This is just Kepler's third law, which says that the period of an orbit is proportional to the 3/2 power of its radius; 6378 km is the radius of the Earth.

At an altitude of 35 900 km, a satellite orbits the Earth once every 24 hours. If such a satellite is directly above the equator and moving east, it is **geostationary** — that is, its orbital motion matches the rotation of the Earth, and it stays above the same point all the time. Many communications satellites are geostationary so that they can be "tracked" with antennas that don't move.

The brightness of a satellite is hard to estimate, but here is a very rough guide. If the average satellite 1000 km away is fourth magnitude, then for typical satellites at other distances:

$$\text{Magnitude} = 4 + 5 \log_{10} \frac{\text{distance (km)}}{1000}$$

Thus geostationary satellites are eleventh or twelfth magnitude, just within reach of amateur telescopes.

5.6.3 Satellite data files

Fortunately, there is just one standard file format for satellite orbits. It is the TLE (two-line-element) format from NORAD (the North American Aerospace Defense Command). Figure 5.9 describes it briefly. The most important parameter is the date (epoch), since that tells you how fresh the elements are, and for artificial satellites, *out-of-date elements give very inaccurate positions*. The date is given as a year and day number; 02333.5 is 12^{h} UT on the 333rd day of 2002. Fresh elements generally have an epoch slightly in the future of the day they are issued, to allow for gradual changes known to be taking place.

The second most useful parameter is the rate of motion, given as revolutions per day, since this tells you whether the satellite is low and therefore bright. The lowest satellites make about 16 revolutions per day.

Current TLE files can be downloaded from http://www.celestrak.com, http://oig1.gsfc.nasa.gov, and many other places; to find more, do a web search for "satellite tracking" or "two-line elements."