Science And Man—

Hailing ORNL Example Of 'Genetic Engineering'

By JOSHUA LEDERBERG

Recent advances in fundamental biochemistry have generated much speculation about genetic engineering, the calculated modification or design of an organism based on new knowledge of the genetic code. Now the first factual example to illustrate such an effort has been reported.

(The report in Nature magazine, by Drs. Stanfield Rogers and Peter Pfuderer, of Oak Ridge National Laboratory, also indicates the broadening functions of these laboratories, for the research was sponsored jointly by the Atomic Energy Commission and by the National Cancer Institute.)

In higher organisms, the genetic code is embodied in the DNA of the chromosomes of each cell. This is then translated into multiple copies of RNA "messenger" molecules and these in turn regulate the formation of the various proteins that make up the cell.

Some simple viruses, like the tobacco mosaic virus, have a simpler life cycle that bypasses the DNA. Instead, their RNA functions both as the hereditary material, being able to replicate as such, and as its own messenger. The tobacco mosaic virus, a disease of tobacco plants, has been much used for basic studies of virus biochemistry.

Previous studies pioneered by Dr. Marshall Nirenberg had established that the triplet in messenger RNA that reads "A-A-A-" (A standing for adenine) is translated into the amino acid protein chain. Rogers and Pfuderer used a specific enzyme to add a chain of about 18 A's to the end of the natural tobacco mosaic virus molecule. After purifying the product, they then used the modified complex to infect tobacco plants. If the dangling chain of AAA-triplets was translated according to modern theory, they reasoned, they should find new substances in the infected leaves, namely strings of up to six lysines.

This is precisely what they report.

The most important point that remains to be investigated is how the modified complex functions as a virus — that is, whether it replicates itself according to expectation. This information should be available very soon.

The result has mainly theoretical interest, by corroborating contemporary speculations about ways in which modified viruses — and, by implication, genes of higher organisms — can be artificially designed. We can expect to hear soon of methods of grafting two preexisting sequences together, so that tobacco mosaic virus could be extended with a more meaningful message than one for monotonous lysine strings. This could then lead, for example, to the production by virus - infected plants of precious and rare products like human growth hormone.

Even monotonous sequences may have great economic significance. The AAA. . .modification theoretically should exaggerate the amount of lysine manufactured by the infected plant. Lysine is one of the essential amino acids and many cases of malnutrition stem from a deficiency of lysine in the locally available food crops. We can readily visualize the engineering of tempered plant viruses that would augment the value of the protein produced by conventional crops.

The extension of this approach to animal viruses, furthermore, is one of the most promising approaches to a fundamental attack on genetic defects in man: the missing genes might be reintroduced into afflicted children by vaccinating them with specially engineered viruses.

There is, as always, another side to the coin. The lead editorial in the same issue of Nature remarks: "It is hard to decide why discussion of chemical and biological warfare has become so fashionable." But the obvious application of this new science to military progress in anti-human, viral weapons certainly adds new substance to our anxieties about biological warfare.