organized a symposium here on leptin and its effects on the body's balance of energy. "It's a fundamental hormone of nutrition and survival," he says. "That's really the dominant thing it's designed to do."

The first clues that leptin is involved in reproductive behavior came earlier this year when Flier and his colleagues found that the protein can blunt several starvation-induced hormonal changes in mice. Testosterone levels, for example, were more than twice as high in starved mice treated with leptin as in their saline-treated counterparts. The protein also prevented the usual delay in starved females' estrus cycles. (The results were published in the 18 July issue of *Nature*.)

In more recent work, the Flier team has evidence implicating the protein in induction of puberty in both mice and humans. In one experiment, the researchers measured leptin concentrations in the blood of eight boys taking part in a study of puberty. They found that the concentrations increased sharply—to two or three times the normal level—at the same time that testosterone first became measurable in the blood, just before puberty's first outward signs appeared.

Such correlations don't necessarily prove that leptin is inducing puberty. But another mouse experiment, in which Flier and his colleagues injected low levels of leptin into normal female mice from the time they were weaned, supports the idea. Mice usually reach sexual maturity about 40 days after birth, but the leptin-treated mice showed signs of sexual maturity about 3 days earlier, Flier says.

Still, many questions remain to be answered. Flier and his colleagues do not yet know, for example, how leptin modulates sex hormone production, although it's likely that the protein works through the brain region called the hypothalamus. At least one of the protein's receptors is abundant there, and the hypothalamus is known to regulate many hormone-producing glands through its effects on the pituitary, the body's so-called master gland.

Nor do they know what causes the prepubertal spike in blood leptin concentrations. Although Frisch's work has shown that puberty in human females is delayed if they are too lean, Flier says that the leptin spike happens without any sudden weight gain, and he suspects that another signal is involved. He says a similar effect is apparent in mice: Young animals produce a leptin spike at a time when they have relatively little body fat.

As Campfield puts it, "We're just now beginning to open up the black box and see how leptin regulates body fat." But with leptin now implicated in sex as well as obesity, the appetite for research on the protein will only sharpen.

–Gretchen Vogel

PLANETARY SCIENCE

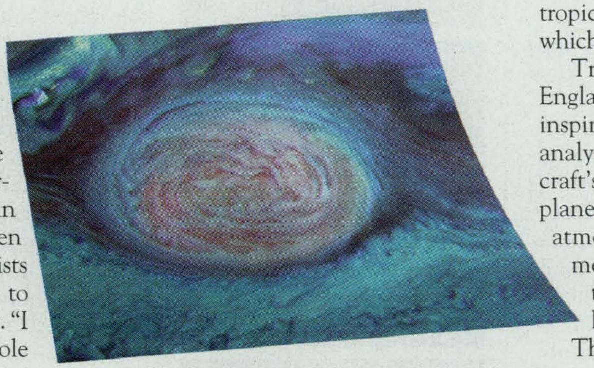
Found: Jupiter's Missing Water

TUCSON, ARIZONA—When the Galileo probe plunged into Jupiter's atmosphere last December, it left a deep mystery in its wake. Conventional theories of how the planets formed imply that this gas giant should have a few times as much water as the sun does, but the probe found a surprising dryness (*Science*, 2 February, p. 593, and 10 May, p. 814). Theorists began trotting out scenarios to explain how water could have been excluded from the forming planet or buried in its core. They can relax a bit now.

Additional analysis of data from the probe and new observations from the Galileo orbiter, presented here at last month's meeting of the American Astronomical Society's Division for Planetary Sciences (DPS), show that the abundance of water varies from place to place on Jupiter. And so most researchers now conclude, as some had suspected early on, that Jupiter's apparent dryness was just the probe's bad luck in falling into a dry spot. That shifts the burden of spinning new theories from cosmochemists to meteorologists, who are seeking ways to create deep dry spots on the gaseous planet. "I don't think anyone believes Jupiter as a whole is dry" anymore, says probe project scientist Richard Young of NASA's Ames Research Center in Mountain View, California. "Now it's more a question of how the [atmospheric] dynamics can make it dry at some places."

Three observations discussed at the DPS meeting have driven the shift from global to local Jovian dryness. It was obvious from the start that the probe had entered a "hot spot" (observable even from Earth), where parts of the atmosphere—wrung free of water during an earlier ascent—were descending. But researchers found it hard to imagine how such a downdraft could sink to the deep level reached by the probe, 150 kilometers beneath the cloud tops. Others argued that the deep dryness could be global. Now that some of the calibration problems induced by unexpectedly high temperatures in the probe have been resolved, however, the mass spectrometer has shown signs of wetter conditions in the deeper reaches of the atmosphere, implying that wetter atmosphere surrounded the hot spot.

Signs of moisture also turned up away from the probe site, in the form of high, thunderheadlike clouds imaged by the Galileo orbiter



NASA/JPL

Signs of a storm. A tall thunderhead (white, *upper left*) in this false-color image of the Great Red Spot suggests abundant water on Jupiter.

near the Great Red Spot (*Science*, 23 August, p. 1048). Planetary meteorologist Andrew Ingersoll of the imaging team and the California Institute of Technology (Caltech) noted at the meeting that the condensation of abundant water is probably the only process energetic enough to drive clouds so far above the planet's usual cloud deck. And the orbiter's near-infrared mapping spectrometer (NIMS) found that different hot spots have different amounts of water, again hinting that local processes, not global conditions, are responsible for the dry regions. "It's a dynamical problem," concludes NIMS team leader Robert Carlson of the Jet Propulsion Laboratory (JPL), "not a problem with the planet being dry to start with."

Responding to the call, planetary meteorologists are now coming forward with ways to explain Jupiter's deep patches of aridity. Ingersoll and Adam Showman, also of Caltech, suggest that the dry Jovian downdrafts are so strong that they plunge deeper than their naturally buoyant level, just as updrafts in Earth's tropics sometimes overshoot the altitude to which their buoyancy should carry them.

Tristan Guillot of Reading University in England has a different slant on that idea, inspired by Uranus and Neptune. He has reanalyzed distortions in the Voyager 2 spacecraft's radio signal as it passed behind those planets in the 1980s, probing deep into their atmospheres. Tracing the abundance of methane rather than water, he finds signs that Neptune's atmosphere in particular is also "dry" to a surprising depth.

The mechanism of deep drying may be the same on all three planets, Guillot speculates: intense upwelling and downwelling, driven by the deep convection that carries heat outward from the planets' interiors. Such drying would be pervasive over large parts of the planet, not just at a few hot spots. For now, Young is reserving judgment: "At this point, I don't think we know [what's going on]." Perhaps not, but at least researchers may find the answers today, in the dynamics of Jupiter's swirling clouds, rather than in the long-ago chaos of its formation.

–Richard A. Kerr