Fighting Our Insect Enemies

ACHIEVEMENTS OF PROFESSIONAL ENTOMOLOGY

1854-1954

AGRICULTURE INFORMATION
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UNITED STATES DEPARTMENT OF AGRICULTURE

BEFORE THE GRASSHOPPERS CAME, THIS MAN was a farmer. Now he is not. There will be no "next year" for him.

This land once belonged to the man, and was productive and beautiful. Now it is his no longer. The season is autumn, but there is no harvest, no beauty.

The man sees withered stalks where a corn crop should be, swirls of dust, and the bodies of countless grasshoppers strewn over the ground.

In early summer the grasshoppers descended on corn, forage crops, and pasture. They devoured the more succulent parts of the plants, then whirred on to the next green field. Throughout the summer, more came.

By fall, when the grasshoppers died, crops had been destroyed. Thousands of farmers, having no feed, sold their livestock hurriedly. Many, like this man, lacked financial resources for another try, and gave up farming.

This happened in the Dakotas in 1932.

Grasshoppers—called locusts in the Bible—have been a plague since man began to till the soil. They destroyed crops in the Nile Valley thousands of years before Christ. In America they have harassed farmers since colonial days. They struck hard in the Mississippi Valley in 1874 and 1875—just as they did in the Dakotas in 1932.

But the grasshopper need never again do serious damage in this country. After years of study, entomologists have come up with new and improved methods for its control. Farmers are applying this scientific know-how with great success.

Entomology has enabled man to deal with many other insect enemies—agricultural pests, household pests, and vectors of disease—as effectively as he has dealt with the grasshopper. In the United States, the organized effort to control insects began just 100 years ago.

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100 YEARS OF PROFESSIONAL ENTOMOLOGY

The profession of entomology began in the United States in 1854. Recognition of the need for insect control led, in that year, to the appointment of two entomologists to government positions. One of them, Townend Glover, worked for the Federal Government and was assigned to the Patent Office. The other, Asa Fitch, worked for New York State.

Glover prepared exhibits of insects, seeds, plants, and fruits. In addition, he did research on insects that attack orange trees and cotton.

Fitch focused his attention on insect problems in New York State. He studied the life histories and destructive habits of many insects, especially those injurious to vegetation. His findings served as a basis for the further development of entomology.

Two other pioneers of the profession were C. V. Riley and L. O. Howard. They broadened the scope of entomology, causing it to embrace not only the observation and classification of insects, but also the control of insects.

Riley was a man of vision. He pressed for a nationwide program for controlling injurious insects. Largely through his efforts, the United States Entomological Commission was created in 1876. He was in charge of entomological work in the United States Department of Agriculture from 1877 to 1878 and again from 1881 to 1894.

Howard was a leader—and a man of action. He served as Riley's assistant for many years and succeeded him in 1894.

Howard did his best to make the public aware of the insect problem. For more than 30 years he wrote and talked about insects and conducted campaigns against them.

These men blazed scientific trails, and left guideposts for other entomologists to follow in studying

methods of controlling insects and minimizing their destructiveness.

In the United States today, about 4,500 men and women are professional entomologists. Many are employed in government—Federal, State, and local. Others are employed in industry and in colleges and universities. A few are businessmen who offer custom pest-control services to the public.

Some entomologists specialize in taxonomy (identification), physiology, or biology, and some in bee culture. Those in schools train future entomologists and pass on new ideas and information to the public. But most entomologists are in the insect-control phase of the profession. As research workers, plant-quarantine inspectors, supervisors of control programs, or Extension Service specialists, they are directly concerned with combating the approximately 10,000 kinds of insects that destroy our food, injure our health, or damage our homes and our possessions.

Most professional entomologists study insects to determine effective methods of controlling them.

Insects and Our Food

That which the palmerworm hath left hath the locust eaten; and that which the locust hath left hath the canker-worm eaten; and that which the cankerworm hath left hath the caterpillar eaten.—Joel 1: 4.

Thus it was many centuries ago—and thus it is today whenever insects get ahead of man in the quest for food.

Insects have ruined farms and farmers the world over. Even in modern times they have brought famine to some countries. They have caused shortages of some foods in this country.

Cutworms topple tomato plants, leafhoppers spread disease to beans, flies worry the flesh off beef cattle and lower the milk production of dairy cows, ants filch sugar from the bowl.

Roaches, beetles, weevils, and moths contaminate or destroy food that we keep on hand in our homes.

Stored-grain insects in homes, mills, elevators, and farm bins destroy a million tons of wheat each year. How much wheat is that? Enough to make 2 billion loaves of bread. Enough to provide everyone in the United States with bread for more than 7 weeks.

Wherever food may be, it has to be protected from insects. The effort to protect it begins at the source—on farms and ranches—and that is where the effort is most vigorous. Entomologists, insecticide chemists, and other scientists have enabled farmers and ranchers to keep ahead of the insects—most of the time.

Entomologists showed applegrowers how to reduce the destruction by the codling moth—the apple worm—from 50 to 90 percent of the crop to less than 5 percent.

In the 1920's entomologists found that larvae of the Mediterranean fruit fly in citrus fruit could be killed by treating the fruit with vapor heat. The treatment helped eradicate the fly from this country in 1929 and 1930. After being treated, fruit from infested areas could be shipped to other areas without the danger that larvae might develop en route and start new infestations. The treatment is still in use; it helps prevent the spread of the Mexican fruit fly from Texas to other

fruit-producing areas. . . . When infested citrus fruit is treated with vapor heat, it turns brown over the holes that were made by the egg-laying flies. The brown spots are readily detected, and fruit on which they appear is discarded during packing.

In 1888, entomologists imported from Australia a ladybird beetle that feeds on the cottony-cushion scale, an insect then ruining the California citrus industry. The beetle ate up the scale.

The Colorado potato beetle once ruined potato crops in large areas of the United States. Arsenical dusts saved the potato crop from this pest more than 80 years ago. Since 1946 control of insects with modern insecticides has increased potato production per acre about 50 percent.

The tomato fruitworm no longer takes a 13-percent bite of the tomato crop as it did in the early 1930's. In southern California alone, growers are saving $2 million a year by controlling it.

Between 1938 and 1951, American farmers produced $900 million worth of food and livestock feed that would have been destroyed if they had not controlled grasshoppers.

In 1952, farmers in just 19 counties in Arkansas grew an extra $4 million worth of soybeans by controlling insects.

The "entomological extra" in the meat, milk, eggs, and other animal products that reach the American market each year amounts to more than $100 million. It is made possible by controlling insect pests of livestock and poultry.

Stored food isn't safe from insect attack. Certain insects can penetrate heavy, multiwall paper bags.

Insects and Our Health

A great "swat that fly" campaign was launched in the United States about 1900. It taught the public that the house fly contaminates food with germs that cause typhoid, cholera, and dysenteries.

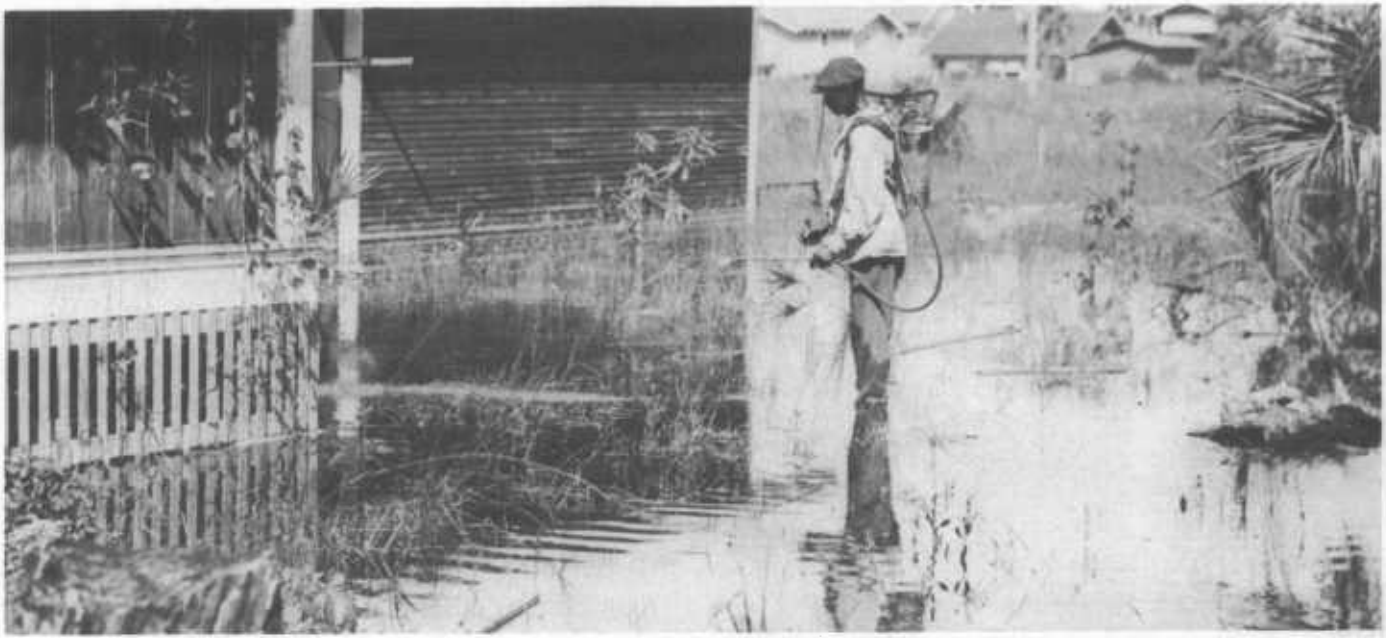
The entomologists and health officials who led the campaign encouraged fly control not only by use of the swatter, the symbol of the campaign, but also by use of screens, traps, poisoned baits, and (when they became available) insecticide sprays. They urged destruction of flies' breeding places through better sewage-disposal practices and improvements in sanitation generally. The excellent public response had much to do with the 90-percent decrease in the number of cases of typhoid in this country since 1912.

Malaria, carried by mosquitoes, assailed many of the inhabitants of colonial America, and reduced the ranks of General Washington's army. Later in our history, the pioneers who pressed beyond the eastern mountain ranges in search of wealth and adventure found mosquitoes and disease; so great was the malaria toll, especially in the Mississippi Valley, that some persons predicted that the disease would prevent the settlement of the West.

Malaria and yellow fever retarded agricultural and industrial development in the South more than the Civil War. Malaria was a plague in parts of the South as late as 1930.

From colonial times until 1905, repeated outbreaks of yellow fever killed more than 100,000 persons in the colonies and in the United States.

Not until late in the 19th century did we make much progress against yellow fever and malaria. Rapid progress became possible when medical men learned the connection between the diseases and mosquitoes, and entomologists showed us how to prevent the diseases by combating mosquitoes.



Mosquitoes breed only in water. At first, entomologists recommended killing larvae by putting a film of kerosene on the water (as shown above). Later, insecticide sprays and dusts came into use.

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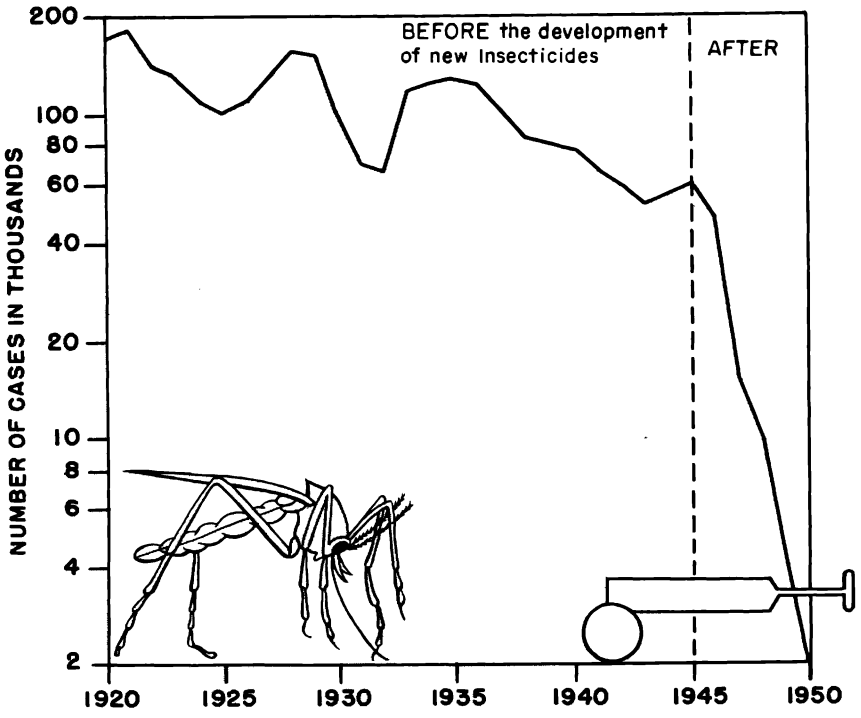
REPORTED MALARIA CASES IN THE UNITED STATES

Before and After the Development of New Insecticides



SOURCE: Public Health Service, U. S. Department of Health, Education, and Welfare

The entomologists said: Mosquito larvae can live only in water. Drain swamps and stagnant ponds. Do not let water stand in barrels, tin cans, and gutters. Where drainage is impracticable, kill the larvae by putting a film of kerosene on the water. . . . Keep mosquitoes out of homes, hospitals, schools, and other buildings. Put up screens.

Later they said: Kill mosquitoes with insecticide dusts and sprays.

As these measures were put into practice, the mosquito menace declined in the United States. Yellow fever has been eradicated from this country. Its control on the Isthmus of Panama enabled Americans to build the Panama Canal.

In 1951 only a few thousand cases of malaria were reported in this country. Only 50 years ago millions were afflicted.

Many insects other than house flies and mosquitoes carry diseases to millions of persons every year. Some of these insects and the diseases they spread are listed below. Of the diseases listed, only plague, typhus, and

relapsing fever occur in the United States—and these infrequently.

Insects	*Diseases*
Assassin bugs	Chagas disease
Tsetse flies	Trypanosomiasis (African sleeping sickness)
Tabanid flies	Loa loa (eye-worm disease)
Fleas (from infected rats)	Bubonic plague and endemic typhus
Lice	Epidemic typhus and relapsing fever
Sand flies	Leishmaniasis

Ticks are not insects, but they are biologically related to insects, and entomologists study them. One kind spreads Rocky Mountain spotted fever, and another spreads relapsing fever.

In large mosquito-infested areas, spray planes can be used for applying insecticide sprays and dusts.

Insects and *Our Possessions*

Insects reduce the sources of our clothing and household fabrics by attacking cotton plants and sheep. They reduce the source of the lumber that goes into the construction of our homes by attacking forests.

Many species damage our homes and possessions by direct attack. They can find all they need in a city apartment.

The housewife who stores blankets, woolen clothing, and furs in the spring without protecting them from insect feeding is taking a risk. She may find, when she unpacks them in the fall, that they have been seriously damaged by the larvae of clothes moths or carpet beetles. These larvae feed on anything that contains wool or other animal fibers, such as drapes, rugs, carpets, pillows, hair mattresses, upholstered furniture—and your suit of clothes. The damage caused by clothes moths and carpet beetles each year in the United States is estimated at $350 million.

Termites weaken supporting timbers in homes and other buildings. The damage they do each year in the United States amounts to many more millions.

The larvae of powder-post beetles tunnel through wood and convert it into a powderlike substance. They cause extensive damage to wood in the structure of buildings and to wood products used in the home.

Carpenter ants, which are distributed over most of the country, nest in wood. They make cavities in parts of buildings that are made of soft wood—porch columns, window sills, and foundation plates.

Silverfish damage books by feeding on paper and paste; they eat rayon and linen fabrics. . . . Crickets ruin curtains and clothing. . . . Bed bugs feed on the blood of people who are asleep. . . . Earwigs cause a bad odor in a house.

Those who have a yard or garden have a still wider acquaintance with insect enemies. The grubs of soil-infesting insects—the Japanese beetle, for example—feed on the roots of grasses, and can do more damage

to a lawn than weeds. A beautiful elm that shades the house is likely to fall prey to the Dutch elm disease, which is spread by bark beetles. To be successful in growing flowers or vegetables, the gardener must know what insecticides to use, and must have the equipment for applying them.

To appreciate how much progress has been made in fighting household insects, we need only compare the old and new methods of fighting that familiar pest, the clothes moth. Fifty years ago entomologists advised homemakers to ward off the moths by using tobacco as a repellent and by lining closets with tar paper. Today the homemaker can protect woolens with insecticidal flakes or crystals, or by spraying them with an insecticide. She can pestproof washable woolens as she washes them simply by adding a small quantity of a newly developed product to the wash water.

Quick-killing, long-lasting insecticides are available for controlling other insects that invade homes. Each year householders spend about $100 million for insecticides; in addition, they use the services of more than 15,000 pest-control operators who are skilled in combating household insects.

Fabric damage caused by clothes moths and carpet beetles totals approximately $350 million a year.

HOW WE FIGHT INSECTS

Methods of controlling insects have advanced remarkably since the days when entomologists could suggest only sanitation, screens, and fly swatters. It wasn't long ago that the fastidious ate from a table whose legs were set in receptacles containing kerosene to keep crawling insects from reaching the food. Most folks kept a cloth spread over the food until they were ready to eat. Southern plantation owners employed small boys to shoo the insects away with large fans.

Scientists keep developing more effective weapons to use against insects. Entomologists investigate the biology and the habits of insects, searching for weak links on which control efforts can be concentrated. Chemists discover new insecticides. Engineers design improved insecticide applicators. Plant breeders help develop insect-resistant crop varieties. Medical doctors and veterinarians have an important part in the fight against insects that attack man and animals.

Insecticides

Insecticides have become the chief weapon in fighting insects. In 1952 Americans bought more than 600 million pounds of insecticides. Since 1944 annual production of DDT insecticides has increased from 130 million pounds to 350 million pounds. Since 1940 the sum spent for sprayers and dusters has jumped from $4 million a year to $40 million.

World War II provided the impetus for the widespread use of DDT. In many parts of the embattled world this insecticide was applied by airplanes and ground sprayers to kill mosquitoes and other disease carriers. It was dusted into the hair and over the bodies of soldiers and civilians to kill lice and fleas.

Since the war, DDT and other new chemicals have been used widely.

Scientists have developed insecticides to fit the pest and the problem. Certain ones are for controlling

household pests, and are applied by housewives. Others are available to the farmer for controlling crop pests. Special insecticides and fumigants are used by pest-control operators in warehouses, greenhouses, and other buildings and in grain elevators.

But the rapid increase in the use of insecticides, most of which are toxic, has caused some persons to wonder whether they can be used safely. Are we applying too much of these materials to our food? Are we applying them too freely in our homes?

Modern insecticides are safe to use if instructions and precautions are carefully followed. The labels on insecticide containers give instructions on proper use. Practically all these instructions have been approved by Federal and State licensing agencies.

Most of the insecticides manufactured today are intended for specific situations and are effective in very small dosages. When only a few, general-purpose formulations were available, heavy dosages were necessary to kill insects. Because of the smaller dosages, modern insecticides are safer to handle, and when prop-

Use of a powerful mist blower mounted on a truck speeds up the task of controlling insects in trees.

Plant-quarantine inspectors at U. S. border stations examine fruits and vegetables for injurious insects.

erly applied their residues are less dangerous to man, livestock, and wildlife.

Improved applicators also promote safety; they enable you to get the liquid or dust where you want it.

DDT is mentioned frequently in expressions of concern over the widespread use of insecticides. The use of DDT for the purpose of killing insects has never resulted in the death of a human being. Its use against disease-carrying insects has saved the lives of 5 million persons, and has prevented 100 million illnesses.

Quarantines

Another method of controlling insects is to prevent them from entering the country or—if they are already here—from spreading to uninfested areas. This is done by placing quarantines on infested plants and plant products.

Since the passage of the Federal Plant Quarantine Act of 1912, it has been possible to carry out a quarantine program on a nationwide scale. Previously, various States had passed quarantine laws to protect

themselves against insect pests that might be brought across their borders.

Quarantine inspectors, who are trained in entomology, plant pathology, or botany, are on the job at ports and at inspection stations throughout the country. They intercept injurious insects in shipments of plants, produce, and lumber, and in plants and fruit in baggage belonging to people entering the country.

Roaches, bed bugs, and fabric pests are some of the insects that came to America with the early settlers. Scores of others found their way here before 1912; they include the hessian fly, the pea weevil, the boll weevil, the horn fly, the Angoumois grain moth, the alfalfa weevil, the codling moth, the imported cabbage worm, the oriental fruit moth, and the gypsy moth.

In one of the earliest efforts to control an insect by quarantine, Massachusetts in 1890 enacted legislation limiting the movement of products infested by the gypsy moth, a defoliator of trees. Despite this measure, the insect spread from Massachusetts, the State in which it first became established, to adjoining States. In 1906 Congress provided funds for Federal work on gypsy

Cotton farmers reduce the number of overwintering pink bollworms by shredding stalks after harvest.

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moth control. Since that time Federal and State quarantines, and cooperative control programs, have held the insect in New England, preventing its spread to the hardwood forests of the South and the Midwest.

In 1929 strict quarantine regulations and a rigorous eradication program held the invading Mediterranean fruit fly in Florida. The infestation was wiped out in about a year.

Natural Methods

Parasites, insect diseases, and good farming practices—these are three natural methods of controlling insects.

Certain insects, such as the oriental fruit moth, can be controlled by releasing parasites that feed on them. Others, such as the Japanese beetle, can be controlled by spreading a disease culture in the infested area. Still others, such as the pink bollworm, can be controlled by shredding and plowing under infested crop remnants.

American wheat farmers have been battling the hessian fly more than 180 years. The insect was in the bedding straw of the Hessians—British-paid German soldiers who were sent here to help quell the American Revolution. Entomologists got into the hessian fly battle about 1885. They found that female flies lay eggs on the green shoots of fall-seeded wheat. When wheat seeding is delayed, the flies have no wheat on which to lay their eggs. Entomologists determined safe fall wheat-seeding dates for every area of the United States in which winter wheat is grown. They work with plant breeders in developing varieties of wheat that are resistant to hessian fly attack.

Thus agricultural science has given wheat farmers two natural weapons to use against the hessian fly. Though not yet vanquished, the pest is nowhere near as destructive as it was in 1915, when it destroyed $100 million worth of wheat.

Pest Surveys

Entomologists operate a warning service for farmers. Survey teams keep check on insect buildups and new infestations. Their reports are made available to farmers through newspaper items, radio announcements, and publications.

State entomologists gather information about the insect situation in their States; they issue bulletins to the press and relay reports to county extension agents. Federal entomologists consolidate State reports into a weekly national report, which is distributed to newspapers and agricultural leaders throughout the country.

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Many insects benefit man.

Pollinating insects—bees, wasps, butterflies, and several other groups—increase the yield of many crops. Pollination—distribution of seed-producing pollen from plant to plant—is no part of their purpose. It is accomplished accidentally as they go from blossom to blossom in search of nectar. The honey bee is by far the most valuable of the insect pollinators; it is a pollinator of some 50 crops.

About 10 years ago several species of beetles were brought to this country from Australia to perform a weed-eradicating service for western ranchers. These beetles feed exclusively on the Klamath weed, a noxious range plant. They have cleared the weed from 100,000 acres in California, and have been released in Oregon, Washington, Montana, and Idaho.

Wasplike parasites imported from Europe help the farmer in his war against the European corn borer.

LOOKING AHEAD

America's population is increasing by more than 7,000 persons a day. A year from now there will be 2½ million more people; in 20 years, more than 30 million. Where are the additional food and fiber coming from that will feed and clothe the growing population?

Most of the land that is suitable for farming is already being used for that purpose. In the main, increased production must come, not from new land, but from improved farming practices.

Insect control is one of the best ways to increase production—and if production must be increased, surely it is important to protect our food and fiber from insect damage after they are produced.

Hundreds of entomologists are at work on research projects aimed at reducing insect damage and providing farmers with the "entomological extra." Here are a few of those projects:

Systemics

Researchers are experimenting with certain toxic chemicals that can be absorbed by plants and carried through their circulatory systems to the roots, stems, foliage, and flowers. The chemicals, called systemics, do not harm the plants but kill some insects that feed on them.

Similar studies are being made with livestock. Chemicals injected into cattle are carried by the blood stream to all parts of their bodies. They kill cattle grubs and blood-sucking pests such as mosquitoes and flies.

Radioactive Materials

Entomologists are applying the techniques of atomic science to the investigation of insects. In recent experiments, scientists "tagged" insects with radioactive phosphorus, released them, and later trapped them, along

with other insects, and determined by means of a Geiger counter which ones were radioactive. Information thus gained about how fast and how far insects can crawl or fly is useful in migration studies.

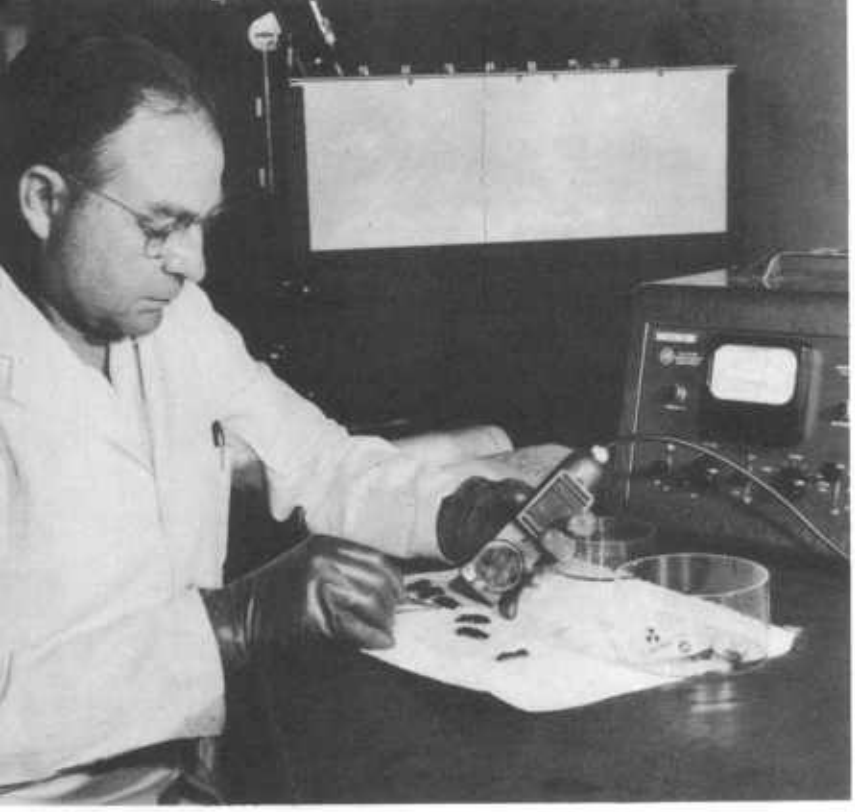
In another series of tests, male screw-worm flies were sterilized with gamma radiations and then released among normal flies in their natural habitat. Female flies that mated with the sterilized males laid sterile eggs. This may be the beginning of a new approach to control of this serious livestock pest.

Cathode Rays and Radio Waves

Cathode rays and radio waves have been used in experiments—but not in actual control operations—to destroy insects. Emanations from cathode rays have killed powder-post beetle larvae in wood, codling moth larvae in apples, and potato tuberworm larvae in potatoes.

In tests with stored-grain pests, high-frequency radio waves killed rice weevils in wheat and pink bollworms in cottonseed. The waves quickly raised the body temperature of the insects to the lethal level.

Experiments show that some pests of livestock can be killed by injecting systemics into the animals.



The Geiger counter, which registers radioactivity, identifies "tagged" insects in migration studies.

These examples give us a glimpse of how insect control may be accomplished in the future. Whether we use fly swatters or cathode rays, insect control merits the support of all our citizens. For some—the farmer, the stockman, the lumberman, and the truck gardener—the new methods will become tools of greater production, to be used along with those already known to be effective. For them, insect control means financial gain. The livelihood of others may not be so closely tied to insect control, but the health and wealth of all of us are affected in some degree by the crawling, flying, burrowing hordes.

We all have a stake in the fight against our insect enemies.

Not all entomologists work in laboratories. When the bugs are biting, many work directly with farmers, helping them to understand the nature of the problem and suggesting up-to-date methods of control.

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