

HUMAN IMPACT

Rachel Carson

Postwar Prosperity

The first four decades of the 20th century, with the exception of the prosperous 20's, were times of frugality and economy in the United States. During the first World War, citizens were asked to economize in many ways: to grow vegetable gardens so that the troops overseas could have more food, to use less sugar and fat in cooking, to save money to buy war bonds, to buy less clothing so there was more cloth for soldiers' uniforms, and more. Even wool yarn was scarce, as women were asked to knit socks and sweaters for soldiers instead of for themselves.



The Great Depression struck in 1929, leaving many people deep in poverty. Vacant lots were turned into vegetable gardens for hungry families, nearly every family learned to preserve food, and people learned to make their shoes, clothing, and other possessions last as long as possible. “Use it up, wear it out, make it do, or do without,” was the motto of the times.

When the U.S. entered the second World War in 1941, the nation's economy was recovering, but again citizens were asked to economize. Housewives saved cooking fat to be used to make nitroglycerine. Children conducted scrap drives to collect paper and metal for the war effort. Food, clothing, car tires, and gasoline were rationed.

By the time the war ended in 1945, Americans were tired of all the scrimping and saving they'd had to do. The economy picked up as the U.S. emerged as a world super power. The factories that had fed the industrial war machine gave way to factories that fed an new industrial economy — an economy based on ever-increasing consumption of factory-made products.

As the U.S. entered the second half of the century, consumerism soared. Every middle-class family expected to have a house with its own lawn, a car or two, a television set, and all the modern appliances that made life easier. Buying more products and enjoying a higher standard of living than the prior generation became patriotic acts. Making clothing, preserving food, and cooking food from scratch were seen as old-fashioned. Why make

things that you could buy ready-made at the store? The chemical industry turned from making bombs to making household chemicals: “Better living through chemistry,” as one company proclaimed. New cleaning products and garden chemicals appeared in grocery stores. Among them was a new super pesticide guaranteed to kill all insect pests: DDT.



Pests and Pesticides

Dichloro-Diphenyl-Trichloroethane, better known as DDT, was one of the first synthetic pesticides ever produced. It was first created in 1874, but wasn't used as a pesticide until 1939. Paul Hermann Müller, a chemist from Switzerland, was awarded the Nobel Prize for his work on DDT and its effects on agricultural pests. During the 1940's, DDT was used widely to kill mosquitoes in areas of the world where malaria, typhus, and other mosquito-borne diseases were widespread. Around the mid-1940's, DDT was produced in quantities large enough that made it practical for U.S. agriculture. It was used to kill a wide variety of pests, including fruit flies, cotton boll weevil, and mosquitoes. DDT could be found on grocery store shelves, where it was sold as a pesticide to kill cockroaches, flies, moths, and other household insect pests.

The chemical industry advertised DDT as a safe pesticide. In fact, it appeared to be toxic only to insects. Joseph Jacobs, a chemist at Merck Industries, ate spoonfuls of DDT in public to show how safe it was, and went on to live a long life, dying of natural causes in his eighties.

It was in the prosperous 1950's that bird watchers and other amateur naturalists first noticed the toxic effects of DDT. Humans weren't dying from it, but birds were, as a biologist by the name of Rachel Carson pointed out in her controversial book, *Silent Spring*.

Carson wasn't the first to spot the toxic effects of DDT. Bird biologists and bird watchers had noticed declines in bird populations ever since the pesticide was introduced. One Massachusetts bird watcher, Olga Huckins, reported to the Boston *Herald* in 1958:

The mosquito control plane flew over our small town last summer. Since we live close to the marshes, we were treated to several lethal doses as the pilot criss-crossed our place... The “harmless” shower bath [of DDT mixed with

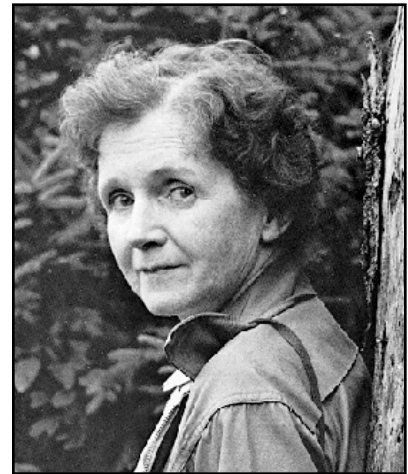
fuel oil] killed seven of our lovely songbirds outright. We picked up three dead bodies the next morning right by our door... All these birds died horribly, and in the same way. Their bills were gaping open, and their splayed claws were drawn up to their breasts in agony.

Not only did the spray kill birds, Mrs. Huckins stated, it also killed grasshoppers and honeybees — but missed the mosquitoes that it was intended to kill.

Huckins wasn't just another amateur bird watcher, however. She was a friend of scientist and nature writer Rachel Carson, and asked Carson to investigate the matter of DDT.

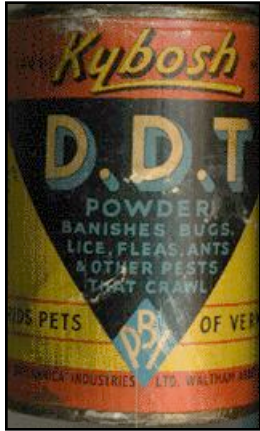
Rachel Carson

Rachel Carson (1907-1964) was a lifelong naturalist, having grown up on a farm near Springdale, Pennsylvania. As a child she learned about the animals and plants of the ponds and prairie from her mother, who was keenly interested in nature study. When Carson went away to Pennsylvania College, she studied English, but soon switched her major to biology. After graduation, she studied for a while at the Marine Biological Laboratory, then studied zoology and genetics as a graduate student Johns Hopkins University. There she completed a Master's degree, but was forced to break off her Ph.D. studies after her father died. Carson became a teacher to support her aging mother. Later, with the help of her former professors, she found a position with the U.S. Bureau of Fisheries, where she wrote scripts for a weekly educational radio program. She was so successful at this temporary position that she applied for a full-time job, and became the first woman employed full time by the fisheries bureau.



When Huckins first asked Carson to investigate DDT, the public knew very little about the pesticide. Carson dug into academic research journals and soon learned that scientists knew a great deal about DDT, but the information was buried in technical journals and was not getting to the public. The problem was a matter of translation: most of the information on DDT and other pesticides was in articles that chemists wrote for other chemists. The average person on the street wouldn't be able to make any sense of the information. The problem, Carson knew, was that it wasn't just a matter of *what* was known: it was also a matter of *who* knew it. If the knowledge was not made public, there could be no public input into policies that regulated the use of pesticides. Yet the public was directly affected.

Carson decided to do her best to educate the public about the effects of synthetic pesticides, including DDT. Her solution to the problem was to write a book that she titled *Silent Spring*.



What about DDT?

All the public knew about DDT was that it killed insects, and that seemed to be enough to satisfy most people. DDT had been the soldier's friend during World War II, where it was used in the South Pacific to kill mosquitoes and control disease. This created an aura of patriotic glamor around the chemical. After the war, the pesticide increased food production in the U.S. by killing many different insect pests, making DDT a chemical national hero.

Deep in the academic literature, Carson uncovered the first information on how the pesticide worked, though it wasn't until well after the publication of her book that scientists fully understood DDT's effects. The chemical, once it enters an animal's body, migrates into the mitochondria. These cell structures break apart energy-rich compounds such as sugar and create ATP, the universal energy-carrier. DDT interferes with this process by disrupting the electron transport chain that creates energy necessary for making ATP.

In mammals, the toxic effects of DDT are low. Mammals seem to absorb very little, especially through the digestive system. This is why Joseph Jacobs, and even volunteer prisoners who ate DDT to tests its effects, were able to consume it with little apparent effect. Birds, however, are much more sensitive to the effects of DDT than mammals are. The birds that Mrs. Huckins observed suffocated because their cells were unable to make enough ATP to keep their respiratory systems working.

But even at low levels, DDT killed birds in a more subtle fashion. DDT does not break down in the ecosystem. Insects that were exposed to the pesticide absorbed it into their bodies. If enough was absorbed, the insects died, but even insects that survived spraying carried the toxin in their body fat. Birds that ate the insects consumed the DDT that was in the insect's tissues. Since birds eat a lot of insects, they ended up eating a lot of DDT. Because DDT does not break down, the toxin accumulated in the birds' tissues. At low levels, DDT



interfered with bird hormones. Birds high on the food chain, such as predatory birds that ate birds that had eaten poisoned insects, had problems reproducing. Even if they managed to lay eggs, the shells of their eggs were so thin that the eggs broke when the female birds sat on them. The few chicks born to the poisoned birds often had fatal deformities of the beak and skeleton.

Later studies on DDT have found long-term effects in mammals, including humans. The prisoner studies where volunteers ate DDT lasted for two years, which was too short a period of time to track long-term effects. Other studies found that workers in DDT factories suffered from a number of neurological problems by the time they retired. Farmers exposed to DDT over a decade or more suffered from higher rates of asthma. Long-term DDT exposure has also been linked to higher rates of liver and testicular cancers.

Writing *Silent Spring*

Carson's expertise was in wildlife biology. She began her research on the animals of the Atlantic coast, and compiled much of her knowledge into a popular series of three books: *Under the Sea Wind* (1941), *The Sea Around Us* (1951), and *The Edge of the Sea* (1955). While she knew a great deal about wildlife, she was not an expert in either chemistry or physiology. Her audience was hugely diverse, ranging from the average citizen to chemical experts, government administrators, and politicians. The topic was not just environmental, but also highly political. Carson knew that she was risking her reputation as a biologist and science writer as she began writing *Silent Spring*. She wouldn't just be making science popular, as she had with her earlier books. She had to persuade the public to her point of view: that nature was a complex system, far too complex for the simplistic approaches used by the agricultural chemical industry. It was her sense of ethics that drove her to complete the book. As she confided to a friend later, "there would be no peace for me if I kept silent."

The scientific research community, too, was concerned about DDT. In 1944, the American Association of Entomologists made an official statement to contradict the "over-optimism and distorted impressions" about DDT. *Harper's* and *Atlantic Monthly*, which were popular magazines, printed articles by prominent scientists which warned about the dangers of DDT. In 1950, the U.S. Food and Drug Administration announced that it was "extremely likely the potential hazard of DDT has been underestimated."

Yet even reports like these failed to tarnish the glowing image of DDT. Carson knew she had to do careful and meticulous research for her new book. She didn't want to write a book that was merely an inflammatory criticism of pesticides. Neither did she want to write a dry, technical book that presented only the scientific aspects of pesticides. She had to strike a

careful balance of presenting carefully documented technical information in a non-technical context that the general public could understand.

Carson's earlier books had shown her reverence for life and her wonder at the diversity of life on earth. *Silent Spring* took a different tone, in which she showed the tragedy of life lost to pesticides and the threats to diversity of life.

In 1957, while Carson was working on the manuscript for *Silent Spring*, in which she argued that the release of toxic chemicals into the environment might increase rates of cancer, she herself was diagnosed with breast cancer. She underwent radiation therapy, and later a mastectomy in 1960. During this time, her mother and sister died, leaving her to care for her nephew. In spite of personal tragedy and challenges, Carson carried on with her work.

In *Silent Spring*, Carson challenged the common assumption that chemical pesticides were entirely beneficial. She did not argue entirely against pesticides, noting that there were some cases where use was appropriate. She was just as critical of older pesticides as she was of DDT, since older pesticides used arsenic and other poisons that were often worse than DDT. In place of these toxic chemicals, Carson advocated the use of natural pesticides and biological controls. She argued that if landowners took the time to understand the complex food web found in gardens and on farms, they could use that food web to their advantage. For example, instead of planting huge monocultures that attract insect pests, farmers and gardeners could also grow plants that attract insect predators. Killing all insects, pests and predators alike, disrupts the food web and actually allows pests to increase.

The Storm of Controversy

When *Silent Spring* was published in 1961, the public was shocked by the images of crippled and deformed birds and the message that the American public was systematically poisoning the ecosystem. The message of biological control was lost on most readers, who preferred the simpler solution of just spraying poison on pesky bugs and not worrying about complicated things like food webs. But the message about pesticides raised public awareness that “better living through chemistry” might have some serious side-effects.

The chemical industry was sharply critical of the book. Officials from the various chemical industries stated that the conclusions were flawed, though they never commented on the specific studies that Carson had cited in her book. Instead, they used scare tactics, suggesting that if farmers stopped using pesticides, food production would drop and the nation's economy would be crippled. Since the U.S. was involved in the Cold War with the Soviet Union, anything that might slow the economy was viewed with deep suspicion as a possible Communist threat. Critics also tried to discredit the author herself. At the time,

pointing out that she was a woman was criticism enough, suggesting that she was swayed by sentiment and emotion. She was described as everything from a mere “bird lover” to “hysterical,” and some critics suggested that a “mere” woman could not be a suitable spokesperson for science.

Reaction from the general public was mixed. Some people were outraged that Carson would attack the chemical industry. Others were outraged that the chemical industry appeared to be attacking nature. John F. Kennedy, the U.S. president at the time, read the book and rather than listen to emotional reactions, called in scientific advisers to look at Carson’s claims and to give their advice. The advisers confirmed most of her conclusions, which gave the book greater authority in the eyes of the public.

In the decade that followed, the U.S. passed legislation to ban DDT. Laws were also established to protect clean water and air, protect endangered species, and to regulate the use of other pesticides. The Environmental Protection Agency was established to oversee the use of natural resources and to regulate pollution control. While scientists had known of the dangers of DDT long before *Silent Spring* was published, many historians believe it was Carson’s skill as a writer that captured the public attention. Carson died of cancer in 1964, but her legacy lived on. The images portrayed in *Silent Spring* launched a new environmental awareness that shaped social policy throughout the 1960’s and 70’s.

Questions

1. Why did it take a book by a popular science writer to make the public aware of the dangers of DDT, when scientists had been aware of its effects for at least a decade? In your answer, consider the politics, economics, and social aspects of the situation.
2. Where do people today get their information about science and science-related issues? Is there still a gap between public knowledge and scientific knowledge? Do scientists communicate well with the general public? Why or why not?
3. The problem of DDT was one of bioaccumulation. In studying food chains and energy pyramids, you learned that energy is *lost* at each step of the food chain. How is bioaccumulation different? Why is it different? Why are environmental toxins *more* concentrated in predatory birds than in the insects that were sprayed in the first place? (Consider the differences between energy and materials in the ecosystem.)