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Monster Comet Promises Big Show

The awsome spectacle of a brilliant comet, with its long ghostly tail streaming behind it, is a rare event. Usually one appears about once a decade. This past March, many people thrilled to Comet Hyakutake, which passed within a mere 0.1 astronomical units of Earth (15 million kilometers, 9.5 million miles) and became a stunning sight for several nights. But nature is favoring us again: Another potentially great comet, Comet Hale-Bopp, is poised to enter our night sky in early 1997.

Creature of the night. Late in the evening of Jan. 30, 1996 in Japan's Kyushu region, Yuji Hyakutake left his home in Kagoshima and drove to an observing site far from city lights. There, in the sky above him, was a new comet soon to bear his name. Comet Hyakutake became the most active comet in the past 400 years to come so close to Earth. Photo courtesy of Carter Roberts of Berkeley, Calif. © 1996 Carter Roberts.

Comet Hale-Bopp stands to be among the most intensely studied comets in history. Only one other comet, Comet Halley, was seen so far from the Sun, giving scientists an opportunity to watch it as it slowly warmed up and sprouted a tail. Hale-Bopp appears to be much larger than Halley: about 40 kilometers (25 miles) in diameter, four times the width of Halley. And since Halley's appearance in 1986, scientists have developed new techniques and instruments, not least the Hubble Space Telescope, to scrutinize comets.

Comets are the Rip Van Winkles of the solar system -- mini-worlds that have changed little during their 4.5-billion-year nap far from the Sun. By reading their tales of the distant past, scientists learn about how our solar system came to be. At the same time, comets provide science educators a visual treat to entice their students and the general public.

Ancient History

By studying objects such as comets, astronomers have pieced together the story of the creation of the solar system. A little over 4.5 billion years ago, deep in interstellar space, a cloud of gas and dust began to collapse upon itself. As it contracted under its own weight, it started to spin. Some of the material in the cloud settled onto a large central object, and some of it landed on the rotating disc that surrounded that central object. As time went on, so much material landed on the central object that it became hot enough to ignite nuclear fusion. A star, our Sun, was born.

Out in the disc, the material was creating not a star, but things a bit more prosaic: giant dust balls. The dust grains and other materials from the cloud collided and clumped together. Over a few tens to hundreds of millions of years, the clumps began to form small objects, a few miles across, called planetesimals. Over further tens to hundreds of millions of years, these planetesimals collided with each other and stuck together to form still-larger objects. Eventually, the planets arose.

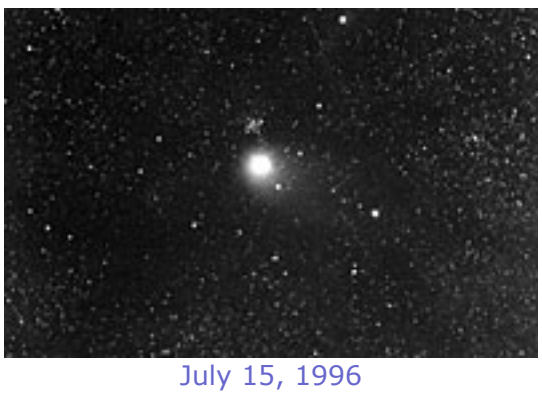
Most of the planetesimals were used up in building the planets, but a few were left over. They are still around today in more or less their original form. Some of these leftover planetesimals are composed of rock and metal: the asteroids. Others consist of easily vaporized materials such as water, carbon monoxide, and other gases in a frozen state: the comets.

Once, comets inhabited the entire solar system. But those near the Sun quickly evaporated into nothingness. Only those that orbited the Sun in the cold, distant reaches of the solar system remained intact. Many of these continue to orbit the Sun in a huge disc -- a remnant of the original planet-forming disc -- beyond Neptune and Pluto: the Kuiper Belt. At its far end, this disc fans out into the Oort Cloud, an enormous sphere of comets which enshrouds the solar system 10,000 astronomical units from the Sun -- a significant fraction of the distance to the nearest star.

Most of those comets remain happily exiled in frigid seclusion. But some are thrust into the realm of the planets. The Sun and the other bodies of the solar system travel through the Galaxy as a unit. Occasionally the solar system passes so close to other stars that it feels their gravity. These gravitational interactions kick some of the comets from the Oort Cloud or Kuiper Belt into the inner solar system.

As these comets make their first swing past the Sun, various planets may yank them into new orbits. Some comets are unceremoniously ejected from the solar system altogether, while others are pulled into short-period orbits of a few thousand, or a few hundred, years. Eventually, some of these are pulled -- usually by Jupiter, the most massive planet -- into very short-period orbits, usually 6 to 8 years long. As these comets slowly evaporate away, others from the outer solar system come in to take their place.


June 17, 1996


July 15, 1996


August 12, 1996

All hail Hale-Bopp. Conrad Jung of Oakland, Calif. took these photos from Fremont Peak in northern California. He used an 800 mm telephoto lens, Fujicolor Super G 800 film, and a 30-minute exposure at f/5.6. In the July photo, the bunch of stars to the right of the comet is the star cluster NGC 6649. Photos courtesy of Conrad Jung.

back to Teachers' Newsletter Main Page