all members of an infestation. Thus, a successful biological attack on, say, the cabbage looper, a pest nearly out of control in Arizona, might involve infection with both the bacterium and a virus specific for the insect. " I envision a day when integrated control might involve many approaches to one insect pest," says Dr. Heimpel. "Included might be insecticides, parasites, predators, bacteria and viruses."

There are about 18 viruses now isolated which have a high potential as insecticides, and viruses are the most promising new approach; the Food and Drug Administration will soon approve the first large-scale experimental use against a specific pest—the corn earworm—in the United States.

There are several types of viruses that have been found to be natural enemies of insects, each of which has a specific mode of attack. Most of the viruses are highly specific for the insect they attack; but because of this specificity, the viruses are hard to produce: They must be raised on the host insects, and insect-rearing facilities are far more complicated and expensive than the fermentation tanks in which bacteria are grown. (However, Dr. James L. Vaughn of the insect pathology laboratory is rapidly closing in on methods for producing insect tissue cultures on which the viruses could be grown.)

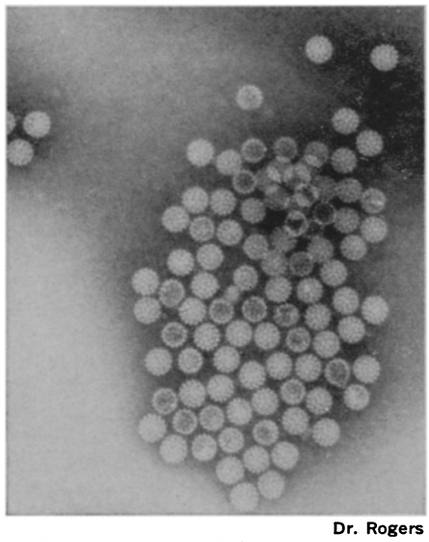
Dr. Heimpel estimates it costs about $2.5 million to get into commercial production with a viral pesticide, about the same as for a new chemical pesticide. But Dr. Knipling points out that a new chemical might attack dozens or more insects, whereas a viral agent is usually specific only for one.

Comparisons of costs between biological and chemical controls are, at best, difficult. Generally, biological controls are more expensive to develop and produce. "But the biological controls are much more economical in the long run," says Dr. Knipling. He explains that once suppressed biologically, insects require only small amounts of the suppressant to keep them in check. With hard pesticides, insects are back the following year in the same, or even larger, numbers. Also, biological controls can often reduce damage by 100 percent, as opposed to smaller reductions with chemicals.

But there are problems. Biological controls often must be applied on a region-wide basis to be effective, instead of on individual farms or orchards as with the chemicals. And the shift required in the pesticide industry is difficult, too, because of the uncertainties and high costs of radically new plants. "It takes a great deal of courage for a company to venture into producing a new biological control," says Dr. Heimpel. □

GENETIC DISEASE

Therapy by virus



Dr. Rogers

Shope virus to fight arginaemia.

Generally speaking, a virus infection is a thing to avoid. Nevertheless, man cannot always dodge the myriad of viruses to which he is exposed.

When a virus infects a cell, its core of genetic information (DNA or RNA) becomes part and parcel of the cell it has penetrated. In most cases, its presence is unwelcome, its effects deleterious. There are, however, times when a man can be infected by a virus and not even know it. Such infections are wrought by so-called passenger viruses, which enter cells without causing any perceptible harm. Among these special agents is the Shope virus. For 40 years scientists have held it to be innocuous in man. Now they speculate that in special circumstances it may be actually beneficial.

A team of European investigators from Berne, Cologne and Antwerp, has deliberately infected two German children with the Shope virus in hopes of reversing the biochemical error in a rare genetic disease known as arginaemia. The two children, aged two and seven, are the only individuals reported with this genetic defect, which is characterized clinically by mental retardation and convulsions and biochemically by high levels of the amino acid arginine in blood.

Unfortunately, there is little expectation that Shope virus infection will alleviate the clinical manifestations of arginaemia. In these two cases, it is probably already too late for that, too late to reverse mental retardation. Experimentally, however, the scientists hope to demonstrate that they can reverse the biochemical defect, reducing blood arginine levels. Thus far, their success is uncertain.

According to Dr. Stanfield Rogers of the Oak Ridge National Laboratory in Tennessee, the children were infected less than four months ago. It is too early to see clear results, although researchers anticipate some indication of whether the Shope virus is inducing the desired arginine-lowering effect by late fall. If it works, it raises the possibility of preventing arginaemia in an individual detected and deliberately infected by virus at birth.

Even more importantly, observes Dr. Rogers, who has been working with the virus in the laboratory and who is in close touch with the foreign team, which includes pediatrician Dr. H. G. Terhaggen of Cologne, the experiment opens the door to the use of viruses to transmit genetic information in man. "The field," says Dr. Rogers, "has fantastic possibilities." Theoretically, viruses could become one of the major tools of future practitioners of genetic engineering. That era is still many years away, however.

Biochemically, arginaemia is an inherited disorder in which the patient is unable to metabolize arginine because he lacks the necessary enzyme—arginase. The small Shope virus, which carries only a few bits of genetic information, happens to carry the DNA triplet that codes for arginase synthesis. Thus, it is likely when Shope virus DNA becomes incorporated into the genetic information of a cell deficient in the gene for arginase, it will fill the gap by supplying the missing gene for arginase synthesis.

Considerable experience with normal individuals accidentally infected by the Shope virus stand behind the presumption that it does no harm. In 1933, Dr. Richard Shope, its discoverer, injected himself with virus. For many years he had low blood arginine levels because additional stores of the enzyme metabolized the amino acid in his body, but there were no other effects. Similarly, innumerable laboratory workers studying the virus are known to have been accidentally infected without harm.

There are two routes to handling genetic diseases by inducing virus infection. The first, Dr. Rogers points out, is to find in nature those viruses which are safe in man but which carry identifiable, specific genes missing in certain diseases, as in the Shope virus and arginaemia. At present, he and his colleagues are trying to determine what other genes are carried by Shope DNA. This, however, is an arduous task, and a broad-scale screening program of large numbers of viruses is unlikely to produce benefits to outweigh costs in time, manpower and money.

Other passenger viruses have been tried in experimental systems but as yet have not produced dramatic results.

Recently, Dr. James E. Cleaver of the University of California Medical

Center in San Francisco conducted experiments to see if the SV40 virus, harmless to human cells, contained a gene that would code for a missing enzyme in an inherited disease called xeroderma pigmentosum. The condition, associated with a sometimes lethal sensitivity to sunlight, emerges because of the absence of an endonuclease, a gene that repairs DNA damaged by ultraviolet light (SN: 10/18, p. 348). "The SV40, regretfully, does not work," Dr. Cleaver reports. "Most of the genetic information it introduces appears to be characteristically viral." It is not useful to mammalian cells. Dr. Cleaver adds that while there may be a safe, natural virus capable of inducing endonuclease synthesis in defective human cells, the search would be monumental and is not on the drawing board.

The alternative to employing the genes of innocuous natural viruses is to tailor-make synthetic genes that can be incorporated into Shope, SV40 or other passenger viruses, which will then carry them into human cells. To this end, Nobel laureate Dr. Gobind Khorana of the Massachusetts Institute of Technology has made some advances with his first synthesis of a yeast gene (SN: 6/6, p. 547). However, the transition from such work to human medicine is complex and does not loom in the immediate future. □

AMENDMENT BOUND

Feminism moves on

As militant women gathered last week across the nation to celebrate the 50th anniversary of female suffrage, there was little mood of self congratulation. Rather, the demonstrations and the publicity served to make the people, males and females alike, conscious of the incipient changes in woman's role in society.

A major focus of the events was the proposed equal rights amendment to the United States Constitution. At present, the extent to which women may invoke the Constitution against laws that discriminate on the basis of sex is unclear. Many state laws place special restrictions on women with respect to hours of work, working in certain occupations and equal admissions to institutions of higher learning. Some legal observers maintain that women are relegated to second-class citizenship because they cannot invoke the Constitution against discriminatory treatment.

Although resolutions proposing an equal rights amendment to the Constitution have been introduced in every Congress since 1923, they have been killed. But revival of a modern feminist movement in the past four years, particularly among young women, has brought new life to the issue.

ESS

Women's role: A new consciousness.

Two major forces in the feminist movement are the liberal National Organization for Women (NOW), and the radical Women's Liberation. NOW, which has been described as the NAACP of women, receives its main thrust from the efforts of Betty Friedan, a critic of woman's traditional role of housewife and subordinate to her husband. "Support for Friedan's organization comes largely from women over 30 who are quite often following a professional career," says Dr. Laurel Walum, a sociologist from Ohio State University.

"Whereas the more radical women want a total restructuring of society, NOW simply wants a bigger piece of the action," she says.

Women's Liberation has its roots in the civil rights and radical student movements. "Women who were fighting to liberate blacks quickly discovered that they themselves were not liberated," explains Dr. Walum. "Radical women went to make revolution and found themselves as secretaries and coffee makers. The same happened to hippies who joined communes. The women were dishwashers."

These radical advocates seek to change women's role in society, particularly regarding child-rearing.

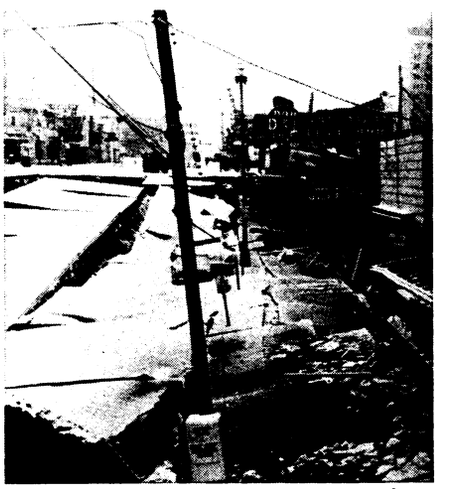
"Women have absorbed a second-class self-concept," says Theo Wells, an activist for women's rights in Beverly Hills, Calif. "From early childhood they are always asking permission, seeking approval. The woman is relating as the other person, not the primary person. She becomes a function of others."

That this is an important psychological barrier has been shown in a number of studies. For example, the 1966 Coleman report on equal opportunity in education, directed by Dr. James Coleman of Johns Hopkins University, indicated that self-concept is one of the areas that is directly related to achievement. Yet competent women find that their sense of achievement is undermined when they are relegated to low skilled, low paying jobs.

From early childhood they are told to play in Henrik Ibsen's Doll's House while males are encouraged to engage in problem solving, achievement-oriented behavior. Females are counseled into secondary roles such as being a nurse to a doctor, a secretary to an executive. "If a girl is interested in male subjects she is channeled elsewhere. She's told 'be a sex object, don't develop your head,' " says Wells. "But in the feminist movement she is joined by other women who feel the same and serve to reinforce the new concepts of womanhood." □

ALASKA EARTHQUAKE

Living on the edge



Army

Anchorage's Fourth Avenue dropped.

"Once bitten, twice shy" is a proverb that may run true in human-canine relations, but evidence from a recently completed survey of human behavior during and after the Alaska earthquake of 1964 shows that it does not apply to where people build their houses. Having had houses knocked down by earth movements during the quake, Alaskans went back and rebuilt on the same sites.

The citizens had been warned even before the quake. Four years earlier, the U.S. Geological Survey had said that much of Anchorage was built over layers of unstable clay. When the quake came the clay slipped and did great damage to structures that stood above it.

In Fourth Avenue in downtown Anchorage the land dropped 11 feet and slid horizontally 14 feet. In the L Street area 30 blocks suffered similar