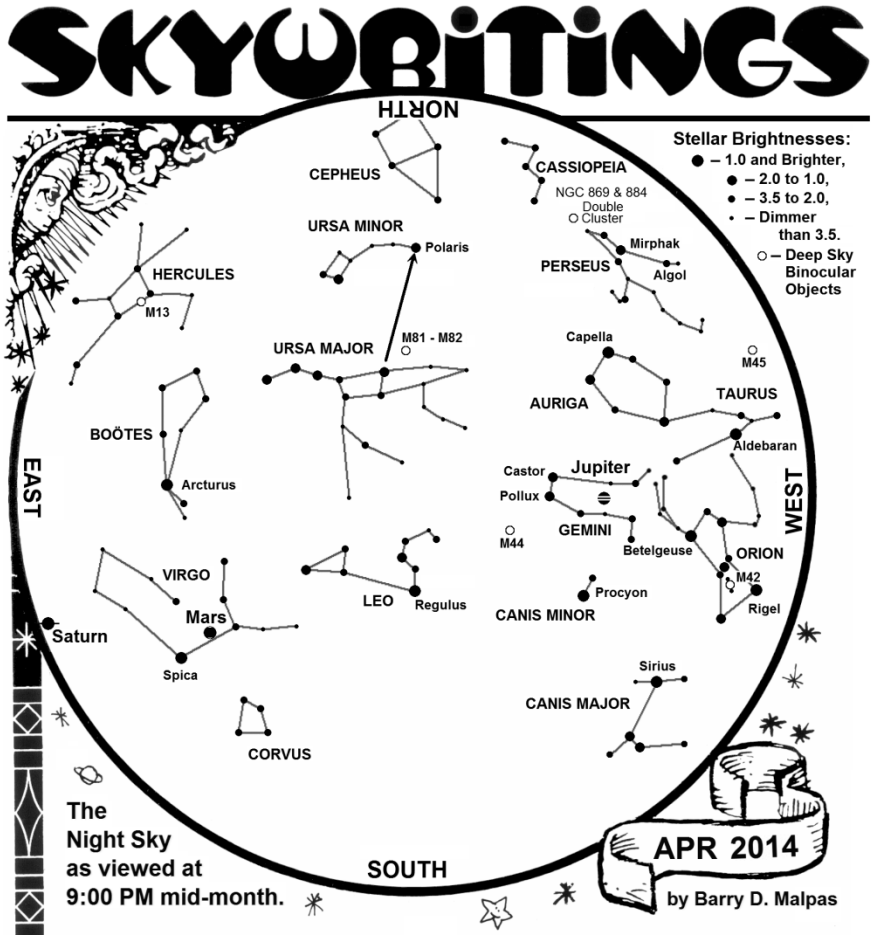
JUPITER AND ITS MOONS – MORE IMPORTANT THAN YOU THINK

By Barry D. Malpas – Special to the Williams-Grand Canyon News – 2014 April

Jupiter, about eleven times the diameter of Earth, is the largest planet in the solar family. It is currently the most observable planet in the night sky, and is found in the constellation Gemini. It is visible directly overhead in the early evening, setting after midnight, and will be observable for the next two months. Unlike our Earth, with its single satellite, Jupiter has 67 moons. The four largest of these range in size from just smaller than Earth's Moon to almost the diameter of the planet Mercury. These orbs, along with Jupiter, have been closely scrutinized by two Pioneer, two Voyager, the Ulysses, Cassini, and New Horizons space missions, and the Galileo orbiter, which have shown them to have four distinctly different types of environments.



Studying these other worlds is important to the better understanding of our own planet. But observations made of Jupiter and its four largest satellites, have been of great historical and astronomical significance since their telescopic discovery.

A few of these large moons were first recorded by Chinese observers over one thousand years ago as bright spots that appeared and disappeared on either side of the planet. Galileo Galilei (1564-1642) applying his telescope to the heavens in 1610, discovered that Jupiter had moons orbiting around it. At the time, the politically, as well as religiously, "correct", point of view was that the Earth was the center of the Universe (now known as the Ptolemaic System.) For this view to be correct, all objects (Sun, Moon, planets, stars, etc.) were required to revolve around the Earth. Galileo's discovery, therefore, became one of several significant arguments in favor of the new Copernican, sun-centered, model of the solar system which allowed for this, otherwise problematic, anomaly.

The Jovian moons again became important in 1676 when the Danish astronomer, Ole Roemer (1644-1710), began studying the motions of its satellites as they moved into the shadow of Jupiter, in order to improve on the eclipse tables of J.D. Cassini (1625-1712). From Earth, the moons are seen to pass into the shadow of Jupiter acting as a measuring marker for the orbital period of the moons. However, Roemer observed that when the Earth was on the opposite side of the sun from Jupiter, the eclipses occurred about 1000 seconds later than the predicted values from six months before. But, six months later, when the Earth was again on the same side of the Sun as Jupiter, the predicted times were correct. The only possible conclusion for the disparity was that the time delay between measurements must be due to the time required for the light to travel the extra distance of the diameter of the Earth's orbit, about 186,000,000 miles. Although scientists, including Galileo, had tried to make experiments to measure the speed of light, Roemer was the first to do so from these observations of Jupiter's moons.

During the 1700's and 1800's the eclipses of the Jupiter moons again became important, but this time as a clock, as part of a method to determine one's location on Earth. For a navigator or civil engineer, to determine his position, he must make measurements of a bright celestial object of known position in the sky. From these measurements the latitude (north-south) is easily derived, but longitude (east-west) requires a knowledge of the correct local time with respect to a standard time and location which was Mean Time at Greenwich, England. Today this is relatively easy with our highly precise clocks and satellite GPS. However, portable chronometers then were very unreliable, and would not be so until the mid to late nineteenth century.

During this time the predicted eclipse times of the Jupiter satellites were well published (with the, aforementioned, speed of light corrections accounted for.) Travelers wanting to know the correct time could observe a Jupiter moon eclipse and compare it with the predicted times for England listed in the eclipse tables. Once observed, their relative longitude could be determined accurately through a few calculations.

Jupiter has also acted as an inner planet protector from comets and asteroids. Due to its immense gravity, it helps to keep some of these objects from reaching Earth, as was noted in July, 1994 when Comet Shoemaker-Levy 9 crashed into Jupiter. The comet broke up into about two dozen pieces prior to striking Jupiter, the largest of which created an impact feature over 7000 miles across.

A PROJECT – OBSERVING JUPITER'S MOONS

You can easily observe the moons of Jupiter with a pair of binoculars or a small telescope. As you observe, note that the moons appear in a straight line. This is because we view the satellite orbits almost edge on.

If you keep notes, you can also observe the orbiting of the moons about the planet and determine their periods. On graph paper, draw the positions of each of the moons relative to Jupiter. Use the diameter of Jupiter as a basic unit to determine the distance away from the planet. (Note that sometimes one or two of the moons will not be visible because they may be behind or in front of Jupiter, or even too close to one another, appearing as one.)

Since the two outer moons, Ganymede and Callisto, take many days to orbit, you will have to view Jupiter each clear night over a few weeks. The two closest moons, Io and Europa, however, will change in position over just a few evenings, with observations made several times each night. By connecting the graphed moon positions as they change from day to day, you can construct wavy patterns called cycles. Each cycle from crest to crest will be the orbital period of that moon in days.