

SILENT SPRING AT 50: REFLECTIONS ON AN ENVIRONMENTAL CLASSIC

PERC POLICY SERIES • No. 51 • 2012

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TO THE READER

By dramatically revealing the potential dangers synthetic chemicals posed to the environment and human health, Rachel Carson's *Silent Spring* (1962a) served as a catalyst for the modern environmental movement. Today, Carson's red flag still influences environmental law and policy.

There have been many celebrations of the 50th anniversary of the publication of *Silent Spring*. Most such symposiums at colleges and elsewhere are laudatory. This *PERC Policy Series* is not. A gimlet eye needs to be turned on any work that is hailed as contributing to the justification for more restrictions on innovation.

Roger E. Meiners and Andrew P. Morriss argue that Carson's red flag was raised too high. Here, the authors examine long-term trends and original-source data, rather than speculate and make assertions about alleged problems.

Careful analysis of environmental issues requires hard thinking. This piece picks apart some of Carson's most noted claims, such as the demise of birds due to DDT, and dulls her horror stories about the impending demise of people poisoned by modern technology. The authors conclude that Carson's celebrated scholarship was, at best, sloppy, and at worst, an intentional deceit.

On the bright side, the fact that we are healthier and wealthier in 2012 than in 1962—and that the birds are still singing—is not the result of policies flowing from *Silent Spring*.

"*Silent Spring* at 50: Reflections on an Environmental Classic" is part of the *PERC Policy Series* of essays on timely environmental topics. This issue was edited by Laura E. Huggins and designed by Mandy-Scott Bachelier.

SILENT SPRING AT 50: REFLECTIONS ON AN ENVIRONMENTAL CLASSIC

Fifty years after the publication of Rachel Carson's *Silent Spring*, the book's legacy is mixed. It helped raise awareness about the costs of mass spraying operations, but it also provided justification for campaigns against the use of DDT in malaria control programs, which contributed to the deaths of millions in Africa and Asia.

Despite blunders in *Silent Spring*, the book is often cited with reverence. An example is *Discover* magazine ranking it one of the 25 greatest science books ever written, noting that “[h]er chilling vision of a birdless America is still haunting” (*Discover* 2006). This accolade for an advocacy book aimed at a mass audience typifies how *Silent Spring* is treated. As Wallace Kaufman notes, except for Henry David Thoreau, Carson has been cited more than any other environmental writer (Meiners, Desrochers, and Morris 2012, Ch. 2).

Carson's earlier publications on the oceans and marine life were fine works of nature writing that helped build her reputation. In *Silent Spring*, she shifted from documenting nature's beauty to advocating positions linked to a darker tradition in American environmental thinking: neo-Malthusian population control and anti-technology efforts. She drew on her reputation as a nature writer to give these ideas a more acceptable face. Canonizing *Silent Spring* helped build those darker themes into mainstream environmentalism today. For those of us who believe, as did the late Julian Simon, that humanity is the “ultimate resource” (Simon 1998), that was a tragic wrong turn.

Carson's prose is powerful, but the substance of the book is not what one would expect from a leading "science" book. *Silent Spring* presented an emotional argument against chemical pesticides. It left key data and issues out of the picture. Her outrage was prompted in part by government spray programs that blanketed cropland and forests with heavy doses of pesticides in efforts to eradicate pests. Such programs often ran roughshod over landowners' wishes. But it was not only the overuse that agitated Carson. She was highly critical of chemical pest control in general. She proposed mass introduction of alien species as a means of "biological" control of pests, a problematic alternative. Above all, *Silent Spring* is a work of advocacy, weaving anecdotes and carefully selected bits of science into a compelling brief against uses of chemicals that had already saved millions of lives at the time Carson wrote.

This *PERC Policy Series* draws on a larger work by a group of scholars assembled to examine *Silent Spring* in the context of the time in which Carson was writing. As is appropriate for a work intended to influence public policy, *Silent Spring* deserves critical analysis. The complete analysis will be published in 2012 by the Cato Institute as *Silent Spring at 50: The False Crises of Rachel Carson* (readers who would like more detailed documentation for the abbreviated discussion here will find it in the book).

HISTORICAL BACKGROUND

Today, there is a vague perception that the 1950s were a time of reckless chemical usage. Although innovations in chemistry were hailed—the inventor of DDT was awarded the Nobel Prize in Medicine for discovering it, and U.S. servicemen in World War II praised it for preventing insect-borne diseases—there were concerns about DDT from its earliest use. As World War II drew to a close, Carson's employer, the U.S. Fish and Wildlife Service (FWS), worried that organochlorides such as DDT damaged wildlife. The U.S. Department of Agriculture (USDA), a larger and more powerful agency than the FWS, won the

initial skirmish, but the claims and the clashes between agricultural interests and wildlife advocates were present from the start. FWS gained an ally when the FDA entered the debate as the agency sought authority to regulate residues in food.

Responding to concerns about chemical exposure, the House of Representatives passed a resolution in 1950 calling for an investigation into chemicals in food products. Rep. James

J. Delaney of New York was named as chair of the House Select Committee to investigate the “Use of Chemicals in Food Products” (Meiners et al. 2012, Ch. 9). To be the committee’s chief counsel, Delaney chose Vincent A. Kleinfeld, the FDA’s general counsel. Kleinfeld ran masterful hearings for the Select Committee, carefully building a case for more authority. Although agricultural interests were represented on the committee and were powerful in Congress, Kleinfeld outmaneuvered them by using USDA and agricultural witnesses’ testimony to paint the USDA as a biased agency beholden to special interests. His questioning of witnesses created the impression that the USDA was ignorant of the harms that were being inflicted on the public by the use of toxic chemicals that tainted food. The hearings attracted considerable attention, drawing major media coverage as they were held around the country.

Kleinfeld used the hearings to build a case that, to protect the public from toxic risks, the FDA needed greater authority to require enhanced testing of chemicals present in food production processes. Physicians from the Centers for Disease Control and the National Institutes of Health discussed concerns about DDT, attacking the USDA standard of 5 ppm in foodstuffs as too lenient given the lack of knowledge of safety for human consumption. Other witnesses

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noted that *Journal of the American Medical Association* had discussed whether “Virus X,” a health scare sparked by a New York physician’s articles that later proved groundless, could be caused by DDT poisoning. A professor of medicine who focused on environmental health hazards testified that not enough was known about DDT, but that “it is probably responsible for such conditions as suicidal tendencies, aplastic anemia, pneumonia, leukemia, virus X, arteriosclerosis, and even cancer” (U.S. Congress 1951, 149).

Kleinfeld argued that agricultural chemicals should not be sold until proven safe, portraying DDT as just the tip of the chemical iceberg. His proposed remedy was for an “impartial board” of scientists to determine what should be allowed on the market and to subject products to extensive pre-market testing, beginning with animal tests and then, for those that passed the first hurdle, human testing to search for safe exposure levels. In short, Kleinfeld sought to give the FDA powers over agricultural chemicals that mimicked the FDA standards for drug approval. Without such standards, he argued, public health was threatened and, thereby, agriculture was threatened because of the possible backlash against chemically tainted foods.

Foreshadowing one of Rachel Carson’s main themes, a committee member noted that the incidence of cancer was rising in the United States and speculated that there “might be a connection between some of these insecticides and chemicals being used” (U.S. Congress 1951, 192). Kleinfeld cited a British scientist who stated that DDT and other insecticides upset the balance of nature (another key theme in *Silent Spring*) and agreed with the witness that there should be extensive testing of all chemicals before use.

Another view came from a farmer who testified that organic agriculture was an alternative that avoided the problem of toxic residues in food: “The use of poisons in the growing and processing of our foods has steadily increased until today millions of pounds of these poisons are used, of which a considerable amount is consumed by our people” (U.S. Congress 1951, 295). Some food processors

demanded organically grown crops so they knew there would be no chemical residue. Furthermore, he asserted that organic farming was better for the environment and sprays unnecessary because nature was “in balance” on organic farms. Such techniques were commercially viable, he posited.

Witnesses raised multiple food safety issues. People were reminded of a mass poisoning at an Oregon state hospital in 1942 that killed 47 people (which had nothing to do with the use of pesticides in food). Regular themes included the dangers of mis-labeled products, the need for the burden of proof of safety to be on manufacturers, the inadequacies of federal regulation, and the need for stronger FDA oversight. Industry representatives from the National Canners Association and the Grocery Manufacturers Association joined in. As the director of the National Canners Association Research Laboratories testified, “Industries are concerned primarily with the unavoidable presence of pesticide residues on certain crops” (U.S. Congress 1951, 833).

The hearings concluded with a California allergist testifying that DDT and other sprays made people sick. He claimed that people suffered from lethargy after exposure to sprays and that DDT was particularly bad. DDT was present in the nation’s milk supply, so steps were needed to “protect our infants” (U.S. Congress 1951, 1047). The hearings helped the FDA secure passage of a 1954 amendment to the Food, Drug, and Cosmetic Act that required inclusion of toxicity and residue studies in petitions to the secretary of Health, Education and Welfare (HEW) for permission to market a new pesticide.

The 1951 hearings show that widespread criticisms of pesticides, including DDT, began immediately after the products were adopted, long before *Silent Spring* crystallized concerns. *Silent Spring* provided the most noteworthy attack as of 1962 on DDT and pesticides, but virtually all of the criticisms made in the book had been articulated previously.

Committee counsel Kleinfeld later played a key role in private practice when he served as plaintiffs’ counsel in the landmark (and

unsuccessful) suits against DDT spraying by the government on Long Island to control gypsy moths in 1957 and 1958. Carson relied heavily on materials collected by the plaintiffs in that suit in her research for *Silent Spring* (Lytle 2007, 60). Those lawsuits rested on common law claims that the spray programs constituted a trespass on the plaintiffs' lands. The federal courts rejected these claims, holding that the greater good trumped property rights: "The rights of individuals are not limitless. Individuals must yield to the requirements of the public as a whole" (*Murphy v. Benson* 1958, 128).

THE PERFECT CHEMICAL STORM

Between 1900 and 1962, when *Silent Spring* was published, improvements in technology had helped increase life expectancy in the United States from 47 years to 70 years. During those years, real per capita income in the United States tripled. Despite these unprecedented gains, some members of the increasingly affluent and healthy society began to look suspiciously at technology. As the preceding discussion notes, trace amounts of unpronounceable chemicals were being viewed with suspicion. Ongoing debates helped to produce, in 1958, the Delaney Amendment to the Food and Drug Act, which outlawed carcinogens in food additives.

Then, just before Thanksgiving 1959, the Secretary of HEW, Dr. Arthur Flemming, announced that a pesticide known to cause thyroid cancer in rats (aminotriazole) had been detected in Oregon cranberries (Meiners et al. 2012, Ch. 5). Although the rats had been given doses equivalent to a human eating 15,000 pounds of cranberries every day for years, Flemming advised consumers not to buy cranberries, citing the Delaney Amendment as authority. Supermarkets suspended sales and restaurants stopped serving the modest side dish. Despite exhortations to eat cranberries from President Eisenhower and presidential candidates John F. Kennedy and Richard M. Nixon, who publicly ate cranberry products, sales collapsed.

Not long after, the *New Yorker* published a three-part serialization

of Rachel Carson's *Silent Spring*, beginning in the June 16, 1962, issue. Carson's work was going to be an event even without the *New Yorker* serialization—her previous books had been best sellers and *Silent Spring* was slated as a Book of the Month Club selection. The high profile magazine series ratcheted interest even higher (Meiners et al. 2012, Ch. 2). The book garnered additional attention when the *New York Times* endorsed it in an editorial entitled "Rachel Carson's Warning."

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Miss Carson will be accused of alarmism, or lack of objectivity, of showing only the bad side of pesticides while ignoring their benefits. But this, we suspect is her purpose as well as her method. We do not ... find a cure for disease by boasting of the reduction in mortality rates. Miss Carson does not argue that chemical insecticides must never be used, but she warns of the dangers of misuse and overuse by a public that has become mesmerized by the notion that chemists are the possessors of divine wisdom and that nothing but benefit can emerge from their test tubes. If her series helps arouse public concern and [mobilize government agencies to enforce] adequate controls, the author will be as deserving of the Nobel Prize as was the inventor of DDT. (*New York Times* 1962, 28)

The *New York Times* was right: Carson was accused of alarmism and ignoring the benefits of chemical pesticides—and she was both alarmist and one-sided in her presentation, as we describe below. Those aspects of *Silent Spring*, however, are largely forgotten today.

Silent Spring also garnered attention because of the contemporaneous thalidomide story in 1962, which increased public concerns

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about chemicals (Meiners et al. 2012, Ch. 5). Originally touted as a wonder drug for a variety of ailments—insomnia, pains, coughs, and colds—thalidomide was prescribed in Europe, Australia, and Canada for, among other things, morning sickness during pregnancy. The *Washington Post* and the *New York Times* each reported many times in 1962 that the drug had been traced to

the births of thousands of deformed babies in Germany and Britain.

On July 15 newspapers named Dr. Frances Oldham Kelsey at the FDA as the heroic figure who had prevented the United States from approving the drug's use. The images of thalidomide's infant victims propelled swift action. Within weeks, Dr. Kelsey received the Distinguished Federal Civilian Service Award from President Kennedy, and Congress held hearings on the issue, keeping it in the public eye.

By the time *Silent Spring* was released as a book on September 26, there had been more than 200 articles on thalidomide in the *Washington Post* and the *New York Times* alone. Carson recognized that the furor over thalidomide aided her book's popularity. Writing in the *New York Times* Christmas edition of its Book Review, she observed

[F]or many reasons the climate of 1962 seems to have been far more favorable for its reception than that of ... any earlier year.... Almost simultaneously, with the publication of *Silent Spring*, the problem of drug safety and drug control, which had been simmering many months, reached its shocking culmination in the thalidomide tragedy. (Carson 1962b, 3)

Timing, however, was not the only reason for the tremendous success of *Silent Spring*. Carson's appealing prose and deftly woven

tapestry of anecdotes were persuasive. Unfortunately, they led her and, more importantly, many readers and policy makers to make leaps in inductive reasoning and to over-generalize from the particular. Her caution that we should be wary of the misuse of pesticides is sensible. However, based on data that were available when Carson was writing, and which she ignored, there were major inconsistencies and oversights in her presentation. Those errors have played an important role in shaping *Silent Spring*'s legacy.

Based on data that were available when Carson was writing, and which she ignored, there were major inconsistencies and oversights in her presentation.

Consider some important problems, such as Carson's claim that bird populations were declining due to pesticides or her claim that pesticides and other chemicals could be responsible for the growth of cancer in America. And what about the offsetting benefits from pesticide use that received short shrift in the book? Finally, one should consider the alternatives to pesticides offered by Rachel Carson, how far would she have pursued them, and how the benefits and costs of various approaches might be reconciled.

BIRD POPULATIONS AND DDT

Carson began *Silent Spring* with what became one of its most famous passages, describing a town where there were no song birds. At the end of this section, entitled "A Fable for Tomorrow," Carson warns the reader of what might await if pesticide use were not curtailed:

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. (Carson 1962a, 3)

This passage, buttressed by anecdotes in the book, leaves the reader with the impression that song bird populations—if not all bird populations—were crashing in the United States due to pesticide usage. Hence the title, *Silent Spring*, evoked a world where “no birds sing” (Keats 2007).

This misrepresented what was actually happening to bird populations at the time she wrote. Trend data on avian populations—available when Carson was writing and about which she must have known because of her ties to the National Audubon Society who collected the data—indicated that many bird populations were not decreasing. A 1964 paper titled “Birds on the Rise” in the *Bulletin of the Entomological Society of America* noted that “[f]ar from declining during the past 15 years of expanded insecticide use, bird numbers have multiplied severalfold” (Marvin 1964, 194). Marvin’s paper was based on the longest running census of bird populations in the country—the Audubon Society’s Christmas Bird Census (CBC). It has been conducted around Christmas time since 1900 (National Audubon Society n.d.). While the data are not ideal, the Audubon Society provides the only data that offer a view of trends from a period preceding the introduction of organic pesticides through the time “Birds on the Rise” was written. Since Rachel Carson was an active member of the local chapter of the Audubon Society and served on its board of directors, she must have been aware of the Society’s annual Christmas Bird Count. Yet, there is no evidence she used this resource to examine bird population trends.

Among the species featured in various bleak anecdotes in *Silent Spring*, but whose numbers actually had increased, according to Audubon counts between 1949–52 and 1961–62, were robins, starlings, meadowlarks, and cardinals. This is approximately the period over

which “[t]he production of synthetic pesticides in the United States soared from 124,259,000 pounds in 1947 to 637,666,000 pounds in 1960—more than a fivefold increase” (Carson 1962a, 17). The upward trend reported by Marvin, relying on Audubon data, casts doubt on the notion of a general decline in bird populations.

Bald eagles also figured prominently in *Silent Spring*'s narrative of looming disaster. Carson stated that “reports by the Florida Audubon Society, as well as from New Jersey and Pennsylvania, confirm the trend that may well make it necessary for us to find a new national emblem” (Carson 1962a, 119). However, data from the Christmas Bird Count showed gradually increasing bald eagle populations from Christmas 1939 through Christmas 1961. Audubon data did not indicate a declining national trend in bald eagle counts during the time of high use of organochlorides. The national count was somewhat higher in the late-1950s and early 1960s than in the early-1940s. While Carson noted that studies of bald eagle nests in a stretch of Florida's west coast from Tampa to Fort Myers showed a decline in reproductive success, she failed to mention that the decline in that locale began before the mid-1940s. That decline was likely due to habitat destruction and increased disturbance and contact with humans.

Carson also singled out the brown thrasher, which she suggested had been affected by mass pesticide spraying campaigns in Iroquois County, Illinois, along the Illinois-Indiana border:

Perhaps no community has suffered more for the sake of a beetleless world than Sheldon, in eastern Illinois, and adjacent

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areas in Iroquois County. In 1954 the United States Department of Agriculture and the Illinois Agriculture Department began a program to eradicate the Japanese beetle along the line of its advance into Illinois, holding out the hope, and indeed the assurance, that intensive spraying would destroy the populations of the invading insect. The first “eradication” took place that year, when dieldrin was applied to 1400 acres by air. Another 2600 acres were treated similarly in 1955, and the task was presumably considered complete. But more and more chemical treatments were called for, and by the end of 1961 some 131,000 acres had been covered....

[By 1955] the chemical had been changed to the even more toxic aldrin, 100 to 300 times as toxic as DDT in tests on quail. By 1960, every species of wild mammal known to inhabit the area had suffered losses. It was even worse with the birds. In the small town of Donovan the robins had been wiped out, as had the grackles, starlings, and brown thrashers. These and many other birds were sharply reduced elsewhere. (Carson 1962a, 91–95)

Data from the CBC for the brown thrasher in both Illinois and Indiana does not indicate a population decline. As seen in Figure 1, the CBC data demonstrate that nationally the brown thrasher population generally increased during the period in which organochlorines such as DDT came on the scene (Meiners et al. 2012, Ch. 5).

The government-subsidized eradication campaign undoubtedly overused pesticides in many areas, as well as violating property owners’ right to determine what would be used on their land. The CBC, however, contradicts the impression of brown thrasher populations being devastated in the United States. No matter how compelling individual stories about birds might be, they are not a substitute for systematic studies. It is odd that, given Rachel Carson’s association with the Audubon Society, she relied on anecdotes and failed to use data from the Society’s Christmas Bird Counts.



Figure 1: Brown thrasher trends for the United States, Christmas 1939–1961.



Source: National Audubon Society, Christmas Bird Counts (various years).
Photo courtesy of Dan Pancamo.

CANCER FROM PESTICIDES

Silent Spring also warned about the effects of pesticides on human health and well-being. As with the bird population, Carson paints a narrow and unrealistic picture of the situation through selective use of data and a lack of consideration of important variables. She begins Chapter 3, titled “Elixirs of Death,” with an ominous statement:

For the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals, from the moment of conception until death. In the less than two decades of their use, the synthetic pesticides have been so thoroughly distributed throughout the animate and inanimate world that they occur virtually everywhere. (Carson 1962a, 15)

Chapter 14 also discusses what the effects of pesticides and other pollutants were and could be on human cancer in alarming tones:

By the end of the 19th century a half-dozen sources of industrial carcinogens were known; the 20th century was to create countless new cancer-causing chemicals and to bring the general population into intimate contact with them.... [But] the environmental situation has been vastly changed. No longer are exposures to dangerous chemicals occupational alone; they have entered the environment of everyone—even of children as yet unborn. It is hardly surprising, therefore, that we are now aware of an alarming increase in malignant disease.

The increase itself is no mere matter of subjective impressions. The monthly report of the Office of Vital Statistics for July 1959 states that malignant growths, including those of the lymphatic and blood-forming tissues, accounted for 15 per cent of the deaths in 1958 compared with only 4 per cent in 1900. Judging by the present incidence of the disease, the American Cancer Society estimates that 45,000,000 Americans now living

will eventually develop cancer. (Carson 1962a, 221)

(Note that U.S. population in 1960 was 180 million, hence the title of chapter 14, “One in Every Four.”)

Carson’s alarmism was not new. But it expressed a theme that can be traced back to the organic food literature of the 1930s. As Pierre Desrochers and Hiroko Shimizu explain (Meiners et al. 2012, Ch. 3), this alarmism goes back to at least two earlier best-sellers, Arthur Kallett and Frederick J. Schlink’s 1933 *100,000,000 Guinea Pigs: Dangers in Everyday Foods, Drugs, and Cosmetics*, and William Vogt’s 1948 *Road to Survival*. Vogt, in particular, was a fervent Malthusian and considered pests such as malaria-carrying mosquitoes to be “blessings in disguise” (Vogt 1948, 28) and argued it was not “kindness” to keep “people from dying of malaria so that they could die more slowly of starvation” (Vogt 1948, 13). Moreover, as Robert Nelson discusses, Carson tapped into a growing, deep unease with rapid social advances that arose to challenge the dominant “gospel of progress,” which resonated with longstanding American religious ideas (Meiners et al. 2012, Ch. 4).

As the title to Kallett and Schlink’s book suggests, this literature portrayed the modern world as filled with dangers for consumers. By the 1950s, the spread of mechanization in agriculture and war time labor demands, along with advances in freezing food, meant that consumers were buying processed foods from supermarkets, not fresh produce from farmers (Meiners et al. 2012, Ch. 9). These changes worried some observers. Carson softened Vogt’s harsh condemnation of the inhabitants of malarial areas to death and suffering by omitting the direct Malthusian arguments, but her work was firmly centered in this genre.

Carson focused her human health

No matter how compelling individual stories about birds might be, they are not a substitute for systematic studies.

arguments on the rise in cancer deaths during the twentieth century. Her analysis, however, neglected critical factors necessary for evaluating those increases (Meiners et al. 2012, Ch. 6). First, the U.S. population in 1958 was two and a half times its 1900 level. Thus, all else being equal, the number of deaths (but not death rates) would have increased correspondingly. Second, the twentieth century saw a continual decline in all-cause deaths and death rates because life expectancy increased from 47.3 years in 1900 to 69.6 years in 1958 (because the risk of death from cancer increases sharply with age, cancer death rates must be adjusted for the aging of the population before the impact of a new element in the environment can be assessed). Adjusted for age, cancer death rates increased less dramatically than unadjusted trends. Third, because death rates from many common diseases, including tuberculosis, influenza, pneumonia, diphtheria, typhoid, paratyphoid, scarlet fever, and whooping cough, declined remarkably over the same period, deaths from cancer automatically loomed larger. In short, some spared whooping cough died later in life of cancer.

SILENCE ON TOBACCO

Cancer was on the 1950s public health agenda in part because there was an increasing debate over the cause of the increase in cancer death rates—was it smoking or some other environmental substance (Yandle et al. 2008)? *Silent Spring* ignores this issue, failing even to mention that smoking tobacco might be a carcinogen. The surprising thing about this oversight is that the relationship of smoking and cancer was under active public debate during the period *Silent Spring* was written. Between January 1959 and March 1962, the *New York Times* carried 133 pieces dealing with “smoking” and “cancer” (*New York Times* 1962, 28).

The reason for silence on this topic may be Carson’s reliance on William Hueper for her understanding of cancer. Hueper was an important figure in the debate over the cause of increasing cancer rates.

He was firmly on the side of environmental contaminants being the culprit rather than tobacco smoking (Hueper 1955, 95–100). Although today skeptics about tobacco’s influence on cancer are mocked as stooges of the cigarette industry, based on the state of knowledge at that time, Hueper’s position may have appeared more plausible than it would have later. But Carson’s failure to consider any role for tobacco use in explaining cancer rates or to even acknowledge the issue is a serious omission.

WHAT ABOUT THE CHILDREN?

Carson raised the alarm about a frightening rapid increase in childhood cancer: “A quarter century ago, cancer in children was considered a medical rarity. Today, more American school children die of cancer than from any other disease” (Carson 1962a, 221). Once again, her failure to control for changes in other causes of death drove the conclusion (Meiners et al. 2012, Ch. 5). The major reason cancer deaths in young age groups appeared larger in 1960 than in 1900 (for instance) was a dramatic decline in all-cause death rates. For the 5–14 year age group, deaths fell from 380 per 100,000 in 1900 to 60 per 100,000 in 1960. Many diseases that used to kill children, such as diphtheria, typhoid, paratyphoid, scarlet fever, and whooping cough, had been largely eliminated in the United States.

ENVIRONMENTAL CONTAMINANTS AND CANCER

Later work has also contradicted Carson’s narrative on cancer. In their authoritative paper on the causes of cancer in the United States, published 19 years after *Silent Spring*, Richard Doll and Richard Peto estimated that fewer than one percent to as much as five percent of cancer deaths in the general population were due to pollution. For occupational exposures, they estimated a range of two percent to eight percent. They also calculated that the share of cancer deaths due to tobacco was 30 percent; to diet, 35 percent (Doll and Peto

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1981). A later review of the literature found that about 50 percent of cancer deaths in the United States among nonsmokers are unavoidable (Peto 2001). For smokers, the figure is 25 percent. Smoking accounts for 60 percent of cancer deaths in smokers. Reduced air pollution, occupational controls, and sunlight avoidance could reduce cancer deaths by one percent among smokers and three percent

among nonsmokers.

From 1900 to 2010, despite a massive increase in the use of synthetic organic compounds, and increases in cancer notwithstanding, U.S. life expectancy increased continually from 47.3 years to 78.3 years. Hence, evidence did not bear out Carson’s speculation that man-made environmental carcinogens would cause an explosion of cancer “yet to come” from the “seeds of malignancy that have been sown by these chemicals” (Carson 1962a, 118).

Moreover, even the data in 1962 showing an increase in crude cancer death rates was inconsistent with Carson’s narrative regarding DDT. She dates the first industrial exposures to DDT to 1942. But cancer death rates had been increasing at least since 1900 (although at later average ages), long before DDT. The increase in the crude cancer death rate actually moderated in the early 1950s, after widespread use of DDT and other organochlorines began. The age-adjusted death rate was essentially the same in 1960 as it was in 1950, the period most relevant to *Silent Spring*’s empirical claims.

The reader of *Silent Spring* would be led astray on the significance and contribution of pesticides to cancer in the United States, partly due to Carson’s reliance on Hueper and to her decision to ignore the possible contribution of smoking. Other problems with the book’s cancer narrative are that it failed to explore more fully the conse-

quences of replacing arsenic-based pesticides, such as lead arsenate, a known carcinogen, with pesticides whose carcinogenicity was uncertain. This was compounded by ignoring the effects of a longer living population on cancer rates, the difference of cancer rates between rural and urban populations, and declining rates of death from other causes that magnified the relative importance of cancer. Had these elements been considered, the reader's perception of the urgency of the pesticide problem most likely would have diminished.

In the years since *Silent Spring* was published, many studies have been done to establish the relationship, if any, between DDT (and its metabolites, DDD and DDE) and cancer. The Agency for Toxic Substances and Disease Registry (ATSDR), a part of the Department of Health and Human Services, determined that DDT, DDE, and DDD "may reasonably be anticipated to be human carcinogens" despite noting that the EPA had classified DDT, DDE, and DDD as probable human carcinogens and that the International Agency for Research on Cancer classified them as possible carcinogens for humans (ATSDR 2002, 26). ATSDR later updated this determination, noting forthrightly that, "...taking all factors into consideration, the existing information does not support the hypothesis that exposure to DDT/DDE/DDD increases the risk of cancer in humans" (ATSDR 2008, 24).

Carson cannot be faulted for failing to anticipate decades of additional scientific research on cancer and pesticide exposure. But that subsequent history should caution us against simply accepting Carson's narrative of technological alarmism based on scanty evidence. She can be faulted for her selective portrayal of what was known at

From 1900 to 2010, despite a massive increase in the use of synthetic organic compounds, and increases in cancer notwithstanding, U.S. life expectancy increased continually from 47.3 years to 78.3 years.

the time, particularly since *Silent Spring* has played such a significant role in restricting the use of DDT for public health purposes, leading to the forgoing of real and demonstrated benefits to avoid hypothetical cancers (Meiners et al. 2012, Chs. 6, 8 and 12).

OVERLOOKED BENEFITS OF PESTICIDES

A major flaw of *Silent Spring* is that it ignored the benefits of pesticides for both human well-being and the environment. These include reductions in habitat loss and biodiversity, lessened hunger, increased no-till farming, reduced erosion and agricultural runoff, and more agricultural productivity.

Habitat Loss

One of Carson's main reasons for writing *Silent Spring* was to focus attention on “permanent destruction of wildlife habitat” through the poisoning of the land and water (Carson 1962a, 74). Given her emphasis on habitat conservation, it is ironic that she overlooked the impact of pesticides on increasing agricultural yields. Higher yields reduce land needed for crops and so contribute to habitat conservation. Today, habitat loss is deemed to be the single largest threat to terrestrial biodiversity worldwide (Meiners et al. 2012, Ch. 5).

Zilberman et al. (1991) provide estimates of the reductions in yield if a pesticide ban were to be applied to various major crops. They estimate that yield loss would vary from 20 percent for sorghum to 70 percent for rice. If one assumes that these estimates hold for the period from 1945–47 to 1960–62, then, but for pesticides, as much as 30 percent or more cropland would have been needed to maintain stable U.S. crop production. This, in addition to increasing the cost of food generally (see below), would have been detrimental for biodiversity.

Carson was also heavily influenced by now-discarded ideas about biology. She repeatedly invoked the “balance of nature” in *Silent Spring*, a concept that remains popular but which is, as wildlife biologist Nathan Gregory explains, out of sync with modern conservation biology’s understanding of habitats (Meiners et al. 2012, Ch. 7). Her

presentation of the impact of pesticides on the environment was thus flawed both by her failure to consider their total impact and by her lack of the knowledge we have developed since 1962.

Hunger around the World

Carson argued that the extra production enabled by pesticides was unnecessary since it contributed to food “overproduction” in the United States:

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. (Carson 1962a, 9)

This narrow assessment of food needs ignored the struggles in other parts of the world to meet food needs reliably and consistently (Meiners et al. 2012, Ch.5). American surpluses led the United States to export food and provide food aid in areas of shortage.

This was a significant omission. At the time Carson wrote, memories of food shortages were fresh even in Europe. In the Netherlands alone, 18,000 people perished from starvation in the so-called Hunger Winter of 1944–45. The United Kingdom did not end food rationing until 1954. Elsewhere, famines were still a regular occurrence. The *New York Times* reported on famines between 1955 and 1961 in Somalia, China, Tunisia, Indonesia, East Pakistan (now Bangladesh), Algeria, Ceylon (Sri Lanka), Haiti, India, Laos, Nepal, Peru, the Congo, Crete, and Kenya.

The desperate need for food around the world prompted U.S. efforts to establish a World Food Bank to relieve hunger and famine. Rising American productivity meant that despite an overall drop in

total cropland, acreage used for exports increased from 42 million acres in 1945 to 66 million acres in 1962. Carson's failure to consider these widely known issues is puzzling until one connects her work with the earlier, more explicitly Malthusian, writings that considered it pointless to save the world's poor from hunger since overpopulation would only lead to further disasters.

No-Till Farming

Carson said nothing about one of the most significant benefits of pesticides, the development of no-till farming. For millennia, farmers prepared land for planting by tilling the earth. Tilling loosens and aerates the soil, kills weeds, and mixes nutrients, crop residue, and other organic matter into the soil. But tilling also makes the soil more susceptible to erosion and to loss of nutrients from wind and water action, problems exacerbated by the growing use of tractors and other heavy machinery in the 1950s. These problems, highlighted by Edward Faulkner in his book, *Ploughman's Folly* (1945), led to the development of no-till farming techniques in an effort to reduce erosion and protect soil productivity.

Until the advent of synthetic herbicides allowed cheap weed control, these techniques had limited application. *Silent Spring* decries the use of “chemical weed killers” for “chemical plowing” (Carson 1962a, 68–69), but does not mention the key role it played in reducing erosion, which not only leads to loss of agricultural productivity but can foul the air and water.

THE OTHER ROAD

The last chapter of *Silent Spring*, “The Other Road,” sets out an alternative approach to pest control. Carson enthusiastically reported on the use of other living organisms (including other insects, small mammals, birds, and carriers of insect disease, such as bacteria, viruses, and fungi), mass introduction of sterile insects, pheromones, and sound. She was correct that all of these could be tried as part

of efforts to control food-destroying or disease-causing pests. But these methods are neither universally available nor always desirable. The book glosses over potential potholes in these other roads. Anti-pest organisms sometimes turned out to be destructive pests themselves (Meiners et al. 2012, Chs. 5 and 7).

Carson said nothing about one of the most significant benefits of pesticides, the development of no-till farming.

As the distinguished ecologist Daniel Simberloff notes, “[a] disadvantage of biological control is that some agents attack nontarget species, and it is very difficult to remove a troublesome introduced natural enemy once it is established” (2000). Today, “invasive introduced species” are generally ranked second to habitat “destruction” in terms of their threat to biodiversity. Yet, in her final chapter endorsing invasive species, Carson seemingly forgot her earlier statement that “[n]early half of the 180 or so major insect enemies of plants ... are accidental imports” (Carson 1962a, 11).

ARE CHEMICAL PESTICIDES A NECESSARY EVIL?

On the one hand, Rachel Carson averred that she was not opposed to chemical pesticides on principle, only to their overzealous application, which had “potentials for harm” (Carson 1962a, 12). On the other hand she argued that,

to establish tolerances is to authorize contamination of public food supplies with poisonous chemicals.... But if ... it is possible to use chemicals in such a way that they leave a residue of only seven parts per million (the tolerance for DDT), or of one part per million (the tolerance for parathion), or even of only 0.1 part per million as is required for dieldrin on a great variety of

fruits and vegetables, then why is it not possible, with only a little more care, to prevent the occurrence of any residues at all? (Carson 1962a, 183)

The problem is that a “no-residue” policy is tantamount to a no-use policy. As Larry Katzenstein explains, Carson’s rhetorical question is an articulation of the present-day environmentalists’ version of the precautionary principle (Meiners et al. 2012, Ch. 11). Carson’s view that policy regarding synthetic chemicals should be “no risk” was not uncommon in her time, as exemplified in the Delaney Amendment. The policy is not only unrealistic but poses significant harm, as geneticist Gary Marchant discusses (Meiners et al. 2012, Ch. 12).

The contradiction could be reconciled by striving to balance the risks and benefits of not using pesticides against those of using them. Many of Carson’s disciples, however, do not favor such balancing of the risks of using DDT versus the risk of abandoning its use. This is evident from their support of a global ban on all DDT uses prior to the signing of the Stockholm Convention’s ban on persistent organic pesticides and the continuing efforts to phase out DDT despite its public health benefits (Meiners et al. 2012, Ch. 8).

Bacillus Thuringiensis

Silent Spring (289–290) suggested the use of *Bacillus thuringiensis* (Bt), a soil bacterium, which can kill various insects, as a biological control alternative to chemical pesticides. Bt was discovered in the early twentieth century in Japan and Germany (Meiners et al. 2012, Ch. 5). At the time *Silent Spring* was written, Bt was just beginning to be used in the United States. It has the advantage that, for practical purposes, it has no effect on human beings and wildlife. Genes from Bt have now been incorporated into some of the more popular genetically modified crops (e.g., Bt corn and Bt cotton) to combat insects. These genes produce proteins that harm the target pest. Humans and wildlife lack the receptors to which the proteins can bind, hence they are immune to that bacterium. In the United States, 63 percent of corn

and 73 percent of cotton were planted with GM Bt varieties in 2010.

One wonders whether Rachel Carson would have been as adamant against the use of genetically modified Bt crops as are many environmentalists who now claim her as a patron saint. Moreover, given the book's ambivalence over the use of chemical pesticides, it raises the question of how far she would have traveled on this branch of the Other Road that she pointed out.

CONCLUSION

Silent Spring is a beautifully crafted but ultimately flawed polemic. It performed a public service in warning against the misuse of chemical pesticides, but it is marred by its overreliance on anecdotes rather than systematic analysis of data on hand (Carson 1962a, 289–290). The book is weakened by gaps such as its silence on smoking as a possible cause of the increase in cancer death rates and the potential benefits of chemical pesticides for both humanity and the rest of nature. Unfortunately, its influence on modern environmental thought encourages some of the most destructive strains within environmentalism: alarmism, technophobia, failure to consider the costs and benefits of alternatives, and the discounting of human well-being around the world.

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- Chapter 5: The Selective Silence of *Silent Spring*: Birds, Habitat Loss and Hunger, Pierre Desrochers and Hiroko Shimizu.
- Chapter 6: The Selective Silence of *Silent Spring*: Cancer, Roger E. Meiners.
- Chapter 7: The Balance of Nature and *The Other Road*: Ecological Paradigms and the Management Legacy of *Silent Spring*, Nathan Gregory.
- Chapter 8: Did Rachel Carson Understand the Importance of DDT in Global Public Health Programs? Donald R. Roberts and Richard Tren.
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