Louis Savas, Robinson

Vaccine-coated gold particles (red) have penetrated the outer skin. Underneath lie lymphoid cells (black) that set off an immune response.

mune system of the invasion.

All of the five routes of inoculation tested by Robinson's team conferred immunity: nose drops, injections — into muscle, veins, and under the skin — and a "shotgun" application to the skin. "We show for the first time that all these multiple routes work," Robinson says.

Tissues differ in DNA uptake and efficacy, the researchers noticed. The skin proved by far the most effective route. So rather than inject DNA and hope that enough of it would sneak into cells, Robinson's co-workers used a gene gun to blast DNA-covered gold particles into outer skin cells.

Thanks to the gun and the nearby lymphoid cells, the amount of DNA needed to immunize mice through the skin dwindled to 0.4 microgram, roughly one-thousandth the amount required by the other routes. "As the method gets more refined, we will need to apply even less DNA," Robinson predicts.

"The technique has tremendous implications, most immediately for the generation of new vaccines. As it outgrows its infancy, however, you will see it made into drug-delivery regimens," says David B. Weiner, an immunologist at the University of Pennsylvania School of Medicine in Philadelphia.

Using a similar approach, Weiner and his colleagues elicited an immune response against a type of human immunodeficiency virus (HIV) in macaques, they report in the Nov. 9 DNA AND CELL BIOLOGY.

The researchers inoculated monkeys with DNA of gp160, a coat protein of HIV, the virus that causes AIDS. In response, the monkeys' immune system made antibodies that blocked HIV infection in laboratory-cultured cells. After four inoculations, 95 to 100 percent of the macaques exhibited that response. The team has yet to infect these monkeys with HIV to test whether they are truly immune.

"Our study is the first to demonstrate a successful vaccination of nonhuman primates using a DNA vaccine," Weiner says. Others may quickly follow suit. Several research teams are devising similar tests in monkeys. *— G. Strobel*

Probing a computer productivity paradox

Information technology pervades the service sector of the economy. A loan officer uses a computer to process an application for a mortgage. A lawyer relies on the same technology to assemble a will, as does a travel agent to make an airline reservation or a sales clerk to prepare a bill.

During the 1980s, banks, airlines, and other U.S. service companies spent more than $750 billion on computer and communications equipment, along with additional billions on software. Yet, conventional measures of economic prowess showed only a 0.7 percent average annual increase in productivity in these industries.

Now, a report from a committee of the National Research Council in Washington, D.C., suggests that this apparent paradox stems in part from the inability of traditional productivity measures to reflect adequately the impact of information technology on the performance of the service sector.

"Productivity data do not capture important elements of service output," says James B. Quinn of Dartmouth College in Hanover, N.H., who chaired the panel. "Key among these are the capacities to handle increased complexity and to provide improved timeliness, flexibility, response times, reliability, or safety for employees, customers, and the general public."

Taking into account these and other factors, "there is little doubt that information technology has had a dramatic impact on service-sector performance," he concludes.

The committee's report, "Information Technology in the Service Society," also recognizes that service companies have not adopted information technology with uniform success. It notes that most problems in achieving payoffs from investments in information technology have arisen from inadequate planning and implementation — including failures to provide adequate training for workers, to pay sufficient attention to customer needs, and to rethink how businesses should operate.

The report, however, does not address some of the problems associated with the tremendous growth of information technology. These concerns range from serious shortcomings in computer security (SN: 12/15/90, p.373; 10/30/93, p.282) and system safety and reliability (SN: 2/16/91, p.104) to the impact of rapid change and increased complexity on companies and their customers and employees. *— I. Peterson*

Beef quality: Ultrasound makes the grade

Meat inspectors today grade carcasses on the basis of how much intramuscular fat, or marbling, they see. However, any two inspectors may eye things differently, especially when distinguishing between "select" cuts (marbling with just 4 percent fat) and "choice" meats (having 5 percent fat). Such differences have important economic consequences: Retailers and consumers pay a premium for more marbled — and presumably tastier, tenderer — cuts of meat.

Now, two researchers at Iowa State University in Ames believe they have a sound means of reducing the subjectivity in grading: acoustical scanning.

Using a hand-held ultrasound pulse generator coupled to a laptop computer, Doyle Wilson and Gene Rouse have scanned the rib-muscle tissue of some 1,200 head of cattle prior to slaughter over the past five years. Then the animal scientists correlated patterns in the resulting black-and-white images with a precise measurement of intramuscular fat that was chemically extracted from a one-quarter-inch-thick rib-eye portion of each carcass. With these data, the researchers developed a computerized image-processing system that can quantify marbling from gray-scale patterns in rib-tissue ultrasound images.

Last year, the Iowa State researchers modified the computer algorithms to evaluate marbling based on ultrasound pictures of about 500 carcasses. When they tested the grading system in an Iowa meat-packing plant recently, they found that 75 percent of the time, human inspectors assigned meat a lower marbling grade than the ultrasound scanning system.

Because of its greater accuracy, "[ultrasound] and other objective instrumentation will eventually replace the current meat-grading system," Wilson predicts. Indeed, later this winter, one Iowa meat packer expects to test such on-line grading of meat. In preliminary tests, "we kept up with a packing line running at 100 carcasses per hour," Wilson says. However, he adds, the device could keep up with double that pace if necessary.

The system, however, may pay more immediate dividends to livestock breeders seeking to develop lean animals with well-marbled muscle. "There's no way you can assess [marbling] by looking at a live animal," Wilson points out. But with ultrasound scanning, he says, breeders can begin reliably identifying those live animals that preferentially lay down desirable amounts of intramuscular fat.
— J. Raloff