Venus: On the nose at last

Numerous spacecraft have been studying Venus for nearly a quarter century, beginning with the first one ever sent to another planet, the United States' Mariner 2 in 1962. Yet only now has such a probe finally been able to answer a key question about the planet's interaction with the sun, an exotic relationship that may be unique among all the planets of the solar system.

At the heart of the matter is a single measurement: the distance from Venus of the "nose" of the huge shock wave formed where the planet is struck at supersonic speeds by the sun-spawned outpouring of charged particles called the solar wind. The resulting shock wave resembles a vast, blunt cone whose sides trail out into the distance like the wake of a blunt boat facing into a rapid stream. Venus is atypical among the planets studied from spacecraft in that it has a substantial atmosphere but only a very weak magnetic field. At earth, Jupiter and Saturn, the field keeps the solar wind from ever reaching the atmosphere, but at Venus, it strikes the atmosphere directly. The question has been, how close does it get to the planet's surface?

The answer has come from the U.S. Pioneer Venus Orbiter spacecraft, which has been circling the planet since late 1978 but whose orbit has only recently risen enough to measure the shock wave where it directly faces the sun. According to Christopher T. Russell and his colleagues at the University of California at Los Angeles, writing in the October GEOPHYSICAL RESEARCH LETTERS, the altitude of the shock wave at that point is about 2,280 kilometers.

Several months ago, notes Russell, a Soviet researcher predicted that the measured altitude would be about 30 percent greater than that. This idea was based on the expectation that the sun's extreme ultraviolet (EUV) radiation would increase the ionization of neutral atoms from Venus's upper atmosphere and thus raise the height of the obstacle to the solar wind. The lower altitude measured by the spacecraft, Russell says, suggests that another factor must also be involved: the neutralization of some of the incoming ions by a process called "charge-exchange" with the atmospheric atoms. As a result, the solar wind can penetrate closer to the planet.

This same balance of forces — EUV ionization vs. charge-exchange — may also govern the solar wind's interaction with comets. Surprisingly, it may even be the case at Uranus, for which the approaching Voyager 2 spacecraft has so far failed to reveal signs that would indicate a magnetic field. —*J. Eberhart*

Olympic asthmatics breathing easy

Ginny Gilder developed asthma as a preteen, and didn't have much trouble with it through high school. But at college in 1975, she discovered rowing, and rediscovered her asthma.

After she had made several trips to the emergency room for epinephrine to stop an asthmatic attack, the health clinic doctors told her they would no longer allow her to compete on the varsity team unless she took medication to control her asthma, instead of dealing with it only when it became life-threatening.

She complied, and went on to join a four-member rowing team that took a silver in the 1984 Summer Olympics.

Gilder, now living in Seattle, was far from the only asthmatic on the U.S. Olympic team. "With treatment, [asthmatic] athletes can achieve world-class performance," says William Pierson of the University of Washington in Seattle.

Pierson and his colleagues last week presented data on the 597 members of the 1984 U.S. Summer Olympic team in Washington, D.C., at the International Conference on Allergology and Clinical Immunology. After administering pre- and postexercise lung tests and questionnaires, they identified 67 athletes on the team as asthmatics. Many had been unaware that they had the condition.

The athletes' asthma evidently didn't hurt their performance: Asthmatics comprised 11 percent of the team but were responsible for 13 percent of the medals.

About 80 percent of asthmatics are subject to exercise-induced bronchospasm, which can cause coughing, chest tightness, wheezing, stomachache or headache within 15 minutes of exercise. The condition can be prevented with drugs and careful warm-up, says Roger Katz of the University of California at Los Angeles. another researcher in the study. The asthma drugs approved by the International Olympic Committee do not affect performance, Pierson says.

Says Katz, "For many years we've been dealing with the myth that if you have asthma you sit on your duff and become a spectator." Asthmatic children who wanted to compete in sports used to be guided to swimming, where the warm moist air and absence of allergens like pollen that can trigger an asthma attack seemed to help. But now, says Pierson, with appropriate management, asthmatic athletes "are limited only by their desire and will to succeed."

Says Gilder, "I'm a very good example of what their research has found. My asthma was just another factor I had to deal with." —*J. Silberner*

Probing deeper into quasicrystals

Less than a year ago, the term "quasicrystal" was practically unknown. Now, hundreds of researchers throughout the world are energetically poking into what many scientists believe is a new kind of crystalline matter. This week, the topic of quasicrystals was highlighted in Washington, D.C., at a National Academy of Sciences symposium featuring significant advances in materials research.

Until recently, most crystallographers believed that atoms within crystals had to be arranged in blocks that stacked evenly to create a regularly repeating pattern. The discovery at the National Bureau of Standards (NBS) in Gaithersburg, Md., of "shechtmanite," an aluminum-manganese alloy that shows a noncrystallographic, fivefold symmetry in electron diffraction patterns, shattered this belief (SN: 1/19/85, p. 37; 3/23/85, p. 188).

"You're talking about a kind of physics in which it's easy to do the experiments," says Paul J. Steinhardt, a physicist at the University of Pennsylvania in Philadelphia. "Once this material was reported, there were many laboratories that were immediately able to reproduce the result."

Recent studies reveal that this icosahedral structure turns up in dozens of alloys, says NBS materials scientist John W. Cahn, who was involved in the initial discovery. These include many aluminum alloys and unusual combinations like uranium, palladium and silicon.

Almost all of these forms are "metastable." A touch of heat, for instance, nudges the atoms of a quasicrystal into a more stable periodic arrangement. However, evidence has emerged that sometimes, at least in the case of an aluminum-lithium alloy, the icosahedral form is the stable phase at room temperature.

Researchers are also finding new ways of making quasicrystals. In the Oct. 7 PHYSICAL REVIEW LETTERS, a team from Cornell University reports that using a xenon ion beam to bombard a thin film of an aluminum-manganese alloy can produce the quasicrystalline phase. Previously, quasicrystals had been created by methods like "splat cooling," which involves rapidly freezing molten metal.

"The advantage of the ion beam technique is that we can control everything," says Cornell's James W. Mayer. This allows researchers to do careful experiments. "The big push is to understand the structure," he says. Cornell graduate students David A. Lilienfeld and Michael Nastasi, who did the ion beam work, are now trying the technique on other materials and exploring the range of alloy compositions that can be jostled into a quasicrystalline state.

Other studies are unveiling nonperiodic symmetries beyond the fivefold, icosahedral structure initially discovered (SN: 8/17/85, p. 102). For example, in the Sept. 30 PHYSICAL REVIEW LETTERS, Leonid Bendersky of the Johns Hopkins University in Baltimore reports the formation of a decagonal phase, which has neatly stacked layers, each showing a nonperiodic, 10-fold symmetry.

Despite the recent flood of research papers devoted to quasicrystals, the theoretical interpretation of the results as a genuinely new crystalline structure remains controversial. In the Oct. 10 NATURE, Linus C. Pauling of the Linus Pauling Institute of Science and Medicine in Palo Alto, Calif., argues that the "icosahedral" structures are really "multiple twins of a cubic crystal."

Pauling proposes that aluminum-manganese alloys, when suddenly cooled, solidify into a cubic form in which each unit contains about 1,120 atoms. About 20 crystals, made up of these cubic units and roughly tetrahedral in shape, could grow out from a central seed to produce an approximate icosahedral shape. Pauling's structure seems to account for the way X-rays diffract from powdered samples of the new materials.

"Crystallographers can now cease to worry that the validity of one of the accepted bases of their science has been questioned," Pauling concludes.

"I'm certainly not convinced that he [Pauling] has the correct explanation for all of the experiments," says Harvard physicist David R. Nelson. "I'm skeptical that his model will account properly for a single-crystal diffraction pattern."

Nelson's comments are typical of the reaction among quasicrystal researchers. Although Pauling's structure seems to work for a powder, consisting of a host of tiny crystals sitting in random positions, it doesn't work, they say, for the distinctive pattern of spots seen in a single-crystal electron diffraction experiment.

"This material really is a quasicrystal," says Steinhardt, "but one that has a lot of defects in it. We'd really like to have a more perfect sample." This would allow researchers to check more closely proposed theories about the structure of the new materials. —*I. Peterson*

Is ozone giving acid rain a bad name?

Ozone, the most plant-damaging gaseous pollutant, decreases photosynthesis and promotes premature leaf aging, a new study reports. The study also suggests that ambient levels of this pollutant, in all but high-elevation areas, may account for much of the U.S. forest damage previously attributed to acid rain.

The study, conducted by researchers at the Boyce Thompson Institute at Cornell University in Ithaca, N.Y., focused on measuring how rates of photosynthesis changed among crop plants (soybeans, wheat and clover) and trees (white pine, hybrid poplar, sugar maple and red oak) exposed to different levels of ozone. Pollutant levels, from 0.02 to 0.14 parts per million (ppm) in air, were "realistic" — characteristic of mean, daylight concentrations actually observed in regions ranging from pristine areas to agricultural regions of the central United States to heavily polluted southern California. Plants were fumigated, either in the field or in controlled laboratory chambers.

Writing in the Nov. 1 SCIENCE, Peter Reich and Robert Amundson report that the ozone vulnerability of a plant species seems to be related to the rate at which gases can enter its leaves — a factor determined by their pores, called stoma. Species with high rates of growth and photosynthesis, such as crop plants, tend to have larger stomal openings — and therefore greater ozone uptake—explains Reich, who is now at the University of Wisconsin in Madison.

In the study, ozone-related declines in photosynthesis occurred among all species and at all concentrations. The rate of damage, however, was unique to each: Clover, wheat and soybeans were most vulnerable; red oak and white pine were least so. For instance, an internal ozone dose of 10 ppm-hr (ppm concentration multiplied by exposure time) brought a 50 percent reduction in wheat photosynthesis and a near 50 percent decline in yield. By contrast, a threefold higher dose to white pine brought only a 10 percent drop in photosynthesis and growth or yield. Finally, although there were no visible signs of acute ozone poisoning (mottled discoloration) in exposed leaves, the time it took a leaf to mature, discolor and drop decreased as ozone exposure increased—suggesting, Reich says, that the pollutant accelerates leaf aging.

When the tests were repeated using water with a pH comparable to that of acid rain, there was no additional decrease in photosynthesis, acceleration in leaf aging or change in plant growth and yield.

These findings came as no surprise to Allen Heagle, a plant pathologist in Raleigh, N.C., who is involved with the four-state, four-year-old National Crop Loss Assessment Network, the nation's largest program studying ozone's effects on plants. "Ozone is clearly the bad guy here," Heagle says. What's more, he says, "In everything we've done with crops here, we find that at ambient levels ozone is much more of a factor [than acid rain]." The big unknown, he says, is how badly ozone is hurting trees, since "there are no studies that have looked at the long-term effects of ozone on trees."

Curbing ozone will be no easy trick, Reich and Heagle point out, since the largest source of the pollutant's chemical precursors is auto exhaust. —*J. Raloff*

Estrogen use raises questions

Estrogen, it seems, may be one of those things some women can't live with and can't live without. Replacing the class of hormones lost as a result of menopause or surgical removal of the ovaries can alleviate the discomforts of menopause and prevent the bone-breaking disease of osteoporosis. But postmenopausal estrogen use is also associated with endometrial cancer, and depending on which of two current studies you believe, it can reduce or increase the risk of heart disease.

While some 2 million to 3 million postmenopausal women in the United States take estrogens daily, scientists are struggling to determine if the practice is ultimately helpful or harmful. In addition to the two studies alternatively associating the hormones with a higher and a lower risk of heart disease, a recent report shows an increased risk of endometrial cancer not just in women currently using estrogens but in past users as well.

The incidence of heart disease in both pre- and postmenopausal women is much lower than it is in men. According to the National Center for Health Statistics in Hyattsville, Md., the heart disease death rate in 1982 among 35- to 44-year-old men was 44 per 100,000, and only 10 per 100,000 among women. In the 65- to 74-year-old range, it was 1,268 per 100,000 men and 568 per 100,000 women. The influence of estrogens has long been suspected as the operative agent. In fact, men who were considered likely candidates for heart attacks were at one time given estrogens as a preventive, until it was shown that the practice put such men at higher risk.

Two studies in the Oct. 24 NEW ENGLAND JOURNAL OF MEDICINE go head-to-head on the heart disease question. One is an analysis of data from the Framingham Heart Study, a collection of medical information regarding the inhabitants of a Massachusetts town. Peter W.F. Wilson and William P. Castelli of the Framingham study and Robert J. Garrison of the National Heart, Lung, and Blood Institute in Bethesda, Md., followed up on 1,234 postmenopausal women who had been questioned between 1970 and 1972 about their estrogen use.

Of these women, 302 had used estrogens after they reached menopause; 932 had not. All were over 50 at the beginning of the Framingham study.

Eight years later, the estrogen users scored better than nonusers on an analysis of various risk factors known to be associated with cardiovascular disease — including blood pressure, weight and the blood level of total cholesterol and its individual components. Despite the apparent advantage, the researchers report that "significant detrimental effects were seen for total cardiovascular disease, coronary