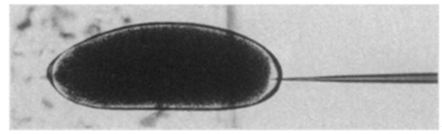
New Vehicle for Reliable Gene Transplant



Carnegie Institution

DNA is injected into the posterior end of a fruit fly embryo 0.5 millimeters long.

In a novel approach to genetic engineering, scientists have successfully moved genes from one strain of fruit fly into other flies. "We are the first to make a really stable modified strain with a different genetic property," says Gerald Rubin of the Carnegie Institution in Baltimore. In work with Allan Spradling, Rubin employed a natural element of the fruit fly genetic material. It is a transposon, a segment of DNA that naturally moves around within the chromosomes.

"The main reason for all the excitement is that the genes are stably inherited in future generations and correctly expressed," Rubin told SCIENCE NEWS. He contrasts the fruit fly results with recent work on mice using animal viruses as carriers or simply injecting genes without any special carrier (SN: 10/16/82, p. 252). In this work the transplanted genes often are present in the recipient animals, but they are usually not functional. When they are expressed it is only at a small fraction of the normal level and not in the appropriate tissues, for instance a blood protein is made in muscle but not in blood cells.

In early work on the new technique, Spradling and Rubin isolated a movable segment, called the P element. They injected copies of the transposon into fruit fly embryos shortly after fertilization and later found the P element stably incorporated into the chromosomes.

With recombinant DNA techniques in their next experiments the scientists replaced part of the transposon with a gene of their choice. The gene first used in these experiments is one responsible for a fly's red eyes and so is called "rosy." They inserted this gene, in a P element, into embryos that would otherwise have matured into flies with brown eyes, the eye color of flies lacking the rosy gene. As many as half the flies that developed from the treated embryos produced some progeny with red eye color instead of brown. Descendants of these red-eyed offspring also had red eyes. Thus the brown eye color was completely and permanently corrected by the transferred gene. In some cases the gene inserted itself in the fruit fly chromosomes near its natural site. In other cases it took up residence in other chromosomes.

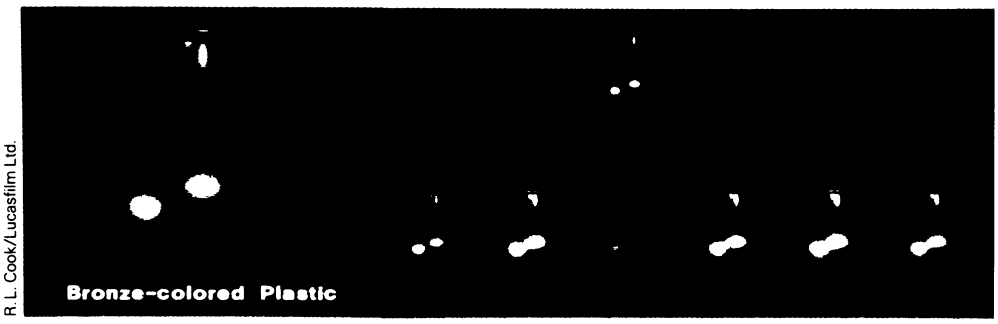
Since the early experiments, the Carnegie scientists and others have transferred five or six genes and have shown them to work properly, Rubin says. The transposon technique has enabled the scientists to bypass a difficulty of previous work: the unpredictable rearrangement of the DNA being transferred. Rubin explains that it is crucial to demonstrate that natural, intact genes work correctly after being transplanted. Then scientists can do experiments to examine how genes are normally regulated and do genetic engineering by altering genes before inserting them into animals.

Although the results of Spradling and Rubin were just published in the Oct. 22 SCIENCE, approximately 70 laboratories are already using the technique with material supplied by the Carnegie scientists. Some of the researchers are trying to use the P element to carry genes into species other than fruit flies. Scientists are trying the technique on mice, plants, frogs and nematodes (microscopic worms), Rubin reports. He and Spradling suggest that even if the P element is not successful in these other species, it should be possible to select similar movable elements native to other organisms and employ them in gene transfer. Transposable elements were first discovered more than 30 years ago in maize by Barbara McClintock, who is now at the Cold Spring Harbor Laboratory.

A special characteristic of transposons gives the scientists control over the movement of genes to make the transplanted genes stable. In their genetic engineering, Spradling and Rubin remove from the natural P element a gene that codes for an enzyme required for the transposon to insert itself into a chromosome. During the initial transfer, they provide this missing gene on another transposon. But in later generations, the enzyme is insufficient for the transplanted gene to move out of the chromosome again. Spradling and Rubin find no limit to the size of gene that can be transferred in a transposon, except perhaps the length of DNA that can be conveniently prepared with recombinant DNA techniques.

Although Rubin and Spradling are providing investigators with cloned P elements, the Carnegie Institution has filed a patent application. Rubin says he hopes some of the money that may be generated by industrial uses will come back to the place where the technique was developed. —*J. A. Miller*

Avoiding the 'plastic look' in computer-generated



R. L. Cook/Lucasfilm Ltd.

Computer-graphics developers have made great strides in producing computer-generated images that look realistic. Or almost realistic. A problem plaguing most graphics programs is that computer-synthesized images appear to be made out of plastic. It's all due to "a misunderstanding" about how to model the reflectivity of a computer image's theoretical surface, explains Rob Cook at Lucasfilm Ltd.'s computer-graphics laboratory in San Rafael, Calif. And at Siggraph 82, a computer-graphics conference recently held in Boston, Cook offered a mathematical cure for the graphics industry's plastic-image problem.

In realistically modeling an illuminated object, three types of reflection must be considered: ambient, diffuse and specular. And Cook notes that nonhomogeneous objects — like a waxed apple — "may have different reflectance spectra for each."

The ambient component represents light that is assumed to be uniformly incident from the environment and that is reflected equally in all directions by the object's surface. (It's the type of illumination provided by a bright, overcast sky.) Diffuse and specular components are associated with light from specific sources, such as a lamp or the sun. The diffuse portion involves light scattered equally in all directions, while the specular component represents highlights — light that is concentrated around "the mirror direction" (bouncing off the object at an angle that is equal to, but complementary to, the incoming light, as measured from a reference line perpendicular to the reflecting surface).

In the past, Cook explains, when people computed an object's reflectance components, they assumed ambient and diffuse components were the color of the object and that the specular component was the color of the light source — generally close to white. But, Cook found, "the specular component is usually the color of the material [doing the reflecting], not the color of the light source."