

8 PLUTO and COMET

SYNOPSIS

PLUTO – Farthest Planet

Long considered as the most distant planet from the Sun, Pluto is so small, it was not discovered until 1930. It was identified by Clyde Tombaugh, who photographed 45-million objects in the process. And it was not until 1978 that Pluto's huge moon Charon was discovered by Jim Christy. It was named for his wife. "Most men promise their wives the moon", she says. "Jim delivered".

COMET – Visitors from Space

The nomads of the Solar System, comets swing through the planets on wild eccentric orbits. Comets plunge into the Sun, others swing round it - like Halley's Comet which completes a vast elliptical orbit once every 76 years. Comets are from the Kuiper Belt and the Oort Cloud, a great halo of debris that envelops the Solar System and stretches a third of the way to the nearest star.

BACKGROUND

Dark, diminutive and cold, Pluto lies far from the Sun – travelling a gigantic elliptical orbit which carries it far beyond the orbit of Neptune. But, at its closest to the Sun, Pluto swings within the orbit of Neptune. Pluto takes 248 years to orbit the Sun.

So tiny and remote is Pluto, it was not discovered until 1930 by a country boy from Kansas, 24-year-old Clyde Tombaugh. Tombaugh had joined the Lowell Observatory, at Flagstaff, Arizona, as a junior observer. For 25 years the observatory had vainly searched for so-called "Planet X". It took Tombaugh's meticulous observational talents to make the find.

Systematically he photographed tiny sections of sky several nights apart. Then he compared the photographs by "blinking" between them. If a dot jumped it would not be a star or galaxy but a rogue object like a comet, asteroid or a planet awaiting discovery. After six months of blinking some 45 million objects, Tombaugh found a dot the jumped.

Despite the insight and rigour that had unmasked "Planet X" – soon to be named Pluto – young Tombaugh's role was played down. He was eventually dismissed from the observatory which pleaded lack of funds. Tombaugh felt the real reason was jealousy. Still energetic, he entered rocket development at White Sands, New Mexico – precursor of the NASA space programme. Then, in Las Cruces, Tombaugh nurtured the astronomy department of New Mexico State University.

Not until 1978 was Pluto's great moon Charon discovered during routine photographic research by Jim Christy via the US Naval Observatory at Flagstaff. He named the moon after his wife. Said she: "A lot of husbands promise their wife the moon, but Jim delivered."

Together, Pluto and Charon are like a double planet locked in a ‘super-synchronous’ rotation less than 20-thousand kilometres apart. They orbit each other in six days and nine hours – movements that reveal Pluto even punier than expected. With a diameter of just 2320 kilometres, Pluto is tiny compared to Earth, Even our Moon has six times the mass.

Scientists think the surface is ice and the interior a mixture of rock and ice. With solid methane detected, Pluto is colder than minus 200 degrees Celsius. As it swings from the Sun, even the wispy atmosphere freezes. At its closest Pluto is almost four-and-a-half billion kilometres from the Sun. At its farthest, the distance is over seven-billion kilometres – well into the Kuiper Belt, a halo of icy bodies that envelop the outer Solar System.

Indeed, for a long time, some astronomers argued that Pluto is not a planet but simply a member of the Kuiper Belt which might well contain another hundred-thousand Pluto-sized objects. To investigate, the New Horizons spaceprobe is on its way to Pluto and the Kuiper Belt. The craft is due to rendezvous with Pluto in 2015.

In 2005, using the Hubble Space Telescope, astronomers discovered two new tiny moons of Pluto, now named Nix and Hydra. In the same year, the discovery of an object even larger than Pluto was announced. Originally called 2003UB313, but now officially known as Eris, after the Greek goddess of discord, the new object also has a moon of its own, named Dysnomia. In 2006, astronomers agreed to call Pluto a “dwarf planet”, and to make it the prototype of a new class of outer Solar System bodies. Eris is also a member of the new ‘dwarf planet’ class.

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To understand the Kuiper Belt and the Oort Cloud beyond, we must return to the earliest Solar System. At the hot centre, where the Sun and the inner planets formed, heavier elements condensed like metals and rocky silicates. Farther out, lighter elements condensed into ices of methane, water and ammonia. They created gas giants like Jupiter and Neptune and the icy planetoids of the Kuiper Belt.

Still farther out, the Oort Cloud condensed into billions more dusty snowballs – the debris of the Solar System. Despite their distance, they all orbit the Sun and stretch a third of the way to the nearest star. Some become comets. Dislodged perhaps by the gravitational twitch of a neighbouring star, a comet is drawn inwards by the tug of the Sun. Bathed in unaccustomed warmth, ancient ices vaporise and stream off as a tail.

Careful observation reveals two tails – a bluish tail of fluorescing gas and a yellowish tail of dust. They always point away from the Sun. The gas tail is blown by the electrically charged particles of the solar wind and the dust tail by radiation pressure of sunlight. The tails disappear as a comet recedes from the Sun. For these are the lucky ones – comets caught in elliptical orbits that carry them round the Sun and back to the freezing outer reaches each time, over and over again.

Many don't make it. Some plunge directly into the Sun. Others are captured by Jupiter, the greatest gravitational pull in the Solar System after the Sun. In 1992, Comet Shoemaker-Levy 9 was torn to pieces by the tug of the gas giant. In July 1994, twenty or more fragments smashed into the planet at 60 kilometres a second. Pinpricks to Jupiter, their impact on Earth would have been catastrophic.

But comets do hit us. The last one was over Siberia in 1908 – probably a comet fragment. Exploding in the atmosphere, uninhabited forest was flattened. Had it been a city, millions could have died. Dust from the tails of comets often intersects Earth to create spectacular showers of meteors or shooting stars.

Comets that survive appear in our skies time after time. The most famous is Halley's Comet, a so-called short period comet. It appears once every 76 years. Halley's elliptical path brings it from beyond the orbit of Neptune, when farthest from the Sun, to within the orbit of Venus, when closest to the Sun. Halley's peanut-shaped nucleus measures 16 kilometres by nine.

Hale-Bopp, which appeared in 1997, is a long-period comet. With a nucleus forty kilometres wide, it hung in our skies for months. But its orbit is so enormous, Hale-Bopp will not reappear for thousands of years.

Spaceprobes are visiting comets and even returning material for analysis on Earth. As the oldest objects in the Solar System, comets hold clues to its birth. Comets may have carried water to Earth and sparked life. Perhaps a hundred billion comets remain in the Oort Cloud, all awaiting a tail-trailing tumble to the Sun.

There have been many space missions to comets, including the armada of spacecraft which intercepted Comet Halley at its last return in 1986. More recently, the Stardust mission flew close to Comet Wild 2 in January 2004 and, for the first time ever, brought cometary material back to Earth for analysis. In July 2005, the Deep Impact mission successfully slammed an impactor into Comet Tempel 1 in a successful effort to learn more about the composition of comets. In 2014, the European Space Agency's Rosetta spacecraft is scheduled to rendezvous with Comet Churyumov-Gerasimenko. It will study the nucleus of the comet and its environment in great detail for a period of nearly two years, and land a probe on its surface.

Weblinks for PLUTO – Farthest Planet

<http://en.wikipedia.org/wiki/Pluto> - From Wikipedia, the free encyclopedia, a helpful introduction to Pluto, its discovery, orbit, physical characteristics and moons, with an overview of the controversy surrounding its recent 'demotion' from planetary status.

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

<http://www.kidsastronomy.com/pluto.htm> - A simple guide to Pluto for young people, including its new status as a "dwarf planet".

<http://www.dustbunny.com/afk/planets/pluto/> - From the “Astronomy for Kids” website, a handy summary of Pluto.

http://www.esa.int/esaKIDSen/SEM8BTMZCIE_OurUniverse_0.html - From the European Space Agency’s Kids website, an accessible summary of Pluto for young people.

<http://www.windows.ucar.edu/tour/link=/pluto/pluto.html&edu=high> - From the University Corporation for Atmospheric Research’s “Windows to the Universe” website, a comprehensive guide to Pluto, with information available at beginner, intermediate and advanced levels.

http://www.planetary.org/explore/topics/our_solar_system/pluto/ - From the Planetary Society, a helpful guide to many facets of Pluto.

<http://www.nasm.si.edu/research/ceps/etp/pluto/> - From the National Air and Space Museum, a guide to various aspects of Pluto.

http://www.planetary.org/explore/topics/our_solar_system/trans_neptunian_objects/ - From the Planetary Society, a guide to Trans-Neptunian objects.

<http://www.ifa.hawaii.edu/~jewitt/kb.html> - From the Institute for Astronomy at the University of Hawaii, David Jewitt’s guide to the Kuiper Belt and the different categories of objects discovered in this region.

<http://hubblesite.org/newscenter/newsdesk/archive/releases/category/solar%20system/kuiper%20belt%20object/> - A selection of observations of Kuiper Belt objects by the Hubble Space Telescope.

<http://pluto.jhuapl.edu/index.php> - The home page of New Horizons, NASA’s Pluto-Kuiper Belt Mission, launched on 19 January 2006 but not due to reach Pluto until July 2015.

<http://hubblesite.org/newscenter/newsdesk/archive/releases/category/solar%20system/pluto/> - A selection of observations of Pluto by the Hubble Space Telescope.

http://en.wikipedia.org/wiki/2006_redefinition_of_planet - From Wikipedia, the free encyclopedia, an extremely helpful summary of the new 2006 IAU definition of a planet, and of the controversy surrounding Pluto’s “demotion” from planetary status.

Weblinks for COMET – Visitors from Space

<http://en.wikipedia.org/wiki/Comet> - From Wikipedia, the free encyclopedia, an introduction to comets, including their physical and orbital characteristics, comet nomenclature, the history of comet study, and great comets of the past.

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

<http://www.kidsastronomy.com/comets.htm> - A simple guide to comets for young people.

<http://www.windows.ucar.edu/tour/link=/comets/comets.html> – From the University Corporation for Atmospheric Research’s “Windows to the Universe” website, a comprehensive guide to comets, with information available at beginner, intermediate and advanced levels.

<http://hubblesite.org/newscenter/newsdesk/archive/releases/category/solar%20system/comet/> - A selection of observations of comets by the Hubble Space Telescope.

http://en.wikipedia.org/wiki/Comet_Halley - From Wikipedia, the free encyclopedia, a useful introduction to the most famous comet of them all, Halley’s Comet.

http://ssd.jpl.nasa.gov/?great_comets – A short article describing the so-called “great comets” seen throughout history, with a listing of such comets and the criteria used for their selection.

<http://www2.jpl.nasa.gov/sl9/> - Extensive coverage of the collision of the fragments of Comet Shoemaker-Levy 9 with Jupiter in July 1994. Includes observations, reports, over 1,400 images, news releases and useful links.

<http://stardust.jpl.nasa.gov/home/index.html> - Homepage for the NASA space mission that flew close to Comet Wild 2 in January 2004 and, for the first time, brought cometary material back to Earth for analysis.

http://www.nasa.gov/mission_pages/deepimpact/main/index.html - Website for NASA’s Deep Impact space mission. Deep Impact slammed an impactor into Comet Tempel 1 in July 2005 in a successful effort to learn more about the composition of comets.

<http://www.esa.int/esaMI/Rosetta/index.html> - Homepage for the European Space Agency’s Rosetta spacecraft, launched in March 2004, whose main objective is to rendezvous with Comet Churyumov-Gerasimenko in 2014. It will study the nucleus of the comet and its environment in great detail for nearly two years and land a probe on its surface.