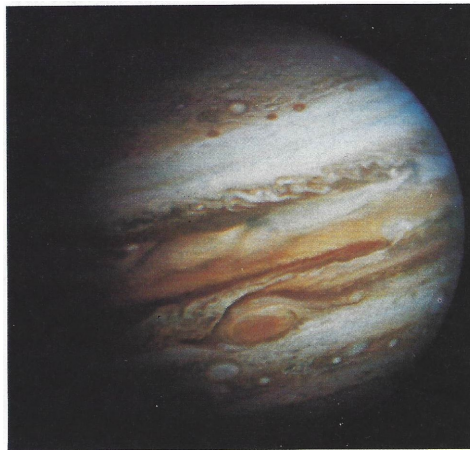


## Chapter 13. Jupiter: A Giant Among Giants



**Figure 13.4.** A Voyager Image of Jupiter.

**Note.** In this section we survey physical properties of Jupiter.

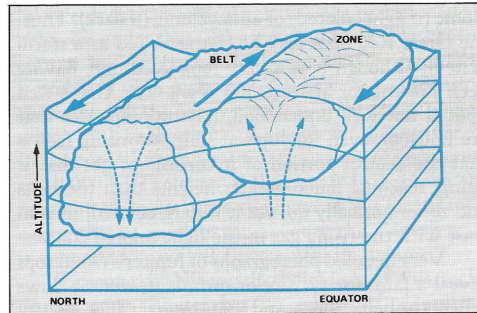
**Note.** Some general facts about Jupiter include:

Orbital Period	11.86 years
Rotation Period	10 hours
Surface Gravity	2.64 of Earth's
Albedo	34%
Satellites	16

Jupiter is big (318 times Earth's mass) and contains 3 times the matter of all the other planets combined. It rotates so rapidly that it is oblate, and it spins differentially, spinning faster at the equator than at the poles.

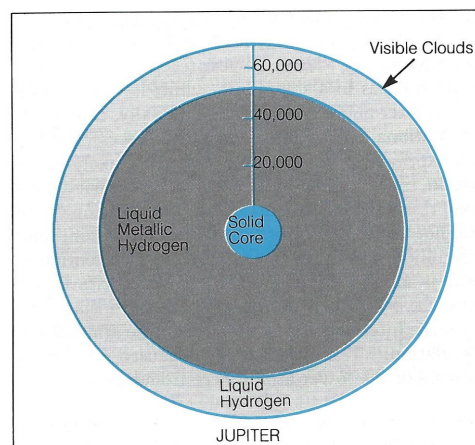
**Note.** The upper atmosphere is largely hydrogen and helium, with an overall composition is similar to that of the Sun. Jupiter is highly differentiated, and is

fluid all the way to the center. We see two features in the atmosphere: (1) dark *belts* are low pressure regions where air is descending, and (2) light-colored *zones* which are regions of high pressure and air is rising. Rapid rotation stretches flow patterns into strips around the planet. Conspicuous is the Great Red Spot which is a rising column of rotating gas.



**Figure 13.7.** Vertical motions in the Jovian atmosphere.

**Note.** Below a “thin” layer of clouds (1000 km) is a layer of liquid hydrogen. This layer is  $\approx 10,000$  km thick and below it is a layer of liquid metallic hydrogen. The core is solid with a mass of 10 to 20 Earth masses. There is no solid surface, just a gradual transition from gas to liquid. Jupiter emits 1.7 times as much energy as it receives, emitting left over interior heat from its formation.

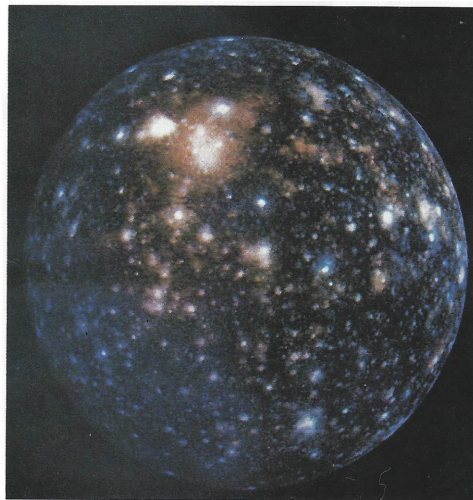


**Figure 13.11.** Internal structure of Jupiter.

**Note.** Jupiter has a strong magnetic field with a magnetic axis  $110^\circ$  to the rotational axis. In the magnetosphere are strong radiation belts (like Van Allen belts). It is found that Io gives off particles that contribute to the radiation belt.

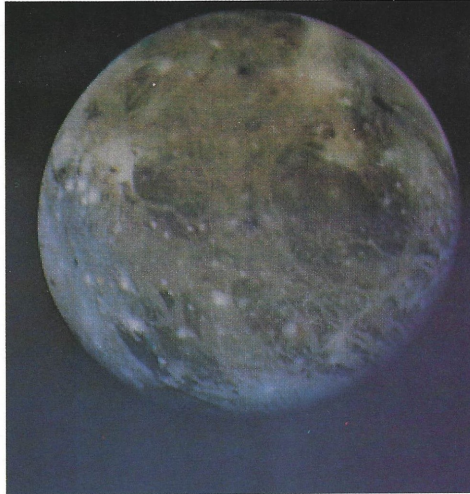
**Note.** Jupiter has 16 satellites, with the outer four orbiting retrograde. We are concerned with the Galilean satellites (in order): Io, Europa, Ganymede, and Callisto. Of the four, densities and albedos decrease with distance from Jupiter. The outer ones contain much water ice, and the inner ones contain more rocks.

**Note.** Callisto is covered with craters, and has a very dark surface with white spots at crater impacts.



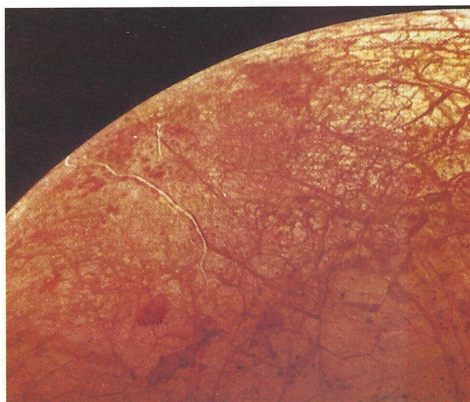
**Figure 13.14.** Callisto.

**Note.** Ganymede has a dark surface with some light streaks, with evidence for tectonics in the past. There are many craters.



**Figure 13.15.** Ganimede.

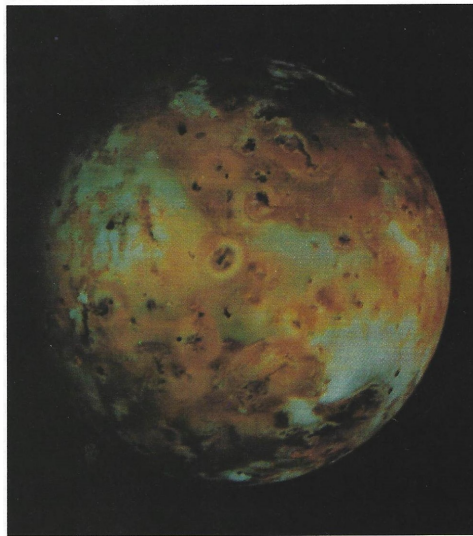
**Note.** Europa is covered with linear features which are rifts in rocky crust that were filled with water oozing from below. It may have liquid water under the surface. It has few craters.



**Figure 13.17.** Europa.

**Note.** Io has a surface that is red, orange, yellow, and white. There are volcanic-looking craters. There are no impact craters. Several active volcanoes were found by the two Voyagers probes. Io is in synchronous rotation. Tidal forces caused by

Jupiter and Europa squeeze and heat Io to drive the volcanism. Similar forces help explain the appearance of the other three Galilean satellites.



**Figure 13.18.** Io.

*Revised: 2/10/2021*