Table 5·20 **Minor planet orbits**

number	name	distance (au) mean	distance (au) perihelion	period (years)	inclination	eccentricity	diameter (km)
1	Ceres	2·7663	2·5488	4·6012	10·604°	0·07863	1003
2	Pallas	2·7687	2·1136	4·6069	34·848°	0·23662	540
4	Vesta	2·3619	2·1528	3·6301	7·137°	0·08851	538
433	Eros	1·4581	1·1333	1·7607	10·828°	0·22286	23*
532	Herculina	2·7728	2·2878	4·6173	16·340°	0·17493	240*
588	Achilles	5·2112	4·4384	11·8964	10·316°	0·14829	53
944	Hidalgo	5·8201	1·9991	14·0413	42·494°	0·65651	16
1566	Icarus	1·0777	0·1868	1·1188	22·994°	0·82667	1
1862	Apollo	1·4697	0·6468	1·78	6·360°	0·55988	?
1973 NA		2·4470	0·8796	3·83	68·056°	0·64053	?
1975 YA		1·2901	0·9054	1·47	64·013°	0·29821	?
1976 AA		0·9664	0·7899	0·95	18·935°	0·18255	1
1976 UA		0·8440	0·4643	0·76	5·852°	0·44983	0·3?
1977 UB	(Chiron)	13·6991	8·5126	50·70	6·923°	0·37860	150–650?

*maximum (equatorial) diameter

that it is not in a stable orbital path, and that at some time in the future it is likely to be ejected from the Solar System. This will be because of interaction with Jupiter or Saturn, and it would also appear that it was originally captured by one or other of those two planets. This would support the idea of the body being more like a comet than a minor planet from the main belt.

Inside the main belt there are about twenty bodies which cross the orbit of the Earth, and which are called the Apollo group after the name of the first to be discovered. Two objects, 1976 AA and 1976 UA, have orbital periods less than that of the Earth and one body, 1566 Icarus, has a perihelion distance of only 0·186 au, inside the orbit of Mercury (0·308–0·467 au). Because they may closely approach the Earth, some very small, faint bodies are known in this group, including the minor planets 1973 NA and 1975 YA with the greatest orbital inclinations, approximately 68° and 64° respectively.

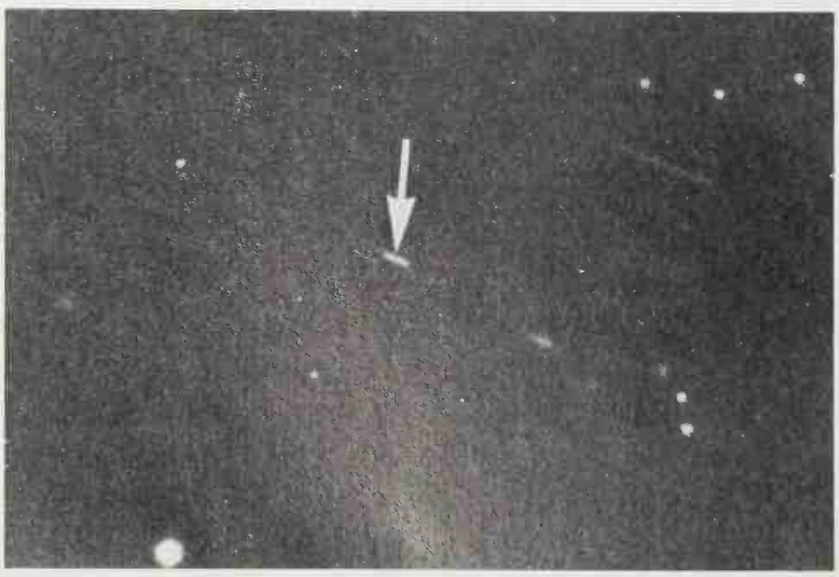
Sizes and composition

For a long time, approximate diameters were known for only a few of the largest minor planets. However, modern techniques allow albedos to be determined and, with measurements of apparent magnitude, it is possible to calculate sizes. By this means the diameters of some 200 objects have been established, ranging from about 1 000 km for Ceres down to 1 km for 1976 AA, while 1976 UA may be only a few hundred metres across. At least fourteen have diameters of 250 km or greater and most of these orbit in the outer part of the belt. Although the older theory that all of the minor planets originated from the break-up of a single object is now discounted, calculations suggest that there have been many collisions between the bodies and that probably only the three largest, Ceres, Pallas and Vesta may be substantially unaltered. Fragmentation of individual bodies is considered to account for the observed families of minor planets with similar orbits and characteristics.

The majority of the planetoids show variations in their magnitudes implying that they are irregular and reflect varying amounts of light as they rotate; periods of about 2·3–18·8 hours having been found. From various results, 433 Eros has been found to have diameters of about 10, 15 and 36 km, thus showing similarities to the Martian satellites in shape. Study of the results of an occultation in 1978 show that 532 Herculina has probable equatorial and polar diameters of approximately 240 and 210 km and is accompanied, at a distance of about 975 km, by a small satellite body of 45–50 km diameter.

The most important result of the determination of albedo is the fact that the majority of bodies fall into two main groups, with the larger (88 per cent) having very dark grey surfaces which reflect from 5 per cent to as little as 0·02 per cent of light. Spectral measurements show that the material is similar to the type of meteorite known as a carbonaceous chondrite (see p. 158). The other major group (1 per cent) is reddish, has a higher albedo of 10–20 per cent and corresponds to silicate material, like that of the stony-iron meteorites. The distribution of orbits shows that the silicate bodies are most numerous at the inner edge of the planetoid belt, and the larger carbonaceous type at the outer edge. Spectra of many planetoids do not resemble any meteorite type, suggesting that known meteoroids may be derived from only a few original bodies. However, some of the rarer meteorites can even be identified with individual minor planets from which they have presumably been fragmented.

Various studies, including the detection of radar echoes from some of the larger bodies, are gradually establishing the distribution of the different types of



The discovery photograph of 1977 UB (Chiron), a 75 min. exposure with the 1·2 m Schmidt telescope at Mount Palomar. The short, bright trail of 1977 UB (arrowed) may be compared with that of a closer, more typical minor planet which is seen towards the upper right.