

StarDate™

JANUARY/FEBRUARY 2015

\$7

BLOWING BUBBLES

SKY ALMANAC 2015

THE UNIVERSITY OF TEXAS AT AUSTIN MCDONALD OBSERVATORY

StarDate

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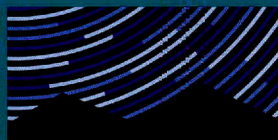
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SKY CALENDAR JANUARY/FEBRUARY 28

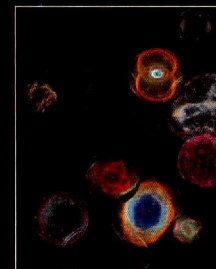
THE STARS IN JANUARY/FEBRUARY 30

This Page

Stars circle across the skies of southern Arizona.

Coming Up in March/April

For more than a decade, astronomers studying Betelgeuse have found that the red supergiant star is shrinking. We'll introduce the scientists and find out what they think is causing the star to change. We'll also delve into history with a look at how World War II affected astronomers and observatories at home and abroad. And, of course, get a jump on your spring skywatching with our tips and charts.



On the Cover

Dying stars create colorful bubbles that dance across the galaxy

BLOWING BUBBLES

SKY ALMANAC 2015

For many stars, the end comes in a blaze of glory. For a brief cosmic moment, the star blows a bubble that shines through the void in vivid Technicolor. For stars like the Sun, the bubble is a relatively gentle creation, like a child blowing a soap bubble on a summer afternoon. For the most massive stars, though, the bubble bursts into view like an exploding Fourth of July rocket. In both cases, the bubble quickly expands and fades from view, leaving nothing but a stellar corpse to mark its passing. Yet these bubbles are an important part of the galactic ecosystem. They seed the interstellar byways with the raw materials for stars, planets, and perhaps even living organisms, and their energy can help trigger the birth of new stars. So the final act of a dying star is one of creation as well as destruction: a beautiful work of cosmic art that helps give life to new orbs that glow through the vastness of space.

Text by Damond Benningfield

OVERVIEW

This is a month for planets. All five of the planets that are easily visible to the unaided eye put in good appearances. Mercury is at its best for the year, not just because it's bright but because it pairs up with Venus, the Evening Star, for several nights. Mars looks down on them. Jupiter is in view for most of the night, while Saturn climbs higher into the morning sky.

HIGHLIGHTS

- Aldebaran, the bright orange eye of Taurus, is close to the lower left of the Moon as night falls.
- The Quadrantid meteor shower is at its peak.
- Earth is at perihelion, its closest approach to the Sun for the year, at a distance of about 91.4 million miles (147 million km), or almost 1.5 million miles (2.4 million km) closer than average.
- The brilliant planet Jupiter stands above the Moon at dawn, with the star Regulus close to the upper left of Jupiter.
- Jupiter stands to the upper right of the Moon at dawn, with Regulus a little farther to the upper left.

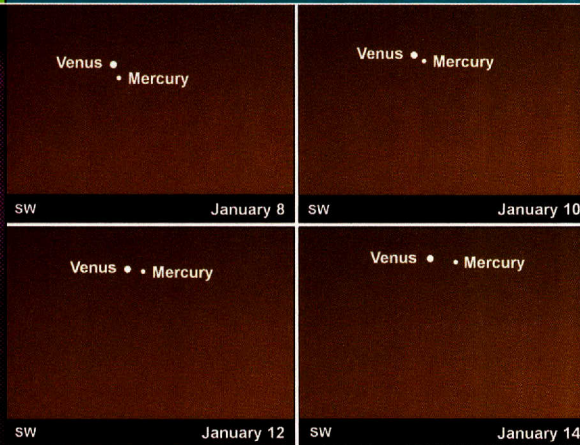
FEATURED EVENT

- 8-15** Venus and Mercury team up in the early evening sky.
- Regulus is to the right of the Moon this morning, with Jupiter farther to the lower right.
 - The Moon squeaks past the star Spica in the pre-dawn sky.
 - Saturn, the solar system's second-largest planet, is dazzlingly close to the right of the Moon at first light.
 - Antares is well to the right of the Moon at first light, with Saturn a little farther to the Moon's upper right.
 - Venus stands close to the left of the crescent Moon as night falls. Fainter Mercury is about the same distance below the Moon.
 - Mars perches close to the left of the Moon this evening, with brilliant Venus not far below them.
 - 28/29** Aldebaran stands to the lower left of the Moon at nightfall on the 28th, and closer to the upper right of the Moon on the 29th.

JANUARY

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

JANUARY



FEATURED EVENT

Peeking Out of the Glare

Mercury is a frustrating little planet. It is one of our closest celestial neighbors, at times passing within about 50 million miles of Earth. Yet because it is the closest planet to the Sun, it seldom moves far enough from the Sun in our sky for good viewing.

This month offers an especially good view of Mercury because the planet climbs well up into the evening twilight. It is in the western sky at sunset and looks like a bright star. And an even brighter beacon helps point the way to Mercury: the Sun's second-closest planet, Venus, which shines as the brilliant Evening Star. The two worlds will stand particularly close together on the evening of January 10, when they will be separated by only about one-half degree — roughly the width of a pencil held at arm's length (see chart).

Because Mercury remains so close to the Sun, it is a difficult world to study. Most research telescopes can't aim close to the Sun because the light would overpower their electronic instruments. And even when Mercury is far enough from the Sun to observe with a telescope, the planet is so low in the sky that the view is distorted because Mercury's light must travel through a thicker layer of Earth's atmosphere.

By far the best view of Mercury has come from spacecraft. In particular, MESSENGER has been orbiting Mercury since 2011. It has mapped Mercury's surface in detail and probed the planet's interior structure. MESSENGER is scheduled to end its mission to this hard-to-study little world this spring.

FEATURED NEBULA

Stellar Artwork

For most of its life, a star like the Sun is drab. Seen from afar, it's simply a steady point of light.

When the star dies, though, it's like a caterpillar emerging from its cocoon as a brilliantly colored butterfly. As the nuclear engine in its core shuts down, the star sheds its outer layers of hot gas, which form a colorful bubble known as a planetary nebula.

The nebula can glow for thousands of years as it expands and cools. The star's rotation and magnetic field, as well as any companion stars, can sculpt the nebula into incredible shapes.

One of the most impressive planetary nebulae is known as the Spirograph because it resembles the geometric shapes produced by an old children's toy. It's probably more than 4,000 light-years away.

The Spirograph probably began taking shape about 50,000 years ago (as seen from Earth), when the star expelled a shell of gas. A second outburst followed about 10,000 years ago. Both of those shells have since faded, so they are difficult to see.

About 2,600 years ago, however, a third outburst produced the nebula that's

seen today. It spans about one-fifth of a light-year, and it's filled with filaments and bubbles of gas

SPIROGRAPH NEBULA

- In the constellation Lepus, the hare, below the feet of brilliant Orion; it circles low across the south on January evenings

that produce its amazing appearance.

The Spirograph should remain visible for thousands of years before it dissipates and vanishes.

THE BASICS

Non-Planetary Planetaries

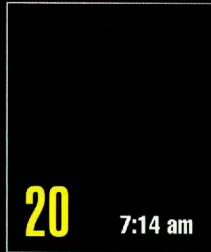
Although it's called a planetary nebula, the final gasp of a dying star is unrelated to planets. Instead, the name was bestowed by early telescopic observers, who thought these objects resembled the disks of planets.



4 10:53 pm



13 3:46 am



20 7:14 am



26 10:48 pm

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.

APOGEE
January 9

PERIGEE
January 21

KEY DATES



Martian spring sometimes stirs up big dust storms, like this one, which is flanked by clouds, in 2007.

NASA/JPL/ISS

January 11

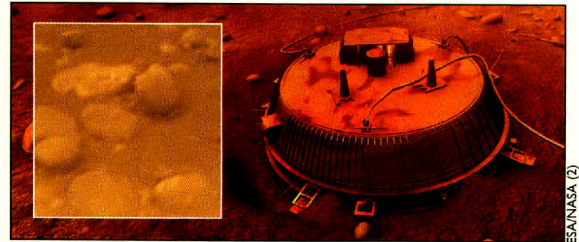
Winter arrives in the northern hemisphere of Mars.

January 12

NASA's New Horizons mission is scheduled to begin scanning Pluto and its entourage of moons. It will fly past Pluto later in the year.

January 14

The Huygens probe landed on Saturn's moon Titan in 2005. It parachuted through Titan's dense, cold atmosphere, photographing river channels below it. It operated for a few hours after touchdown, showing a surface littered with pebbly "rocks" of frozen water, perhaps worn smooth by rivers of liquid ethane and methane.



Artist's concept of Huygens on Titan; Huygens photo of its surroundings (inset)

ESA/NASA (2)

EXPLORATIONS

Ongoing

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

Mission	Target	Arrival
Lunar Reconnaissance Orbiter	Moon	2009
Mars Odyssey	Mars	2001
Mars Express	Mars	2003
Mars Reconnaissance Orbiter	Mars	2006
Curiosity Rover	Mars	2012
MAVEN	Mars	2014
Mars Observer Mission	Mars	2014
Cassini	Saturn	2004

OVERVIEW

The brilliant stars of winter reign on February nights, offering some beautiful skies. Orion is in the south at nightfall, with Sirius, the night sky's brightest star, twinkling fiercely to its lower left. By late in the month, the stars of spring slide into better view. Leo clears the horizon by mid-evening, with Virgo behind him. The planet Venus is climbing higher into the evening sky, while slightly fainter Jupiter rules the sky for the rest of the night.

HIGHLIGHTS

- 3** Brilliant Jupiter is close to the left of the Moon this evening.
- 4** Regulus, the heart of Leo, crouches quite close to the left of the Moon at nightfall. Brighter Jupiter stands above them.
- 6** Jupiter, the giant of the solar system, is at its best for the year. It rises at sunset, remains in view all night, and shines at its brightest. After the Moon and Venus, it's the brightest object in the night sky.
- 8** Spica, the leading light of Virgo, stands below the Moon as they climb into good view late tonight.
- 12** Golden Saturn is to the lower left of the Moon at first light. Antares, the heart of the scorpion, stands below Saturn.
- 13** Saturn is close to the right of the Moon at first light, with Antares below them, completing a tight triangle.
- 19** Venus, which shines as the brilliant Evening Star, and the planet Mars look down on the crescent Moon as darkness falls.

FEATURED EVENT

- 20** The Moon, Venus, and Mars form an especially tight grouping in early evening.
- 21** Venus and Mars are separated by a fraction of a degree, well below the crescent Moon. A third planet, Uranus, is quite close below the Moon. Through binoculars, it looks like a tiny blue-green star.
- 25** Aldebaran, the eye of Taurus, is quite close to the lower right of the Moon as night falls.
- 28** Alhena, a second-magnitude star in Gemini, perches about one degree (less than the width of a finger held at arm's length) to the left of the Moon before they set in the wee hours of the morning.

FEBRUARY

Su	M	T	W	Th	F	Sa
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FEBRUARY



February 20, about 45 minutes after sunset WEST

TIM JONES

FEATURED EVENT

Evening Traffic Jam

One of the most impressive skywatching events of the year takes place shortly after sunset on February 20, when the Moon bunches up with Venus and Mars. Venus is by far the brighter of the two planets, shining as the dazzling Evening Star. Mars is only about one percent as bright as Venus, but its closeness to Venus and the Moon will help it stand out.

Venus shines so much brighter than its sibling for several reasons. Venus is a much larger target, for example, with a diameter nearly twice that of Mars. Mars is roughly half-again as far as Venus this month, further dulling its luster. And Venus is completely blanketed by clouds that reflect more than half of the sunlight that strikes them, compared to the relatively dark rock and dust on the surface of Mars. And finally, Venus is only about half as far from the Sun, so it receives about four times as much sunlight per square foot as Mars does.

Both planets line up almost behind the Sun as seen from Earth, but they are moving in opposite directions. Venus is moving away from the Sun, so it will move higher into the sky each evening. Mars, on the other hand, is dropping toward the Sun. It will disappear from view in the Sun's glare in a couple of months, while Venus will reign well into summer.

THE BASICS

Far and Farther

All of the lights that dot the night sky are a great distance away, but there's a huge difference between planets and stars. The visible planets range from 25 million to almost 1 billion miles from Earth. It takes light a few minutes to a few hours to cross those distances. The visible stars are all thousands to millions of times farther than even the most distant planet, so their light takes years, centuries, or millennia to reach us.

FEATURED NEBULA

Knotted Hoodie

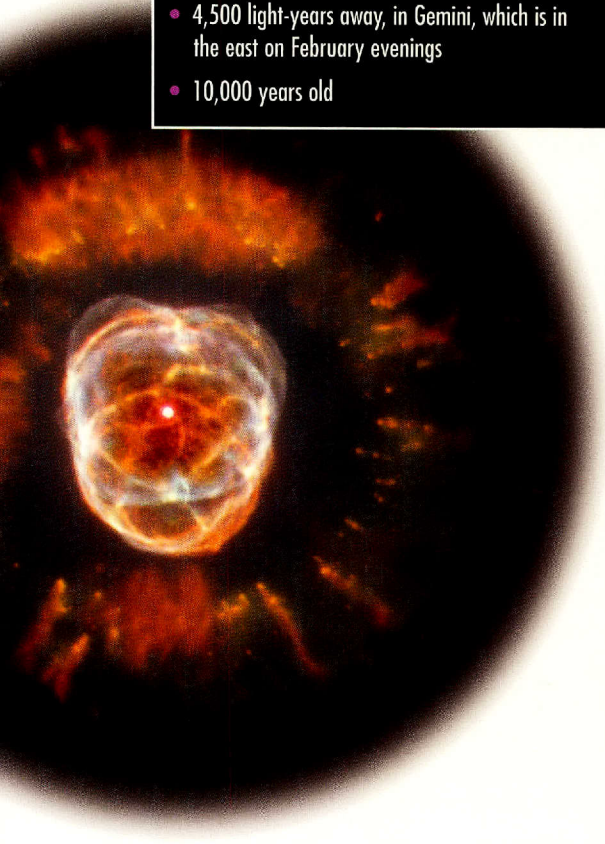
Seen through a telescope, NGC 2392 looks like a face surrounded by the furry hood of a parka, so it was named the Eskimo Nebula. A detailed look from Hubble Space Telescope, however, reveals that the hood is not so much fuzzy as knotty. Streaks of material radiate away from the center of the nebula like skinny fingers, with smaller blobs around them.

Astronomers are still trying to understand these structures, which are described as cometary knots. They're seen in many planetary nebulae, suggesting that they're a normal part of a star's final phase of life.

The leading idea says the dying star at the center of the Eskimo's face (which looks more like the eye of a robotic cyclops in the Hubble image) originally shed much of its material from its equator, forming a disk of gas around the star's waist. Later, the star began expelling gas from across its entire surface as a high-speed "wind." As the wind hit the earlier material, it began sculpting it into knots that are several times the size of our entire solar system. Material streaming around the dense knots forms the glowing fingers.

ESKIMO NEBULA

- 4,500 light-years away, in Gemini, which is in the east on February evenings
- 10,000 years old



3 5:09 pm



11 9:50 pm



18 5:47 pm



25 11:14 am

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 6

PERIGEE
February 19

KEY DATES

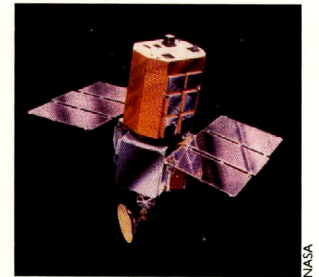
February 2

CALENDAR EVENT

Legend says that if a groundhog sees its shadow when it pokes its head out of its burrow on February 2, winter will last another six weeks; if not, expect an early spring. In ancient Britain, February 2 was known not as Groundhog Day, but as Candlemas, and it represented the end of winter and the beginning of spring. It was one of the year's four cross-quarter days, which occur about halfway between a solstice and an equinox. These dates marked the changing of the seasons, and people celebrated them with feasts and religious ceremonies.

February 14

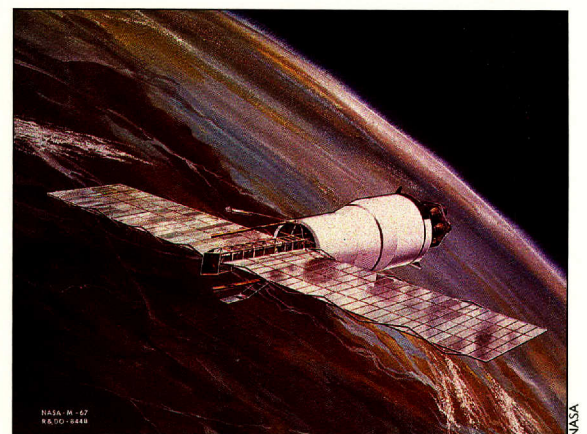
NASA launched the Solar Maximum Mission in 1980 to study the Sun during the peak of its roughly 11-year magnetic cycle. The spacecraft died less than a year after launch, but was restored by a space shuttle crew in 1984.



Artist's concept of Solar Max

February 16

Before it could send astronauts to the Moon, NASA needed to understand the risk from the tiny bits of space rock known as micrometeoroids. It launched a series of spacecraft to assess that risk, beginning with Pegasus 1 in 1965. It deployed two large "wings" laced with sensors to study the number of hits and the size and speed of the impactors. The missions demonstrated that the risk of a major collision was small, helping clear the way for Apollo.



Artist's concept of Pegasus; its 'wings' spanned 96 feet

OVERVIEW

The warmer nights of spring bring a panoply of new stars and constellations. Leo is in good view by nightfall, climbing straight up from the eastern horizon, led by his bright “heart,” Regulus. Virgo follows a couple of hours later; the maiden’s brightest star, Spica, looks like a near twin to Regulus. The planet Venus continues its climb into the western sky as the Evening Star, while Mars, which is near Venus as the month begins, drops ever lower into the twilight.

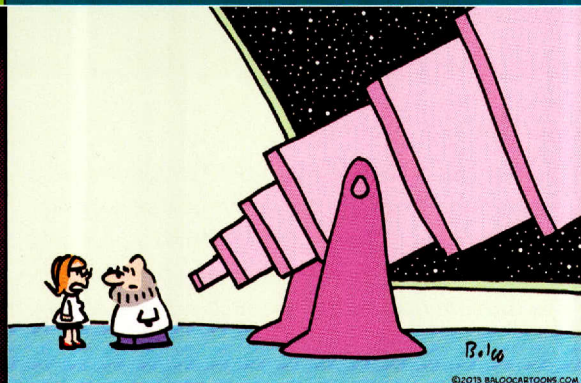
HIGHLIGHTS

- 2** Dazzling Jupiter is close to the left of the Moon at nightfall.
 - 3** Regulus stands to the lower left of the Moon at nightfall. The Moon creeps slightly closer to the star during the night.
- FEATURED EVENT**
- 8** Daylight Saving Time begins in the United States at 2 a.m.
 - 8** Spica is quite close to the right or upper right of the Moon as they rise in late evening.
 - 12** The planet Saturn looks like a golden star close to the lower right of the Moon at first light, with the orange star Antares below them.
 - 13** Saturn and Antares are about the same distance to the right and lower right of the Moon, respectively, at dawn.
 - 20** A solar eclipse will be visible across parts of Europa, Asia, and Africa, but not the Americas.
 - 20** Spring arrives in the northern hemisphere with the vernal equinox at 5:45 p.m. CDT.
 - 22** The crescent Moon and Venus, the Evening Star, pose low in the west at nightfall. Much fainter Mars is well to their lower right.
 - 24** Aldebaran, the eye of Taurus, twinkles close to the upper left of the Moon at nightfall.
 - 29** Jupiter is close to the left or upper left of the Moon as night falls.
 - 30** Regulus is close to the left of the Moon this evening, with Jupiter farther above the Moon.
 - 31** Regulus stands just above the Moon as night falls this evening.

MARCH

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

MARCH



“You’re two hours late *again*? How many times do I have to tell you?
— It’s ‘spring forward, fall back’!”

FEATURED EVENT

Burning Daylight

The second Sunday in March is the time for most of the United States to begin “saving” daylight, as Daylight Saving Time starts at 2 a.m. Most Americans will “spring ahead” by one hour, losing an hour of sleep that they won’t regain until November.

The name is misleading, though, because no one actually saves any daylight at all. Earth’s rotation is unaffected by the change in timekeeping, so the Sun rises and sets at the same pace no matter what the clock says.

The purpose of Daylight Saving Time is to save energy, not time. The rationale is that most people are likely to use more energy in the evening, especially during the summer, when it’s hotter and they’re more likely to turn on the air conditioner. Shifting the clock means that people go to bed sooner after sunset, so they spend less time burning the lights and watching television, reducing overall energy use.

The idea of saving energy by “springing forward” first caught on in Europe, during World War I. The United States adopted the idea in 1918. It lasted only a year, but was reinstated during World War II. After the war, individual states were free to use Daylight Saving Time or not, for any part of the year they chose. The dates were standardized in 1966, and in 2007 were extended to encompass most of the year. Every state uses Daylight Saving Time except Hawaii and most of Arizona, which remain on Standard Time all year.

The question is whether Daylight Saving Time actually saves energy. Researchers have conducted several studies over the years, with some showing small energy savings, but others showing a net increase in energy consumption. Either way, DST continues until the first Sunday of November.

FEATURED NEBULA

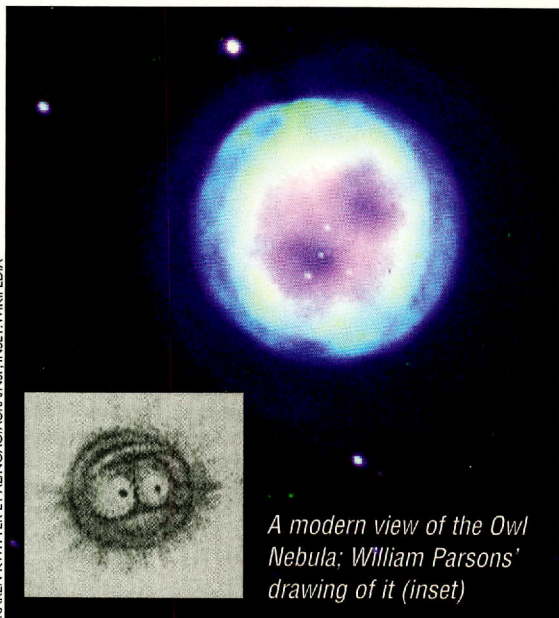
Eyeing a Distant Owl

In the 1840s, William Parsons, the Earl of Rosse, designed and built the world's largest telescope, a 72-inch reflector nicknamed the Leviathan of Parsonstown. It provided exceptionally sharp views of the heavens, so it was well suited for studying faint, fuzzy nebulae.

Parsons turned his giant telescope toward M97, an object near the bottom of the Big Dipper's bowl that had been cataloged by Charles Messier, a French comet hunter. His drawing of the object resembled an owl, showing a disk with two round voids, each with a bright pinpoint at its center. The object became known as the Owl Nebula, a moniker it retains today.

The nebula's central star blew the first shell into space about 8,000 years ago, with the second following a few thousand years later. Even later, the star expelled a third wave of gas, which consisted of two separate bubbles that expanded outward from its poles, carving voids in the earlier shells. From Earth's point of view, those empty regions look darker, giving the owl a pair of eyes.

Those bubbles have stopped expanding, so gas in the older shells is beginning to collapse and fill the voids. The voids eventually may collapse, depriving the owl of its distinctive eyes.



A modern view of the Owl Nebula; William Parsons' drawing of it (inset)

OWL NEBULA

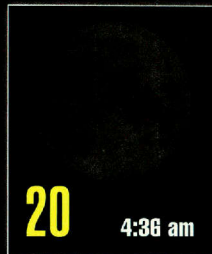
- In Ursa Major, the great bear, which is in the northeast on March evenings. The nebula is just below the line that forms the bottom of the Big Dipper's bowl.
- 2,500 light-years away



5 12:05 pm



13 12:48 pm



20 4:36 am



27 2:43 am

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.

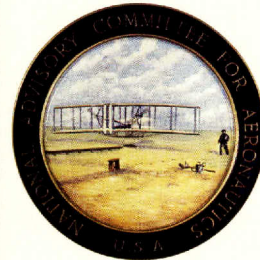
APOGEE
March 5

PERIGEE
March 19

KEY DATES

March

MESSENGER will conclude four years of orbiting Mercury this month. The date will be dictated by spacecraft fuel supplies and other factors.



March 3

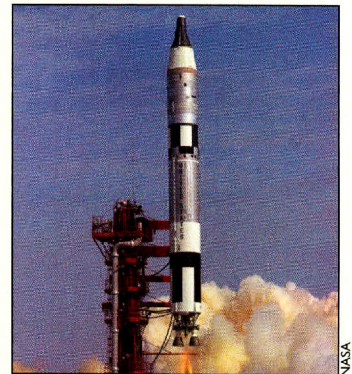
The National Advisory Committee on Aeronautics, the predecessor to NASA, was founded in 1915.

March 18

Soviet cosmonaut Alexei Leonov became the first person to walk in space when he stepped outside his Voskhod 2 capsule in 1965. Returning to the spacecraft wasn't easy, though; Leonov had to release some air from his suit before he could squeeze through the hatch.

March 23

Astronauts Gus Grissom and John Young flew the first mission of NASA's new Gemini spacecraft. Gemini 3 circled Earth three times, setting the stage for missions that would develop the techniques needed to send astronauts to the Moon.



Gemini 3 heads for space.

SKY WATCH

This Year's Meteor Showers

Shower	Peak	Moon
Quadrantids	Night of January 3	In view most of the night
Lyrids	Nights of April 21/22	Sets after midnight
Eta Aquarids	Night of May 5	Full Moon
Perseids	Night of August 12	Rises at dawn
Orionids	Night of October 21	Sets after midnight
Leonids	Night of November 17	Sets in late evening
Geminids	Night of December 13	Sets in early evening

Actual times may vary. The best view is usually after midnight. The glare of a bright Moon makes it harder to see the meteors.

OVERVIEW

April kicks off with the first of two total lunar eclipses that are visible from North America this year, then continues with some especially close encounters between the Moon and several stars and planets. The rest of the month's rapidly warming nights offer a panoply of bright stars, from Aldebaran, which is vanishing in the western evening sky, to Regulus and Spica, which are climbing higher into the eastern evening sky.

HIGHLIGHTS

FEATURED EVENT

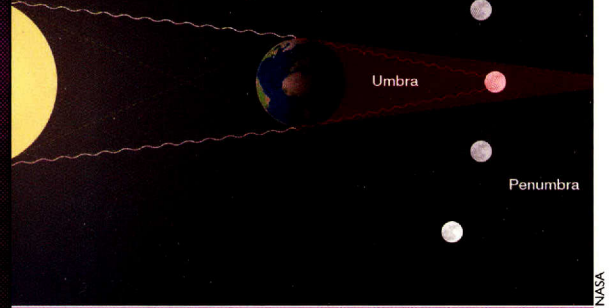
- 4** A total lunar eclipse will be visible before dawn.
- 4** Spica, the leading light of Virgo, perches close to the lower right of the Moon as they climb skyward not long after nightfall.
- 8** Saturn, the solar system's second-largest planet, glows like a golden star close to the lower left of the Moon at first light. The orange star Antares is a good bit farther along the same line.
- 9** Saturn stands to the right of the Moon at first light, with Antares about the same distance to the lower right of the Moon.
- 15** Aldebaran, in Taurus, stands to the left of Venus, the Evening Star, at nightfall.
- 20** Venus lofts high above the Moon at sunset, with Aldebaran closer to the upper left of the Moon.
- 21** Aldebaran poses closer to the Moon tonight, with Venus farther away from them.
- 21** The Lyrid meteor shower will be at its best tonight.
- 25/26** The brilliant planet Jupiter stands to the upper left of the Moon at nightfall on the 25th, and to the upper right of the Moon on the 26th.
- 27** Leo's bright heart, the star Regulus, lurks close above the Moon at nightfall.

APRIL

Su	M	T	W	Th	F	Sa
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12	13	14	15	16	17	18
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26	27	28	29	30		

APRIL

Illustration shows the Moon moving through Earth's shadow; sunlight passing through the atmosphere can color the lunar surface orange or red



FEATURED EVENT

Eclipses Across the Ages

In May 1492, as Christopher Columbus was preparing to cross the Atlantic Ocean, a barely-there lunar eclipse took place above Europe. The Moon just grazed Earth's faint outer shadow, beginning a new eclipse series that would last for centuries.

The 30th eclipse in that series — a total eclipse — takes place in the early morning hours of April 4, with all or part of it visible across the United States. It begins when the Moon first touches the inner shadow, known as the penumbra, at 4:01 a.m. CDT. The Moon first touches the dark inner portion of the shadow, the umbra, at 5:16 a.m., and is completely immersed in the shadow by 6:58 a.m., beginning the total eclipse. The Moon is at the edge of the shadow, however, so the total eclipse will last just 4 minutes, 43 seconds. The Moon will set before or during totality across the eastern half of the U.S., but the western half of the country will see all of the total eclipse.

An eclipse series is known as a Saros. The circumstances for each eclipse in the group are similar. The Moon is about the same distance from Earth, for example, and the eclipses occur at the same time of year.

Each Saros begins with a bare penumbral eclipse, like the one in 1492. With each succeeding eclipse, though, the Moon dips deeper into Earth's shadow. By the middle of the cycle, the eclipses are total, with the Moon immersed in the shadow. After that, the Moon moves away from the center of the shadow, and the cycle ends with another grazing penumbral eclipse, but with the Moon at the opposite side of the shadow from where the Saros began.

The April 4 eclipse is part of Saros 132. It will consist of 71 eclipses in all, with each eclipse in the cycle coming a little more than 18 years after the previous one. Saros 132 will last 1,262 years, with its final eclipse on June 26, 2754.

FEATURED NEBULA

Ghost Hunting

William Herschel got a late start in astronomy. His early calling was music, and he was an accomplished performer, composer, conductor, and teacher. At age 35, though, he bought an astronomy book and quickly turned his attention to the night sky. He discovered the planet Uranus in 1781, then became fascinated by the wispy objects known as nebulae. Over the following two decades, Herschel (with the aid of his sister Caroline) discovered more than 2,500 of these deep-sky objects, including three dozen planetary nebulae.

One of those is NGC 3242, also known as the Ghost of Jupiter because it is about the same angular size as the planet. Herschel discovered the nebula from his home observatory on February 7, 1785, using a large telescope he designed and built himself.

The nebula spans roughly two light-years, suggesting that it began forming many centuries ago, when its star's outer layers began sloughing off into space. It consists of two separate shells of gas and dust.

Observations by both ground- and space-based telescopes also show that a vast cloud of material surrounds the Ghost of Jupiter. This gas and dust may have been expelled by the star long before the nebula was formed, or it may be an interstellar cloud that happens to line up near the nebula, enhancing the beauty of one of William Herschel's discoveries.



Vast clouds of gas and dust surround the Ghost of Jupiter, the bright object at upper right

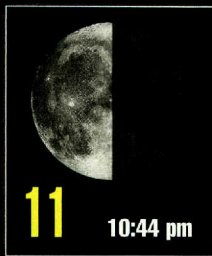
GHOST OF JUPITER

- Roughly 1,800 light-years away in the constellation Hydra, which climbs across the southern sky on April evenings



4

7:06 am



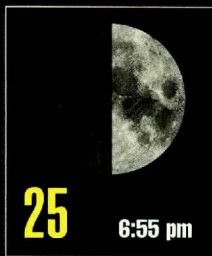
11

10:44 pm



18

1:57 pm



25

6:55 pm

Moon phase times are for the Central Time Zone.

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

APOGEE
April 1, 28

PERIGEE
April 16

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

Perhaps the most celebrated spacecraft in history, Hubble Space Telescope, was launched in 1990 aboard space shuttle Discovery. Early problems with its mirror left it with blurry vision, which astronauts would later correct. Thanks to several upgrades and repairs, the space observatory remains at the forefront of astronomical study a quarter-century after its launch.



Discovery sends Hubble on its way.

April 25

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

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

THE BASICS

Rising Tides

The Moon's orbit around Earth is slightly lopsided, so the Earth-Moon distance, which averages about 238,000 miles (384,000 km), varies by almost 30,000 miles. The Moon's closest point is known as **perigee**, with the farthest point known as **apogee**. The Moon's gravitational pull is strongest at perigee, so ocean tides are highest then. They are especially high when perigee coincides with full or new Moon, because the gravity of Moon and Sun pull along the same line.

OVERVIEW

May's evening skies are soft and subdued. Leo leaps high across the sky, with the twins of Gemini sinking in the west, along with the nearby brilliant star Capella. Equally brilliant Arcturus climbs high overhead. The planets make up for some of the faintness of the stars, though. Venus, the Evening Star, is well up in the west, climbing toward Gemini's twins. The next-brightest dot in the night sky, the planet Jupiter, is higher in the sky. And though it's not as brilliant as its sibling worlds, giant Saturn puts in its best showing of the year, sparkling all night.

HIGHLIGHTS

1/2 Spica, the leading light of Virgo, stands close below the Moon at nightfall on the 1st, and to the upper right of the Moon on the 2nd.

4 The golden planet Saturn stands close to the lower left of the Moon as they climb into good view in late evening.

5 The Moon, Saturn, and Antares form a beautiful triangle tonight. As they climb into view in late evening, Saturn stands to the upper right of the Moon, with fainter Antares, the heart of Scorpius, a bit farther to the lower right of the Moon.

6 Mercury stands farthest from the Sun for its current evening appearance. It is in the west-northwest as night begins to fall. It looks like a bright star, but it's so low in the sky that you need a clear horizon to spot it.

20/21 Venus, the Evening Star, poses high above the Moon at nightfall on the 20th, and to the right or upper right of the Moon on the 21st.

FEATURED EVENT

22 The planet Saturn is at opposition.

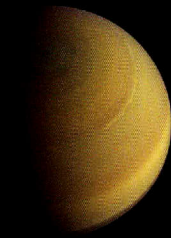
29 Spica is close to the right of the Moon at nightfall.

31 Saturn is to the lower left of the Moon as they climb into good view in early evening, with Antares, the orange heart of the scorpion, below Saturn.

MAY

Su	M	T	W	Th	F	Sa
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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 2013 view of Saturn from the Cassini spacecraft



NASA/JPL/CORNELL

MAY

FEATURED EVENT

Giant Planet, Giant Appearance

Saturn, the second-largest planet in the solar system, puts in a first-rate performance in May. The planet, which is second only to Jupiter, lines up opposite the Sun, so it rises around sunset, scoots low across the south during the night, and sets around sunrise. Saturn is brightest for the year as well, shining like a golden star along the border between Libra and Scorpius.

Saturn features some amazing artistic and scientific treasures.

Most of the planet itself looks like a bland beachball, with stripes of pale yellow, tan, and white. The stripes are created by the planet's high-speed rotation, which stretches clouds at the top of its atmosphere into globe-circling bands. Each of Saturn's polar regions is wrapped in a hexagonal cloud formation that scientists are still trying to understand.

Much of Saturn's great beauty comes from its rings, which span almost the distance between Earth and the Moon. They're made of small particles of ice and rock, and may consist of debris from a pulverized moon.

Saturn also has an impressive entourage of moons. Geysers of water and ice shoot into space from the south pole of one of the larger ones, Enceladus, placing it on the list of possible homes for microscopic life.

The largest moon, Titan, is enveloped in a thick, cold atmosphere that may resemble that of the early Earth. Liquid hydrocarbons form clouds that drop rain or drizzle on the surface, carving rivers and filling lakes, some of which are as big as Earth's Great Lakes. A large reservoir of liquid water may lurk below the surface, providing another possible abode for life.

FEATURED NEBULA

Having a Blast!

For most of its life, a massive star fights a battle it cannot win. Gravity pulls it inward, while radiation from the nuclear fusion reactions in its core push outward. Eventually, though, the star's nuclear reactor can no longer keep up. It stops producing energy, so gravity wins: The core collapses to form a neutron star or a black hole.

The star's outer layers fall toward the crushed core, then rebound, blasting into space in a titanic explosion known as a supernova. For a few days or weeks, the blast can outshine billions of normal stars. As it expands and cools, it forms a colorful shell known as a supernova remnant.

One of the largest is the Cygnus Loop, which is near one of the wings of Cygnus, the swan. It forms a giant bubble that's about six times the diameter of the full Moon. A couple of segments glow brightly enough to see through small telescopes, although much of it is visible only with the help of more-sensitive instruments.

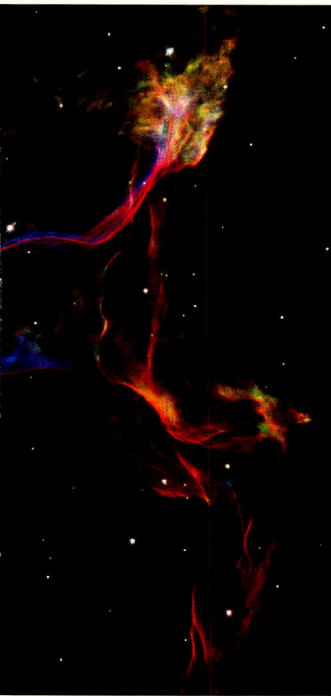
The Cygnus Loop (part of which is also known as the Veil Nebula) is roughly 1,750 light-years away. It was born about 5,000-10,000 years ago (as seen from Earth) with the explosion of a star at least a dozen times as massive as the Sun.

The outer layers of the exploded star raced into space at a few percent of the speed of light, crashing into surrounding filaments of gas and dust and heating them to millions of degrees.

The Cygnus Loop continues to expand today, clearing out a bubble in space that's several light-years wide. It should continue to glow for a few thousand years more before fading from sight.

CYGNUS LOOP

- In Cygnus, which climbs into view in late evening by the end of May



A section of the Cygnus Loop shows a shock wave plowing into surrounding gas and dust.



3 10:42 pm



11 5:36 am



17 11:13 pm



25 12:19 pm

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.

PERIGEE
May 14

APOGEE
May 26

KEY DATES

May 1

CALENDAR EVENT

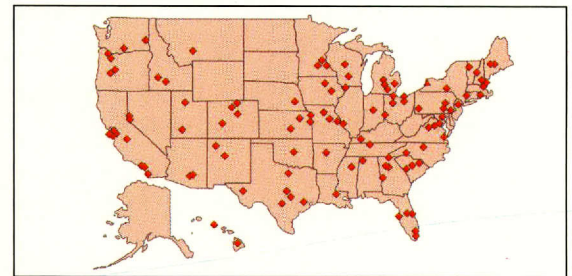
Today is Beltane, an ancient Celtic festival that was celebrated with bonfires. The date is a cross-quarter day, which falls roughly half-way between a solstice and an equinox. In many cultures, these dates marked the beginning of the seasons, so in the Celtic calendar, May 1 was the first day of summer. Some of the traditions are preserved today as May Day.

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/2015

NASA Eclipse Web Site

Charts, tables, and much more on lunar and solar eclipses for 2015 and beyond eclipse.gsfc.nasa.gov

Hubble Planetary Nebula Gallery

<http://hubblesite.org/gallery/album/nebula/planetary>

PUBLICATIONS

Observer's Handbook 2015, edited by David Chapman rasc.ca/handbook

Astronomical Calendar 2015, by Guy Ottewill universalworkshop.com/AC.htm

OVERVIEW

As spring gives way to summer, the signature star patterns of the new season climb into view during the short nights. The teapot of Sagittarius rises in late evening, with the curving form of Scorpius following it into view in the south a little later. They never climb far above the horizon, although their distinctive shapes make them easy to find. Venus and Jupiter, the night sky's brightest objects after the Moon, draw closer as June progresses, and stand breathtakingly close together by month's end.

HIGHLIGHTS

- 1 The planet Saturn is close to the upper right of the Moon at nightfall, with the orange star Antares below the Moon.
- 2 Antares, the heart of Scorpius, stands to the right of the Moon at nightfall, with Saturn farther to the upper right of the Moon.
- 2 The twins of Gemini line up directly to the right of Venus, the Evening Star. Pollux is closer to Venus, with fainter Castor about the same distance to the right of Pollux.

FEATURED EVENT

- 19-21** The Moon, Venus, and Jupiter stage a beautiful encounter, with the star Regulus close by.
- 25** Spica, in the constellation Virgo, is close below the Moon at nightfall.
- 28** Saturn is quite close to the lower right of the Moon at sunset.
- 29** Antares is to the lower right of the Moon, with Saturn farther to the upper right of the Moon.
- 30** Venus and Jupiter stand almost atop each other in the early evening sky. Jupiter is just above brighter Venus.

JUNE

Su	M	T	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
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28	29	30				

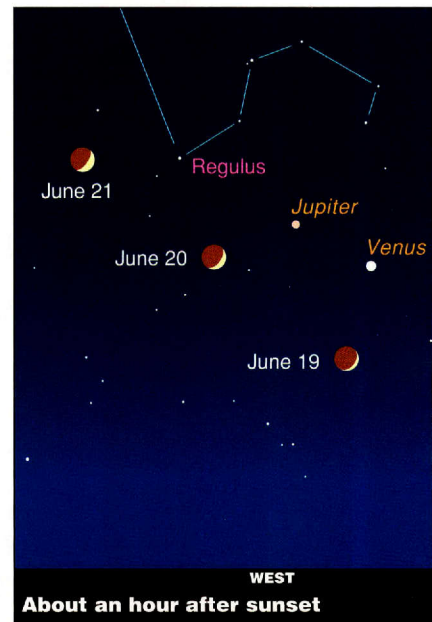
FEATURED EVENT

Triple Treat

The three brightest objects in the night sky stage a bit of a celestial traffic jam June 19 and 20, with one other prominent light joining them on the 21st.

The crescent Moon is the brightest member of the trio. The others are the planet Venus, which shines as the brilliant Evening Star, and the planet Jupiter, which is a little higher in the sky. Regulus, the brightest star of Leo, is to the upper left of Venus and Jupiter, but the Moon will squeak close by the star on the 21st.

Venus is putting in its best evening appearance of the year. It stands farthest from the Sun on June 6, and will be at its brightest in early July. Its brightness varies as the planet moves in its orbit around the Sun, which changes its distance from Earth. It is moving closer to Earth this month, which makes it a bigger target in the sky.



Venus' brightness is complicated by its phase. Because the planet orbits inside Earth's orbit, Venus shows phases, just as the Moon does. When the planet is closest to Earth, it is a thin crescent. But its proximity to Earth makes up for the fact that most of the hemisphere that faces our way is in darkness.

Jupiter, on the other hand, is far outside Earth's orbit, so it is always "full" (or almost so) as seen from Earth. Any change in brightness, then, is a result of its changing distance from Earth. Jupiter was brightest in mid-winter, when it was opposite the Sun in our sky and therefore closest to Earth. Now, it is getting ready to pass behind the Sun as seen from Earth, so it is moving farther away.

The gap between Venus and Jupiter will narrow after the Moon passes them by. They will stand almost atop each other on the 30th, with Jupiter slightly higher in the sky. They'll stand side by side on July 1, with Venus moving up and away from its sibling world after that.

JUNE

FEATURED NEBULA

Lining Up a Cat's Eye

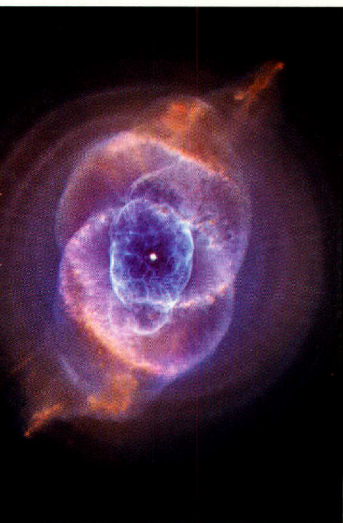
From his private observatory in South London, William Huggins was examining one of the most intriguing objects in the night sky — an elongated blob that resembles a cat's eye. Huggins was using a new instrument, called a spectroscope. When aimed at a star, it produces a rainbow of colors with some dark, narrow gaps, which are the “fingerprints” of elements in the star's outer layers.

On August 29, 1864, Huggins became the first astronomer to turn this new tool toward a planetary nebula. At the time, some thought these round, hazy objects were distant clouds of stars.

When Huggins looked at the cat's eye, though, he saw no rainbow at all. “At first I suspected some derangement of the instrument had taken place,” he reported in a scientific paper, “for no spectrum was seen.” Instead, his instrument displayed only one thin blue line and two even thinner green ones against a black background.

Huggins soon realized that the cat's eye wasn't a star or group of stars, but a thin cloud of glowing gas known as a nebula. The blue line in his spectrum was produced by hydrogen atoms, but Huggins had no idea what produced the green ones, so he called this mysterious new element “nebulium.”

Today, astronomers understand that the Cat's Eye Nebula (NGC 6543) is the last gasp of a dying star. The star's outer layers are streaming into space at thousands of miles per hour, forming colorful bubbles. This process began a millennium ago as seen from Earth and continues today. The expelled material consists mostly of hydrogen and helium, with a smattering of other elements, including the one that produced the green lines in Huggins' spectrum: a rare form of oxygen.



CAT'S EYE NEBULA

- About 3,000 light-years away in Draco, the dragon, which wheels high above the North Star on June evenings

Hubble view of the Cat's Eye reveals bubbles and shells of gas and dust around the central star.



2 11:19 am



9 10:42 am



16 9:05 am



24 6:03 am

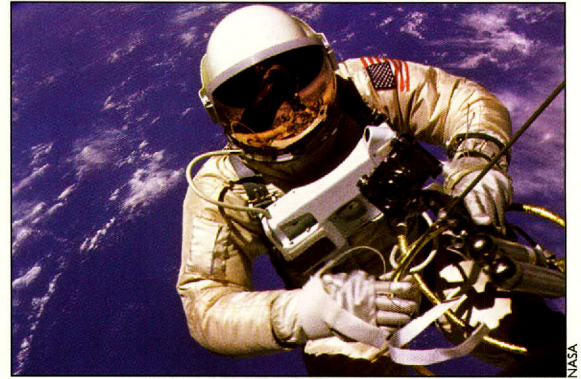
Moon phase times are for the Central Time Zone.

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

PERIGEE
June 10

APOGEE
June 23

KEY DATES



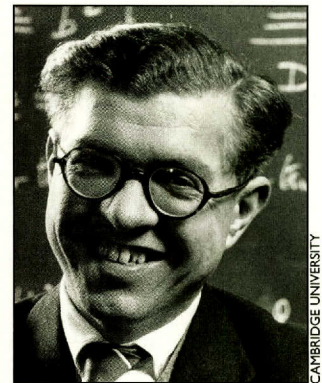
Ed White floats outside his Gemini 4 spacecraft.

June 3

Astronaut Ed White became the first American to walk in space on June 3, 1965, during the Gemini 4 mission. White spent about 20 minutes floating outside the spacecraft, and used a small gas-filled “gun” to maneuver. The spacewalk produced some of the most iconic photographs of the entire space program. Gemini 4 was the longest American space mission to date, logging four days in orbit.

June 24

Fred Hoyle, a brilliant but controversial astronomer who coined the term “Big Bang” was born in 1915 in England. Hoyle was one of the first to realize that most of the chemical elements are forged either in the cores of stars or in stellar explosions. He supported the steady-state theory of cosmology, which holds that the universe is eternal and that matter is constantly being created, eschewing the idea of a single moment of creation (he called it a big bang as a form of derision). Later in his career he became a well-known science popularizer and science-fiction author.



Fred Hoyle in the 1950s

THE BASICS

Tilting Toward Summer

The seasons are caused by Earth's tilt on its axis. As Earth orbits the Sun, the north pole appears to “nod” up and down as viewed from the Sun. It nods most directly toward the Sun at the June solstice, which is the beginning of summer in the northern hemisphere. Six months later, however, as Earth moves half-way around its orbit, the north pole nods away from the Sun, so it's winter in the northern hemisphere and summer in the southern hemisphere.

OVERVIEW

Venus and Jupiter, the brightest points of light in the night sky, dominate the early evening hours for most of the month. They are especially close together as the month begins, but remain close until late July. By the time they set, the two signature constellations of summer, Sagittarius and Scorpius, are in good view in the southern sky. The brightest stars of Sagittarius form a teapot, while those of Scorpius form the curved body and barbed tail of a scorpion.

HIGHLIGHTS

- 1/2** Venus and Jupiter stage a brilliant conjunction in the west shortly after sunset. Venus is the Evening Star, with slightly fainter Jupiter quite close to its upper right on the 1st, and to its right on the 2nd. The two worlds will remain close together for several weeks.
- 6** Earth is at aphelion, its greatest distance from the Sun for the year.
- 12** Aldebaran, the eye of the bull, is close to the lower left of the Moon at dawn.
- 14** Regulus, the bright heart of Leo, stands directly above Venus at nightfall, with Jupiter farther to the right of Venus.
- 18** Venus is close to the upper right of the Moon at nightfall, with Regulus farther along the same line and Jupiter well to their right.
- 22/ 23** Spica is to the left of the Moon at nightfall on the 22nd, and to the lower right of the Moon on the 23rd.
- 25** The bright golden planet Saturn nestles close to the lower left of the Moon at nightfall, with Antares, the brightest star of Scorpius, well to their lower left.
- 26** Saturn stands to the right of the Moon this evening, with Antares about the same distance below the Moon.

FEATURED EVENT

31 Today is the second full Moon of the month, so it is known as a Blue Moon.

JULY

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26	27	28	29	30	31	

JULY



FEATURED EVENT

A Bit of Modern Skylore

Folklore doesn't have to be old to be popular. Consider, for example, the modern definition of Blue Moon: the second full Moon in a calendar month. Although that definition began as a mistake, it became popular two decades ago and has ingrained itself in skywatching lexicon.

Blue Moon already had several traditional definitions, including the thirteenth full Moon in a calendar year and the third full Moon in a calendar quarter. The phrase could also be taken literally, because under certain rare atmospheric conditions (when there is a layer of ash high in the air, for example), the Moon can actually look blue. And the phrase "once in a blue moon" is unrelated to the Moon itself, and simply means that an event is rare.

The modern definition entered the public imagination in the 1980s, thanks to a misinterpretation of a decades-old magazine article. It was popularized by both the Star Date radio program and the game Trivial Pursuit.

Some have tried to stamp out the second-full-Moon-in-a-month definition, but it's unlikely they'll succeed. Like Super Moon (an unusually close full Moon) and Blood Moon (a reference to the Moon's red color during a lunar eclipse), which have gained popularity in the last couple of years, Blue Moon is probably here to stay — a bit of modern folklore about the night sky.

July offers this year's only Blue Moon. It occurs on July 31, roughly 29.5 days after the previous full Moon, on July 1.

FEATURED NEBULA

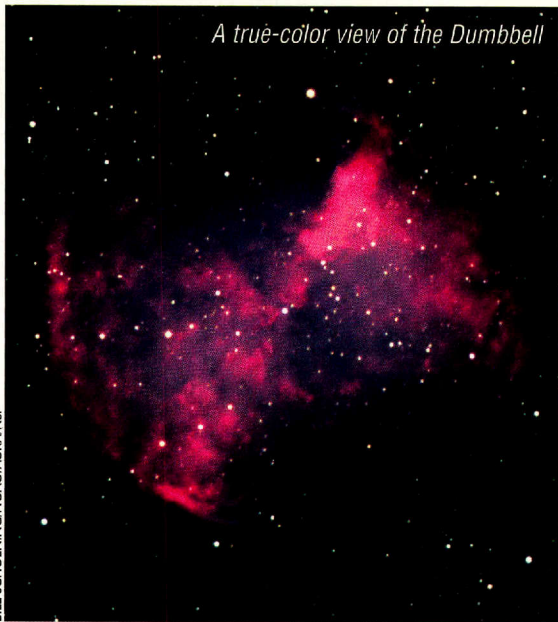
Changing Directions

French comet hunter Charles Messier discovered the first planetary nebula — the last gasp of a dying star — in the constellation Vulpecula, the fox, in July 1764, and skywatchers have been turning their telescopes toward this bright but hazy disk ever since. Known today as the Dumbbell Nebula and as Messier 27 (the 27th object on Messier's list of objects that resemble comets), it is the favorite planetary nebula of most amateur astronomers.

The Dumbbell is named for its resemblance to a hand weight like those you use at the gym. That structure is produced by a disk of dust around the dying star's waist, which squeezes much of its expelled gas into two bubbles above the star's poles.

The best measurements say the Dumbbell is about 1,360 light-years away, although that distance could be off by a couple of hundred light-years in either direction. It spans a few light-years, and it shines roughly 10 times brighter than the Sun.

The Dumbbell spans roughly one-quarter the diameter of the Moon in our sky, which, combined with its brightness, makes it perhaps the finest planetary nebula for skywatchers. It is visible through good binoculars as a small, fuzzy disk, while a small telescope reveals its "dumbbell" shape.



A true-color view of the Dumbbell

BILL SCHOENING/NOAO/AURA/NSF

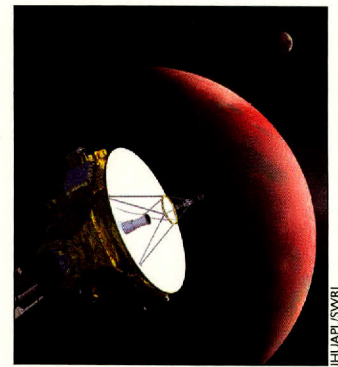
DUMBBELL NEBULA

- In Vulpecula, the fox, which is high in the east at nightfall this month. The constellation is high in the east at nightfall, in the middle of the bright Summer Triangle.

KEY DATES

July 14

New Horizons is scheduled to become the first spacecraft to visit Pluto. The spacecraft, which launched in January 2006, will pass just 6,200 miles (10,000 km) from the dwarf planet, and about twice as far from its largest moon, Charon. Because of the extreme distance, though, it will take months for the craft to transmit all of its readings to Earth.

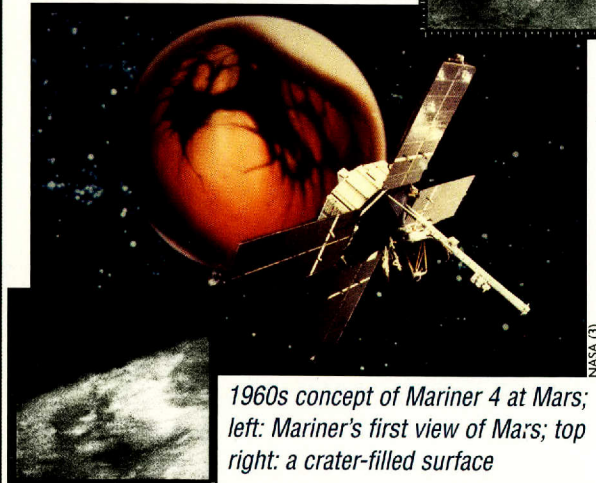
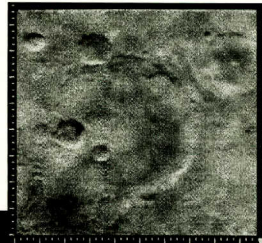


JHU/APLUSVRI

New Horizons at Pluto and Charon (background)

July 14

Mariner 4 staged the first successful encounter with Mars when it flew just 6,118 miles (9,846 km) from the Red Planet in 1965. Its 22 crude pictures showed a landscape that resembled the Moon's, dominated by impact craters. The photos squelched any hope of finding life on Mars.



NASA (3)

1960s concept of Mariner 4 at Mars; left: Mariner's first view of Mars; top right: a crater-filled surface

July 28

Charles Townes, one of the "fathers" of the laser, was born in 1915. He and his colleagues developed the maser, which uses microwaves, in the 1950s, then applied that knowledge to visible wavelengths to create the laser. He shared the 1964 Nobel Prize in Physics for this work. In astronomy, lasers have measured the distance from Earth to the Moon and they can sharpen the view through ground-based telescopes.



RANDALL L. RICKLES/MCDONALD OBSERVATORY

A laser 'shoots' the Moon from McDonald Observatory.



1 9:20 pm



8 3:24 pm



23 11:04 pm



31 5:43 am

Moon phase times are for the Central Time Zone.

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

PERIGEE
July 5

APOGEE
July 21

OVERVIEW

Summer evenings offer the most glorious view of the Milky Way of the entire year. The glowing band of our home galaxy arcs from Sagittarius and Scorpius in the south to the graceful outline of the swan overhead to the W of Cassiopeia in the north. Although it's not visible from most light-polluted urban areas, under dark country skies it offers a magnificent sight.

HIGHLIGHTS

FEATURED EVENT

5 Uranus, the solar system's third-largest planet, stands almost directly above the Moon shortly before dawn.

8/9 The Moon passes Aldebaran, the orange eye of Taurus, in the dawn sky. Aldebaran stands to the lower left of the Moon on the morning of the 8th, and to the upper right of the Moon on the 9th.

10 Another orange star, Betelgeuse, is to the lower right of the Moon at first light. It is the second-brightest star of Orion, the hunter.

12 The Perseid meteor shower should be at its best tonight.

15 Venus crosses between Earth and Sun today, so it is lost from view in the Sun's glare. It will return to view in the early morning twilight in a few days.

19 Spica, the brightest star of Virgo, perches close below the Moon at nightfall.

21 The giant planet Saturn shines like a golden star to the left of the Moon at nightfall.

22 Saturn is close to the lower right of the Moon this evening, with Antares, the brightest star of Scorpius, much farther to the lower left of the Moon.

31 The giant planet Neptune is at opposition, shining brightest for the year. It is so far away, however, that you still need a small telescope to see it, in the constellation Aquarius.

AUGUST

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30	31					

FEATURED EVENT

Pointing Out a Neglected Giant

Uranus is a neglected giant. Although the planet is about four times Earth's diameter, it's so remote that it's difficult to spot. The morning of August 5, however, offers a good chance to view it through binoculars because it hovers near the gibbous Moon. It stands almost directly above the Moon shortly before dawn.

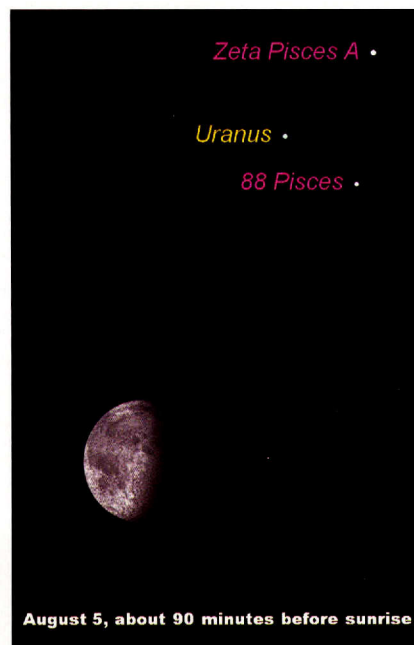
Uranus probably consists of a small, rocky core surrounded by a layer of frozen water and other ices and topped by a thick atmosphere. A methane haze atop the atmosphere absorbs red wavelengths of light, giving the planet a blue-green color. The haze blocks the view of the cloud layers below, so even through a telescope the planet looks almost featureless. To see any details, astronomers must look at Uranus in wavelengths of light that penetrate the haze, such as the infrared.

Instead of standing more or less upright like Earth and the other planets, Uranus lies almost on its side, with its axis aligning with the planet's orbital plane. That orientation may be the result of a collision between Uranus and another planet-sized body early in the solar system's history.

Uranus has 27 known moons, although the largest, Titania, is less than half the diameter of Earth's moon.

At its peak, the planet can shine just bright enough to see with the unaided eye, although locating it requires dark skies and a good knowledge of the night sky. Most of the time, you need binoculars to spot it.

On August 5, though, it will stand close above the Moon. The planet will form a tight triangle with two similarly bright stars in the constellation Pisces, one to the upper right of Uranus and the other closer to the lower right. All three should fit in your binocular field of view, helping you pick out this neglected giant.



AUGUST

FEATURED NEBULA

A Butterfly Spreads its Wings

The scorpion is one of the most unappealing creatures on the planet. The celestial scorpion, however, offers one of the most appealing creatures in the galaxy: the Butterfly Nebula. This amazing structure emerged from its cocoon about 2,000 years ago as seen from Earth, and today its colorful wings span more than two light-years.

The “wings” are big bubbles of gas and dust that once formed the outer layers of a star that was more massive than the Sun. The star’s hot but dead core sits at the center of the nebula.

Until the last couple of thousand years, the core generated energy through nuclear fusion. Today, though, nuclear fusion has stopped. The leftover core, which is about two-thirds as massive as the Sun, shines perhaps 2,000 times brighter than the Sun and has a surface temperature of roughly 400,000 degrees Fahrenheit (compared to about 10,000 degrees for the Sun). But it may be fading by as much as one percent per year.

The star will continue to cool and fade rapidly over the next few thousand years. At the end of that process it will be classified as a white dwarf, a dense ball not much bigger than Earth. By then, the surrounding butterfly will begin to fade, destroying a bit of beauty in the celestial scorpion.



BUTTERFLY NEBULA

- Near the stars that form the “stinger” of Scorpion, the scorpion
- Roughly 4,000 light-years away



Moon phase times are for the Central Time Zone.

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

PERIGEE
August 2, 30

APOGEE
August 17

KEY DATES

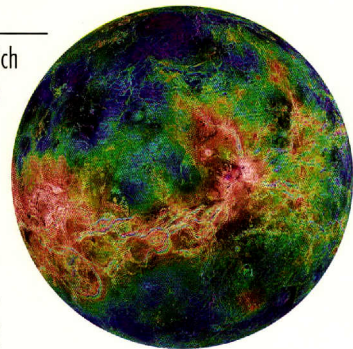
August 1

CALENDAR EVENT

Today is Lammass, 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. Lammass 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 10

The Magellan spacecraft, which mapped the surface of Venus in unprecedented detail, entered orbit around the planet in 1990. Magellan used radar to peer through the planet’s unbroken cloud cover, revealing large mountains, domes, spidery structures, and other features. Magellan’s map of Venus remains the most detailed yet compiled.



Magellan map of one hemisphere of Venus. False colors indicate altitude; redder shades are highest, blues are lowest.

August 25

Mars invaded Earth 150 years ago on this date, when an 11-pound (5-kg) meteorite fell on Shergotty, India. Several witnesses saw it fall to the ground after hearing loud booms in the sky. Studies in the 20th century identified it as a piece of the Martian crust. The rock formed about 165 million years ago and was blasted free of Mars by a powerful impact 2.6 million years ago.

SKY WATCH

Naked-Eye Planets

Venus	The brilliant morning or evening star
Jupiter	The largest planet in the solar system Second only to Venus in brightness
Mars	Shines brightest at year’s end
Mercury	Best this year in the dawn sky in October
Saturn	Shines brightest this year in May
Uranus	Visible in mid October; requires dark skies and good eyes

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

OVERVIEW

The stars of autumn begin to push those of summer out of the way as the nights grow longer and cooler. Pegasus is in view in the east as night falls, with several related constellations following the flying horse into the sky over the next few hours. Venus and Mars team up as the month begins, with Jupiter climbing toward them by month's end. And an event sure to grab your attention highlights September's wane: the Bloody Super Moon.

HIGHLIGHTS

- 4** The planet Mercury stands highest in the western sky for its current evening appearance. It is fairly easy to pick out from southern latitudes, but difficult from farther north.
- 5** Aldebaran, the eye of Taurus, is especially close to the Moon as they climb into view after midnight. From the far northeastern United States, in fact, the Moon will briefly pass in front of the star, blocking it from view.
- 5** Mars stands to the left of brilliant Venus, the Morning Star, at first light.
- 9/10** The crescent Moon sweeps past Venus and Mars in the dawn sky. Venus is below or to the lower left of the Moon on the 9th, and closer to the right or upper right on the 10th. Mars is to the left of Venus.
- 18** Saturn stands close to the lower left of the Moon at nightfall. Antares, the brightest star of Scorpius, is well to their left.
- 19** Antares is below the Moon this evening, with Saturn about the same distance to the lower right of the Moon.
- 23** The autumnal equinox takes place at 3:21 a.m. CDT, marking the start of fall in the northern hemisphere.
- 25** Mars and Regulus stand quite close together in the dawn sky, with Mars on the left and Regulus on the right. Venus is to their upper right, with Jupiter about the same distance to their lower left.

FEATURED EVENT

- 27** The Moon stages a triple whammy tonight.

SEPTEMBER

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FEATURED EVENT

A Moon by Any Other Name ...

Thanks to an astronomical coincidence, you can expect every TV meteorologist in America to act a bit gaga about the full Moon on the night of September 27, because it will be the Bloody Harvest Super Moon.

The Harvest Moon designation comes from its place in the calendar: It's the first full Moon after the autumnal equinox on September 23. In earlier eras, farmers used the extra moonlight to gather their crops well into the night. The Moon was especially beneficial at more northerly latitudes, where it rises at around the same time for several nights in a row, so the farmers didn't have to wait for moonrise.

The "Super" Moon designation applies to a full Moon that occurs when the Moon is especially close to Earth. The Earth-Moon distance varies by almost 30,000 miles, with the two bodies at their closest roughly every 27.3 days. That is offset from the Moon's cycle of phases by more than two days, so despite what most people think, the Moon usually isn't closest to Earth when it's full. This month, however, that closest point, known as perigee, comes within minutes of the exact time of the full Moon. The Moon looks a little bigger and brighter when it's closest to us, although the difference isn't as pronounced as many TV and social-media folks might suggest.

Finally, the Moon will pass through Earth's shadow tonight, creating a total lunar eclipse. Sunlight filtering through Earth's atmosphere usually gives the Moon a reddish tinge, which in recent years has been described as a Blood Moon. Exactly how much red you see, however, depends on sky conditions, your sensitivity to red light, and other factors, so the Moon rarely looks as red as it does in photographs. The entire eclipse will be visible across the eastern half of the United States; from the rest of the country, it will be under way as the Moon climbs into view.

Our best advice is to ignore the hype and just enjoy the show: a big, fully eclipsed Harvest Moon decorating the sky of an early autumn night.



SEPTEMBER

FEATURED NEBULA

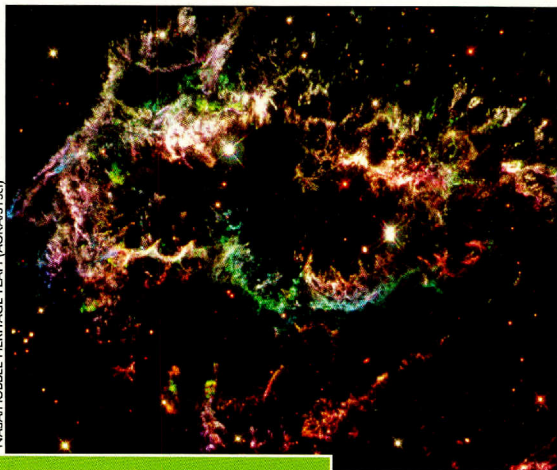
Galactic Chemistry Lesson

A rapidly expanding bubble in the constellation Cassiopeia is sprinkling almost an entire periodic table of chemical elements into the galaxy — a rich mixture of iron, oxygen, silicon, magnesium, uranium, xenon, and dozens of others. Over time, these elements will spread into the galaxy, where they may someday be incorporated into new stars, planets, and even living organisms.

The bubble is Cassiopeia A, the remains of a star that exploded as a supernova more than 300 years ago as seen from Earth. The bubble, which is expanding at tens of millions of miles per hour, contains enough material to make several stars as massive as the Sun.

The star that gave birth to Cassiopeia A originally was 15-25 times as massive as the Sun. Under the extreme temperatures and pressures in its core, nuclear fusion reactions quickly forged different chemical elements, all the way up to iron. It takes more energy to fuse iron to heavier elements than the core could produce, however, so fusion shut down and the core collapsed, while the surrounding layers blasted into space. The fury of the explosion provided the energy to create elements heavier than iron, adding to the chemical brew.

Many of the chemical elements found on Earth were created in similar stars. That means we are all children of the stars, with many of the atoms that make up our own bodies forged by stars that died billions of years ago.

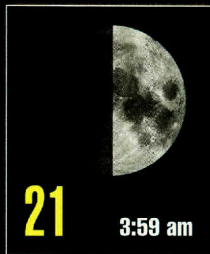
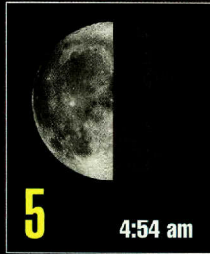


NASA/HUBBLE HERITAGE TEAM (AURA/STSC)

CASSIOPEIA A

- In Cassiopeia, the queen, which is in the northeast on September evenings
- Roughly 11,000 light-years away
- The closest supernova to Earth yet recorded

Hubble Space Telescope image of part of Cassiopeia A; different colors are produced by different chemical elements



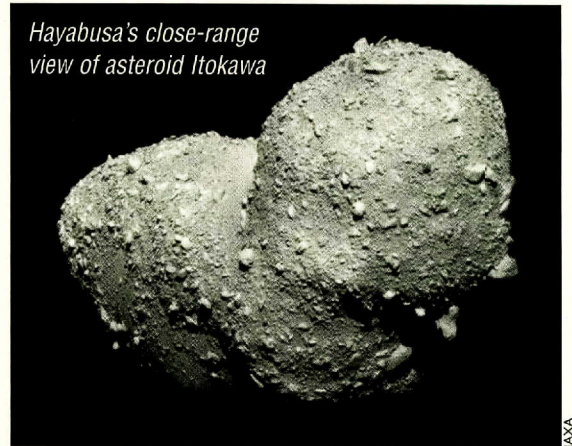
Moon phase times are for the Central Time Zone.

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

APOGEE
September 14

PERIGEE
September 27

KEY DATES



September 12

Hayabusa, a Japanese mission, arrived at the asteroid Itokawa in 2005. The craft briefly touched down to grab a sample of material from the asteroid's surface. The sample retrieval system malfunctioned, but it did manage to snag a few grains for return to Earth.

September 14

John Dobson, who made skywatching easier and more affordable for thousands, was born in China in 1915. He became a monk in the 1940s, and built his own telescopes to pursue his studies of cosmology in his religious order. Known as Dobsonian reflectors, these telescopes are far simpler and less expensive than more traditional designs, allowing amateurs to build relatively large instruments.

September 19

Tonight is Observe the Moon Night, which encourages skywatchers of all ages and skills to look at our satellite world. Dozens of observatories, museums, and other science centers will host special events.



observethemoonnight.org

THE BASICS

Not-Equal Nights

The **autumnal equinox** takes place on September 23, marking the start of fall in the northern hemisphere. Equinox means "equal nights," so theoretically, all points on Earth should see equal amounts of daylight and darkness. But for several reasons, the interval between sunrise and sunset — which should be exactly 12 hours — is off by a few minutes. Unless you live directly along the equator, the equinoxes are the only two days of the year when the Sun rises due east and sets due west; the rest of the year, the sunrise and sunset points are north or south of these cardinal points.

OVERVIEW

A giant story unfolds across the evening skies of October. It involves Andromeda and four surrounding constellations. They tell us of the mother who angered the gods, the father who ordered Andromeda sacrificed to appease them, the sea monster that tried to destroy her, and the hero who saved her. And in the morning sky, Venus, Jupiter, and Mars all congregate within the borders of Leo, adding some zest to the chilly autumn mornings.

HIGHLIGHTS

FEATURED EVENT

8/9 The Moon teams up with three planets and one bright star in the pre-dawn sky.

11 The little planet Mercury stands close to the upper left of the Moon in the dawn twilight. You will need a clear horizon to spot them. Mercury will be farthest from the Sun for its current morning appearance on the 15th.

15 Saturn is to the left of the Moon and just slightly higher in the sky at nightfall, with Antares, the brightest star of Scorpius, about the same distance to the lower left of Saturn.

16 Saturn is close to the lower right of the Moon this evening, with Antares a little farther to the lower left of the Moon.

25 Jupiter and Venus, the brightest objects in the night sky after the Moon, stand side by side in the early morning sky. Jupiter is to the left of brighter Venus.

26 Venus stands farthest from the Sun for its current Morning Star appearance.

29 Aldebaran, the brightest star of Taurus, is close to the upper right of the Moon as they climb into view in mid evening.

OCTOBER

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

OCTOBER



About an hour before Sunrise.

TIM JONES

FEATURED EVENT

Running Around the Sun

The stars move in step with each other, maintaining the same separation from night to night and year to year. The planets, however, move in frustrating ways. They sometimes halt their normal eastward motion against the sky, and even reverse direction for a few weeks or even months. To complicate matters even more, each planet moves at a different speed across the sky. It took centuries for astronomers to work out the reason for these odd motions against the starry background.

To understand the challenge, watch Venus, Jupiter, and Mars this month. All three are in the morning sky, passing through the boundaries of Leo. Venus is the brightest member of the trio, followed by Jupiter, with Mars a pale third.

As the month begins, Venus is the highest in the sky, Jupiter is the lowest, and Mars is about half-way between them. As the month progresses, however, Venus and Mars will slide back toward Jupiter and then pass it. By October's end, Venus and Mars will be almost side by side, with Jupiter above them.

The three bright points of light move that way because they are at different distances from Earth. Venus is closest, so it typically moves fastest across the sky. Mars is farther, so it moves a little more slowly. And Jupiter is the most distant of the three, so it moves slowest.

As Earth overtakes each of these worlds in its own orbit around the Sun, they appear to slow down, stop, and then reverse direction for a while. As our planet then moves away from them, they stop again and then resume their normal motion against the background of distant stars.

Once you understand the geometry, there's little mystery to the motions of the planets. They're like runners in their own lanes on a wide track, perpetually circling the Sun.

FEATURED NEBULA

Star in a Barrel

One of the nearest planetary nebulae highlights the constellation Aquarius, which scoots low across the south on October evenings. The Helix Nebula forms a lopsided ring that resembles a human eye (in fact, it's also known as the Eye of Sauron). Based on its size and how fast its expanding, astronomers calculate its distance at roughly 650 light-years.

That close range means the Helix is quite large in our night sky: it spans roughly half the diameter of the full Moon. That makes it a big target for binoculars and small telescopes. The glowing gas covers such a large region, however, that the nebula is rather faint, so it's best appreciated in long-exposure photographs.

The Helix is actually shaped like a barrel. From Earth, we're looking down into the barrel, which is why the nebula resembles a ring.

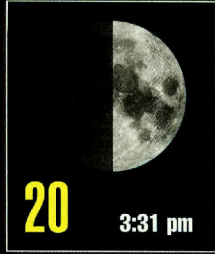
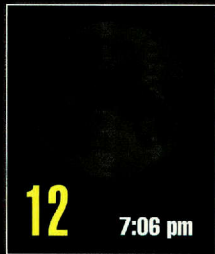
The barrel spans about three light-years. From that, astronomers deduce that the Helix began expanding more than 10,000 years ago as seen from Earth, with the brightest, densest portion of the nebula blowing into space a few thousand years later.

Even though it is only a few times the size of Earth, the nebula's central star is easily visible in photographs. Its sizzling surface is pumping out ultraviolet energy, which causes the nebula to glow. Oxygen atoms in the center of the nebula glow blue and green, while nitrogen and hydrogen farther from the star shine red and orange.

The star's ultraviolet energy is eroding dense knots of gas and dust that were ejected by the original star. Some estimates say there are 20,000 of the knots, each of which is much larger than our entire solar system.



- HELIX NEBULA**
- In Aquarius, the water bearer, which arcs low across the south on autumn nights
 - The nebula covers roughly the same area in the sky as the full Moon



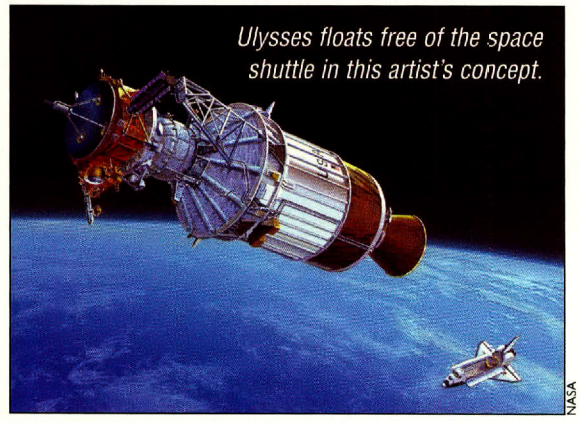
Moon phase times are for the Central Time Zone.

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

APOGEE
October 11

PERIGEE
October 26

KEY DATES



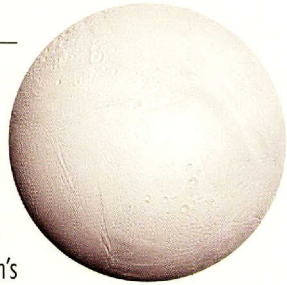
October 6
Ulysses, a spacecraft designed to study the Sun from above its poles, was launched aboard space shuttle Discovery 25 years ago. It used a gravitational assist from Jupiter to probe the Sun's magnetic field and the solar wind from angles never before achieved.

October 22
Venera's first panorama of Venus



The Soviet Union's Venera 9 spacecraft transmitted the first picture from the surface of another planet 40 years ago when it safely touched down on Venus. It survived only 53 minutes on the planet, but in addition to snapping pictures it also measured the surface temperature (86C degrees Fahrenheit) and pressure (90 time's Earth's surface pressure). A companion probe, Venera 10, successfully landed three days later.

October 28
The Cassini spacecraft is scheduled to make its closest approach to Saturn's moon Enceladus in several years today, passing just 30 miles (50 km) above the icy moon. Geysers of liquid water and ice shoot into space from an underground reservoir near the moon's south pole.



Bright white Enceladus

October 31 **CALENDAR EVENT**
Today is Halloween, one of the cross-quarter days, which fall 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, this 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.

OVERVIEW

Taurus climbs high across the sky on November nights, reaching its zenith around midnight late in the month. The bull is marked by its orange eye, which stands at one point of its V-shaped face, and by the Pleiades star cluster at its sparkly shoulder. Orion and Gemini climb skyward earlier each evening, and by month's end are in good view by 9 p.m. or so. And on the other side of the sky, the Summer Triangle drops from sight by late evening.

HIGHLIGHTS

- 2** The orange planet Mars stands directly to the left of Venus, the Morning Star, at first light. Jupiter, which is second only to Venus in brightness, is well above them.
- 6** Jupiter stands close to the left of the Moon at dawn, with Venus and Mars below them.
- 7** Venus is very close to the Moon at daybreak. Mars is close above them, with Jupiter higher above them.
- 9** The star Spica is close to the lower left of the crescent Moon at first light.
- 17** The Leonid meteor shower should be at its best tonight.

FEATURED EVENT

- 25** The Moon stages a close encounter with Aldebaran, the eye of Taurus. From parts of the United States, the Moon will actually cover the star before dawn.
- 26** Taurus is farther to the upper right of the Moon as they rise this evening.
- 27** Betelgeuse, the sparkling orange shoulder of Orion, stands to the right of the Moon as they climb into view in mid evening.
- 29** Procyon, the "little dog star," perches well to the right of the Moon as they climb into view in late evening. Sirius, the Dog Star, is farther to the lower right of Procyon.

NOVEMBER

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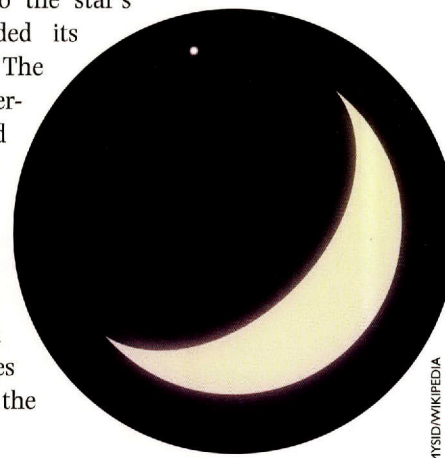
NOVEMBER

FEATURED EVENT

The Blink of an Eye

The Moon will form a bright eye patch for the celestial bull before dawn on November 26. As seen from the northern half of the United States, it will pass in front of Aldebaran, the bright orange eye of Taurus, briefly blocking the star from view.

The cover-up is known as an occultation, from a Latin word that means to hide or conceal. Yet for astronomers, an occultation can be quite revealing. They have used previous occultations of Aldebaran, for example, to determine the star's size. As the Moon moved in front of the star, astronomers measured how long it took Aldebaran to completely vanish from view, which revealed its angular size. Comparing that measurement to the star's distance provided its true diameter. The occultation observations agreed nicely with measurements with other techniques; they all show that Aldebaran is about 44 times the diameter of the Sun.



Lunar occultations aren't as important today as they were even a few decades ago, although occultations of stars by other bodies are still quite helpful. An occultation revealed the rings of Uranus, for example, as the rings partially blocked the light from a distant star. And recent occultations allowed astronomers to discover the first rings around an asteroid, to measure the sizes of binary asteroids, and much more.

The November 26 occultation of Aldebaran begins a couple of hours before sunrise for those on the East Coast, and earlier than that for those in more westerly time zones. The length of the occultation depends on your location. For those at the highest northern latitudes, Aldebaran will remain hidden for almost an hour. For those at the southern edge of the occultation path, however, it will last for just minutes or even seconds. Skywatchers in the southern half of the country will have to settle for a breathtakingly close encounter between the Moon and the bull's bright orange eye.

MYSTIKWIKIPEDIA

FEATURED NEBULA

Less Than the Blink of an Eye

In the fall of 1967, graduate student Jocelyn Bell discovered a source of radio waves that was flashing on and off about once every second. Neither Bell nor her adviser, Anthony Hewish, could explain the pulses, so they called the source Little Green Men 1 in the unlikely event it was a beacon from another civilization.

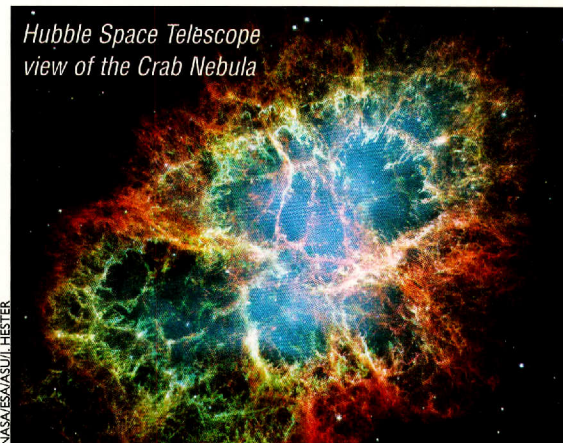
They quickly found several similar objects, though, suggesting that the pulses must have a natural cause. That explanation was confirmed in late 1968 when a pulsing radio source was discovered in the Crab Nebula, the expanding remnant of an exploding star.

The original star exploded in the year 1054 as seen from Earth, producing a “guest star” that was visible for almost two years.

The explosion was triggered by the collapse of the star’s core, which formed an ultra-dense neutron star. It is roughly twice as massive as the Sun, but only about as wide as a small American city. The neutron star spins 30 times per second, beaming pulses of radio energy into space like a fast-paced lighthouse, so like the first sources discovered by Bell, it’s also known as a pulsar.

The star’s outer layers exploded as a supernova, blasting enough material into space to make several stars as massive as the Sun. The nebula spans about a dozen light-years, and it is expanding at several million miles per hour. Over the eons, the nebula’s gas and dust will spread out even more, providing raw materials for new stars and planets.

Hubble Space Telescope view of the Crab Nebula



CRAB NEBULA

- In Taurus, the bull, which passes high overhead at midnight on November nights
- Also known as M1, the first object in Charles Messier’s 18th-century catalog of hazy, comet-like objects

KEY DATES

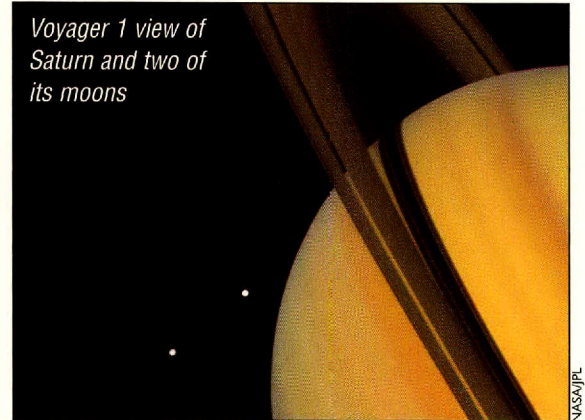
November 11

CALENDAR EVENT

A second celebration tied to the start-of-winter cross-quarter day, Martinmas commemorates Saint Martin of Tours, who was executed in the year 397. In Scotland, landlords collected rent on Martinmas.

November 12

Voyager 1 view of Saturn and two of its moons



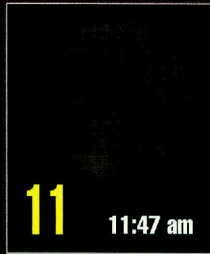
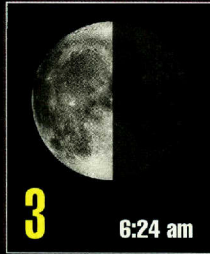
Voyager 1 flew past Saturn 35 years ago. The spacecraft snapped spectacular pictures of Saturn, its rings, and several of its moons; measured the composition of the planet’s atmosphere; probed its magnetic field; and made many other observations.

November 17

John Stanley Plaskett, who was the founder of Canadian astrophysics, was born in 1865 in Ontario. Plaskett worked on his family farm and then for the Edison Company before earning his degree in physics at age 33. He became an accomplished instrument designer, and helped establish the Dominion Astrophysical Observatory in British Columbia, which he then directed. Using its big new telescope, he was the first to measure the size, mass, and rotational speed of the Milky Way galaxy. After his retirement in 1935, he was involved in the construction of the first telescope at McDonald Observatory in Texas.

November 25

Albert Einstein submitted a paper to a physics journal outlining his theory of gravity in 1915. General Relativity explains gravity as a warp in space and time caused by matter. Einstein had spent years working on the problem, and had published several versions of his gravitational equations. This paper, however, presented relativity in its nearly final form.



Moon phase times are for the Central Time Zone.

Daylight Saving Time ends November 1.

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

APOGEE

November 7

PERIGEE

November 23

OVERVIEW

Venus and Jupiter dominate the early morning sky this month. Venus is the Morning Star, while Jupiter, which is higher in the sky, is only slightly less dazzling. Fainter Mars lines up between them. Mercury puts in a brief appearance in the evening sky late in the month, while Saturn is just climbing into view in the morning sky by the end of December.

HIGHLIGHTS

2 Regulus, the heart of Leo, is close to the upper left of the Moon at first light. At the same time, Spica, the brightest star of Virgo, is close to the right of Venus, the Morning Star.

3/4 Jupiter dazzles to the lower left of the Moon at daybreak on the 3rd, and closer above the Moon on the 4th.

5 Mars stands to the lower left of the Moon at daybreak.

6 Mars is close to the upper right of the Moon at first light, with Spica below them and Venus farther to the lower right of the Moon.

7 Venus is close below the Moon at dawn.

21 Winter arrives in the northern hemisphere at 10:48 p.m. CST, the moment of the winter solstice. This is the shortest day of the year north of the equator.

23 Aldebaran, the orange eye of Taurus, looks down on the Moon at nightfall.

FEATURED EVENT

25 The Moon is full today. It is known as the Long Night Moon.

28 The planet Mercury is quite low in the southwest as darkness begins to fall. The view is slightly better from the southern states than the north.

28/29 Regulus is to the lower left of the Moon as they rise late on the evening of the 28th, and above the Moon on the 29th.

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

DECEMBER

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

DECEMBER



FOTOLIA

FEATURED EVENT

Moonlight Galore

Santa Claus shouldn't need Rudolph's help this year, because the full Moon will light up Christmas Eve and Christmas night. In fact, there is more moonlight on these two nights than at any other time of year.

The Moon is full at 5:11 a.m. CST December 25, so it will illuminate the nights of December 24 and 25. The full Moon lines up opposite the Sun in Earth's sky, so it does the opposite of what the Sun does in the daytime sky. Since the winter solstice, which is the shortest day of the year in the northern hemisphere, took place on December 21, the Sun is putting in its most feeble appearances of the year. It rises late, sets early, and scoots low across the south during the short day. So the full Moon does just the opposite: It rises around sunset, climbs high across the sky during the night, and sets around sunrise.

The difference is more dramatic at more northerly latitudes. San Antonio, for example, will see about 3 hours, 45 minutes more moonlight than sunlight on Christmas. But from Seattle, the difference is almost seven hours: 8-and-a-half hours of sunlight, followed by 15-and-a-quarter hours of moonlight.

Not only does the Moon remain in view for a long time, it also climbs highest across the sky for the year. That's because the Moon lies close to the ecliptic, which is the Sun's path across the sky. At this time of year, the ecliptic arcs low across the sky during the day because Earth's north pole is tipped away from the Sun. But the full Moon is on the opposite side of Earth, so the north pole tips toward it. As a result, the ecliptic climbs high across northern skies — and so does the full Moon.

FEATURED NEBULA

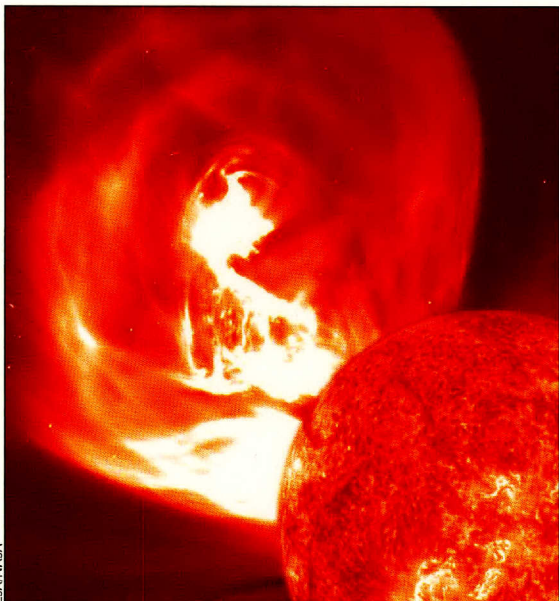
Looking into the Future

Perhaps five billion years from now, a lonely, nondescript star in the suburbs of the Milky Way galaxy will puff up to giant proportions. Its outer layers will swallow the charred remains of its innermost planets, dragging them to a fiery doom.

After a billion years or so of gianthood, the star's core will no longer be able to produce energy. The core will shrink, forming a dense ball no bigger than Earth known as a white dwarf. The star's outer layers will stream away into space, surrounding the white dwarf with an expanding bubble of gas and dust. For tens of thousands of years, ultraviolet energy from the hot white dwarf may make the gas around it glow like an iridescent soap bubble.

Finally, when the gas becomes too thinly spread, the bubble will fade from sight, and our Sun will become just another white dwarf star, slowly fading over the eons.

Yet the Sun's story may not end there. As the bubble of gas and dust expands into space, the carbon, oxygen, nitrogen, and a few other elements created inside the Sun during its long lifetime, along with heavier elements from the pulverized planets, will mix with other interstellar clouds. In the far distant future, some of that material may be incorporated into new stars and planets. And some of it may even be incorporated into living organisms, making them not just children of the stars, but of the demise of our own solar system.



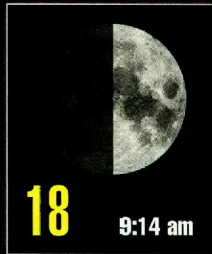
A massive eruption on the Sun. In the distant future, eruptions will strip all of the Sun's outer layers of gas, briefly creating a beautiful planetary nebula.



3 1:40 am



11 4:29 am



18 9:14 am



25 5:11 am

Moon phase times are for the Central Time Zone.

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

APOGEE
December 5

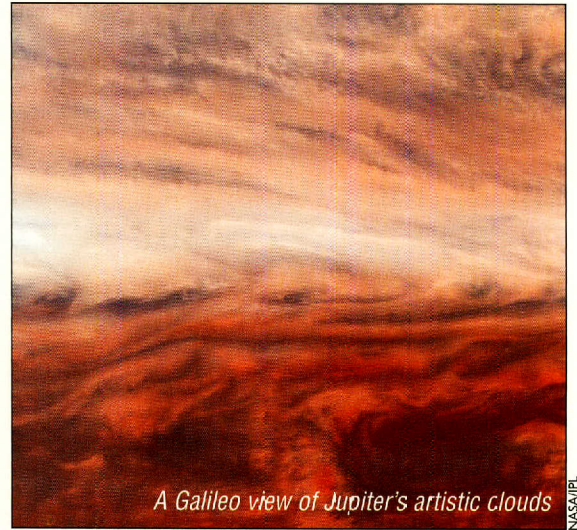
PERIGEE
December 21

KEY DATES

December 2

NASA launched the Solar and Heliospheric Observatory (SOHO), a collaborative project with the European Space Agency, in 1995. The craft, which is still operating, has studied the Sun's interior, sunspots, the solar wind, the corona, and many other aspects of our star.

December 7



A Galileo view of Jupiter's artistic clouds

The Galileo spacecraft entered orbit around Jupiter in 1995. A crippled main antenna limited the craft to a fraction of its planned observations, yet during a decade of operations it still managed to probe the giant planet's atmosphere, study volcanoes on the moon Io, and detect evidence of an ocean of liquid water beneath the icy crust of the moon Europa.

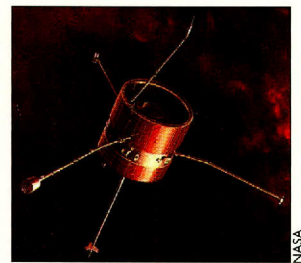
December 13

CALENDAR EVENT

In Scandinavian, today is known as Saint Lucy's Day, a celebration of the year's longest nights. In Sweden, tradition calls for the girls of the household to dress in white and serve pastries, while songs commemorate the return of light in the coming weeks and months.

December 16

Pioneer 6, the first of four spacecraft designed to monitor the solar wind, was launched from Cape Canaveral in 1965. The craft provided data for many years, helping scientists chart the solar wind's composition, intensity, and variability. It was last tracked in 2000, but could be contacted again for its 50th anniversary.



December 17

CALENDAR EVENT

Today is Saturnalia, one of several ancient festival days that were tied to the winter solstice. This Roman event honored Saturn, the god of the harvest. Many of Saturnalia's customs survive in the celebration of Christmas.

The Sky Almanac that fills most of this issue is something you'll want to keep handy all year. But it's only a part of what's up. Most of the sky sights that will draw your eyes on a clear night are visible for weeks or months at a stretch. Here's a wider look at what awaits you on sparkling January and February nights.

JANUARY 1 - 15

Venus and Mercury, the two worlds interior to Earth, will put on a show not to miss during the first half of January.

Watch low above the west-southwest horizon about a half hour after sunset each clear evening. Venus will emerge into view there within the new year's first week, if you haven't picked it up already. Look below it for fainter Mercury, perhaps (at first) with the help of binoculars.

By January 7, they're higher and easier to see, Mercury especially. It's closing right in on Venus. They'll appear closest from the 9th through 11th, less than one degree apart. After that, Mercury starts drawing away from Venus, to the right.

All the while Mars, fainter and yellow-orange, looks down on them from the upper left.

Off to the left of the three planets, in the south-southwest, the "autumn star" Fomalhaut is heading down and away as twilight fades.

Meanwhile, winter splendor ascends in the east. Of course Orion, the hunter, is the iconic constellation of this season. It sparkles high in the southeast after dinnertime. Look for the three-star row of Orion's Belt, almost vertical. Look to the belt's upper left for Orion's shoulders: bright orange Betelgeuse and not-

so-bright Bellatrix. Look to the belt's right and lower right for the hunter's feet: bright Rigel and not-so-bright Saiph.

Brilliant Sirius, the brightest star in the night sky, sparkles far below Orion, down where the belt is pointing. (You may have to wait a while for it to rise over trees or buildings on your local horizon.) Sirius is the Dog Star, named for its constellation: Canis Major, the big dog. The name Sirius itself comes from the Greek for "blazing" or "searing."

Look to the right of Sirius for the big dog's front-foot star: Mirzim, "the Announcer" — so named because it always precedes Sirius up from the horizon.

About a fist-width at arm's length below them, three other prominent stars make a nice triangle: Adhara, Wezen, and Aludra, the big dog's hind foot, rump, and tail, respectively.

Dawn and sunrise come late in early January (a couple of weeks after the winter solstice), so maybe you're up and moving while it's still fairly dark. Look southeast about an hour before sunrise. There's Saturn, glowing steady yellow-white, with Antares about a fist at arm's length below it.

The stars of the head of Scorpius are just below and to the lower left of Saturn; binoculars will help you spot them as dawn brightens.

JANUARY 16 - 31

Venus is edging higher week by week in the southwestern twilight, and now Mercury is fading and dropping away to Venus' lower right. On January 21, the thin crescent Moon will form a lovely triangle with them: above Mercury

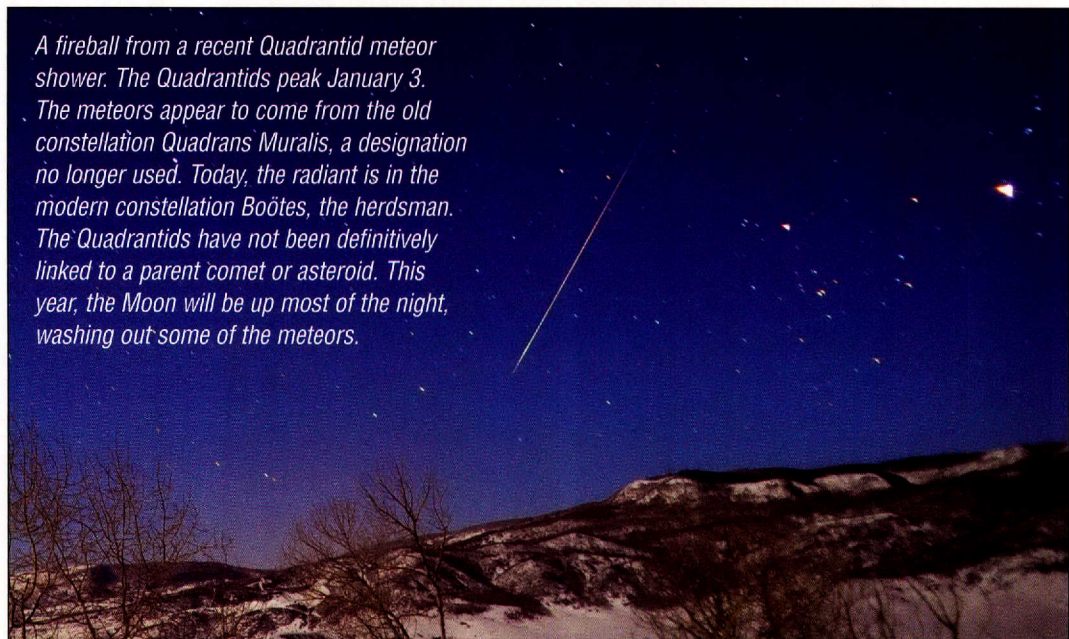
and to the right of Venus. Mark your calendar for this one. The next evening, the crescent Moon shines higher, now to the right of Mars.

That's at dusk. Give the Earth a couple of hours to turn, bringing Orion and Sirius high overhead in the southeast, and you'll find an even brighter beacon climbing up in the east. That's Jupiter, more massive than all the solar system's other planets, moons, asteroids, comets and everything else put together (except for the Sun). That's why Jupiter greets you so brightly in the east after dinnertime, even though it's so far away that it's lit by sunlight only four percent as bright as the sunlight on Earth.

FEBRUARY 1 - 15

Venus and Jupiter, the two brightest planets, climb into better view on opposite sides of the sky as winter proceeds.

Venus is rising boldly in the twilight; look west-southwest as dusk deepens. Identified by the ancients with the goddess of love, blazing Venus is



A fireball from a recent Quadrantid meteor shower. The Quadrantids peak January 3. The meteors appear to come from the old constellation Quadrans Muralis, a designation no longer used. Today, the radiant is in the modern constellation Boötes, the herdsman. The Quadrantids have not been definitively linked to a parent comet or asteroid. This year, the Moon will be up most of the night, washing out some of the meteors.

JIMMY WESTLAKE

homing in on faint Mars, the wimpy little god of war, to its upper right. Venus currently outshines Mars by a factor of 100. They'll pass close by each other later this month, just as the crescent Moon pops up to join the party.

Jupiter reaches opposition on February 6, so in the first half of February it's already shining low in the east as twilight fades, and by mid-evening it's well up, just waiting to show off its belts and moons in a telescope.

Jupiter is just above the constellation Leo. Below it by a fist at arm's length (or a little more) is Leo's own leading light, Regulus. Leo's Sickle asterism extends from Regulus to the upper left, shaped like a backwards question mark.

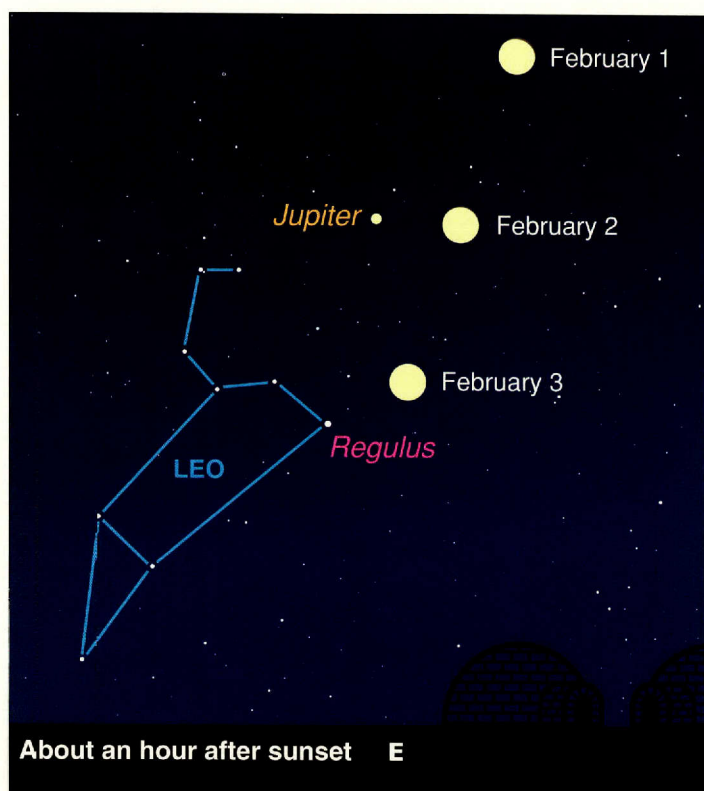
And on the subject of climbing planets, Saturn is also doing better and better before dawn. It's rising in the south-southeast at the top of Scorpius, above Antares and the near-vertical lineup of Scorpius' head stars.

February is the crowning month for Sirius; it reaches its highest position due south around 9 or 10 p.m. in early February, and 8 or 9 p.m. in late February.

Look to the upper right of Sirius for Orion, looking oddly smaller now than he did when low in the east a couple of months ago. This is an example of the "Moon illusion," whereby any celestial object seems to loom bigger when near the horizon than when high in the sky.

Procyon shines to Sirius' upper left by the same distance. Sirius and Procyon are the Dog Star and the "little dog star," respectively, in Canis Major and Canis Minor. They form a bright equilateral triangle with orangey Betelgeuse in Orion's shoulder: the Winter Triangle.

Below Orion's feet crouches dim Lepus, the hare. To Ori-



on's right or upper right is Taurus, the bull, whom he forever pushes westward. Taurus is lit in particular by orange Aldebaran and, farther right or upper right, the unique little Pleiades star cluster, ice chips in frost.

FEBRUARY 16 - 28

Venus is really coming into its own now, beautiful in the west as the stars come out. Its assignation with faint little Mars is the highlight of late February. Watch Venus draw upward toward Mars each evening until they pass a mere one-half degree apart on February 20 and 21. That's about the width of a chopstick at arm's length. Venus is now more than 100 times brighter than Mars and may all but hide it when they're meeting so close-y. Binoculars will give a better view.

And that's not all. On February 20, the thin crescent Moon joins the Venus-Mars tryst, forming a triangle with them. Binoculars give an excellent view of the earthshine that will be on the Moon: the light of the nearly full Earth in the

Moon's sky, dimly illuminating the Moon's night landscape.

But these three won't be together for long. The Moon hops away by the next night to shine above the planet pair. Then in the following weeks, Venus advances higher and brighter into her role as the Evening Star, while Mars gradually drops down into the sunset.

As for the stars? The Sun is setting later and later in the evening now, so the stars are

taking ever longer to come out, which gives them more time to wheel westward before you see them each night. This makes the constellations' seasonal march across the sky seem to speed up.

The whole huge swarm of winter constellations stands highest in the southern sky after dinnertime now. Auriga, with bright Capella, is almost straight overhead, Orion is high in the south, and the little and big dogs follow Orion to his left and lower left, respectively.

But turn to the east, and although it's definitely still winter, you'll see mild constellations of spring already pushing fairly high.

The Big Dipper, best seen in spring and summer, is already standing on its handle well clear of the horizon in the northeast in early evening.

Look due east at about the same height, where the stars of Leo, the lion, glimmer below brilliant Jupiter. "Leo announces spring," goes an old nature-watcher's saying.

But in February? Well, the announcement comes early.

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

The Brightest Stars

Now is a great time to spy Sirius, the brightest star in the night sky. Here are the top five luminaries, and when to view them.

NAME	MAGNITUDE*	BEST VIEWING	FACTOID
Sirius	-1.46	Winter	"The Dog Star," a binary in Canis Major.
Canopus	-0.72	Winter**	A rare yellow-white supergiant.
Alpha Centauri	-0.01	Summer**	A triple system of the closest stars to the Sun.
Arcturus	-0.04	Spring	"The spring star," 25 times larger than the Sun.
Vega	+0.03	Summer	"The summer star," surrounded by a dust disk and possible planet.

* Lower values mean increasing brightness. ** Visible from the southern United States.

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

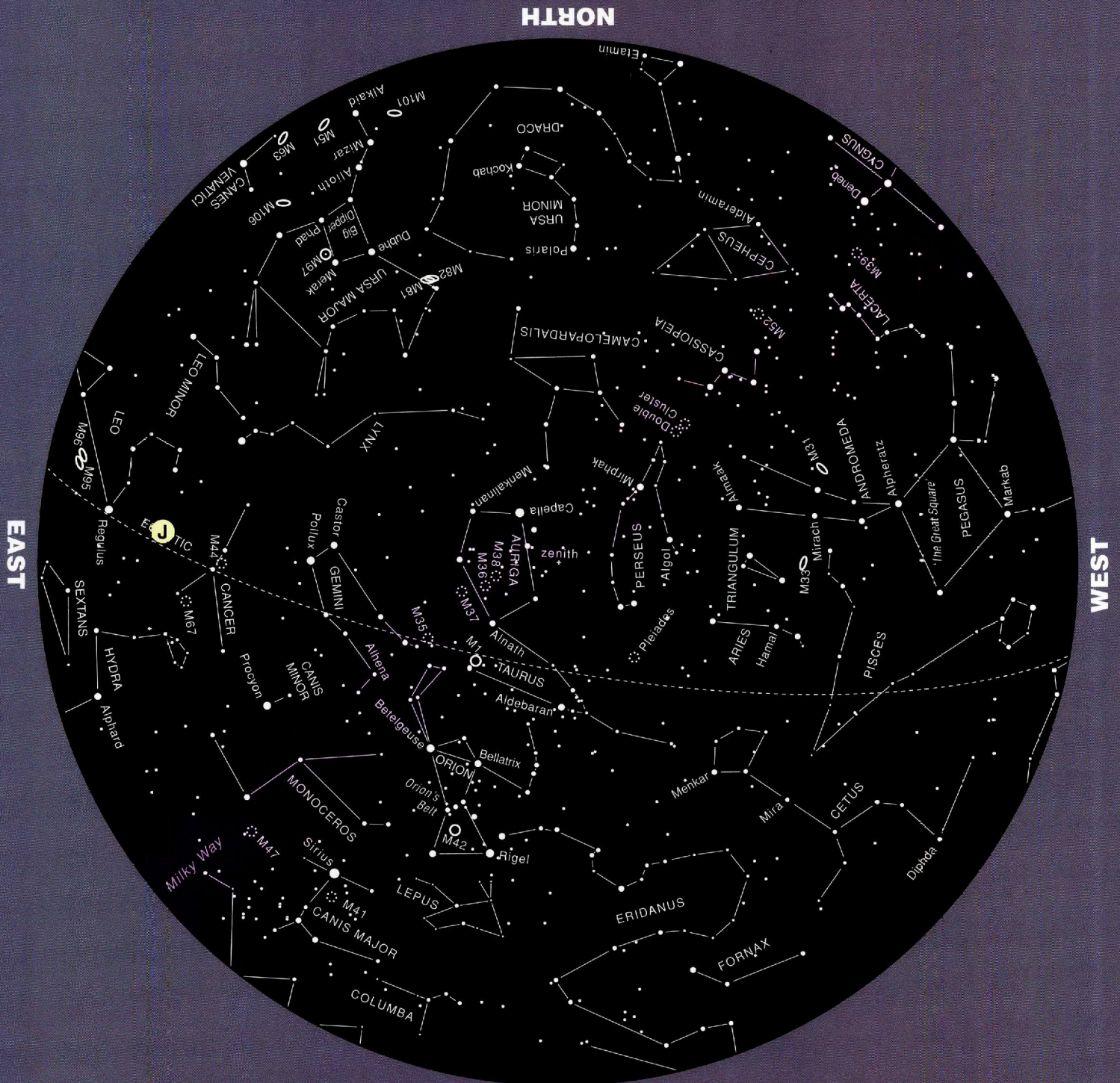
11 p.m.

January 5

10 p.m.

January 20

9 p.m.



MAGNITUDES

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

SOUTH

- ♃ Jupiter
- ☾ open cluster
- ☼ globular cluster
- ☾ nebula
- ☾ planetary nebula
- ☾ galaxy

FEBRUARY

How to use these charts:

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January 20

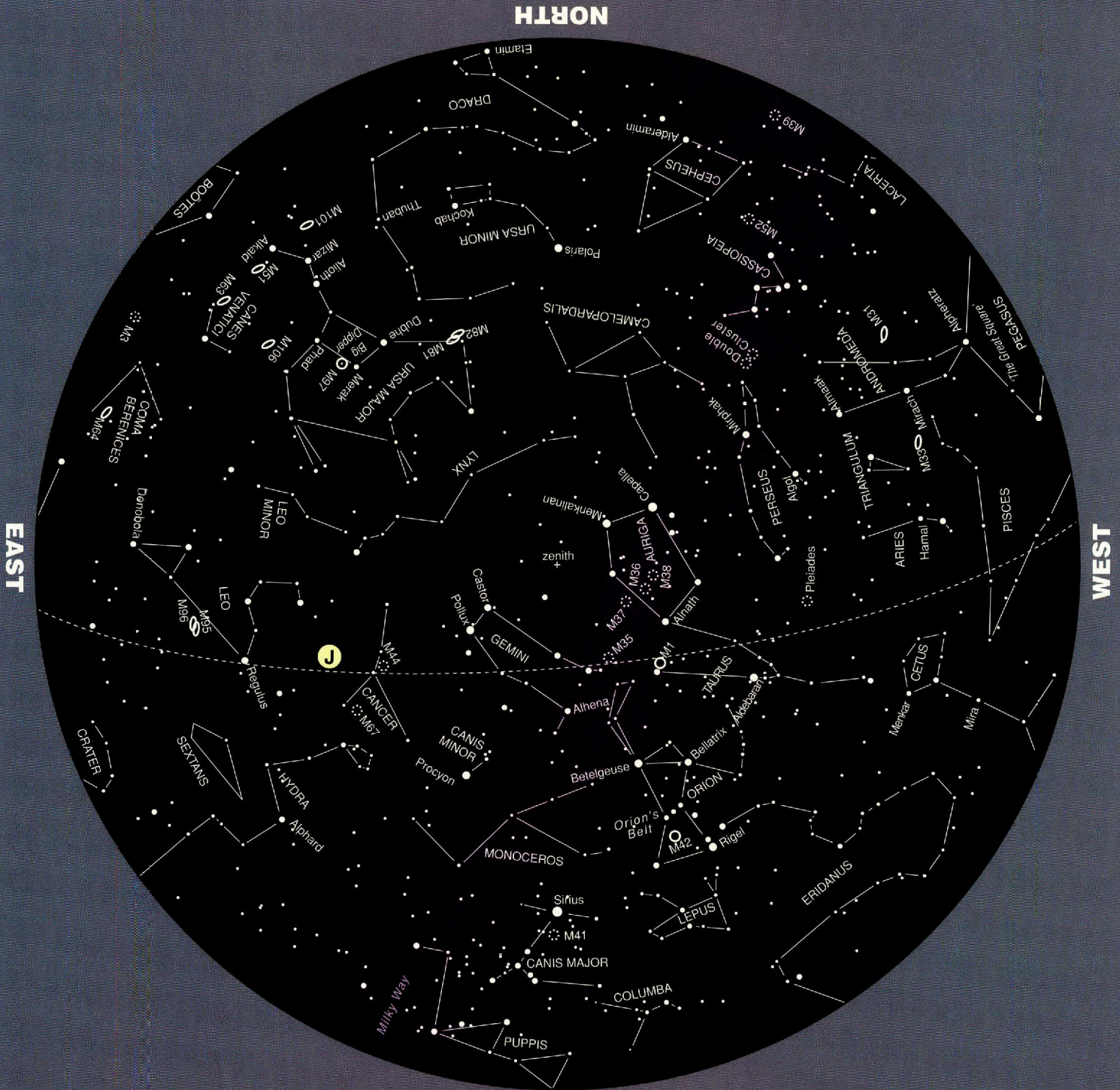
11 p.m.

February 5

10 p.m.

February 20

9 p.m.



MAGNITUDES

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

J Jupiter

- open cluster
- ⊛ globular cluster
- nebula
- planetary nebula
- galaxy



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