Astronomy

Comet find: Five easy pieces

Some planetary scientists consider comets to be fragile objects, breaking apart easily as soon as their crusty surface is broken (SN: 5/7/94, p.298). A case in point: the cosmic traveler found by amateur astronomer Donald E. Machholz on Aug. 13.

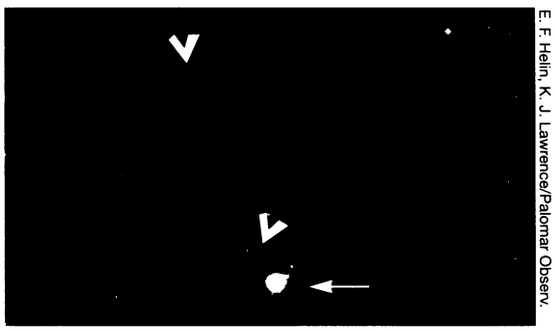
Two weeks later, another astronomer found an icy fragment belonging to the comet. Then two additional astronomers independently discovered a third chunk on Sept. 2 and 3. Several researchers identified yet two more pieces on Sept. 4 and 5. The verdict: The comet, dubbed Machholz 2, consists of a bright parent body plus at least four additional fragments.

The most recent example of a fragmented comet, Shoemaker-Levy 9, broke into some 21 pieces near Jupiter 2 years ago and then plowed into the planet last July. In contrast, Machholz 2 hasn't ventured near a planet in the last 100 years or so and isn't likely to in the next 100 years, says Donald K. Yeomans of NASA's Jet Propulsion Laboratory in Pasadena, Calif. His analysis disputes media accounts that the comet may soon be heading toward Earth.

Yeomans proposes that Machholz 2 broke apart because of internal activity, perhaps a structural change in some of the comet's supply of frozen water.

Brian G. Marsden of the Smithsonian Astrophysical Observatory in Cambridge, Mass., notes that although the fragments line up over a distance of some 1 million kilometers, the relative separation of the five pieces indicates that they clump as one group of two and another group of three. He suggests that the two groups of fragments were created during the comet's last two closest approaches to the sun. Machholz 2 passes near the sun once every 5.2 years.

That would mean that some of the pieces have survived for more than a decade, an intriguing finding since astronomers generally believe that after a few weeks, most fragments crumble into pieces too small for a telescope to detect.



E. F. Helin, K. J. Lawrence/Palomar Observ.

Image taken Sept. 8 shows the parent body of Comet Machholz 2 (arrow) and two fainter fragments (carets).

Toasted asteroids

The orbits of some comets suggest that they either graze the sun or die a fiery death by falling into the solar furnace. But planetary scientists have thought that asteroids weren't likely to suffer a similar fate. In order to crash into the sun, these rocky bodies would have to change their orbit dramatically, from an oval to a highly elongated path.

Now, a computer analysis of the orbits of a small sample of near-Earth asteroids suggests that more of them will sing their swan song by diving into the sun than by colliding with a planet or being ejected from the solar system. One near-Earth asteroid more than 1 kilometer across may collide with the sun every 100,000 years or so, report Paolo Farinella of the University of Pisa in Italy and his colleagues in the Sept. 22 NATURE.

At most, about 20 percent of the current near-Earth asteroids might fall into the sun — not enough to forestall worries that one of them might someday collide with Earth, he says. Farinella adds that grazing the sun may alter the surface of asteroids. But such effects should be explored in the laboratory before astronomers go out and look for them, he says.

Energy

Radioactivity from burning coal

Worry about the release and accumulation of radioactive materials in the environment has led to much hand wringing over the risks of accidents at nuclear power plants and weapons facilities.

But what about radioactivity released from burning coal?

W. Alex Gabbard, a nuclear physicist at the Oak Ridge (Tenn.) National Laboratory, did a little calculating. According to Environmental Protection Agency figures, an average ton of coal contains 1.3 parts per million of uranium and 3.2 parts per million of thorium. Both naturally occurring trace metals are radioactive. Of the uranium, roughly 0.71 percent is U-235, the fissionable variety used by nuclear power plants.

Thus in 1982, he estimates, U.S. coal-burning power plants, which collectively consumed 616 million tons of coal, released 801 tons of uranium and 1,971 tons of thorium into the environment — virtually unnoticed.

Roughly 11,371 pounds of the uranium was U-235.

Moreover, global combustion of 2,800 million tons of coal that year released 8,960 tons of thorium and 3,640 tons of uranium, of which 51,700 pounds was U-235.

Ironically, in 1982, 111 U.S. nuclear power plants used 540 tons of nuclear fuel to generate electricity. Thus, "the release of nuclear components from coal combustion far exceeds the entire U.S. consumption of nuclear fuels," Gabbard notes in the fall issue of the OAK RIDGE NATIONAL LABORATORY REVIEW.

Gabbard then calculated the energy value of the lost radioactive materials. He found that the nuclear fuel released by burning coal has one and a half times more energy than the coal itself.

Because electric utilities are not perceived to be as hazardous as nuclear power plants, "large quantities of uranium and thorium and other radioactive species in coal ash are not being treated as radioactive waste," Gabbard says.

"These products emit low-level radiation. But because of regulatory differences, coal-fired power plants are allowed to release quantities of radioactive material that would provoke enormous public outcry if such amounts were released from nuclear facilities," he adds.

"Nuclear waste products from coal combustion are allowed to be dispersed throughout the biosphere in an unregulated manner," Gabbard concludes. Such wastes accumulate on electric utility sites and are "not protected from weathering, thus exposing people to increasing quantities of radioactive isotopes through air and water movement and the food chain."

Computers enhance solar efficiency

The phrase "cat on a hot tin roof" captures the sense of how much heat can accumulate atop a typical U.S. home. If only that heat could be captured and used efficiently.

Now, A. Hunter Fanney, a researcher at the National Institute of Standards and Technology in Gaithersburg, Md., and his colleagues report a new type of solar water-heating system that uses microprocessors to increase efficiency by as much as 25 percent.

In the new system, a rooftop array of photovoltaic cells sends electricity to heating elements in a water tank inside a house. The novel component is a computerized control module that regulates current flow between the solar cells and heating elements, Fanney reports.

As the intensity of sunlight falling on solar cells varies, the computer adjusts the distribution of power to an array of heating elements in the water tank. Regulation of the energy flow converts a higher percentage of power to heat.

With the controller, a 16-square-meter solar panel could supply up to 75 percent of the hot water used by a typical family of four, Fanney says.