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SKY ALMANAC 2014

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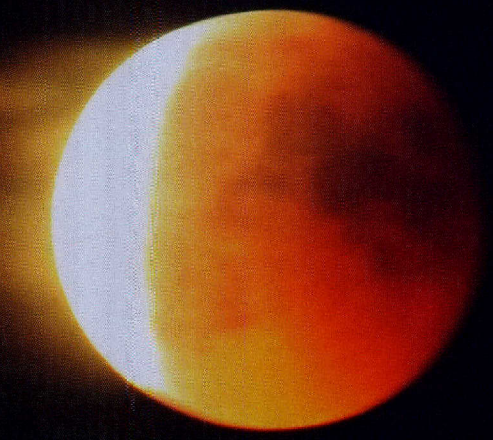
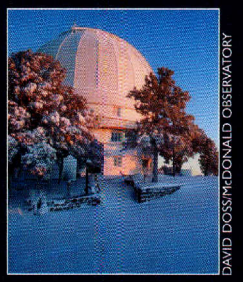
Features

Departments



This Page
A lunar eclipse colors the skies above Riga, Latvia.

Coming Up in March/April
In our next issue, find out how astronomers are searching for the signs of life in the light signatures from extrasolar planets. And brush up on how colonial astronomy played a role in the trial for treason of Aaron Burr.



DAVID DOSS/McDONALD OBSERVATORY

On the Cover
The Otto Struve Telescope sits serenely atop Mount Locke after a major snowstorm in 2012. The telescope was dedicated in 1939 and is still observing the stars today.

SKY ALMANAC 2014

75 YEARS OF McDONALD OBSERVATORY

Every clear night of the year, the bulbous domes of McDonald Observatory open to the dark skies above the Davis Mountains of West Texas. Their giant telescopes rotate into position to track the wonders of the night sky, from nearby stars and planets to some of the most distant galaxies in the universe. Astronomers will use the telescopes to hunt for planets in other star systems, to probe the mysteries of dark matter and dark energy, and to study the death throes of stars large and small.

Their work is continuing a scientific legacy established 75 years ago, when McDonald Observatory first opened its doors — and the shutters above its first large telescope. The Observatory was born with a bequest from a reclusive Texas banker, nurtured by a rare scientific partnership, and brought to full bloom by the efforts of scores of University of Texas scientists and their students.

We relate some of the story of McDonald Observatory in the pages of this year's Sky Almanac. But thanks to new and improved technologies, international collaborations, and the bounty of the night sky, the story is still being written, with no end in sight.

Text by Damond Benningfield

JANUARY

OVERVIEW

Venus pulls a switcheroo during January. The night sky's second-brightest object (after the Moon) begins the month quite low in the western sky at sunset. On the 11th, though, it whisks between Earth and the Sun, moving into the morning sky. It moves far enough from the Sun to see by about the 16th or 17th, beginning its long reign as the "morning star." In the meantime, the next-brightest nighttime object, the planet Jupiter, shines at its brightest for the entire year, and is in view all night.

HIGHLIGHTS

2 Venus, the "evening star," stands to the lower right of the Moon as the Sun sets.

2/3 The Quadrantid meteor shower is at its peak.

4 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.

5 Jupiter is at opposition. It rises at sunset and remains in the sky all night. The giant planet is closest to Earth for the year, so it shines at its brightest, outperforming all the other planets and stars in the sky for most of the night.

11 Venus passes between Earth and the Sun. It will climb into view as the "morning star" by the 16th or 17th, depending on your location.

18 Regulus, the heart of Leo, the lion, is to the upper left of the Moon as they rise in mid-evening.

FEATURED EVENT

23 The Moon, Mars, and Spica stage a spectacular encounter.

25 The planet Saturn is close to the upper left of the Moon at first light.

28/29 Venus, now in the morning sky, is to the lower left of the Moon at first light on the 28th, and to the upper left on the 29th.

31 Mercury stands close to the left or upper left of the Moon about 30 minutes after sunset. The little planet is at its farthest from the Sun for its current evening apparition.

JANUARY

Su	M	T	W	Th	F	Sa
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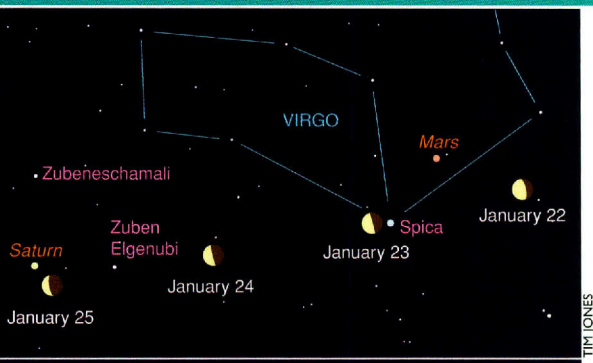


TIM JONES

FEATURED EVENT

Morning Trio

The Moon pays a close call on a bright star in the wee hours of January 23, just slipping past Spica, the luminary of the constellation Virgo. They rise around midnight and stand high in the south at dawn, with a third bright object standing close above them: the planet Mars.

This tight grouping is possible because all three objects are close to the ecliptic, which is the Sun's path across the sky. Spica is only about two degrees from the ecliptic, which is roughly the width of your finger held at arm's length. The orbits of Mars and the Moon are tilted slightly with respect to the ecliptic, but neither object wanders far from it.

In ages past, skywatchers attributed special qualities to bodies near the ecliptic. The constellations along this path became the 12 signs of the zodiac, and individual bright stars were assigned mystical powers. In reality, though, there's no difference between these stars and the thousands of others that sprinkle the night sky, they just happen to line up near the Sun's path.

Mars and the other planets align near the ecliptic because they were born from a flat disk of gas and dust that surrounded the newborn Sun. And the Moon is near the ecliptic because it was born when a planet-size body, coming in from near the plane of the ecliptic, slammed into the young Earth. The impact spewed out gas and molten rock, which quickly coalesced to form our satellite world.

THE BASICS

Not every constellation on the ecliptic is a member of the zodiac. In 1930, astronomers drew boundaries for 88 official constellations. Their work extended Ophiuchus, the serpent bearer, creating a 13th ecliptic constellation. Ophiuchus is in view low in the east to southeast just before dawn by mid-January.

McDONALD MOMENT

'Brain Motor'

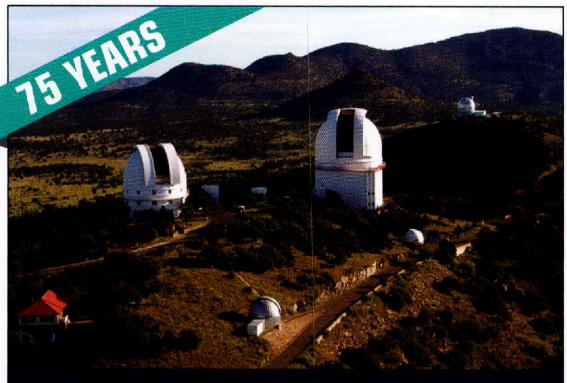
Astronomers from around the world were gathered in the remote Davis Mountains of West Texas in May 1939 to dedicate McDonald Observatory and its giant new telescope. The telescope boasted a primary mirror 82 inches in diameter, second only to the mammoth 100-inch reflector at Mount Wilson, California.

Inspired by the size and power of the new telescope, a reporter for *The Dallas Morning News* called it a "brain motor." "This is its psychological effect," he wrote, "the way it will stir the imagination and convince people of all walks of life that pure thought pays dividends better than dollars."

Observatory and telescope continue to stir the imagination 75 years later. The scientific problems are different, of course. Instead of moons in our own solar system, McDonald astronomers look for planets in other star systems. They probe the mystery of dark energy, model the death throes of exploding stars, and search out black holes big enough to swallow the entire solar system — phenomena that no one even knew existed in the late 1930s.

The tools are a bit different, too. Bigger telescopes, electronic detectors, computer controls, and other innovations have sharpened the view of the heavens, allowing astronomers to see galaxies that formed when the universe was young.

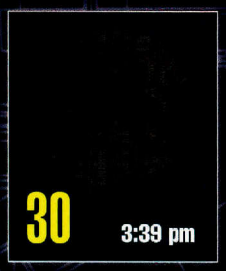
Despite the changes, though, McDonald Observatory remains a "brain motor" — an outpost for pondering the mysteries of the universe and stirring the imaginations of new generations of skywatchers.



Birthday Party

McDonald Observatory will host special events to commemorate its 75th anniversary throughout the year, at the Observatory and at other locations throughout Texas.

mcdonaldobservatory.org



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.

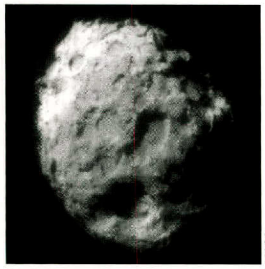
PERIGEE
January 1, 30

APOGEE
January 15

KEY DATES

January 2

NASA's Stardust mission flew through the coma of Comet Wild 2 on this date in 2004, using a spongy material known as aerogel to capture a few grains of comet dust for return to Earth in 2006. Planetary scientists are still analying this material to gain new clues about the birth of the solar system's planets.

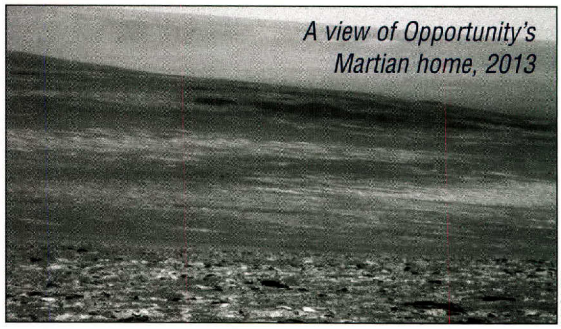


NASA

Comet Wild 2 from Stardust

January 4

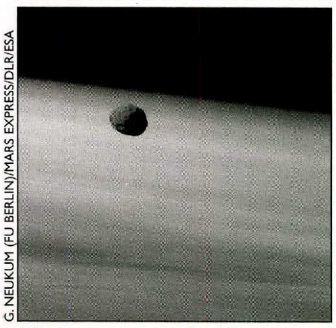
The first of two Mars Exploration Rovers, nicknamed Spirit, landed on Mars in 2004. It overcame early memory problems that threatened to scuttle the mission to eventually cover 4.8 miles (7.7 km). It discovered evidence that its landing site, Gusev Crater, was a watery environment in the distant past. Spirit expired in 2010 after becoming stuck in thick sand. The second rover, Opportunity, landed in Meridiani Planum just three weeks after its twin. Like Spirit, it also found evidence of ancient water on the Red Planet. Opportunity was still going as of late 2013, and had racked up about 24 miles (40 km) of driving.



A view of Opportunity's Martian home, 2013

NASA/JPL

January 29



G. NEUKUM (FU BERLIN)/MARS EXPRESS/DLR/ESA

Phobos against the Martian landscape from a European spacecraft

Phobos 2, a Soviet craft designed to drop a probe on the Martian moon Phobos, entered orbit around Mars in 1989. A twin, Phobos 1, failed en route. Phobos 2 snapped pictures and took other measurements, but failed before the probe could be deployed.

January 31 — *CALENDAR EVENT*

Today is the Chinese New Year. The Chinese calendar is based on the motions of the Moon, not the Sun. Adjustments must be made to keep it roughly aligned with the seasons.

FEBRUARY

OVERVIEW

All five of the naked-eye planets put in an appearance this month. Mercury is quite low in the western evening sky early in the month before disappearing in the Sun's glare. Venus reaches its most brilliant for its current "morning-star" appearance. Jupiter, the next-brightest planet, is in view all night, with Mars rising before midnight and Saturn a little after.

HIGHLIGHTS

7 Aldebaran, the brightest star of Taurus, stands to the lower left of the Moon at nightfall.

10 The brilliant planet Jupiter is close to the left or upper left of the Moon at nightfall.

14 Regulus, the brightest star of Leo, is close to the left of the Moon at nightfall.

FEATURED EVENT

15 Venus is shining at its brightest in the morning sky about now, at a magnitude of –4.9, or roughly 10 times brighter than Jupiter, which is the next-brightest star-like object in the night sky.

18/19 The Moon, Mars, and the star Spica team up, rising before midnight. Spica is below the Moon as they rise on the 18th, with Mars farther to the Moon's lower left. On the 19th, Mars rises above the Moon with Spica to its upper right.

21 The golden planet Saturn stands to the left of the Moon at first light. The star Zubenelgenubi, the scorpion's southern claw, is closer to the right of the Moon.

22/23 Antares, the brightest star of Scorpius, huddles to the lower left of the Moon at first light on the 22nd, and to its lower right on the 23rd.

25/26 Venus, the "morning star," is to the lower left of the crescent Moon at first light on the 25th, and closer to the upper right of the Moon on the 26th.

FEBRUARY

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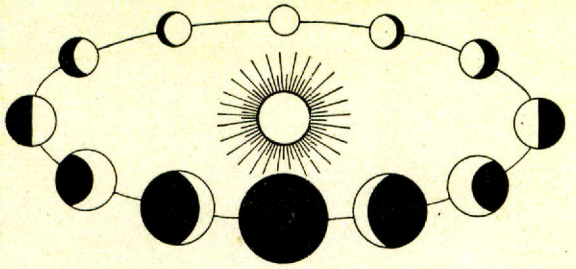


This cartoon depicts how the phase of Venus varies as the planet orbits the Sun.

FEATURED EVENT

Brilliant Crescent

The planet Venus shines at its brilliant best this month, blazing through the early morning sky like a cosmic spotlight. It's easy to mistake the planet for an approaching airliner or something more nefarious. In fact, the number of UFO reports is likely to climb as the uninformed call police or post their jittery videos on the Internet.

Venus' brightness varies based on its distance from Earth and its phase.

It recently passed between Earth and the Sun, so like a young Moon, it forms a crescent, which is easy to see in even the smallest telescopes. With sunlight illuminating only a sliver of the hemisphere that faces Earth, you might expect Venus to be faint. However, the planet is also quite close to Earth right now, so the illuminated crescent covers a large area on the sky. And at close range, each square foot reflects more sunlight toward Earth than when it is farther away.

Negative Brilliance

Venus peaks this month at a magnitude of -4.9. Under the magnitude system, negative numbers represent brighter objects than positive numbers. The system is logarithmic, with a difference of five magnitudes representing a hundredfold difference in brightness. At the same time that Venus is at peak brightness, the next-brightest point of light this month, February, is at -2.5, which is only about 10 percent as bright as Venus.

Over the next few months, Venus will loop to the far side of the Sun, so more of its Earth-facing hemisphere will be bathed in sunlight. At the same time, though, Venus will be much farther from Earth, so the planet will gradually grow fainter. It will be at its weakest in summer, shortly before it passes behind the Sun, shining just half as brightly as this month.

The crescent Moon will pass by the crescent planet on the mornings of the 25th and 26th, creating a beautiful display in the dawn sky.

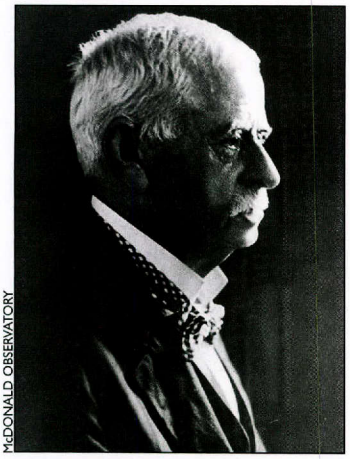
McDONALD MOMENT

Parisian Lightning

In the winter of 1926, the University of Texas received a bolt from the blue: a bequest from a Texas banker that was "like lightning out of a clear sky," according to H.Y. Benedict, the dean of the University's College of Arts and Sciences. The bequest spawned a legal tussle that would last for six years, but eventually lead to the establishment of McDonald Observatory.

William Johnson McDonald was a lawyer, banker, and philanthropist who developed a keen interest in the natural world. He was born in 1844, in the struggling Republic of Texas. After the death of his parents, he attended tiny McKenzie College in north Texas. He joined the Confederate army in 1864, but returned at the end of the Civil War to complete his studies.

McDonald became a noted lawyer, then established three banks in small Texas towns, including the First National Bank in Paris, not far from Dallas. He settled there, and quietly amassed a fortune. McDonald had no family, so he used some of his wealth to travel through Europe and the United States, and to pursue his love of science. He took a summer session in botany at Harvard, and once told his barber that astronomy was the science of the future.



McDONALD OBSERVATORY

William J. McDonald

When McDonald died, in February 1926, he left the bulk of his estate — more than $1.2 million — to the University to build an astronomical observatory. Texas was stunned by the news because it had no astronomy department. But Benedict, who was trained as an astronomer, accepted the challenge.

Distant relatives contested McDonald's will, and after several nasty trials, they and the University settled out of court in 1932. Texas received more than $800,000. That was enough to build a first-class observatory, but not to build a faculty to go with it — a shortcoming that required Benedict, now the University's president, to come up with a creative solution.

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.

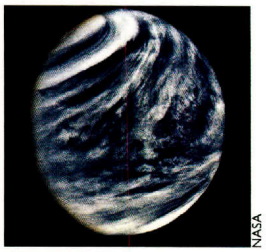
APOGEE
February 11

PERIGEE
February 27

KEY DATES

February 5

The Mariner 10 spacecraft flew past Venus in 1974. Although it was not the first Venus encounter, it was a historic space "first": the first time a planet's gravity was used to retarget a spacecraft. Using the gravity assist, Mariner 10 later became the first craft to fly past Mercury.



NASA

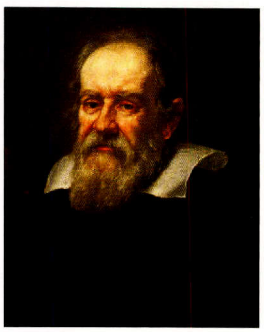
Mariner 10 snapped this ultraviolet view of Venus, showing structure in the planet's clouds.

February 7

The Astronomical Society of the Pacific, a leader in astronomy outreach and education, celebrates its 125th birthday. *www.astrosociety.org*

February 15

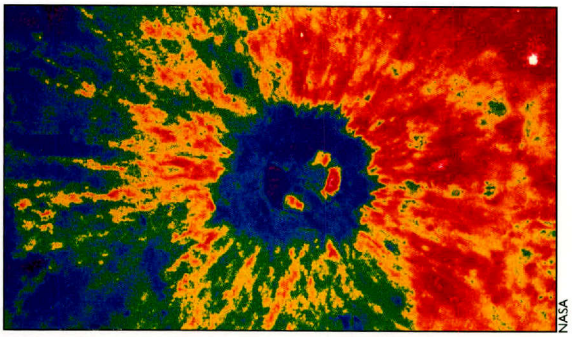
Summer begins in the northern hemisphere of Mars, and winter in the southern hemisphere. The season will last about six months.



Galileo Galilei, one of history's greatest astronomers, was born on February 15, 1564. He was the first to turn a telescope toward the heavens, discovering the largest moons of Jupiter, the phases of Venus, and many other wonders.

February 19

The Clementine spacecraft entered lunar orbit in 1994. The small, inexpensive craft was designed to test new sensors and instruments for future use on spacecraft in Earth orbit and deep space. It compiled the best maps of the chemical and mineral composition of the Moon to date.



NASA

A Clementine map of iron (red) around Dionysius crater

MARCH

OVERVIEW

The month marches in like a lion, with the constellation Leo leaping proudly across the sky all night. Some of the icons of winter remain in good view as well. Orion is in the southwest at nightfall, with Sirius, the brightest star in the night sky, twinkling in the south. Venus continues to dominate the dawn as the "morning star," while orange Mars huddles close to blue-white Spica.

HIGHLIGHTS

7 The bright star close beneath the Moon at nightfall is Aldebaran, the brightest star of Taurus. The bull's V-shaped face stretches below Aldebaran.

9 Daylight Saving Time begins in the United States at 2 a.m. local time.

9/10 Dazzling Jupiter is close to the upper left of the Moon at nightfall on the 9th, and a little farther to the upper right of the Moon on the 10th.

13 The Moon swings by Regulus, the heart of Leo. Regulus is to the lower left of the Moon at nightfall.

17 Spica and Mars are to the lower left of the Moon as they rise in mid-evening, with Spica closer to the Moon.

18 The Moon, Spica, and Mars form a beautiful triangle as they climb skyward by around 10:30 or 11 p.m, with orange Mars to the upper left of the Moon and Spica to the upper right.

20 The planet Saturn looks like a golden star to the upper left of the Moon at first light, with orange Mars farther to the right of the Moon.

FEATURED EVENT

20 Spring arrives in the northern hemisphere with the vernal equinox at 11:57 a.m. CDT.

21 Saturn stands just above the Moon as they climb skyward in the wee hours of the morning, and to the Moon's right at first light.

22 Antares, the orange supergiant at the heart of Scorpius, huddles to the lower right of the Moon in the pre-dawn sky.

27 Venus, the "morning star," shines close to the lower right of the Moon at first light, low in the east-southeast.

MARCH

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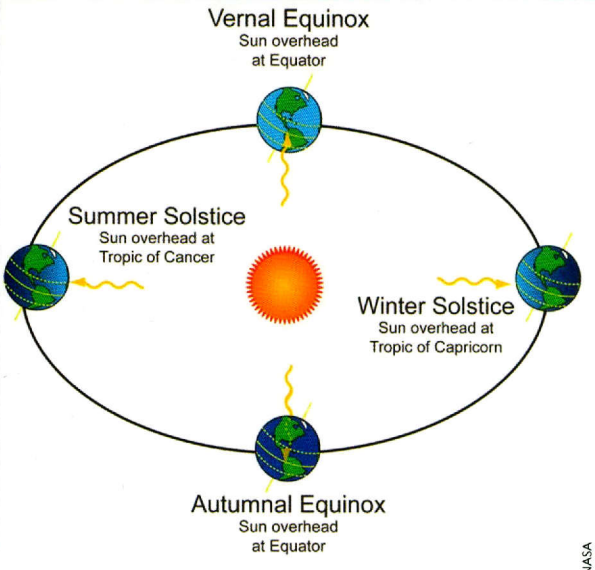


NASA

FEATURED EVENT

Equalizing the Nights

Spring arrives in the northern hemisphere on March 20, when the Sun crosses the equator from south to north. This passage is known as the vernal or spring equinox. It is one of two equinoxes; the other is the autumnal or fall equinox in September.

The Sun's north-and-south motion across the sky is caused by Earth's tilt on its axis. As Earth orbits the Sun, the north and south poles take turns dipping toward the Sun. Neither pole dips sunward at the equinoxes, so the Sun rises due east and sets due west for all points on the globe except the poles.

The name "equinox" means "equal nights." In theory, it means that day and night are equal lengths, so the intervals between sunrise and sunset, and sunset and sunrise, should each be exactly 12 hours. For several reasons, though, that's not the case.

The "equinox" definition assumes that the sunrise and sunset points occur when the horizon bisects the Sun, so that half the solar disk is above the horizon, half below. Yet the modern definition of sunrise is the moment when the top of the solar disk first peeks into view above the horizon, while sunset is the moment when the last portion of the disk drops below the horizon.

And the "daylight" portion of the day is lengthened by atmospheric effects. When the Sun first appears above the horizon at sunrise, for example, it is still physically below the horizon. But Earth's atmosphere acts as a lens, bending the sunlight up and over the horizon a few minutes early.

Thanks to these effects, the dates when daylight and darkness are truly equal occur a few days before the spring equinox and after the fall equinox.

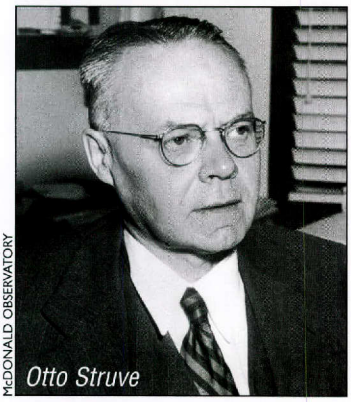
McDONALD MOMENT

Finding a Partner

Otto Struve knew an opportunity when he saw one.

The University of Chicago astronomer knew that his institution needed a big new telescope to supplement the 40-inch refractor at Chicago's Yerkes Observatory in Wisconsin. Yet Chicago just didn't have the funding to pay for a new instrument.

When William J. McDonald left his fortune to the University of Texas to build an astronomical observatory, Struve suggested a partnership: Texas would provide the observatory, and Chicago would provide the astronomers. Texas agreed, and in 1932, the two universities signed a 30-year deal. Struve, recently promoted to the directorship of Yerkes Observatory, would also direct the new McDonald Observatory.



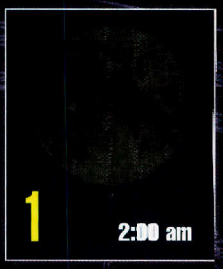
McDONALD OBSERVATORY

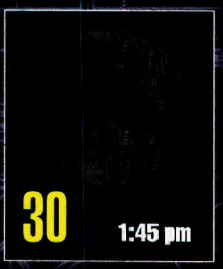
Otto Struve

Struve was a fourth-generation astronomer, born in Ukraine to one of Europe's leading scientific families. He served in the Russian army during World War I, and soon after he fought on the losing side in the Russian civil war. He escaped to Turkey, where he ate at soup kitchens and was working as a lumberjack when he received a letter from Yerkes director Edwin Frost offering him a job at Chicago. Struve arrived in 1921, earned a Ph.D. from Chicago, and began working his way up through the university's astronomy program.

Struve oversaw design and construction of McDonald Observatory's 82-inch telescope, which was the world's second largest, and presided over its dedication in 1939. He spent long hours using the telescope for his studies of stars, while continuing to build the Chicago astronomy faculty.

Personality conflicts with his young, talented scientists eventually led to Struve's resignation. Yet his name continues to resound in West Texas. In 1966, three years after Struve's death, McDonald Observatory named the 82-inch telescope in his honor.





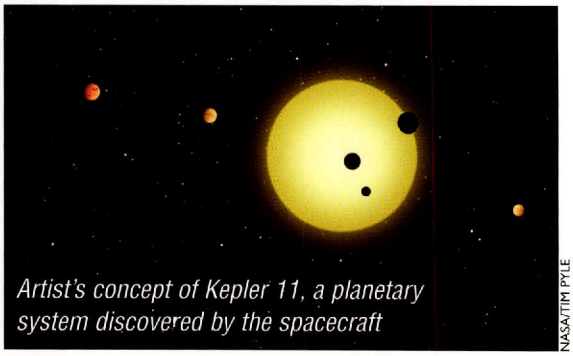
Moon phase times are for the Central Time Zone.

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

APOGEE
March 11

PERIGEE
March 27

KEY DATES



NASA/TIM PYLE

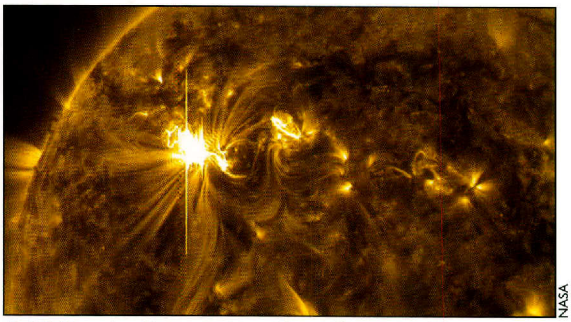
Artist's concept of Kepler 11, a planetary system discovered by the spacecraft

March 6

NASA launched the Kepler space telescope in 2009. The satellite discovered thousands of possible planets in other star systems before a mechanical failure ended its planet-hunting days in 2013. It is pursuing other research using a backup pointing system.

March 13

In 1989, solar storms knocked out power to much of Quebec. The blackout lasted for several hours.



NASA

A 2012 solar flare captured by a Sun-watching satellite

SKY WATCH

This Year's Meteor Showers

Shower	Peak	Moon
Quadrantids	Night of January 2	Just past new
Lyrids	Night of April 21	Rises around 3 a.m.
Eta Aquarids	Night of May 5	Sets after midnight
Comet 209P/LINEAR	Night of May 23	Early morning crescent
Perseids	Night of August 12	In view most of the night
Orionids	Night of October 21	Dawn crescent
Leonids	Nights of November 16/17	Early morning crescent
Geminids	Night of December 13	In view after midnight

Actual times may vary. The glare of a bright Moon makes it harder to see the meteors.

APRIL

OVERVIEW

April's warm nights are especially bountiful this year. Mars is at opposition, shining brightly all night, and American skywatchers are perfectly placed for a lunar eclipse at mid-month. Leo springs high across the sky on April evenings, while Virgo follows a couple of hours behind the lion. The highlights of winter, Orion and Canis Major, get ready to exit the evening sky in the west.

HIGHLIGHTS

3 Aldebaran, the orange eye of Taurus, gazes down on the Moon at sunset.

5 The brilliant planet Jupiter stands to the upper left of the Moon at nightfall, with the orange star Betelgeuse, the shoulder of Orion, the same distance to the lower left of the Moon.

6 Jupiter is close to the upper right of the Moon this evening.

8 Mars is at opposition today, lining up opposite the Sun in Earth's sky. The bright orange planet rises at sunset and remains in the sky all night.

10 Leo's bright heart, the star Regulus, lurks close to the upper left of the Moon at nightfall.

FEATURED EVENT

13/14 Brilliant orange Mars, the star Spica, and the full Moon will stage a beautiful encounter, with the Moon undergoing a total eclipse on the second night.

16 The golden planet Saturn is roughly one degree to the left of the Moon as they rise in late evening.

18/19 Antares stands below the Moon as they climb into view in the wee hours of the 18th, and about the same distance to the right of the Moon on the 19th.

21 The Lyrid meteor shower will be at its best tonight.

25/26 Venus, the "morning star," blazes to the lower left of the Moon at first light on the 25th, and to its right on the 26th.

APRIL

Su	M	T	W	Th	F	Sa
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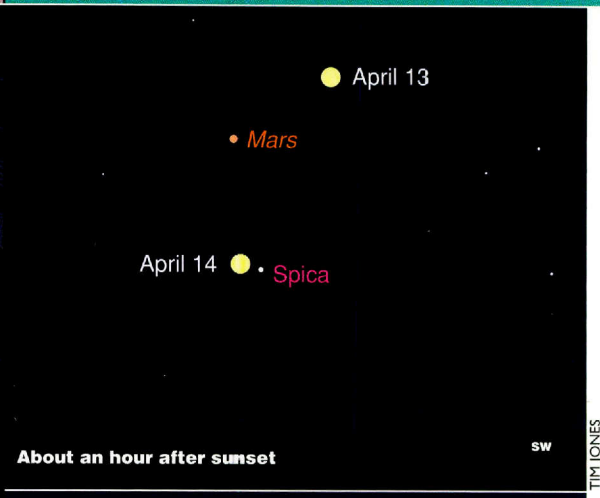


TIM JONES

FEATURED EVENT

Triple Threat

Except for the Moon, nothing in the night sky catches our fancy like Mars. And the planet is especially fetching this month, shining brightest for the entire year. It rises around sunset and remains in view all night. Even better, it's brightest for the year, shining like a brilliant orange star within the borders of the constellation Virgo. At its peak brilliance, it will outshine everything else in the night sky except the Moon and the planets Venus and Jupiter.

Mars will pass closest to Earth on the 14th, at a distance of 57.4 million miles (92.4 million km). That's not an especially close encounter, though. At its best, Mars can approach to within about 35 million miles, but its orbit is quite stretched out, so its distance from the Sun varies by tens of millions of miles. This time, we're catching Mars when it is near its farthest point from the Sun, so it's farther away than at most other oppositions.

Even so, the night of April 14 is one of the best skywatching nights of the year. Not only is Mars shining at its orange best, but the Moon will be, too, as it undergoes a total eclipse. The eclipse occurs in the wee hours of the morning of the 15th, with the Moon fully immersed in Earth's shadow. Sunlight filtering through the shadow usually gives the Moon a deep red or orange cast, although it can also look dark gray.

And just to add to the night's skywatching entertainment, the star Spica will huddle quite close to the Moon. At their closest, they'll be separated by just a degree or so — the width of your finger held at arm's length. Spica will look a bit pale next to the uneclipsed full Moon, but should be an especially beautiful beacon as the eclipse unfolds.

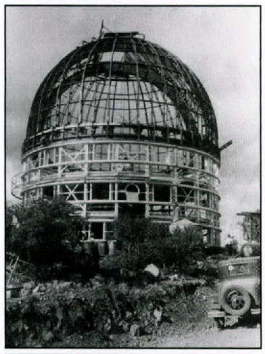
McDONALD MOMENT

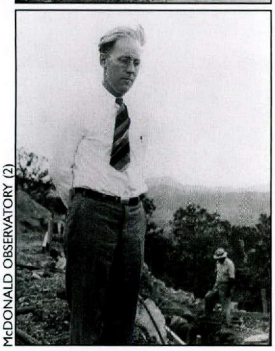
Hunting for a Mountain

In the Davis Mountains region of West Texas, the news seemed to go from bad to worse. In 1932, the newspapers talked about a bank failure and flooding rains that washed out roads and bridges, and one headline encouraged local residents to spend money to create jobs for unemployed men.

But things began to perk up in July when University of Chicago astronomers visited the Davis Mountains to scout locations for the new McDonald Observatory.

The astronomers wanted a high mountain, limited rainfall (periodic gully-washers notwithstanding), and steady skies for their new telescope, with reasonable access to water and roads. They considered putting the telescope on a hill west of Austin, but rejected the idea because of the encroaching city. It was clear, though, that the University of Texas expected the observatory to be built in Texas, so the Chicago astronomers staged a mountain-hunting safari.





McDONALD OBSERVATORY (2)

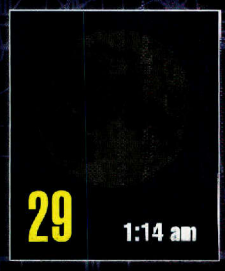
The 82-inch telescope dome takes shape (top); McDonald's first resident astronomer, Franklin Roach, looks over the site.

After the Davis Mountains they considered sites near El Paso and in the Guadalupe mountains, along the New Mexico border. They quickly decided that the Davis Mountains offered the best site.

Otto Struve spent several nights evaluating conditions on Spring Mountain and declared it his favorite spot. But logistical considerations required a shift a few miles away, to present-day Mount Locke. Ranchers Violet Locke McIvor and E.H. Fowlkes each donated 200 acres, and Texas finalized the deal in 1933.

Construction began later that year, with the State of Texas building a paved highway to the summit of Mount Locke. The first resident astronomer, Franklin Roach, arrived in 1934, well before anything was built, and spent his nights testing the sky's brightness.

The dome for the giant new telescope was completed in 1936. But it would take several frustrating years more to finish the telescope's delicate mirror and bring McDonald Observatory to fruition.



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 8

PERIGEE
April 22

KEY DATES

April 12

Space enthusiasts around the world will celebrate Yuri's Night, which commemorates the anniversaries of Yuri Gagarin's first human spaceflight and the first flight of an American space shuttle. *yurisnight.net*

April 24

McDonald Observatory will host an open house, with free admission, special events, and speakers to discuss the Observatory's anniversary. *mcdonaldobservatory.org*

SKY WATCH

Naked-Eye Planets

Venus

The brilliant morning or evening star starts 2014 in the evening sky, but moves to the morning sky by mid-January, where it remains through summer. It returns to the evening sky by year's end.

Jupiter

The largest planet in the solar system, and the brightest object in the night sky after the Moon and Venus. It shines at its best in early January, when it is brightest and is in the sky all night.

Mars

The Red Planet shines brightest this year in April, when it will briefly rank as the fourth-brightest object in the night sky.

Mercury

Best this year in the dawn sky around the end of October, and in the evening sky in late January to early February and again in mid-May.

Saturn

Shines brightest this year in May, as it moves through Libra.

Uranus

Visible in early October; requires very dark skies and good eyes.

Ranked in order of maximum brightness when not too near the Sun for viewing

MAY

OVERVIEW

Planets scatter across the sky this month, with Saturn and Mars in view for most of the night, Jupiter dropping down the western evening sky, and Venus low in the dawn sky. Mercury pops in for a brief evening visit late in the month. Among the stars, Orion makes its last stand in the evening sky, as does Sirius, the brightest star in the night sky.

HIGHLIGHTS

1 Aldebaran, the eye of Taurus, looks up at the Moon at nightfall.

3/4 Brilliant Jupiter stands above the Moon at nightfall on the 3rd and to the right of the Moon on the 4th, when Procyon, the "little dog star," is farther to the lower left of the Moon.

7 Regulus, the heart of Leo, is close above the Moon this evening.

10 Bright orange Mars huddles close to the Moon tonight.

10 The planet Saturn is at opposition, lining up opposite the Sun in our sky. It rises at sunset and remains in view all night. It is brightest for the year, too, shining like a bright golden star.

11 Spica, the leading light of Virgo, stands close to the lower left of the Moon, with Mars to their upper right.

13 Golden Saturn stands close to the lower left of the Moon at nightfall, and is closer above the Moon at first light on the 14th.

14 Saturn is to the upper right of the Moon as they climb into view in early evening, with Antares, the heart of the scorpion, below.

23 Mercury is low in the west-southwest at nightfall, with the star El Nath, which represents the tip of one of the bull's horns, to its right.

FEATURED EVENT

24 A brilliant meteor shower may light up the pre-dawn sky.

25/26 Venus, the "morning star," poses just below the Moon at first light on the 25th, and farther to its upper right on the 26th.

30 The planet Mercury is to the right of the Moon at nightfall, with much brighter Jupiter above them.

31 Jupiter is close to the upper right of the Moon, with Procyon farther to the left of the Moon.

MAY

Su	M	T	W	Th	F	Sa
				1	2	3
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The 1966 Leonid meteor storm

NOAO/AURA/NSF

FEATURED EVENT

Stormy Spring Sky?

The most impressive meteor shower in more than a decade could light up the pre-dawn sky on May 24, perhaps firing off hundreds of "shooting stars," with American skywatchers perfectly placed for the fireworks.

The shower could be spawned by debris from 209P/LINEAR, a small comet discovered in February 2004 by an automated search telescope. It orbits the Sun once every five years, moving as close to the Sun as Earth's orbit and as far as Jupiter's orbit.

Like all comets, 209P/LINEAR sheds grains of rock and dirt as it orbits the Sun. These small bits of debris spread out, forming long streamers along the comet's orbital path. If Earth flies through one of these streamers, some of the comet dust slams into the upper atmosphere at tens of thousands of miles per hour. The particles quickly vaporize, forming the streaks of light known as meteors.

Several meteor-shower experts say that's just what will happen before dawn on May 24. Earth will pass through several of the comet's debris streams at about the same time, peppering our planet with countless bits of dust. Conservative estimates say that could spawn rates of perhaps a few hundred meteors per hour, while bolder predictions say the hourly rate could top 1,000. We haven't seen such an impressive display since the Leonid meteor shower in 2001.

The shower's peak should come between midnight and dawn for most of the United States. The meteors should appear to "rain" into the sky from the direction of the faint constellation Camelopardalis, the giraffe, which will be low in the north. Individual meteors can shoot across any part of the sky, though, so you won't need to look in a specific direction to see them. The Moon will be a waning crescent, so its feeble light shouldn't hinder the show.

The comet itself will pass about five million miles from Earth on May 29, perhaps becoming bright enough to see with the unaided eye for a while.

McDONALD MOMENT

Party Time!

With everything from a rodeo and chuckwagon dinner to an international scientific confab, McDonald Observatory formally opened for business on May 5, 1939. The Warner and Swasey Company, which built the telescope, chartered railroad cars to bring leading astronomers from across the country, including Edwin Hubble, for whom Hubble Space Telescope is named.

As the astronomers celebrated the beautiful new telescope, though, Otto Struve was perhaps breathing a sigh of relief. Although the dome was completed in 1936, it took another three years to finish the telescope. Part of the delay was understandable; the 82-inch was the world's second-largest telescope, and such a big job inevitably takes longer than expected. A bigger problem, though, is that the people who were polishing the telescope's primary mirror, which gathers and focuses starlight, didn't really know what they were doing.

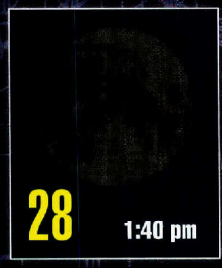
The mirror was made of a then-new material, Pyrex. It expands and contracts very little as the temperature changes, which keeps the mirror from changing shape as it cools in the night air. The mirror was cast on December 31, 1933. When it had cooled several months later, though, its surface was severely cracked, so it had to be remelted.

Long months of grinding and polishing the mirror to achieve a precise shape followed — months that made the McDonald people extremely anxious. By 1937, they discovered that the person in charge of the mirror wasn't testing it correctly. He kept polishing small spots to eliminate flaws in the mirror, only to make them worse.

It took two changes in management to complete the mirror, in late 1938. It was delivered to Texas in early 1939, and fitted in the telescope tube in March. Later tests showed that the mirror still wasn't as good as hoped, but it was good enough to begin astronomical observations. It was time to celebrate.

McDONALD OBSERVATORY

The world's astronomers gather outside the new telescope during the McDonald Observatory dedication.



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 6

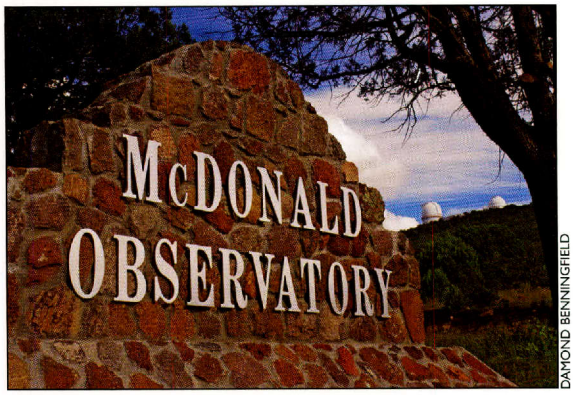
PERIGEE
May 18

KEY DATES

May 1 — *CALENDAR EVENT*

Today is Beltane, an ancient Celtic festival that honored the newly arrived summer with bonfires. Some of the traditions are preserved today as May Day. The date is one of the four annual cross-quarter days, which occur roughly half-way between a solstice and an equinox. Many cultures used these dates to mark the changing of the seasons.

May 5



DAMOND BENNINGFIELD

McDonald Observatory was dedicated 75 years ago (see left). Official events this month include:

- An exhibit at the Bob Bullock Texas History Museum in Austin, opening May 1
- An astronomy evening at the Perot Museum of Nature and Science in Dallas, May 1
- A talk by Observatory Director David Lambert in Paris, Texas, home of William J. McDonald, May 2

May 10

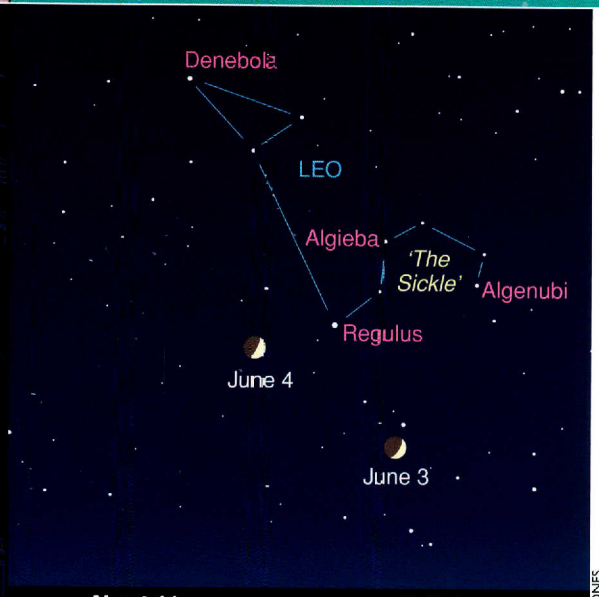
Astronomy Day, organized by the Astronomical League, is a nationwide celebration in which museums, astronomy clubs, libraries, universities, and other groups host star parties, lectures, and other events for general audiences. Many events are held at shopping malls or other convenient locations.

www.astroleague.org/al/astroday/astroday.html

JUNE

OVERVIEW

As spring gives way to summer, the signature star patterns of the new season climb into view during the brief nights. Sagittarius, whose brightest stars outline the shape of a teapot, rises in late evening, with the curving form of Scorpius in the south. They never climb far above the horizon, although their distinctive shapes make them easy to find. Jupiter gets ready to make its exit from the evening sky by month's end, while bright orange Mars and golden Saturn continue to dazzle in the south during the evening.



TIM JONES

HIGHLIGHTS

1 Brilliant Jupiter stands to the lower right of the Moon at nightfall.

FEATURED EVENT

3/4 Regulus, the brightest star of Leo, is above the Moon on the evening of the 3rd and to the right of the Moon on the 4th.

6/7 Bright orange Mars stands to the left or upper left of the Moon on the evening of the 6th, and quite close to the upper right of the Moon on the 7th.

8 The star Spica is close to the right of the Moon as night falls on the 8th, with the planet Mars to their right.

9/10 Golden Saturn is to the left of the Moon on the 9th and closer to the upper right of the Moon on the 10th.

11 Antares, the heart of Scorpius, is below the Moon at nightfall.

21 Summer arrives in the northern hemisphere at 5:51 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.

23-25 The Moon passes by Venus, the dazzling "morning star." They are closest on the morning of the 24th.

28/29 Jupiter, which is rapidly slipping toward the Sun, lines up near the crescent Moon in the early evening. Jupiter is close to the upper right of the Moon on the 28th, and farther to the right on the 29th. Jupiter is quite low in the sky and drops from view not long after the sky gets dark.

JUNE

Su	M	T	W	Th	F	Sa
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29	30					

FEATURED EVENT

Head on the Chopping Block?

Many of the classical constellations are tough to decipher. Few modern-day skywatchers see a charioteer in the stars of Auriga or even a ram in Aries. In a few cases, though, the picture shines through. Once you see the curving body of Scorpius, for example, you'll understand why the ancients named it for a scorpion.

Another example is Leo, which gets a visit from the Moon on the nights of June 3 and 4. It takes little imagination to fit together its stars to form a crouching lion, with its head to the right and its tail to the left.

Leo's brightest star, Regulus, represents the lion's heart. The lion's head and mane form a big arc that's known as the Sickle. It's an asterism — an identifiable shape that doesn't represent a constellation. The most famous asterism is the Big Dipper, which formally is part of Ursa Major, the great bear.

After Regulus, the Sickle's brightest star is Algieba, which connects the mane to the lion's body. Algieba consists of two aging giant stars that orbit each other about every 500 years. Both stars are much bigger, brighter and heavier than the Sun, and although they are just one-tenth the Sun's age, they are nearing the ends of their lives.

The star at the tip of the blade is Algenubi, from an Arabic name that means "southern star in the lion's head." It, too, is a stellar giant, which makes it easily visible even though it's 250 light-years away.

These and other stars perform double duty, outlining two easy-to-see pictures: the wide curve of a sickle and the prominent mane of a lion.

McDONALD MOMENT

Star Trek: A Long Road for Science

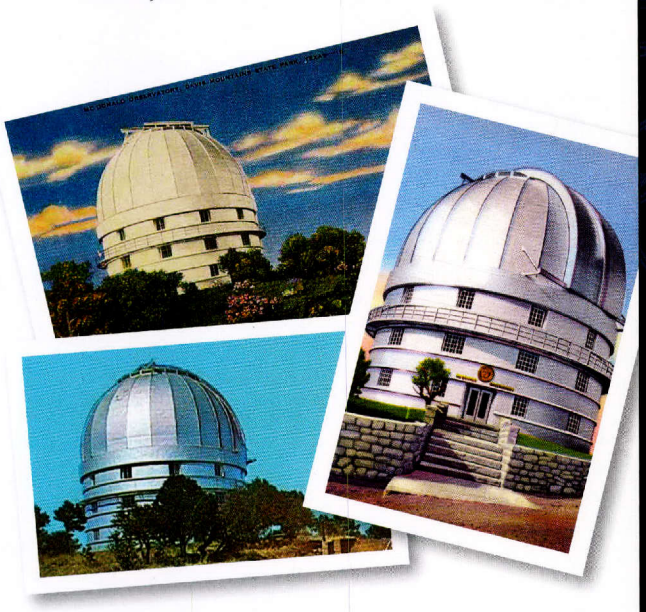
Even today, McDonald Observatory is remote. The nearest supermarket is close to an hour away; the nearest commercial airport, about three. For the astronomers who put the Observatory's first big telescope to work, though, a trip to McDonald was an expedition. It took them a couple of days to travel from Chicago to the nearest railroad station in West Texas and on to McDonald. They stayed for observing runs of a month or so, living in one of the new houses atop Mount Locke or in a small apartment inside the telescope dome.

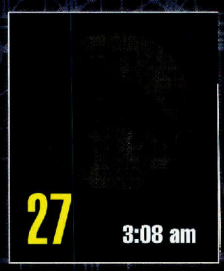
Conditions were especially austere during World War II, when rationing limited both travel and supplies, and many of the Observatory's astronomers and support staff were involved in the war effort.

Even so, McDonald quickly became one of the most productive research observatories in the country. Struve and his colleagues conducted pioneering spectroscopic studies of the stars, revealing new details about their composition and helping decipher the mechanism by which the stars shine.

Gerard Kuiper, who succeeded Struve as McDonald director in 1947, was one of the most productive solar system observers in the world. He discovered moons of the giant planets Uranus and Neptune, and discovered the atmosphere of Titan, the largest moon of Saturn. He also was the first to detect carbon dioxide in the atmosphere of Mars.

These and other world-class astronomers continued to make the long trek to McDonald through the 1950s, keeping the telescope busy while filling research journals with world-class scientific results.





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.

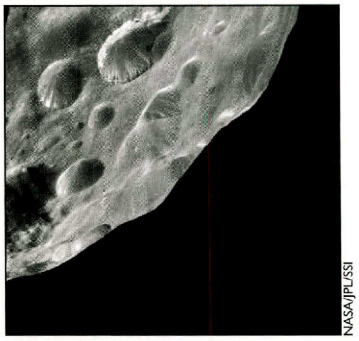
APOGEE
June 2, 30

PERIGEE
June 14

KEY DATES

June 11

The Cassini spacecraft arrived at the Saturn system when it flew just a few hundred miles from Phoebe, a small outer moon, in 2004. The craft entered orbit around Saturn on June 30. Cassini continues to study Saturn and its rings and moons.



NASA/JPL/SSI

A Cassini view of Phoebe

June 26

Lyman Spitzer Jr., the driving force behind space-based telescopes, was born on June 26, 1914. In 1946, he proposed placing a large optical telescope in Earth orbit, where it could see the universe unobstructed by Earth's atmosphere. His dogged pursuit of this goal eventually led to the construction of Hubble Space Telescope, and Spitzer conducted observations with the telescope. Spitzer also headed another space telescope project, Copernicus, which studied the universe in ultraviolet wavelengths. After his death, NASA's large space-based infrared telescope was named Spitzer Space Telescope in his honor.

LOCKHEED MARTIN

Spitzer with the space telescope that would be named in his honor.

JULY

OVERVIEW

This is an especially good month for conjunctions between the Moon and bright stars and planets. The Moon splits the gap between Mars and Spica on the night of the 5th, huddles close to Saturn a couple of nights later, then goes eye-to-eye with Aldebaran late in the month. As the Moon's journey plays out, the summer constellations Scorpius and Sagittarius climb into good view in the southern sky. On moonless nights, the subtle glow of the Milky Way extends upward from these constellations, providing a breathtaking view for those who can escape the glow of city lights.

HIGHLIGHTS

1 Regulus lines up to the upper right of the Moon as night falls.

3 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).

FEATURED EVENT

5 The Moon, Mars, and Spica stage an impressive conjunction this evening.

7 The planet Saturn stands close above the Moon at nightfall, with the star Zubenelgenubi, which represents the scorpion's southern claw, a little farther to the Moon's right.

8/9 Antares, the heart of the scorpion, stands close to the lower left of the Moon at nightfall on the 8th, and to the lower right of the Moon on the 9th.

12 The planet Mercury stands farthest from the Sun for its current morning appearance. It looks like a moderately bright star to the lower left of Venus, the brilliant "morning star."

13/14 Mars passes by Spica on these evenings. At their closest, they will be separated by about the width of a finger held at arm's length.

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

24 Venus stands to the left of the crescent Moon at first light.

JULY

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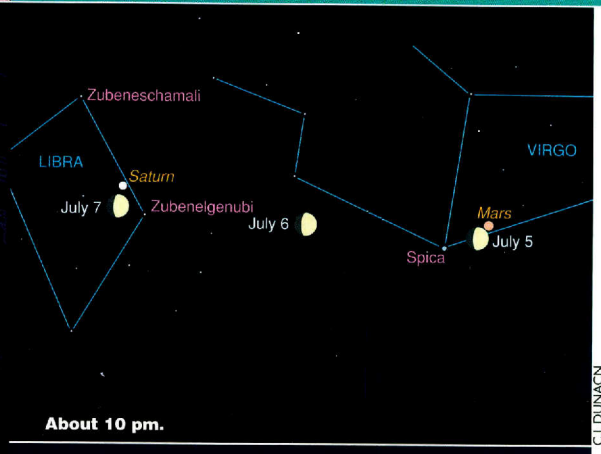


About 10 pm.

C.J. DUNACN

FEATURED EVENT

Sprinting Across the Sky

One of the best conjunctions of the year highlights the sky on July 5, as the Moon lines up between Mars and Spica. Mars and the Moon will almost touch each other as night falls, but the Moon will move away from the Red Planet and toward Spica as the evening progresses. Depending on where you live, Spica may be a bit closer to the Moon by the time they set in the wee hours of the morning.

The Moon's relatively speedy trek across the night sky is the result of its proximity to Earth. It's just a quarter-of-a-million miles away, so it orbits our planet once every 27.3 days, which is also the time it takes to make one full loop against the background of stars. At that rate, the Moon moves the equivalent of its own diameter (roughly one-half degree) in a little less than one hour.

The planets and stars move across the sky as well, but their motion is more difficult to detect. The speed of a planet depends on its distance and the relative orbital motions of Earth and the planet. Mars is about 75 million miles away on the night of July 5, which is about half of its average distance from Earth. For a casual skywatcher, its motion from hour to hour is imperceptible. Yet it is moving quickly enough that its position changes noticeably from one night to the next.

Spica is moving, too. It is about 250 light-years away, which is more than 20 million times the distance to Mars. So even though Spica is moving at thousands of miles per hour relative to Earth, it would take lifetimes for even the most skilled observer to notice any shift in its position relative to other stars. So while the Moon and Mars will loop through the starry background night after night, year after year, Spica will stay right where it is.

McDONALD MOMENT

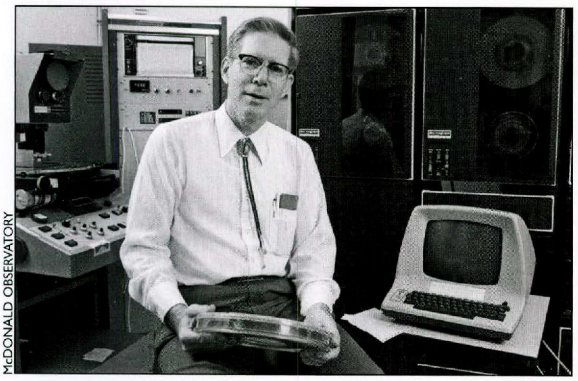
Changing Directions

For its first three decades, McDonald Observatory was operated as a scientific partnership. The University of Texas provided the facilities, while the University of Chicago provided the astronomers. The arrangement brought great scientific returns. By the late 1950s, though, the partnership was ending. Chicago didn't want to invest in the Observatory's upkeep, and Texas had not yet established an astronomy program, so it wasn't upgrading the place, either. In fact, for a while Texas even considered shuttering the Observatory.

Instead, though, it turned to a young Ivy Leaguer to rejuvenate the Observatory. Harlan J. Smith was a 38-year-old Yale astronomer when the University of Texas offered him the job. Despite its run-down and neglected condition, Smith saw potential in the historic site and agreed to take the job — but only if the University met a few conditions.

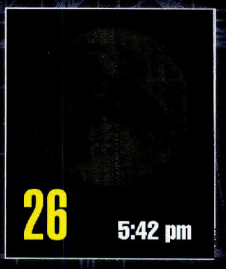
"I told the University that we should be allowed to build up to at least 12 full-time faculty members," Smith recalled at the Observatory's 50th anniversary celebration in 1989. "We should be given substantial University funds to refurbish the 82-inch, that we should have support in building a substantially larger telescope, we should be allowed to begin radio astronomy, and that we should be supported in moving into space astronomy as that became practicable. Well, there was never a written answer to these written conditions, but there was a phone call that said 'Yeah, we'll take it, come on.' So I came."

Smith started the job on September 30, 1963. He was director of McDonald Observatory and chairman of the University's new Department of Astronomy. Within a few years, he managed to refurbish the old telescope and, with a grant from NASA, build a new one that was even bigger. Today, that bigger telescope has been renamed in Smith's honor, continuing his legacy into the 21st century.



McDONALD OBSERVATORY

Harlan Smith with the Observatory's 1970s computers.



Moon phase times are for the Central Time Zone.

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

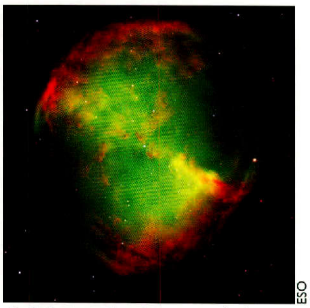
APOGEE
July 13

PERIGEE
July 27

KEY DATES

July 12

In 1764, renowned comet hunter Charles Messier discovered the Dumbbell Nebula, the last gasp of a dying star. In the telescopes of the day, the nebula formed a small disk, like a planet, so it was called a planetary nebula. The Dumbbell was the first planetary ever discovered.

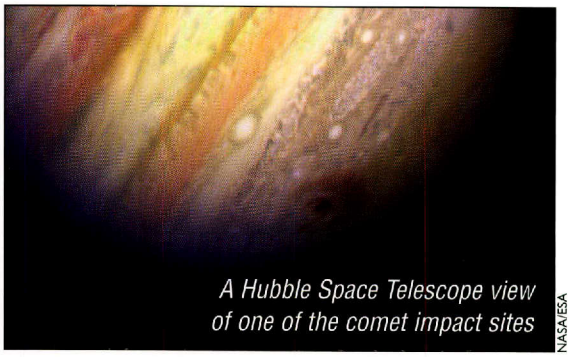


ESO

A false-color image of the Dumbbell Nebula, M27

July 16

Telescopes in space and on the ground watched in 1994 as the first fragments of comet Shoemaker-Levy 9 slammed into Jupiter. More than a dozen fragments eventually hit Jupiter, forming dark scars as big as Earth in the planet's atmosphere. Some of the scars remained visible for months.



NASA/ESA

A Hubble Space Telescope view of one of the comet impact sites

July 31

The United States scored its first success in the Moon Race in 1964 as the Ranger 7 spacecraft slammed into the lunar surface. Its cameras transmitted more than 4,300 pictures, with the final snaps showing details as small as 15 inches across.

NASA

This shot by Ranger 7 was the first picture of the lunar surface taken by an American spacecraft.

AUGUST

OVERVIEW

August nights provide an excellent chance to see the spectacle of the Milky Way, especially early and late in the month, when there's little or no moonlight to overpower its subtle glow. It arcs directly overhead around midnight, anchored by teapot-shaped Sagittarius in the south. The dazzling planets Venus and Jupiter, and the fainter planets Saturn and Mars, zip past each other in the last half of the month.

HIGHLIGHTS

1-4 The Moon slides past a star and two planets on these evenings. On the 1st, Spica, Mars, and Saturn line up to the upper left of the Moon (in that order from the Moon). The Moon is closer to Mars on the 2nd, between Mars and Saturn on the 3rd, and to the left of Saturn on the 4th.

5 Antares, the heart of Scorpius, is below the Moon at nightfall.

11/12 The Perseid meteor shower peaks on these nights. The just-past-full Moon, however, will overpower most of the fireworks.

FEATURED EVENT

17-19 Venus and Jupiter, the most brilliant objects in the night sky other than the Moon, slip past each other in the dawn sky.

18 Aldebaran, the eye of Taurus, the bull, snuggles to the lower left of the Moon at first light.

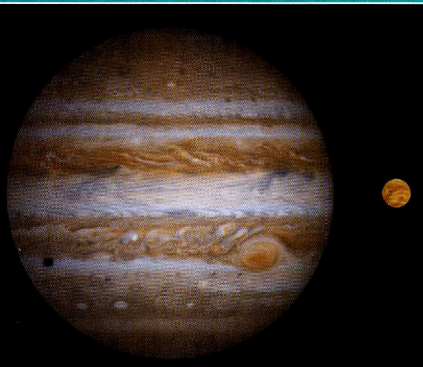
22 The planet Saturn, which shines like a golden star, stands just above the orange planet Mars at nightfall. They are low in the southwest.

23 Jupiter is to the upper left of the Moon at first light, with brighter Venus to the lower left.

31 Saturn stands to the lower right of the Moon, and Mars to the lower left, at nightfall. Zubenelgenubi, the second-brightest star of Libra, is to the lower right of Saturn.

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						



Jupiter (left) and Venus shown to scale. Although Venus is much smaller, it's also much closer to Earth and the Sun, so it appears brighter in our sky.

NASA (2)

FEATURED EVENT

Gods and Goddesses

To ancient skywatchers, the planets were more than just bright, moving points of light in the night, they were the embodiments of the gods. Jupiter was the Roman version of Zeus the king of the gods, and Venus was the goddess of love and beauty.

These two ancient symbols cross paths on the mornings of August 17-19, as Jupiter climbs past Venus. Venus is the brilliant "morning star." Jupiter shines only about one-seventh as bright, although it's still brighter than any other star or planet in the night sky except Venus. Venus stands higher in the sky on the 17th, then they stand side by side, just a whisker apart, on the 18th. Jupiter climbs past Venus on the 19th, and will continue to pull away from its brighter planetary sibling as August rolls on.

Each planet was associated with a long list of objects or characteristics, such as colors, metals, and precious gems. Jupiter was associated with the color blue, the metal tin, and with sapphires.

Each planet was also associated with human characteristics or behaviors. This association was part of the attempt to relate the orderly motions of the heavens to the cycles of life on Earth. Jupiter was thought to make the people born under its influence feel jolly or joyful, or using Jupiter's other name, Jove, it made them "jovial."

Venus was among the few sky objects that were identified as female. In just about every culture, most of the other planets, the stars, and the constellations were male. Perhaps because of the planet's great beauty, though, most saw Venus as a goddess.

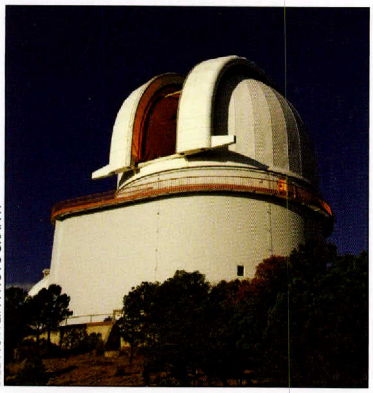
Venus was the Roman version of the Greek goddess Aphrodite, who in turn was adapted from Ishtar of Babylon. Today, almost all the features on Venus are named for real or fictional women, with two of the most prominent named Aphrodite and Ishtar.

McDONALD MOMENT

Movin' On Up

When the University of Texas took over full operation of McDonald Observatory in the 1960s, the Observatory consisted of the original 82-inch telescope, one smaller telescope, plus a few houses and support structures. To stay at the leading edge of astronomical research, though, the facility needed a larger telescope.

Fortunately for Texas, NASA was embarking on an ambitious program of exploring the solar system and needed ground-based observations of the planets to both plan its missions and verify their results. So NASA agreed to pay for a new telescope at McDonald while the University of Texas would pay for the building. In return, the Observatory would devote a large fraction of the telescope's time to solar system observations.



BILL NOWLIN PHOTOGRAPHY

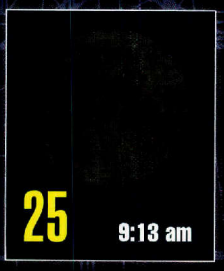
MARTY HARRIS/McDONALD OBSERVATORY

The 107-inch Harlan J. Smith Telescope casts its eye on the night sky (top); the telescope itself

The $5 million telescope was completed in 1968, slightly down the slope of Mount Locke from the original telescope. Its primary mirror measured 107 inches (2.7 meters) in diameter, making it the world's third-largest at the time of its dedication and giving it a light-gathering power a quarter-million times greater than the unaided eye.

The telescope was one of the first to be controlled by computers, which improved its pointing accuracy and made observations easier on the astronomers. The telescope even survived a shooting by a distraught employee, who fired seven 9-mm rounds into the primary mirror at close range. The impacts gouged small holes in the mirror, but they caused so little damage that there was no loss in the telescope's effectiveness.

As with the 82-inch telescope, continued improvements in control systems and instruments have helped keep the 107-inch telescope at the cutting edge of astronomy many decades after it entered service.



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 24

PERIGEE
August 10

KEY DATES

August 1

CALENDAR EVENT

Today is Lammas, a festival evolved from a celebration known as "loaf-mass." It is a celebration of a cross-quarter day, which falls roughly half-way between a solstice and an equinox, and was used in earlier eras to mark the beginning of a season. Lammas evolved from the Celtic celebration of Lugh, whose name means "the Shining One." In Celtic mythology, he was a great warrior, a sorcerer, and a master of arts and crafts.

August 13

Anders Ångström was born in Sweden in 1814. He was one of the pioneers of spectroscopy, which breaks the light from an object into its individual wavelengths, providing a wide range of information about the source object. Ångström also studied the spectrum of the Sun, confirming that it contains hydrogen. A unit of measurement used in spectroscopy, abbreviated with a Swedish capital "A," was named in his honor.

August 18

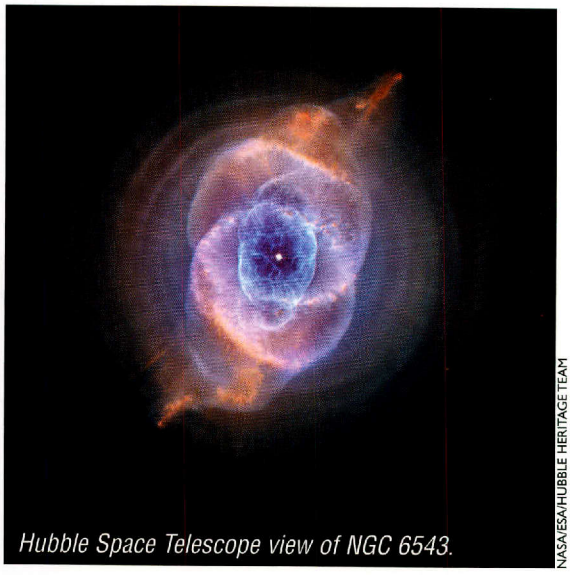
Today is the northern autumnal equinox on Mars, marking the beginning of fall in the northern hemisphere and spring in the south.

August 25

Voyager 2 flew past Neptune, the solar system's most distant planet, in 1989. Its close encounter provided the first look at details in Neptune's blue-green atmosphere, revealed icy geysers on the planet's largest moon, and measured Neptune's thin rings.

August 29

An English amateur astronomer, William Huggins, took the first spectrum of a planetary nebula when he observed NGC 6543. Spectra helped astronomers determine that these objects are clouds of gas and dust expelled into space by dying stars.



NASA/ESA/HUBBLE HERITAGE TEAM

Hubble Space Telescope view of NGC 6543.

SEPTEMBER

OVERVIEW

With summer's luminaries dropping from view, a new season opens up in the evening sky. Pegasus slides into view in the east shortly after night falls, marked by the Great Square. The constellations that form the "celestial sea" — Capricornus, Aquarius, Pisces, and others with a watery theme — flow across the south during the night. The Milky Way arches high overhead during the evening, putting on a grand display from sites with dark skies.

HIGHLIGHTS

1 Antares, the bright orange heart of Scorpius, stands to the lower left of the Moon at nightfall. The bright planets Mars and Saturn are farther to the Moon's lower right.

8 The Moon is full tonight. As the full Moon closest to the autumnal equinox, it is the Harvest Moon.

14 Aldebaran, the eye of the bull, is to the left of the Moon at first light, with the bull's shoulder, the Pleiades star cluster, to the upper right of the Moon.

15 Aldebaran is now to the right of the Moon at dawn.

19 The brilliant planet Jupiter is to the lower left of the Moon at first light, with the star Procyon farther to the right of the Moon.

20 Jupiter now stands to the upper left of the Moon at first light, with much fainter Regulus farther to the lower left of the Moon.

21 Regulus, the brightest star of Leo, crouches to the left of the Moon in the dawn sky.

22 The autumnal equinox is at 9:29 p.m. CDT, marking the beginning of autumn in the northern hemisphere.

27 The planet Saturn perches close to the upper left of the Moon at nightfall.

FEATURED EVENT

27-29 Mars and Antares, two bright orange points of light, are separated by about three degrees, roughly the width of two fingers held at arm's length, in the southwest as night falls. The Moon moves past them on the 28th and 29th.

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
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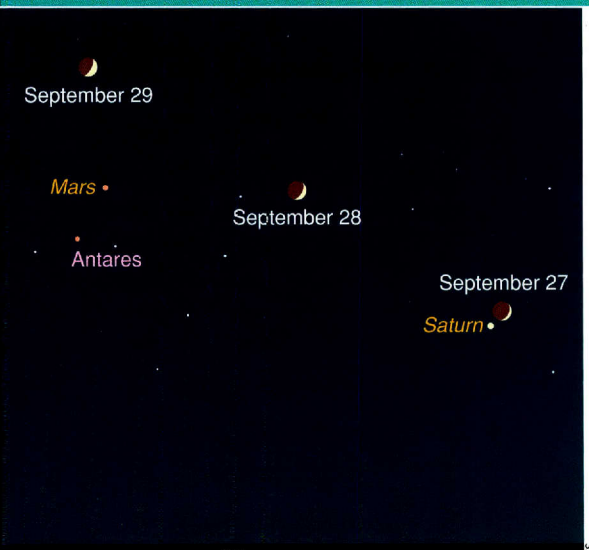


About an hour after sunset.

TIM JONES

FEATURED EVENT

Wandering Past a Rival

What's in a name? Keep an eye on the southwestern evening sky this month to find out. A pair of orange pinpoints move closer to each other as the month progresses, looking almost like twins. The Moon joins them on the nights of September 28 and 29, making it even easier to pick them out.

The best-known member of the pair is the planet Mars. It's also known as the Red Planet, although that's a bit of a misnomer, because its color is decidedly orange. It's one of the reddest-looking objects in the night sky, though, and at its brightest it far outshines all the others. That brilliant orange countenance reminded the cultures of the ancient Mediterranean of blood, so the planet was named for the god of war. In Greece he was known as Ares; in Rome, Mars.

Like all the planets, Mars circles through the background of stars, completing a circuit every couple of years. This motion earned Mars and its fellow worlds the name "planet," which comes from a Greek word meaning "wanderer."

During each loop through the sky, Mars passes the bright orange star at the heart of Scorpius, the scorpion. (This year Mars will skim within the width of two fingers at arm's length of the star, with closest approach on the evenings of September 27-29.)

Skywatchers commemorated the star by calling it Antares, which means "anti-Ares," or, using the Roman name, "rival of Mars."

Mars begins the month well to the right of Antares, about the same height in the sky, but stands directly above the star by September's end.

McDONALD MOMENT

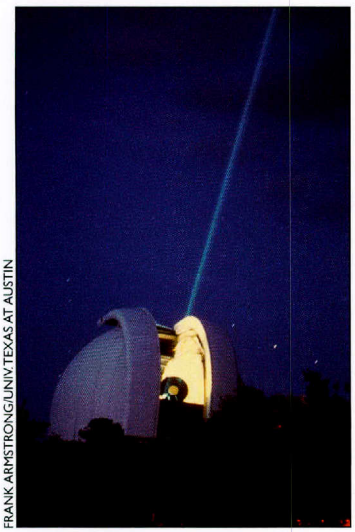
Moonshots and Other Diversions

As Apollo 11 reached the halfway point to the Moon in July 1969, Mission Control asked the crew to look back at Earth. "We've got a laser — it's a blue-green laser — that we're gonna flash on and off," said CAPCOM Charles Duke. "It's coming out of McDonald Observatory near El Paso."

The laser flash was more than just a friendly greeting. It was the first step in an experiment that McDonald scientists conducted for 40 years. They bounced laser beams off reflectors left on the Moon by the crews of Apollo 11 and two other missions, and another on a robotic Soviet rover.

The experiment helped measure the Earth-Moon distance to within a fraction of an inch, which revealed how fast the Moon is moving away from Earth. It also revealed information about the Moon's structure and composition, and helped scientists test Albert Einstein's theory of gravity to find out whether gravity changes over time.

The first laser "hit" came just days after the Apollo 11 astronauts left the Moon, using McDonald's new 107-inch reflecting telescope, which had been built in part to study the solar system in support of NASA's exploration program. The big telescope continued the observations for years before they were turned over to a smaller telescope. The lunar observations continued for four decades, and the smaller telescope continues laser work with orbiting satellites.



FRANK ARMSTRONG/UNIV.TEXAS AT AUSTIN

A laser beam shoots from the Harlan J. Smith Telescope.

Today, the 107-inch telescope, which was the third-largest in the world when it was dedicated in late 1968, typically aims farther into space, conducting research into stars, galaxies, dark matter and energy, and many other topics. And although it's slipped down the world rankings, improvements have actually made the telescope even more effective than during the days when it routinely "shot" the Moon.

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 7

APOGEE
September 20

KEY DATES

September 17

John Goodricke was born in the Netherlands in 1764. Growing up in England, he discovered that some variable stars brighten and fade with a predictable tempo. He suggested that one of these, Algol, varies because it undergoes regular eclipses with a second body, which proved true. Goodricke died at age 21 — just four days after he was elected to the Royal Society.

September 22

MAVEN (Mars Atmospheric and Volatile Evolution) is scheduled to enter orbit around Mars. The craft will study Mars' upper atmosphere to learn how the planet lost most of its early water and air to space.

NASA

September 27

Daniel Kirkwood, who made important contributions to the study of asteroids, was born in 1814 in Maryland. He found that asteroids orbit the Sun in bands, which are created by the gravity of the planet Jupiter. The gaps between these bands today are known as Kirkwood gaps. He found similar gaps in the rings of Saturn.

RESOURCES

ONLINE

StarDate Online
Daily skywatching tips, lunar phases, daily StarDate radio program, and other skywatching resources — stardate.org

Publicly Accessible Telescope Viewing
State-by-state listings — telescopes.stardate.org/guide/public.php

U.S. Naval Observatory
Custom sunrise/sunset and moonrise/moonset charts and much more — www.usno.navy.mil/USNO/astronomical-applications

SpaceWeather
Updates on solar flares, photo galleries, skywatching news, aurora-watching details — spaceweather.com

Meteor Shower Calendar
International Meteor Organization — www.imo.net/calendar/2014

NASA Eclipse Web Site
Charts, tables, and much more on lunar and solar eclipses for 2014 and beyond — eclipse.gsfc.nasa.gov

OCTOBER

OVERVIEW

October offers some of the best skywatching conditions of the year. The nights are getting longer, while the weather is cooler but not yet bitter. The evening sky offers such treats as Andromeda and several other constellations associated with her story, and the Pleiades and Hyades star clusters in Taurus. Jupiter is climbing higher into the morning sky, while Mars is getting ready to exit the evening sky.

HIGHLIGHTS

7 Uranus, the seventh planet from the Sun, lines up opposite the Sun and shines brightest for the year. The giant planet stands close to the lower left of the full Moon tonight. It will be in better view in a few nights, when the Moon rises later. All but the most experienced skywatchers need a star chart and binoculars or a telescope to see it.

FEATURED EVENT

8 A total lunar eclipse will be visible across much of the United States before dawn this morning.

11 Aldebaran, the eye of Taurus, stands close below the Moon as they climb into good view in late evening. They will move closer together during the night, and stage an especially close encounter at dawn on the 12th.

17 Jupiter, which looks like a dazzling star, stands to the lower left of the Moon at first light.

18 Regulus, the brightest star of Leo, stands to the lower left of the Moon at first light, with brighter Jupiter above them.

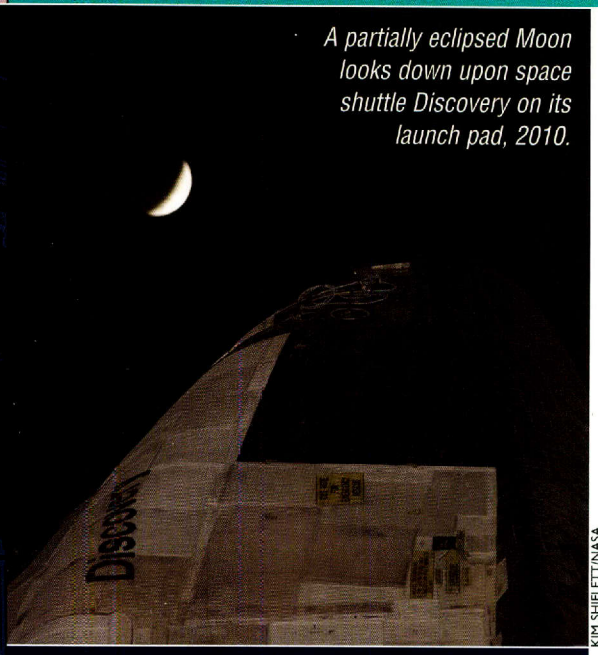
23 A partial solar eclipse will be visible across the United States this afternoon. The eclipse peaks at 4:45 p.m. CDT. The Moon will cover more of the Sun's disk from northern latitudes than southern ones.

27/28 Mars perches to the left or lower left of the Moon at nightfall on the 27th, and to the lower right of the Moon on the 28th. Mars is above the "spout" of teapot-shaped Sagittarius, near the spot that marks the center of the Milky Way galaxy.

31 The planet Mercury shines low in the east during early twilight. It looks like a fairly bright star, but you need a clear horizon to see it.

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	



A partially eclipsed Moon looks down upon space shuttle Discovery on its launch pad, 2010.

KIM SHIFLETT/NASA

FEATURED EVENT

Eclipse Doubleheader

American skywatchers get a rare treat this month with the second total lunar eclipse of the year. It takes place in the wee hours of October 8.

A lunar eclipse occurs when the full Moon passes through the dark central portion of Earth's long shadow. (Eclipses occur only at full Moon because the Moon must align directly opposite the Sun in our sky, which is the moment of full Moon.) The Moon's orbit is tilted slightly with respect to Earth's orbit around the Sun, though, so most months the Moon passes a little above or below the shadow. An eclipse occurs only when the full Moon is passing through Earth's orbital plane.

On average, there are about two lunar eclipses per year, although not all of them are total — in some eclipses, the shadow covers only a portion of the lunar disk. Any given spot on Earth will see an average of about one eclipse per year (total, partial, or penumbral, when the Moon passes only into Earth's faint outer shadow), and all or part of a total eclipse about once every other year. So seeing two total lunar eclipses from beginning to end in one year is rare.

This month, the Moon first touches Earth's dark inner shadow, beginning the partial eclipse, at 4:15 a.m. CDT. The Moon is fully immersed in Earth's shadow at 5:25 a.m., beginning the total eclipse, which lasts for 59 minutes. The Moon will set while the Moon is still fully eclipsed as seen from the Northeast, and will set during the partial eclipse as seen from the eastern half of the country. The western part of the country, including Alaska and Hawaii, will see all phases of the eclipse.

McDONALD MOMENT

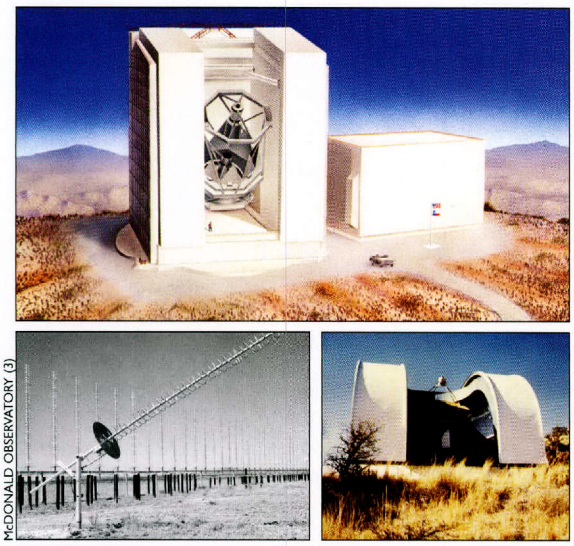
Onward and Upward

McDonald Observatory and the Department of Astronomy experienced explosive growth in the 1970s and '80s. The astronomy department became one of the largest in the world, with thousands of graduate and undergraduate students taking classes on the Austin campus. A growing faculty and research staff brought expertise in everything from comets to galaxies.

The Observatory expanded into new areas of study, building a radio telescope near Marfa, a town about 35 miles to the southeast, and a millimeter-wave dish that first operated in Austin and later at Mount Locke. The Observatory also became a leader in implementing computerized control systems for its telescopes. It established one of the country's most expansive public outreach programs, with a visitor center at the Observatory, the StarDate radio program, and a newsletter that evolved into today's *StarDate* magazine.

By the early '80s, however, the Observatory was ready for a new telescope to expand its research capabilities. It designed a behemoth known as the New Texas Telescope, featuring a single primary mirror about 25 feet (7.6 meters) in diameter, which would have been the world's largest. Shortly before the University was ready to commit to the project, though, the Texas real estate and energy industries suffered major collapses, limiting fund-raising prospects, so the new telescope faded away.

Yet it set the stage for an even bigger telescope in the following decade, which today ranks as one of the largest in the world: the Hobby-Eberly Telescope.



McDONALD OBSERVATORY (3)

Clockwise from top: Artist's concept of the New Texas Telescope; the millimeter-wave telescope; detail of the radio telescope at Marfa

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.

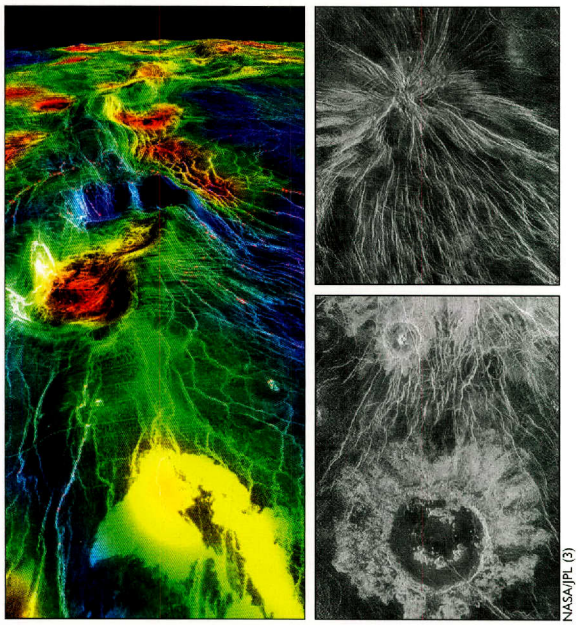
PERIGEE
October 6

APOGEE
October 18

KEY DATES

October 11

After more than five years of studying Venus, in 1994 the Magellan spacecraft fired its engines to end its mission by plunging into the planet's thick atmosphere. Magellan used cloud-penetrating radar to map Venus' hidden surface in far greater detail than any other mission before or since. Its observations revealed that the surface is largely volcanic, and likely was repaved by a global volcanic event about 800 million years ago.



NASA/JPL (3)

Clockwise from left: A false-color image based on Magellan radar data shows the contours of Venusian volcanoes; a region of the surface cracked by pressure from below; a pair of large craters

October 31 — *CALENDAR EVENT*

Today is Halloween, a modern commemoration of one of the cross-quarter days, which falls between a solstice and an equinox. In many cultures, these dates represented the start of a new season, not its mid-point. In northern Europe, the start of winter (on their calendar) was a dreaded time of year, with the long, cold nights of winter ahead. Many thought it was a time when lost souls roamed the land, looking for new bodies to inhabit. The Celts extinguished their hearthfires on November 1, All Saint's Day, to make their homes less appealing to wandering souls. Priests lit bonfires to scare away the spirits, and people dressed up as goblins or witches, made loud noises, and played pranks to convince the spirits that they were already possessed. Irish immigrants brought the tradition to the United States in the mid-1800s. The customs of Halloween caught on, and remain with us today.

NOVEMBER

OVERVIEW

November is a time of transition in the night sky. The signature star pattern of summer, the Summer Triangle, drops down the western sky during the evening hours, while some of the leading constellations of winter, including Orion and Canis Major, creep into view by mid- to late-evening. The zone between them is devoid of bright stars and constellations. It is dominated by the "celestial sea," a collection of relatively faint star patterns with a watery theme that stretches from Capricornus, the sea goat, to Cetus, the sea monster. Lonely Fomalhaut, in Pisces Austrinus, the southern fish, is the only bright spot in this watery stretch of stars.

HIGHLIGHTS

1 Mercury is farthest from the Sun for its current morning appearance. The solar system's innermost planet looks like a bright star quite low in the east as dawn begins to paint the sky.

5/6 Mercury stands side by side with Spica, the brightest star of Virgo, in the east in the early dawn.

7/8 Aldebaran, the eye of Taurus, is to the lower left of the Moon as they climb into view on the evening of the 7th, and closer to the upper right of the Moon on the 8th.

FEATURED EVENT

9 Betelgeuse, another orange star, stands to the lower right of the Moon as they climb into view on the evening of the 9th.

14 Brilliant Jupiter is close to the upper left of the Moon at first light, with Regulus farther to the Moon's lower left.

15 Regulus stands above the Moon at first light, with Jupiter above them.

19 Spica hangs close below the Moon at first light.

25 Mars perches close to the left of the Moon at nightfall. They set in early evening.

NOVEMBER

Su	M	T	W	Th	F	Sa
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2	3	4	5	6	7	8
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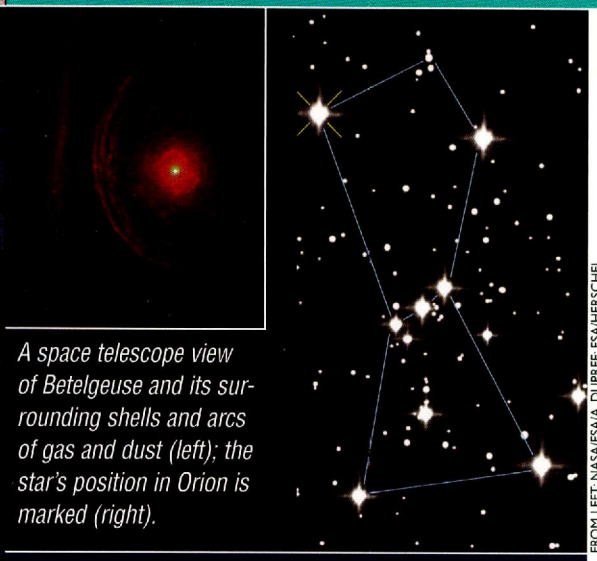


A space telescope view of Betelgeuse and its surrounding shells and arcs of gas and dust (left); the star's position in Orion is marked (right).

FROM LEFT: NASA/ESA/A. DUPREE, ESA/HERSCHEL

FEATURED EVENT

A Big, Messy Star

Big stars tend to be messy. They blow strong "winds" into space, surrounding themselves with dense clouds of gas and dust. These expanding clouds can ram into the material between stars, piling it up to form denser clouds.

A prime example is Betelgeuse, the bright orange shoulder of Orion, the hunter. It climbs skyward in late evening in early November, but by early evening at month's end. The Moon points the way to the giant star on November 9, when Betelgeuse stands fairly close to the right of the Moon.

Betelgeuse is many times heavier than the Sun. That enormous mass squeezes the star's core tightly, producing intense heat that revs up the nuclear reactions that power the star. Energy from these reactions pushes the surrounding layers of gas outward, causing the star to puff up like a giant balloon. Betelgeuse is several hundred times the Sun's diameter, although it's difficult to measure its exact size because the star's winds have surrounded it with so much gas and dust.

Recent observations have shown that the winds cool and condense to form giant shells and arcs around Betelgeuse. One shell is squeezed in the direction of Betelgeuse's path around the center of the galaxy to form a bow shock, like water piling up in front of a ship.

The clouds that are closest to Betelgeuse are lumpy, suggesting that the wind sometimes blows stronger and thicker from some parts of the star than others, enhancing the "messy" appearance of this giant star.

McDONALD MOMENT

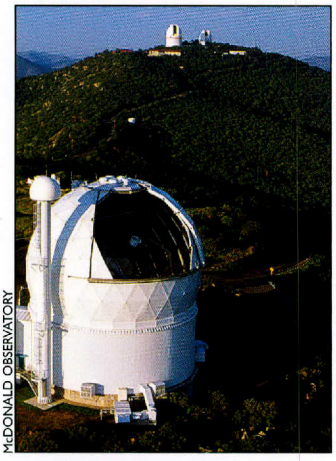
A New Giant

The demise of the New Texas Telescope project in the mid-'80s left McDonald Observatory in need of a big new telescope to help keep the Texas astronomy program competitive. And thanks to the inspiration of two astronomers at Penn State, it got one, in collaboration with several other universities.

Penn State astronomers Daniel Weedman and Larry Ramsey proposed a giant new optical telescope that would operate like the Arecibo radio telescope in Puerto Rico. The giant Arecibo dish is built in a bowl-shaped depression in the hills, and always stares straight up into the sky. But a tracking device suspended above its reflective surface moves back and forth, allowing the telescope to follow astronomical objects as Earth rotates on its axis.

The proposal called for a similar design for a giant optical telescope. Since the telescope itself wouldn't move, it wouldn't need the same type of support structure as conventional designs, greatly reducing its weight and cost. The new concept was named the Spectroscopic Survey Telescope. When it was completed a decade later, it was renamed the Hobby-Eberly Telescope (HET).

Penn State teamed with The University of Texas at Austin to build the telescope atop Mount Fowlkes at McDonald Observatory. Development began in the late 1980s, and the telescope was dedicated in 1997, after three other partners joined the project team.

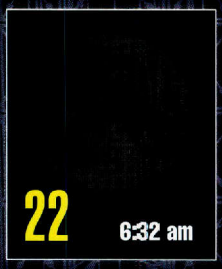


McDONALD OBSERVATORY

The Hobby-Eberly Telescope soon after its dedication

HET's primary mirror consists of 91 individual hexagonal segments that span a total of 11 meters (35 feet). It can rotate 360 degrees, allowing it to see about 80 percent of the sky. The assembly at the top of the telescope moves across the mirror, allowing HET to track individual targets for up to 2.5 hours.

HET operated in its original configuration until the summer of 2013, when it was taken out of commission for a major upgrade. The revisions were designed for a major new scientific project, which will begin in late 2014: the Hobby-Eberly Telescope Dark Energy Experiment.



Moon phase times are for the Central Time Zone.

Daylight Saving Time ends November 2.

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

PERIGEE
November 2, 27

APOGEE
November 14

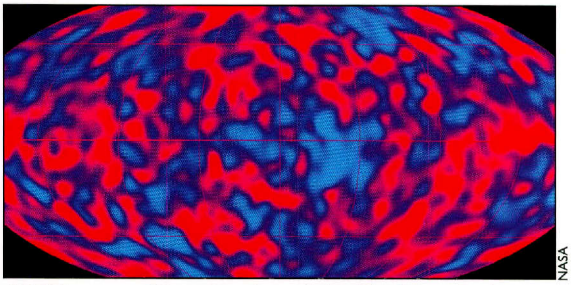
KEY DATES

November 17

A paper by Margaret Geller and John Huchra, published in 1989, revealed the discovery of the largest structure yet seen in the universe, known as the Great Wall. It is a sheet of thousands of galaxies about 400 million light-years from Earth, and extends across hundreds of millions of light-years. Later research found an even bigger wall deeper in space.

November 18

In 1989, NASA launched COBE (Cosmic Background Explorer), a small space telescope that looked at the "afterglow" of the Big Bang. The spacecraft mapped this radiation, which is visible as a microwave glow across the sky. COBE's instruments detected tiny variations in the temperature of this glow. Variations in temperature allowed matter to clump together to form the first stars and galaxies. COBE's lead scientists, George Smoot and John Mather, later earned a Nobel Prize for the craft's work.



NASA

COBE's map of the afterglow of the Big Bang. Red indicates slightly warmer temperatures than blue.

November 20

Edwin Hubble, for whom NASA's large space telescope is named, was born in Missouri in 1889. He confirmed the idea that the Milky Way is just one of billions of galaxies in the universe. By studying many of these galaxies, he discovered that the farther a galaxy is, the faster it is moving away from Earth, demonstrating that the universe is expanding. Hubble also devised a system for classifying galaxies that is still used today.

Edwin Hubble and a postage stamp in his honor.

DECEMBER

OVERVIEW

As fall gives way to winter, some of the most spectacular stars and constellations in the night sky wheel into prime viewing hours. Orion, the hunter, is in view for most of the night as the month begins, and all night by December's end. A rectangle of four bright stars outlines his body, with his three-star belt at the rectangle's center. The belt points toward Sirius, the brightest star in the night sky. Other bright sights include the twins of Gemini, yellow-orange Capella high overhead, and the V-shaped face and orange eye of Taurus.

HIGHLIGHTS

5 Aldebaran, the eye of Taurus, is just below the Moon at nightfall. The two bodies move slightly closer during the evening, with their closest approach around 10 or 11 p.m. CST, when they will be separated by about one degree.

10 Jupiter dazzles to the lower left of the Moon as they climb into good view in late evening.

11 The Moon, Jupiter, and Regulus form a prominent triangle tonight. Jupiter is to the upper left of the Moon as the trio rises in late evening, with Regulus about the same distance to the lower left of the Moon.

17 Spica, the brightest star of Virgo, is close to the upper right of the Moon at first light.

19 The planet Saturn perches below the Moon at first light.

21 Winter arrives in the northern hemisphere at 5:03 p.m. CST, the moment of the winter solstice.

24 Orange Mars stands close to the left of the Moon at nightfall.

DECEMBER

Su	M	T	W	Th	F	Sa
	1	2	3	4	5	6
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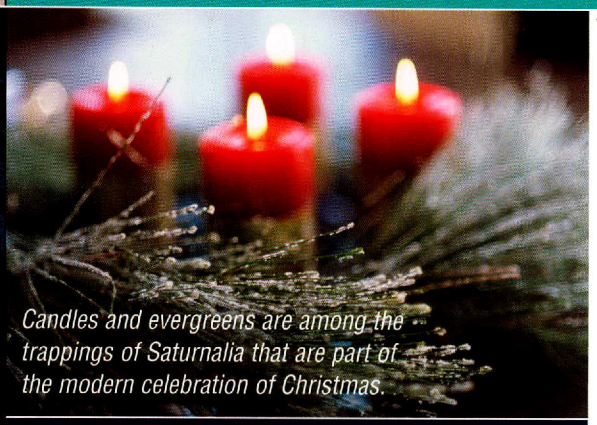


Candles and evergreens are among the trappings of Saturnalia that are part of the modern celebration of Christmas.

FEATURED EVENT

Cheering Up the Darkness

December marks the start of winter in the modern western calendar, beginning on the shortest day of the year, the solstice, on December 21. In many older cultures, though, the solstice marked not the start of winter, but its middle. And with the promise of longer, warmer days ahead, it was often a time to celebrate.

In Scandinavia, for example, December 13 was Saint Lucy's Day, a celebration of the year's longest nights. In Sweden, the girls of the household dressed in white and served pastries, and people sang songs to commemorate the return of light in the coming weeks and months.

And in ancient Rome, the solstice was celebrated with Saturnalia, a festival that honored Saturn, a god of the harvest. Saturnalia began as a single-day affair, celebrated on December 17. It proved so popular, however, that it quickly was expanded to six days.

The extra days were added because Saturnalia was a time of feasting and good cheer. People decorated evergreen trees with sweets and ornaments and performed acts of charity, like forgiving debts and making donations. They also exchanged small gifts, and slaves were given a bit more freedom. Houses were decorated with plenty of candles and lamps, and villages built big bonfires to cheer up the long winter nights.

Many of the customs of Saturnalia are observed today as part of the celebration of Christmas. In fact, there may be a relation between Saturnalia and the date of Christmas.

The early Christian Church was looking for a way to overcome the many solstice celebrations throughout Europe. In essence, it followed the philosophy of, "if you can't beat 'em, join 'em." It picked December 25 as the date to commemorate Christ's birthday, and incorporated some of the trappings of the older festival into the new celebration of Christmas.

McDONALD MOMENT

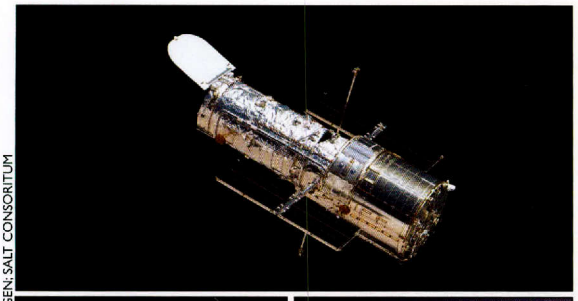
Stellar Collaborations

When William J. McDonald donated his fortune to the University of Texas, most observatories were owned and operated by a single university, and astronomers at one seldom collaborated with those of any other. McDonald Observatory pioneered a new model, with Texas and Chicago teaming up to build and operate the facility.

Today, collaboration is the norm, not the exception. The Hobby-Eberly Telescope is a joint enterprise of Texas and several other institutions in the United States and Germany. So is its premier project for the next few years, the Hobby-Eberly Telescope Dark Energy Experiment, which will use the upgraded telescope to determine the cause of dark energy, a mysterious force that is causing the universe to expand faster as it ages.

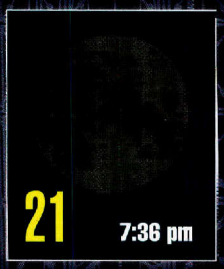
Texas astronomers collaborate on other large projects, including space telescopes like Hubble and Spitzer. Mount Locke and Mount Fowlkes are festooned with small telescopes that are owned by other institutions but that are shared with astronomers from Texas and elsewhere. And Texas astronomers use other telescopes around the world, while astronomers from outside Texas use the McDonald telescopes.

These joint projects greatly extend the reach of McDonald Observatory and its astronomers, increasing the scientific contributions of both. Future giant telescopes, space missions, and other major projects will increase them even more. So an observatory built to fulfill the needs of two major universities will continue to partner with others to build new pathways to the stars.



CLOCKWISE FROM TOP: NASA; FREDERIC HESSMAN/UNIV. GOETTINGEN; SALT CONSORTIUM

Clockwise from above: Hubble Space Telescope; MONET, one of the small 'guest' telescopes at McDonald; Texas astronomers get observing time on the SALT telescope in South Africa



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.

APOGEE
December 12

PERIGEE
December 24

KEY DATES

December 12

Mars is closest to the Sun today, at a distance of about 128 million miles (207 million km). Mars' orbit is much more lopsided than Earth's orbit, so the planet's distance from the Sun varies by about 26 million miles. That has a dramatic effect on the Martian seasons. Mars is closest to the Sun when it is summer in the southern hemisphere and farthest when it's winter. So southern summers are much warmer than those in the northern hemisphere, while southern winters are much colder.

December 17 *CALENDAR EVENT*

Today is Saturnalia, one of several ancient festival days that were tied to the winter solstice. Many of Saturnalia's customs survive in the celebration of Christmas.

December 31

Robert Grant Aitken was born 150 years ago in Jackson, California. As an observer at Lick Observatory, near San Jose, he discovered thousands of binary stars and compiled them into the leading catalog of its day. A large lunar crater is named in his honor. The crater is at the edge of a giant impact structure, one of the largest features on the Moon, known as the South Pole-Aitken Basin.

A portrait of Aitken

RESOURCES

PUBLICATIONS

Observer's Handb ook 2014, edited by Patrick Kelly
A detailed look at upcoming astronomical events plus an extensive reference section.

rasc.ca/handbook

Astronomical Calendar 2014, by Guy Ottewell
An over-sized reference with detailed star charts, meteor shower details, planet viewing, and much more.

universalworkshop.com/AC.htm

Sky Calendar

by Alan MacRobert

In the opening months of the new year, watch the waxing and waning crescents of the Moon and (with optical aid) Venus. Mercury pops up low to the horizon on early February mornings, and a giant Winter Circle of bright stars claims your attention high overhead in the evenings.

JANUARY 1 - 15

Here's a project for Christmas vacation (if you're reading this magazine a little early), and for the first few days of the new year. Shortly after sunset, bring binoculars or a small telescope to a spot with a good view low to the west-southwest, right about where the Sun went down. Look there for Venus. It's getting lower every day. Even good binoculars will show that Venus has become a tiny, brilliant crescent, extremely thin. It will help to brace the binoculars against the side of a tree trunk or something to stabilize the view.

Venus has become a crescent because it's passing close to our line of sight to the Sun. This means that most of its Sun-facing daylit side is aimed away from us; we see only a thin sliver of the dayside around one edge.

On New Year's Day, there's a tougher crescent challenge. With your binoculars or a low-power, wide-field telescope, look about a binocular field-width (7 degrees) to the lower right of Venus (almost exactly above the sunset point) for the extremely young, extremely thin crescent Moon.

It probably will be invisible at the time of early twilight for the eastern half of North America. But from the Pacific time zone, your chances of spying the Moon at twilight are better. Start watching 15 minutes after sundown, and continue for another 25 minutes to catch the brief time of the hairline crescent's best visibility (which will depend on where you are and how clear the air is).

If you see it with optical aid, then try with your unaided eyes. Note the time. The "age" of the crescent you're seeing is the amount of time since the moment of New Moon: 5:14 a.m. CST January 1. You have almost certainly just set your personal young-Moon record, one you might never beat.

On January 2, a thicker, easier hairline Moon hangs to Venus' upper left. The Moon's crescent will continue to thicken in the next few days as the Moon moves farther away from our line of sight to the Sun.

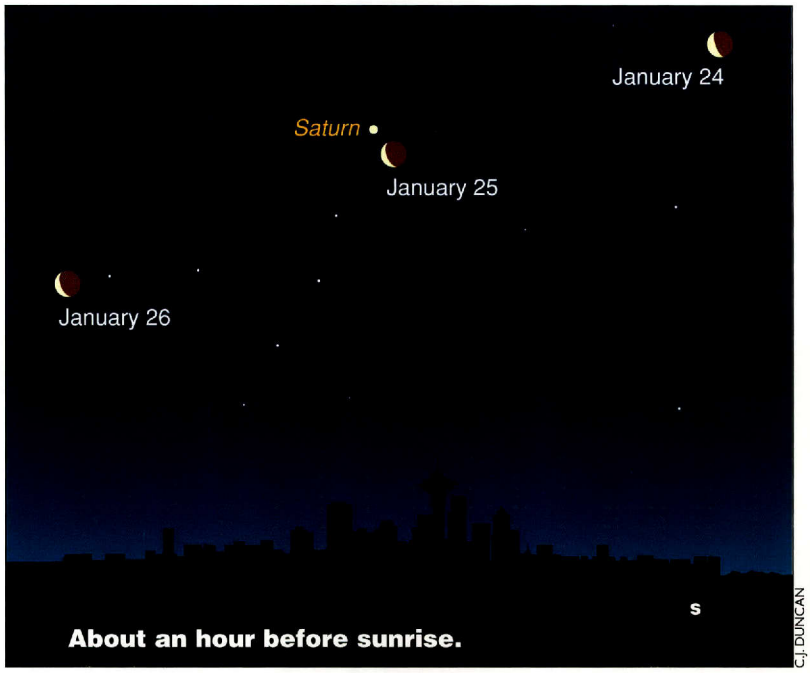
Venus, meanwhile, moves in the other direction — its crescent is sinking lower and getting slimmer each day. It passes by the Sun on January 11. After that, it will slowly re-emerge into view on the other side, low in the east-southeast before sunrise, with the crescent now facing the other way.

Venus is the third-brightest celestial body after the Sun and Moon. Jupiter is the fourth brightest. The king of planets is on the opposite side of the sky from Venus in early January. Look for Jupiter rising low in the east-northeast as twilight fades. As Venus sets, Jupiter climbs.

Jupiter is at opposition on January 5, so it's about at its nearest and brightest for the month. It lies in the middle of the constellation Gemini. Look to Jupiter's left for the not-quite-twin stars of Gemini's heads, Castor and Pollux, one above the other. Castor is on top. Look a similar distance on the other side of Jupiter for Alhena, the brightest star in Gemini's feet.

Moving farther right, you'll hit bright orange Betelgeuse and then the rest of the constellation Orion. As always, when Orion is on the way up, his three-star belt is nearly vertical.

Look high above Orion for Taurus, with Betelgeuse-colored Aldebaran and, above that, the Pleiades.



About an hour before sunrise.

C.J. DUNCAN

JANUARY 16 - 31

Venus is gone from the sunset afterglow, but as January proceeds, watch Venus' former haunt low in the west-southwest for little Mercury coming up and taking its place. Mercury is in fine view as January nears its end. Don't confuse it with Fomalhaut, twinkling well off to its left, low in the southwest in twilight.

A very thin crescent Moon poses to Mercury's lower right after sunset on January 31.

Jupiter, in Gemini, dominates the eastern sky in early evening. Later, it shines very high in the south, beautifully placed for telescopes. Jupiter passes almost overhead in late evening if you live as far south as Miami.

Meanwhile, starry glories of the eastern sky rise higher every week.

Orion now strides high in the southeast to south, driving Taurus ahead of him toward the upper left. Orion's

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 best, with up to 100 meteors per hour at its peak. The peak lasts only a few hours, though, so the viewing window is brief. Although this year's shower is unhampered by moonlight, its peak is expected to come during daylight hours in the United States.

Belt points up roughly toward Aldebaran, the orange giant star that is the eye of the bull. Aldebaran is about two fist-widths at arm's length from the Belt. Another fist or so brings you to the Pleiades cluster, a glistening swarm of stars about the size of your fingertip at arm's length.

Look about two fists-widths below or to the lower left of Orion for the bright lights of Canis Major, Orion's big dog. The head of this pack is brilliant white Sirius. Mirzim, "the Announcer," lies a few finger-widths to Sirius' upper right or right — Sirius' eternal precursor across the sky.

Canis Major's tail and hindquarters, marked by the triangle of Adhara, Wezen, and Aludra, are farther below Sirius. These secondary stars of Canis Major would be better known if Sirius weren't hogging the attention.

FEBRUARY 1 - 15

Every two weeks, the constellations reach their same positions in your local sky about one hour earlier. The same is true of those planets that don't move fast against the starry background. So, for instance, Jupiter shines high about an hour earlier than it did two weeks ago and two hours earlier than a month ago. It rules the winter night.

Mercury is having a fine evening apparition in the first week of February, low in the west-southwest in the fading glow of sunset. Watch as the thin crescent Moon poses above it on February 1, and higher above it as the Moon waxes in the following days.

A new planet is making itself known later at night: Mars rises in the east between 10 p.m. and midnight (depending on the date and where you live in your time zone). Mars is unmistakable, glaring yellow-orange and brightening on the way to its April opposition.

Pale blue-white Spica shines not far to the right of Mars. Look far to their left for Arcturus, a much paler shade of orange-yellow.

By the first light of dawn, Mars shines high in the southwest with Spica below it. Spot Saturn about three fists at arm's length to their left.

February is the crowning month for Sirius, at least for skywatchers who do their winter observing in the evening rather than the chill and lonely hours of the late night. Sirius reaches its highest position due south around 9 or 10 p.m. in early February, and 8 or 9 p.m. in late February.

Orion, to Sirius' upper right, looks oddly smaller now than it did when low in the east a couple of months ago. This is an example of the "Moon illusion," which makes any celestial object appear to loom bigger when near the horizon than when high in the sky.

Procyon, the "little dog star," shines to Sirius' upper left. Procyon and Sirius form an equilateral triangle with orangy Betelgeuse in Orion's shoulder: the Winter Triangle.

FEBRUARY 16 - 28

Late February is when Orion and his whole family of constellations stand highest in early evening, with Jupiter, brightest of all, in their midst.

Some of their brightest stars form the enormous Winter Circle, the sky's biggest well-known asterism. Start with bright Sirius at the bottom in the south. Working clockwise from there, move upper left to Procyon, on to Pollux and Castor left of Jupiter, to Capella almost overhead, around to Aldebaran, down to Rigel in Orion's western foot, and back to Sirius. Betelgeuse is shining within the circle, and this year, Jupiter is, too.

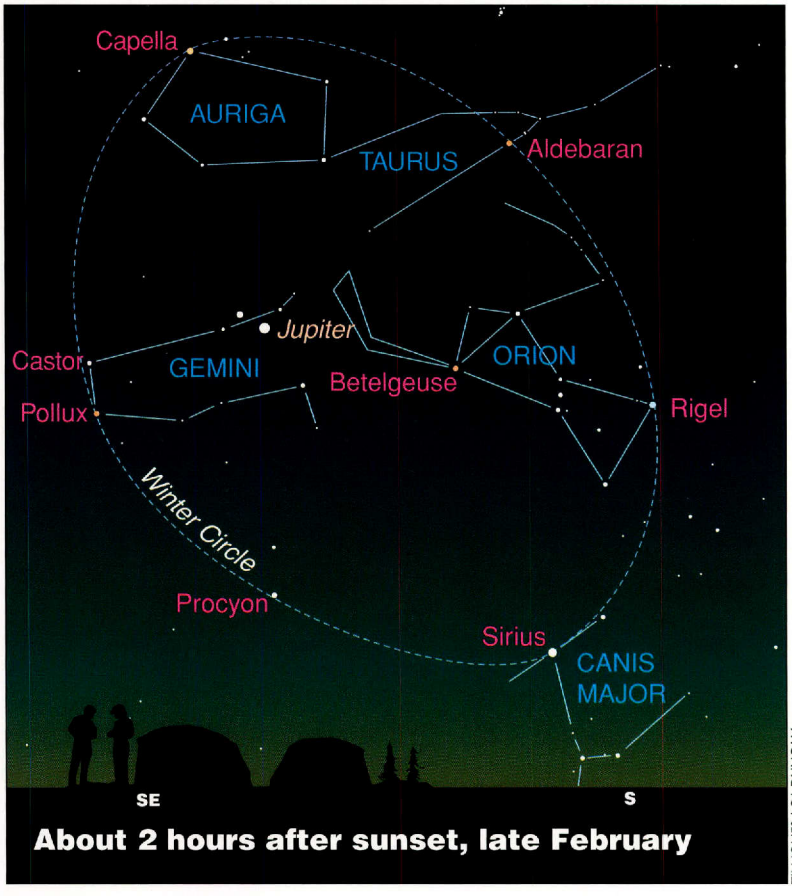
And yet, signs of the coming spring are already in the sky if not yet in the cold winter air.

Look northeast in early evening, not too high. There's the Big Dipper, an eternal sign of spring and summer, already standing on its handle well clear of the horizon.

In the east, Leo, too, is climbing up to announce spring's approach, with his brightest star, Regulus, in his forefoot.

To the right of Regulus and a little below (by about two fist-widths at arm's length) is the slightly fainter orange star Alphard. It's the heart of another big springtime carnivore on the rise: Hydra the sea serpent. About halfway between Procyon and Regulus, look for the dim but pretty little group of stars forming Hydra's head.

Alan MacRobert is a senior editor of Sky & Telescope *magazine.*



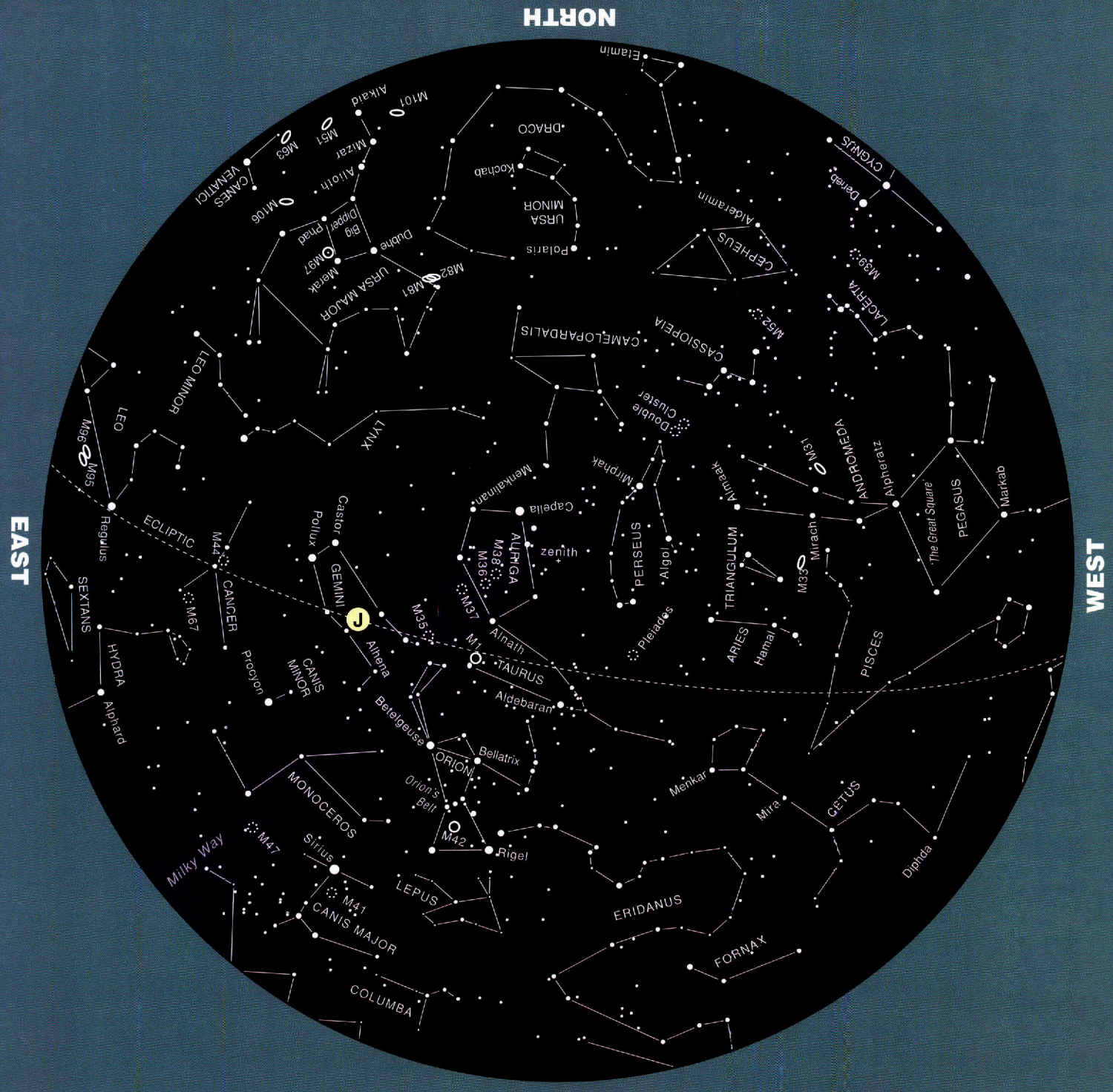
About 2 hours after sunset, late February

TIM JONES / C.J. DUNCAN

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	**11 p.m.**
January 5	**10 p.m.**
January 20	**9 p.m.**



MAGNITUDES

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

- 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	**11 p.m.**
February 5	**10 p.m.**
February 20	**9 p.m.**

MAGNITUDES

- 0 and brighter
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