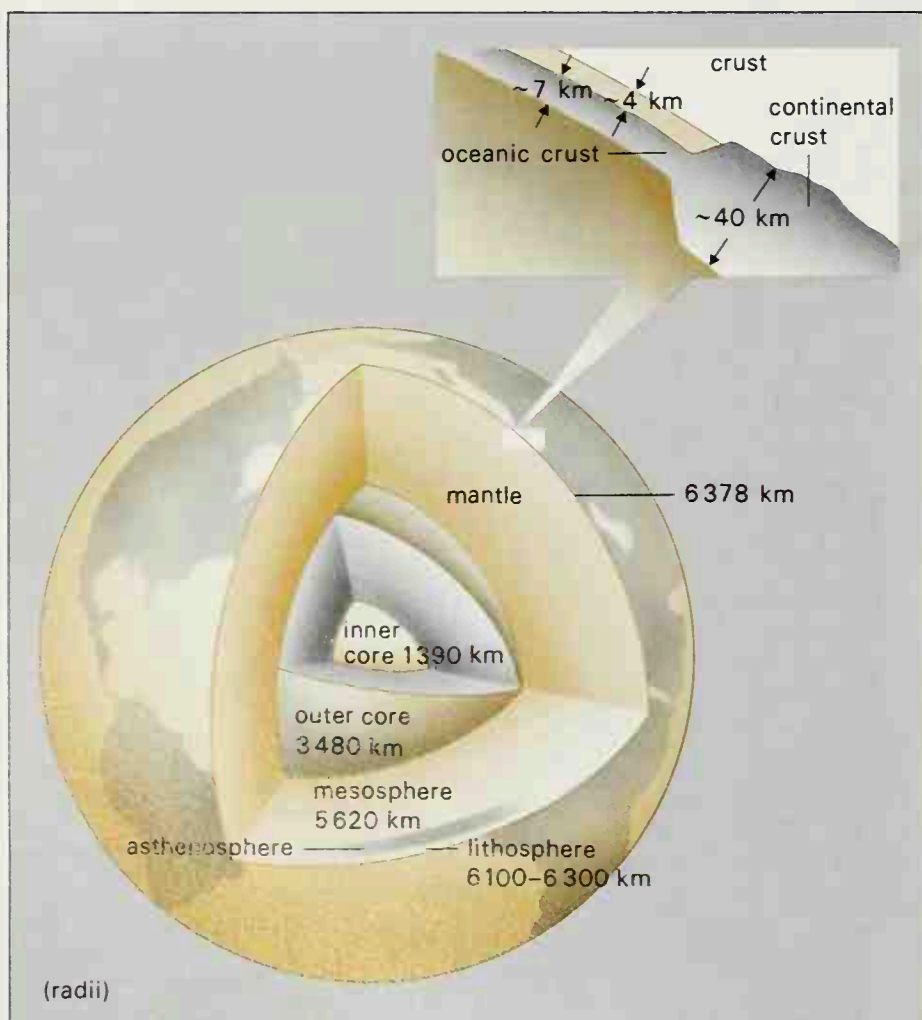


# The Solar System

## The Earth

The number and diversity of objects within the solar system is not always appreciated. Besides the Sun there are nine planets, tens of known satellites, a few thousand minor planets and a host of comets numbering perhaps millions. The range of sizes is also vast. Comets may have haloes of tenuous gas which extend  $3 \times 10^7$  km into space; the Sun, a far denser body, has a diameter of almost  $1.4 \times 10^6$  km, but all the other bodies are far smaller. Even the giant planet Jupiter is only a tenth the size of the Sun, while Mercury is little more than a thirtieth as big as Jupiter and Pluto less than one fortieth as big. Smaller still are their satellites and the many thousands of minor planets, some of which are only a few hundred metres across. In addition, there are the tiny bodies which make up the rings of Jupiter, Saturn and Uranus, and the innumerable meteors and particles of interplanetary dust.

Fig. 5.1 The interior of the Earth. Average figures are given for crustal thicknesses and the radii of the various layers. The asthenosphere may be regarded as plastic and the outer core is liquid.



Although in the past it was natural to try to interpret the planets in the light of conditions on Earth, one of the most important results of space research is that it is now possible to examine our planet with new insights into the processes which are at work, and to determine how it resembles, or differs from, all the other planets. We now see that as a planet, it is comparatively undistinguished except for the fact that it is the only one with large quantities of liquid water and an oxygen-rich atmosphere. Geologically it is very active, being subjected to endless changes due to mountain-building and erosion, and in these respects it is somewhat similar to the planets Venus and Mars.

It is the largest of the inner planets with an equatorial diameter of 12 756 km, but rotation has caused a flattening at the poles, reducing the polar diameter to 12 714 km. The accurate tracking of Earth-orbiting spacecraft which, obviously, are affected by gravitational irregularities, has revealed that it is uneven and slightly pear-shaped, with a bulge in the southern hemisphere. In addition, such tracking gives information which reveals the distribution of mass within a planetary body and provides a guide to the densities of the Earth within the various internal layers at various depths.

## Interior

The structure of the Earth has been principally determined by the study of seismic waves produced by both earthquakes and man-made explosions. From a study of the arrival times of the various waves which are produced, it is possible to determine the nature and depth of the different internal layers in which they have travelled. The general structure is shown in Fig. 5.1, the major divisions being the **crust**, the **mantle** and the **core**. The mantle itself consists of three regions, the highest and deepest of which are rigid, while the intervening one is weak and composed of material which is able to flow. One form of seismic wave is unable to travel through liquids and its absence from certain records indicates that the majority of the core is in liquid form. Waves which do traverse it, however, reveal the presence of a solid inner core.

The densities which have been found are given in Table 5.1 and suggest that the mantle is principally composed of silicates, while the predominant material in both the inner and outer core is iron, although there may be a difference in detailed composition.