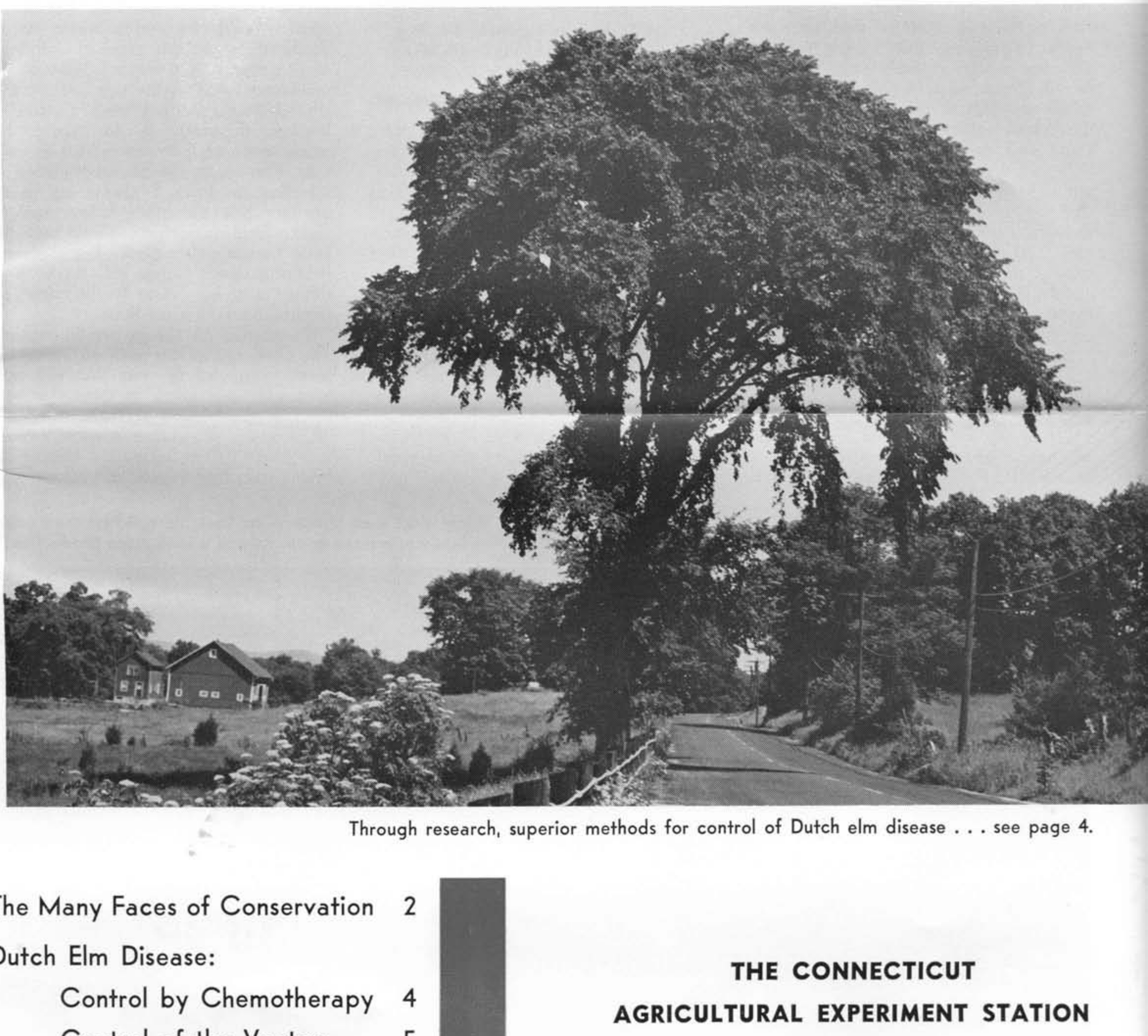
Frontiers of PLANT SCIENCE

SPRING ISSUE

1962



Through research, superior methods for control of Dutch elm disease . . . see page 4.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN

Paul E. Waggoner writes on

THE MANY FACES OF CONSERVATION

WRITING AND SPEAKING on conservation is not my regular employment. Rather I am a scientist who attempts to learn how plants grow — not in isolation, but in relation to soils and weather. In the Department of Soils and Climatology we study the creation of soils and the release of nutrients and water to roots and reservoirs. We study how light, wind, and carbon dioxide of the atmosphere control synthesis of plant stuff by corn or pine. We study how drought, insects, or soil change the forests that clothe the hills and valleys, swamps and trap ridges.

All this research is directed — as productive research must be — to answering specific questions.

But above this hovers a vague and difficult question. If we cannot answer this question, perhaps we can at least help to phrase it precisely.

"How can man proceed so that his children can enjoy a landscape more beautiful and a land more productive of water, wood, and food than we have today?"

I said we might not answer this question, only phrase it more clearly. This may seem small fruit for the toil of grown men. This is, however, the nature of science: If we can but ask a clear question of Mother Nature — whether of the inner secrets of the atomic nucleus or of the course of water through a plant — she will provide a clear answer.

Thus if we can say clearly what we mean by "beauty," whether we most value wood, water, or food; then Nature and the logical methods of science will provide the answer. Now let us return to my irregular employment, conservation.

The Many Faces of Conservation is adapted from a talk given by Dr. Waggoner at a meeting of the Leetes Island Garden Club on September 12, 1961.

I am a conservative by nature: when I look at the tree-clad hills, with interspersed meadows and a white steeple in the distance, I'm satisfied and want to conserve it. But when I listen to the missionary zeal of the true believers in what is loosely called "conservation," I become skeptical, as do Missourians when confronted by an appeal to emotion. Finally, in the liberal tradition as I define the term, I always try to remember that the other fellow may be right. As I investigate plants and the soils that nourish them, I am always debating which course will reveal those things most important to the conservation of our beautiful land.

In science all things are interesting. The challenge in this park of interesting trails is to pick the one that will lead to a new and splendid view. For our time is short: each scientist has only 24 hours a day for a lifetime briefer than that of trees he studies. During his brief career he can pick and pursue only

"How shall man proceed so that his children may enjoy a landscape more beautiful and a land more productive?"

a few paths, and his picking must be wise as well as his gait rapid if he would reach the higher lookouts before his time passes. And I am constantly debating which of the many proposals laid before us is the most important.

Thus although not a professional in conservation, I am concerned. I want to conserve and improve our land, but I must stand back a bit from the heat generated by some conflicts in conservation.

My responsibility, as I see it, is to try to determine what research will light our way to real conservation, not merely provide more fuel for interminable recrimination. My words therefore cannot be inspiring. I hope they may be disturbing, provocative, and uncomfortable. First, we shall see how conflict clouds conservation, and, then, how conservation is achieved.

At the very outset questions of conservation are broad and vague. Unfortunately the conflicts that arise confuse rather than clarify. It goes thus: to conserve one must have an object; when one has a thing—an object—more than one will surely want it; and hence conflict. Of course controversy is the way free people arrive at truth. But conflicts of conservation seem designed to obscure an already cloudy issue because an unwritten rule of the game requires that all be on the side of God and against the artifices of Man.

There Is Much Talk

For example consider the Wilderness bill, debated last summer in the Senate. The bill revealed disillusion with ourselves as well as love of Nature, saying a wilderness is "where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."

In opposing the bill, Senator Gordon Allcott was not to be outdone in selflessness, asserting that powerful economic interests supported the bill, while he fought for the worker or retired person who could not afford to equip himself for a long hike into the wilderness.

Replying to this, Senator Hubert H. Humphrey, who had also charged abusive pressures (but from the other side), said he knew of no powerful economic interests lobbying for it "unless it's the Boy Scouts and the Izaak Walton League."

Then Senator Wayne Morse mentioned "the grandeur of this great heritage which God Almighty has given the American people," provoking Mr. Allcott to ask "by what right does he claim closer kinship to God than I do. I have been threatened politically, too..." And so it went.

Now that I have been critical of both sides in this controversy, justice requires me to state where I stand.

First, belonging to the human race, my interests are for the continuity, comfort, and enlightenment of man. I am selfish. I don't oppose the works of man, for they make life more comfortable.

I don't regret that Virginians farmed their red soil, for from this came Washington and Jefferson (and my great grandparents).

I don't regret that Yankees clear-cut the forests of Maine and New Hampshire, for they built the ships that brought the wealth and ease that permitted the flowering of New England letters, the invention of mass production, the establishment of this Experiment Station.

I don't regret the clearing and plowing of the erodable hills of Missouri, for this supported my pioneering great grandparents and helped my grandparents and parents build the schools that permitted me to write here as a scientist.

Let's Be Honest

Finally, I am for plain speaking that will permit true judgments. If we want land to hike and camp upon or a beautiful vista to enjoy and cannot afford it ourselves, or if we feel this can be more economically attained for more people through public action, let us say so without alluding to God or the balance of Nature.

If we want to mine a metal needed for a convenient machine, to cut trees needed to shelter ourselves, to pasture cattle needed for food, or to satisfy the very human wish for a profit; let's say so without alluding to the poor people who cannot afford camping gear or to the creation of jobs.

If we remember that our interests lie with man, since we can ill afford to hate ourselves, and if we speak the bald truth, the right decision on conservation can more easily be reached.

Having discussed the clouding by conflict, let's describe the ways to conservation, not in terms of their sensationalism or excitement, but in terms of their fruit. I would call them four: Petitions, preservation, plums, and the surprising parallel.

Petitions are familiar. Someone is going to do something to a possession of his. Although it's his we are interested, we don't like the proposed change and we bring public opinion against him. This is exciting and entertaining. If the property is public this is a natural and democratic procedure: whoever has the most votes wins. But if private property is involved, it's sticky going.

The second approach — preservation — is exemplified by the Wilderness bill. Land is set aside in trust and man's works are excluded.

The third approach is plums. Private landowners hold most of the land. For a generation plums have been offered to them to do the right thing by the land. Contour construction, drainage, lime, and ponds have been encouraged by partial payment of cost.

Exemplary neighborhoods can be found after 30 years. Many ponds have been built in Connecticut. But as you travel you will find surprisingly few farmers who farm other than the most efficient way: straight furrows and straight rows.

The last means of conservation — the surprising parallel — is the most heartening because it is the most successful. This means was not designed to set aside erodable, impoverished land. But it runs parallel to the needs of conservation and has quietly accomplished much.

The success of the surprising parallel has been so great that it has overtaken our ability to adjust, and we often consider this great victory for conservation as a catastrophe. I refer, of course, to the phenomenal increase in agricultural production *per acre* that has marked this generation of farmers.

We all know something of the means, but the effectiveness of these means in conservation is commonly overlooked.

Through agricultural research, the aggressiveness of farmers, productive varieties, effective insecticides and fungicides, and better fertilizers the yield per acre has been multiplied — not added to but multiplied — since 1930.

But how has this helped conservation? It has permitted, indeed compelled, us to set aside erodable marginal land that was once farmed. And still we produce enough food for an exploding population on fewer acres. What a miracle!

The consequences lie all about us, providing clues to a massive conversion from tillage to forest.

Much Land Is Being Retired

Go into the woods of New England, even on the forest edge in northern Maine, settled only a few generations ago, and see the stone walls and the cellar holes, the lonely lilacs and gnarled old apple trees. Dig 8 inches into the soil of the forest and you will likely find the mark of the plow. The men who made that mark were not anti-conservationists. They wanted to stay alive, and it took all the land they could till to do it.

Today the retirement of farms continues. In the Farm Belt, when my father was in school, there were over 2,500 farms in Appanoose County. Today there are less than 1,500, and the eroded fields are returning to forest.

With a skyrocketing population whose demands are multiplied by an exploding standard of living, how else but through higher yields per acre could we have afforded to retire this land and so conserve it?

Thus one clear question for research that will conserve land is, as it long has been: "How can we increase yields of food plants and so grow food for more people on fewer acres?"

DUTCH ELM DISEASE

CONTROL BY CHEMOTHERAPY

A. E. Dimond

AT THIS STATION we have vigorously conducted research on Dutch elm disease since it became a threat to the trees we value so highly.

With the tools and methods of science we have asked many specific questions. We think that we interpret the answers correctly.

This new knowledge is invaluable as we proceed toward discovery of more practical and effective controls than we now have.

As you probably know, once an elm is diseased it cannot be cured. But the disease can be prevented.

Dormant sprays containing DDT kill the elm bark beetle that carries the causal fungus from one tree to another. Soil treatments containing oxyquinoline benzoate enter the tree and, acting as a mild fungicide, this compound prevents infection when the bark beetle carries fungal spores into the tree. Much as these treatments have improved the situation, we seek more effective treatments to combat the disease.

Our research on chemotherapy seeks compounds that will enter the tree, making it resistant to disease, or killing the fungus directly. But finding effective compounds for this purpose requires special knowledge in order to use specialized strategy. For example, we might think that a water-soluble fungicide would do the job. The Dutch elm disease fungus lives primarily in water-conducting wood, however, and damages the tree by plugging up this wood so that insufficient water reaches the leaves. Thus, in order to combat a fungus in the wood, we must have a fungicide that remains in the wood. A water-soluble fungicide ordinarily moves rapidly into the foliage. The wood remains unprotected. Also, if the wood is plugged in diseased areas, the water-soluble fungicide moves around the infected zones with what water does move, so that the fungicide does not have a chance to act upon the fungus.

Dr. Lloyd V. Edgington, left, adds a solvent to extract a chemotherapeutant applied to the bark and taken up by elm tissues. At right, Dr. Charles C. Doane, entomologist.

We have tried to control the movement of a fungicide by taking advantage of the fairly strong negative electric charge found on wet woody tissue in the elm. To do so, we used fungicides that carry a strong positive charge because of their molecular structure. As you might expect, these fungicides remain just where they are introduced into the tree and do not move up the stem at all. The wood to which the fungicide is attached does not support growth of the elm disease fungus. But one would like to be able to control where the fungicide goes in a more satisfactory way.

This group of fungicides develops the positive charge when dissolved in water, but when dissolved in alcohol and other so-called organic solvents, they have little charge, and in this condition they move freely in the plant.

Would such solutions sprayed on the bark of a tree penetrate the bark and carry the uncharged fungicide into the wood? Would these fungicides regain their charge when they met the sap stream, which is mostly water? We found they did enter, but unfortunately the organic solvents killed bark and cambium in doing so.

A few solvents are not very injurious. We may find one that will work satisfactorily without damaging the elm itself, while permitting entry of the fungicide and its fixing to the wood so that the fungus cannot grow in it.

But no one puts all of his eggs in one basket.

We have tried another approach, using the same group of fungicides. This approach involved changing the structure of the inert part of the fungicidal molecule.

We soon found that the shorter the chain length of the molecule, the more readily it moves. An intermediate chain length permits reasonable control of where the compound goes. A very short chain permits free movement to the leaves, whereas little remains in the stem. We found that as mobility in the stem is improved the compounds become less toxic to the fungus. Apparently, an intermediate chain length permits the desired degree of distribution of the compound, and the toxicity to the fungus is still reasonably good.

This is where the investigation stands at present. We must still determine if the compounds having intermediate chain length will move satisfactorily through tall trees (as contrasted with short ones used in early experiments). And we must learn whether the toxicity of such compounds is sufficient to give a practical degree of control of the disease, even under experimental conditions. This ap-

Dr. A. E. Dimond, chief of the Department of Plant Pathology and Botany at the Station, has made many contributions to knowledge of Dutch elm disease and its control. Here he treats with a subsurface nozzle the earth around an elm on the historic Green of New Haven. The picture was taken in August, 1946.

proach also looks promising, but many experiments must yet be done to prove its worth.

There is another possibility of controlling the disease. This is based upon our discovery several years ago that some plant growth hormones act directly upon plants to make them more resistant to wilt diseases.

Several years ago we found one compound that successfully suppressed the symptoms of elm disease, but it was so active as a growth regulating compound that it caused all the dormant buds on the elm tree to grow vigorously. This completely changed the habit of the tree. Such a compound is not useful in a practical way.

Old Trees Seldom Outgrow Disease

We have known for years that the Dutch elm disease fungus can grow rapidly in a tree in the direction of the length of the wood fibers. It grows very poorly in a radial direction, where it must cross many woody walls to keep pace with the rate at which the tree grows. This is the reason why very small trees frequently outgrow Dutch elm disease, but very old trees rarely do. When a thick growth ring is formed each year the fungus is walled off by a layer of healthy wood, but the fungus keeps pace with the growth at the rate that medium to large trees grow.

Growth-regulating compounds that we are now testing do not change the thickness of the growth ring. They do change the distribution of large water-conducting vessels, relative to the small cells that make up the balance of the wood produced in the annual ring of wood. Compounds affecting growth in this way do not change the ability of the fungus to infect the tree, but our measurements so far indicate that the fungus invades the tree more slowly after the tree becomes infected.

Such compounds, if they eventually prove practical, may so reduce the rate at which the disease spreads in a tree that one can successfully prune the infection out after the first symptoms of disease appear.

We must remember the difference between experimental results that come from research and the performance of treatments under practical conditions. Though the prospect for finding a control for the Dutch elm disease is good, the working out of control methods in detail takes time. Everyone suffers if experimental materials and methods are employed prematurely as practical controls.

No one at this time can promise that the methods we are now using will be practically useful, but research will determine if this is so. Research will find in due time a control method superior to any now available, of that we can be sure.

In the East, Dutch elm disease control programs keep annual losses of street trees low.

CONTROL OF THE VECTORS

Charles C. Doane

Throughout the land each spring millions of tiny beetles emerge from dead elm wood and converge on the nearest healthy elm trees. These are elm bark beetles, and some from diseased trees carry with them the fungus spores that cause Dutch elm disease. In the course of feeding they eat through the bark of the twigs and any spores on their bodies may be drawn into the water-conducting elements of the tree. Here the spores germinate and the fungus grows.

Dutch elm disease is still considered the most serious shade tree disease in the United States. First noted in Holland in 1921, the disease was found in Ohio nine years later. Shortly after this it began to kill trees in the East where it caused tremendous losses in the thirties and early forties.

All control measures failed until the advent of DDT. It was used to kill elm bark beetles and so prevent spread of the disease. Many towns with DDT spray programs lose no more than one per cent of their treated elms each year.

The disease has continued to move west, however, and has become even more serious in the Midwest. Elms are the principal shade tree species in many midwestern towns and cities. Many municipalities did not start control programs as the disease moved into the area. They soon found that the threat to the elm was not idle and the consequences of no control, catastrophic.

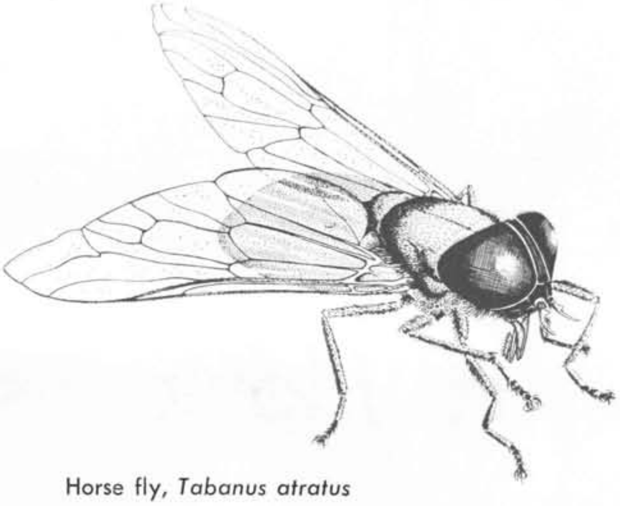
In one midwestern city with 47,000 elms the first diseased tree was found in 1954. By 1958 a total of 4,000 trees were dead. Losses that could only be estimated thereafter were placed in 1960 at 15,000 dead or dying street trees.

When such epidemic losses occur, tree removal is completely inadequate. Only 3,600 trees have been removed from this city and the total cost of removal is estimated at 2 million dollars, since almost all of the elms will soon become infected.

Effective as DDT may be for control of the beetle vectors, its use brings calculated risk. Small amounts of DDT on leaves and grass may be ingested by earthworms and concentrated in their bodies. DDT is not very toxic to the earthworms, but 25 to 30 such worms could prove lethal to robins or other birds that feed on them.

The heaviest mortality of birds has occurred in the midwestern states. New England towns have not observed such losses. Lower mortality is believed to be related both to density of elms and numbers of robins. The eastern towns do not have the continuous stands of elms found in the Midwest, due to early losses and

(Continued on page 7)



Horse fly, *Tabanus atratus*

GREEN DEVILS in Your Backyard

Robert C. Wallis

WITH the onset of warm weather, people in suburban Connecticut leave the fireside and move the television set out to the patio. As they venture from behind protective screens into the yard and garden, to the pool or barbecue, they enter the realm of devilish flies that have been patiently waiting for the happy days of togetherness outdoors. So begins the battle for the backyard. The backyard may be a recent development but the battle is not.

When Menelaus, the King of Sparta, invoked the goddess Athena for strength to withstand Hector, she gave him "the courage of the most fearless and audacious of creatures, the fly." Baalzebub, god of the Philistine city of Ekron, had the awesome power to bring or send away flies, since time immemorial linked to disease. As dysentery spread among his troops Napoleon Bonaparte cursed the "green devils" befouling the food. Now the green devils, or blow flies, elicit the same reaction from the suburban homeowner.

The vast majority of flies encountered by Connecticut people are in two main groups— those that enter the house and those that are pests in the yard and garden.

In the former group, the common house fly is no longer the summer-long nuisance of a generation ago.

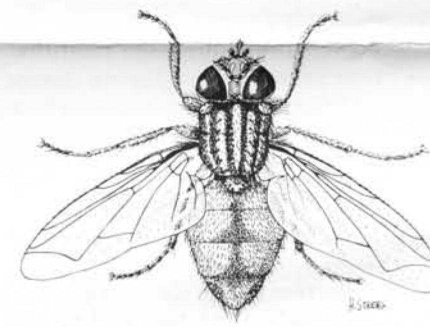
Flies in the second and larger group encountered by the homeowner enter houses only occasionally, but they are the principal pests outside in the garden. These are the blow flies and flesh flies that thrive, as residential communities spread out into the suburban areas.

Any discussion of flies may well begin with a brief review of their biology and life history.

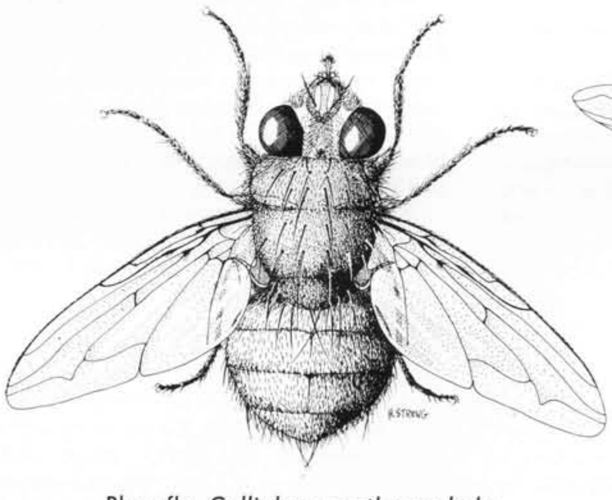
Flies, like other insects, do not grow in size as they age, but pass through four distinct stages in their life cycle in which growth is accomplished. The cycle begins when the female fly deposits eggs, often as many as 150 in one egg-laying period. One fly may oviposit as many as 20 or more batches of eggs, a total of more than 2,000 eggs, in one season.

The female fly usually deposits eggs on media suitable for food, and when the eggs hatch after 6 to 12 hours, the larvae (maggots) begin feeding. After the larva grows through three developmental stages within about a 1-week period, the fully grown maggot crawls away from the moist breeding medium to a drier place and forms a pupa. In this process the larval skin shortens, the ends round off and the skin hardens, developing into a dark brown puparium. Within this protective case, during a 3- to 4-day period, the worm-like maggot is transformed into an adult fly.

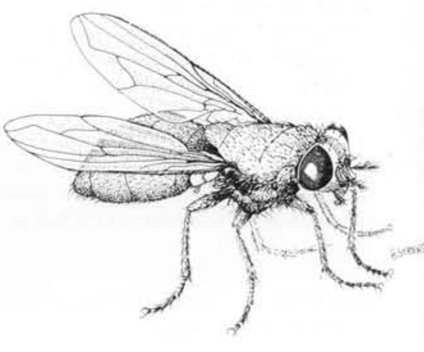
During the first day the new adult fly recovers from the rigors of extracting itself from the pupal case, and mating occurs. Within 3 days, the female is ready to lay eggs. Moist, decomposing organic material is a preferred site for egg-laying. And so the life cycle repeats.



House fly, *Musca domestica*



Blow fly, *Calliphora erythrocephala*



Green bottle fly
Phaenicia sericata

In urban areas the garbage dumps, garbage cans, dog dung, scraps of food, and seepage from faulty septic disposal systems all provide excellent breeding sites.

When food and breeding places are close at hand, the fly seldom travels far. When these essentials are lacking, however, it may search over long distances. One highly infested breeding site may, therefore, provide flies for an entire community.

Blow Flies Look Alike

Blow flies come in different sizes and colors, most of them so closely related that they are not distinguished from each other by the homeowner.

The well-known blue bottle flies, and the green bottles or blow flies are representatives of the family Calliphoridae. They are pests, and more. Some of the species in this group are dangerous. The green bottle flies and the black blow flies have been known to carry the poliomyelitis virus. While the significance of these flies in the epidemiology of polio and other enteric viruses is not fully understood, the blow flies are receiving increased attention.

Some of the large blow flies or blue bottle flies in the genus *Calliphora* pose a special problem in identification. However, the two most common ones occur in the greatest numbers during the springtime and fall. Eggs are deposited on dead animals and decaying meat that serve as food for the developing larvae. The flies have also been known to oviposit in open wounds or ulcers of animals. Around the home in yard and garden, meat scraps in garbage cans, dog and cat droppings, dead birds and rodents are particularly attractive breeding material.

Another green bottle fly in the genus *Calliphora* is about the size of the common house fly but smaller than the blue bottle fly. Body color may range from the usual green to a blue, and occasionally to a red "coppery" luster. It is primarily an urban species and breeds most frequently in backyard garbage cans, market districts, and city dumps.

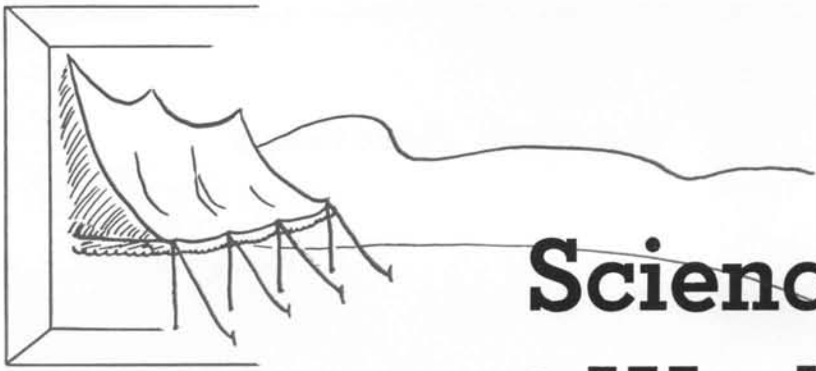
Another of the green bottle flies is very similar in appearance and habits. It breeds in dead animal matter and garbage cans but is found more commonly in rural and suburban residential areas. Still another closely related species is one that is known to be a parasite of toads and frogs and has a rural and suburban-woodland distribution.

The so-called black blow fly with the queenly scientific name, *Phormia regina*, is a dark metallic green or green-blue. Like other blow flies, it breeds in dead animal matter, garbage, and city dumps. It is most prevalent in the fly population during the spring and fall seasons. We know that this black blow fly is a good host of the poliomyelitis virus. In the laboratory, the virus persisted within the fly during an experimental 3-month hibernation period. Because of this, *Phormia regina* is now thought to be a possible extra-human reservoir of the poliomyelitis virus.

Fly abatement practices in the backyard begin with prevention of egg laying or, failing in that, with extermination of the larvae. Barring or excluding flies from breeding media prevents the gravid female fly from finding a suitable place to deposit eggs. Residual insecticides are also very effective for this purpose. If flies cannot be excluded from garbage or decaying plant and animal material, and eggs are deposited, then proper disposal or treatment to kill the immature stages of the fly is indicated.

Years ago, one species, the house fly, outnumbered all others about the home. Now it is not one species, but several that are similar in appearance and habits, that beset the family as they enjoy outdoor living.

General instructions on fly control are given in Circular 213 of this Station, Insects in Houses. More detailed descriptions of the kinds of flies encountered in Connecticut and their biology are given in Station Bulletin 650, Common Connecticut Flies, now in press.



Science at Work

1962 Field Meeting of the

FIRST STATION IN THE NATION*

Wednesday, August 8

Lockwood Farm Mt. Carmel

* THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

Control of the Vectors

(Continued from page 5)

greater variety of trees in the East. It is likely that there are fewer robins in the eastern towns than in the midwestern, even where no spraying has been done.

A search for safer, more effective means of control has been in progress many years. There are several possible ways of stopping the disease. In this issue of FRONTIERS Dr. Dimond and Dr. Edgington report progress in control through chemotherapy. New methods of preventing feeding by the beetle vectors are also under study.

Certain systemic insecticides may be taken up by the tree and stored in the bark, making it toxic to the beetles. One such chemical is giving good results but is not ready for general use. Systemic insecticides used in this way have the advantage of being safer than conventional sprays to wildlife and beneficial insects.

At present DDT spraying is the most effective method for beetle control. Another compound, methoxychlor, is less dangerous to birds, but it is also not as toxic as DDT to the beetles.

Until an acceptable alternate is ready, the difficult fact is that Dutch elm disease cannot be controlled without hazard to some birds.

Wanted: Amateurs

Neely Turner

In the beginning amateur naturalists were the students of biology. They remained the major source of information on classification and distribution of plants and animals for many decades. Their interests declined between the two World Wars, and today amateur biologists are few and far between.

The contribution of the early amateurs was substantial, as professional taxonomists have long acknowledged. The causes of their disappearance are obscure. Some of them did "turn pro" and trained the first generation of the professional staff of colleges and laboratories. But this seems too small a number to account for the loss of interest.

It seems more likely that specialization in biological training was a major factor. Specialization in biology is as inevitable as it is in medicine, manufacturing, or marketing. Sheer volume of literature, for instance, is enough to discourage an attempt to acquire a complete knowledge of biology. Further, the special skills needed to study experimental applications of knowledge in a completely objective way require extensive special training.

All this discouraged the amateur. His contribution seemed as small as a grain of dust in a hundred-acre field. He could not even understand the jargon coined by the specialist. Many amateurs lost heart or retired into their shells.

A new interest in nature has appeared. This is expressed in desire for open space, nature preserves, and wilderness areas, and in philosophizing on "the balance of nature." New amateur naturalists are also appearing just as they did more than a century ago. These new amateurs can be assured that their observations and studies may contribute to the basis for management of natural areas in a desired state.

Clear Answers to Clear Questions

It is hoped that these new amateurs will make full use of the sound methods developed by professional specialists. These pros have long since learned the necessity for objectivity. As the cliché goes, nature answers the questions you *really* asked, not necessarily those you *thought* you asked.

This is especially true in studies of interrelations of living things, called ecology. Every suburbanite has learned that nature is not going to provide him with a perfect lawn, with no Japanese beetles, dandelions, or crabgrass. This is because the climate, soil, and plants and animals that exist here tend to produce something besides grassland. And if the specialized care of lawns is stopped for even a decade, something far removed from a lawn will develop.

Thus in management is the clue to maintenance of parks, open spaces, and nature preserves in the state people seem to want them. A group of amateur botanists and zoologists, working independently as specialists, and cooperatively in applying their findings, can not only contribute notably towards the desired effects, but also add information of lasting scientific value.

The time is ripe. The need is here. The areas are being set aside. The libraries are full of the information from the past. Bookstores are filling with inexpensive editions of all sorts of biological science. With a will and a proper approach, amateur biologists can find a satisfying hobby, and at the same time contribute substantially to an understanding of the bounds of nature.

Cicadas Coming

The periodical cicada, more commonly known as the 17-year locust, will appear late in May in central Connecticut. The adults cause no damage by feeding, but the females slash into twigs and form elongated punctures to protect their eggs. The punctured twigs may break and die.

Circular 221 of this Station gives information on the periodical cicada and its control.

New Publications

Publications listed below have been issued by the Station since you last received Frontiers. Address request for copies to Publications, Box 1106, New Haven 4.

Entomology

B 646 Population Ecology of the Gypsy Moth

C 221 The Periodical Cicada

Lawns

B 649 Control of Crabgrass and Other Weeds in Turf

C 208 (revised) Diseases and Other Disorders of Turf

Reports on Inspections

B 647 Food and Drug Products, 1959

B 648 Commercial Fertilizers, 1961

Soils

C 220 Rotations, Organic Matter, and Vegetables

Frontiers of PLANT SCIENCE

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Bruce B. Miner, Editor

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION
NEW HAVEN 4, CONNECTICUT

James G. Horsfall
Director

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