Only once has it ever been possible to wipe out one of the diseases that affect humanity. The means of achieving that success was a vaccine.

On May 8, 1980, the World Health Organization officially declared that smallpox had been eliminated, the most spectacular success ever achieved by vaccination. Vaccines haven’t always been so successful in combating other diseases such as herpes, diarrhea, leprosy, AIDS, flu, or the parasitic diseases. Still, they have enormously reduced the incidence of yellow fever, rabies, polio, measles, mumps, diphtheria, tetanus, cholera, and whooping cough.

Thanks to molecular biology and chemical synthesis, a new breed of vaccines has begun to appear. A single injection may eventually afford protection against several diseases. At last, a vaccine against one of the parasitic diseases, malaria, is being tested on human beings. The spate of promising results in this area of medical research comes as the reward for years of work by researchers in both public and private organizations. These new developments demonstrate the capabilities of biotechnology, which makes it possible to control and modify the constant process of renewal that characterizes all living beings.

A new application of vaccinia—the cowpox virus upon which smallpox vaccine is based—illustrates the possibilities that have been opened up.

As is well known, a vaccine is a harmless form of the pathogen of a viral or bacterial disease. In practice, this is likely to be the actual disease virus, but killed or attenuated and then injected into people in good health. Their immune system learns to recognize the enemy beforehand and is thus prepared to fight off a real attack. In fact, vaccination often occurs naturally when the body rejects a virus or other pathogen successfully and the action confers immunity.

Before the introduction of vaccination, healthy people were inoculated with a sample taken from a smallpox pustule. This ancient method of vaccination was extremely dangerous, but it was successful often enough that it was quite regularly used in Europe in the Middle Ages.

A British doctor, Edward Jenner, invented vaccination when he injected people with samples from the pustules of a similar disease in cows, cowpox. What he had observed was that people frequently in contact with cows often caught cowpox, but never smallpox. The symptoms of cowpox were harmless compared with those of smallpox. Thus, the principle of vaccines was discovered. In effect, Jenner had shown that people could acquire immunity to a dangerous viral disease by being exposed to a similar but harmless virus. This took place in 1798, before the discovery of viruses per se.

Thus, the vaccinia virus of cowpox, the basis of the first true vaccine, went on to enjoy an extraordinary career. In the early 1960s about 15 million people a year were still contracting smallpox, a terrible disease which killed half its victims and left ugly scars on those who survived. However, the last natural occurrence of the disease was identified on October 26, 1977. Since then the only person to have contracted the disease was a medical photographer who died after being infected in a laboratory at Birmingham University in England, where experiments were being done using samples of smallpox virus.

As a result of the eradication of smallpox, some countries destroyed their stocks of the virus and, even, of vaccines. One might have supposed that vaccinia had earned a well deserved rest, but, as it turned out, it was not yet time to retire the virus.

What happened was that scientists discovered a large number of ‘blank pages’ in vaccinia’s genetic instructions. On those blank pages they have been able to insert instructions to make the cowpox virus manufacture substances normally produced by other viruses. Injections of this multipurpose virus...
may eventually enable the immune system to recognize herpes, flu, hepatitis B, rabies, and perhaps even the AIDS virus.

At a workshop held during the annual meeting of the American Association for the Advancement of Science (AAAS) in Philadelphia last May, Enzo Paolletti of the Wadsworth Center for Laboratories and Research in Albany, U.S.A., explained that there was room for two or three dozen more genes in the DNA of vaccinia. Since each gene carries the code for the production of a specific protein, and since our immune system needs to recognize only a single protein on the outside of a virus in order to be able to 'remember' it, it's easy to understand why scientists don't want to let vaccinia pass into history. Although a number of genes have already been put into the vaccinia DNA, the ameliorated vaccine has not yet been tested on human beings.

According to Paolletti, the cowpox virus has the potential to become a true multipurpose vaccine, effective in a single injection against a whole series of viral, bacterial, and parasitic diseases. The possibility of modifying the grandfarther of vaccines in this way is made even more significant by the fact that smallpox vaccine is, in some ways, the ideal vaccine. It is easy to manufacture and can be dehydrated and packaged in bags so that it lasts for more than one month without refrigeration. As it is a live vaccine, it multiplies in the body with the result that one injection confers adequate immunity for a long period. (With killed-virus vaccines, injections have to be repeated at fairly close intervals.) These characteristics make smallpox vaccine particularly well suited to tropical conditions.

Paolletti did, however, draw attention to some of the dangers of the vaccine. Vaccination against smallpox has sometimes brought on eczema and scarring around the place vaccinated, and even encephalitis. However, the incidence of such complications is very low. The other specialists present agreed that the advantages far outweigh the disadvantages.

Despite the increased potential of future vaccines, health specialists do not think that they alone can bring down the incidence of disease. Efforts must be made to mobilize the people involved. At the AAAS meeting, Felipe Cabello of the New York Medical College, Valhalla, USA, showed that although the same antibiotics have been available in Chile and Cuba, the incidence of TB remained stable in the former country and dropped in the latter over the same period of time. In Cabello's opinion, the success recorded in Cuba resulted from greater participation by the population.

Further reading:


Les vaccins modernes (French), by Albert Sassen, in La Recherche, No. 177, May 1986.