Chapter 14. Saturn and Its Attendants

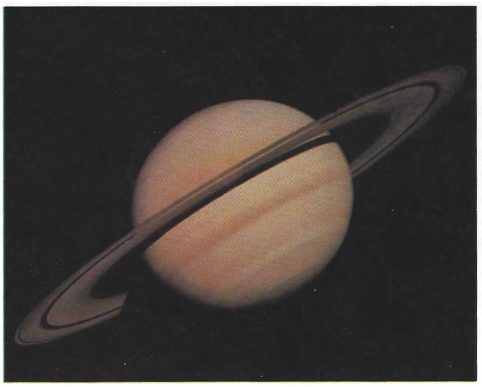

Figure 14.3. A Voyager portrait.

Note. In this section we survey physical properties of Saturn.

Note. Some general facts about Saturn include:

Orbital Period	29.5 years
Rotation Period	10 hours 40 minutes
Tilt of Axis	26°
Mass	95 times Earth's mass
Surface Gravity	1.13 of Earth's
Albedo	34%
Satellites	17 known

Galileo was the first to see Saturn's rings. Huygens explained them as rings and discovered the moon Titan. Cassini observed gaps in the rings and discovered four satellites. Saturn also has differential rotation, and a composition similar to that of Jupiter.

Note. Saturn is similar to Jupiter, with belts and zones, but the contrast on Saturn is less extreme. Rising and descending gas combines with rapid rotation to form strips circling the planet, as on Jupiter. The interior is similar to Jupiter, with a very thick layer of clouds, a layer of liquid hydrogen and helium, a layer of liquid metallic hydrogen, and a rock-and-ice solid core. Saturn puts out 1.8 times as much energy as it takes in, the excess is from continued differentiation (the heavy stuff sinks and releases energy). Saturn has a magnetic field slightly stronger than Earth's and its magnetosphere fluctuates in size with solar activity.

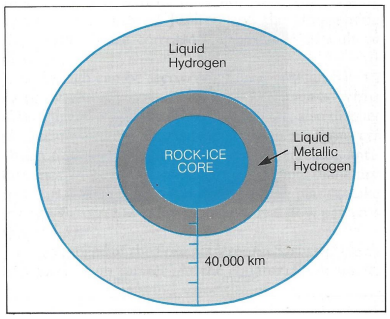

Figure 14.7. The internal structure of Saturn.

Note. There is evidence for as many as 22 satellites. Of primary concern are (in no particular order):

Titan. It is only one of two satellites that has an atmosphere. The atmosphere is so thick that Voyager could not see the surface. Methane is present in the atmosphere, possibly in solid, liquid, and gas. The surface temperature is 90° K, the atmospheric pressure is 1.5 atmospheres. Titan is about 60% larger in diameter than the Earth's Moon.

Dione. It has valley systems and white wispy patterns that may be frozen gases solidified as soon as they are emitted from surface rocks or volcanoes.

Figure 14.11. Dione.

Tethys. It has linear trenches probably due to impacts.

Figure 14.12. Tethys.

Mimas. It has and impact crater 1/4 the size of the surface and it resembles the "Death Star."

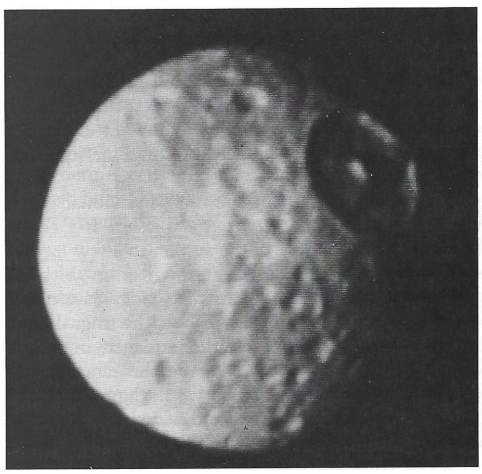

Figure 14.14. Mimas.

Iapetus. It has a very bright side and a dark side. One side probably is covered with dark soot or ooze.

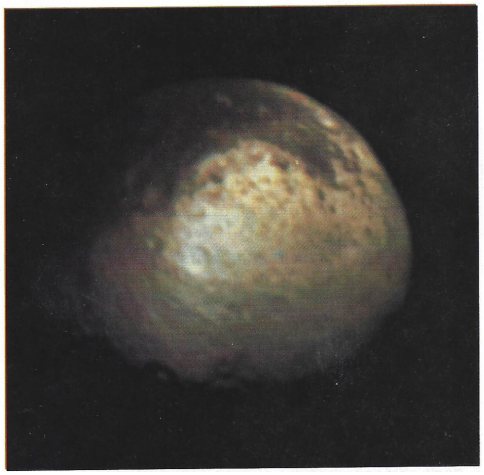

Figure 14.15. Iapetus.

Enceladus. It is the shiniest object in the solar system with an albedo near 100%.

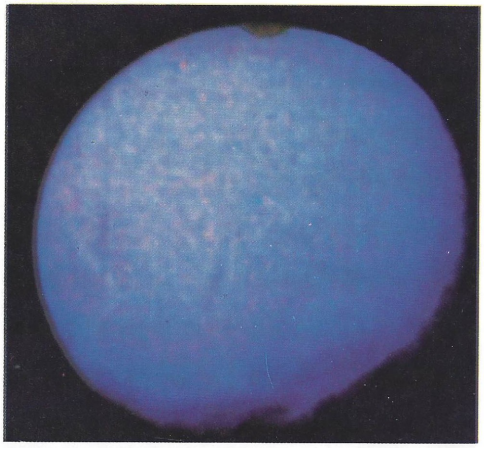

Figure 14.16. Enceladus.

Hyperion. It is oddly shaped but large, implying that it was never molten.

Phoebe. It has a retrograde orbit. Its orbital plane is perpendicular to the other satellite's orbits. It is probably a captured asteroid.

Rhea. It has craters and light areas. It is probably icy.

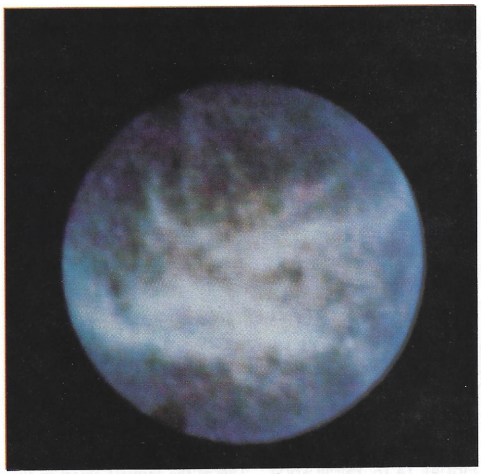

Figure 14.13. Rhea.

Note. The rings of Saturn are bunches of particles, with sizes less than a centimeter to several meters. The rings are not rigid. Cassini's gap is a result of orbital resonance of this area with the moon Mimas. The total mass of the ring is $1/10^6$ of Earth's Moon. The rings can be asymmetric, indicating instability and the fact that the rings are young features. The best theory for the formation of the rings of any planet is that they are the result of the destruction of satellites by collisions.

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