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[**Editor's note**: *The Christian Science Monitor archive includes stories dating back to 1980. Some early articles lack sufficient formatting, and will appear as one long column without paragraph breaks. We apologize for the aesthetics and hope that the information will still be of value to you.*]

In Jupiter discovery, clues to solve a planetary puzzle

Robert C. Cowen, Special to The Christian Science Monitor

- New information gathered from a probe that plunged into Jupiter four years ago is raising fundamental questions about how planets form.

The data suggest that Jupiter's building blocks came from a far colder place than the planet inhabits today - a discovery that challenges current models of our solar system's creation.

Researchers can't yet explain how this occurred. But one tantalizing theory laid out in yesterday's issue of Nature could shed light on a vexing mystery of planetary science: why Jupiter-like gas giants in other solar systems orbit close to their parent stars - a place once considered far too hot for such planets to form.

This discovery "will affect the theory of formation of giant planets severely," says planetologist Sushil Atreya, who contributed to the Nature article with six colleagues.

According to current theory, Jupiter was built up with material left over from the sun's formation and small icy bodies called planetesimals. Yet the probe found that Jupiter has two to three times more argon, krypton, xenon, and nitrogen than such solar junk could supply.

If planetesimals formed between the orbits of Uranus and Neptune - as scientists have believed - they couldn't have had much of those gases either. Only if they formed in a colder place, farther from the

sun, could microplanets capture the gases in the icy form needed to build a giant planet.

But if the planetesimals then migrated to Jupiter's present orbit, they would have had to be very cold indeed. Otherwise, the increasing warmth would have dispersed their frozen gases before they built up Jupiter. Once inside the planet, gravity would then confine the gases.

Dr. Atreya, director of planetary science at the University of Michigan at Ann Arbor, says it's tempting to think Jupiter itself was born far from the sun and then migrated inward.

If scientists can show Jupiter probably made such a journey, it would be reasonable to think alien planets also formed in cold parts of their star systems and have moved inward. Some of these alien gas giants are as close to their stars as Mercury is to the sun.

In the Nature paper, though, the research team notes other possibilities. Could the solar nebula from which the planets formed have been much colder than scientists think? Could planetesimals have formed in the intense cold of interstellar space while the solar nebula was getting its act together?

Atreya explains that, so far, there are only two "hard" facts to go on. "The [probe] data are hard. The other thing that is hard is that the planetesimals were very cold," he says. He adds that everything else "is just speculation."

Meanwhile, Jovian scientists are eyeing the Galileo spacecraft that originally carried the Jovian penetrator. It is winding up its four-year exploration with two close passes of the moon Io. It came within 380 miles of the moon's surface Oct. 11. It is to come even closer - 186 miles - next Friday. NASA is releasing more information on the Oct. 11 flyby today. Scientists already praise Galileo's Io explorations as providing a rich opportunity to learn about key planetary processes.

The moon is the most volcanically active body in the solar system. Duane Bindschadler, Galileo science operations manager at the Jet Propulsion Laboratory in Pasadena, Calif., has said that studying Io "may even help us predict the behavior of volcanoes on Earth."

Indeed, astronomers Nick Schneider and Michael Kueppers from the University of Colorado at Boulder have reported finding chlorine in Io's atmosphere. They noted that the atmospheric chemistry of chlorine is a key factor in destruction of Earth's ozone layer. They hope to gain insight that may be useful at home by studying that chemistry on another solar system body.

Galileo's mission ends in January. The program team already is preparing a bid to extend the exploration.