Recycling of solid wastes received a "major setback," the report concludes, and the "recycling boom of the early 1970s appeared to be over," as many volunteer recycling centers went out of business. Prospects for the long run remain promising, however, as the costs of new materials continue to rise.

Wildlife continues to bear the brunt of human expansion. Commercial ocean fishing continues to seriously reduce numbers of the most plentiful fish off U.S. coasts—populations of some stocks are only about half those of the early 1960s. On shore, approximately one out of every 10 animal and plant species native to the United States may now be endangered or threatened.

One of the most disturbing discoveries of recent research is that 60 to 90 percent of all cancer is related to environmental factors and that 15 to 40 years may pass between exposure and tumor development. The majority of known carcinogens are encountered in the workplace, but the sheer volume of new chemicals (some two million compounds are now known) has impeded full understanding of their possible hazards.

What does it all cost? Estimates by CEQ show that each American will spend (indirectly) some $98 in 1976 for environmental improvement and that costs will rise to 2.5 percent of gross family income by 1983. More jobs have been created than lost in the effort. □

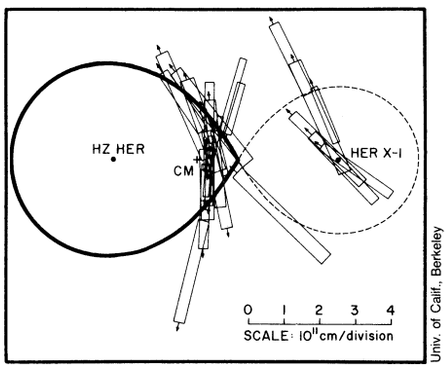
Her X-1: A middleweight neutron star

Several of the newly discovered pulsating X-ray sources or X-ray pulsars are members of binary star systems. This fortunate fact gives a hope of determining the mass of the body emitting the X-rays by studying the interactions of the two members of the binary. Determining the masses is important in deciding just what the X-ray sources are, because theory assigns different mass ranges to the possible candidates: white dwarfs, neutron stars or black holes.

Using the classical physics techniques by which astronomers have weighed stars for centuries, a group at the Massachusetts Institute of Technology determined a mass for the X-ray source Vela X-1 to an accuracy of about 30 percent (SN: 9/20/75, p. 182). Now two astronomers from the Lawrence Berkeley Laboratory, John Middleditch and Jerry Nelson, have determined the mass of Hercules X-1. The latest in sensitive optoelectronic observing equipment enabled them to make the determination, which they call "the first precise measurement of the mass of a pulsar, or neutron star." An accuracy figure of 10 percent is quoted.

Hercules X-1, as Middleditch and Nelson describe it, is a binary system consisting of an aged blue star and a dark companion that revolve around each other every 1.7 days. The gravitational interaction between the two bodies has distorted the outer atmosphere of the blue star into a teardrop shape with its pointed end toward the dark companion. Through the point of the teardrop, gas streams from the blue star onto the surface of the dark companion. This activity generates heat (to a temperature of more than 100 million degrees) that causes the surface of the dark companion to emit X-rays with an energy 10,000 times the energy of the sun's emissions.

The dark companion is a rotating body with a strong magnetic field. The magnetic field makes the X-ray emission directional like a lighthouse beam, and the rotation carries it around with a frequency of one



Univ. of Calif., Berkeley

Teardrop shape of HZ Herculis outlined by light flashes generated as X-ray pulses from Hercules X-1 strike its surface.

circuit every 1.24 seconds. During part of the sweep, the X-ray beam strikes the atmosphere of the blue star. The X-rays cause the matter they strike there to emit pulses of visible light.

What Middleditch and Nelson have succeeded in doing, believe it or not, is to detect these visible pulses as individual photons. To do so they used a sensitive photomultiplier tube mounted on the 61-centimeter telescope at the Lick Observatory on Mt. Hamilton near San Jose, Calif. The photon events were recorded on magnetic tape and analyzed for periodic patterns by a computer at LBL.

The results of that analysis allowed Middleditch and Nelson to determine the shape of the blue star's teardrop atmosphere, and that plus the duration of the eclipse as the dark companion passes behind the blue star (known in optical catalogs as HZ Herculis) permits calculation of the masses of the two stars. The dark companion's mass comes to 1.3 times the sun's mass, well in the range that theory predicts for neutron stars. Its diameter is about 20 kilometers.

Middleditch and Nelson hope to use the same method on other bodies, especially black holes, using the rapid light variations that should occur as gas from companion stars falls into them. □

Images of Venus by infrared

Astronomers have long studied Venus in the infrared in an effort to probe the secrets of its visually featureless atmosphere. The earliest attempts were simply full-disk measurements, basically nothing more than single, bulk temperature readings. In 1963, Bruce C. Murray, James A. Westphal and Robert L. Wildey made the first infrared "maps" of the planet, but the scan lines used to construct the maps were widely spaced, requiring the researchers to interpolate to produce their contour lines. The results thus were not true images.

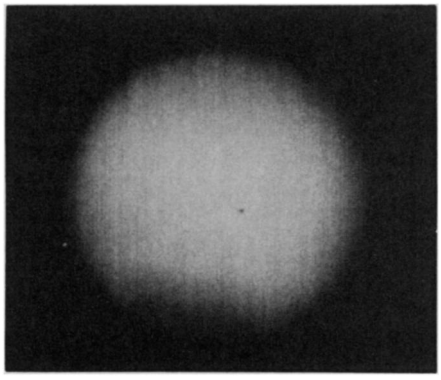
Now David J. Diner, Westphal and F. Peter Schloerb of the California Institute of Technology have produced what they call the first true, high-resolution, infrared images of the Venusian atmosphere. As the 200-inch Hale telescope on Palomar Mountain scanned slowly across the planet's face in an east-west direction, the researchers used a moving secondary mirror to step quickly and automatically along measured, north-south intervals, producing a series of precise, vertical scan lines, each one arc-second wide and overlapping its predecessor by half its width.

Using a relatively large bandwidth of 8 to 14 microns, the Caltech team assumed the bright parts of the images represented a temperature of 230°K, based on the Mariner 10 spacecraft's non-imaging infrared detector. This, they report in ICARUS (27:191), implies that the features in the images are at about the 50-millibar pressure level in the atmosphere, which Diner says is about 80 kilometers above the Venusian surface.

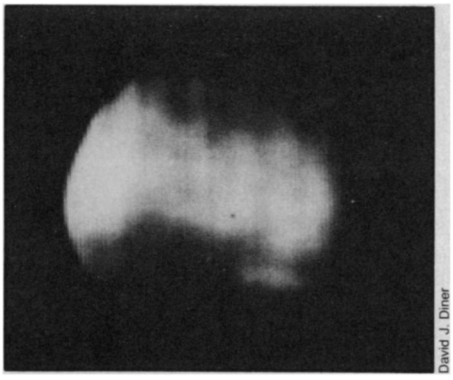
The original, unenhanced version of the image shows what appears at a glance to be a bright spot at the south pole, bordered by a dark "collar." Actually, the scientists report, the south and north poles appear at about the same brightness; it is the dark collar, which also appears in the earlier "maps," that is the anomaly, making the south pole seem brighter.

With contrast enhanced by a computer, the image, in fact, confirms previous signs that the planet's polar limbs are darker than the equatorial limbs. The same technique also reveals a number of more subtle blotchy and band-like features, though they represent temperature differences of only 1° to 3°K. Even the difference between the planet's day and night sides (the dawn terminator is roughly along the inside edge of the bright spot at the left-hand edge of the enhanced image) is only about 2°K.

More important than the specific features in these first images, says Diner, is the potential of the precise, moving-mirror technique to show whether infrared features in the atmosphere correspond to ultraviolet ones, such as those photographed



Venus in IR shows dark southern collar.



Enhancement brings out faint features.

David J. Diner

strikingly by Mariner 10 (though from a different direction). Diner has already made several sets of near-simultaneous infrared and ultraviolet images through the 200-inch telescope, observing the planet during half a Venusian year so that it could be seen rotating both into and out of darkness at a variety of solar illumination angles. In addition, he has made infrared images at six much narrower bandwidths to probe different levels in the atmosphere. □

X-ray pulses from all over

The X-ray sky is bursting out all over. The Astronomical Netherlands Satellite and the third U.S. Small Astronomy Satellite have been giving evidence of sudden sharp flaring bursts of X-rays from different parts of the sky.

The first reported apparently came from a globular cluster of stars (NGC 6624) in the constellation Sagittarius and were recorded by the ANS for a group from Massachusetts Institute of Technology (SN: 2/14/76, p. 101). Then another MIT group, led by Walter H.G. Lewin, a professor of physics, announced in International Astronomical Union Circular 2914 that SAS-3 had recorded similar bursts from the region of the galactic center near R.A. 6h 15m, Dec. +9.3°. In the same circular, C. Jones and W. Forman of the Center for Astrophysics at Cambridge, Mass., reported a burst from somewhere near the globular cluster NGC 1851. Most recently (IAU Circular 2916) George W. Clark, under whose general direction the MIT work on SAS-3 is conducted, reports that the MIT SAS-3 group has recorded a similar burst from the constellation Aquila in a region far from the galactic center. The Aquila burst comes from somewhere in a circle of 12° centered at R.A. 19h 29m, Dec. +7.9°.

Theoretical speculations vary. The bursts from the center of the galaxy hint at a connection with energetic processes there, but the association of more than one burst with a globular cluster suggests a connection with strange doings in the centers of those objects. Say Jones and Forman: "This event, taken together with that reported . . . from . . . NGC 6624, suggests that X-ray bursts may be a common feature associated with globular clusters. . . ." Lewin, referring to his galactic-center bursts, says: "Of course it is conceivable that the newly discovered bursts come from one or more unknown globular clusters hiding behind dust that obscures our vision of the galactic center. But I would not be surprised at all if there is no unique link between the burst sources and globular clusters."

Theorists have long suspected that there are extremely massive black holes in the centers of globular clusters. Those who would see a unique link between these X-ray bursts and the globular clusters are attributing the X-ray production somehow to those black holes.

Another suggestion is that the bursts represent a kind of X-ray nova erupting in a binary star system in which a neutron star is bound to a more or less ordinary star. According to this model, gravity pulls nuclear fuel from the companion star onto the neutron star until the concentration becomes unstable, and a nuclear explosion occurs. The explosion could generate the X-ray flare. Laura Maraschi of the University of Milan, who was at MIT when the bursts were first recorded, is working on the details of this model to see if it can explain the observed bursts.

"If this model proves to be correct," Lewin says, "one would not expect any unique relation between burst sources and globular clusters. However, one would expect that most X-ray burst sources are then associated with previously known X-ray binary star systems."

Bursts from different sources vary in duration, though all range around 10 to 20 seconds. Periodic repetition has already been reported for the bursts from NGC 6624, and searches for similar periodicity are being made in the other cases. The spectral shapes of the pulses also vary. Dozens of people are at work trying to narrow down the directions from which the emissions come (all the first reports show fairly large error circles) so as to make more certain the attribution of association with visible objects. □

Vitamin C: Alters blood-test results

Vitamin C enthusiasts don't usually agree with this. But taking large quantities of it does little more, in one physician's words, than "make very expensive urine." The intestine can absorb only a certain amount of ascorbic acid (vitamin C). It excretes the rest. A new study now adds one more drawback to the expensive-urine syndrome. Too much vitamin C in the intestine, a team of pathologists have found, can sabotage the results of important blood tests.

Russell M. Jaffe and colleagues at the National Institutes of Health report the case of a woman who underwent certain tests for blood in the stool. The results were negative even though blood was actually present. Such tests are made on body fluids suspected of containing small amounts of blood. Feces or urine are exposed to certain chemicals, and reactions between the reagents and hidden "occult" blood reveal the excretion of amounts of blood too small for the pathologist to detect by eye. The woman was anemic and excreted blood in stools, but, the team found, she also took 1 to 2 grams of vitamin C per day, and this prevented the blood from reacting and showing up positive. She agreed to stop taking vitamin C, and within 72 hours the blood tests showed positive.

At low levels, less than 500 milligrams per day, the team reported in the ANNALS OF INTERNAL MEDICINE (83: 824), the human gut can absorb and break down vitamin C. But at higher levels, it is excreted. "Taking between 1 and 2 grams of vitamin C per day," Jaffe says, "is the equivalent of eating 5 or 6 dozen oranges." Some medicines such as ferrous gluconate (an iron preparation) and tetracycline (an antibiotic) are made with ascorbic acid, Jaffee said, and may also cause false negatives.

Occult blood tests are important and frequently used diagnostic tools. More than 20 million such tests are administered in the United States each year during annual check-ups and to detect symptoms of bowel cancer, some forms of anemia, stomach ulcers, ulcerative colitis, regional enteritis and other bowel diseases. "We just don't know how widespread these vitamin C effects are," Jaffe says. "We know that sales have been more than doubling for the last several years, but we don't know what the habits of Americans are in this area." The team advises that patients be required to stop taking vitamin C at least 72 hours before occult blood testing. The team, Jaffe says, is working with physicians to determine how widespread the effects have been and has developed a new occult blood test which is not subject to false negatives due to ingestion of ascorbic acid. □