison, the next-brightest object, Jupiter, will shine at -2.6 early this month, just one-eighth as bright as Venus.

Venus will cross between Earth and Sun in January, shine brightly again when it emerges on the other side (as the "morning star"), then slowly fade as it circles to the other side of the Sun. It will be almost full before it disappears in the Sun's glare next October. However, it will be about six times farther from Earth then, so it will cover a much smaller area of the sky and will reflect less light toward Earth, so it won't shine as brilliantly. Even then, though, Venus will outshine all the other planets and stars in the night sky.

FEATURED MESSIER OBJECT

M35: Getting to Know You

After more than two-and-a-half centuries of study, you might think astronomers would know everything there is to know about the star cluster M35, yet that is far from the case. Even such basic details as the cluster's distance, age, and the number of stars it contains are still debated.

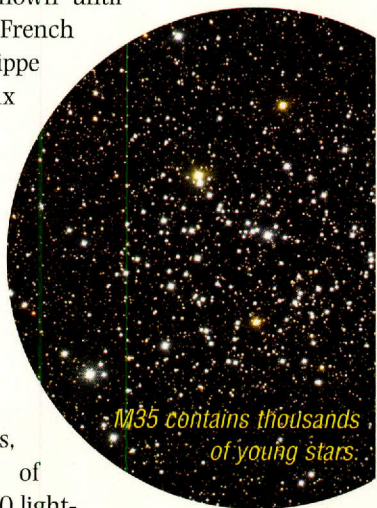
Under dark skies, M35 is visible to the unaided eye as a faint patch of light near the feet of Gemini, which rises in early evening and soars high across the sky on December nights. Yet M35's identity as a star cluster was unknown until its discovery by French astronomer Philippe Loys de Chéseaux in 1745.

Studies published in the last decade or so have put the cluster's distance at anywhere from about 2,500 to 3,000 light-years, with margins of error of up to 200 light-years. Studies give a population of roughly 1,000 to 2,000 stars, and an age of 133 million to 180 million years.

The disagreements show the complexity involved in astronomical observations.

You might think it would be easy to determine the cluster's population, for example, by simply counting the stars. But there are many stars between us and M35, and many more stars in view beyond the cluster, so determining which ones belong to M35 is tricky. Astronomers must take pictures of that region of sky over many years and see which stars appear to move through space as a group. And the counting is complicated by the fact that many of M35's stars are quite faint, so they don't show up in older images that were shot through smaller telescopes and with less-sensitive instruments. Astronomers also measure the motions of individual stars toward or away from Earth, but that is a time-consuming and complex process.

Measuring distance and age are even more complicated. So even for a relatively bright, close, and well-studied object like M35, plenty of questions remain.



M35 contains thousands of young stars.

NASA SHARON/NOAO/JRANSF

2

6:22 pm

9

9:12 am

17

3:28 am

25

7:48 am

Moon phase times are for the Central Time Zone.

The full Moon of December is known as the Long Night Moon or Moon Before Yule.

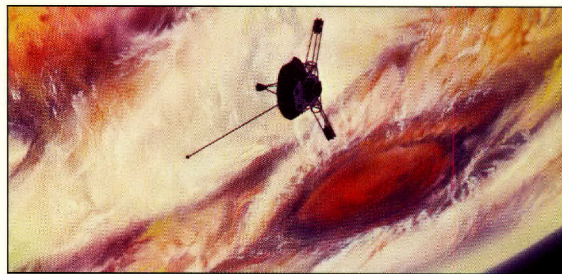
PERIGEE

December 4

APOGEE

December 19

ANNIVERSARIES



NASA

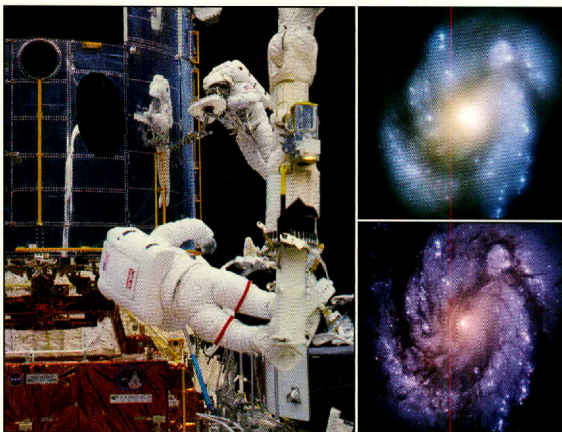
Artist's concept shows Pioneer 10 above Jupiter's Great Red Spot.

40 Years Ago

Pioneer 10 became the first spacecraft to visit any of the solar system's giant outer planets when it flew past Jupiter on December 4, 1973. Launched in 1972, it flew just 81,000 miles above Jupiter's cloudtops, recording information on the planet's magnetic field, radiation belts, and atmosphere. Pioneer 10 continued to return data until 1997 as it flew far beyond the realm of the planets. Final contact with the probe came in 2003.

20 Years Ago

One of NASA's most ambitious missions took flight on December 2, 1993, as space shuttle Endeavour headed for Hubble Space Telescope. Shortly after HST's launch in 1990, astronomers discovered that its primary mirror could not properly focus starlight because of a small, undiscovered flaw in its manufacture. The flaw turned the telescope into a national joke. However, the crew of shuttle mission STS-61 changed that by installing corrective lenses. The astronauts also installed new solar arrays along with equipment that improved the telescope's pointing accuracy and expanded its computer capacity.



NASA (2)

Astronauts Story Musgrave (top) and Jeffrey Hoffman repair HST. The telescope's view of the galaxy M100 before (top right) and after receiving corrective lenses.

The constellations of winter shine brightly on January and February nights. Orion, the hunter, is forever reaching out to defeat Taurus, the bull, as the twins of Gemini look on. Jupiter lords over the night and Saturn the dawn, while Mercury, Venus, and Mars are harder to spot but still visible to the careful observer.

JANUARY 1 - 15

Jupiter, king of the planets, reigns supreme high over the cold January night. In the early-winter darkness of dinnertime, look for Jupiter glaring high over Orion in the southeast. The planet is in Taurus this season, more or less between Aldebaran and the Pleiades.

By 9 p.m., Jupiter is at its highest due south. At midnight it's still high in the southwest, shining now to Orion's right. It doesn't set in the west until 3 or 4 a.m.

But Jupiter's rule over the night is not entirely unchallenged. Sirius, the brightest star, rises in the southeast beneath Orion by 7 p.m. or so, depending on where you live. It's about as far below Orion as Jupiter is above it.

Once Sirius is well up, it glitters with its full brightness of magnitude -1.4 , while Jupiter is three times as bright at magnitude -2.7 .

Dim little Mars is quite low in the southwest in twilight. It's been hanging there at about the same spot in twilight for an incredible five months now, but during winter it will finally give up the effort and sink out of sight — slowly, over several weeks. How long into January or February can you keep Mars in view? Bring binoculars.

Two more planets are visible in the dawn. The Sun rises its latest of the year in early January, so your workday schedule may give you an easy shot at Saturn glowing fairly high in the south before the sky gets too bright. Saturn is well to the left of nearly-as-bright Spica. Look also for Venus just above the southeast horizon as sunrise approaches.

The waning crescent Moon shines near Saturn on the mornings of January 6 and 7, then close to Venus near the horizon on the 10th.

JANUARY 16 - 31

Jupiter is now at its highest in early evening, still in Taurus, in the vicinity of Aldebaran and the Hyades and Pleiades star clusters. On January 21, the waxing gibbous Moon shines strikingly close to Jupiter amid this panoply.

Look below Jupiter for Orion. The star marking Orion's left corner is bright Betelgeuse,

an orange-red supergiant. The opposite corner is the bright white giant Rigel, one of the most obvious color contrasts among the stars. They're Orion's two brightest stars, named Alpha and Beta Orionis, respectively.

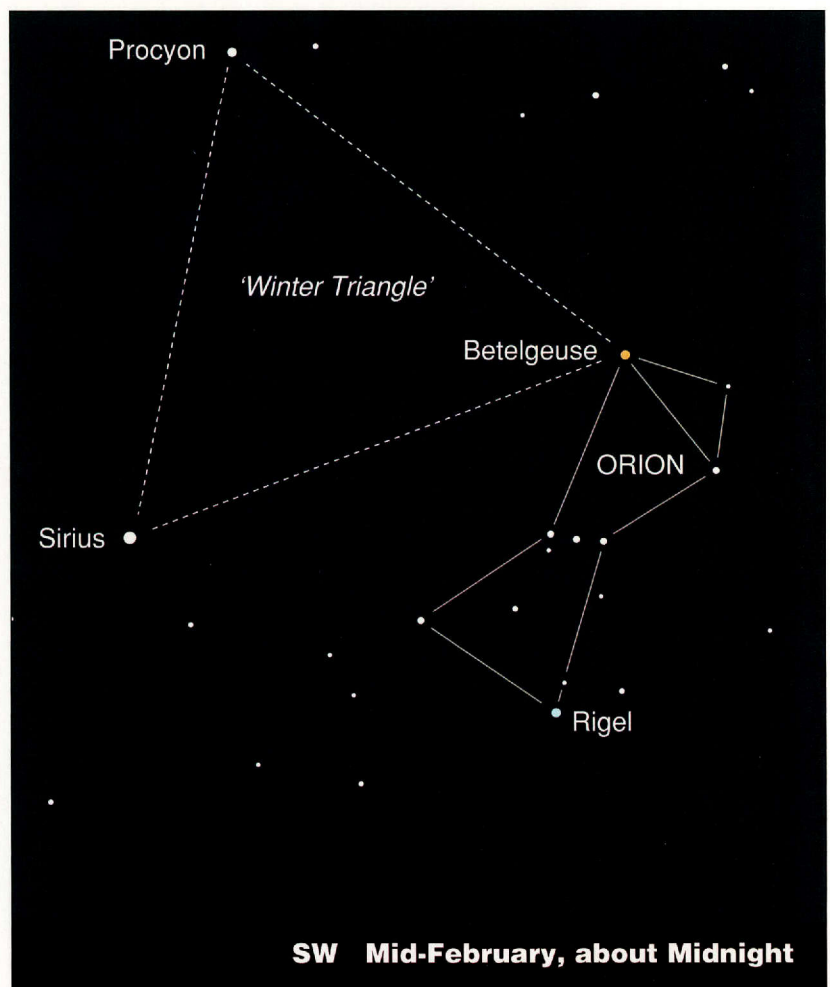
Orion's Belt is midway between them. It points down toward brilliant Sirius, the Dog Star, which now rises into sparkling view by early evening.

Once you've identified Betelgeuse and Sirius, you can use them to pin down Procyon, the "little dog star." These three form a big, bright equilateral triangle with Procyon as its left corner: the Winter Triangle. Each of its sides is

about as wide as your fully outstretched hand at arm's length, from thumbtip to little fingertip.

As night advances, and as winter advances, Orion and company rise higher and shift to the south. Orion himself tilts more upright, and his Belt rotates from vertical to diagonal. But the Belt always points one way toward Sirius and the other way toward orange Aldebaran — and this season, Jupiter.

Look well to Orion's left in early evening, and to his upper left later, for the constellation Gemini: two stick figures lying horizontal and holding hands. Their heads are on the left, marked by



Castor and Pollux. The stars are named for the mythical Gemini twins of ancient Greece and Rome who supposedly hatched from an egg — demigods who watched over sailors and horsemen. For all we know, Castor, Pollux, and Orion may have been actual people in prehistoric times, transformed by many generations of storytelling before their legends were first written down.

FEBRUARY 1 - 15

Jupiter in Taurus remains lord of the evening high overhead. But it moves lower in the west sooner now as night grows late.

After sunset on February 7 and 8, scan with binoculars just above the west-southwest horizon before twilight deepens much. See if you can pick up Mercury there. Mars, much fainter, is just $2/3$ -degree from Mercury on the 7th and $1/3$ -degree from it on the 8th.

February is winter's crowning month for bright constellations in the early evening hours. Orion stands at his highest in the south, with his Belt still aimed diagonally toward Aldebaran, with Jupiter off to the upper right and Sirius to the lower left. Procyon is a similar distance directly to the left of Orion.

Capella, one of the brightest stars in the entire sky, shines almost at the zenith, the point directly overhead.

Over in the west, meanwhile, look shortly after dark for the Great Square of Pegasus, tilted onto one corner. It's somewhat larger than your fist at arm's length. From the Great Square's top corner, a tall row of three stars (including the corner) extends far upward; these are the brightest stars of the

constellation Andromeda.

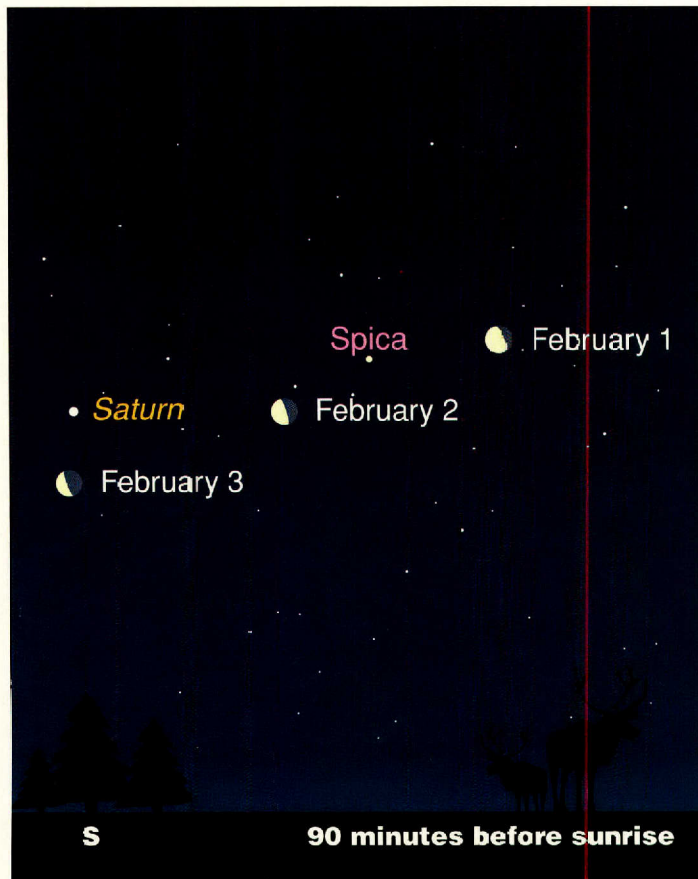
W-shaped Cassiopeia is high in the northwest now. The W has turned way around from its position in the fall, now extending more or less from upper right to lower left. Its lower three stars are the brightest.

Cassiopeia lies along the winter Milky Way. The Milky Way's great band currently arches across the sky from the northwest, crossing the zenith, and heading down to the southeast, where it passes between Orion and Gemini and close by Sirius. If there's much light pollution in your sky, it will dim the Milky Way or wash it out completely. But if you have a dark, natural sky, the Milky Way is one of the most impressive glories of the winter night.

FEBRUARY 16 - 28

Little Mercury is in fine evening view in mid- to late February. Look for it low in the west as the glow of sunset fades. Binoculars help show much fainter Mars a few degrees below it from about February 9 through 22.

Jupiter is about 6 degrees to the right of Aldebaran, high in the southwest after



dusk. Look for the Pleiades farther to Jupiter's right. The arrangement sinks as evening advances.

Binoculars are a valuable astronomical tool. Try them on the Pleiades. Where the unaided eye shows six Pleiads, or maybe eight if your eyes are sharp, binoculars reveal dozens.

Now sweep to Jupiter. Good binoculars, steadily braced, will show at least hints that Jupiter is an extended little disk, not a starlike point. Look especially for Jupiter's big moons lined up very closely on either side of the planet. Usually, binoculars will show at least two, sometimes three, and occasionally all four. They change positions from night to night.

Continue left to Aldebaran and you'll run through the Hyades cluster, which is much bigger and looser than the Pleiades. The brightest Hyades stars form a V shape about as big as a typical bin-

ocular's field of view. Aldebaran forms one tip of the V.

Turn around to the northeast. There you'll find the Big Dipper, already pretty high and balancing on its handle. The handle is bent. Examine the star at the bend. This is Mizar, accompanied by its little companion Alcor. You may or may not see Alcor with your unaided eyes (keep trying), but binoculars give anyone super vision and render Alcor plain as day.

Binoculars make an excellent "first telescope." Get a good, detailed star atlas and a binocular observer's guide to the sky (good picks are Craig Crossen's and Wil Tirion's *Binocular Astronomy* and Gary Seronik's *Binocular Highlights*), and you'll have all you need to keep busy as a serious amateur astronomer for a long time to come.

Alan MacRobert is a senior editor of Sky & Telescope in Cambridge, Massachusetts.

Meteor Watch

The Shower

Quadrantids

Named for the extinct constellation Quadrans Muralis, which honored an astronomical instrument.

Peak

Night of January 2

Notes

The shower is one of the year's most active, with perhaps 80 to 100 meteors per hour at its peak. The peak lasts only an hour or two, however, so the viewing window is brief. Unfortunately, the gibbous Moon rises by around 11 p.m. on the night of January 2 and lights up the sky during the prime meteor hours, significantly dimming the show.

JANUARY

How to use these charts:

1. Determine the direction you are facing.
2. Turn the chart until that direction is at the bottom.

December 20

January 5

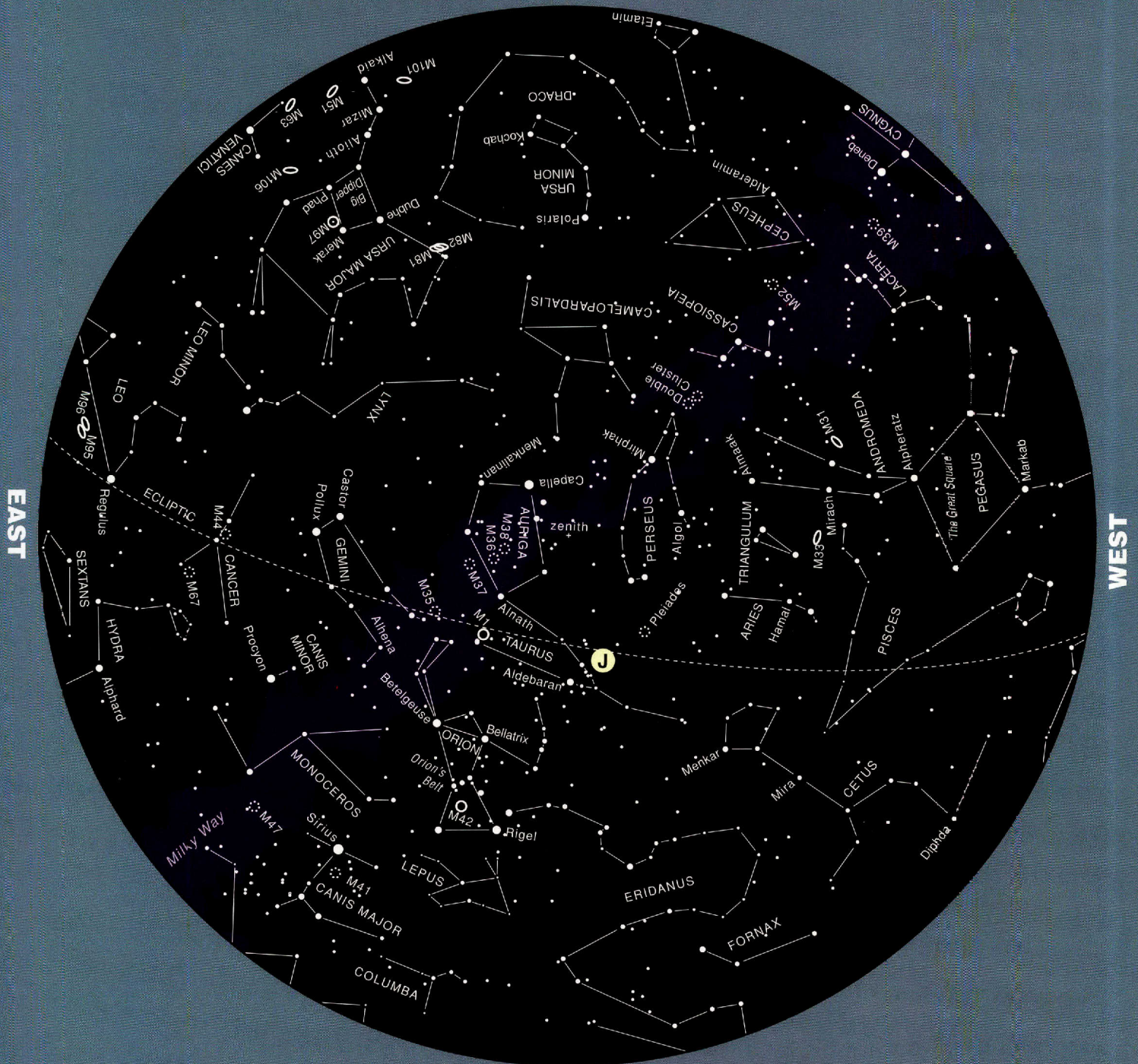
January 20

11 p.m.

10 p.m.

9 p.m.

NORTH



MAGNITUDES

- 0 and brighter
- 1
- 2
- 3
- 4 and fainter

SOUTH

- J Jupiter
- open cluster
- globular cluster
- nebula
- planetary nebula
- galaxy

FEBRUARY

How to use these charts:

1. Determine the direction you are facing.
2. Turn the chart until that direction is at the bottom.

January 20

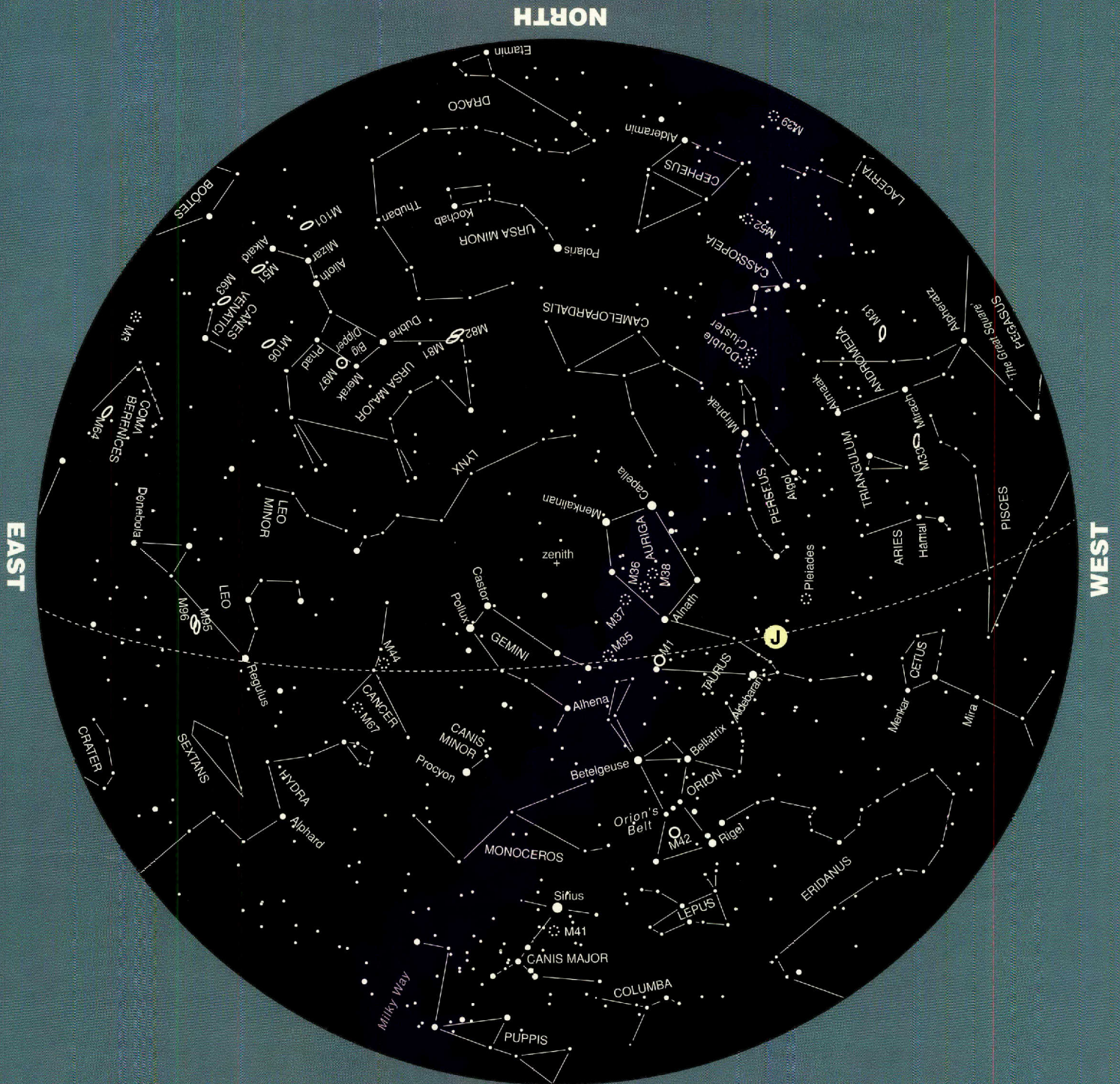
February 5

February 20

11 p.m.

10 p.m.

9 p.m.



MAGNITUDES

- 0 and brighter
- 1
- 2
- 3
- 4 and fainter

- J Jupiter
- ☉ open cluster
- ☼ globular cluster
- nebula
- ⊙ planetary nebula
- ∞ galaxy



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