Transplanting a Gene

Many scientists have boldly stated that they will some day be able to cure hereditary diseases by changing the genetic mechanism of human cells. The day of such genetic engineering may now be a little closer. In a report to *Nature* on work that the journal hailed as "little short of revolutionary," three American scientists claimed the first successful transplant of bacterial genes into living human tissue.

The cells used by Molecular Biologists Carl Merril, Mark Geier and John Petricciani at the National Institutes of Health in Bethesda, Md. were taken from a victim of the hereditary disease called galactosemia. Because of a defect in the genes in the nuclei of his cells, the victim was unable to produce the essential enzyme that enables the body to metabolize galactose, a simple sugar found in milk and other dairy products. Unless an infant born with the defect is quickly placed on a milk-free diet, he faces malnutrition, mental retardation and even death.

Favorite Tool. To correct this genetic failing in such cells, the scientists used a favorite tool of geneticists: bacteriophages, or viruses that prey on bacteria and may pick up genes from them. The viruses used in the test had a particular virtue: the gene that they had acquired from the common intestinal bacteria *Escherichia coli* was the one that orders the bacterial cell to manufacture the same galactose-metabolizing enzyme produced in humans.

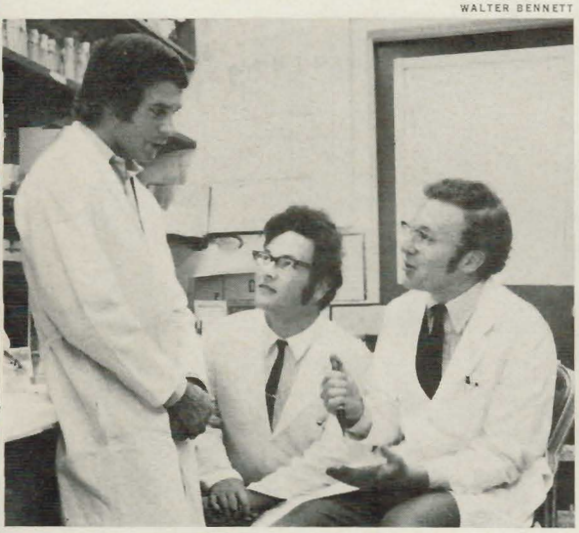
Hoping to transmit the gene to the human cells, the scientists placed a solution of the gene-bearing viruses in a lab flask containing the cells. Then they incubated the culture at body temperatures in an atmosphere enriched with carbon dioxide. The next step was more subtle: to determine whether the viruses had actually invaded the cells and insinuated their genetic instructions into them. If the genetic transfer had really taken place, the researchers reasoned, the cells would begin issuing their own instructions for making the enzyme.

Clear Implication. To find out if those orders were being given, the scientists used another laboratory trick. Before incubation was completed, they had radioactively tagged the cells' messenger RNA (the single-stranded molecule that carries genetic instructions from one part of the cell to another) so they could later identify it. Then they mixed these radioactive strands with complementary strands of genetic material from viruses carrying the crucial gene, hoping that they would combine; pairing off would take place only if the cellular RNA now had the same genetic structure.

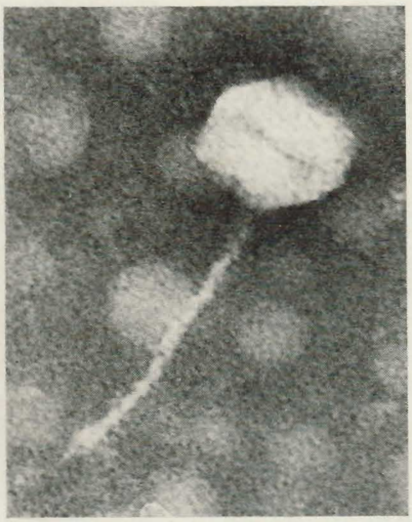
To their great satisfaction, the experimenters found that such hybridization of the viral and RNA strands had occurred. In contrast, when the researchers tested RNA from cells that had not been exposed to the viruses, hybridization virtually ceased. The implication was clear: the cells were indeed ordering up the essential enzyme. Furthermore, the scientists not only found the enzyme and confirmed that it was chemically active but also determined that the cells passed on their enzyme-making ability when they reproduced themselves.

The experiment, to be sure, was performed only in the artificial environment of the test tube. But if the results withstand the scrutiny of further testing, the researchers are convinced that their experiment will provide new insights into the workings of the genes. Even more important, it may offer effective means of correcting defects in the human body. Working toward that goal, the NIH scientists disclosed at week's end that they are already attempting the same kind of genetic transplant with a laboratory animal.

WALTER BENNETT



BIOLOGISTS PETRICCIANI, GEIER & MERRIL



MAGNIFIED GENE-CARRYING VIRUS

Little short of revolutionary.

A Wet Moon?

In spite of their heated arguments about the moon's origin, history and composition, lunar scientists usually agree on one point: that the moon is a bleak, waterless place, a million times dryer, as one researcher put it, than the Gobi Desert. That idea was challenged last week, as two Rice University scientists disclosed that they had detected the first evidence of water on the moon.

The provocative report came from Physicists John Freeman and H. Kent Hills. They have been keeping track of signals from extremely sensitive devices left behind at the Apollo landing sites and capable of detecting positive ions, atoms or molecules carrying a positive electrical charge. On at least three occasions, the scientists say, the detectors registered activity that was unusual on the atmosphereless moon: clouds of gases were passing by. Analyzing the data, the scientists determined that the gases had the unmistakable characteristics of ionized water vapor.

Even more intriguing, the greatest flow of gases was detected last March 7, when the seismometers left on the moon were registering strong rumblings in the lunar interior. Convinced that the timing of the seismic activity and ion flows was more than coincidental, Freeman concluded that water may well have burst forth from the moon in geyser-like eruptions, an event that would have been recorded by the seismometers. Then, as the water rose and became a vapor, it also quickly ionized in the strong ultraviolet radiation from the sun, acquired a positive charge and registered on the ion detectors.

If water is in fact locked inside the moon, its presence may be confirmed by electronic surveying gear aboard next year's Apollo 17 flight. Such water could have significance for future lunar explorers and colonizers, who would be relieved of the considerable problem of bringing their supply all the way from earth.

The Longest Root

Since ancient times, mathematicians have been fascinated by the problem of determining the square root of 2 —that number which, when multiplied by itself, will equal 2. As early as 1750 B.C., the Babylonians computed a value that was accurate to five decimal places (1.41421). By 1967, researchers in England, working with a computer, had stretched the answer to 100,000 digits. Now a Columbia University mathematician has surpassed even that prodigious effort. In what may well be the lengthiest computation of a mathematical constant of all time, Jacques Dutka has calculated the square root of 2 to more than one million places.

Starting with a rough approximation of the root derived from the mathematically well-known Pell Equation, Dutka devised a special algorithm (mathemat-