

This computer-enhanced photograph of Titan shows some of the haze layers overlying the otherwise featureless, thick, nitrogen-rich atmosphere.



Opposite page, top:

A composite Voyager picture (in true colour) of Saturn also showing three of the satellites – Tethys, Dione and Rhea. The black spot on the southern hemisphere of the planet is the shadow of Tethys. Some of the 'spokes' can be seen (particularly left) on the bright B Ring.

Opposite page, bottom left:

A close-up view in false colour of two of Saturn's rings – the C Ring (blue in this picture) and the B Ring (orange). Seen from this close, the two rings are clearly made up of many smaller ringlets, of which more than 60 are evident in this frame.

Opposite page, bottom right:

Unlike Jupiter, Saturn has a thick overlying haze which hides most of the atmospheric features. Complete computer-processing and image-enhancement was required before any details could be seen, as in the case of this Voyager 2 picture.

satellites (as described below for the F ring) orbiting within the ring system.

The particles comprising the whole ring system must number many thousands of millions, the largest being of the order of 10 m in diameter, while the smallest are only micron-sized (10^{-6} m). The brightest ring, the B Ring, showed remarkable dark irregular 'spokes', which formed, apparently rotated with the ring, and then dissipated. These are now thought to be due to tiny particles like smoke, out of the general plane of the rings, perhaps levitated by electrostatic forces. (The appearances described are those of the ring system as seen from the sunlit side; these change completely when viewed from 'beneath' – that is from the 'shadow' side. Then the densest parts of the rings – the B Ring in particular – are opaque and appear black, whereas the Gaps and Divisions and some of the less dense portions of the various Rings appear bright with scattered sunlight.)

It has long been established that the ring particles mainly consist of water ice, but subtle variations in the colour in various parts of the system suggest that other substances could be present. It is unlikely that the rings could be of recent origin; they probably consist of material remaining after the formation of Saturn and the larger satellites. It is possible that they were formed from larger bodies which were fragmented by collision or tidal forces.

The A Ring appears to be bounded by the small satellite which orbits at its outer edge, in the same way as Jupiter's rings seem to be restricted by the two satellites orbiting just outside them. The narrow F Ring, which is a few hundred kilometres across, is gravitationally limited by the two small 'shepherd' satellites (XV and XVI) which orbit on either side.

This ring appears to consist of several strands with various kinks as well as an apparently 'twisted' or 'braided' structure. Gravitational interactions with the confining satellites probably produce the kinks, but the twists are more likely to be illusory – the

Table 5-14 Saturn's rings

	distance from Saturn's centre		
Cloud tops	60 300		
D Ring	inner edge	67 000	
	outer edge	73 200	
C Ring	inner edge	87 500	Maxwell Division
	outer edge	92 200	
B Ring	inner edge		
	outer edge	117 500	Huygens Gap
		119 250	
A Ring	inner edge	121 000	outer edge
	outer edge	136 500	
F Ring		140 600	Encke Division
G Ring		170 000	
E Ring	inner edge	210 000	(approx.)
	outer edge	300 000	(approx.)

result of the displacement of some of the strands from the general plane of the rings. The Encke Division also contains a ringlet which exhibits kinks, but the cause in this case is quite unknown.

Further out from the planet, well beyond the main rings, and outside the orbits of satellites X and XI (provisionally called Janus and Epimetheus) there exists the very tenuous G ring, about which little is known. Neither it nor the final ring, the broad E Ring, show any of the fine structure of the main belt.

Satellites

The system of satellites around Saturn is quite remarkable, not only for their number (seventeen confirmed and a further six suspected), but also for the extraordinary orbital characteristics of several of