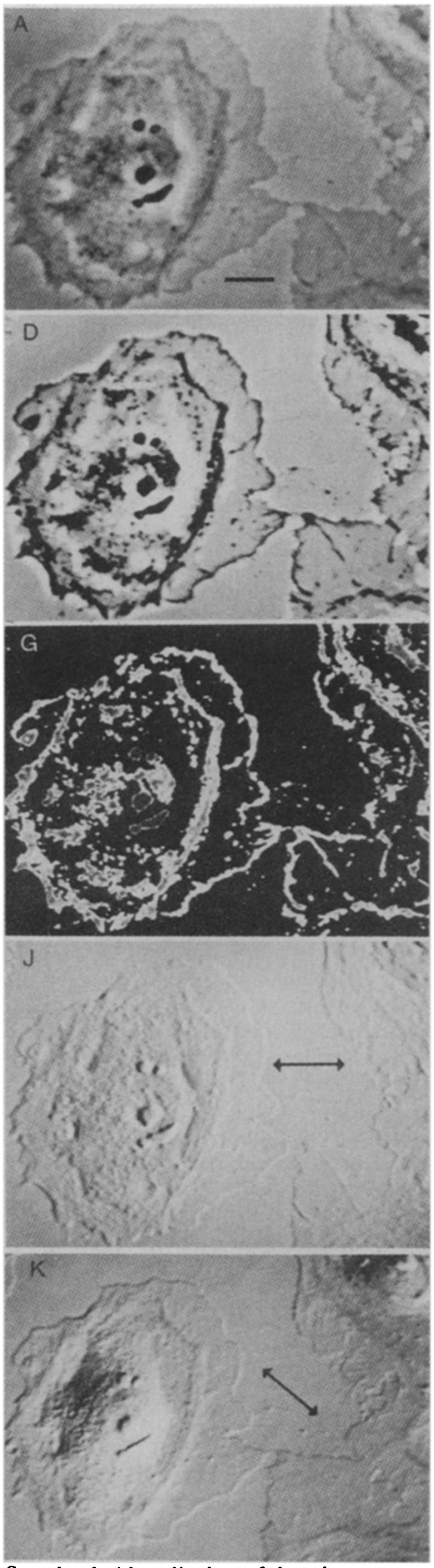
from measurements of the present amount of water in the atmosphere (the H_2O:CO_2 ratio), says Donahue, indicates that at one time there was at least 1.5 percent (the similarity with the D:H ratio is coincidence), the equivalent of adding nearly one and a half times the total atmospheric pressure of the earth, all of it in the form of water.

There could well have been far more, in fact, Donahue notes, without the D:H measurement being able to reveal its presence. Any more water than 1.5 percent, he says, would have so increased the greenhouse effect that hydrogen from the dissociated water would have escaped into space at supersonic speed, carrying the telltale deuterium with it. The similar amounts of carbon and nitrogen on Venus and earth, however, have suggested to some researchers that Venus could have "outgassed" as much as 300 bars of water in its early days, for a total atmospheric pressure equal to that nearly 4 km down in an earthly sea. The carbon-nitrogen argument is only circumstantial evidence, but it becomes considerably more persuasive in the light of the D:H result.

But was it ever an actual liquid ocean? Perhaps, Donahue says, though it would have lasted for no more than the planet's first few hundred million years. As the sun's heat evaporated some of the water, the greenhouse effect would increase, evaporating more water and further raising the temperature until most of the water had dissociated out of existence. If there was once 300 bars of water, in fact, the temperature could have reached 1,500 K (more than 2,700°F), says Donahue, which would also help explain another problem that has bothered advocates of a once-wet Venus: While the hydrogen from the water escaped into space over the eons, where did the heavier oxygen go? It, too, is rare in the present Venusian atmosphere, but 1,500 K, the Michigan scientist notes, happens to be about the melting point of basalt, a likely major component in the planet's rocky crust. A molten surface would have made the rocks ready candidates for oxidation, stealing the oxygen back out of the atmosphere.

Support for the probe's D:H measurement, meanwhile, may also exist in data from another source, an ion mass spectrometer aboard the Pioneer Venus orbiter that accompanied the Multiprobe vehicle to the planet and now looks down on the atmosphere from above. Several researchers have interpreted that instrument's measurements at atomic mass 2 as representing molecular hydrogen ions (H_2^+), but Harvard's Michael B. McElroy and colleagues believe the cited abundance to be incompatible with the observed amount of atomic hydrogen, or H_1. Instead, they suggest, the mass 2 reading could be indicating deuterium, leading to a calculated D:H ratio of about 1 percent, in the same range as the number from the probe. —*J. Eberhart*

Real-time computer-enhanced microscopy



PNAS

Standard video display of the phase-contrast microscopic image of a cultured kangaroo-rat cell (A). Clarity improves with computer: edge enhancement (D), same with background blackened (G), and contrast heightened by intensity transformations (J). Bottom is standard DIC-*microscopy image (K).*

Those who peer into the microscopic world are limited by the resolution of their magnifying instruments. Michael Berns, for example, found he was able to focus laser light beamed through a microscope into a point smaller than the diffraction limits of the best light microscope available. For one who studies subcellular — often molecular-level — changes wrought by such laser irradiation, this was a serious obstacle. But he and Robert Walter have made headway in overcoming the problem by borrowing from the space program those computer-enhancement techniques used to sharpen the focus of video images beamed back from space.

What the University of California at Irvine team has done is to couple a highly light-sensitive video camera and an image processor (originally designed for analysis of LANDSAT satellite images) to a Zeiss Axiomat microscope. Video display often provides viewers better-quality detail than would be possible using a microscope alone, Walter says. But by adding a digital image-processing computer, the researchers further enhanced data by reducing signal "noise," subtracting out background media, highlighting the edges of selected features, or arbitrarily altering image contrast — all in real time. And switching between alternate imaging techniques can be achieved at practically the push of a button, Walter says. A report on the system appears in the November PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

There has been a virtual explosion in video microscopy, Berns notes, with people using TV cameras to get good images from microscopes. "I think we've taken the next step," he told SCIENCE NEWS, "by running those good TV images through the computer for enhancement. I don't know if anyone else is doing what we're doing, but I suspect not."

Built for the laser-microbeam program, a national biotechnology-research facility, the system Berns and Walter developed was costly, roughly $500,000. But a more moderately priced system might be assembled for roughly $100,000, Walter says. Computer software is the critical component, but the university team is willing to share programs they've developed.

Some traditional techniques, such as differential interference contrast (DIC) microscopy, offer the level of detail and contrast achieved with computer enhancement (compare at left the DIC-image, K, with computer-enhanced version, J). However, the computer system develops images more quickly, offers greater flexibility in customizing enhancements, and requires less light to view objects. The last is notable, Berns points out, since the light required for DIC microscopy can damage or kill some living systems. —*J. Raloff*