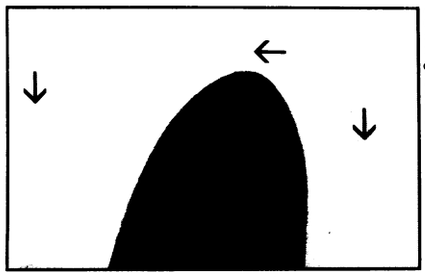
Needling tissues to accept foreign genes

Remove the shells from 1,000 housefly eggs by mixing them in a mild bleach. Pour the shelled eggs into a 25-milliliter test tube. Add a healthy dollop of DNA, a few milliliters of water and a pinch of microscopic silicon-carbide needles. Now mix vigorously for 1 minute with a standard laboratory vortex agitator. For variety, try substituting plant tissues or the embryos of other insects.

What sounds like the preparation sequence for a witch's cocktail is actually the recipe for the basic steps in a new gene-engineering technique developed by a molecular biologist at the Agriculture Department's Insects Affecting Man and Animals Research Laboratory (IAMARL) in Gainesville, Fla.

For years, plant and animal breeders have attempted to insert novel genes into unwitting hosts by injecting DNA with a microscopic syringe or by blasting DNA-coated tungsten pellets into biological targets with a special "shotgun" (SN: 5/16/87, p.310). The first technique is arduous, sometimes requiring the injection of 10,000 or more specimens – perhaps over a year or two – to yield just one that incorporates the new gene and expresses its function. Though shotgunning can potentially target 10,000 specimens at once, this newer technology has proved very costly and rather "disappointing," says Andrew F. Cockburn of IAMARL. "If we shot 10,000 [insect] embryos with the gun, half would be killed outright," he says. And among the survivors, only two or three might incorporate the new material, he adds.



USDA Agricultural Research Service

Vortex mixing: Three "whiskers" (arrows), each 0.2 micron in diameter and up to 20 microns long, surround this fly egg. Two are seen in solution; another is sticking out of the egg.

In contrast, Cockburn says, his new "vortex mixing" procedure is inexpensive, using off-the-shelf technology, "and almost ludicrously simple." Though the treatment may kill up to three-quarters of the embryos in any batch, he says, "essentially all that survive will be injected," for a 1,000-fold increase in injection efficiency and a far lower cost. Conceived just a year ago, this was just one of several innovations Cockburn planned to investigate for redesigning the genetic makeup of insect pests. But he recalls that the approach worked so well the first time it was tried, "I immediately told my technician to drop everything else."

The key to Cockburn's new technique is the use of needle-like, silicon-carbide "whiskers." During mixing, these fibers "punch a lot of little holes" in the target tissues, allowing the infusion of foreign DNA from the cocktail mix, he says.

A few months ago, Gloria Moore, a citrus geneticist at the University of Florida in Gainesville, began testing the technique on tangerine-like tissues grown in culture. "We've had some encouraging results" suggesting gene incorporation and expression, she says, but it's still too early to be sure.

In the future, Cockburn hopes to improve criteria for such things as optimal mixing times and whisker characteristics. And work by Norbert Perrimon, a geneticist at Harvard Medical School in Boston, suggests such custom tailoring may be essential for certain applications. "Though we had some results which looked kind of promising," Perrimon says, the membranes surrounding fruit-fly eggs proved tougher for the whiskers to puncture than expected. The pricking frequency ultimately proved so low that Perrimon has abandoned vortex mixing – at least for now. *– J. Raloff*

Enigmas of the sky: Partners or strangers?

Two astronomers report a possible and controversial physical link between two of the more dramatic heavenly enigmas: the brightest quasar ever identified and a recently discovered hydrogen cloud that has variously been characterized as a newborn galaxy or an already evolved irregular dwarf galaxy.

The potential link hinges on the objects' alignment and a long-running astronomical controversy. No one disputes that the quasar 3C273, as viewed from Earth, appears to lie near the hydrogen cloud in the Virgo cluster, a region of energetic galaxies. Researchers also agree that a radio jet from the quasar appears to line up almost exactly with the cloud's center. For Halton C. Arp of the Max Planck Institute for Physics and Astrophysics in Garching, West Germany, and Geoffrey Burbidge of the University of California, San Diego, that's enough to assume a possible physical association between the two objects – even though the quasar has a redshift some 40 times greater than the Virgo cloud, suggesting a vast distance separates the two.

In the usual interpretation of cosmological redshift – a well-known effect in which light from a rapidly receding source appears redder than it would had it remained at rest – the greater the shift, the greater the object's distance from an observer. By that standard, which fits the widely accepted model of an expanding universe, 3C273 should lie several billion light years in back of the cloud, and no physical link between the two would seem possible.

But Arp and Burbidge, citing their previous arguments that larger redshifts do not always signify greater distances, contend the quasar and cloud lie astronomically close to one another. "These two objects are rare, and it seems to me that their alignment is more than just a statistical argument; they really are physically associated," says Burbidge.

In the April 10 Astrophysical Journal Letters, Arp and Burbidge suggest several scenarios for the proposed link. They note that the quasar jet might have spewed the hydrogen cloud from 3C273. A more likely association, they say, is that radiation from the quasar has ionized the intergalactic medium of the Virgo cluster, exciting atomic hydrogen gas (which would not normally emit radiation) to produce the radio emissions that led to the hydrogen cloud's discovery last September (SN: 9/15/89, p.164).

"While it's an interesting [proposed] connection between the cloud and the quasar," ignoring redshift as a measure of distance "means you first have to overthrow all the evidence that supports that view," notes astronomer Cyril Hazard of the University of Pittsburgh.

Astronomer Arthur M. Wolfe at the University of California, San Diego, suggests a way to test Arp and Burbidge's idea. If the Virgo cloud and the quasar were neighbors, then 3C273 would heat the cloud, causing it to absorb far less 21-centimeter radio emission than it normally would from a distant quasar, Wolfe told Science News.

Michael J. Irwin of the University of Cambridge in England asserts that the cloud is not as rare an object as originally thought, and so does not require a quasar to explain its existence or its radiation emission. Wolfe and Richard G. McMahon of Cambridge announced last September that the presumed starless hydrogen cloud in Virgo actually contains some starlight and may harbor an irregular dwarf galaxy. Irwin, along with Wolfe, Hazard, McMahon and the cloud's discoverers – Martha P. Haynes of Cornell University and Riccardo Giovanelli of the Arecibo Observatory in Puerto Rico – expect to report details of the starlight findings in the August 1990 Astrophysical Journal.

Irwin told Science News that a colleague's recent redshift measurements indicate the purported dwarf galaxy moves with the cloud, suggesting the two are physically associated. *– R. Cowen*