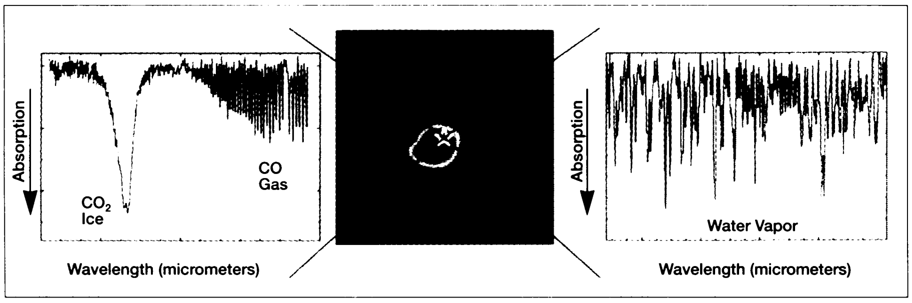
Observatory spies some familiar compounds

Flying above the veil of Earth's atmosphere, an infrared observatory has for the first time detected the heat radiated by water vapor in the interstellar medium. In finding copious amounts of water vapor as well as icy, carbon-bearing compounds typical of comets, the Infrared Space Observatory (ISO) has revealed that the chemistry of far-flung regions of the Milky Way has a lot in common with that of our solar system.

Astronomers have long believed that the raw material for the solar system had its origins in interstellar space, but direct evidence of several key compounds has been scant, notes Martin Kessler, ISO project scientist at the European Space Agency in Villafranca, Spain. "Now, the same building blocks [found in the solar system] are observed in many other places in the Milky Way," he says. "We are beginning to have a new perspective on how pieces of the puzzle fit together to form—or not form—a planetary system."



Center: Radio image shows the densest part of the molecular cloud that gave birth to the young, massive star GL 2591 (denoted by star). Left: ISO absorption spectrum shows frozen carbon dioxide (CO_2) and gaseous carbon monoxide (CO). Right: ISO spectrum reveals abundant water vapor in the direction of GL 2591.

The findings could take on special significance in light of a flurry of recent evidence that several nearby stars may possess planets (SN: 6/15/96, p. 373). The chemical composition of these unseen bodies and their capacity to support life remain unknown.

In the vicinity of massive newborn stars, bombardment by ultraviolet light would destroy the water vapor detected by ISO, says ISO scientist Martin Harwit of Washington, D.C. However, water observed around low-mass, young stars may survive and even be incorporated into the disks of gas and dust thought to give rise to planets.

ISO's two spectrometers also made the first observation of frozen carbon dioxide and the first clear-cut detection of carbon dioxide gas in interstellar space, notes Harwit. Moreover, the craft found significant amounts of frozen methane and both gaseous and frozen carbon monoxide in several Milky Way locales. In dust surrounding some young stars and old, oxygen-rich stars, ISO has confirmed the presence of silicon oxide in crystalline form. Planetary scientists have detected this material in meteorites, and it is also thought to reside in the tails of comets.

Researchers from ISO presented their findings last week at a meeting of the American Astronomical Society in Madison, Wis. Launched last November and now expected to last for another 18 months, ISO avoids the obscuring effects of carbon dioxide and water vapor in Earth's atmosphere (SN: 3/16/96, p. 168).

The existence of large amounts of water vapor in molecular clouds, the spawning grounds of stars, is especially intriguing, notes Kessler. When part of a cloud begins to contract, it heats up. If this region can't cool, contraction halts and a star will not form. Water vapor efficiently radiates heat away and may play a key role in hastening star formation, Kessler says.

Harwit adds that enough water vapor may exist throughout the galaxy to explain a long-standing mystery: why the oxygen-to-carbon ratio in the interstellar medium is lower than the ratio in our solar system. Some of the missing oxygen may simply be tied up in water.

The ISO measurements have "opened up a whole new capability in [observing] the interstellar medium," says Michael G. Hauser of the Space Telescope Science Institute in Baltimore. — *R. Cowen*

How temperature, plant defenses alter bugs

Researchers have long tried to thwart insects that devour crops, but the bugs often get the upper hand. Now, a new study may help scientists trying to boost the effectiveness of allelochemicals, natural anti-insect compounds that many plants produce.

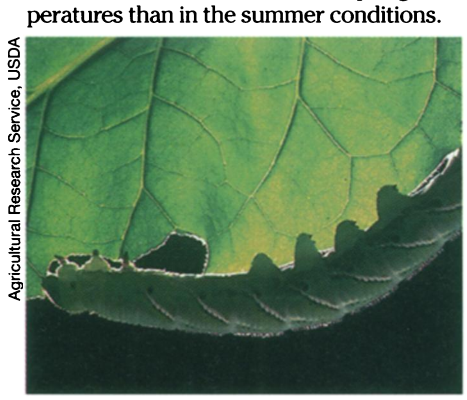
Breeders have developed plants with high concentrations of these compounds. By slowing the insects' development, allelochemicals make the bugs more vulnerable to predators and diminish their impact on the plant.

Scientists know that temperature alters insects' voracious appetites, but they don't know how temperature and allelochemicals interact, note Nancy E. Stamp of the State University of New York at Binghamton and Yuelong Yang of the University of New Mexico in Albuquerque.

So Stamp and Yang examined how the tomato fruitworm, fall armyworm, and tobacco hornworm—all tomato pests—respond in the laboratory to a diet laced with different combinations of three tomato allelochemicals—chlorogenic acid, rutin, and tomatine. They conducted tests at 21°C and 10°C, typical springtime day and evening temperatures for Binghamton, and at summer norms of 26°C and 15°C, they report in the June ECOLOGY. They have since examined four more caterpillar species.

The insects responded in very different ways to the various chemicals and temperatures, the researchers found. The compounds usually slowed the insects' development, but changing the temperature or adding other allelochemicals, or both, sometimes reversed that effect.

"Often the negative effect of an allelochemical was greater at the warm regime than at the cool regime, but not consistently so," Stamp and Yang report. Tomatine and rutin, for example, each harmed the tobacco hornworm more in the spring temperatures than in the summer conditions.



A tomato hornworm.

At the summer temperatures, pairs of compounds produced the greatest negative effect, whereas in the cooler air, single chemicals did. But since the chemicals varied in their effects on a particular insect, plants would fare best if armed with all three allelochemicals, they assert.

Stamp and Yang have yet to identify the mechanisms causing these patterns. Their results suggest, however, that testing how insects respond to just one allelochemical at one temperature will prove misleading.

The findings are likely to interest not only plant growers but also researchers who, like Stamp, study the effects of global warming on plant defenses (SN: 4/9/94, p. 230), notes Mark Scriber of Michigan State University in East Lansing. However, he cautions that insects' responses to the chemicals in the wild may differ from their reactions in the lab. — *T. Adler*