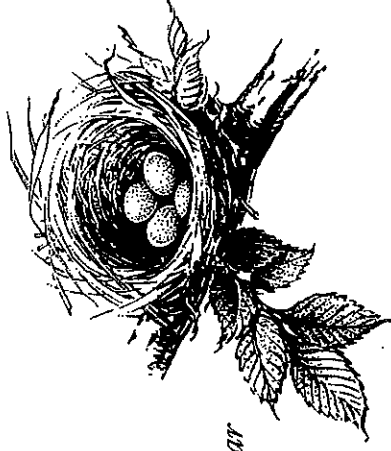


SILENT SPRING



RACHEL
CARSON

Introduction by Linda Lear

Afterword by

Edward O. Wilson



MARINER BOOKS

HOUGHTON MIFFLIN HARCOURT

Boston New York

1962
2002 edition

BY RACHEL CARSON

Under the Sea-Wind

The Sea Around Us

The Edge of the Sea

Silent Spring

To Albert Schweitzer
who said

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

First Mariner Books edition 2002

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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 in-
stead of skeptically and dictatorially.

E. B. WHITE

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ica's military enemies and dramatically altered the balance of power between humans and nature. The public endowed chemists, at work in their starched white coats in remote laboratories, with almost divine wisdom. The results of their labors were gilded with the presumption of beneficence. In postwar America, science was god, and science was male.

Carson was an outsider who had never been part of the scientific establishment, first because she was a woman but also because her chosen field, biology, was held in low esteem in the nuclear age. Her career path was nontraditional; she had no academic affiliation, no institutional voice. She deliberately wrote for the public rather than for a narrow scientific audience. For anyone else, such independence would have been an enormous detriment. But by the time *Silent Spring* was published, Carson's outsider status had become a distinct advantage. As the science establishment would discover, it was impossible to dismiss her.

Rachel Carson first discovered nature in the company of her mother, a devotee of the nature study movement. She wandered the banks of the Allegheny River in the pristine village of Springdale, Pennsylvania, just north of Pittsburgh, observing the wildlife and plants around her and particularly curious about the habits of birds.

Her childhood, though isolated by poverty and family turmoil, was not lonely. She loved to read and displayed an obvious talent for writing, publishing her first story in a children's literary magazine at the age of ten. By the time she entered Pennsylvania College for Women (now Chatham College), she had read widely in the English Romantic tradition and had articulated a personal sense of mission, her "vision splendid." A dynamic female zoology professor expanded her intellectual horizons by urging her to take the daring step of majoring in biology rather than English. In doing so, Carson discovered that science not only engaged her mind but gave her "something to write about."

Introduction

by Linda Lear

HEADLINES IN THE *New York Times* in July 1962 captured the national sentiment: "*Silent Spring* is now noisy summer." In the few months between the *New Yorker's* serialization of *Silent Spring* in June and its publication in book form that September, Rachel Carson's alarm touched off a national debate on the use of chemical pesticides, the responsibility of science, and the limits of technological progress. When Carson died barely eighteen months later in the spring of 1964, at the age of fifty-six, she had set in motion a course of events that would result in a ban on the domestic production of DDT and the creation of a grass-roots movement demanding protection of the environment through state and federal regulation. Carson's writing initiated a transformation in the relationship between humans and the natural world and stirred an awakening of public environmental consciousness.

It is hard to remember the cultural climate that greeted *Silent Spring* and to understand the fury that was launched against its quietly determined author. Carson's thesis that we were subjecting ourselves to slow poisoning by the misuse of chemical pesticides that polluted the environment may seem like common currency now, but in 1962 *Silent Spring* contained the kernel of social revolution. Carson wrote at a time of new affluence and intense social conformity. The cold war, with its climate of suspicion and intolerance, was at its zenith. The chemical industry, one of the chief beneficiaries of postwar technology, was also one of the chief authors of the nation's prosperity. DDT enabled the conquest of insect pests in agriculture and of ancient insect-borne disease just as surely as the atomic bomb destroyed Amer-

She decided to pursue a career in science, aware that in the 1930s there were few opportunities for women.

Scholarships allowed her to study at Woods Hole Biological Laboratory, where she fell in love with the sea, and at Johns Hopkins University, where she was isolated, one of a handful of women in marine biology. She had no mentors and no money to continue in graduate school after completing an M.A. in zoology in 1932. Along the way she worked as a laboratory assistant in the school of public health, where she was lucky enough to receive some training in experimental genetics. As employment opportunities in science dwindled, she began writing articles about the natural history of Chesapeake Bay for the *Baltimore Sun*. Although these were years of financial and emotional struggle, Carson realized that she did not have to choose between science and writing, that she had the talent to do both.

From childhood on, Carson was interested in the long history of the earth, in its patterns and rhythms, its ancient seas, its evolving life forms. She was an ecologist—fascinated by intersections and connections but always aware of the whole—before that perspective was accorded scholarly legitimacy. A fossil shell she found while digging in the hills above the Allegheny as a little girl prompted questions about the creatures of the oceans that had once covered the area. At Johns Hopkins, an experiment with changes in the salinity of water in an eel tank prompted her to study the life cycle of those ancient fish that migrate from continental rivers to the Sargasso Sea. The desire to understand the sea from a nonhuman perspective led to her first book, *Under the Sea-Wind*, which featured a common sea bird, the sanderling, whose life cycle, driven by ancestral instincts, the rhythms of the tides, and the search for food, involves an arduous journey from Patagonia to the Arctic Circle. From the outset Carson acknowledged her “kinship with other forms of life” and always wrote to impress that relationship on her readers.

Carson was confronted with the problem of environmental

pollution at a formative period in her life. During her adolescence the second wave of the industrial revolution was turning the Pittsburgh area into the iron and steel capital of the Western world. The little town of Springdale, sandwiched between two huge coal-fired electric plants, was transformed into a grimy wasteland, its air fouled by chemical emissions, its river polluted by industrial waste. Carson could not wait to escape. She observed that the captains of industry took no notice of the defilement of her hometown and no responsibility for it. The experience made her forever suspicious of promises of “better living through chemistry” and of claims that technology would create a progressively brighter future.

In 1936 Carson landed a job as a part-time writer of radio scripts on ocean life for the federal Bureau of Fisheries in Baltimore. By night she wrote freelance articles for the *Sun* describing the pollution of the oyster beds of the Chesapeake by industrial runoff; she urged changes in oyster seeding and dredging practices and political regulation of the effluents pouring into the bay. She signed her articles “R. L. Carson,” hoping that readers would assume that the writer was male and thus take her science seriously.

A year later Carson became a junior aquatic biologist for the Bureau of Fisheries, one of only two professional women there, and began a slow but steady advance through the ranks of the agency, which became the U.S. Fish and Wildlife Service in 1939. Her literary talents were quickly recognized, and she was assigned to edit other scientists' field reports, a task she turned into an opportunity to broaden her scientific knowledge, deepen her connection with nature, and observe the making of science policy. By 1949 Carson was editor in chief of all the agency's publications, writing her own distinguished series on the new U.S. wildlife refuge system and participating in interagency conferences on the latest developments in science and technology.

Her government responsibilities slowed the pace of her own

writing. It took her ten years to synthesize the latest research on oceanography, but her perseverance paid off. She became an overnight literary celebrity when *The Sea Around Us* was first serialized in *The New Yorker* in 1951. The book won many awards, including the National Book Award for nonfiction, and Carson was elected to the American Academy of Arts and Letters. She was lauded not only for her scientific expertise and synthesis of wide-ranging material but also for her lyrical, poetic voice. *The Sea Around Us* and its best-selling successor, *The Edge of the Sea*, made Rachel Carson the foremost science writer in America. She understood that there was a deep need for writers who could report on and interpret the natural world. Readers around the world found comfort in her clear explanations of complex science, her description of the creation of the seas, and her obvious love of the wonders of nature. Hers was a trusted voice in a world riddled by uncertainty.

Whenever she spoke in public, however, she took notice of ominous new trends. "Intoxicated with a sense of his own power," she wrote, "[mankind] seems to be going farther and farther into more experiments for the destruction of himself and his world." Technology, she feared, was moving on a faster trajectory than mankind's sense of moral responsibility. In 1945 she tried to interest *Reader's Digest* in the alarming evidence of environmental damage from the widespread use of the new synthetic chemical DDT and other long-lasting agricultural pesticides. By 1957 Carson believed that these chemicals were potentially harmful to the long-term health of the whole biota. The pollution of the environment by the profligate use of toxic chemicals was the ultimate act of human hubris, a product of ignorance and greed that she felt compelled to bear witness against. She insisted that what science conceived and technology made possible must first be judged for its safety and benefit to the "whole stream of life." "There would be no peace for me, she wrote to a friend, "if I kept silent."

• • •

Silent Spring, the product of her unrest, deliberately challenged the wisdom of a government that allowed toxic chemicals to be put into the environment before knowing the long-term consequences of their use. Writing in language that everyone could understand and cleverly using the public's knowledge of atomic fallout as a reference point, Carson described how chlorinated hydrocarbons and organic phosphorus insecticides altered the cellular processes of plants, animals, and, by implication, humans. Science and technology, she charged, had become the handmaidens of the chemical industry's rush for profits and control of markets. Rather than protecting the public from potential harm, the government not only gave its approval to these new products but did so without establishing any mechanism of accountability. Carson questioned the moral right of government to leave its citizens unprotected from substances they could neither physically avoid nor publicly question. Such callous arrogance could end only in the destruction of the living world. "Can anyone believe it is possible to lay down such a barrage of poisons on the surface of the earth without making it unfit for all life?" she asked. "They should not be called 'insecticides' but 'biocides.'"

In *Silent Spring*, and later in testimony before a congressional committee, Carson asserted that one of the most basic human rights must surely be the "right of the citizen to be secure in his own home against the intrusion of poisons applied by other persons." Through ignorance, greed, and negligence, government had allowed "poisonous and biologically potent chemicals" to fall "indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm." When the public protested, it was "fed little tranquilizing pills of half-truth" by a government that refused to take responsibility for or acknowledge evidence of damage. Carson challenged such moral vacuity. "The obligation to endure," she wrote, "gives us the right to know."

In Carson's view, the postwar culture of science that arro-

gantly claimed dominion over nature was the philosophic root of the problem. Human beings, she insisted, were not in control of nature but simply one of its parts: the survival of one part depended upon the health of all. She protested the "contamination of man's total environment" with substances that accumulate in the tissues of plants, animals, and humans and have the potential to alter the genetic structure of organisms.

Carson argued that the human body was permeable and, as such, vulnerable to toxic substances in the environment. Levels of exposure could not be controlled, and scientists could not accurately predict the long-term effects of bioaccumulation in the cells or the impact of such a mixture of chemicals on human health. She categorically rejected the notion proposed by industry that there were human "thresholds" for such poisons, as well as its corollary, that the human body had "assimilative capacities" that rendered the poisons harmless. In one of the most controversial parts of her book, Carson presented evidence that some human cancers were linked to pesticide exposure. That evidence and its subsequent elaboration by many other researchers continue to fuel one of the most challenging and acrimonious debates within the scientific and environmental communities.

Carson's concept of the ecology of the human body was a major departure in our thinking about the relationship between humans and the natural environment. It had enormous consequences for our understanding of human health as well as our attitudes toward environmental risk. *Silent Spring* proved that our bodies are not boundaries. Chemical corruption of the globe affects us from conception to death. Like the rest of nature, we are vulnerable to pesticides; we too are permeable. All forms of life are more alike than different.

Carson believed that human health would ultimately reflect the environment's ills. Inevitably this idea has changed our response to nature, to science, and to the technologies that devise and deliver contamination. Although the scientific community

has been slow to acknowledge this aspect of Carson's work, her concept of the ecology of the human body may well prove to be one of her most lasting contributions.

In 1962, however, the multimillion-dollar industrial chemical industry was not about to allow a former government editor, a female scientist without a Ph.D. or an institutional affiliation, known only for her lyrical books on the sea, to undermine public confidence in its products or to question its integrity. It was clear to the industry that Rachel Carson was a hysterical woman whose alarming view of the future could be ignored or, if necessary, suppressed. She was a "bird and bunny lover," a woman who kept cats and was therefore clearly suspect. She was a romantic "spinster" who was simply overwrought about genetics. In short, Carson was a woman out of control. She had overstepped the bounds of her gender and her science. But just in case her claims did gain an audience, the industry spent a quarter of a million dollars to discredit her research and malign her character. In the end, the worst they could say was that she had told only one side of the story and had based her argument on unverifiable case studies.

There is another, private side to the controversy over *Silent Spring*. Unbeknown to her detractors in government and industry, Carson was fighting a far more powerful enemy than corporate outrage: a rapidly metastasizing breast cancer. The miracle is that she lived to complete the book at all, enduring a "catalogue of illnesses," as she called it. She was immune to the chemical industry's efforts to malign her; rather, her energies were focused on the challenge of survival in order to bear witness to the truth as she saw it. She intended to disturb and disrupt, and she did so with dignity and deliberation.

After *Silent Spring* caught the attention of President John F. Kennedy, federal and state investigations were launched into the validity of Carson's claims. Communities that had been subjected to aerial spraying of pesticides against their wishes began

to organize on a grass-roots level against the continuation of toxic pollution. Legislation was readied at all governmental levels to defend against a new kind of invisible fallout. The scientists who had claimed a "holy grail" of knowledge were forced to admit a vast ignorance. While Carson knew that one book could not alter the dynamic of the capitalist system, an environmental movement grew from her challenge, led by a public that demanded that science and government be held accountable. Carson remains an example of what one committed individual can do to change the direction of society. She was a revolutionary spokesperson for the rights of all life. She dared to speak out and confront the issue of the destruction of nature and to frame it as a debate over the quality of all life.

Rachel Carson knew before she died that her work had made a difference. She was honored by medals and awards, and posthumously received the Presidential Medal of Freedom in 1981. But she also knew that the issues she had raised would not be solved quickly or easily and that affluent societies are slow to sacrifice for the good of the whole. It was not until six years after Carson's death that concerned Americans celebrated the first Earth Day and that Congress passed the National Environmental Policy Act establishing the Environmental Protection Agency as a buffer against our own handiwork. The domestic production of DDT was banned, but not its export, ensuring that the pollution of the earth's atmosphere, oceans, streams, and wildlife would continue unabated. DDT is found in the livers of birds and fish on every oceanic island on the planet and in the breast milk of every mother. In spite of decades of environmental protest and awareness, and in spite of Rachel Carson's apocalyptic call alerting Americans to the problem of toxic chemicals, reduction of the use of pesticides has been one of the major policy failures of the environmental era. Global contamination is a fact of modern life.

Silent Spring compels each generation to reevaluate its rela-

tionship to the natural world. We are a nation still debating the questions it raised, still unresolved as to how to act for the common good, how to achieve environmental justice. In arguing that public health and the environment, human and natural, are inseparable, Rachel Carson insisted that the role of the expert had to be limited by democratic access and must include public debate about the risks of hazardous technologies. She knew then, as we have learned since, that scientific evidence by its very nature is incomplete and scientists will inevitably disagree on what constitutes certain proof of harm. It is difficult to make public policy in such cases when government's obligation to protect is mitigated by the nature of science itself.

Rachel Carson left us a legacy that not only embraces the future of life, in which she believed so fervently, but sustains the human spirit. She confronted us with the chemical corruption of the globe and called on us to regulate our appetites—a truly revolutionary stance—for our self-preservation. "It seems reasonable to believe," she wrote, "that the more clearly we can focus our attention on the wonders and realities of the universe about us, the less taste we shall have for the destruction of our race. Wonder and humility are wholesome emotions, and they do not exist side by side with a lust for destruction."

Wonder and humility are just some of the gifts of *Silent Spring*. They remind us that we, like all other living creatures, are part of the vast ecosystems of the earth, part of the whole stream of life. This is a book to relish: not for the dark side of human nature, but for the promise of life's possibility.



I. A Fable for Tomorrow

THERE WAS ONCE a town in the heart of America where all life seemed to live in harmony with its surroundings. The town lay in the midst of a checkerboard of prosperous farms, with fields of grain and hillsides of orchards where, in spring, white clouds of bloom drifted above the green fields. In autumn, oak and maple and birch set up a blaze of color that flamed and flickered across a backdrop of pines. Then foxes barked in the hills and deer silently crossed the fields, half hidden in the mists of the fall mornings.

Along the roads, laurel, viburnum and alder, great ferns and wildflowers delighted the traveler's eye through much of the

year. Even in winter the roadsides were places of beauty, where countless birds came to feed on the berries and on the seed heads of the dried weeds rising above the snow. The countryside was, in fact, famous for the abundance and variety of its bird life, and when the flood of migrants was pouring through in spring and fall people traveled from great distances to observe them. Others came to fish the streams, which flowed clear and cold out of the hills and contained shady pools where trout lay. So it had been from the days many years ago when the first settlers raised their houses, sank their wells, and built their barns.

Then a strange blight crept over the area and everything began to change. Some evil spell had settled on the community: mysterious maladies swept the flocks of chickens; the cattle and sheep sickened and died. Everywhere was a shadow of death. The farmers spoke of much illness among their families. In the town the doctors had become more and more puzzled by new kinds of sickness appearing among their patients. There had been several sudden and unexplained deaths, not only among adults but even among children, who would be stricken suddenly while at play and die within a few hours.

There was a strange stillness. The birds, for example—where had they gone? Many people spoke of them, puzzled and disturbed. The feeding stations in the backyards were deserted. The few birds seen anywhere were moribund; they trembled violently and could not fly. It was a spring without voices. On the mornings that had once throbbed with the dawn chorus of robins, catbirds, doves, jays, wrens, and scores of other bird voices there was now no sound; only silence lay over the fields and woods and marsh.

On the farms the hens brooded, but no chicks hatched. The farmers complained that they were unable to raise any pigs—the litters were small and the young survived only a few days. The apple trees were coming into bloom but no bees droned

among the blossoms, so there was no pollination and there would be no fruit.

The roadsides, once so attractive, were now lined with browned and withered vegetation as though swept by fire. These, too, were silent, deserted by all living things. Even the streams were now lifeless. Anglers no longer visited them, for all the fish had died.

In the gutters under the eaves and between the shingles of the roofs, a white granular powder still showed a few patches; some weeks before it had fallen like snow upon the roofs and the lawns, the fields and streams.

No witchcraft, no enemy action had silenced the rebirth of new life in this stricken world. The people had done it themselves.

This town does not actually exist, but it might easily have a thousand counterparts in America or elsewhere in the world. I know of no community that has experienced all the misfortunes I describe. Yet every one of these disasters has actually happened somewhere, and many real communities have already suffered a substantial number of them. A grim specter has crept upon us almost unnoticed, and this imagined tragedy may easily become a stark reality we all shall know.

What has already silenced the voices of spring in countless towns in America? This book is an attempt to explain.



2. The Obligation to Endure

THE HISTORY OF LIFE ON earth has been a history of interaction between living things and their surroundings. To a large extent, the physical form and the habits of the earth's vegetation and its animal life have been molded by the environment. Considering the whole span of earthly time, the opposite effect, in which life actually modifies its surroundings, has been relatively slight. Only within the moment of time represented by the present century has one species — man — acquired significant power to alter the nature of his world.

During the past quarter century this power has not only increased to one of disturbing magnitude but it has changed

in character. The most alarming of all man's assaults upon the environment is the contamination of air, earth, rivers, and sea with dangerous and even lethal materials. This pollution is for the most part irrecoverable; the chain of evil it initiates not only in the world that must support life but in living tissues is for the most part irreversible. In this now universal contamination of the environment, chemicals are the sinister and little-recognized partners of radiation in changing the very nature of the world—the very nature of its life. Strontium 90, released through nuclear explosions into the air, comes to earth in rain or drifts down as fallout, lodges in soil, enters into the grass or corn or wheat grown there, and in time takes up its abode in the bones of a human being, there to remain until his death. Similarly, chemicals sprayed on croplands or forests or gardens lie long in soil, entering into living organisms, passing from one to another in a chain of poisoning and death. Or they pass mysteriously by underground streams until they emerge and, through the alchemy of air and sunlight, combine into new forms that kill vegetation, sicken cattle, and work unknown harm on those who drink from once pure wells. As Albert Schweitzer has said, "Man can hardly even recognize the devils of his own creation."

It took hundreds of millions of years to produce the life that now inhabits the earth—eons of time in which that developing and evolving and diversifying life reached a state of adjustment and balance with its surroundings. The environment, rigorously shaping and directing the life it supported, contained elements that were hostile as well as supporting. Certain rocks gave out dangerous radiation; even within the light of the sun, from which all life draws its energy, there were short-wave radiations with power to injure. Given time—time not in years but in millennia—life adjusts, and a balance has been reached. For time is the essential ingredient; but in the modern world there is no time.

The rapidity of change and the speed with which new situations are created follow the impetuous and heedless pace of man rather than the deliberate pace of nature. Radiation is no longer merely the background radiation of rocks, the bombardment of cosmic rays, the ultraviolet of the sun that have existed before there was any life on earth; radiation is now the unnatural creation of man's tampering with the atom. The chemicals to which life is asked to make its adjustment are no longer merely the calcium and silica and copper and all the rest of the minerals washed out of the rocks and carried in rivers to the sea; they are the synthetic creations of man's inventive mind, brewed in his laboratories, and having no counterparts in nature.

To adjust to these chemicals would require time on the scale that is nature's; it would require not merely the years of a man's life but the life of generations. And even this, were it by some miracle possible, would be futile, for the new chemicals come from our laboratories in an endless stream; almost five hundred annually find their way into actual use in the United States alone. The figure is staggering and its implications are not easily grasped—500 new chemicals to which the bodies of men and animals are required somehow to adapt each year, chemicals totally outside the limits of biologic experience.

Among them are many that are used in man's war against nature. Since the mid-1940's over 200 basic chemicals have been created for use in killing insects, weeds, rodents, and other organisms described in the modern vernacular as "pests"; and they are sold under several thousand different brand names.

These sprays, dusts, and aerosols are now applied almost universally to farms, gardens, forests, and homes—nonselective chemicals that have the power to kill every insect, the "good" and the "bad," to still the song of birds and the leaping of fish in the streams, to coat the leaves with a deadly film, and to linger on in soil—all this though the intended target may be only a few weeds or insects. Can anyone believe it is possible

to lay down such a barrage of poisons on the surface of the earth without making it unfit for all life? They should not be called "insecticides," but "biocides."

The whole process of spraying seems caught up in an endless spiral. Since DDT was released for civilian use, a process of escalation has been going on in which ever more toxic materials must be found. This has happened because insects, in a triumphant vindication of Darwin's principle of the survival of the fittest, have evolved super races immune to the particular insecticide used, hence a deadlier one has always to be developed — and then a deadlier one than that. It has happened also because, for reasons to be described later, destructive insects often undergo a "flareback," or resurgence, after spraying, in numbers greater than before. Thus the chemical war is never won, and all life is caught in its violent crossfire.

Along with the possibility of the extinction of mankind by nuclear war, the central problem of our age has therefore become the contamination of man's total environment with such substances of incredible potential for harm — substances that accumulate in the tissues of plants and animals and even penetrate the germ cells to shatter or alter the very material of heredity upon which the shape of the future depends.

Some would-be architects of our future look toward a time when it will be possible to alter the human germ plasm by design. But we may easily be doing so now by inadvertence, for many chemicals, like radiation, bring about gene mutations. It is ironic to think that man might determine his own future by something so seemingly trivial as the choice of an insect spray.

All this has been risked — for what? Future historians may well be amazed by our distorted sense of proportion. How could intelligent beings seek to control a few unwanted species by a method that contaminated the entire environment and brought the threat of disease and death even to their own kind?

Yet this is precisely what we have done. We have done it, moreover, for reasons that collapse the moment we examine them. We are told that the enormous and expanding use of pesticides is necessary to maintain farm production. Yet is our real problem not one of *overproduction*? Our farms, despite measures to remove acreages from production and to pay farmers *not* to produce, have yielded such a staggering excess of crops that the American taxpayer in 1962 is paying out more than one billion dollars a year as the total carrying cost of the surplus-food storage program. And is the situation helped when one branch of the Agriculture Department tries to reduce production while another states, as it did in 1958, "It is believed generally that reduction of crop acreages under provisions of the Soil Bank will stimulate interest in use of chemicals to obtain maximum production on the land retained in crops."

All this is not to say there is no insect problem and no need of control. I am saying, rather, that control must be geared to realities, not to mythical situations, and that the methods employed must be such that they do not destroy us along with the insects.

The problem whose attempted solution has brought such a train of disaster in its wake is an accompaniment of our modern way of life. Long before the age of man, insects inhabited the earth — a group of extraordinarily varied and adaptable beings. Over the course of time since man's advent, a small percentage of the more than half a million species of insects have come into conflict with human welfare in two principal ways: as competitors for the food supply and as carriers of human disease.

Disease-carrying insects become important where human beings are crowded together, especially under conditions where sanitation is poor, as in time of natural disaster or war or in situations of extreme poverty and deprivation. Then control of some sort becomes necessary. It is a sobering fact, however,

as we shall presently see, that the method of massive chemical control has had only limited success, and also threatens to worsen the very conditions it is intended to curb.

Under primitive agricultural conditions the farmer had few insect problems. These arose with the intensification of agriculture — the devotion of immense acreages to a single crop. Such a system set the stage for explosive increases in specific insect populations. Single-crop farming does not take advantage of the principles by which nature works; it is agriculture as an engineer might conceive it to be. Nature has introduced great variety into the landscape, but man has displayed a passion for simplifying it. Thus he undoes the built-in checks and balances by which nature holds the species within bounds. One important natural check is a limit on the amount of suitable habitat for each species. Obviously then, an insect that lives on wheat can build up its population to much higher levels on a farm devoted to wheat than on one in which wheat is intermingled with other crops to which the insect is not adapted.

The same thing happens in other situations. A generation or more ago, the towns of large areas of the United States lined their streets with the noble elm tree. Now the beauty they hopefully created is threatened with complete destruction as disease sweeps through the elms, carried by a beetle that would have only limited chance to build up large populations and to spread from tree to tree if the elms were only occasional trees in a richly diversified planting.

Another factor in the modern insect problem is one that must be viewed against a background of geologic and human history: the spreading of thousands of different kinds of organisms from their native homes to invade new territories. This worldwide migration has been studied and graphically described by the British ecologist Charles Elton in his recent book *The Ecology of Invasions*. During the Cretaceous Period, some hundred million years ago, flooding seas cut many land bridges between

continents and living things found themselves confined in what Elton calls "colossal separate nature reserves." There, isolated from others of their kind, they developed many new species. When some of the land masses were joined again, about 15 million years ago, these species began to move out into new territories — a movement that is not only still in progress but is now receiving considerable assistance from man.

The importation of plants is the primary agent in the modern spread of species, for animals have almost invariably gone along with the plants, quarantine being a comparatively recent and not completely effective innovation. The United States Office of Plant Introduction alone has introduced almost 200,000 species and varieties of plants from all over the world. Nearly half of the 180 or so major insect enemies of plants in the United States are accidental imports from abroad, and most of them have come as hitchhikers on plants.

In new territory, out of reach of the restraining hand of the natural enemies that kept down its numbers in its native land, an invading plant or animal is able to become enormously abundant. Thus it is no accident that our most troublesome insects are introduced species.

These invasions, both the naturally occurring and those dependent on human assistance, are likely to continue indefinitely. Quarantine and massive chemical campaigns are only extremely expensive ways of buying time. We are faced, according to Dr. Elton, "with a life-and-death need not just to find new technological means of suppressing this plant or that animal"; instead we need the basic knowledge of animal populations and their relations to their surroundings that will "promote an even balance and damp down the explosive power of outbreaks and new invasions."

Much of the necessary knowledge is now available but we do not use it. We train ecologists in our universities and even employ them in our governmental agencies but we seldom take

their advice. We allow the chemical death rain to fall as though there were no alternative, whereas in fact there are many, and our ingenuity could soon discover many more if given opportunity.

Have we fallen into a mesmerized state that makes us accept as inevitable that which is inferior or detrimental, as though having lost the will or the vision to demand that which is good? Such thinking, in the words of the ecologist Paul Shepard, "idealizes life with only its head out of water, inches above the limits of toleration of the corruption of its own environment . . . Why should we tolerate a diet of weak poisons, a home in insipid surroundings, a circle of acquaintances who are not quite our enemies, the noise of motors with just enough relief to prevent insanity? Who would want to live in a world which is just not quite fatal?"

Yet such a world is pressed upon us. The crusade to create a chemically sterile, insect-free world seems to have engendered a fanatic zeal on the part of many specialists and most of the so-called control agencies. On every hand there is evidence that those engaged in spraying operations exercise a ruthless power. "The regulatory entomologists . . . function as prosecutor, judge and jury, tax assessor and collector and sheriff to enforce their own orders," said Connecticut entomologist Neely Turner. The most flagrant abuses go unchecked in both state and federal agencies.

It is not my contention that chemical insecticides must never be used. I do contend that we have put poisonous and biologically potent chemicals indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm. We have subjected enormous numbers of people to contact with these poisons, without their consent and often without their knowledge. If the Bill of Rights contains no guarantee that a citizen shall be secure against lethal poisons distributed either by private individuals or by public officials, it is surely only because

our forefathers, despite their considerable wisdom and foresight, could conceive of no such problem.

I contend, furthermore, that we have allowed these chemicals to be used with little or no advance investigation of their effect on soil, water, wildlife, and man himself. Future generations are unlikely to condone our lack of prudent concern for the integrity of the natural world that supports all life.

There is still very limited awareness of the nature of the threat. This is an era of specialists, each of whom sees his own problem and is unaware of or intolerant of the larger frame into which it fits. It is also an era dominated by industry, in which the right to make a dollar at whatever cost is seldom challenged. When the public protests, confronted with some obvious evidence of damaging results of pesticide applications, it is fed little tranquilizing pills of half truth. We urgently need an end to these false assurances, to the sugar coating of unpalatable facts. It is the public that is being asked to assume the risks that the insect controllers calculate. The public must decide whether it wishes to continue on the present road, and it can do so only when in full possession of the facts. In the words of Jean Rostand, "The obligation to endure gives us the right to know."