

U3A-GROUP ASTRONOMY (28-4-2006)

TARGET EARTH: Meteors - Asteroids - Comets

We see how the Moon (like most other celestial bodies) is dotted with impact craters.

The Earth must receive a similar battering, but there are less craters because:

- much small material burns up in the atmosphere (meteors, shooting stars);
- about 2/3 of everything that reaches the Earth, falls into the sea;
- craters on land 'disappear' through erosion, sedimentation, vegetation etc.

What is flying around ?

- Loads of small bits and dust. Some 40,000 tonnes which does not burn up in the atmosphere reaches the Earth annually.
- Larger, shapeless lumps of *rock* or *nickel+iron* (NiFe): Asteroids (or Planetoids). Most of them orbit the Sun in a belt between Mars and Jupiter: material for a planet which failed to materialize. About 40,000 of them are known today, but there exist probably between 1 and 2 million with diameters of more than 1 km. Under the gravitational influence of Jupiter or through collisions they can be diverted and become a threat to the Earth: *Near-Earth Objects* (or NEO's).
- Lumps of ice + rock + dust: Comets ('Dirty Snowballs'), moving around the Sun in often very large elliptical orbits. There are trillions of them: remains from the formation of the Solar System. When they approach the Sun, the heat forms a long fiery tail. There are two types:

Short-period comets, mostly originating from the *Kuiper Belt*, with orbits < 200 years. For example: *Halley* (1682) which returns every 76 years (last time: 1986).

Long-period comets, mostly originating from the *Oort Cloud*, with orbits > 200 years. For example: *Hale-Bopp*, clearly visible for weeks in the spring of 1997, not to return within the next 1-2000 years.

(Near-)Impacts in the distant and recent past

- Best-known: *K/T-impact*, 65 mln years ago, which wiped out the dinosaurs.

K = Cretaceous (Kreta or Kreide etc.), T = Tertiary. Big change in fossils between 'K' and 'T', + thin layer of *iridium*. Must have been a massive impact, but the remains of the crater were not discovered until 1990: *Chicxulub-crater* in/under Yucatan/Gulf of Mexico, with diameter of c. 300 km. Asteroid must have measured c. 10 km, explosion of c. 6 bln Hiroshima-bombs. Long dark, cold period followed → c. 70% of all animals extinguished. Positive for remaining 30%, such as mammals → eventually MAN!

- In earlier times between 5 and 10 similar (or even bigger) extinctions have taken place.

- *Arizona crater*, diameter 1200 m, was caused c. 49,000 years ago by impact of NiFe-lump of c. 40 m diameter. Also several big craters – mostly of older impacts – in Australia.

- Probably heavy impact around AD 540: end of the Roman Empire, beginning of the *Dark Ages*, similar reports from China.

- *Tunguska-event* in Siberia, 1908. Lump of rock with diameter 50-100m, exploded 8 km above the ground. Forest destroyed in area of 2000 sq.km., curious world-wide aftermaths.

- A 100 tonnes meteorite caused 120 craters in E.Siberia in 1947.

- In 1972 a Tunguska-size object flew over the Rocky Mountains at 55 km altitude and headed back out into space above Canada.

- A fireball 'nearly as bright as the Sun' was observed over the Pacific Ocean in February 1994.

Further there must be many *unobserved* events, above oceans, deserts, polar regions etc.

Probabilities

Impact of object with diameter of 10 km (=K/T): 1 x per 100 mln years.

Object with diameter 50 m (=Tunguska): 1 x per 100 years.

Chance of being killed by asteroid or comet impact for US-citizen = chance of being killed in air-crash.

What to do?

1. Monitoring systems: *Spaceguard* etc. Funding so far insufficient (mostly by USA).
2. Action: trying to deflect incoming object by means of nuclear explosion. Only applicable if the approaching object is known years before the possible impact. Often not the case, especially with fast moving long-period comets.
3. Keep your fingers crossed!