6 ASTEROID and KING PLANET

SYNOPSIS

ASTEROID – The Threat
Between the orbits of Mars and Jupiter is the Asteroid Belt, a swarm of rocky bodies. Every so often, perturbed perhaps by the gravitational tug of Jupiter, asteroids collide and tumble towards the Sun. If they pass Mars, they can threaten Earth. Sixty-five million years ago an asteroid impact most probably killed the dinosaurs. That threat from space continues. How do we protect our planet? One way is to know our enemy. Robot spacecraft visit asteroids.

KING PLANET– Jupiter
Jupiter, bigger than all the other planets combined, could swallow Earth 1,323 times. Yet this giant ball of gas has no solid surface. Comprising roughly 90 per cent hydrogen and the rest mainly helium and orbited by more than 60 moons, Jupiter is a mini solar system. Four moons are big enough to make small planets. The moon Europa has an icy crust that may conceal an ocean. Primitive life may lurk there - evolved, as in seas on Earth, around hydro-thermal vents.

BACKGROUND

Beyond Mars is the Asteroid Belt – hundreds of thousands of rocky objects, a great ring of so-called minor planets left over from the formation of the Solar System. Were it not for the disruptive pull of Jupiter, which lies farther out, the belt might have formed a small, single planet. As it is, orbiting the Sun between Mars and Jupiter, the belt is an array of potential projectiles that every so often threaten Earth.

Gaspra is a typical asteroid – 20 kilometres across, composed of silicates and pure metal. Imagine it plunging to Earth. Another is Ida, twice the size of Gaspra. Mathilde, blacker than coal, is 52 kilometres wide and Vesta, brightest of all the asteroids, is an impressive 530 kilometres in diameter.

Occasionally, asteroids collide with each other. Some of the resulting fragments can be ejected into orbits that carry them closer to Mars. Then, in repeated passes of Mars, an asteroid may be nudged by the mighty tug of Jupiter to a new path – a trajectory that crosses the orbit of Earth.

Such an asteroid has struck us. Sixty-five-million years ago a 15-kilometre-wide asteroid hit what is now Mexico's Yucatan Peninsula. The result was a cosmic winter and mass extinction. When the skies cleared, two thirds of all species were gone – including the dinosaurs. The impact crater, buried now beneath forest and ocean, was 200 kilometres wide.

While inert bodies like Mercury and the Moon are pocked with such craters, Earth's weather, vegetation and oceans obscure aeons of impacts. The Australian Outback has some of the best remnants – like the Henbury craters from 5,000 years ago, Wolf

Creek from 300-thousand years ago and Gosses Bluff, 20 kilometres wide and gouged 142-million years ago.

Smaller projectiles reach us every day. Each year, 16-thousand tonnes of debris rains from space – harmless meteors and fireballs that burn up in the atmosphere. If a chunk reaches the ground, it is called a meteorite. But meteorites pose little threat. Asteroid do. They could wipe us out. So how do we protect ourselves?

In the United States, automated telescopes watch for intruders. Many thousands have been logged. Of special interest are near-Earth objects. Once identified, radar takes over. Dishes of the Deep Space Network bounce radio waves off the Earth-crossing bodies. Size, shape and rotation are logged. We must know the enemy. Probes have rendezvoused with asteroids and even landed on one.

So far, no asteroid threatens Earth. But if one does and if there is time, a warhead might divert an asteroid headed this way. Another idea could be to attach a rocket driver and push the projectile out of harm's way – or to use a solar reflector to burn a hole that would eject material from the interior and jet the asteroid to a safer path.

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With a diameter of 143,000 kilometres, Jupiter is the biggest planet. Earth would fit across 12 times and inside 1,323 times. Jupiter is larger than all the other planets combined – a ball of gas, 90 per cent hydrogen and the rest mainly helium, whirling on an axis (tilted at three degrees) in less than ten hours.

Jupiter has no solid surface, just bands of soupy weather blowing in opposite directions. White and yellow bands are high cloud, red and yellow low cloud. Eddies and storms race around the planet. The biggest is the Great Red Spot, an anti-cyclone three times the size of Earth that has raged for centuries.

Jupiter's atmosphere is 18 times denser than Earth's. Five cloud layers are topped by the wispy stratosphere. Ammonia ice crystals are the layer beneath. The middle layer is smelly ammonium-hydrosulphide. Below are water ice crystals, then water like a deep warm ocean on Earth.

The atmosphere disappears in the next layer down. At 2,000 degrees Celsius and 1,000 kilometres deep, hydrogen turns liquid. Deeper still, hydrogen becomes a metallic liquid. At the rocky core, it is 20-thousand degrees.

Jupiter's vast magnetic field springs, probably, from the internal layer of metallic hydrogen that conducts electricity. If we could see it, the magnetic field is so big it would appear from Earth as large as the Moon in our skies. Like a doughnut within the field is a ring of electrically charged particles called the Io-torus. It carries two-trillion watts of power. The generator is the moon Io which orbits within the Io-torus. Io is the closest major moon to the planet.

Larger than our Moon but unlike our Moon, Io has no craters. Constant eruptions renew the surface and feed charged particles into the Io-torus. Io's surface is a

sizzling pizza – the most volcanically active body in the Solar System. The cause is probably gravitational flexing – the pull of both Jupiter and the moon Europa.

Europa is an extraordinary world criss-crossed with icy ridges and glacial ravines. Like rippling sea-ice on Earth, Europa's shell probably conceals an ocean. It may be deep, salty and warm, heated by the tidal stresses of neighbouring moons. Excitingly, hydrothermal vents may spew volcanic gases that harbour simple life. Robot missions will investigate.

Ganymede is Jupiter's biggest moon, larger even than the planet Mercury. Beneath its ice, Ganymede could also hide a slushy sea - so too Callisto, outermost of Jupiter's big four moons. The other moons – and there are 60 or more – are tiny. Many are mere chunks of rocks.

Weblinks for ASTEROID

http://en.wikipedia.org/wiki/Asteroid and http://en.wikipedia.org/wiki/Near-Earth_asteroid - From Wikipedia, the free encyclopedia, two detailed reviews covering the history of asteroids, groups of asteroids, and spectral types. Includes tables of largest and notable asteroids. The second entry covers near-Earth asteroids and the threat they pose to Earth.

http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level1/asteroids.html - From the "StarChild" service at NASA's Goddard Space Flight Center, an introduction to the Asteroid Belt written for young people. Information available at two levels.

http://www.kidsastronomy.com/asteroid.htm - A simple guide to the Asteroid Belt for young people.

http://www.esa.int/esaKIDSen/SEMN99WJD1E_OurUniverse_0.html - From the European Space Agency's Kids website, an accessible summary of asteroids and meteorites for young people.

http://www.windows.ucar.edu/tour/link=/asteroids/asteroids.html&edu=high - From the University Corporation for Atmospheric Research's "Windows to the Universe" website, a guide to asteroids, with information available at beginner, intermediate and advanced levels.

http://pan-starrs.ifa.hawaii.edu/public/asteroid-threat/asteroid_threat.html - From the Institute for Astronomy at the University of Hawaii, a detailed summary of the threat to Earth from asteroids and comets.

http://neo.jpl.nasa.gov/ - The main page for NASA's Near Earth Object Program, with a wealth of useful information and links to related websites around the world.

http://impact.arc.nasa.gov/ - From NASA's Ames Research Center, David Morrison's comprehensive website on asteroid and comet impact hazards.

http://www.cfa.harvard.edu/iau/lists/Dangerous.html - The IAU Minor Planet Center's List of Potentially Hazardous Asteroids.

http://neo.jpl.nasa.gov/neo/close.html - Tables showing future and past close approaches by near-Earth objects.

http://en.wikipedia.org/wiki/Meteorite - From Wikipedia, the free encyclopedia, a good introduction to meteorites.

http://meteorites.lpl.arizona.edu/toc.html - From David Kring of the Lunar and Planetary Laboratory at the University of Arizona, a world-wide web edition of "Meteorites and Their Properties".

Weblinks for KING PLANET

http://en.wikipedia.org/wiki/Jupiter_(planet) – From Wikipedia, the free encyclopedia, an introduction to Jupiter, its internal composition, atmosphere, rings, magnetosphere and moons, with an overview of the exploration of the planet by spacecraft.

http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level1/jupiter.html - From the "StarChild" service at NASA's Goddard Space Flight Center, an introduction to Jupiter written for young people. Information available at two levels.

http://www.kidsastronomy.com/jupiter.htm - A simple guide to the planet Jupiter for young people.

http://www.dustbunny.com/afk/planets/jupiter/ - From the "Astronomy for Kids" website, a handy summary of Jupiter.

http://www.planetary.org/explore/topics/our_solar_system/jupiter/ - From the Planetary Society, a helpful guide to many aspects of the planet Jupiter.

http://voyager.jpl.nasa.gov/ - From NASA's Jet Propulsion Laboratory, a complete guide to the Voyager spacecraft missions to the outer planets and beyond, including Jupiter.

http://www.windows.ucar.edu/tour/link=/jupiter/jupiter.html&edu=elem - From the University Corporation for Atmospheric Research's "Windows to the Universe" website, a comprehensive guide to Jupiter and its moons, with information available at beginner, intermediate and advanced levels.

http://www.jpl.nasa.gov/jupiterflyby/ - From NASA's Jet Propulsion Laboratory, a helpful overview of the results of the Cassini spacecraft's flyby of Jupiter in 2000/2001.

http://photojournal.jpl.nasa.gov/targetFamily/Jupiter - NASA's image access page for a wide range of images of Jupiter, its rings and satellites.

http://www2.jpl.nasa.gov/galileo/ - From NASA's Jet Propulsion Laboratory, a complete guide to the results of the Galileo spacecraft's mission to Jupiter with images of the planet, its rings and moons, artwork, animations and resources.