December 2020: Great Conjunction, Venus with the Scorpion*

by Jeffrey L. Hunt

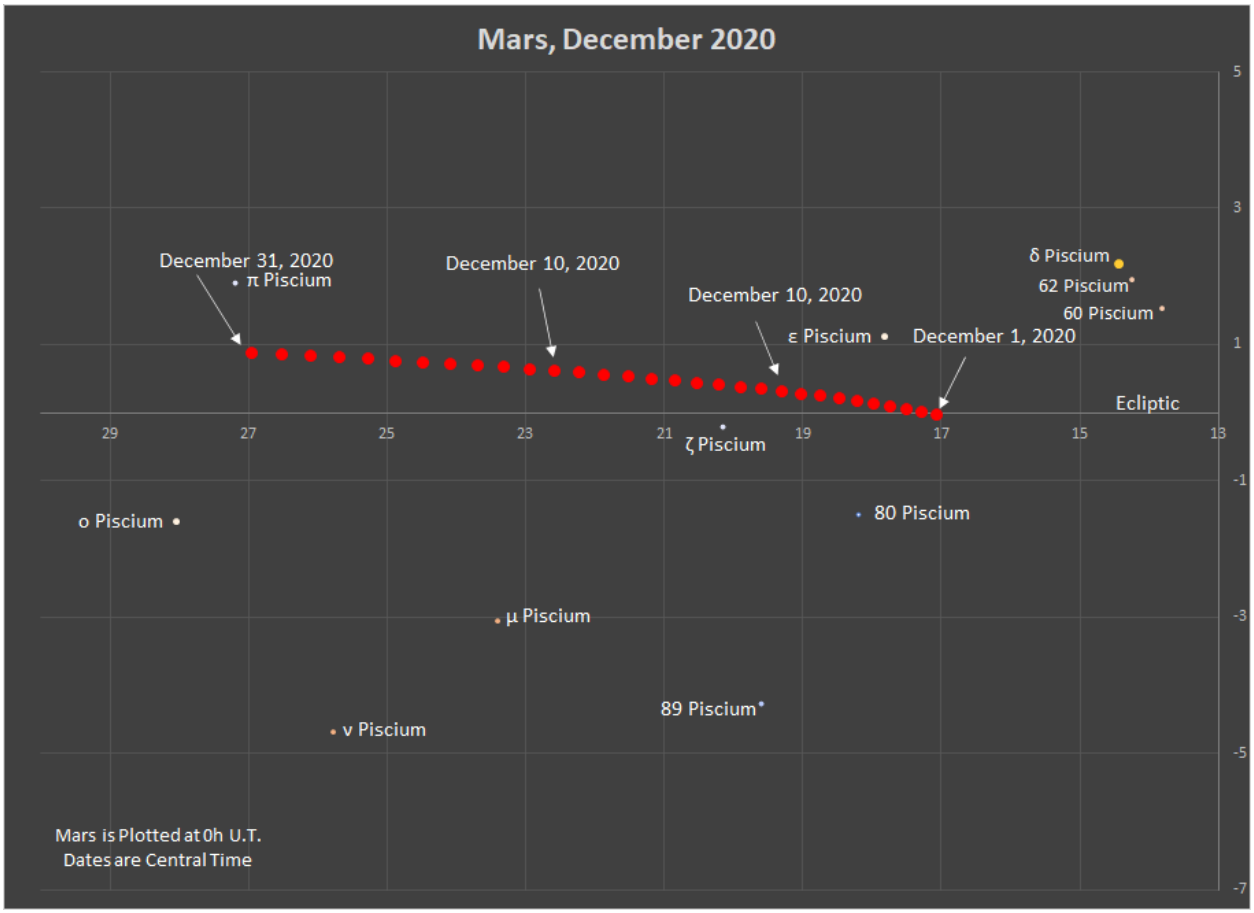

Figure 1 - Mars: Watch the Red Planet move eastward through Pisces. Early in the month, it passes through a triangle made by Zeta Piscium (ζ Psc), Epsilon Piscium (ε Psc), and 80 Piscium (80 Psc).

At the beginning of morning twilight (5:20 a.m. CST) when December begins, a bright moon outshines the subtle features of the Orion region of the Milky Way. The lunar orb shines from the horns of Taurus. Sirius, Orion, and Taurus are lined up along the western horizon as they appear on a spring evening. The arc of stars – Procyon, Pollux, Castor, and Capella – appear as an umbrella that is higher in the sky. Farther eastward, Regulus and the Sickle of Leo is at the meridian. The Big Dipper is high in the north, nearly the same distance as Leo from the zenith. The dipper's Pointer Stars reliably aim at the Pole Star. The handle curves toward the east, where topaz Arcturus – over a third of the way up in the sky – is now well-placed for easy reference. Spica is low in the southeast to the lower right of Arcturus. Brilliant Venus is nearby, the lone bright planet in the morning sky. Watch the planet move through Libra and then close to brighter stars in Scorpius during the month. Moving northward along the horizon, you might spot the backwards "C" of Corona Borealis, to the lower left of Arcturus. Vega is low in the northeast. Cassiopeia is low in the north, west of the meridian. Daylight is about 9.5 hours long. From now until the winter solstice, daylight loses about 20 minutes, as the sun loses 1° of noon altitude.

Darkness – the span of time after the end of evening twilight until the beginning of morning twilight – is 11 hours, 20 minutes. Throughout the month, the end of evening twilight occurs slightly after 6 p.m. CST. While the weather is not yet bone-numbing, the early onset of darkness allows for early observing. So, bundle up, get outside, to look at the evening sky with a binocular, telescope, or just a quick tour of the sky without optical help. At this hour, the bright moon is low in the east-northeast, to the left of the horns of Taurus. Bright Capella stands to the lunar orb's upper left while Aldebaran is to the upper right. Even though the moon is bright, you might spot the Pleiades, higher than Aldebaran, about a third of the way up in the east. At the meridian, working upward, Fomalhaut – Mouth of the Fish – is slightly to the east and about a quarter of the way up in the sky. Aquarius is above the Southern Fish. A circular pattern of pairs of 3rd and 4th magnitude, to the upper left Fomalhaut – are unique to Aquarius. The Great Square of Pegasus, over two-thirds of the way up in the sky, is east of the meridian. Andromeda's stars, beginning at Alpheratz, point toward the northeast horizon and Capella. Perseus is between Andromeda and Auriga. Bright Mars, dimmer than when it was at closest approach during early October, marches eastward in Pisces. During the next several days, watch the planet step through a miniature triangle made by Epsilon Piscium, Zeta Piscium, and 80 Piscium. Back at the meridian, Cassiopeia is over two-thirds of the way up in the northern sky, east of the celestial divider. The Big Dipper scrapes along the horizon at this time. Even though the seasons have changed, the Summer Triangle – Vega, Altair, and Deneb – dominate the western sky. The impending Great Conjunction is playing out in the southwest. Bright Jupiter is to the lower right of Saturn.

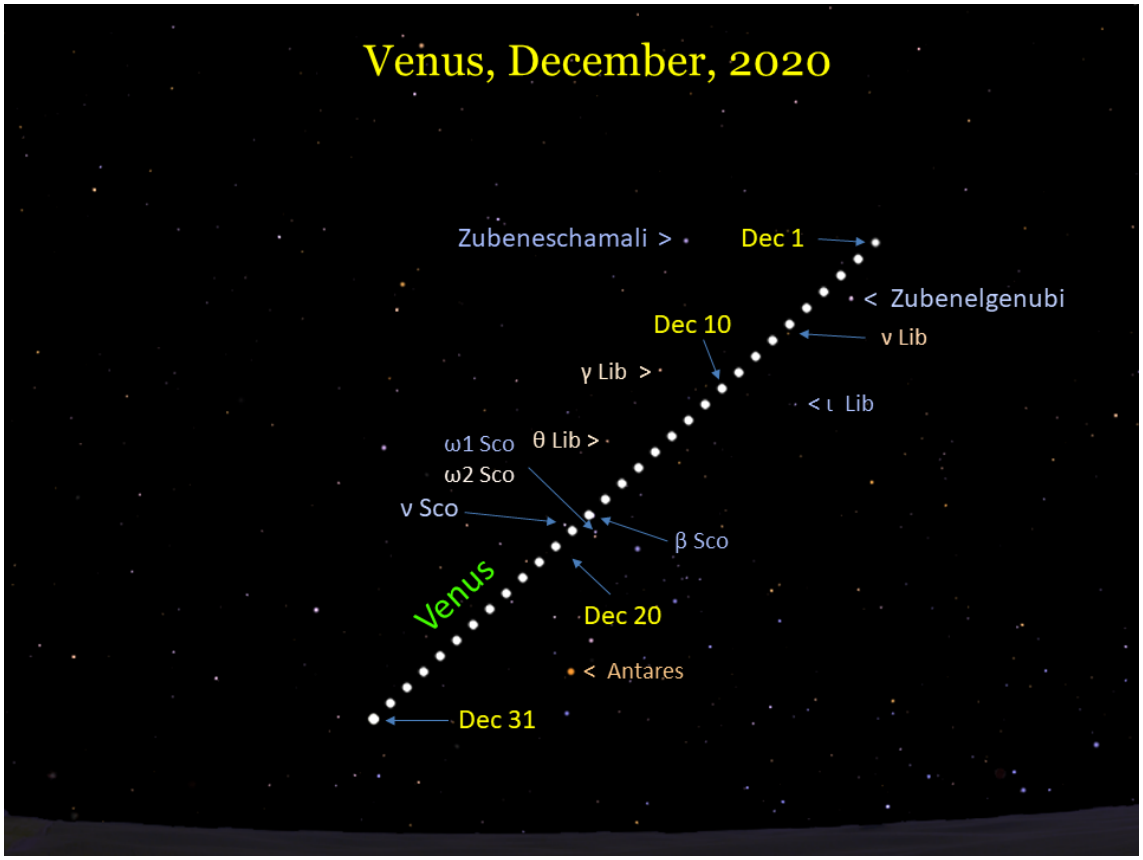

Figure 2 - Venus: In the morning sky during December, Venus steps through Libra and Scorpius, and into Ophiuchus.

Figure 3 - December 1: One hour before sunrise, the bright moon is in the west-northwest, between the Horns of Taurus, Zeta Tauri (ζ Tau) and Beta Tau (β Tau).

- **December 1**: One hour before sunrise, brilliant Venus (m = −3.9) – low in the east-southeast – is the lone bright morning planet. It is among the stars of Libra, 3.8° to the upper right of Zubenelgenubi (α Lib, m = 2.8). Use a binocular to spot the brilliant planet 2.1° to the upper right of Mu Librae (μ Lib, m = 5.3). Through a telescope, Venus is a morning gibbous, 89% illuminated and 11.6" across. The gibbous moon (16.3 days after the New Moon phase, 99% illuminated) – nearly 21° up in the west-northwest – is between the Horns of Taurus. Block the moon's glare to see the stars that mark the horn's tips. Zeta Tauri (ζ Tau, m = 3.0) is 4.2° to the upper left of the moon. Beta Tauri (β Tau, m = 1.6) is 5.8° to the upper right of the lunar orb. Mercury (− 0.8) rises about 50 minutes before sunrise. By 30 minutes before sunrise, the planet is less than 3° in altitude in the east-southeast, clearly a challenge to see. Daylight is a minute less than 9.5 hours long. Until the solstice, daylight loses less than 25 minutes. The shortest daylight of the year is with us. Antares is in conjunction with the sun today. It makes its first morning appearance later in the month. One hour after sunset, Jupiter (m = −2.0) and Saturn (0.6) are about 19° up in the southwest. The gap between the planets is 2.1°. Saturn is to Jupiter's upper left. **Great Conjunction Countdown: 20 days**. In the starfield, Jupiter is 2.1° to the lower left of 56 Sagittarii (56 Sgr, m = 4.8), while Saturn is 3.7° to the upper left of that star. Additionally, Saturn is 4.5° to the lower right of Sigma Capricorni (σ Cap, m = 5.2). Use a binocular to track the progress of the planets compared to these stars. Jupiter sets about 7:40 p.m. Saturn follows several minutes later. Mars (m = −1.1) is 80.9° of ecliptic longitude east of Jupiter. The gap between them opens during December as Mars picks up eastward speed after the conclusion of its recent retrograde. Through a telescope, the Red Planet is 14.4" across. At this hour, the planet is over 38° in altitude above the east-southeast horizon. While its

Figure 4 - December 1 – 5: Brilliant Venus passes Zubenelgenubi on December 3. This chart shows the motion of Venus compared to the star for a few days around the conjunction date.

brightness is diminished since its October 13 opposition, the rusty tint and brightness makes it the brightest "star" in the eastern sky at this hour. It seems to move across the sky during the night, setting in the west about 2:30 a.m. CST, long before Venus rises. Among the stars, Mars is 1.2° to the lower right of Epsilon Piscium (ε Psc, m = 4.2) and 1.7° to the upper right of 80 Piscium (80 Psc, m = 5.5). With a binocular, watch the planet move between the two stars during the next few evenings. About 3 hours after sunset (7:20 p.m. CST), the bright gibbous moon (16.8d, 97%) is nearly 20° up in the east-northeast. Now outside the Horns of Taurus, the lunar orb is 5.1° to the lower left of ζ Tau and 8.4° below β Tau.

Figure 5 - December 1: One hour after sunset, Jupiter is 19° up in the southwest, 2.1° to the lower right of Saturn.

- **December 2**: One hour before sunrise, the bright gibbous moon (17.3d, 96%) is over 30° in altitude in the west. It is 2.5° to the lower right of Mu Geminorum (μ Gem, m = 2.8) and nearly 20° to the lower right of Castor (α Gem, m = 1.6). Block the moon's glare to see the dimmer stars of Gemini. Farther east, Venus is 2.2° to the upper right of Zubenelgenubi and 0.9° to the upper right of μ Lib. One hour after sunset, Mars is 39.0° up in the east-southeast, moving eastward compared to Pisces' starry background. Use a binocular to spot the Red Planet 1.1° to the lower right of ε Psc and 1.6° to the upper right of 80 Psc. Farther westward, Jupiter is 19.0° up in the south-southwest. Dimmer Saturn is 2.0° to the upper left of the Jovian Giant. **Great Conjunction Countdown: 19 days**. In the starfield, Jupiter is 2.3° to the lower left of 56 Sgr, and Saturn is 3.8° to the upper left of the star. Additionally, Saturn is 4.4° to the lower right of σ Cap. Four hours after sunset (8:20 p.m. CST), the moon (17.9d, 93%) – nearly 20° up in the east-northeast – is over 12° to the upper right of Pollux (β Gem, m = 1.2).
- **December 3**: One hour before sunrise, brilliant Venus – over 12° up in the east-southeast – is 1.3° to the upper left of Zubenelgenubi and 0.5° to the lower right of μ Lib. Farther west, the moon (18.3d, 91%) is 8.6° to the lower right of Pollux. In the evening, Mars (m = −1.0) – moving eastward in Pisces – is 1.0° to the lower right of ε Psc and 1.6° to the upper right of 80 Psc. Use a binocular to spot the planet among the dimmer stars. Farther west, Saturn is 20.0° up in the south-southwest, 1.9° to the upper left of Jupiter. **Great Conjunction Countdown: 18 days**. In the starfield, the Ringed Wonder is 3.9° to the upper left of 56 Sgr and 4.3° to the lower right of σ Cap, while Jupiter is 2.4° to the lower left of 56 Sgr. Five hours after sunset (9:20 p.m. CST), the moon (18.9d, 86%) is over 20° in altitude above the east-northeast horizon. It is 4.6° to the lower right of Pollux.

Figure 6 - December 4: One hour before sunrise, the bright gibbous moon is to the upper left of the Gemini Twins.

- **December 4**: One hour before sunrise, the moon (19.3d, 85%) is 49.0° above the west-southwest horizon. It is 6.7° to the upper left of Pollux. Farther east, brilliant Venus is 12.0° up in the east-southeast, 1.4° to the left of Zubenelgenubi and 1.6° to the lower left of μ Lib. One hour after sunset, Mars is over 41° up in the east-southeast, between ε Psc and 80 Psc. The Red Planet is 1.0° to the lower right of ε Psc and 1.6° to the upper right of 80 Psc. Farther west, Jupiter is over 18° above the southwest horizon. The Jupiter – Saturn gap is 1.8°. Dimmer Saturn is to bright Jupiter's upper left. **Great Conjunction Countdown: 17 days**. Among the stars, Jupiter is 2.5° to the left of 56 Sgr, while Saturn is 3.9° to the star's upper left. Additionally, Saturn is 4.2° to the lower right of σ Cap. Six hours after sunset (10:20 p.m. CST), the moon (20.0d, 79%) is over 19° in altitude in the east. It is in front of the dim stars of Cancer. With the Andromeda Galaxy (M31, NGC 224) high in the sky, near the meridian, other deep sky objects follow this dramatic and extensive galaxy into the sky. Start at Alpheratz and star hop toward Perseus. Go to Pi Andromedae (π And), then to Mu Andromedae (μ And). Here turn your attention upward to go to M31. Otherwise, continue toward Perseus, by making a big hop from μ And to 51 Andromedae (51 And). By doing so you hop over several 4th and 5th magnitude stars. The next star is Phi Persei (φ Per). The "Little Dumbbell Nebula" (M76, NGC 650, NGC 651) is 0.9° to the upper right of the star. Like its more famous namesake, M76 is a planetary nebula, but it is one of the dimmest objects in the famous catalog. The nebula has two lobes and initially thought to be two separate objects, and the reason for two entries in the *New General Catalogue*. Use some moderate magnifications to view the star in its terminal stages as it spreads its stellar ingredients across space. The famous "Double Cluster," h (NGC 869) and χ Persei (NGC 884), is about 10° to the lower left of 51 Per, between the brighter stars of Perseus and Cassiopeia. Like M31, shift your finder or binocular in that direction and both clusters are spotted easily. The cluster is high in the sky around 9:30 p.m. CST. In his *Deep Sky Wonders*, Walter Scott Houston explains that Messier did not include the pair in his catalog (too well-known) as well as the origin of the name. He thinks it may have originated in in publication in 1867 where it was described as "the magnificent double cluster in the sword-handle of Perseus" (p. 18). The clusters are separate entities that are over 7,000 light years away, but with a gap between them that is approximately 200 light years. Whether you prefer a low-power view to capture the pair or a high-power observation to darken the sky and focus in on parts of the cluster, the view is one to enjoy. During the early evening, another open cluster, M103 (NGC 581) is about 8° to the upper left of h and χ Persei, and 1.0° below Delta Cassiopeiae (δ Cas). Farther

away than the famous cluster pair, M103 is described by Mallas in *The Messier Catalog* as, "A grand view! The stars form an arrowhead" (p. 183). The cluster has a combined magnitude of a 6th magnitude star. It has about 40 stars within the capabilities of a moderate-size telescope and a dark sky.

- **December 5**: One hour before sunrise, brilliant Venus is nearly 12° in altitude above the east-southeast horizon and 2.3° to the lower left of Zubenelgenubi. Use a binocular to see dim Nu Librae (ν Lib, m = 5.2) 1.7° to the lower left of Venus. Watch Venus pass and move away from ν Lib during the next few mornings. Through a telescope, Venus is 11.5" across and 90% illuminated, a morning gibbous. Meanwhile, in the west, the bright gibbous moon (20.3d, 76%) is nearly two-thirds of the way up in the sky in the west-southwest. It is between Gemini and Leo, in the dim constellation Cancer. It is nearly midway from Regulus (α Leo, m = 1.3) and Pollux. Antares rises at sunrise. Jean Meeuss calls this the star's "Cosmic Rising." Aldebaran rises at sunset. One hour after sunset, Jupiter is over 18° up in the southwest, 1.7° to the lower right of Saturn. **Great Conjunction Countdown: 16 days**. Among the stars, Jupiter and Saturn are near 56 Sgr. Jupiter is 2.7° to the left of the star, while Saturn is 4.0° to the upper left of 56 Sgr. Additionally, Saturn is 4.1° to the lower right of σ Cap. Mars – over 40° up in the east-southeast - is 81.0° of ecliptic longitude east of Jupiter. The gap between the two planets grows slowly as Mars picks up speed as it marches eastward in Pisces. With a binocular spot the Red Planet inside a triangle made by ε Psc, ζ Psc, and 80 Psc. The planet is 1.2° to the lower left of ε Psc and 1.5° to the upper right of ζ Psc. Mars is to the right of a line from ε Psc to ζ Psc. Make nightly observations of the morning and evening planets to see them move compared to their starfields. Through a telescope, Mars is 13.7" across.

Figure 7 - December 6: In the morning sky, the bright gibbous moon is 5.9° to the upper right of Regulus and 2.6° to the lower right of Eta Leonis (η Leo).

Figure 8 - December 6: In the evening sky, Mars is inside a triangle formed by Epsilon Piscium (ε Psc), Zeta Piscium (ζ Psc), and 80 Piscium (80 Psc).

- **December 6**: One hour before sunrise, the bright gibbous moon (21.3d, 66%) – 60° up in the southwest – is 5.9° to the upper right of Regulus and 2.6° to the lower right of Eta Leonis (η Leo, m = 3.5). Farther eastward, Venus is about 12° in altitude above the east-southeast horizon, 3.4° to the lower left of Zubenelgenubi and 0.6° to the upper right of Nu Librae (ν Lib, m = 5.2). Use a binocular to see Venus with the dimmer stars. One hour after sunset, Mars (m = −0.9) is over 40° up in the southeast, moving eastward in Pisces. With a binocular note that it is inside a triangle formed by ε Psc, ζ Psc, and 80 Psc. The Red Planet is 1.1° to the lower left of ε Psc and to the right of a line from ε Psc to ζ Psc. Farther west, Saturn is nearly 19° in altitude above the southwest horizon, 1.6° to the upper left of Jupiter. The Jovian Giant continues to close the gap on the Ring Wonder as the Great Conjunction of December 21 is approaching. **Great Conjunction Countdown: 15 days**. In the starfield, Saturn is 4.1° to the upper left of 56 Sgr, while Jupiter is 2.8° to the lower left of the star. Saturn is approaching σ Cap. This evening's gap is 4.0°. As midnight approaches, the moon (22.0d, 58%) is about 12° up in the east, 7.6° to the lower left of Regulus.
- **December 7**: One hour before sunrise, the moon (22.3d, 56%) – over 60° in altitude in the south-southwest – is over 10° to the upper left of Regulus and nearly 15° to the lower right of Denebola (β Leo, m = 2.1). The lunar orb is below a line that connects the two stars. At this time, brilliant Venus shines from low in the southeast. It is 4.5° to the lower left of Zubenelgenubi and 0.8° to the lower left of ν Lib. Look at the starfield with a binocular. The trio is nearly in a line. One hour after sunset, Jupiter is over 17° up in the southwest, 1.5° to the lower right of Saturn. Jupiter continues to close the gap to Saturn. **Great Conjunction Countdown: 14 days**. Continue to watch the nightly change with a binocular. Jupiter is 3.0° to the left of 56 Sgr. Saturn is 4.2° to the upper left of that

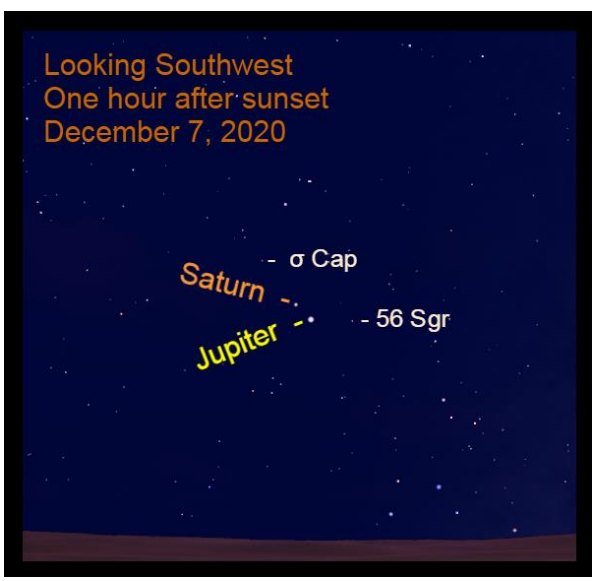

Figure 9 - December 7: Jupiter is 1.5° to the lower right of Saturn.

star and 3.9° to the lower right of σ Cap. Mars shines from the southeast, nearly halfway up in the sky. The Red Planet is inside a triangle formed by dim stars ε Psc, ζ Psc, and 80 Psc. It is 1.2° to the lower left of ε Psc and 1.5° to the upper right of ζ Psc. It is to the right of a line from ε Psc to ζ Psc. The moon is at its Last Quarter phase at 6:37 p.m. CST.

- **December 8**: One hour before sunrise, brilliant Venus is nearly 11° in altitude above the southeast horizon. It is 5.6° to the lower left of Zubenelgenubi, 1.9° to the lower left of ν Lib, and 3.2° to the upper left of Iota Librae (ι Lib, m = 4.5). Farther west, the thick crescent moon (23.3d, 44%) is over 55° up in the south, 7.5° to the lower right of Denebola – the Lion's tail. One hour after sunset, bright Jupiter is 17° up in the southwest, 1.1° to the lower right of Saturn. **Great Conjunction Countdown: 13 days**. Farther east, Mars is nearly halfway up in the sky in the southeast. Mars is 1.4° to the lower left of ε Psc, 1.2° to the upper right of ζ Psc, and 1.9° to the upper left of 80 Psc. Use a binocular to spot the planet with the stars that make a small triangle.
- **December 9**: One hour before sunrise, the moon (24.3d, 33%) is over halfway up in the sky in the south-southeast. It is 3.3° to the upper right of Gamma Virginis (γ Lib, m = 3.4). Venus is lower in the southeast, about 11° in altitude. It is 3.4° to the upper left of ι Lib. One hour after sunset, Saturn is nearly 18° up in the southwest, 1.0° to the upper left of brighter Jupiter. The Jovian Giant continues to close the gap with the Ringed Wonder. **Great Conjunction Countdown: 12 days**. Mars is farther east, less than halfway up in the sky above the southeast horizon on a line that connects ε Psc and ζ Psc. The Red Planet is 1.6° to the lower left of ε Psc, 1.0° to the upper right of ζ Psc, and 2.0° to the upper left of 80 Psc. Use a binocular to spot the planet with the stars.
- **December 10**: One hour before sunrise, Venus is over 10° up in the southeast, between ι Lib and γ Lib. Venus is about 3° from each star. The crescent moon (25.3d, 23%) is higher in the sky, over 36° up. The lunar slice is 6.3° to the upper left of Spica (α Vir, m = 1.0). In the evening, one hour after sunset, Mars (m = −0.8) is nearly halfway up in the southeastern sky. The Red Planet is now east of the small triangle formed by ε Psc, ζ Psc, and 80 Psc. It is 1.9° to the lower left of ε Psc, 0.8° to the upper right of ζ Psc, and 2.2° to the upper left of 80 Psc. Jupiter is over 16° up in the southwest, 81.4° of ecliptic longitude west of Mars. In the southwest, Saturn is 1.0° to the upper left of the brighter planet. **Great Conjunction Countdown: 11 days**.
- **December 11**: One hour before sunrise, the crescent moon (26.3d, 14%) is about 25° up in the southeast, 8.8° to the upper right of Zubenelgenubi. Venus – 10° above the horizon – is nearly 18° to the lower left of the lunar arc and 3.0° to the lower right of γ Lib. In the evening, Saturn is nearly 17° up in the southwest, 1.0° to the upper left of bright Jupiter. The Jovian Giant continues to close the gap to Saturn. **Great Conjunction Countdown: 10 days**. The Jupiter- Saturn gaps until the conjunction: **Dec. 12**, 0.9°, **Dec. 13**, 0.8°; **Dec. 14**, 0.7°; **Dec. 15**, 0.6°, Saturn moves into Capricornus; **Dec. 16**, 0.5°; **Dec. 17**, 0.4°; **Dec. 18**, 0.3°, Jupiter moves into Capricornus; **Dec. 19**, 0.2°; **Dec. 20**, 0.1°, Jupiter below Saturn. Farther eastward, Mars – nearly halfway up in the southeast – is 0.6° to the upper right of ζ Psc and 2.1° to the lower left of ε Psc. Use a binocular to observe Mars in front of the starry background.

Figure 10 - December 12: One hour before sunrise, the crescent moon is 4.2° to the upper right of Venus.

- **December 12**: One hour before sunrise, the crescent moon (27.3d, 6%) is over 13° up in the southeast, 4.2° to the upper right of Venus. In the starfield, the planet is 3.0° to the lower right of γ Lib. The moon is at perigee at 2:42 p.m. CST – 224,826 miles away. One hour after sunset, Jupiter is nearly 16° in altitude above the southwest horizon. Saturn is 0.9° to the upper left of Jupiter. **Great Conjunction Countdown: 9 days**. Farther eastward, Mars is nearly halfway up in the sky in the southeast. The Red Planet passes 0.6° to the upper left of ζ Psc. The planet is 2.4° to the lower left of ε Psc.
- **December 13**: Forty-five minutes before sunrise, Venus is about 12° up in the southeast. The razor-thin, crescent moon (28.3d, 2%) – only about 4° up in the east-southeast – is 9.5° to the lower left of Venus. One hour after sunset Saturn is over 16° in altitude in the southwest, 0.8° to the upper left of Jupiter. **Great Conjunction Countdown: 8 days**. Farther east Mars is over 45° up in the southeast, 0.7° to the upper left of ζ Psc and 2.7° to the lower left of ε Psc.

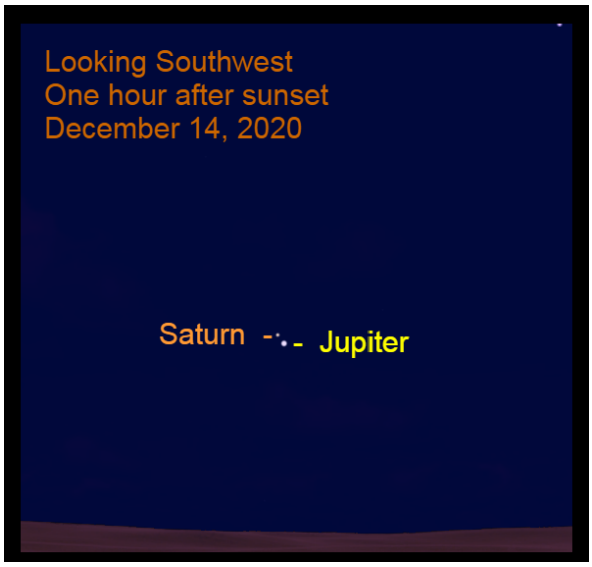

Figure 11 - December 14: The Jupiter- Saturn gap is 0.7°.

- **December 14**: One hour before sunrise, Venus is less than 10° up in the southeast. It is 4.3° below γ Lib. The moon is at its New phase at 10:17 a.m. CST. A total solar eclipse is visible from the South Pacific, Chile, Argentina, and the South Atlantic. The maximum duration of totality is 2 minutes, 11 seconds. None of the eclipse is visible over land in North America. One hour after sunset, the Jupiter – Saturn gap is 0.7°. **Great Conjunction Countdown: 7 days**. Find the giant planets about 15° in altitude in the southwest. Farther east Mars (m = −0.7) is over halfway up in the southeast. In the starfield, the Red Planet is 0.9° to the upper left of ζ Psc and 3.0° to the lower left of ε Psc.
- **December 15**: Venus rises two hours before sunrise. One hour later, it is nearly 9° up in the southeast. With a binocular observe that it is 2.2° to the lower right of Theta Librae (θ Lib, m = 4.1). At this time the brilliant planet is 3.7° to the upper right of Beta Scorpii. (β Sco, m = 2.6). Watch Venus close the gap during the next two mornings: **Dec 16**, 2.4°;

Dec 17, 1.2°. In a telescope, Venus is 91% illuminated – a morning gibbous – and 11.1" across. Thirty minutes after sunset, the moon (1.3d, 2%) is about 6° up in the southwest – over 18° to the right of Jupiter. Half an hour later, Saturn is 15° up in the southwest 0.6° to the upper left of bright Jupiter. Today, Saturn moved into Capricornus from Sagittarius. **Great Conjunction Countdown: 6 days**. Mars is 81.9° of ecliptic longitude east of Jupiter, over 46° in altitude above the southeast horizon. In the starfield, the planet is 1.2° to the upper left of ζ Psc and 3.4° to the lower left of ε Psc.

At the beginning of morning twilight, the bright stars of the Orion region are in the western sky. Sirius and Aldebaran are likely difficult to see. The arc made by Procyon, Pollux, Castor, and Capella is lower than earlier in the month. The Sickle of Leo is west of the meridian, followed by the Lion's haunches, now at the celestial divider. Venus is slowly sliding back into sunlight. At this hour it is low in the east-southeast, below Zubenelgenubi and Zubeneschamali. Arcturus and Spica mark the eastern sky. The Big Dipper is at the meridian with its Pointers aiming downward toward the Pole Star. At the end of evening twilight, the Jupiter-Saturn Great Conjunction continues its seemingly slow-motion play in the southwest. Farther east Fomalhaut, low in the south, is now west of the meridian. Higher along the meridian, the Great Square of Pegasus, is nearly cut into equal parts by the celestial divider. The Great Andromeda Spiral is near the zenith, but slightly east of the meridian. With early sunsets and before the coldest nights set in, this could be one of the best seasons to observe the galaxy near its highest point in the sky. At this hour, Mars is over halfway up in the southeast. It is among the dim stars of Pisces. In a dark location, the Milky Way, climbs into the sky from the west-southwest, cutting through the Summer Triangle and seemingly trapping Deneb on an island. In the eastern sky, the river of celestial light backlights Cassiopeia and Perseus. If you can trace it to the horizon, the glow passes Capella and near the Southern Horn of Taurus. At this hour, the great congregation of the Orion region is appearing in the east, seemingly overwhelming the majesty of the summer Milky Way region with the Summer Triangle. Capella, Aldebaran, and the Pleiades are well-placed for viewing. The pack seems to be pulled into the sky by the star cluster. Betelgeuse and Castor are just above the horizon. This section of the sky does not seem to be complete until Sirius is well-up in the southeast, twinkling wildly in a binocular or telescopic eyepiece. This does not occur for another the hours.

Figure 12 - December 16 – 20: Venus passes Beta Scorpii in a close conjunction. This chart shows the motion of Venus relative to the starfield during five days.

Figure 13 - December 16. The moon joins Jupiter and Saturn five days before the Great Conjunction of 2020.

- **December 16**: Forty-five minutes before sunrise, Venus is nearly 11° up in the southeast. It is 2.4° to the upper right of β Sco. Use a binocular to see the planet in the starfield of Scorpius. One hour after sunset. Jupiter is 16° up in the southwest, 0.5° to the lower right of Saturn. **Great Conjunction Countdown: 5 days**. The crescent moon (2.3d, 7%) is 5.4° below Jupiter. Farther east, Mars (m = −0.6) is over 45° up in the southeast. In the starfield, the Red Plant is 1.5° to the upper left of ζ Psc and 3.7° to the lower left of ε Psc.
- **December 17**: Before sunrise, find brilliant Venus about 10° up in the southeast, 1.1° to the upper right of β Sco. Forty-five minutes after sunset, Jupiter is nearly 16° up in the southwest, 0.4° to the lower right of Saturn. **Great Conjunction Countdown: 4 days**. The lunar crescent (3.3d, 13%) is over 10° to the upper left of Jupiter. As the sky darkens further, Mars is over 47° up in the southeast, 1.8° to the upper left of ζ Psc and 4.0° to the lower left of ε Psc.
- **December 18**: Venus moves into Scorpius. It crosses the constellation in four days. Forty-five minutes before sunrise, Venus – over 10° up in the southeast – is 0.1° to the upper left of β Sco. Use a binocular to observe that the brilliant planet is 1.4° to the upper right of Nu Scorpii (ν Sco, m = 4.0) and 1.0° to the upper left of Omega1 Scorpii (ω1 Sco, m = 3.9). In the evening, look for Jupiter and Saturn in the southwest as the sky darkens after sunset. Jupiter moved into Capricornus from Sagittarius today. The planet pair is about 15° up in the southwest. The Jupiter – Saturn gap is 0.3°, with Jupiter to Saturn's lower right. **Great Conjunction Countdown: 3 days**. The moon (4.3d, 21%) is over 20° to the upper left of Jupiter. Farther east, Mars is over 48° up in the southeast. It is moving eastward among the stars of Pisces. The Red Planet is 2.1° to the upper left of ζ Psc and 4.6° to the lower left of ε Psc.
- **December 19**: Forty-five minutes before sunrise, Venus is less than 10° in altitude in the southeast, 1.3° to the lower left of β Sco, 0.5° to the lower right of ν Sco, and 1.2° to the left of ω1 Sco. Venus is below a line from ν Sco to ω1 Sco. As the sky darkens after sunset this evening, the Jupiter – Saturn pair is about 15° up in the southwest. The gap between the planets is 0.2° with Jupiter to the lower right of Saturn. **Great Conjunction Countdown: 2 days**. The moon (5.3d, 30%), over one-third of the way up in the south-southwest, is 4.5° to the right of Delta Aquarii (δ Aqr, m = 3.2). Look for Fomalhaut (α PsA, m = 1.2) about 15° to the lower left of the moon. Mars is nearly 49° in altitude in the southeast. In the starfield, the planet is 2.5° to the upper left of ζ Psc and 4.8° to the right of Pi Piscium (π Psc, m = 5.5). Find π Psc nearly midway from Eta Piscium (η Psc, m =

3.6) to Omicron Piscium (o Psc, m = 4.2), although it is to the right of a line that connects the two stars. Mercury is at its superior conjunction at 9:26 p.m. CST.

- **December 20**: Forty-five minutes before sunrise, Venus – less than 10° in altitude in the southeast – is 2.5° to the lower left of β Sco. About mid-twilight (45 minutes after sunset), Jupiter is less than 15° up in the southwest. It is 0.1° (471 arcseconds) below Saturn. **Great Conjunction Countdown: 1 day**. As the sky darkens further, the thick crescent moon (6.3d, 40%) – about 38° up in the south – is 8.9° to the upper left of δ Aqr. Because of the moon's brightness, it might be necessary to shield your eyes from the glare to see the starfield. Mars is 35° east of the lunar slice and 82.4° of ecliptic longitude east of Jupiter. The Red Planet is 49° up in the southeast among the dim stars of Pisces. It is moving eastward toward π Psc and away from ζ Psc. This evening it is 2.8° to the upper left of ζ Psc and 4.4° to the upper right of π Psc. Mars passes π Psc early in the new calendar year.

Figure 14 - December 21: The Great Conjunction of 2020. Jupiter appears 0.1° to the lower left of Saturn.

- **December 21**: The winter solstice occurs at 4:02 a.m. CST. Forty-five minutes before sunrise, Venus is less than 10° up in the southeast, 3.8° to the lower left of β Sco and 0.7° to the right of Psi Scorpii (ψ Sco, m = 4.5). Use a binocular to see the star. This morning's test is whether Antares is visible. Venus is 6.2° to the upper left of Antares (α Sco, m =1.0). The star is less than 4° in altitude. You'll need exceptional observing conditions and a binocular to see it. Forty-five minutes after sunset, Mars (m = −0.5) is nearly 48° up in the southeast. The half-full moon (7.3d, 50%), over 40° up in the south-southeast, is about 24° to the lower right of Mars. The moon reaches its First Quarter phase at 5:41 p.m. CST. **This is the evening of the once-every-generation Great Conjunction of Jupiter (m = −2.0) and Saturn (m = 0.6).** They are 30° east of the sun. The conjunction is about 14° in altitude above the southwest horizon. The separation of the two planets is 377 arcseconds. Both planets fit into the eyepieces of modest telescopic powers. Jupiter's Galilean Satellites are nicely lined up along the equatorial plane of the planet. Ganymede, Io, and Calisto are east of Jupiter, and Europa is west of the planet. Titan is nicely placed to the northwest of Saturn. After the conjunction, Jupiter moves eastward along the ecliptic, separating from Saturn. Each evening the planetary pair appears lower in the sky. The gap stays within 0.5° for five

Figure 15 - Telescope View: Jupiter and Saturn are close enough to appear together through a telescope's low power eyepiece. Saturn's rings and Jupiter's four brightest and largest moons are visible as well. The view shows no inversions.

more evenings. Tomorrow they are still close, 0.1° (602 arcseconds), but slightly farther apart than this evening. The Jupiter – Saturn gaps after the conjunction: **Dec. 22**, 0.1°, Jupiter left of Saturn; **Dec. 23**, 0.2°, Jupiter is to the upper left of Saturn; **Dec. 24**, 0.3°; **Dec. 25**, 0.4°, **Dec. 26**, 0.6°, **Dec. 27**, 0.7°, **Dec. 28**, 0.8°, **Dec. 29**, 0.9°; **Dec. 30**, 1.0°.

- **December 22**: Forty-five minutes before sunrise, Venus – in Ophiuchus – is 9.0° up in the southeast, 5.0° to the lower left of β Sco. The planet is 5.8° to the upper left of Antares that is over 4° above the horizon. Forty-five minutes after sunset, Jupiter and Saturn are less than 14° in altitude above the southwest horizon. The Jupiter – Saturn gap is 0.1° (602 arcseconds.) Jupiter is to the left of Saturn. As the sky darkens further, the bright gibbous moon (8.3d, 60%) – about halfway up in the sky in the southeast is nearly 13° to the lower right of Mars. Use a binocular to spot the starfield behind Mars. The planet is nearly midway from ζ Psc to π Psc, but slightly below a line that connects them. Mars is 3.6° to the left of ζ Psc and 3.7° to the lower right of π Psc.

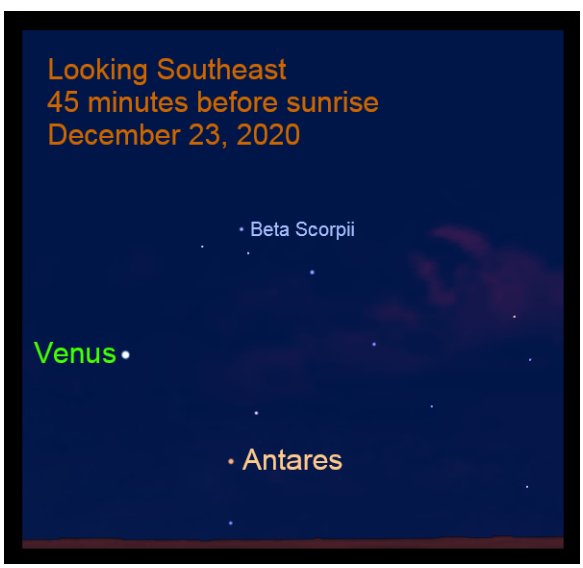

Figure 16 - December 23: Venus is 5.5° to the upper left of Antares.

- **December 23**: Forty-five minutes before sunrise, brilliant Venus is low in the southeast, only about 9° in altitude. The planet is 5.5° to the upper left of Antares. A binocular and a very clear horizon may be needed to see the star. With the binocular look at the starry region of Ophiuchus and Scorpius to the upper right of Venus. In that starfield, Venus is 2.0° to the lower left of ψ Oph and 0.5° to the upper left of Omega Ophiuchi (ω Oph, m = 4.4). One hour after sunset, Jupiter and Saturn are still close together in the southwest. The Jovian Giant is 0.2° to the upper left of the Ringed Wonder. In the starfield, Jupiter is 2.2° to the lower right of σ Cap and 6.0° to the upper left of 56 Sgr. Read the notes for earlier dates this month to observe how much the planets have

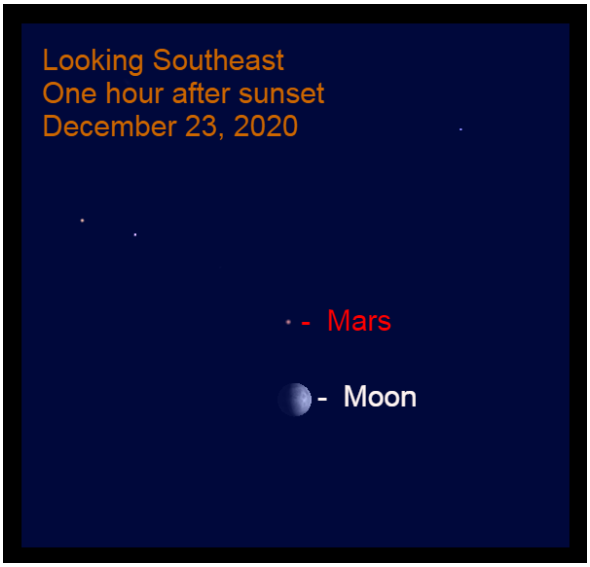

Figure 17 - In the evening sky the moon is 5.6° to the lower left of Mars.

moved compared to those stars during December. At the end of evening twilight, Mars is 55° up in the south-southeast. The moon (9.3d, 69%) is 5.6° to the lower left of Mars.

- **December 24**: Venus is about 8° in altitude in the southeast at 45 minutes before sunrise. The brilliant planet is 5.6° to the upper left of Antares and 1.2° to the lower left of ω Oph. The moon is farthest from Earth (apogee) at 10:31 a.m. CST, 251,640 miles away. In the evening sky, the Jupiter – Saturn gap has grown to 0.3°. Jupiter is to Saturn's upper left. In the starfield, Jupiter is 2.0° to the lower left of σ Cap and 6.2° to the upper left of 56 Sgr. One hour after sunset, Jupiter is nearly 11° in altitude in the southwest. The moon (10.3d, 77%) is nearly halfway up in the east-southeast, nearly 13° to the lower left of Mars.
- **December 25**: Forty-five minutes before sunrise, brilliant Venus is 8° up in the southeast. It is 5.9° to the upper left of Antares, and 2.4° to the lower left of ω Oph. One hour after sunset, Jupiter is over 10° above the southwest horizon, 0.4° to the upper left of Saturn. In the starfield, Jupiter is 1.8° to the lower right of σ Cap. Mars is 83.4° of ecliptic longitude east of Jupiter among the dim stars of Pisces. The Red Planet is marching eastward. It is 4.7° to the upper left of ζ Psc and 2.6° to the lower right of π Psc. The bright gibbous moon (11.3d, 85%) is over 24° to the lower left of Mars and about 14° to the lower right of Pleiades. Block the moon's glare to see the star cluster.
- **December 26**: Venus rises at the beginning of morning twilight, 100 minutes before sunrise. By 45 minutes before sunrise, the brilliant planet is less than 8° in altitude above the southeast horizon and 6.4° to the upper left of Antares. With a binocular spot ω Oph, 3.6° to the upper right of the planet. Notice that Antares, Venus, and Eta Ophiuchi (η Oph, m = 2.4) are nearly in a line that is over 14° from star to star. One hour after sunset, bright Jupiter is less than 10° in altitude in the southwest. The Jupiter – Saturn gap is 0.6°, as Jupiter moves father away from Saturn. Jupiter is 1.5° to the lower right of σ Cap. Farther east Mars is over 50° altitude in the southeast. It is 5.1° to the left of ζ Psc and 2.2° to the lower right of π Psc. The moon (12.3d, 91%) is over one-third of the way up in the sky in the east. It is 10.1° to the upper right of Aldebaran (α Tau, m = 0.8).
- **December 27**: Forty-five minutes before sunrise, brilliant Venus is less than 8° up in the southeast. It is 7.2° to the left of Antares. Venus is the lone morning bright planet. In the evening, the bright gibbous moon (13.3d, 96%) is in the east – 4.8° to the upper left of Aldebaran. Block the moon's brightness to see the Pleiades and Hyades. During the summer I used tree leaves to block the moon to photograph Aldebaran and the Hyades. Farther west, Mars (m = −0.7) is over 50° up in the southeast. It is marching eastward in

Pisces. This evening it is 1.9° to the lower right of π Psc and 3.4° to the upper right of Omicron Piscium (o Psc, m =4.2). Jupiter and Saturn are farther west, less than 10° up in the southwest. Jupiter continues to dance away from Saturn. This evening's gap is 0.7°. Jupiter is to the upper left of Saturn. This evening Jupiter sets a few minutes before 6:30 p.m. CST, about 2 hours after sunset.

- **December 28**: During mid-twilight (45 minutes before sunrise), Venus is nearly 7° up in the southeast, 8.0° to the left of Antares. In the evening sky, Jupiter continues to dance away from Saturn. One hour after sunset, find the bright planet about 9° up in the southwest. It is 0.7° to the upper left of Saturn and 1.3° below σ Cap. Bright Mars is over 50° in altitude in the southeast, among the dim stars of Pisces. It is 1.5° to the lower right of dim π Psc and 3.1° to the upper right of o Psc. Use a binocular because the bright moon (14.3d, 99%) is over 20° up in the east-northeast, seemingly caught between the horns of Taurus. Block the moon's glare to see Aldebaran nearly 16° to the upper right of the moon. The Southern Horn (ζ Tau, m = 3.0) is 2.0° to the lower right of the moon and the Northern Horn (β Tau, m = 1.6) is 5.9° to the upper left of the lunar orb.

Figure 18 - December 28: One hour after sunset, find Jupiter about 9° up in the southwest. It is 0.7° to the upper left of Saturn.

- **December 29**: Two hours before sunrise, the bright moon (14.8d, 100%) – nearly 16° up in the east – is 5.3° to the upper left of ζ Tau. Forty-five minutes before sunrise, Venus is less than 7° in altitude above the southeast horizon. It is 9.0° to the lower left of Antares. In the evening sky, the Jupiter – Saturn gap continues to grow. This evening it is 0.9°. Jupiter is over 8° up in the southwest about one hour after sunset. The planet is 1.1° to the lower left of σ Cap. Farther east, Mars is less than 55° in altitude above the southeast horizon. It continues its eastward march in front of the stars of Pisces. Use a binocular to see it 1.2° to the lower right of dim π Psc and 2.8° to the upper right of o Psc. At this hour, the moon is low in the east-northeast, about 16° to the upper right of Castor (α Gem, m = 1.6).
- **December 30**: One hour before sunrise, the moon (15.8d, 100%) is over 24° in altitude in the west-northwest. The lunar orb is over 11° to the lower left of Castor. Thirty minutes – about the time of Civil Twilight – Venus shines from about 9° up in the southeast. Castor rises at sunset. One hour after sunset, Jupiter – nearly 8° up in the southwest – is 1.0° to the upper left of Saturn. Jupiter is 1.0° to the lower left of σ Cap. Farther east, Mars is nearly 55° up in the southeast. Its eastward march, places it 1.0° to the lower right of π Psc and 2.7° to the upper left of o Psc. Two hours after sunset, the moon (16.3d, 99%) is about 13° up in the east-northeast. It is 5.2° to the right of Pollux (β Gem, m = 1.2).

- **December 31**: One hour before sunrise, the moon (16.8d, 98%) – nearly 24° above the west-northwest horizon – is 4.6° to the lower left of Pollux. A half hour later, Venus is over 8° up in the southeast. One hour after sunset, Jupiter is over 7° in altitude, 1.1° to the upper left of Saturn. Jupiter is 0.9° to the lower left of σ Cap. Jupiter passes the star tomorrow. Mars is 84.6° of ecliptic longitude east of Jupiter. Tonight, the Red Planet passes 1.0° to the lower left of π Psc. Additionally, the planet is 2.6° to the upper right of o Psc. Three hours after sunset, the moon (17.4d, 96%) – nearly 13° up in the east.

At the end of morning twilight at month's end, the morning sky is without a bright planet. Mars started the year in the morning sky. During the summer five naked-eye worlds were lined-up across the sky before sunrise. Now we've dwindled to none at this hour. Venus rises later and it is low in the east-southeast during bright twilight. The bright moon is in the west near Pollux. With the Celestial Twin, Procyon, Castor, and Capella are less than one-third of the way up in the sky. Farther east, all of Leo is west of the meridian. In the eastern sky, the trapezoid shape of Corvus is nearing the imaginary line, while Spica is to the upper left of the Crow. Arcturus is higher in the southeast. The Celestial Scorpion is crawling across the southeast horizon. The claws (Libra) are to the lower left of Spica. They are followed by the critter's head. Its heart (Antares) and tail are below the horizon. Moving northward along the horizon, Vega and Deneb are low in the northeast, while Cassiopeia is east of the north cardinal point. The Big Dipper is high in the north, turned upside down. Daylight is slowly starting to lengthen, although it is nearly 9 hours, 15 minutes long. At the end of evening twilight, as most of the Orion region is now above the eastern horizon, only Sirius and Procyon are below the horizon at this hour. The Pleiades are leading the way, over halfway up in the southeast. At the meridian, the Great Square of Pegasus is west of the celestial divider. Mars, now the lone bright evening planet at the end of evening twilight, is nearly two-thirds of the way up in the south-southeast. Fomalhaut is below the horse, low in the south-southwest. The Great Andromeda Spiral is slightly west of the meridian, near the zenith. The Summer Triangle dominates the western sky, although with Orion in the east, Vega, Altair, and Deneb seem muted in comparison. Along the northern horizon, the end of the Big Dipper's handle, scratches the horizon as the celestial wheel turns and the famous shape begins to climb into the north-northeastern sky.

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This was written for Chicago, Illinois in the Central Time Zone. Observers should make corrections for their specific locations.

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