# SPACE SCIENCES

*Jonathan Eberhart reports from the meeting in Boston of the American Astronomical Society's Division for Planetary Sciences*

## Neptune's inner warmth

Infrared observations from a balloon-borne telescope have indicated that the planet Neptune is considerably warmer, relative to the heat it receives from the sun, than was formerly believed, says Mark T. Stier of the Harvard-Smithsonian Center for Astrophysics. The observations, in the 40-to-250-micron band, suggest that Neptune emits about 3.5 times as much heat as it takes in. This is in contrast with observations made by other researchers at shorter wavelengths (30 to 40 microns), says Stier, in which Neptune's thermal output seemed to be only about 2.3 times the sun's input.

The longer-wavelength observations, reported by Stier and colleagues from the CFA and from the University of Arizona, show Neptune to have an effective temperature of 63°K ±4, whereas the earlier studies indicated only about 57°K. The solar equilibrium temperature of Neptune, says Stier, is about 46°K. Stier maintains that the longer-wave observations give a better indication of the planet's general thermal balance, since at short wavelengths, small changes in the relative abundances of atmospheric constituents can produce large changes in the planet's emissions.

Stier's group also confirmed earlier signs that Uranus has little, if any, internal heat source. Its effective temperature was measured to be 60°K±3, compared to a solar equilibrium temperature of 57°K, which is within the measurement uncertainty of the effective temperature.

## Water of hydration seen on Ceres

Ceres, first-discovered and largest of the asteroids in the belt between Mars and Jupiter, has for some time been suspected of being made of carbonaceous chondritic material, believed to be among the most pristine material remaining from the early days of the solar system. The basis for this speculation has been the comparison of spectra of Ceres with laboratory spectra of carbonaceous chondrite meteorites. It has been uncertain, however, whether Ceres is a type 1 or 2 carbonaceous chondrite—both of which contain significant amounts of water—or a type 4, which does not. Now there seems to be an answer—but an unexpected one.

Larry Lebovsky, currently at the University of Arizona, reports detecting as much as 10 to 15 percent water (in the form of water of hydration, such as in clays) in the surface material of Ceres, based on the strength of absorption spectra near 3 microns measured through the University's 28-inch telescope at Mt. Lemmon Observatory. Comparison with lab spectra, he says, "shows great similarity" to spectra of type 2 carbonaceous chondrites. According to Lebovsky, "This is the first evidence of water in the surface material of an asteroid."

But is it a classic type 2? Michael Gaffey of the University of Hawaii points out that other expected spectra, notably those of iron oxide "opaques," seem lacking on Ceres. The discovery of the water is valuable, he says, but it is only part of the emerging—and unusual—picture of Ceres, which does not seem to match any of the 31 or so carbonaceous chondrites that have been recovered on earth. "The exciting thing," says Gaffey, "is that it's a new material."

## Lunar institute adds planets

The Lunar Science Institute in Houston, set up by the National Academy of Sciences and NASA in 1968 as a center for lunar research, will become the Lunar and Planetary Institute on Jan. 1, reflecting the spread of lunar data into comparative planetology.

The institute is run, under NASA contract, by the University Space Research Association.

# CHEMISTRY

## Clay gloss for rocks

The recipe for desert varnish, the glossy black or red-orange finishes that accumulate on rock formations, has been revealed by mineralogists at the California Institute of Technology. To their surprise, the main ingredient is an old staple—clay. The red coating on the underside of rocks is not iron oxide, but 90 percent clay mixed with an iron oxide stain. The black top-surface finish is 70 percent clay and 30 percent manganese and iron oxides.

George R. Rossman and Russell M. Potter analyzed samples of different types of rock from 20 locations in California, New Mexico and Arizona. They found that all desert varnish shares a similar composition. They illuminated samples with infrared light and measured its transmission through the samples. Desert varnish had not been analyzed previously because its particles are too fine to be characterized by X-rays.

The researchers propose that fine clay, carried by the wind from a wide geographic area, settles on a rock's surface. Then water carrying traces of manganese and iron migrates through the clay film. "The oxides build bridges across the clay particles and cement them," Rossman explains.

## Crystal cage for hydrogen

Trapping hydrogen in molecular cages may be the best way to store the element if it is to be used as a multipurpose fuel. Dan Fraenkel and Joseph Shabtai of the Weizmann Institute of Science in Israel have shown that chemical structures known as zeolites can contain hydrogen molecules. The atoms of a zeolite are arranged in a crystal lattice leaving a large number of small cavities interconnected by pores of a uniform size. If the effective diameter of a passing "guest" molecule is only slightly larger than the pores, high pressure and temperature can force the guest into a cavity, where it will be trapped when the lattice is returned to room temperature. Fraenkel and Shabtai loaded samples with hydrogen at 200° to 400°C and at 350 to 13,000 pounds per square inch pressure. At the highest pressure the zeolite holds 0.6 percent hydrogen by weight. some zeolites retained 90 percent of the hydrogen for at least five days. The process can be reversed and the guest hydrogen released by heating the zeolite again, the researchers report in the Oct. 12 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

## Polyester modifier lullaby

Children may soon sleep soundly in fire-resistant pajamas that do not present a potential health hazard. Flame-retardant chemicals previously used to treat fabrics have been suspected of causing cancer, and at least one, Tris (tris [2,3-dibromopropyl] phosphate), produces kidney cancer in laboratory rats. The problem is that the chemicals leach out of the fabric, so children may absorb harmful substances through the skin or by sucking on the cloth. Since Tris was banned in April, chemists have searched for a safe fabric.

Cloth woven from an inherently flame-resistant fiber may fill the bill. Hoechst Fibers Industries in Spartansburg, S.C., has announced development of a polyester fiber called Trevira 271, that contains a flame-retardant modifier within the polymer structure itself. According to a spokesman for the company, pajamas made from the fiber will melt and shrink away if put directly into a flame. When the flame is removed, the fabric will self-extinguish.

The fiber company says that children's sleepwear made of the new fiber should be on the market within a year. This fiber is the second developed that contains a flame-retardant. An earlier attempt by DuPont was withdrawn from the market because it was too expensive. Although the new Hoechst fiber will cost almost 50 percent more than ordinary polyester, the company says it will "fit into the existing price structure."