

# Jupiter and Saturn in 2020: The Great Conjunction

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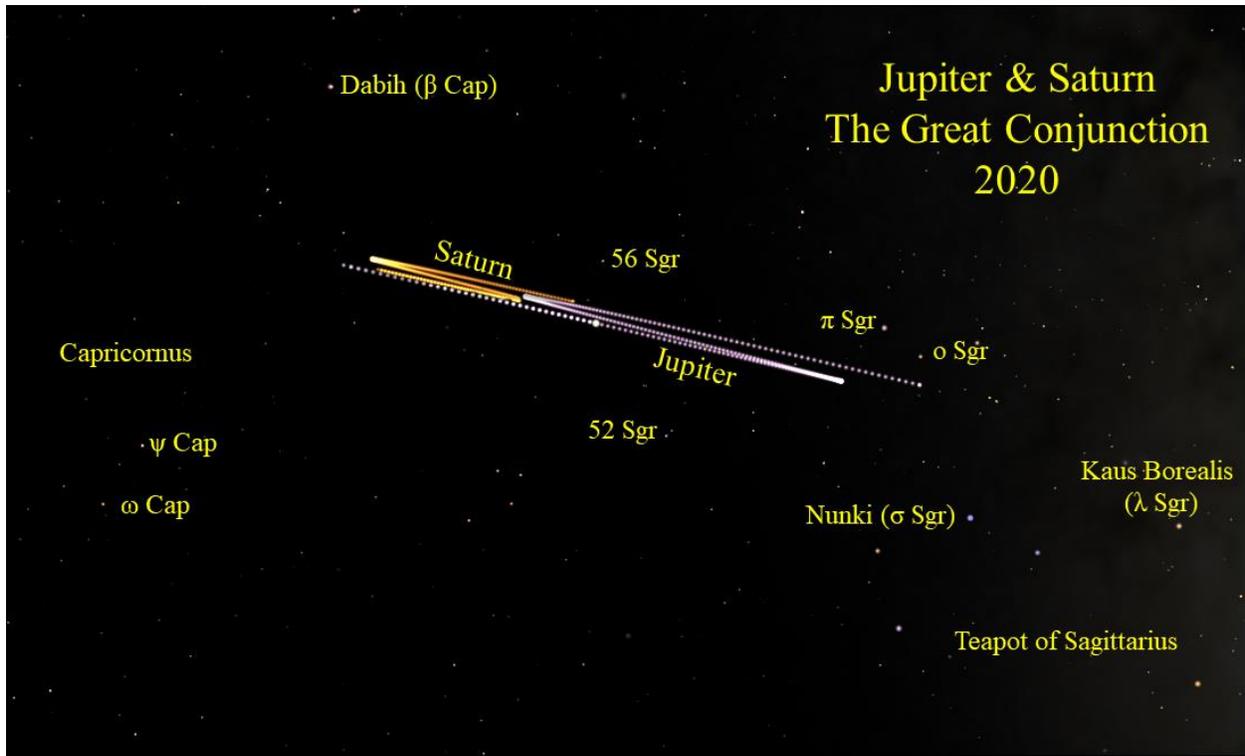


Figure 1 The chart above shows the general celestial regions for the apparitions of the planetary pair among the dim star fields of Sagittarius and Capricornus.

A Great Conjunction of Jupiter and Saturn occurs December 21, 2020. Jupiter – Saturn conjunctions occur every 20 (19.86) years, so-called Great Conjunctions. The 2020 conjunction occurs December 21. The planetary separation is  $0.1^\circ$ , easily fitting into a telescopic field. It is the closest conjunction of this planetary pair since July 16, 1623. The record is unclear whether that conjunction was observed. More about this later.

To track the planets, early sky watchers – even those we consider serious astronomers – divided the ecliptic into 12 equal parts that were  $30^\circ$  long. To solve the cosmological problem of the day – planetary motion – the sky watchers tracked, charted, plotted, and calculated the planets' positions on these diagrams. They predicted planets' conjunctions with other planetary bodies and stars, adjusting their own calculations when the observed positions deviated from their predicted coordinates.

Jupiter and Saturn conjunctions have long been interesting to observe. Occurring once every human generation and moving slowly against the background stars, they appear close to each other for nearly a year between their successive solar conjunctions. Each year, Jupiter moves about  $30^\circ$  eastward against the stars of the ecliptic, while Saturn moves over  $12^\circ$  annually. Jupiter catches and passes Saturn in nearly twenty years. It has been long noted that Saturn

moves over  $240^\circ$  along the ecliptic during the twenty-year interval. After three conjunctions, the next conjunction occurs when the planets are slightly east of the first conjunction's coordinates in the sequence.

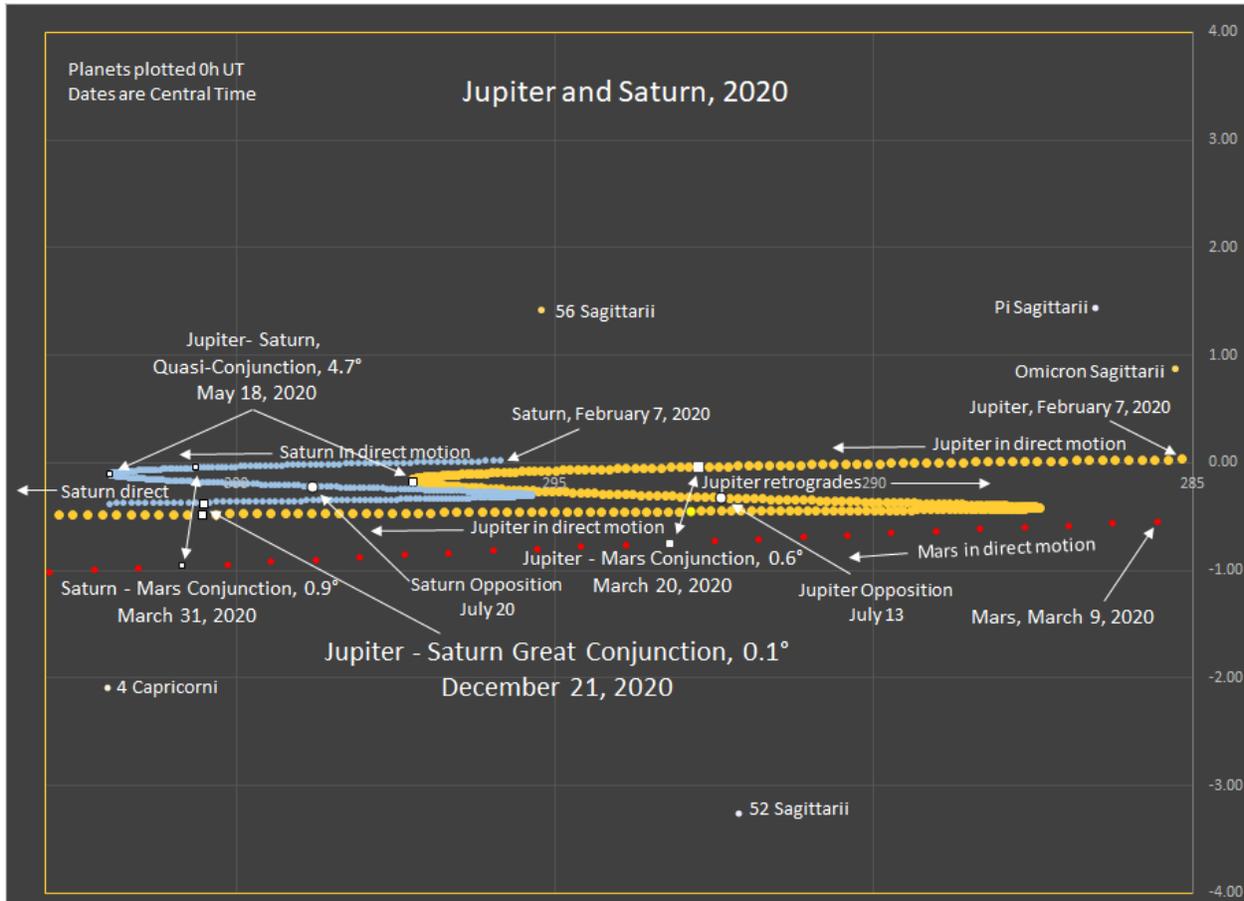


Figure 2 The chart above shows a section of the ecliptic,  $18^\circ$  long, where the planets appear during most of 2020. The planets appear against the background stars of eastern Sagittarius and western Capricornus. The chart includes the path of Mars.

If a Jupiter – Saturn conjunction occurs in Aries, the next conjunction occurs in Sagittarius, and the third occurs in Leo. The fourth conjunction likely occurs in Aries, several degrees east of the initial conjunction. Lines drawn between three successive Great Conjunctions, as seen from above the ecliptic, roughly form a triangle (trigon). The fourth begins a new trigon. The vertices of each successive trigon appear farther east along the ecliptic than the previous shape. Depending on the reference system, a complete set of conjunctions occurs along the entire ecliptic on a cycle that ranges from 794 years to 913 years or 40 to 46 conjunctions. Often 800 years is the round number that refers to the 794-day-interval, measured by coordinates that are shifted by precession.

The trigon planetary configuration was of special interest to those looking to predict world affairs. Three  $30^\circ$  intervals of the ecliptic – Aires, Sagittarius, and Leo – were known as the fiery trigon, and provided special interest in world affairs. Only the appearance of a comet was more ominous than planetary events in the fiery trigon, especially those of Jupiter and Saturn.

Today, there is a web site that notes presidential deaths during the occurrence of a Great Conjunction in this triad of ecliptic doom!

In 1961, the Jupiter – Saturn conjunction occurred in the morning sky, about 2° below 56 Sagittarii. (Note the star's location on the accompanying charts, nearly 5° west of the Capricornus – Sagittarius border.) The 2020 conjunction occurs about 6° farther eastward, just east of the constellations' border.

During his lifetime, the Jupiter – Saturn trigon sent Kepler looking for other geometrical shapes to explain planetary movements and conjunction relationships. His mathematical prowess yielded three dimensional shapes to represent the known planets' relationships.

Kepler became interested in Jupiter – Saturn conjunctions during the Great Conjunction of 1603, occurring in Sagittarius, along with the first appearance of the *Nova Stella in Pede Serpentarii* (New star on the foot of the Serpent Holder) nearby in southern Ophiuchus in 1604. Mars passed Jupiter and Saturn several months later at the nova's first appearance. His research and detailed calculations centered on the Jupiter – Saturn triple conjunction of 7 B.C. and a later passage of Mars. He thought this Great Conjunction explained the Star of Bethlehem.

In the simplest description, a triple conjunction occurs when faster moving Jupiter overtakes slower moving Saturn before they reach opposition. Then as the planets retrograde, Jupiter again passes Saturn. After Jupiter begins its direct motion, it passes Saturn a third time. It should be noted that the two planets' 2020 apparitions coincide with an apparition of Pluto. Jupiter has a triple conjunction with Pluto during this apparition. The conjunctions are listed in the highlights, but a detailed finder chart is not included here. I encourage those with the desire to see Pluto near Jupiter and have sufficient apertures to consult other sources that provide detailed guidance to find the distant, dim planet.

The Jupiter – Saturn conjunction of 1623 occurred in the wake of the invention of the telescope, so observing was in its infancy; yet, the sky was full of planetary activity. A partial lunar eclipse (April 15, 1623) was visible throughout the Americas and in Central Europe, where the moon was setting as the eclipse reached its 90% magnitude. Venus passed Jupiter and Saturn in late June and Mercury passed the planetary pair less than two weeks later, when the planets were about 22° east of the sun. With the inner planets in the vicinity of the impending Great Conjunction and Mars reaching opposition (July 4, 1623), surely sky watchers were observing the planets' locations to test and revise their planetary motion equations.

By the time of the Great Conjunction on July 16, 1623, the planetary pair was less than 13° east of the sun. By Civil Twilight, the pair was near the horizon at mid-latitudes. Without optical help, the conjunction likely went unobserved, even for those with recently minted telescopes. Even then, the observer needed some luck to find the conjunction.

In later years, two British publications stated that the 1623 conjunction was not observed. In 1886, the *Monthly Notices of the Royal Astronomical Society* state that the February 8, 1683, Jupiter – Saturn conjunction was the first observed “since the invention of the telescope” and that the 1623 passing went unobserved. The same statement was written in the *Journal of the British*

*Astronomical Association* in 1897. Perhaps the conjunction was observed without optical aid and recorded from more southerly latitudes, when the planets were higher in the sky.

Did the two British publications make the statements out of parochialism, rather than from factual observations made around Europe regarding the first Great Conjunction observed with a telescope, or was this the first time that the conjunction fit into an eyepiece since the telescope's invention? The February 24, 1643, conjunction was visible in the western sky during mid-twilight as well as the October 16, 1663, conjunction. At the second conjunction the planets were about  $10^\circ$  up in the southwest at one hour after sunset. However, at both conjunctions, the planets were nearly  $1^\circ$  apart. At the 1683 conjunction, the planets were close, about  $0.2^\circ$  apart, twice the separation of the upcoming event. While the two previous conjunctions were visible to the naked eye and individually in a telescopic eyepiece, the 1683 conjunction was the first observed with both planets simultaneously in an eyepiece. With a separation of  $0.1^\circ$ , the 1623 conjunction would have fit into telescopes eyepieces of that generation, but certainly those early telescopes were unwieldy to steer and hold steady, and the telescope operator needed some persistence during the days preceding the conjunction to follow the converging planets into bright twilight while they had sufficient altitude to observe them. So, while the British publications are accurate about viewing the planets simultaneously through a telescope, the two preceding conjunctions were visible to the unaided eye and individually through a telescope, and this does not speak to the issue as whether the 1623 conjunction when unobserved across all of humanity.

In recent times, Great Conjunctions occurred February 18, 1961; followed by a triple conjunction of the two planets in 1980-81; and the last occurred May 30, 2000, although this was difficult to observe.

As 2019 closes, the Great Planets, Jupiter and Saturn, are near their solar conjunctions. Jupiter's occurs December 27, 2019, followed 17 days later by Saturn. They begin a slow climb into the morning sky and toward their Great Conjunction that occurs December 21, 2020.

In the notes that follow, specific times are calculated for Chicago, Illinois. Observers should note time differences for their observing locations. Here is the summary of the "co-appearance" of the two planets:

### **January 2020**

Jupiter makes its first morning appearance late in the month, joining Mars as morning planets. Saturn passes its solar conjunction near mid-month and slowly crawls into the morning sky.

- **January 7:** Jupiter rises at Civil Twilight when the sun is  $6^\circ$  below the horizon.
- **January 13:** Saturn is at its solar conjunction, 9:17 a.m. CST.
- **January 20:** Jupiter ( $m = -1.9$ ) rises at Nautical Twilight, when the sun is  $12^\circ$  below the horizon. Thirty minutes before sunrise, it is  $5^\circ$  up in the southeast, nearly  $30^\circ$  to the lower left of Mars ( $m = 1.8$ ). The dimmer Red Planet is lost in the brightness of the pre-sunrise sky, but the moon (25.2 days past the New phase, 19%

illuminated) is nearby,  $3.9^\circ$  to the upper right of Mars. Use a binocular to see them.

- **January 22:** Forty-five minutes before sunrise, Jupiter is about  $4^\circ$  up in the southeast. The crescent moon (27.2d, 6%) is  $7^\circ$  to the upper right of Jupiter.
- **January 24:** Saturn rises at Civil Twilight.
- **January 27:** Jupiter passes  $3.4^\circ$  to the upper left of Nunki ( $\sigma$  Sgr,  $m = 2.0$ ), a star in the handle of the Teapot of Sagittarius.

### **February 2020**

Bright Jupiter appears among the stars of Sagittarius, appearing higher in the southeast each morning. Mars begins to close in on the two other Bright Outer Planets. By month's end, the planetary trio appears in the southeastern sky. The moon occults Mars on the morning of February 18.

- **February 3:** Jupiter rises at Astronomical Twilight, when the sun is  $18^\circ$  below the horizon. Forty-five minutes before sunrise, the Giant Planet is over  $7^\circ$  in altitude in the southeast among the stars of Sagittarius.
- **February 5:** Saturn rises at Nautical Twilight.
- **February 8:** Jupiter passes  $0.8^\circ$  to the lower right of Omicron Sagittarii ( $\omicron$  Sgr,  $m = 3.8$ ). Forty-five minutes before sunrise, Jupiter is nearly  $9^\circ$  up in the southeast.
- **February 9:** About 45 minutes before sunrise, Jupiter is about  $9^\circ$  up in the southeast,  $20^\circ$  to the lower left of Mars ( $m = 1.3$ ).

- **February 14:** Jupiter passes Pi Sagittarii ( $\pi$  Sgr,  $m = 2.9$ ),  $1.4^\circ$  to the lower right of the star. Forty-five minutes before sunrise, Jupiter is over  $10^\circ$  in altitude in the southeastern sky. Saturn is about  $10^\circ$  to Jupiter's lower left, nearly  $6^\circ$  in altitude.
- **February 18:** One hour before sunrise, the crescent moon (24.6d, 24%), about  $17^\circ$  up in the southeast, is  $0.4^\circ$  to the right of Mars. Mars is nearly  $16^\circ$  to the upper right of Jupiter. As sunrise approaches, the moon inches toward the planet. If you can track Mars into a brighter sky, the moon occults it a few minutes after 6 a.m. CST, about 35 minutes before sunrise in Chicago. Observers in the Western U.S. see the moon occult Mars in a darker sky.
- **February 19:** Saturn ( $m = 0.6$ ) rises at Astronomical Twilight. Forty-five minutes before sunrise, Jupiter, nearly  $12^\circ$  up in the southeast, is  $3.9^\circ$  to the left of the crescent moon (25.6d, 16%). Saturn is  $9.5^\circ$  to the lower left of Jupiter.
- **February 20:** Forty-five minutes before sunrise, the old moon (26.6d, 9%) is about  $6^\circ$  up in the southeast,  $2.5^\circ$  to the lower right of Saturn. Jupiter is  $9.0^\circ$  to the upper right of the moon.

### **March 2020**

The three Bright Outer Planets appear in the southeast before sunrise. Early in the month, they appear equally spaced with Jupiter between Saturn and Mars. Mars closes in and passes the planets as the month progresses.

- **March 1:** About an hour before sunrise, Jupiter ( $m = -2.0$ ) is about  $16^\circ$  up in the southeast. Mars ( $m = 1.1$ ) is  $10^\circ$  to the Giant Planet's upper right, and Saturn ( $m = 0.7$ ) is nearly  $9^\circ$  to Jupiter's lower left. During the next few mornings watch Mars close the gap on Jupiter and the planetary trio is equally spaced along the ecliptic.
- **March 5:** One hour before sunrise, Jupiter is over  $16^\circ$  above the southeast horizon. The planets are nearly equally spaced. Mars is about  $8^\circ$  to the upper right of Jupiter and Saturn is over  $8^\circ$  to the Giant Planet's lower left.
- **March 11:** One hour before sunrise, Jupiter, over  $16^\circ$  up in the southeast, is  $4.9^\circ$  to the lower left of Mars ( $m = 1.0$ ). At the same time, Jupiter is nearly  $8^\circ$  to the upper right of Saturn. Mars continues to close the gap on Jupiter. Separations until the Jupiter – Mars conjunction: **Mar. 12**,  $4.3^\circ$ ; **Mar. 13**,  $3.7^\circ$ ; **Mar. 14**,  $3.3^\circ$ ; **Mar. 15**,  $2.7^\circ$ ; **Mar. 16**,  $2.2^\circ$ ; **Mar. 17**,  $1.7^\circ$ , Mars to the right of Jupiter; **Mar. 18**,  $1.2^\circ$ ; **Mar. 19**,  $0.9^\circ$ .
- **March 15:** One hour before sunrise, Jupiter,  $16^\circ$  up in the southeast, is  $2.7^\circ$  to the left of Mars. The Red Planet is  $10^\circ$  to the upper right of Saturn ( $m = 0.7$ ).
- **March 16:** One hour before sunrise, Jupiter,  $16^\circ$  up in the southeast, is  $3.2^\circ$  to the upper left of 52 Sagittarii (52 Sgr,  $m = 4.6$ ).
- **March 18:** The crescent moon (24.1d, 29%) joins the scene with Jupiter ( $m = -2.1$ ) and Mars. The trio makes a small triangle; the moon

is  $2.4^\circ$  to the lower right of Jupiter and  $2.2^\circ$  to the lower left of Mars.

- **March 19:** The crescent moon (25.1d, 21%),  $9^\circ$  up in the southeast, is over  $6^\circ$  to the lower left of Saturn. The Jupiter – Mars gap is  $0.9^\circ$ . Mars is to the lower right of brighter Jupiter.



Figure 3 2020, March 20: Mars passes Jupiter in the southeastern morning sky with Saturn nearby.

- **March 20:** Jupiter is now rising about 3 hours before sunrise. This morning is the **Jupiter – Mars conjunction!** Mars is  $0.6^\circ$  to the lower right of Jupiter. The gaps after the conjunction as Mars moves away from Jupiter: **Mar. 21**,  $0.9^\circ$ ; **Mar. 22**,  $1.3^\circ$ ; **Mar. 23**,  $1.7^\circ$ ; **Mar. 24**,  $2.3^\circ$ ; **Mar. 25**,  $2.7^\circ$ ; **Mar. 26**,  $3.4^\circ$ ; **Mar. 27**,  $3.9^\circ$ ; **Mar. 28**,  $4.5^\circ$ ; **Mar. 29**,  $5.0^\circ$ .
- **March 24:** One hour before sunrise, Jupiter is over  $17^\circ$  up in the southeast, nearly  $7^\circ$  to the upper right of Saturn. Mars is  $4.6^\circ$  to the upper right of Saturn and  $2.3^\circ$  to the lower left of Jupiter. The Saturn – Mars gaps until the conjunction:

**Mar. 25**, 4.0°; **Mar. 26**, 3.4°; **Mar. 27**, 2.6°; **Mar. 28**, 2.2°, Mars to the right of Saturn; **Mar. 29**, 1.7°, Mars to the lower right of Saturn; **Mar. 30**, 1.2°.

- **March 26:** One hour before sunrise, Jupiter is over 17° up in the southeast. Mars ( $m = 0.8$ ) is nearly equidistant from the two bright giant planets, although Mars is below a line that connects Jupiter and Saturn. Mars is 3.3° to the lower left of Jupiter and 3.4° to the upper right of Saturn. The Jupiter – Saturn gap is 6.4°.

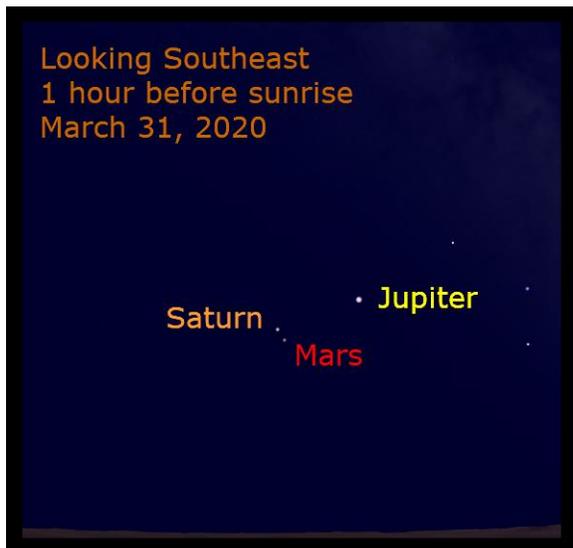


Figure 4 2020, March 31: Look in the southeast for the Saturn – Mars conjunction about an hour before sunrise.

- **March 31:** One hour before sunrise, Jupiter is over 18° up in the southeast. The Giant Planet is 6.3° to the upper right of Saturn. This morning is the **Saturn – Mars conjunction!** Mars is 0.9° to the lower right of Saturn. The Saturn – Mars gap grows after the conjunction: **Apr. 1**, 1°; **Apr. 2**, 1.4°; **Apr. 3**, 1.9°; **Apr. 4**, 2.5°; **Apr. 5**, 3.1°; **Apr. 6**, 3.7°; **Apr. 7**, 4.3°;

**Apr. 8**, 5.0°. This morning the Jupiter – Mars gap is 6.1°.

### April 2020

Jupiter and Saturn continue to rise earlier in the morning, now before 3 a.m. daylight time. Jupiter continues to inch toward Saturn. Both planets move through dim star fields. Choose your favorite 5<sup>th</sup> or 6<sup>th</sup> magnitude stars in the region and watch the planets approach the stars. Mars, now moving away from Jupiter and just after its conjunction with Saturn, continues its eastward march, widening its gap with the two other Bright Outer Planets.

- **April 2:** Saturn ( $m = 0.6$ ) rises 3 hours before sunrise. One hour before sunrise, Jupiter ( $m = -2.2$ ) is nearly 19° in altitude above the southeast horizon. Saturn is about 6° to Jupiter's lower left. Mars is near Saturn, 1.4° to the Ring Wonder's lower left.
- **April 4:** One hour before sunrise, Jupiter, over 19° up in the southeast, is 0.7° to the upper left of Pluto ( $m = 14.3$ ) for the first conjunction of three during this apparition of Jupiter. Saturn is 6.0° to the lower left of Jupiter, and Mars is 2.5° to the lower left of Saturn.
- **April 7:** One hour before sunrise, Jupiter, about 20° up in the southeast, is 1.4° to the lower right of 56 Sagittarii (56 Sgr,  $m = 4.8$ ). Mars ( $m = 0.7$ ) is 10° to the lower left of Jupiter and over 4° to the lower left of Saturn.
- **April 14:** One hour before sunrise, the moon (21.0d, 55%) is over 20° up in the south-southeast. It is about 7° to the lower right of Jupiter and Jupiter is 5.5° to the upper right of

Saturn. Mars, about  $16^\circ$  up in the southeast in central Capricornus, is nearly  $9^\circ$  to the lower left of Saturn.

- **April 15:** One hour before sunrise, the thick crescent moon (22.0d, 45%) is  $3.3^\circ$  below Saturn,  $20^\circ$  up in the southeast. Mars is  $10^\circ$  to the left of the moon. This morning Jupiter is  $5.5^\circ$  to the upper right of Saturn and nearly  $15^\circ$  to the upper right of Mars.
- **April 16:** One hour before sunrise, Mars is  $10^\circ$  to the lower left of Saturn. Mars, over  $16^\circ$  up in the southeast, is  $3.8^\circ$  to the upper right of the crescent moon (23.0d, 36%).
- **April 22:** Jupiter ( $m = -2.3$ ) rises at 2:00 a.m. CDT, 4 hours before sunrise. One hour before sunrise, Jupiter is nearly  $23^\circ$  in altitude in the south-southeast,  $5.2^\circ$  to the right of Saturn. Mars is in Capricornus, near Theta Capricorni ( $\theta$  Cap,  $m = 4.1$ ), over  $14^\circ$  to the lower left of Saturn.
- **April 29:** Saturn rises at 1:50 a.m. CDT, 4 hours before sunrise. One hour before sunrise, Jupiter is over  $24^\circ$  in altitude in the south-southeast,  $4.9^\circ$  to the right of Saturn. Mars continues to move through Capricornus. This morning it is over  $18^\circ$  to the lower left of Saturn, near Gamma Capricorni ( $\gamma$  Cap,  $m = 3.6$ ).

### May 2020

Both planets begin to retrograde this month. Jupiter retrogrades  $9.8^\circ$  along the ecliptic, while Saturn moves  $6.6^\circ$  in its apparent westward movement. Jupiter has a quasi-conjunction with Saturn near midmonth. Jupiter does not pass Saturn, but it moves within  $5^\circ$  as the two planets retrograde.

- **May 10:** Saturn ( $m = 0.5$ ) stops moving eastward and begins to

retrograde,  $109^\circ$  west of the sun. It rises a few minutes after 1 a.m. CDT, nearly 4.5 hours before sunrise. One hour before sunrise, Saturn is nearly  $26^\circ$  up in the south-southeast,  $4.7^\circ$  to the left of bright Jupiter ( $m = -2.4$ ).

- **May 12:** One hour before sunrise, Saturn is  $26^\circ$  up in the south,  $4.7^\circ$  to the left of Jupiter. The moon (19.3d, 72%) is  $3.1^\circ$  below Jupiter.
- **May 14:** Jupiter's direct motion ends and it begins to retrograde,  $117^\circ$  west of the sun. It rises at 12:30 a.m. CDT, 5 hours before the sun. One hour before sunrise, Jupiter is  $26^\circ$  up in the south,  $4.7^\circ$  to the right of Saturn.
- **May 18: This morning is a Jupiter – Saturn quasi-conjunction!** For several previous entries, the separation for Jupiter ( $m = -2.5$ ) and Saturn has been  $4.7^\circ$ . When fractions of a degree are considered, this morning the planets are closest in a quasi-conjunction, when two planets are within  $5^\circ$  of each other. One hour before sunrise, Jupiter is  $26^\circ$  in altitude in the southern sky with Saturn to its left.
- **May 23:** Jupiter is now rising before midnight CDT. One hour before sunrise, it is  $27^\circ$  up in the south,  $4.7^\circ$  to the lower right of Saturn.

### June 2020

This month the planets are rising before midnight and appearing in the southwest before sunrise. They continue to retrograde. Jupiter moves away from Saturn. The apparent gap between them widens to nearly  $6^\circ$  by month's end. The moon passes the pair early in the month.

- **June 8:** One hour before sunrise, the moon (16.6d, 92%), 22° up in the south, is 5.8° to the lower right of Jupiter ( $m = -2.6$ ). The Giant Planet is 5.0° to the lower right of Saturn ( $m = 0.4$ ).
- **June 9:** One hour before sunrise, the moon (17.6d, 85%) makes a triangle with the two planets. The moon, 25° up in the south, is 4.8° to the lower left of Saturn ( $m = 0.3$ ) and 8.9° to the left of Jupiter. The Jupiter – Saturn gap is 5.0°.
- **June 12:** One hour before sunrise, Jupiter, over 25° up in the south-southwest, is 5.1° to the lower right of Saturn. Later that night, Jupiter rises at 10:30 p.m. CDT, about 130 minutes after sunset.
- **June 17:** One hour before sunrise, Jupiter ( $m = -2.7$ ) is nearly 25° up in the south-southwest. It is 5.3° to the lower right of Saturn. Later that night, Saturn rises at 10:30 p.m. CDT, about 120 minutes after sunset.
- **June 20:** One hour before sunrise, look for Jupiter 1.6° to the lower left of 56 Sagittarii, 23° up in the south-southwest. Saturn is 5.5° to the upper left of Jupiter.
- **June 27:** Jupiter rises at 9:30 p.m. CDT, about one hour after sunset. An hour later, Jupiter is nearly 9° up in the southeast. It is 5.9° to the upper right of Saturn ( $m = 0.2$ ). By the next morning, about 60 minutes before sunrise, Jupiter is 20° up in the southwest. Saturn is to its upper left.
- **June 29:** As midnight approaches, Jupiter is over 19° up in the south-southeast. Jupiter passes 0.6° to the upper left of Pluto ( $m = 0.6^\circ$ ). At

this hour, Jupiter is 5.9° to the upper right of Saturn as the planetary trio (Jupiter, Saturn, and Pluto) retrogrades.

### July 2020

The planets are now appearing in the sky nearly all night. They pass opposition this month, about 7 days apart. As they retrograde, the gap between them continues to widen to nearly 8° by month's end.

- **July 1:** Saturn rises one hour after sunset, about 9:30 p.m. CDT. An hour later, Jupiter is over 11° up in the southeast. Jupiter is 6.1° to the upper right of Saturn. Overnight, the planets move farther west. By one hour before sunrise, Jupiter is 18° up in the southwest, to the lower right of Saturn.
- **July 4:** At 10:30 p.m. CDT, about 2 hours after sunset, the moon (13.9d, 100%) is 15° in altitude above the southeast horizon. It is over 10° to the upper right of Jupiter which is 6.2° to the upper right of Saturn.
- **July 14:** Jupiter ( $m = -2.8$ ) is at opposition at 2:58 a.m. CDT. Two hours after sunset, Jupiter is over 17° up in the south-southeast. The Jupiter – Saturn gap is 6.8°. Jupiter is to the upper right of Saturn ( $m = 0.1$ ).
- **July 15:** Pluto is at opposition at 2:12 p.m. CDT. Just before midnight, Pluto is nearly 24° up in the south-southeast, 1.7° to the lower left of Jupiter.
- **July 16:** Jupiter passes 2.9° to the upper left of 52 Sagittarii. Use a binocular to see the planet and the star.

- **July 20:** Saturn is at opposition at 5:28 p.m. CDT. As midnight approaches, Saturn is 25° up in the south-southeast, 7.1° to the left of bright Jupiter ( $m = -2.7$ ).
- **July 31:** One hour after sunset, the moon (11.4d, 93%), nearly 20° up in the south-southeast, is 12.0° to the right of Jupiter, while Saturn is 7.6° to the lower left of the Giant Planet.

### August 2020

The retrograding planets are well up in the east during the early evening hours and setting a few hours after midnight. They end the month over 8° apart. The moon passes the planets twice during the month.

- **August 1:** Four hours before sunrise (about 1:45 a.m. CDT), the moon (11.6d, 94%) is about 13° up in the southwest. It is to the lower right of Jupiter. The moon, Jupiter, and Saturn extend along an 18° arc. In the evening, one hour after sunset, the moon (12.4d, 97%) is 14° up in the southeast, 2.9° to the lower left of Jupiter and 6.7° to the lower right of Saturn.
- **August 2:** Four hours before sunrise, the bright gibbous moon (12.6d, 98%), nearly 19° up in the southwest, makes a pretty triangle with the planetary duo. The moon is 4.2° to the left of Jupiter and 5.2° to the lower right of Saturn ( $m = 0.2$ ). The planets are 7.7° apart. One hour after sunset, the moon (13.4d, 100%) is about 10° in altitude in the southeast. It is nearly 8° to the lower left of Saturn.
- **August 3:** Four hours before sunrise, the moon (13.6d, 100%), nearly 20° up in the south-southwest, is nearly

10° to the upper left of Saturn. The Ringed Wonder is 7.6° to the upper left of Jupiter, over 11° up in the southwest.

- **August 15:** One hour after sunset, Jupiter, over 21° up in the south-southeast, is 8.2° to the upper right of Saturn.
- **August 25:** One hour after sunset, Jupiter ( $m = -2.6$ ), over 23° up in the south-southeast, is 8.3° to the upper right of Saturn ( $m = 0.3$ ). Jupiter sets at nearly 2:30 a.m. CDT.
- **August 28:** Just after midnight, the gibbous moon (9.1d, 75%), over 9° up in the southwest, is 12° to the lower right of Jupiter, while Saturn is 8.3° to the upper left of the Giant Planet. The Ringed Wonder is over 20° in altitude in the south-southwest. In the evening, one hour after sunset, the moon (10.0d, 83%), over 21° up in the south-southeast, is 2.2° to the lower right of Jupiter.
- **August 29:** As the new day begins, the moon (10.1d, 84%), over 15° up in the southwest, is 2.6° to the lower left of Jupiter. In the evening, one hour after sunset, bright Jupiter is nearly 24° up in the south-southeast. The Jupiter – Saturn gap is 8.3°. Saturn is to the lower left of Jupiter. The moon (11.0d, 90%) is 5.7° to the lower left of Saturn.
- **August 30:** Just after midnight, the bright moon (11.1d, 91%), nearly 22° in altitude in the south-southwest, is 6.7° to the left of Saturn.

### September 2020

The planets are about one-third of the way up in the southern sky after sunset.

Retrograde motion ends for both planets during September and they resume their direct motion. The Great Conjunction is about three months away. Watch Jupiter close the gap.

- **September 5:** One hour after sunset, Jupiter ( $m = -2.5$ ), nearly  $25^\circ$  up in the south-southeast, is  $8.2^\circ$  to the right of Saturn.
- **September 12:** Jupiter's retrograde ends  $117^\circ$  east of the sun. It is  $2.0^\circ$  to the lower left of Pi Sagittarii. Find them one hour after sunset when the Giant Planet is  $25^\circ$  up in the south. Saturn ( $m = 0.4$ ) is  $8.1^\circ$  to the left of Jupiter.
- **September 20:** One hour after sunset, Jupiter, nearly  $26^\circ$  up in the south, is  $7.8^\circ$  to the lower right of Saturn.
- **September 24:** One hour after sunset, the gibbous moon (7.6d, 60%),  $23^\circ$  up in the south, is  $4.2^\circ$  to the lower right of Jupiter ( $m = -2.4$ ). The Jupiter – Saturn gap is  $7.7^\circ$ .
- **September 25:** One hour after sunset, the brightening moon (8.6d, 70%),  $23^\circ$  up in the south-southeast, is  $3.7^\circ$  to the lower left of Saturn. The Jupiter – Saturn gap is  $7.6^\circ$ .
- **September 28:** Saturn's retrograde ends  $109^\circ$  east of the sun. One hour after sunset, the Ringed Wonder is over  $26^\circ$  up in the south,  $7.5^\circ$  to the upper left of Jupiter. With a binocular observe that Saturn is  $1.7^\circ$  to the lower left of 56 Sagittarii.

### October 2020

Jupiter and Saturn are now west of the meridian during the early evening hours. They are setting in the southwest before midnight. Jupiter continues to close the gap

to Saturn during the month, reducing the separation to less than  $5.5^\circ$  by month's end.

- **October 1:** One hour after sunset, Jupiter is  $25^\circ$  up in the south. It is now past the meridian at this time interval. Jupiter is  $7.3^\circ$  to the lower right of Saturn ( $m = 0.5$ ).
- **October 10:** Jupiter ( $m = -2.3$ ) is  $90^\circ$  east of the sun. One hour after sunset, Jupiter is  $25^\circ$  up in the south,  $6.8^\circ$  to the lower right of Saturn.
- **October 13:** Mars ( $m = -2.6$ ) reaches opposition over  $90^\circ$  from Jupiter. Through a telescope, Mars is  $22.3''$  in apparent diameter.
- **October 17:** Saturn is  $90^\circ$  east of the sun. One hour after sunset, it is  $27^\circ$  up in the south, now past the meridian at this time interval. The Ringed Wonder is  $6.3^\circ$  to the upper left of Jupiter ( $m = -2.2$ ).
- **October 21:** One hour after sunset, the crescent moon (5.2d, 34%), nearly  $20^\circ$  up in the south-southwest, is over  $10^\circ$  to the lower right of Jupiter. The Jupiter – Saturn gap is  $6.0^\circ$ .
- **October 22:** One hour after sunset, the thick crescent moon (6.2d, 44%),  $23^\circ$  up in the south, makes a nice triangle with Jupiter and Saturn. The crescent is  $4.4^\circ$  to the lower left of Jupiter and  $4.2^\circ$  to the lower right of Saturn. The Jupiter – Saturn gap is  $5.9^\circ$ .
- **October 23:** One hour after sunset, the slightly gibbous moon (7.2d, 55%),  $25^\circ$  up in the south, is  $11^\circ$  to the lower left of Saturn ( $m = 0.6$ ). The Jupiter – Saturn gap is  $5.8^\circ$ .
- **October 28:** One hour after sunset, Jupiter, nearly  $25^\circ$  up in the south-

southwest, is  $5.4^\circ$  to the lower right of Saturn.

### November 2020

The planetary duo is in the south-southwest during the early evening hours, setting before 9 p.m. standard time. Jupiter cuts the distance to Saturn in half by month's end. The Giant Planet passes Pluto again for the third conjunction.

- **November 2:** One hour after sunset, Jupiter ( $m = -2.1$ ), over  $24^\circ$  up in the south-southwest, is  $5.0^\circ$  to the lower right of Saturn.
- **November 7:** One hour after sunset, Jupiter, nearly  $24^\circ$  up in the south-southwest, is  $4.5^\circ$  to the lower right of Saturn.
- **November 8:** One hour after sunset, Jupiter, nearly  $24^\circ$  up in the south-southwest, is  $2.8^\circ$  to the upper left of 52 Sagittarii. Use a binocular to see the star with the planet.
- **November 12:** At the end of evening twilight, Jupiter,  $19^\circ$  up in the southwest, is  $0.6^\circ$  to the upper right of Pluto, for the third conjunction of Jupiter's apparition. At the same time, Jupiter is  $4.0^\circ$  to the lower right of Saturn.
- **November 14:** Jupiter is  $60^\circ$  east of the sun. Find it nearly  $23^\circ$  up in the south-southwest,  $3.8^\circ$  to the lower right of Saturn.
- **November 18:** Look for the crescent moon (3.8d, 18%) over  $16^\circ$  in altitude in the south-southwest. It is  $6.8^\circ$  to the lower right of Jupiter. The Jupiter – Saturn gap is  $3.5^\circ$ . Jupiter is to the lower right of Saturn.
- **November 19:** Saturn is  $60^\circ$  east of the sun. Find it near the crescent moon (4.8d, 28%), one hour after

sunset. The moon is over  $22^\circ$  up in the south-southwest,  $5.4^\circ$  to the lower left of Saturn. The Jupiter – Saturn gap is  $3.3^\circ$ .

- **November 24:** One hour after sunset, Jupiter, nearly  $21^\circ$  up in the south-southwest, is  $2.8^\circ$  to the lower right of Saturn.
- **November 26:** Jupiter ( $m = -2.0$ ) passes  $1.8^\circ$  to the lower left of the dim star 56 Sagittarii. Look for them with a binocular one hour after sunset, when Jupiter is over  $20^\circ$  up in the south-southwest. At this time Jupiter is  $2.6^\circ$  to the lower right of Saturn.
- **November 29:** One hour after sunset, Jupiter is less than  $20^\circ$  up in the south-southwest. It is  $2.3^\circ$  to the lower right of Saturn.

### December 2020

Jupiter closes in and passes Saturn so closely ( $0.1^\circ$ ) that the planetary pair fits into telescopes' eyepieces of modest magnifications, the 2020 Great Conjunction.

- **December 2:** The Jupiter – Saturn gap is  $2.0^\circ$ . One hour after sunset, find bright Jupiter  $19^\circ$  up in the southwest, to the lower right of Saturn.
- **December 7:** The Jupiter – Saturn gap is  $1.5^\circ$ . Look for them over  $15^\circ$  up in the southwest, one hour after sunset. The planets are setting about three hours after sunset.
- **December 11:** The Jupiter – Saturn gap is  $1.0^\circ$ . Look for them about  $15^\circ$  up in the southwest about one hour after sunset. The Jupiter- Saturn gaps until the conjunction: **Dec. 12**,  $0.9^\circ$ , **Dec. 13**,  $0.8^\circ$ ; **Dec. 14**,  $0.7^\circ$ ; **Dec. 15**,  $0.6^\circ$ , Saturn moves into Capricornus; **Dec. 16**,  $0.5^\circ$ ; **Dec. 17**,  $0.4^\circ$ ; **Dec. 18**,  $0.3^\circ$ , Jupiter moves into Capricornus;

**Dec. 19**, 0.2°; **Dec. 20**, 0.1°, Jupiter below Saturn.



Figure 5 2020, December 16: The crescent moon joins the impending Jupiter – Saturn conjunction in the southwest about one hour after sunset.

- **December 16:** One hour after sunset, the crescent moon (2.3d, 7%) joins the planets. It is over 6° up in the southwest, about 5° below Jupiter. The Jupiter – Saturn gap is 0.5°.
- **December 17:** One hour after sunset, Jupiter is over 11° up in the southwest, 0.4° to the lower right of Saturn. The waxing crescent moon (3.3d, 13%) is over 10° to the upper left of Jupiter.
- **December 21: Jupiter – Saturn Great Conjunction!** One hour after sunset, Jupiter is about 12° up in the southwest, 0.1° to the lower left of Saturn. They are 30° east of the sun. Both 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 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 26:** The planets set two hours after the sun sets.
- **December 30:** One hour after sunset, Jupiter is about 8° up in the southwest.
- **December 31:** Saturn sets at the end of evening twilight.

### January 2021

Jupiter and Saturn rapidly fall into twilight as they head toward their solar conjunctions. Mercury joins the view, but clear horizons and some optical help are needed to catch the trio together.

- **January 3:** One hour after sunset, Jupiter is nearly 6° up in the south-southwest. Saturn is slipping lower in the sky at this hour and becoming more difficult to see. Use a binocular to see it 1.5° to the lower right of Jupiter. The Giant Planet sets at the end of evening twilight.
- **January 8:** Saturn sets at Nautical Twilight when the sun is 12° below the horizon.
- **January 9:** Thirty minutes after sunset, Jupiter ( $m = -1.9$ ), about 7° up in the west-southwest is 2.2° to the upper left of Saturn. Use a binocular to locate them, especially Saturn. Mercury ( $m = -0.9$ ) makes a pretty triangle with Jupiter and Saturn. It is 1.6° to the lower left of Saturn and 2.8° below Jupiter.

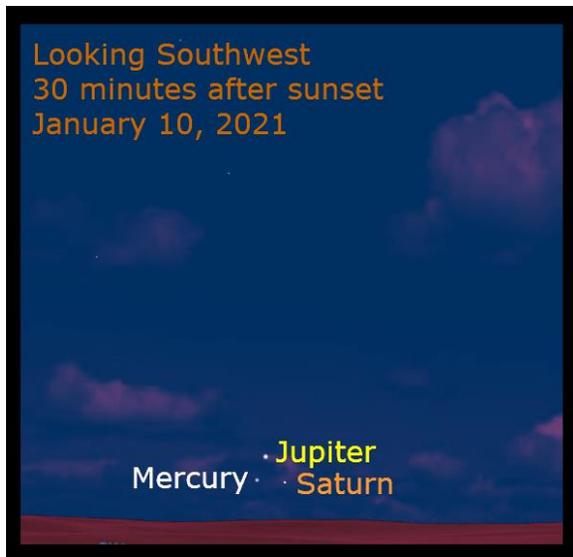


Figure 6 2021, January 10: Mercury joins Jupiter and Saturn in the southwest during bright twilight as the outer planets head toward their solar conjunctions.

- **January 10:** Again, this evening, look for Jupiter and Saturn with a binocular about 30 minutes after sunset. The Jupiter – Saturn gap is  $2.0^\circ$ . Mercury is  $2.0^\circ$  to the left of Saturn and  $1.8^\circ$  below Jupiter. The trio makes nearly an equilateral triangle.
- **January 11:** Saturn continues to be difficult to see as it is lower in the west-southwest during early twilight. Look with a binocular to see Jupiter, less than  $6^\circ$  in altitude and  $2.4^\circ$  to the

upper left of Saturn. Mercury is  $3.1^\circ$  to the upper left of Saturn and  $1.4^\circ$  to the lower left of Jupiter. Jupiter sets at Nautical Twilight.

- **January 12:** Let's attempt to view Saturn one more evening with optical aid around 30 minutes after sunset. This will be a challenge. Jupiter is about  $5^\circ$  up in the west-southwest,  $2.5^\circ$  to the upper left of Saturn. Mercury is  $4.5^\circ$  to the upper left of Saturn and  $2.1^\circ$  to the upper left of Jupiter.
- **January 14:** Thirty minutes after sunset, with a binocular look for Jupiter about  $3^\circ$  in altitude in the west-southwest. Mercury is  $4.5^\circ$  to the upper left of Jupiter. The young moon (1.8d, 4%) is nearly  $7^\circ$  to the upper left of Mercury.
- **January 16:** Saturn sets at Civil Twilight when the sun is  $6^\circ$  below the horizon.
- **January 20:** Jupiter sets at Civil Twilight.
- **January 23:** Saturn is at its solar conjunction, 9:01 p.m. CST.
- **January 28:** Jupiter is at its solar conjunction, 7:40 p.m. CST. The planets' apparitions of the Great Conjunction of 2020 ends.

The next Great Conjunction is October 31, 2040, when looking at the closest approach. This occurs in the morning sky. One hour before sunrise, Jupiter ( $m = -1.7$ ) is  $1.1^\circ$  to the lower right of Saturn ( $m = 0.8$ ). The planets make nearly an equilateral triangle with Theta Virginis ( $\theta$  Vir,  $m = 4.4$ ), about  $1^\circ$  to the lower left of Jupiter. Mercury is also in the morning sky, nearly  $5^\circ$  up and  $4.0^\circ$  to the lower left of Jupiter. The crescent moon (25.3d, 19%) stands over  $37^\circ$  to the upper right of Jupiter.

The Great Conjunction of 2020 provides several opportunities to observe Jupiter creep toward Saturn, separate during retrograde, and make its approach and close passing of Saturn before the planetary pair disappears into evening twilight. Mars passes both planets early in their apparitions. Mercury makes a difficult to observe grouping with Jupiter and Saturn after their conjunction as they move toward their solar conjunctions. For those with sufficient apertures,

Jupiter provides general guidance to view distant Pluto. Celebrate this once-in-a-generation conjunction!