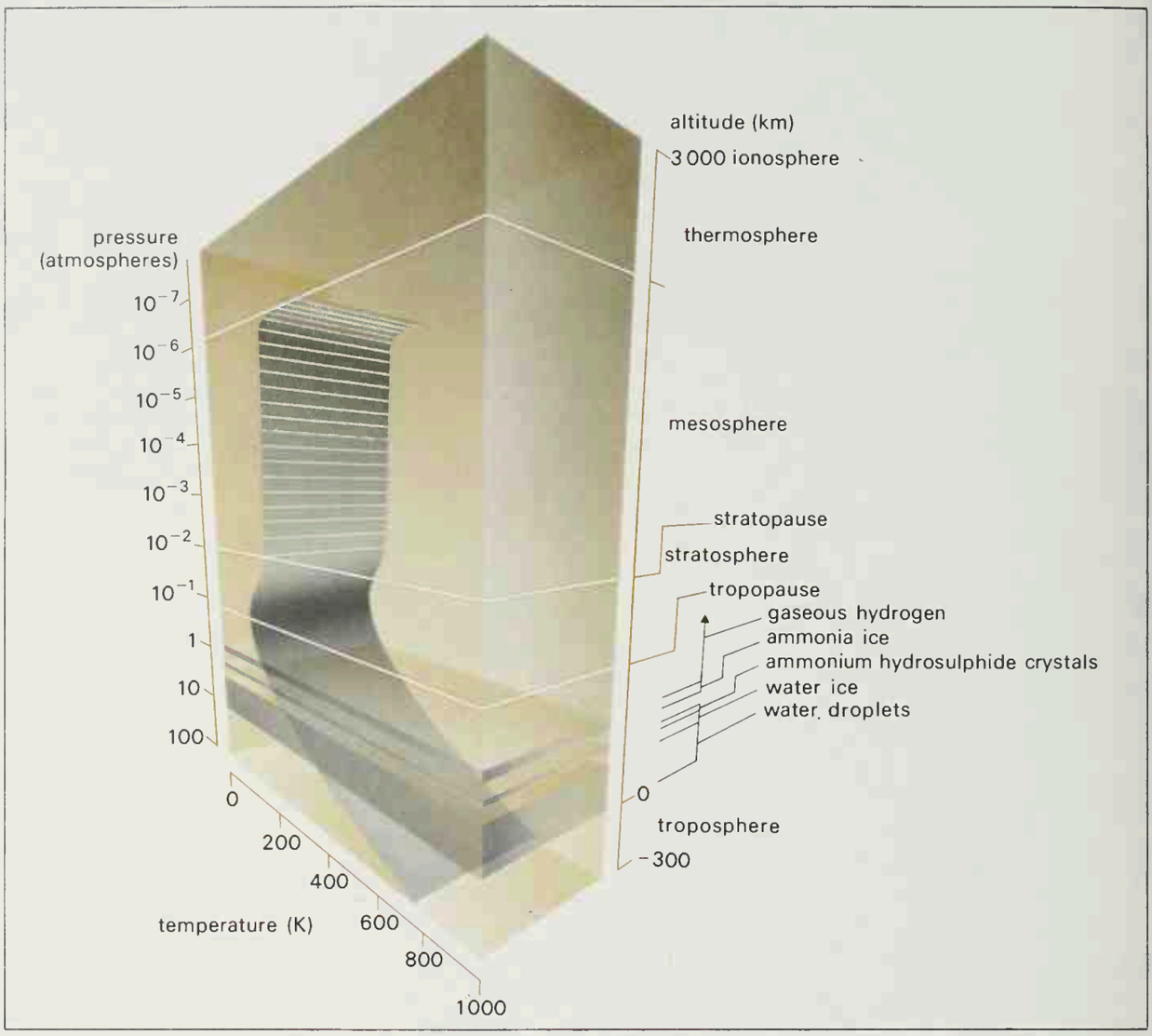

Fig. 5·16
The atmospheric structure of Jupiter. The height of clouds observed in the zones is approximately 120 km. The temperature is rather uncertain above the stratopause.

The cause of the distinct brown and reddish colouring of the clouds remains uncertain. It is most likely that it is related to the presence of phosphine (PH_3), which may be broken down by ultraviolet radiation from the Sun to give red phosphorus (P_4). This process should be most pronounced at the highest levels, and would thus nicely account for the colour of the Great Red Spot, which is the highest feature on the planet. However, some of the smaller red spots are very much lower, so the matter is unresolved. Other colouring agents almost certainly exist, such as complex hydrocarbon compounds produced from the methane (CH_4) and ammonia (NH_3) present in the atmosphere.

Magnetic field

Jupiter's strong magnetic field is probably generated as a result of the internal heat producing convection currents inside the liquid metallic hydrogen. Close to the planet the field is extremely complex and possibly related to circulation within this liquid metallic hydrogen. From about three Jupiter radii, however, the simple bar-magnet type of dipole field is like the Earth's, and the magnetic axis is tilted by about 10–11° from the axis of rotation and displaced by about 7 000 km from the centre of the planet. Between about 20 and 50 Jupiter radii there is a sheet of low-energy trapped particles which themselves produce a magnetic field, influencing the overall lines of force (Fig. 5·17). Further out the dipole field is weak; it ends at the magnetopause, but the position of this depends strongly on solar activity, and may range from 100 to 50 Jupiter radii. In the other direction the spacecraft measurements indicate that the magnetic tail extends out beyond the orbit of Saturn, having been detected at about 7×10^8 km (more than 4·5 au) from Jupiter.

The immensely strong magnetic field has given rise to a vast radiation belt, rotating with the planet, with a trapped plasma of highly energetic electrons and protons. By means of a process known as synchrotron radiation, the trapped electrons produce powerful radio emission at wavelengths between 5 and 300 cm. Although all the inner satellites are within this belt and are bombarded by the charged particles, the density reaches a maximum in a ring-shaped torus around the orbit of Io. This satellite is connected to Jupiter by a flux tube of magnetic field lines which carries an immense current of about 5 million amps. Electrons from this flux tube sometimes precipitate into the upper atmosphere, giving rise to the aurorae observed by Voyager 1. Similar discharges are responsible for the bursts of radio emission between about 7·5 and 670 m which are observed from Earth. These are linked with specific