

*The author of THE SEA AROUND US and
THE EDGE OF THE SEA
questions our attempt to control the
natural world about us*

SILENT
SPRING
Rachel
Carson

Silent
Spring

BY RACHEL CARSON

UNDER THE SEA-WIND

THE SEA AROUND US

THE EDGE OF THE SEA

SILENT SPRING

Silent Spring



by Rachel Carson

Drawings by Lois and Louis Darling

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To Albert Schweitzer
who said

“Man has lost the capacity to foresee
and to forestall. He will end by
destroying the earth.”

The sedge is wither'd from the lake,
And no birds sing.

KEATS



I am pessimistic about the human race because it is too ingenious for its own good. Our approach to nature is to beat it into submission. We would stand a better chance of survival if we accommodated ourselves to this planet and viewed it appreciatively instead of skeptically and dictatorially.

E. B. WHITE

Author's Note

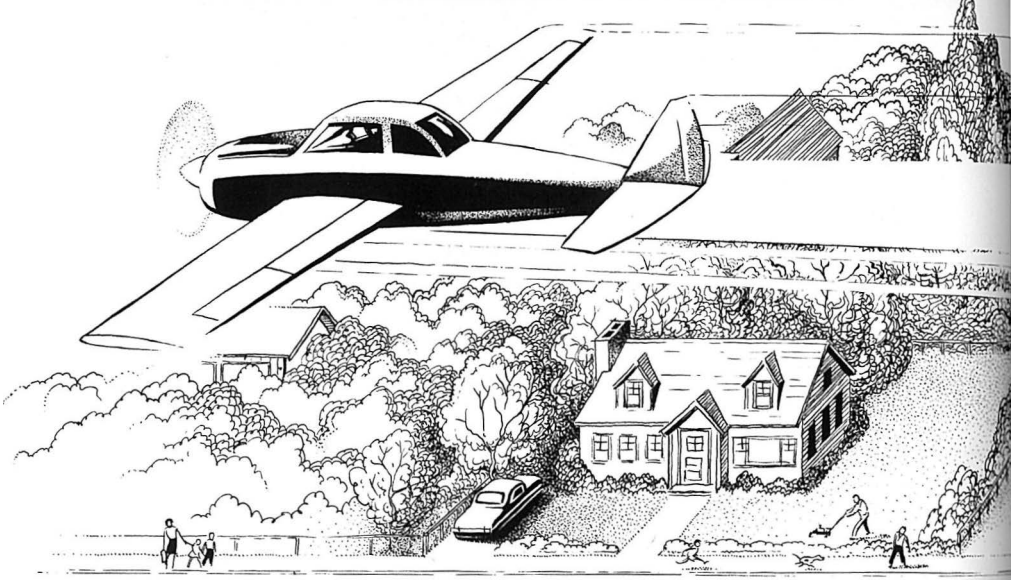
I HAVE NOT WISHED to burden the text with footnotes but I realize that many of my readers will wish to pursue some of the subjects discussed. I have therefore included a list of my principal sources of information, arranged by chapter and page, in an appendix which will be found at the back of the book.

R.C.

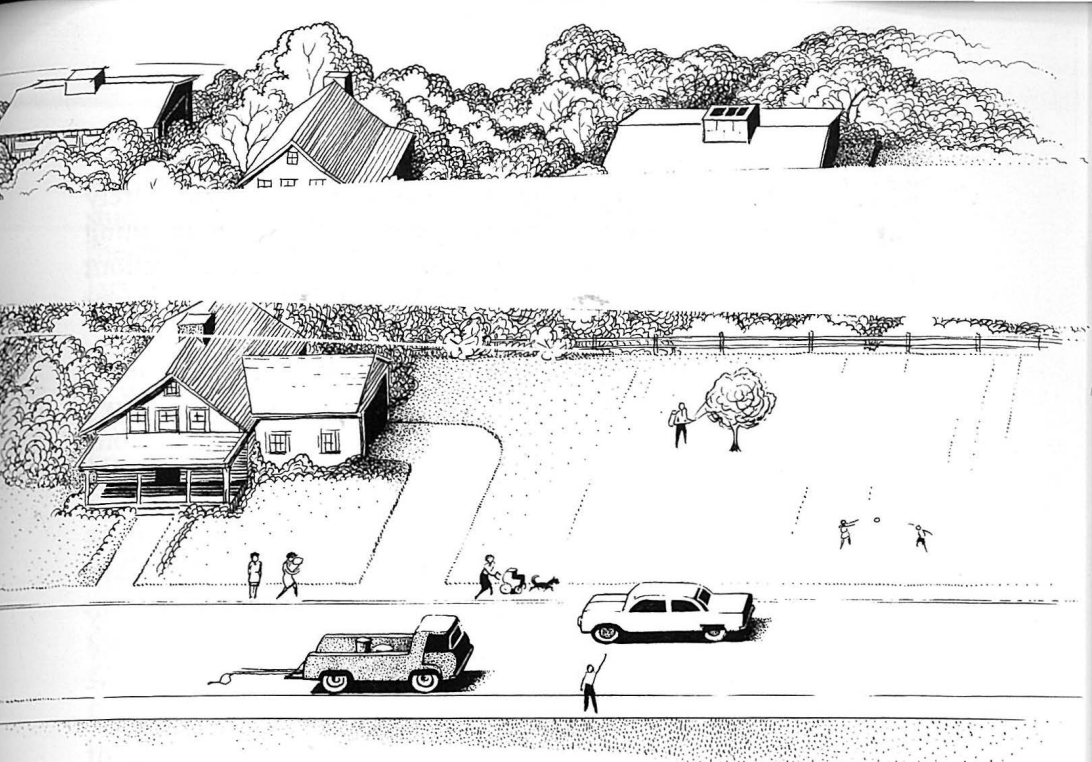
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Silent
Spring



10. Indiscriminately
from the Skies



FROM SMALL BEGINNINGS over farmlands and forests the scope of aerial spraying has widened and its volume has increased so that it has become what a British ecologist recently called “an amazing rain of death” upon the surface of the earth. Our attitude toward poisons has undergone a subtle change. Once they were kept in containers marked with skull and crossbones; the infrequent occasions of their use were marked with utmost care that they should come in contact with the target and with nothing else. With the development of the new organic insecticides and the abundance of surplus planes after the Second World War, all this was forgotten. Although today’s poisons

are more dangerous than any known before, they have amazingly become something to be showered down indiscriminately from the skies. Not only the target insect or plant, but anything — human or nonhuman — within range of the chemical fallout may know the sinister touch of the poison. Not only forests and cultivated fields are sprayed, but towns and cities as well.

A good many people now have misgivings about the aerial distribution of lethal chemicals over millions of acres, and two mass-spraying campaigns undertaken in the late 1950's have done much to increase these doubts. These were the campaigns against the gypsy moth in the northeastern states and the fire ant in the South. Neither is a native insect but both have been in this country for many years without creating a situation calling for desperate measures. Yet drastic action was suddenly taken against them, under the end-justifies-the-means philosophy that has too long directed the control divisions of our Department of Agriculture.

The gypsy moth program shows what a vast amount of damage can be done when reckless large-scale treatment is substituted for local and moderate control. The campaign against the fire ant is a prime example of a campaign based on gross exaggeration of the need for control, blunderingly launched without scientific knowledge of the dosage of poison required to destroy the target or of its effects on other life. Neither program has achieved its goal.

The gypsy moth, a native of Europe, has been in the United States for nearly a hundred years. In 1869 a French scientist, Leopold Trouvelot, accidentally allowed a few of these moths to escape from his laboratory in Medford, Massachusetts, where he was attempting to cross them with silkworms. Little by little the gypsy moth has spread throughout New England. The primary agent of its progressive spread is the wind; the larval, or caterpillar, stage is extremely light and can be carried to con-

siderable heights and over great distances. Another means is the shipment of plants carrying the egg masses, the form in which the species exists over winter. The gypsy moth, which in its larval stage attacks the foliage of oak trees and a few other hardwoods for a few weeks each spring, now occurs in all the New England states. It also occurs sporadically in New Jersey, where it was introduced in 1911 on a shipment of spruce trees from Holland, and in Michigan, where its method of entry is not known. The New England hurricane of 1938 carried it into Pennsylvania and New York, but the Adirondacks have generally served as a barrier to its westward advance, being forested with species not attractive to it.

The task of confining the gypsy moth to the northeastern corner of the country has been accomplished by a variety of methods, and in the nearly one hundred years since its arrival on this continent the fear that it would invade the great hardwood forests of the southern Appalachians has not been justified. Thirteen parasites and predators were imported from abroad and successfully established in New England. The Agriculture Department itself has credited these importations with appreciably reducing the frequency and destructiveness of gypsy moth outbreaks. This natural control, plus quarantine measures and local spraying, achieved what the Department in 1955 described as "outstanding restriction of distribution and damage."

Yet only a year after expressing satisfaction with the state of affairs, its Plant Pest Control Division embarked on a program calling for the blanket spraying of several million acres a year with the announced intention of eventually "eradicating" the gypsy moth. ("Eradication" means the complete and final extinction or extermination of a species throughout its range. Yet as successive programs have failed, the Department has found it necessary to speak of second or third "eradications" of the same species in the same area.)

The Department's all-out chemical war on the gypsy moth began on an ambitious scale. In 1956 nearly a million acres were sprayed in the states of Pennsylvania, New Jersey, Michigan, and New York. Many complaints of damage were made by people in the sprayed areas. Conservationists became increasingly disturbed as the pattern of spraying huge areas began to establish itself. When plans were announced for spraying 3 million acres in 1957 opposition became even stronger. State and federal agriculture officials characteristically shrugged off individual complaints as unimportant.

The Long Island area included within the gypsy moth spraying in 1957 consisted chiefly of heavily populated towns and suburbs and of some coastal areas with bordering salt marsh. Nassau County, Long Island, is the most densely settled county in New York apart from New York City itself. In what seems the height of absurdity, the "threat of infestation of the New York City metropolitan area" has been cited as an important justification of the program. The gypsy moth is a forest insect, certainly not an inhabitant of cities. Nor does it live in meadows, cultivated fields, gardens, or marshes. Nevertheless, the planes hired by the United States Department of Agriculture and the New York Department of Agriculture and Markets in 1957 showered down the prescribed DDT-in-fuel-oil with impartiality. They sprayed truck gardens and dairy farms, fish ponds and salt marshes. They sprayed the quarter-acre lots of suburbia, drenching a housewife making a desperate effort to cover her garden before the roaring plane reached her, and showering insecticide over children at play and commuters at railway stations. At Setauket a fine quarter horse drank from a trough in a field which the planes had sprayed; ten hours later it was dead. Automobiles were spotted with the oily mixture; flowers and shrubs were ruined. Birds, fish, crabs, and useful insects were killed.

A group of Long Island citizens led by the world-famous

ornithologist Robert Cushman Murphy had sought a court injunction to prevent the 1957 spraying. Denied a preliminary injunction, the protesting citizens had to suffer the prescribed drenching with DDT, but thereafter persisted in efforts to obtain a permanent injunction. But because the act had already been performed the courts held that the petition for an injunction was "moot." The case was carried all the way to the Supreme Court, which declined to hear it. Justice William O. Douglas, strongly dissenting from the decision not to review the case, held that "the alarms that many experts and responsible officials have raised about the perils of DDT underline the public importance of this case."

The suit brought by the Long Island citizens at least served to focus public attention on the growing trend to mass application of insecticides, and on the power and inclination of the control agencies to disregard supposedly inviolate property rights of private citizens.

The contamination of milk and of farm produce in the course of the gypsy moth spraying came as an unpleasant surprise to many people. What happened on the 200-acre Waller farm in northern Westchester County, New York, was revealing. Mrs. Waller had specifically requested Agriculture officials not to spray her property, because it would be impossible to avoid the pastures in spraying the woodlands. She offered to have the land checked for gypsy moths and to have any infestation destroyed by spot spraying. Although she was assured that no farms would be sprayed, her property received two direct sprayings and, in addition, was twice subjected to drifting spray. Milk samples taken from the Wallers' purebred Guernsey cows 48 hours later contained DDT in the amount of 14 parts per million. Forage samples from fields where the cows had grazed were of course contaminated also. Although the county Health Department was notified, no instructions were given that the milk should not be marketed. This situation is unfortunately

typical of the lack of consumer protection that is all too common. Although the Food and Drug Administration permits no residues of pesticides in milk, its restrictions are not only inadequately policed but they apply solely to interstate shipments. State and county officials are under no compulsion to follow the federal pesticides tolerances unless local laws happen to conform — and they seldom do.

Truck gardeners also suffered. Some leaf crops were so burned and spotted as to be unmarketable. Others carried heavy residues; a sample of peas analyzed at Cornell University's Agricultural Experiment Station contained 14 to 20 parts per million of DDT. The legal maximum is 7 parts per million. Growers therefore had to sustain heavy losses or find themselves in the position of selling produce carrying illegal residues. Some of them sought and collected damages.

As the aerial spraying of DDT increased, so did the number of suits filed in the courts. Among them were suits brought by beekeepers in several areas of New York State. Even before the 1957 spraying, the beekeepers had suffered heavily from use of DDT in orchards. "Up to 1953 I had regarded as gospel everything that emanated from the U.S. Department of Agriculture and the agricultural colleges," one of them remarked bitterly. But in May of that year this man lost 800 colonies after the state had sprayed a large area. So widespread and heavy was the loss that 14 other beekeepers joined him in suing the state for a quarter of a million dollars in damages. Another beekeeper, whose 400 colonies were incidental targets of the 1957 spray, reported that 100 per cent of the field force of bees (the workers out gathering nectar and pollen for the hives) had been killed in forested areas and up to 50 per cent in farming areas sprayed less intensively. "It is a very distressful thing," he wrote, "to walk into a yard in May and not hear a bee buzz."

The gypsy moth programs were marked by many acts of irresponsibility. Because the spray planes were paid by the

gallon rather than by the acre there was no effort to be conservative, and many properties were sprayed not once but several times. Contracts for aerial spraying were in at least one case awarded to an out-of-state firm with no local address, which had not complied with the legal requirement of registering with state officials for the purpose of establishing legal responsibility. In this exceedingly slippery situation, citizens who suffered direct financial loss from damage to apple orchards or bees discovered that there was no one to sue.

After the disastrous 1957 spraying the program was abruptly and drastically curtailed, with vague statements about "evaluating" previous work and testing alternative insecticides. Instead of the 3½ million acres sprayed in 1957, the treated areas fell to ½ million in 1958 and to about 100,000 acres in 1959, 1960, and 1961. During this interval, the control agencies must have found news from Long Island disquieting. The gypsy moth had reappeared there in numbers. The expensive spraying operation that had cost the Department dearly in public confidence and good will—the operation that was intended to wipe out the gypsy moth for ever—had in reality accomplished nothing at all.

Meanwhile, the Department's Plant Pest Control men had temporarily forgotten gypsy moths, for they had been busy launching an even more ambitious program in the South. The word "eradication" still came easily from the Department's mimeograph machines; this time the press releases were promising the eradication of the fire ant.

The fire ant, an insect named for its fiery sting, seems to have entered the United States from South America by way of the port of Mobile, Alabama, where it was discovered shortly after the end of the First World War. By 1928 it had spread into the suburbs of Mobile and thereafter continued an invasion that has now carried it into most of the southern states.

During most of the forty-odd years since its arrival in the United States the fire ant seems to have attracted little attention. The states where it was most abundant considered it a nuisance, chiefly because it builds large nests or mounds a foot or more high. These may hamper the operation of farm machinery. But only two states listed it among their 20 most important insect pests, and these placed it near the bottom of the list. No official or private concern seems to have been felt about the fire ant as a menace to crops or livestock.

With the development of chemicals of broad lethal powers, there came a sudden change in the official attitude toward the fire ant. In 1957 the United States Department of Agriculture launched one of the most remarkable publicity campaigns in its history. The fire ant suddenly became the target of a barrage of government releases, motion pictures, and government-inspired stories portraying it as a despoiler of southern agriculture and a killer of birds, livestock, and man. A mighty campaign was announced, in which the federal government in cooperation with the afflicted states would ultimately treat some 20,000,000 acres in nine southern states.

“United States pesticide makers appear to have tapped a sales bonanza in the increasing numbers of broad-scale pest elimination programs conducted by the U.S. Department of Agriculture,” cheerfully reported one trade journal in 1958, as the fire ant program got under way.

Never has any pesticide program been so thoroughly and deservedly damned by practically everyone except the beneficiaries of this “sales bonanza.” It is an outstanding example of an ill-conceived, badly executed, and thoroughly detrimental experiment in the mass control of insects, an experiment so expensive in dollars, in destruction of animal life, and in loss of public confidence in the Agriculture Department that it is incomprehensible that any funds should still be devoted to it.

Congressional support of the project was initially won by

representations that were later discredited. The fire ant was pictured as a serious threat to southern agriculture through destruction of crops and to wildlife because of attacks on the young of ground-nesting birds. Its sting was said to make it a serious menace to human health.

Just how sound were these claims? The statements made by Department witnesses seeking appropriations were not in accord with those contained in key publications of the Agriculture Department. The 1957 bulletin *Insecticide Recommendations . . . for the Control of Insects Attacking Crops and Livestock* did not so much as mention the fire ant—an extraordinary omission if the Department believes its own propaganda. Moreover, its encyclopedic *Yearbook* for 1952, which was devoted to insects, contained only one short paragraph on the fire ant out of its half-million words of text.

Against the Department's undocumented claim that the fire ant destroys crops and attacks livestock is the careful study of the Agricultural Experiment Station in the state that has had the most intimate experience with this insect, Alabama. According to Alabama scientists, "damage to plants in general is rare." Dr. F. S. Arant, an entomologist at the Alabama Polytechnic Institute and in 1961 president of the Entomological Society of America, states that his department "has not received a single report of damage to plants by ants in the past five years . . . No damage to livestock has been observed." These men, who have actually observed the ants in the field and in the laboratory, say that the fire ants feed chiefly on a variety of other insects, many of them considered harmful to man's interests. Fire ants have been observed picking larvae of the boll weevil off cotton. Their mound-building activities serve a useful purpose in aerating and draining the soil. The Alabama studies have been substantiated by investigations at the Mississippi State University, and are far more impressive than the Agriculture Department's evidence, apparently based either on conversations with farmers,

who may easily mistake one ant for another, or on old research. Some entomologists believe that the ant's food habits have changed as it has become more abundant, so that observations made several decades ago have little value now.

The claim that the ant is a menace to health and life also bears considerable modification. The Agriculture Department sponsored a propaganda movie (to gain support for its program) in which horror scenes were built around the fire ant's sting. Admittedly this is painful and one is well advised to avoid being stung, just as one ordinarily avoids the sting of wasp or bee. Severe reactions may occasionally occur in sensitive individuals, and medical literature records one death possibly, though not definitely, attributable to fire ant venom. In contrast to this, the Office of Vital Statistics records 33 deaths in 1959 alone from the sting of bees and wasps. Yet no one seems to have proposed "eradicating" these insects. Again, local evidence is most convincing. Although the fire ant has inhabited Alabama for 40 years and is most heavily concentrated there, the Alabama State Health Officer declares that "there has never been recorded in Alabama a human death resulting from the bites of imported fire ants," and considers the medical cases resulting from the bites of fire ants "incidental." Ant mounds on lawns or playgrounds may create a situation where children are likely to be stung, but this is hardly an excuse for drenching millions of acres with poisons. These situations can easily be handled by individual treatment of the mounds.

Damage to game birds was also alleged, without supporting evidence. Certainly a man well qualified to speak on this issue is the leader of the Wildlife Research Unit at Auburn, Alabama, Dr. Maurice F. Baker, who has had many years' experience in the area. But Dr. Baker's opinion is directly opposite to the claims of the Agriculture Department. He declares: "In south Alabama and northwest Florida we are able to have excellent hunting and bobwhite populations coexistent with heavy popu-

lations of the imported fire ant . . . in the almost 40 years that south Alabama has had the fire ant, game populations have shown a steady and very substantial increase. Certainly, if the imported fire ant were a serious menace to wildlife, these conditions could not exist."

What would happen to wildlife as a result of the insecticide used against the ants was another matter. The chemicals to be used were dieldrin and heptachlor, both relatively new. There was little experience of field use for either, and no one knew what their effects would be on wild birds, fishes, or mammals when applied on a massive scale. It was known, however, that both poisons were many times more toxic than DDT, which had been used by that time for approximately a decade, and had killed some birds and many fish even at a rate of 1 pound per acre. And the dosage of dieldrin and heptachlor was heavier — 2 pounds to the acre under most conditions, or 3 pounds of dieldrin if the white-fringed beetle was also to be controlled. In terms of their effects on birds, the prescribed use of heptachlor would be equivalent to 20 pounds of DDT to the acre, that of dieldrin to 120 pounds!

Urgent protests were made by most of the state conservation departments, by national conservation agencies, and by ecologists and even by some entomologists, calling upon the then Secretary of Agriculture, Ezra Benson, to delay the program at least until some research had been done to determine the effects of heptachlor and dieldrin on wild and domestic animals and to find the minimum amount that would control the ants. The protests were ignored and the program was launched in 1958. A million acres were treated the first year. It was clear that any research would be in the nature of a post mortem.

As the program continued, facts began to accumulate from studies made by biologists of state and federal wildlife agencies and several universities. The studies revealed losses running all the way up to complete destruction of wildlife on some of the

treated areas. Poultry, livestock, and pets were also killed. The Agriculture Department brushed away all evidence of damage as exaggerated and misleading.

The facts, however, continue to accumulate. In Hardin County, Texas, for example, opossums, armadillos, and an abundant raccoon population virtually disappeared after the chemical was laid down. Even the second autumn after treatment these animals were scarce. The few raccoons then found in the area carried residues of the chemical in their tissues.

Dead birds found in the treated areas had absorbed or swallowed the poisons used against the fire ants, a fact clearly shown by chemical analysis of their tissues. (The only bird surviving in any numbers was the house sparrow, which in other areas too has given some evidence that it may be relatively immune.) On a tract in Alabama treated in 1959 half of the birds were killed. Species that live on the ground or frequent low vegetation suffered 100 per cent mortality. Even a year after treatment, a spring die-off of songbirds occurred and much good nesting territory lay silent and unoccupied. In Texas, dead blackbirds, dickcissels, and meadowlarks were found at the nests, and many nests were deserted. When specimens of dead birds from Texas, Louisiana, Alabama, Georgia, and Florida were sent to the Fish and Wildlife Service for analysis, more than 90 per cent were found to contain residues of dieldrin or a form of heptachlor, in amounts up to 38 parts per million.

Woodcocks, which winter in Louisiana but breed in the North, now carry the taint of the fire ant poisons in their bodies. The source of this contamination is clear. Woodcocks feed heavily on earthworms, which they probe for with their long bills. Surviving worms in Louisiana were found to have as much as 20 parts per million of heptachlor in their tissues 6 to 10 months after treatment of the area. A year later they had up to 10 parts per million. The consequences of the sublethal poisoning of the woodcock are now seen in a marked decline in the

proportion of young birds to adults, first observed in the season after fire ant treatments began.

Some of the most upsetting news for southern sportsmen concerned the bobwhite quail. This bird, a ground nester and forager, was all but eliminated on treated areas. In Alabama, for example, biologists of the Alabama Cooperative Wildlife Research Unit conducted a preliminary census of the quail population in a 3600-acre area that was scheduled for treatment. Thirteen resident coveys — 121 quail — ranged over the area. Two weeks after treatment only dead quail could be found. All specimens sent to the Fish and Wildlife Service for analysis were found to contain insecticides in amounts sufficient to cause their death. The Alabama findings were duplicated in Texas, where a 2500-acre area treated with heptachlor lost all of its quail. Along with the quail went 90 per cent of the songbirds. Again, analysis revealed the presence of heptachlor in the tissues of dead birds.

In addition to quail, wild turkeys were seriously reduced by the fire ant program. Although 80 turkeys had been counted on an area in Wilcox County, Alabama, before heptachlor was applied, none could be found the summer after treatment — none, that is, except a clutch of unhatched eggs and one dead poul. The wild turkeys may have suffered the same fate as their domestic brethren, for turkeys on farms in the area treated with chemicals also produced few young. Few eggs hatched and almost no young survived. This did not happen on nearby untreated areas.

The fate of the turkeys was by no means unique. One of the most widely known and respected wildlife biologists in the country, Dr. Clarence Cottam, called on some of the farmers whose property had been treated. Besides remarking that “all the little tree birds” seemed to have disappeared after the land had been treated, most of these people reported losses of livestock, poultry, and household pets. One man was “irate against

the control workers," Dr. Cottam reported, "as he said he buried or otherwise disposed of 19 carcasses of his cows that had been killed by the poison and he knew of three or four additional cows that died as a result of the same treatment. Calves died that had been given only milk since birth."

The people Dr. Cottam interviewed were puzzled by what had happened in the months following the treatment of their land. One woman told him she had set several hens after the surrounding land had been covered with poison, "and for reasons she did not understand very few young were hatched or survived." Another farmer "raises hogs and for fully nine months after the broadcast of poisons, he could raise no young pigs. The litters were born dead or they died after birth." A similar report came from another, who said that out of 37 litters that might have numbered as many as 250 young, only 31 little pigs survived. This man had also been quite unable to raise chickens since the land was poisoned.

The Department of Agriculture has consistently denied livestock losses related to the fire ant program. However, a veterinarian in Bainbridge, Georgia, Dr. Otis L. Poitevint, who was called upon to treat many of the affected animals, has summarized his reasons for attributing the deaths to the insecticide as follows. Within a period of two weeks to several months after the fire ant poison was applied, cattle, goats, horses, chickens, and birds and other wildlife began to suffer an often fatal disease of the nervous system. It affected only animals that had access to contaminated food or water. Stabled animals were not affected. The condition was seen only in areas treated for fire ants. Laboratory tests for disease were negative. The symptoms observed by Dr. Poitevint and other veterinarians were those described in authoritative texts as indicating poisoning by dieldrin or heptachlor.

Dr. Poitevint also described an interesting case of a two-month-old calf that showed symptoms of poisoning by hepta-

chlor. The animal was subjected to exhaustive laboratory tests. The only significant finding was the discovery of 79 parts per million of heptachlor in its fat. But it was five months since the poison had been applied. Did the calf get it directly from grazing or indirectly from its mother's milk or even before birth? "If from the milk," asked Dr. Poitevint, "why were not special precautions taken to protect our children who drank milk from local dairies?"

Dr. Poitevint's report brings up a significant problem about the contamination of milk. The area included in the fire ant program is predominantly fields and croplands. What about the dairy cattle that graze on these lands? In treated fields the grasses will inevitably carry residues of heptachlor in one of its forms, and if the residues are eaten by the cows the poison will appear in the milk. This direct transmission into milk had been demonstrated experimentally for heptachlor in 1955, long before the control program was undertaken, and was later reported for dieldrin, also used in the fire ant program.

The Department of Agriculture's annual publications now list heptachlor and dieldrin among the chemicals that make forage plants unsuitable for feeding to dairy animals or animals being finished for slaughter, yet the control divisions of the Department promote programs that spread heptachlor and dieldrin over substantial areas of grazing land in the South. Who is safeguarding the consumer to see that no residues of dieldrin or heptachlor are appearing in milk? The United States Department of Agriculture would doubtless answer that it has advised farmers to keep milk cows out of treated pastures for 30 to 90 days. Given the small size of many of the farms and the large-scale nature of the program — much of the chemical applied by planes — it is extremely doubtful that this recommendation was followed or could be. Nor is the prescribed period adequate in view of the persistent nature of the residues.

The Food and Drug Administration, although frowning on

the presence of any pesticide residues in milk, has little authority in this situation. In most of the states included in the fire ant program the dairy industry is small and its products do not cross state lines. Protection of the milk supply endangered by a federal program is therefore left to the states themselves. Inquiries addressed to the health officers or other appropriate officials of Alabama, Louisiana, and Texas in 1959 revealed that no tests had been made and that it simply was not known whether the milk was contaminated with pesticides or not.

Meanwhile, after rather than before the control program was launched, some research into the peculiar nature of heptachlor was done. Perhaps it would be more accurate to say that someone looked up the research already published, since the basic fact that brought about belated action by the federal government had been discovered several years before, and should have influenced the initial handling of the program. This is the fact that heptachlor, after a short period in the tissues of animals or plants or in the soil, assumes a considerably more toxic form known as heptachlor epoxide. The epoxide is popularly described as "an oxidation product" produced by weathering. The fact that this transformation could occur had been known since 1952, when the Food and Drug Administration discovered that female rats, fed 30 parts per million of heptachlor, had stored 165 parts per million of the more poisonous epoxide only 2 weeks later.

These facts were allowed to come out of the obscurity of biological literature in 1959, when the Food and Drug Administration took action which had the effect of banning any residues of heptachlor or its epoxide on food. This ruling put at least a temporary damper on the program; although the Agriculture Department continued to press for its annual appropriations for fire ant control, local agricultural agents became increasingly reluctant to advise farmers to use chemicals which would probably result in their crops being legally unmarketable.

In short, the Department of Agriculture embarked on its program without even elementary investigation of what was already known about the chemical to be used — or if it investigated, it ignored the findings. It must also have failed to do preliminary research to discover the minimum amount of the chemical that would accomplish its purpose. After three years of heavy dosages, it abruptly reduced the rate of application of heptachlor from 2 pounds to $1\frac{1}{4}$ pounds per acre in 1959; later on to $\frac{1}{2}$ pound per acre, applied in two treatments of $\frac{1}{4}$ pound each, 3 to 6 months apart. An official of the Department explained that “an aggressive methods improvement program” showed the lower rate to be effective. Had this information been acquired before the program was launched, a vast amount of damage could have been avoided and the taxpayers could have been saved a great deal of money.

In 1959, perhaps in an attempt to offset the growing dissatisfaction with the program, the Agriculture Department offered the chemicals free to Texas landowners who would sign a release absolving federal, state, and local governments of responsibility for damage. In the same year the State of Alabama, alarmed and angry at the damage done by the chemicals, refused to appropriate any further funds for the project. One of its officials characterized the whole program as “ill advised, hastily conceived, poorly planned, and a glaring example of riding roughshod over the responsibilities of other public and private agencies.” Despite the lack of state funds, federal money continued to trickle into Alabama, and in 1961 the legislature was again persuaded to make a small appropriation. Meanwhile, farmers in Louisiana showed growing reluctance to sign up for the project as it became evident that use of chemicals against the fire ant was causing an upsurge of insects destructive to sugarcane. Moreover, the program was obviously accomplishing nothing. Its dismal state was tersely summarized in the spring of 1962 by the director of entomology research at

Louisiana State University Agricultural Experiment Station, Dr. L. D. Newsom: "The imported fire ant 'eradication' program which has been conducted by state and federal agencies is thus far a failure. There are more infested acres in Louisiana now than when the program began."

A swing to more sane and conservative methods seems to have begun. Florida, reporting that "there are more fire ants in Florida now than there were when the program started," announced it was abandoning any idea of a broad eradication program and would instead concentrate on local control.

Effective and inexpensive methods of local control have been known for years. The mound-building habit of the fire ant makes the chemical treatment of individual mounds a simple matter. Cost of such treatment is about one dollar per acre. For situations where mounds are numerous and mechanized methods are desirable, a cultivator which first levels and then applies chemical directly to the mounds has been developed by Mississippi's Agricultural Experiment Station. The method gives 90 to 95 per cent control of the ants. Its cost is only \$.23 per acre. The Agriculture Department's mass control program, on the other hand, cost about \$3.50 per acre — the most expensive, the most damaging, and the least effective program of all.

Reading Rachel Carson's books, one has the feeling that she is forever embarked on a voyage of discovery. As a professional writer she uses words to reveal the poetry — which is to say the essential truth and meaning — at the core of any scientific fact. As a trained scientist she has never lost the poet's sense of wonder.

The interests she was later to combine so successfully were foreshadowed even in early childhood — the desire to write and an abiding love of the world of nature. In college she specialized in English composition, then, coming under the spell of biology, she took her degree in that subject and continued in graduate work at Johns Hopkins University, where she studied genetics and

Rachel Carson

development under H. S. Jennings and worked in the laboratories of geneticist Raymond Pearl. From 1936 until 1952 she was on the staff of the U.S. Fish and Wildlife Service as a biologist and editor. Meanwhile, her own literary career had begun: an article in the *Atlantic* led to her first book, *Under*

the Sea-Wind (1941). Ten years later came *The Sea Around Us*. Between one spring tide and the next, she had become world famous. The book was on the best-seller lists for 86 weeks and was eventually translated into 30 languages. Among other honors, Miss Carson was awarded the Gold Medal of the New York Zoological Society, the John Burroughs Medal, the Gold Medal of the Geographical Society of Philadelphia, and the National Book Award for non-fiction. She became a member of the National Institute of Arts and Letters and a Fellow of the Royal Society of Literature. On resigning from government service to give full time to writing she received the Interior Department's Distinguished Service Award. Under a Guggenheim Fellowship she then began studies of offshore life which led to *The Edge of the Sea* in 1955.

In all her work Rachel Carson's basic interest has been the relation of life to its environment. Since 1958 she has collected data from scientists all over the world about the dangerous effects of deadly poisons, especially in the form of synthetic insecticides, on the living community. The result is *Silent Spring* — a courageous revelation of the forces that modern man has brought into being in his ruthless war on life, an eloquent protest in behalf of the unity of all nature, a protest in behalf of life.