ENTOMOLOGY

The Insect War

Insects throughout the world have shown an alarming ability to build up resistance in insecticides. So far scientists have developed chemicals faster than insects adapt to them.

By HENRY W. PIERCE

➤ A WORLD-WIDE armaments race is under way between chemists and insects. The chemists develop new insecticides, but the insects create their own special defenses against these insecticides within two to three years.

Latest insect victory is one scored by the housefly in the battle against phosphate insecticides, reported losing their efficiency in the United States and Denmark.

Cotton and cabbage pests have been adapting to a variety of insect-killers, and cockroaches in southern Texas are able to survive formerly deadly chlordane.

One of the most widely publicized insecticides has been DDT. Soon after its introduction in this country, DDT did a job that doctors and sanitation experts thought unbelievable. The insecticide quickly arrested a typhus epidemic in Naples, Italy, by killing its carriers, body lice. Yet DDT proved ineffective against body lice in Korea at the start of the Korean War.

Body lice in Egypt are now building an immunity to DDT, and the chemical is losing its potency against bedbugs. Houseflies mastered it some time ago, and malaria mosquitoes are proving that they, too, catch on to new things.

Resistance Not Believed at First

When insects first began building defenses against DDT, scientists and insecticide manufacturers alike blamed the chemical's failures on local conditions. The insecticide was not being applied properly, or perhaps some insecticide other than DDT was mistakenly being used, the experts said.

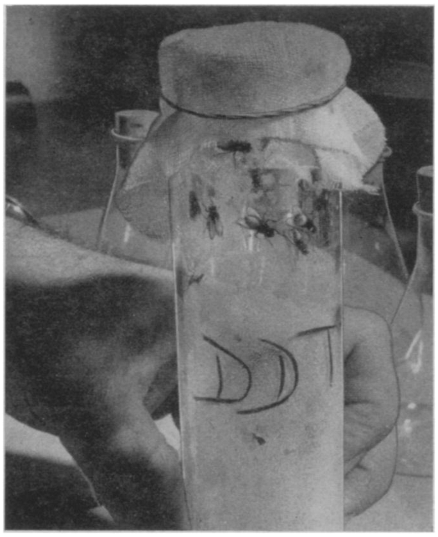
Since then, however, the ability of an insect to build up resistance has been definitely proved. Entomologists at the U. S. Agricultural Research Service in Beltsville, Md., have developed a breed of housefly that can live in a tube lined with DDT.

The scientists have done this by exposing successive generations of flies to increasing amounts of the chemical. Only those insects in each generation that can tolerate DDT survive to produce offspring.

Entomologists agree that insects' capacity to adapt to chemical killers is the gravest problem facing insect control specialists today. Virtually every large university in the United States is seeking a solution. Chemical companies in this country and abroad are giving a major share of time and money to the development of anti-insect weapons. The U. S. Army has been spending an average of more than $200,000 a year on the study of insect physiology alone.

Insect experts are frankly pessimistic over the possibility of developing a permanently effective exterminator. Each new chemical kills the great majority of susceptible insects, but there are always a few that, because of some physiological peculiarity, can survive. These remaining insects multiply and pass on their tolerance to their offspring. Soon the entire species is able to ward off chemical attacks.

So far the only solution scientists have found is that of trying to develop new insecticides faster than insects can adjust to them. Atomic energy is playing a vital role in this research by permitting scentists to trace, with radioactive isotopes, the biological changes that affect insecticides within their intended victims.



DDT-RESISTANT FLIES — These houseflies are quite at home in a DDT-lined tube. They are the offspring of DDT-resistant strains bred by entomologists at the U. S. Department of Agriculture research station, Beltsville, Md.

Atomic energy also promises to play an important part in sterilizing male insects. In 1954, three Department of Agriculture scientists rid an entire island in the Caribbean of a destructive cattle pest with this method.

Drs. R. C. Bushland, A. W. Lindquist and E. F. Knipling, found that atomic radiation can cause sterility in the pupae of male screw-worm flies without inhibiting their growth and vigor.

Since female screw-worm flies mate only once, a large number of sterile males could, they reasoned, bring about the extinction of the screw-worm in a localized area. No offspring would be produced.

The scientists released a large number of sterile male screw-worm flies on the Dutch Island of Curacao in the Caribbean. Each time a female fly mated with a sterile male, unfertile eggs resulted. The one-time mating females did not produce enough offspring to enable the screw-worm to survive on Curacao.

Insect repellents, which drive the pests away without killing them, have been widely used against mosquitoes. For the first time, entomologists are seeking to develop a non-poisonous chemical to repel cockroaches. So far as is known, insects do not develop a tolerance to repellents.

Although the usual goal of cockroach control is extermination, scientists believe a repellent might be useful in view of the insect's increasing ability to adapt to insecticides.

"Counterfeit" DDT

Another development still in the experimental stage is "counterfeit" DDT. This is a chemical group, structurally similar to DDT, which kills DDT-resistant flies when added to the insecticide. The chemical group, called the diaryl-(trifluoromethyl)-carbinols, is not effective unless added to DDT.

Insect resistance to chemical killers was first noted in 1914 in California. California scale insects, ordinarily controlled with hydrocyanic acid, unaccountably began surviving the lethal poison. The only explanation lay in the possibility that they were somehow developing their own defense mechanism to deal with the acid.

Scattered reports of similar cases appeared between then and 1942, when DDT came into general use in the United States. DDT was the first insecticide that would continue to kill long after it had been applied, so this was the first opportunity insects had to build up resistance to chemical exterminators.

Perhaps the biggest contribution DDT has made to human health has been in the fight against malaria and yellow fever mosquitoes.

Before World War II, the disease-carrying insects could only be exterminated with calcium arsenate applied in conjunction with expensive drainage programs. Besides being time-consuming and costly, the task often was opposed by conservationists who shuddered at the loss of wildlife incidental to draining swamps.

DDT changed this. Where calcium arsenate had been used at the rate of a half pound an acre, less than one-tenth of a pound of DDT was required. And DDT was not as expensive as calcium arsenate.

Here, for the first time, was an effective insecticide cheap enough for large-scale use against mosquitoes. Much of the progress that has been made in the fight against yellow fever and malaria since 1942 can be directly traced to DDT.

Now, however, malaria mosquitoes are showing the first signs of resistance to DDT. Florida salt marsh mosquitoes, which do not carry disease, have already become indifferent to the chemical's effects.

If the malaria and yellow fever carriers follow the salt marsh mosquito's lead, it may again become necessary to rely solely on swamp drainage and insecticides.

Insecticides now being developed will not be on the market for three to four years. After chemists have synthesized the new products, they must be tested by entomologists.

The testing is done on a small scale first. If the insecticide proves successful, further tests are performed on more insects over a larger area. If the scientists are satisfied that the chemical is truly effective, plans are made for its manufacture.

What insecticides are effective today?

DDT is still effective against mosquitoes, although how long it will remain so is a matter for conjecture.

Lindane is used against body lice and agricultural insect pests generally. Its chief disadvantage is its high cost. The chemical is not effective against spider mites.

Parathione is used on farm crops, but it is highly poisonous and presents a constant threat to farm animals.

Pyrethrins are the old standard knockdown making up a major part of the fluid in your own spray gun. Pyrethrins are not good killers, but will knock flies out of the air fast. They are usually mixed with another chemical which kills insects after they have been brought to the floor.

Malathione is widely used because it will kill almost any variety of insect. It is especially effective against cockroaches. It has a bad smell, however, and must be re-applied every few weeks to insure lasting effects.

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NUTRITION

Too Much Iron Can Be Dangerous

➤ TOO MUCH IRON in your system can be dangerous, although most people, when they think of iron, worry about being anemic from insufficient amounts, the Federation of American Societies for Experimental Biology meeting in Atlantic City was told.

This danger of too much iron was cited as a possible human health hazard from a new chemical in bread and other foods in a report by Dr. Robert W. Wissler and associates of the University of Chicago. Their report was based on feeding studies with hamsters conducted at the University's Argonne Cancer Research Hospital.

Chemically, the food additive that is dangerous if eaten in too great amounts is polyethylene sorbitan monolaurate. It is used in emulsifying food and keeping bread from going stale.

The reason too much iron is dangerous is that, once absorbed into the body, it is difficult to eliminate. Cirrhosis of the liver, diabetes, and pancreas damage, which causes the skin to turn brown, are results of excess iron.

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PHYSICS

Total Radioactive Fallout

➤ THE TOTAL RADIOACTIVE FALLOUT from all atomic and hydrogen bomb tests so far conducted probably will produce in the nation's capital only a fraction of the lifetime dose due to natural and cosmic radiation, two scientists report.

Although their calculations were made only for Washington, the results would be about the same for other places in the Northern Hemisphere not too close to the explosion points, they report in *Science* (April 13).

About 60% of the lifetime total of radioactive dosage in Washington results from fallout from the Nevada tests, about 33% from Soviet tests and only about seven percent from Pacific tests, Drs. Irving H. Blifford Jr. and Herbert B. Rosenstock of the U. S. Naval Research Laboratory calculated.

The low contribution of Pacific tests, although "surprising" because the total energy released and the resulting fission debris "far exceeded the combined total of all other tests," shows that fallout is much more dependent on distance than on energy release.

All fusion and fission weapons explosions between January, 1951, and May, 1955, will give a lifetime fallout dose at Washington of less than one-fifth of a roentgen, the international standard of X-ray quantity.

These results, they report, are in agreement with other measurements previously made for various locations in the United States and in England. They are based on measurements of ground-level concentration of fission products in the air in Washington for several years, which are usually "less than the natural background."

The two scientists calculated the dosage received by an unshielded man for all "biologically significant" time. Fission products contained in the part of the mushroom cloud from H-bomb explosions that extends above 40,000 feet, the top level at which rain clouds form, were found to contribute only slightly to dosage at great distances.

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ENTOMOLOGY

Cotton Gin Kills Plant Insect Pests

➤ THE COTTON GIN is going to become an important insect killer on American cotton farms, saving growers a total of $1,500,000 a year.

Putting cotton through a gin kills pink bollworms in the seed, making heat sterilization unnecessary, research by the U. S. Department of Agriculture indicates.

The pink bollworm is a serious threat to the American cotton industry. The process of ginning, which includes drying, cleaning, extracting, and moving seed cotton and cotton seed pneumatically through gins, has been shown to kill from 90% to 100% of the insects in the cotton seed.

The gin's newly discovered function may mean modifying present Federal and state quarantine regulations. Texas, New Mexico, Arizona, Oklahoma, Louisiana and Arkansas will be most affected.

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