Briefing:

A Surprising Action for the AIDS Virus

Few viruses have received closer scrutiny than the one that causes AIDS (acquired immune deficiency syndrome). If researchers can learn what it does in the cell, then they may be able to devise ways of stopping the relentless progression of the disease it produces. Now, Craig Rosen, Joseph Sodroski, Wei Chun Goh, and William Haseltine of Harvard's Dana-Farber Cancer Center have obtained a surprising new clue to how the virus works.*

About a year ago, Haseltine's group, in collaboration with that of Robert Gallo at the National Cancer Institute, discovered that the AIDS virus, which is called human T-cell lymphotropic virus III (HTLV-III) or lymphadenopathy-associated virus (LAV), produces a "*trans*-activating" protein that greatly stimulates the expression of viral genes. In that regard it resembles HTLV-I and -II, which cause human leukemias or lymphomas.

The gene-stimulating proteins of HTLV-I and -II act by increasing the transcription of genes into messenger RNA's. The current work shows, Haseltine says, that "The trans-activation of the type III DNA is completely different. It works to speed up production of viral products by increasing translation of messenger RNA's into protein."

The investigators had originally proposed that *trans*-activation by HTLV-III also involved increased transcription. However, an early clue that effects on translation might contribute came last summer when the Dana-Farber workers identified the segment of the HTLV-III genome that is needed for the response to the *trans*-activating protein. The responding sequence turned out to be transcribed into the viral messenger RNA and to be located at the message beginning where it could influence translation.

To show that this is the case the investigators attached the responding sequence to various genes and then compared their expression in matched pairs of cell lines that differed only in that one member of the pair was able to make the HTLV-III *trans*-activating protein. Protein synthesis proved to be much higher—by as much as 1000- to 2000-fold—in the cells with *trans*-activating capabilities than in cells without it. Although transcription of the genes was also higher sometimes in the cells with the *trans*-activating protein, the increases were far too small to account for the differences in protein synthesis, which could thereby be attributed to an effect on translation.

The manner in which the HTLV-III *trans*-activating protein stimulates translation is not yet known. Nevertheless, the research points the way to designing new drugs to inhibit HTLV-III's effects. Agents that inhibit the stimulation of translation, which occurs late in the viral life cycle, may be particularly useful if combined with drugs that inhibit earlier steps such as the copying of the viral RNA into DNA by the enzyme reverse transcriptase.

In addition, the work provides direct evidence that translational control can be a highly effective means of regulating gene expression. The few other incidences of translational control have not shown the large increases evoked by the HTLV-III *trans*-activating protein. "What is really surprising," Haseltine says, "is the size of the effect. There is enormous room for play for genetic regulation."

Finally, the HTLV-III *trans*-activating gene and its corresponding response sequence may also find an application in biotechnology by allowing the production of large quantities of biologically useful proteins, such as hormones and interferons, in mammalian cells. ■ JEAN L. MARX

*C. A. Rosen *et al.*, *Nature (London)* 319, 555 (1986).

Where to Put the Missing Venusian Ocean

Planetary scientists have found that, beneath the obscuring clouds of Venus that turn sunlight to an orange glow, the searing surface of Venus is covered with dark, almost black rock. From that and the color of hot rocks in the laboratory, these researchers conclude that they may have found the final resting place—the rocks themselves—of the oxygen component of Venus's ancient store of now missing water. That water may have been abundant enough to form an ocean that has dwindled to but a trace of water vapor in the atmosphere.

Only long after Pioneer Venus's 1979 sampling of the Venusian atmosphere did Thomas Donahue of the University of Michigan and his colleagues realize that Pioneer had recorded a vital clue to the bone-dry planet's history. The clue was the relatively high ratio of deuterium, a heavy isotope of hydrogen, to ordinary hydrogen in a cloud droplet of sulfuric acid that had clogged the intake of the Pioneer Venus mass spectrometer. Rather than the near disaster that it appeared to be, the droplet provided a hydrogen sample whose isotopic ratio indicated that Venus once had at least as much water as a few tenths of a percent of Earth's present ocean volume. There might have been as much as an entire terrestrial ocean. The present store of water in the desiccated Venus atmosphere is only 0.0014 percent of a terrestrial ocean, the difference presumably having dissociated into hydrogen and oxygen.

The hydrogen from the missing water would have readily escaped to space, leaving a disproportionate amount of the heavier deuterium behind, but the fate of the oxygen remained unknown. Perhaps, it was suggested, it combined with dark, chemically reduced basalt on the surface to produce reddish, oxidized rock the color of the volcanic cinder cones of Hawaiian volcanoes.

In order to determine whether crustal rock had taken up the water's oxygen, researchers from Brown University, under the direction of Carle Pieters, and from the Vernadsky Institute of the Soviet Academy of Sciences, under the direction of Valery Barsukov, conducted a joint study of the color pictures of the Venus surface sent back by Soviet Venera landers. That was not a simple matter. Among other adjustments required to arrive at the true rock color in white light, they had to remove from the photos the effect of the orange sunlight filtering down to the surface and the discoloration of the camera's color calibration chips caused by the 500°C heat.

After all the adjustments to the apparently orangish color of the rocks, they were dark and nearly colorless. But a bit of lab work showed that even true visual color can be misleading. Heating red, oxidized basalt to 500°C turned it dark and colorless, just like unoxidized basalt. But despite being the same color to the eye, this heated, oxidized basalt does reflect more light than hot unoxidized basalt outside the visible range at a wavelength of 1 micrometer. With a Venera measurement at 1 micrometer at each of two sites, it would appear that Venus rocks are dark but oxidized.

In order to account for the missing water, now-buried rock must have been oxidized as well. According to Donald Hunten of the University of Arizona, the minimum amount of water required by the isotopic analysis could have formed an "ocean" 10 meters deep. Losing it would have required that oxygen combine with an amount of rock equivalent to a layer 40 meters thick that was then reburied. A full terrestrial ocean would have required 10 kilometers of rock. Hunten sees a good chance that that much rock could have been exposed and then buried by volcanism, which to judge from radar images of the surface was abundant. ■ RICHARD A. KERR