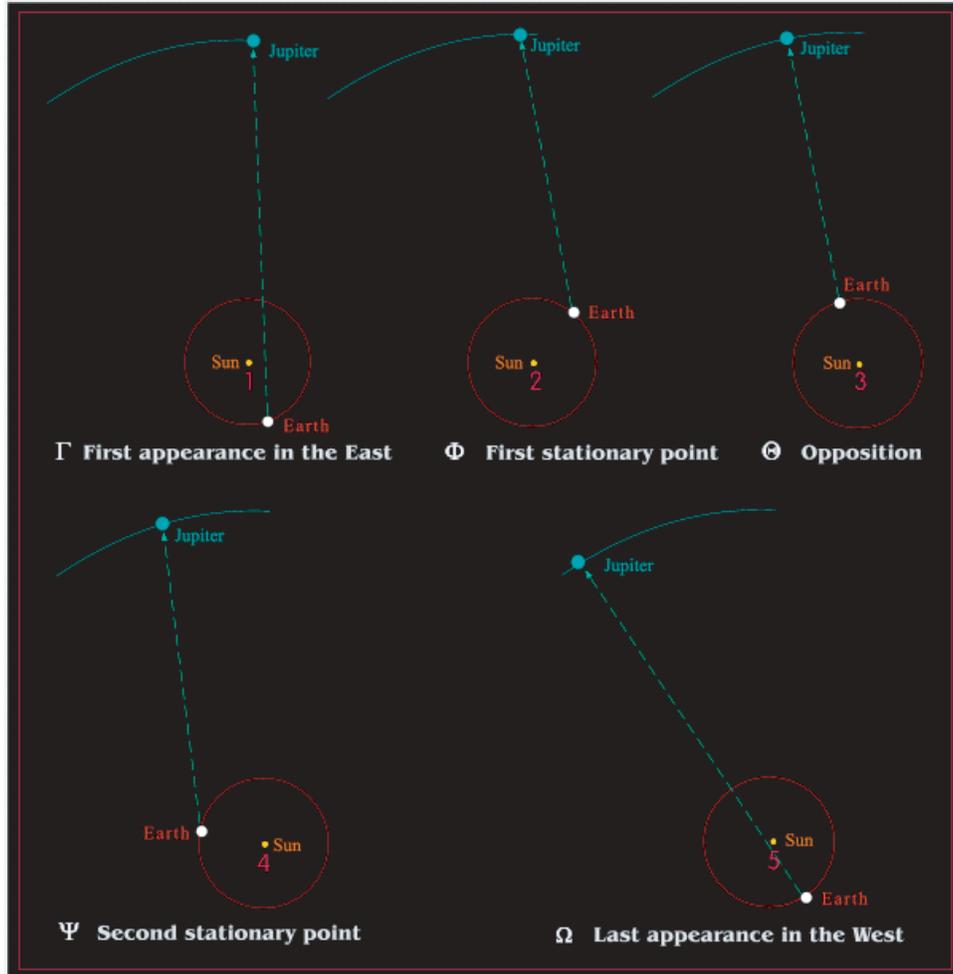


CHARACTERISTIC PLANETARY PHENOMENA

THE SUPERIOR PLANETS



Characteristic Planetary Phenomena for Jupiter

GENERAL REMARKS

The following notes deal with the characteristic planetary phenomena of the three superior planets -- Saturn, Jupiter and Mars. Jupiter is used here as the primary example, and the same procedures are applicable to Saturn and Mars.

JUPITER: In a synodic year of Jupiter, the planet moves approximately one twelfth of its orbit around the sun. Meanwhile, the earth has completed one cycle around the sun (360 degrees) plus an additional one twelfth of its orbit.

Jupiter becomes obscured from earth-based observers only when the earth passes *behind* the sun. The final evening (sunset) when Jupiter can still be seen, is the planet's "the Last Appearance in the West." As earth and Jupiter continue around the sun, the earth "gains" on the planet until Jupiter is seen to "rise" on "the First appearance in the East." .

As the configuration of earth and Jupiter progress from the First stationary point in the East to the Last stationary point in the West, on a particular day the earth is between the sun and Jupiter such that all three are momentarily in line. At sunset on that day, the rising of Jupiter on the eastern horizon occurs at the same time the sun sets in the west. The *conjunction* of a planet and earth is also called the *acronychal rising of the planet*. (There is room for quibbling over these definitions.)

In spite of periods of forward motion, retrograde motion and stationary points, Babylonian astronomers understood that Jupiter proceeds with direct forward sidereal motion over each successive synodic arc. Babylonian Seleucid Era Procedure text No. 813, Section 21 lines 5 and 6 states:

[7,7, years (corresponds to) 6,31 appearances] 36 rotations, 3,36,0 motion. 33,8,[4]5 (is the) mean value of the longitudes.
(Neugebauer, 1955:403-404)

The text implies 427 years corresponds to 391 mean synodic appearances plus 36 sidereal revolutions. (In 427 years, the earth has gone around the sun 427 times; it has overtaken Jupiter 391 times and Jupiter has gone around the sun 36 times.) Thus, the mean synodic arc works out to 33;8,45 degrees (rounded) (Multiply 36 sidereal revolutions x 360 degrees divided by 391 synodic appearances.) Moreover, a simple division of 427 years by 391 synodic appearances gives 1.09207 years for the mean synodic period of Jupiter. Procedure text (No. 812, Section 1) also gives the synodic period as 13;30,27,46 mean synodic months. Using a mean synodic month of 29;31,50,8,20 days, the Procedure text provides an accurate value of 398.89079 days for the mean synodic period of Jupiter.

CHARACTERISTIC PLANETARY PHENOMENA FOR SUPERIOR PLANETS

1. First appearance in the East

Position 1 (figure above) The "First appearance in the East" (1) takes place before sunrise. Jupiter has not visible until this time because the earth has been traveling on the far side of the sun since last observing Jupiter set in the West (5), i.e., at the planet's "Last Appearance."

The early morning observation of Jupiter takes place on the eastern horizon during "the last part of the night" before sunrise.

Jupiter (Diary No. - 378)

Artaxerxes II year 26 VIII 0 = VII 29 -378 Oct 26/27 (New Moon)

'Obv.'

Line 3' Month VIII, ...

Line 7' [The 1]6th, Jupiter's first appearance in Scorpius; it was bright; rising of Jupiter to sunrise: 11;30.' Night of the 17th, last part of the night, the moon was 1 cubit below beta Geminorum ...

REMARKS:

The 1st day of Month VIII is 27/28 October, -378 (one day after New Moon.) On the 16th day of the month (12 November, -378) Jupiter rises in the east before sunrise at 5;44, the Sun at 6;30, a difference of 46 minutes, or 11;30 degrees as given in the Diary. The following morning on the 17th day (13 November, -378) viewed to the west, the moon is a little "in front" of β Geminorum with a separation of approximately 2;10 degrees, or slightly more than 1 cubit.

(For a Skyspot of Jupiter rising on Nov 12, see frame 31: Characteristic phenomena, an analysis of 8 inscriptions - Report 45.)

2. First Stationary Point

Position 2. Observations of the "First stationary point" take place against the stellar background with the earth moving towards (or down) the observer's line of sight in the direction of Jupiter such that the planet's motion relative to the stellar background becomes less and less detectable. Jupiter's monthly and daily progress is relatively slow in any case, rendering the observation when the planet becomes "stationary" difficult to determine precisely.

Mars (No. -182)

'Obv.'

Line 33' [...] around the 10th, when Mars became stationary to the east, [it became stationary] 2/3 cubit behind β Virginis.

3. Opposition (Achronical Rising)

Position 3. Each synodic year between the First stationary point (in the East) and the Last stationary point (in the West), the earth moves between the sun and Jupiter such that all three are in line, the sun on one side of the earth and Jupiter on the other. On the evening of the event Jupiter is seen to rise on the eastern horizon as the Sun sets in the west.

Jupiter (No. -273)

SE 38 XII 0 = XI 29 -273, Mar 1/2 (New Moon)

'Rev...

Line 21 a Virginis,

Line 22 ' it stood ½ cubit in front of Jupiter to the west; around the 16th, Jupiter's acronychal rising.

(For a Skyshot of Jupiter's acronychal rising, see frame 31: Characteristic phenomena, an analysis of 8 inscriptions - Report 46.)

4. Second Stationary Point

Position 4. Analogous to the First stationary point, but with Earth now moving away from the line of sight from Jupiter, the combined motions of the two again produce the apparent point at which Jupiter appears to become stationary.

Saturn (No. -321)

Alexander III year 14 = Philip III year 1 XII 0 = Mar 3/4 (New Moon)

Month XII

Line 19 ... Night of the 2nd, very overcast, lightning [...]

Line 20 ...[...] when Saturn became stationary in the west, [it became] stationary 1/2 cubit behind theta Canceri, [nn fin]gers below Praesepe ... [...]

Line 27 Around the 14th, Saturn moved back to the east.

(For a Skyshot of Saturn's Second Stationary Point, see frame 31: Characteristic phenomena, an analysis of 8 inscriptions - Report 47.)

5. Last Appearance in the West

Position 5. As Earth continues to gain on Jupiter following the Last stationary point, Jupiter will eventually reach a position on the far side of the Sun where it becomes totally obscured from view in the "west" at sunset.

Saturn (No. -266)

SE 45 II 0 -266, Apr 24/25 (New Moon)

A: 'Rev.'

Line 12' [...] 1/2 mina. At that time, Jupiter and Venus were in Aries; around the 12th, Saturn's [last appearance in the Chariot, ...]

REMARKS:

The 1st day of Month II falls on 25th April, -266. "Around " the 12th (6 May, -266) Saturn is between the Northern and Southern Normal Stars of the Chariot (Beta and Zeta Tauri respectively) and about to disappear from view as Earth moves into the part of its orbit that takes it around to the opposite side of the Sun. On this date the Sun sets at 17:40,

Saturn at 18:16, a difference of 36 minutes or degrees. Jupiter is also in the Chariot in a similar situation in Diary No. -324 (see below and Report 45).

Jupiter (No. -324)

Alexander III year 12 I 0 = XII 30 -324, May 4/5 (New Moon)

Line 12. The 28th, Jupiter's last appearance in the Chariot.

REMARKS:

The 1st day of Month I begins on April 5/6; Day 28 falls on May 3/4. At the start of the month Jupiter is located midway between the two major Normal Stars of the Chariot (Beta and Zeta Tauri) halfway between this same pair and Aldebaran but still visible, setting in the west after the sun, and apparently closing on the latter as Earth continues moving on the other side of the Sun. An evening observation to the west around sunset on May 4, with Jupiter setting shortly after the Sun; the interval between their setting is 29 minutes or 7:15 degrees.
