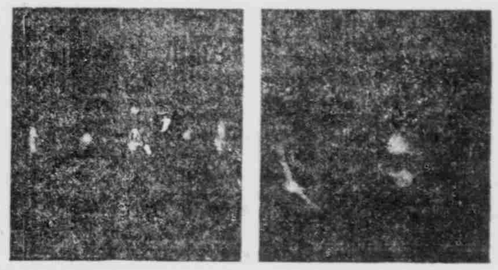
How Jupiter Appears in the Sky to Its Nearest Satellite, Io, Which Is About the Same Distance from That Planet As Our Moon Is from Earth. Down Toward the Lower Left Hand Corner Is Seen the Mysterious Red Spot Which Still Remains an Astronomical Enigma.

How the Giant Planet Jupiter Steals the Comets

Astronomy's Newest Facts About the Most Troublesome Member of the Sun's Family, Who Takes Everything That Comes Within His Reach and Probably Once Broke to Pieces a Good Planet



The Extraordinary Lights Which Are Sometimes Seen on Jupiter Have Been Exactly Reproduced by Professor Birkeland by Exposing a Magnetic Globe in a Vessel Exhausted of Air to the Action of Electric Discharges. These Two Photographs Show the Lights as They Appear on the Birkeland Globe Exactly Duplicating the Lights Seen on Jupiter.

By Isabel M. Lewis,

Connected with the Nautical Almanac Office of the U. S. Naval Observatory at Washington.

THE most troublesome member of the sun's family is the planet Jupiter. Far exceeding all the other planets combined in mass and in bulk, he holds sway over a miniature solar system of his own and exerts in addition a disturbing pull upon all the other planets.

He seriously interferes with the motions of the comets that chance by on their journeys to and from the sun, and the numberless asteroids that circulate around the sun between the giant's path and the orbit of his little neighbor Mars placed at a safe distance of 340,000,000 miles.

In fact to Jupiter's disturbing presence is attributed the existence of the fragments of planetary matter known as the asteroids in place of a single planet revolving between Jupiter and Mars. It is believed that Jupiter's gravitational pull was so great that he kept separated the particles of matter that would have otherwise formed into one body.

It is the comets, however, that have suffered most from Jupiter's gravitational power. More than thirty comets have been captured by this thief among the planets.

If Jupiter is in a distant part of his orbit when a comet crosses it no harm is done, but if the comet is unfortunate enough to so time its arrival that Jupiter is in the immediate neighborhood disaster is sure to follow.

In such a case the comet's rate of motion is either increased or retarded according to whether it is approaching or receding from the planet and its path is radically changed in form. If the comet's speed is accelerated by the encounter it is driven away from the solar system into interstellar space, possibly to try its fate in the vicinity of some other sun. If, on the other hand, the comet's motion is retarded, its path is shortened and bent into an eclipse passing around the scene of the encounter. It then becomes a member of Jupiter's captured comet family.

An example of Jupiter's influence over comets is furnished by the little comet known as 1889 V, discovered by Brooks. It was found after this comet's orbit had been computed that in 1886 it had chanced to pass very close to Jupiter, in fact so close that it came between Jupiter's surface and the path of his nearest satellite and was even disrupted into two parts under the force of Jupiter's attraction. By this encounter its previous period of twenty-seven years was reduced to seven years and it became a member of Jupiter's comet family.

The change that Jupiter makes in the paths of comets is usually a gradual process. At each close approach the orbit is reduced more and more and in some cases the comet's orbit may get so far inside of Jupiter's path that he can no longer seriously disturb it.

Fortunately for all the members of the solar system comets are bodies of little mass. The heads of even the largest comets are probably nothing more than a swarm of meteoric particles. Head-on collisions with planets possessing atmospheres would doubtless result in nothing more serious than a heavy meteoric shower in which most of the particles would be consumed by friction with the atmosphere.

The fact that comets have such small mass is proven by their not disturbing in the least any of the planets they chance to graze. If this were not so interference with the motions of these bodies might be disastrous for the members of our system.

The paths of the most prominent members of Jupiter's comet family have been charted by astronomers. It will be noticed that these comets all pass around the sun in obedience to the overwhelming gravitational attraction of the ruler of the solar system, but their aphelia or the points in their orbits farthest from the sun are all found near Jupiter's path. Each orbit loops around the scene of its close encounter with the planet. We might roughly trace the path of Jupiter around the sun by means of the aphelia of the various members of his comet family.

Saturn, Uranus and Neptune also have a few captured comets, but nothing to compare with Jupiter's extensive and troublesome family.

No comet can ever become a satellite of the planet, however, but must always continue to pass around the sun in obedience to his greater attraction as long as it remains in the solar system. The most Jupiter can accomplish is either to shorten the path so that it cannot extend far beyond his own orbit or else to drive the comet permanently beyond the limits of the solar system on the curve of a parabola or hyperbola.

The Planetoid Eros, "A Mountain Tumbling Through the Sky"—Part of a Planet Which Science Now Believes to Have Been Shatter by Jupiter.

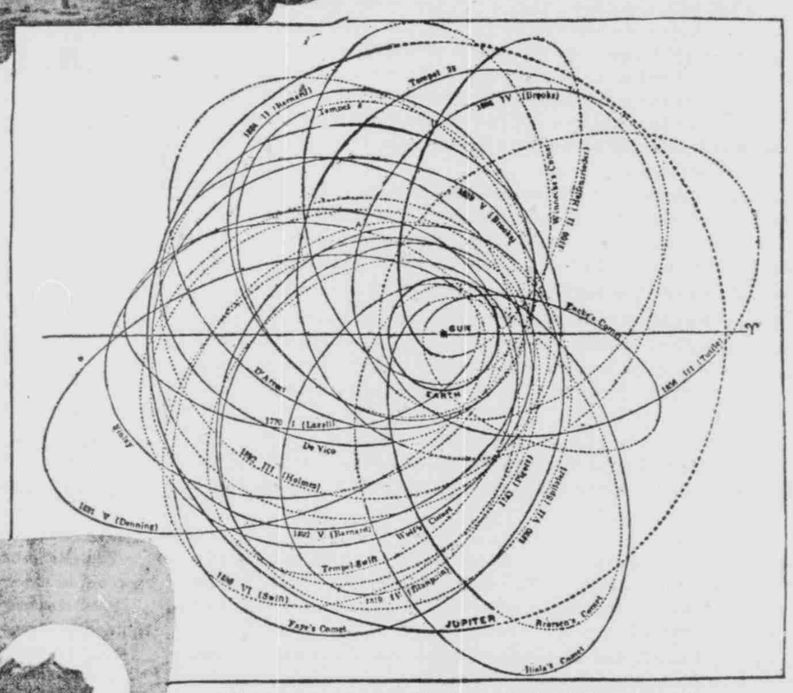


Diagram Showing the Number and the Orbits of the Comets Which Jupiter Has Captured.

The fact that a few comets have been found to have the most distant points in their orbits grouped at certain definite distances far beyond Neptune's orbit has caused some astronomers to believe that Neptune may not be the outermost member of the sun's family and the future may disclose the presence of one or more additional planets.

Jupiter has nine satellites, of which four have been known from the days of Galileo. They were the first objects to be discovered with the telescope and can be easily seen with an opera glass. The transits of these satellites across Jupiter's disk, when their shadows appear as round, black dots upon his face, both satellite and shadow being visible at one time, their occupation behind the planet Jupiter and their disappearances in his shadow make the observation of this planet in a small telescope a source of never failing interest.

Vague markings have been observed upon these moons at times, but their great distance and small size make them very difficult to observe. Since it is possible, however, that one or two of the larger of them may be the abode of some forms of life, they possess an added interest for us. Jupiter beyond doubt supplies his satellites with a certain amount of heat, and below his dense canopy of clouds he may possess some luminosity as well.

Of course, the supply of light and heat from the sun is greatly reduced at the distance at which Jupiter and his satellites are found, being only 1-27th of the amount we receive. The other satellites of Jupiter are extremely small and are only visible in large telescopes. The eighth and ninth possess a particular interest from the fact that they and the ninth satellite of Saturn are the only members of the solar system that revolve around the mother planet in a retrograde direction, that is, from east to west. The almost universal direction of motion among the planets and satellites is from west to east.

As the distance from the planet increases its gravitational control over its satellites weakens, and at last a point is reached where the attraction of the sun for the satellite would overbalance the planet's attraction. At this critical point the satellite would leave the planet's control in obedience to the greater attraction of the sun.

It has been found, however, that as this critical position is neared the backward direction of revolution is safer than the direct. This is probably why Jupiter's most distant satellites back around their primary contrary to the direction of all the nearer satellites.

Jupiter is almost entirely composed of gaseous matter and midway in evolution between the sun and earth. It is still a question just what portion of the planet is composed of solid or liquid matter; in fact, whether it is not gaseous even to the centre. Its very low density (one and one-quarter that of water) and even less than that of the sun, shows that it cannot contain much solid matter. Moreover, the fact that its equatorial regions rotate more rapidly than those in higher latitudes, in which respect it also resembles the sun, furnishes proof of its gaseous condition.

What we see of the planet is its cool, dense atmosphere. Above the intensely hot interior of the planet lie layer after layer of dense gaseous vapors condensed by contact with the frigid cold of space. The vapors of all the different elements found in the sun and earth are doubtless to be found here—hydrogen, helium, calcium, vion, manganese, etc.

The planet's disk is diversified by a great variety of color. The general background is of a yellowish tinge splotched with spots of intense white, reddish, brown or green that are of a fleeting nature. Some of these spots pass each other with a speed two or three times that of the swiftest hurricane that ever blew over the face of the earth.

The most conspicuous feature of the planet are the belts of reddish color that lie parallel to the equator and constantly change in width and form. As many as nine parallel belts have been counted at one time reaching from the equator to high polar latitudes. There are always at least two well defined belts visible in positions corresponding to the sunspot belts upon the sun.

It is strongly suspected that Jupiter exhibits atmospheric phenomena that are dependent upon some cycle of change within his highly heated interior analagous to the sunspot period upon the sun. The great red spot that excited such a lively interest among astronomers was by far the most puzzling marking that ever appeared upon this huge planet. Its real nature is a mystery.

It appeared first in 1878 as a pinkish oval spot near the edge of the south equatorial belt. The next year it became brick red in color and the most conspicuous thing about the planet. Its size was enormous, in extent, one-third the diameter of the planet, or 30,000 miles, and in width, 7,000 miles. Its area in miles was greater than the entire surface of our planet.

After three years' time it began to fade and though it had times of partial revival of color it never regained its intense red color.

In some mysterious way it seemed to derive its sustenance from the highly heated interior of Jupiter. It exerted, moreover, a repellent effect, whether electrical or not is unknown, upon other spots in the vicinity. When most intensely red it seemed to hold at bay a fringe of intensely white clouds evidently bent upon overwhelming it.

Some observers believed that it lay deep down in the lower strata of the atmosphere, while others received the impression that it rode at a much higher level. It is impossible to determine whether its reddish tinge was dependent upon the nature of the material composing it or due to the fact that it lay at such a great depth that the rays of sunlight penetrating to it acquired a reddish tinge, as in sunset skies, through the loss of the light waves of shortest length, the violet and the blue, in the planet's atmosphere.

The reddish tinge of the belts of Jupiter has been ascribed by some to the fact that they form rifts in the clouds through which sunlight penetrates deeply into the lower strata of the planet's gaseous envelope.