Astronomy

Asteroids and meteorites: A new link

Astronomers agree that the vast majority of meteorites that fall to Earth represent fragments of asteroids, rocky bodies that reside in a belt between Mars and Jupiter. But it isn't always easy to determine which asteroid group gave rise to a particular set of meteorites or how these fragments could have traveled to Earth.

Consider the meteorite class called basaltic achondrites, which make up about 6 percent of all meteorites recovered on Earth and which formed from once-molten material that originated on or under the surface of a small body.

Only one known asteroid, 4 Vesta, has a surface composition similar to that of basaltic achondrites, researchers showed in the 1970s. Thus, 4 Vesta seems likely to be the parent of this group of meteorites. But that poses a problem, because 4 Vesta resides in a region of the asteroid belt from which material can't easily reach the inner solar system and Earth.

Now, Richard P. Binzel of the Massachusetts Institute of Technology and graduate student Shui Xu say they have solved the puzzle. In recording the spectra of eight small asteroids near Vesta, they found that each has a composition similar to Vesta's. This suggests the asteroids, each measuring about 7 kilometers across, formed when another asteroid collided with Vesta, gouging out fragments that escaped Vesta's gravitational field with a speed as great as 500 meters per second.

Binzel and Xu calculate that if the eight asteroids near Vesta had substantial velocities as they exited Vesta, then smaller fragments, measuring only about a kilometer in width, would have left Vesta at speeds exceeding 1,000 meters per second. Such speeds, forbidden by previous models, are great enough for the fragments to reach locations in the asteroid belt from which material could travel to Earth. Binzel and Xu conclude that 4 Vesta is indeed the parent body of most basaltic achondrites. They reported their work last week in Munich, Germany, at a meeting of the American Astronomical Society.

Neptune's weather

A new analysis of old data suggests that Neptune periodically develops an atmospheric burp — a localized outburst similar to Saturn's white spot (SN: 11/23/91, p.332).

JPL/Hammel

Left: Neptune image taken by Voyager 2 in 1989 shows a bright area just above the planet's Great Dark Spot. Right: Image taken from Earth shows same feature depicted as bright blob.

In examining images of Neptune taken by the Voyager 2 spacecraft and measurements of the planet's luminosity recorded by an Earth-based telescope, MIT astronomer Heidi B. Hammel and G. Wesley Lockwood of Lowell Observatory in Flagstaff, Ariz., realized they were tracking a bright, expanding blob high in the planet's atmosphere. For example, they found that the typical daily variation in Neptune's visible-light intensity doubled in 1986. By 1987, the planet's infrared luminosity had increased five-fold. And in 1988, although the overall variation in Neptune's brightness declined, the side of the planet opposite the luminous blob increased in brightness, indicating that the atmospheric outburst had spread in a belt around the planet, a movement akin to that of Saturn's white spot.

Hammel notes that Neptune experienced a similar burp in the infrared in the mid-1970s, and she now plans to track the evolution of the next outburst. She reported the work last week at the astronomy meeting in Munich.

Physical Science

Mathematics of laundry unveiled

Have you ever wondered why laundry hung on a clothesline dries from the top down? This question so piqued the curiosity of Erik B. Hansen, a mathematician at the Technical University of Denmark in Lyngby, that he applied the rigor of mathematical modeling to the problem. Hansen reports on the secret life of laundry in the October issue of SIAM JOURNAL ON APPLIED MATHEMATICS.

"In almost everything you do, from shaving in the morning to putting your pajamas on at night, you'll find some interesting mathematics, and drying laundry is no exception," comments John Ockendon of the Mathematical Institute at the University of Oxford in England.

The most obvious explanation for top-down drying — that gravity draws the water down and out of the fabric until it is completely dry — is incorrect, says Hansen. Gravity is involved, but it plays a secondary role.

Hansen explains that water resides in discrete pores within damp cloth. Capillary forces act on these isolated islands of water, counterbalancing the tug of gravity. Therefore, gravity cannot pull water out of cloth in a continuous sheet.

Then what *does* cause clothes to dry from the top down? Hansen came up with an explanation for this phenomenon and used it to build his mathematical model of drying laundry.

In the model, vertical air movement causes top-down drying. To dry, hanging laundry must be cooler than the surrounding air. The air right next to the garment is also cooler, and therefore heavier, than the air around it. Gravity pulls this cooler air down across the surface of the cloth. The air current soaks up evaporated water, becoming more saturated as it sinks. Since the air flow can carry away less water vapor at the bottom than at the top, the garment dries from the top down.

But does real laundry behave as Hansen's model says it should? To find out, he used the model to predict the rate at which a garment should dry under certain conditions. Then he hung up a wet T-shirt and recorded what he observed. At first, the shirt dried more or less as predicted. As time passed, however, it began to dry more slowly. This came as no surprise to Hansen, because he had deliberately idealized some of the processes at work on the drying fabric. Despite these mixed results, Hansen claims success in reaching his general goal of better understanding the physics of drying laundry.

This kind of applied mathematical study aids the general health of the field, says Ockendon, because "mathematics gets very sterile unless it has input from the real world, and [the] drying of laundry is a perfectly good example of how you get exciting new mathematics that you would never get if you just sat at your desk."

No room to hang out? Try microwaves

For consumers lacking the space or ambition to hang up their laundry to dry, mechanical clothes dryers are a must. Now, the appliance industry and the Electric Power Research Institute (EPRI) have joined forces to develop a machine that dries garments with microwaves instead of hot air.

According to John Kesselring, senior project manager at EPRI, the proposed appliance will dry clothing faster, more gently, and more efficiently than electric or gas-powered dryers. Instead of heating the entire garment, the microwaves selectively zap the water in damp clothing, Kesselring says. Conventional dryers can overstress and weaken fabrics in the course of heating them with hot air, he adds.

EPRI plans to field-test commercial and residential versions of the new dryer next year. The U.S. Public Health Service Center for Devices and Radiological Health will evaluate the EPRI design to make sure it protects consumers from possible exposure to microwaves.