Silent Spring Study Guide

Silent Spring by Rachel Carson

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Introduction

First published in the United States in 1962, *Silent Spring* surveys mounting evidence that widespread pesticide use endangers both wildlife and humans. Along the way, Rachel Carson criticizes an irresponsible chemical industry, which continues to claim that pesticides are safe, and imprudent public officials, who accept without question this disinformation. As an alternative to the "scorched earth" logic underlying accepted pest-control practices, the author outlines the "biotic" approach cheaper, safer, longer acting, natural solutions to pest problems (for example, controlling the Japanese beetle by introducing a fungus that causes a fatal disease in this insect).

The primary inspiration for the book was a friend of Carson's who was concerned about dying birds in her hometown where the authorities had sprayed DDT to control mosquitoes. At about the same time, a disastrous pesticide campaign against the fire ant of the Southeast was receiving national attention. Formerly a science writer for the United States Fish and Wildlife Service, Carson already had some acquaintance with research on pesticides, and she was ready to speak out. Originally planned as an article, *Silent Spring* became a book of more than two hundred pages when the only outlet she could find was the book publisher Houghton Mifflin.

Though *Silent Spring* is without question her best-known book today, Carson was already a national literary celebrity when it came out. As workof social criticism, Silent Spring represented a considerable departure from the natural history with which she had made a name for herself. Whether this would have been a turning point in her career or merely a detour is impossible to know because Carson succumbed to breast cancer only a year and a half after *Silent Spring* appeared. What is clear, however, is that her public image was irrevocably transformed. Average Americans came to see her as a noble crusader while the chemical industry would quickly spend more than a quarter of a million dollars to discredit her.

Few books have had as much impact on late twentieth-century life as Carson's *Silent Spring*. Though an environmental consciousness can be discerned in American culture as far back as the nineteenth century, environmentalism as it is known today has only been around for about forty years, and Carson's book is one of its primary sources. Her tirade against humankind's attempt to use technology to dominate nature wrenched environmentalism from its relatively narrow, conservationist groove and helped transform it into a sweeping social movement that has since impacted almost every area of everyday life.

Author Biography

Rachel Louise Carson was born on May 27,1907, in Springdale, Pennsylvania, the daughter of Robert Warden Carson and Maria Frazier McLean. The family had very little money□Robert Carson made only a slim living as a salesman and utility employee□but thanks to their talented and well-educated mother, Rachel and her older brother and sister enjoyed a comparatively stimulating childhood. A great reader and passionate naturalist, Maria Carson left an especially deep imprint on her youngest child. While still quite young, Rachel began writing stories about animals, and by age ten, she had published a prize-winning magazine piece.

In 1925, Carson earned a scholarship for Pennsylvania Women's College where she hoped to prepare herself for a literary career by majoring in English. As had always been her habit in school, the bright but reserved student focused on academics rather than socializing and was soon one of the college's top scholars. Less expected was Carson's changing her major to biology after taking a class taught by a captivating young zoology professor named Mary Scott Skinner. In 1929, after graduating with high honors, the writer who would someday earn fame for her work on marine life got her first look at the sea as a summer intern at Woods Hole Laboratory on Cape Cod. Later that year, Carson began graduate work in zoology at Johns Hopkins University, but in 1935, when her father suddenly died, family responsibilities put an end to her formal studies. By 1937, she was the sole provider for both her mother and the children of her now deceased sister.

It was at this point that she embarked on her long career as a civil servant, an endeavor that would occupy her for the next decade and a half and the crucible out of which would come the influential nature writing of her later life. Producing publications for the Bureau of Fisheries and the United States Fish and Wildlife Service, Carson increased her already considerable expertise in biology and honed her skills as a writer. The bureaucratic elements of such work do not seem to have been at all stifling; in *Notable American Women*, Paul Brooks credits Carson for setting "a new standard for government publication." It was inevitable that such work would someday come to the notice of a wider circle of readers, as it did in 1941, when she published *Under the Sea Wind*, a work of natural history that originated in an article she had written for a Bureau of Fisheries publication in the late 1930s. Though it was well received by reviewers, the book was something of a false start: the entrance of the United States into World War II led to poor sales, and Carson herself soon had to put other such projects aside to deal with growing responsibilities at Fish and Wildlife. (By 1949, she was editor of all agency publications.)

It wasn't until 1951 that her next and most popular book, *The Sea Around Us,* appeared. It was among the first examples of what was to become an important late twentieth-century genre, science as literature. On the *New York Times* bestseller list for eighty-six weeks, this volume earned Carson enough royalties to enable her to retire from government work and focus on the projects that most interested her.

After completing the third and final volume of her "biography of the sea," *The Edge of the Sea*, and a handful of smaller projects, Carson was prompted by a series of events to write the book that would make her one of the most important women of the twentieth century. Carson was recruited to help a friend from Duxbury, Massachusetts, challenge a state mosquito control program that seemedto be wiping out birds. This and another widely publicized controversy over a similar development in the Southeast led Carson to write on the mounting scientific evidence about the risks of pesticides. Doubting that she could find a magazine that would publish an article on so gloomy a topic, Carson produced an entire book for an interested editor at Houghton Mifflin. Serialized by the *New Yorker* in advance of its 1962 publication, *Silent Spring* became the focus of intense attention, not least because the chemical industry responded with a quarter-million-dollar campaign to discredit the author. Before the controversy cooled, a presidential commission began looking into the problem, and Congress began considering tougher restrictions on dangerous chemicals. (Carson herself testified before Congress.) Already a prize-winning writer, Carson was now elevated to the ranks of the nation's most important public figures. The true magnitude of her accomplishment would only become clear some months later, when Carson died on April 14, 1964, in Silver Springs, Maryland. During the four years that she worked on *Silent Spring,* Carson also had been battling cancer.

Plot Summary

Chapter One

Carson's survey of the research on pesticides opens in a most unscientific fashion with a tale about an American town that has suffered a series of plagues. At chapter's end, Carson acknowledges that the town is an imaginary one, but lest the tale be dismissed as mere fantasy, she hastens to add that each of the catastrophes it catalogs "has actually happened somewhere, and many real communities have already suffered a substantial number of them."

Chapters Two and Three

Not until chapter two does Carson identify the source of the ills described in chapter one: potent synthetic poisons of relatively recent design, proliferating at the rate of about five hundred a year, applied in massive quantities virtually everywhere, with disastrous short- and long-term consequences for both wildlife and humans. To convey the grave danger that these substances represent, she introduces an analogy that will resurface over and over in *Silent Spring*: pesticides are like atomic radiation invisible, with deadly effects that often manifest themselves only after a long delay. Chapter three identifies a small handful of qualities that make the new pesticides so much more dangerous than their predecessors: 1) greater potency 2) slower decomposition and 3) a tendency to concentrate in fatty tissue. Carson clarifies the significance of the last two characteristics by pointing out that a toxin that might not constitute a danger in small doses will ultimately do so if it accumulates in the body, and also that substances with this propensity concentrate as one moves up the food chain.

Chapters Four, Five, and Six

Chapters four, five and six form a triptych that stresses the highly interconnectedness of life in three biological systems plant systems and those centered in water or soil. Given its fluidity and interconnectedness, water is an extremely difficult place to contain a problem, Carson points out. As an unintended result of runoff from agricultural spraying and of poisons sometimes directly introduced in the water supply, groundwater nearly everywhere is tainted with one or more potent toxins. The full extent of the problem, she worries, cannot even be precisely measured because methods for screening the new chemicals have yet to be routinized. In some instances, the danger lies in substances formed by unexpected reactions that take place betweenindividual contaminants; in such cases, toxins might escape detection even where tests are available. Chapter five explains the life cycle within soil-based ecosystems: rich soil gives rise to hearty plant life; then the natural process of death and decay breaks down the plants, and the soil's vitality is restored. Pesticides threaten this fundamental dynamic fundamental not just for plants but also for the higher organisms that live on plants. An insecticide applied to

control a particular crop-damaging insect depletes the microbial life within the soil that facilitates the essential enrichment cycle, hence the millions of pounds of chemical fertilizer required each year by factory-farms. In chapter six, Carson's focus shifts from insecticides to herbicides. The general picture that emerges is of a deceptive chemical industry and ill-informed public authorities spending large sums of taxpayers' money undermining whole ecosystems to eradicate one or two nuisance species.

Chapter Seven

In "Needless Havoc," Carson's attention turns to the people behind pesticides, the public officials who are responsible for the widespread use of these dangerous chemicals. What has typified their behavior in her view is almost unbelievable recklessness followed by an irrational unwillingness to reckon with the catastrophes they have wrought. Exhibit A is the infamous campaign against the Japanese beetle, a frenzy that swept the Midwest in the late fifties. In the first place, Carson argues, there was no real evidence that the beetle constituted a serious threat. Secondly, officials failed to warn the public of potential risks involved in combating the insect with pesticides.

Chapter Eight

Not surprisingly, at the very heart of *Silent Spring* lies a chapter called "And No Birds Sing," where the author recounts the true stories from whence the book's most unforgettable image comes. The chemical villain in these tragedies is the notorious DDT; the principal victims are the robin, beloved herald of spring, and the eagle, revered symbol of national spirit. That the shrewd writer chose species with so much emotional resonance is hardly an accident. Both birds' fates bring the discussion back to the problem of bio-magnification, the concentration of toxins as they pass from one organism to the next along the food chain: the robin receive fatal doses from consuming poisoned worms and other insects, the eagle from pesticide-carrying fish.

Chapter Nine

Chapter nine explains how blanket pesticide spraying□of forests, crop fields, and suburban lawns□is wreaking havoc on aquatic life in the streams, estuaries, and coastal waters that receive runoff from treated areas. The chapter's most frightening observation is that runoff concentrates in marshes and estuaries where freshwater meets the seas, extraordinarily fragile ecosystems and the primary feeding and spawning grounds for many species□the foundation of much aquatic life.

Chapter Ten

Reviewing two more disastrous eradication efforts, chapter ten sounds many of the same notes as chapter eight. What chapter ten adds to this now fairly well-developed

picture is a clearer sense of the colossal blunder that was aerial spraying. Carson reports that pilots were paid according to how much pesticide they sprayed, and so they drenched the countryside with toxic chemicals, contaminating orchards and gardens, killing birds, bees and other wildlife, poisoning milk cows and even soaking humans who happened to get in the way.

Chapter Eleven

Chapter eleven concerns the minute but repeated exposures to pesticides that every man, woman, and child suffers in all but the most isolated regions of the planet. Carson lays the blame for the breathtaking diffusion of dangerous chemicals in everyday life on the deceptive marketing campaigns of pesticide makers, which insist these products are safe, and government agencies like the Department of Agriculture and the FDA, which not only countenance such disinformation but actively promoted the use of synthetic poisons.

Chapters Twelve, Thirteen, and Fourteen

Chapters twelve, thirteen and fourteen focus on the effects of pesticides on people. Chapter twelve stresses two key issues: first, that pesticides are absorbed by fat, a widely dispersed tissue, and so they insinuate themselves in virtually every part of the system, including the ever so crucial organs and fundamental cell structures; and second, because most people accumulate these toxins by way of repeated minute exposure of which they are rarely aware, it difficult to trace the resulting pathologies to their true cause. Chapter thirteen explains one of the book's main refrains□that pesticides are so very dangerous because they disrupt basic biological processes like oxidation (cell metabolism) and mitosis (cell reproduction). The central claim here is that pesticides are probably responsible for cancer, birth defects, and a wide array of chromosomal abnormalities. Scientific research in this area was still in an early stage when Carson wrote *Silent Spring*, but plant and animal studies were already suggesting what had long been known about radiation, namely that pesticides had powerful mutagenic properties. Chapter fourteen chronicles the history of the carcinogen, a term that has become only more familiar since 1962. It was first surmised that cancer related to environmental conditions in the eighteenth century, when a London physician noted an extremely high incidence of scrotal tumors among the city's chimney sweeps, who were all day covered in soot. During the nineteenth century, with the rise of industry, several other suspicious relationships had been observed. But with World War II and the rise of widespread pesticide use, the risk of cancer confronted not just members of certain occupational groups but virtually everyone

Chapters Fifteen and Sixteen

Chapters fifteen and sixteen discuss in a comprehensive way one of Carson's most damning criticism of pesticides, but one she has thus far only voiced in passing: not only

are pesticides expensive and extremely dangerous, but they are also terribly ineffective. The trouble is twofold. Chapter fifteen focuses on the first part of the problem; current pesticide practice, Carson argues, is like trying to repair a delicate watch with a sledgehammer. Massive applications of highly toxic substances reverberate through whole ecosystems, upsetting delicate balances and often compounding the original problem. Chapter sixteen highlights the tendency of pesticides to lose effectiveness quickly as insects and other nuisance organisms develop resistance. The problem arises from the indefatigable reality of natural selection. Within any given pest species, some number of organisms will be less susceptible to pesticides as a function of ordinary genetic variety within the species. Pesticide kills off the weak, leaving the pesticide-resilient to thrive and establish a new generation of super bugs. Of particular concern is the loss of effective tools in the fight against disease carrying insects like the mosquito.

Chapter Seventeen

Since so many of the book's chapters conclude with some mention of safer alternatives to current pesticide practices, it is hardly surprising that the book itself concludes with an extended discussion of what Carson calls "biotic controls." One of the main arguments of the chemical industry in the face of mounting evidence about the dangers of pesticides is that the risks are justified by benefits to agriculture and other areas. By laying out in fine detail cheaper, safer, and more effective alternatives, Carson pulls the rug out from under the industry with its self-interested talk of pesticide benefits. Broken into three sections, each of which focuses on a slightly different basic strategy, chapter seventeen offers a cogent overview of the elegant science of natural pest control. Part one explains how chemicals derived from the insects themselves can be used as repellants or lures for traps that pose no risk to humans. Part two shows how repeatedly introducing sterilized males into target populations can bring about a gradual decline of pests. And part three reports on the use of natural enemies□bacterial insecticides and predator species□to combat pests.

Chapter 1 "A Fable for Tomorrow"

Chapter 1 "A Fable for Tomorrow" Summary

Carson describes a beautiful American town where townsfolk and farmers and wildlife all live in harmony with each other. Farms and orchards are interspersed with maple, birch, and pine trees. Foxes and deer live and romp in the misty woods. The roadsides are lush with trees, ferns, and wildflowers. Birds are numerous both in kind and in sheer quantity. In winter, migratory birds are so numerous that tourists come to see them. Trout is plentiful in the streams, which have been good fishing spots since early settler times. Then a mysterious blight strikes the area, and wildlifeand farm animals die. People become ill, puzzling the doctors. The birds disappear. There are no bees to pollinate plants and trees, so there is no fruit in the orchards. The vegetation dies. The fish die. A white powder lingers on some rooftops; the people themselves have poisoned the entire environment. Carson then states that the town she described does not actually exist, but that the individual environmental disasters have all happened in real communities.

Chapter 1 "A Fable for Tomorrow" Analysis

Carson sets the scene for the entire book with this "once upon a time" introduction. The description of the pre-destruction town and countryside is idyllic, full of lush detail about specific flora and fauna. The language is fairly rhapsodic in its celebration of the harmony between man and nature that once existed. She continues the fairy tale tone by describing the mysterious blight as an "evil spell" falling upon the land and its creatures, including human beings. Again, she uses specific detail to create a vivid picture in her readers' minds: the birds tremble violently before they die; where there had been throbbing birdsong, now there is silence; chickens and pigs stop producing young; the roadsides look scorched as if by fire. Finally, she snaps the reader out of the fairy tale by stating that the people themselves have caused the widespread destruction of life. In the final two paragraphs of the chapter, set apart from the "fairy tale" by a space, Carson explains that the town does not actually exist, but that the individual examples of environmental destruction have indeed taken place in various locations. She does not yet identify the "grim specter" that has caused so much death, but says that in this book she attempts to explain why spring is now silent in so many American towns.

Chapter 2 "The Obligation to Endure"

Chapter 2 "The Obligation to Endure" Summary

Throughout earth's history, living things have interacted with their environment but not changed it. In fact, the environment has often played an important role in forming the different kinds of life - plants and animals specifically adapted to live in whatever their environments are. Only human beings have gained the ability to reverse the roles and actually change the environment they live in, and this power has become disturbingly great only over the past 25 years (the book was first published in 1962). Now humanity has irreversibly polluted the earth's air, water, and animal life (including human life). The combination of radiation (released through nuclear explosions) and toxic chemicals (purposely distributed as insecticides, herbicides, etc.) produces chemical deposits in the earth, water, and living tissues of everything on earth. Life, which took hundreds of millions of years to develop, evolve, and diversify, is now threatened. Life is able to adapt to environmental change over millennia, but in the modern world, life does not have the luxury of time.

Radiation used to be limited to that which occurred naturally, in some rocks, cosmic rays, and sunlight; now it includes fallout from atomic bombs. Chemicals in the environment used to be limited to naturally occurring minerals; now humankind creates new chemicals in the laboratory. Nearly 500 new chemicals are introduced into the environment every year. Since the 1940s, more than 200 chemicals have been created for the purpose of "pest control." After DDT was released for civilian use, ever more powerful chemicals have had to be developed as the targeted insects have adapted and become resistant to the substances developed to kill them. Humanity is poisoning itself in its effort to control its environment by killing certain unwanted organisms. Carson states that American farms are continuing to apply dangerous chemicals to their land to increase production despite the fact that overproduction is a large problem.

Carson enumerates the problems with attempting to control insects on a large scale. Massive chemical control can actually worsen the problem rather than solve it. Large-scale, single-crop farming eliminates the biodiversity that provided built-in control of pests attracted to particular plants. Suburbia also has contributed to the elimination of biodiversity, such as in the widespread planting of elm trees along neighborhood streets. "Invasions" of problem insects have been helped along by humans importing non-native plants in which the insects live. Carson suggests that American science wastes the training of its scientists by insisting that they work on further chemical means of controlling plants and insects, rather than working with nature's own built-in controls. She contends that little or no research has been done on the chemicals' effects on life other than the targeted insects, and that it is unfair for people to bear these effects without knowing the full facts. The chapter's title comes from a quote from Jean Rostand: "The obligation to endure gives us the right to know."

Chapter 2 "The Obligation to Endure" Analysis

Here Carson builds on her opening statement by explaining how life works: that all forms of life require many thousands of years to adapt to a changing environment. She provides a time frame for her reader to consider - from World War II to the present (1962) - and points out how terribly short this scant 17 years is, compared with the millennia all life has had to adapt to changes in the past. She introduces ideas she will build on in future chapters, especially the idea that more and more chemical escalation is necessary to stay ahead of the insects' adaptations to each successive chemical attack and the fact that insecticides remain in the environment and inevitably make their way into the body tissues of every living thing, including people. She points out the unregulated way DDT and other dangerous chemicals have been used, not only by people who know their dangerous power, but also by consumers who lack scientific knowledge but believe the marketing slogans that promise them "safe" pest control. She insists that the chemical assaults must stop, and that we all must be given full access to all the facts.

Chapter 3 "Elixirs of Death"

Chapter 3 "Elixirs of Death" Summary

Here, Carson provides minute details about the synthetic pesticides, which in less than twenty years have been so thoroughly distributed throughout the world that they are truly everywhere. Every human being now has contact with dangerous chemicals every moment of his life - even from conception. These chemicals have made their way deep into the groundwater; they stay in the soil to which they are applied, remaining detectable even 12 years later; they collect in the fatty tissues of wild and domestic animals. Animals are so widely affected that scientists have a hard time finding uncontaminated animals to serve as controls in experiments. For almost every human being on the planet, synthetic pesticides are present in mother's milk and probably in bodily tissues from the beginning. Chemical warfare in World War II led to the discovery of substances that were lethal to insects.

Whereas pre-war insecticides were simple compounds of naturally occurring minerals, the new synthetic pesticides are organic substances that have been carefully created by manipulation of molecules and atoms. Because they are organic, they can easily poison intended and unintended targets and become part of the bodily processes of numerous creatures. These substances work to stop the body's natural functions; some of them may cause cancer cells to begin growing. The use of these chemicals is now nearly worldwide. In 1947 less than 300,000 pounds were produced in the U.S.; in 1960, over 600 million pounds were produced.

Carson lists and describes in detail the pesticides that are poisoning the planet, explaining their chemical development. Arsenic, a naturally occurring mineral that is toxic to humans and most creatures, is widely used as a pesticide in various forms, despite the fact that it generally kills everything in its path. The chlorinated hydrocarbons include DDT as well as other deadly substances. The organic phosphorus insecticides such as malathion and parathion are another group of deadly substances that are in wide use (in 1962). The history of DDT is related, including its increasing appearance in stored body fat and organs rich in fatty substances, and its ability to produce drastic and devastating changes in the body even when present in extremely small quantities. There is disagreement among scientists about how much DDT may be safely stored in the body. Even people with no known exposure to DDT have been found to have it in their bodies. DDT is passed along through the food chain, so that feed contaminated with DDT passes it on to chickens; the eggs laid by those chickens are contaminated; and people eating the eggs are likewise contaminated. The even more readily absorbed and deadly poisons Carson details are chlordane, heptachlor, dieldrin, aldrin, endrin, parathion, malathion, and several herbicides that will be explored further in a later chapter. The ways these chemicals act upon creatures (including humans) are explained in detail.

Chapter 3 "Elixirs of Death" Analysis

Here Carson uses a detailed history of the specified deadly poisons, as well as a thorough explanation of how these chemicals are developed and work upon life forms, to build her case against their use. She again emphasizes the carelessness with which these deadly chemicals have been used, and gives gruesome examples of deaths that have occurred despite safety precautions that were thought to be sufficient but were clearly not. She ends by pointing out that many of these chemicals have been proven to be "mutagens," that is, substances that are capable of modifying the genes of organisms. Following the lessons of World War II and the now-understood horrific effects of radiation not only on those directly exposed but upon their progeny, she poses the question of how can we tolerate the same effect created by the deadly chemicals we willingly and widely apply to the land?

Chapter 4 "Surface Waters and Underground Seas"

Chapter 4 "Surface Waters and Underground Seas" Summary

The majority of the earth's surface is covered with water, but most of it is seawater, which is not usable for drinking, irrigation, or industry. There is widespread, critical shortage of fresh water across the globe. Much of the world's water is polluted by waste from many sources. Chemical insecticides and herbicides are a relatively new source of water pollution, and they bring unique challenges because they are difficult to detect and remove from water. They combine with other pollutants and substances in water to form new, unidentifiable substances that in some cases are known only as "gunk." Some water pollutants come from chemicals used on land, traveling down watersheds or in underground aquifers to the bodies of water, while others are applied directly to the bodies of water to control unwanted plants, insects, or fishes.

There have been instances of extremely high levels of contamination in particular water sources. In other cases, DDT and other dangerous chemicals have been found in water bodies and in the creatures living in those water bodies despite the fact that the chemicals had not been used anywhere near them; this is evidence that chemicals travel via groundwater. All the earth's water systems are connected, so that contamination of any part is contamination of the whole. One example of chemical pollution traveling via groundwater occurred in Colorado in the 1950s; in that case, the chemical that appeared in the water had actually been created spontaneously by the interaction of other chemicals present. Another example given is the Klamath/Tule Lake region in 1960, where agricultural pesticides are collecting in the water bodies of a wildlife refuge. Another example is Clear Lake, California, where attempts in the 1940s and 1950s to control a particular kind of gnat resulted in massive bird kills; the birds ate the fish, which ate the poisoned gnats. Further instances of direct poisoning of water sources continue to collect.

Chapter 4 "Surface Waters and Underground Seas" Analysis

Carson continues building her case as in this chapter she concentrates on the sometimes accidental, but often disturbingly deliberate, contamination of bodies of water. Again, she uses specific examples, citing studies and scientific measurements, to pile facts upon facts. Early in the chapter, she quotes an expert who says no one really knows the effect of the water contaminants on human beings; through successive citations of specific incidences of sickness due to pollution, she inductively disproves that statement; and by the end of the chapter, she points to studies that provide

compelling evidence that many chemical contaminants may cause cancer. She returns to her theme of the interdependency of all nature, reminding the reader that water is connected to the land and air - "in nature nothing exists alone."

Chapter 5 "Realms of the Soil"

Chapter 5 "Realms of the Soil" Summary

Without the earth's soil, there could be no plants; and without plants, there could be no animals of any kind. Life depends on the soil, and the soil depends on animal life to be replenished and nourished. Soil is constantly changing in the continuous cycle of life and death in which all materials and living things participate. The smallest organisms on earth live in the soil: bacteria, fungi, and algae. These organisms facilitate the process of decay, so that as living things die, they become part of the soil, providing habitat and food for more plants and thus, for more animals. Specific chemical processes are involved in this cycle of life and death.

Other creatures dependent upon the soil - and upon which the soil is dependent as well - are tiny insects and mites. Larger creatures, such as worms and insects and mammals, also live in the soil and do their part to keep it healthy and functioning. The earthworm is probably the most important soil-dwelling creature. The earth's soil is a community of living creatures, all interdependent, and the earth itself is healthy only as long as these creatures are. The effects on the soil of widespread chemical use have not been studied or even considered to any significant degree.

Chemicals used to combat "pests" inevitably have an effect on the soil-dwelling organisms. Studies are beginning to take place that show how the use of chemicals in the environment is harming the soil. Carson describes in detail some of the biological and chemical processes that are negatively affected by the introduction of pesticides and herbicides into the environment. Not only do these chemicals harm the soil, they remain in the soil for many years after application and can be converted to other, also harmful, substances. Repeated applications of chemicals to combat weeds or insects can build up enormous levels of chemicals in the soil. Arsenic, for instance, harms the soil on a virtually permanent basis. Plants growing in contaminated soil may carry the contaminants into their tissues. Carrots, for instance, absorb an enormous amount of insecticide. Some crops have had to be destroyed because they were found to carry huge levels of poisons, which would have harmed humans if they had eaten the produce. Other crops show signs of damage or stunted growth when planted in contaminated soil. Continued use of pesticides could very well damage our soil beyond repair.

Chapter 5 "Realms of the Soil" Analysis

Carson continues to build her case with scientific evidence. Here, she first explains how soil works to provide background understanding of the drastic effects of pesticides on such a vital element of the planet's health. Armed with an understanding of how microscopic organisms, earthworms, and other creatures work in harmony to create and maintain the earth's healthy soil, the reader can even better appreciate the strong

evidence Carson lays out in this chapter that the use of chemicals is not-so-slowly destroying our planet. Again, she uses specific examples, giving dates and locations and particular crops, to support her contention that chemicals should not be used in the widespread and careless way they are being used. She concludes the chapter with a strong quote from a 1960 gathering of specialists who stated that the continuing use and misuse of chemicals and radiation could very well result in destruction of the soil's ability to produce and a massive takeover by the insects.

Chapter 6 "Earth's Green Mantle"

Chapter 6 "Earth's Green Mantle" Summary

Water, soil, and plants create the world that sustains humans and all other animal life. Without plants, no animal life could exist - including humans, but humans hold a narrow view of plants, using them when they are immediately useful but destroying them if an immediate use for them is not obvious. Weeds are simply plants that are in the wrong place at the wrong time, as far as humans are concerned. The business of chemical weed killers is booming because people approach plant life without thinking about any perspective but their own immediate desires.

One example of man's arrogant approach to plants is the campaign in the American West to replace vast expanses of sagebrush with grasslands. There is an extensive explanation of the function of sagebrush within its ecosystem, and of its absolutely vital role in sustaining such creatures as the sage grouse, the pronghorn antelope, mule deer, and winter-grazing livestock. The program of sage eradication in favor of extended grasslands ignores the ecology of the region and threatens all the species that rely on the sagebrush to survive. Millions of acres of land covered with sagebrush are sprayed with chemicals yearly. The livestock that are intended to benefit from the replacement of sagebrush with grasslands will actually suffer and possibly die since vast expanses of grasslands will not sustain the same variety of life as the sagebrush. The spraying will also kill many other plants that are not intended targets. An example of this kind of disastrous scenario is the unintended decimation of willows in Wyoming, which along with the sage brush intended to be killed and the meandering streams sheltered by the willows, supported moose, beaver, trout, and waterfowl. All the animals that depended on the willows were destroyed.

Numerous other examples are given of widespread chemical spraying to control unwanted plants. In many cases, the spraying is killing wildflowers and other plant life that attract tourists, thus reducing or eliminating some regions' income from seasonal tourist trade. Roadsides once lush with wildflowers are brown and withered. In some cases, leftover chemicals have been discharged in unauthorized areas, rather than properly disposed of, and large areas of natural beauty have been destroyed. Farm animals have sickened and died. Flocks of birds have disappeared, no longer having habitat to rest in during their migrations. Pollinating insects have nowhere to live and eat, and nothing to pollinate.

Despite strong evidence that the best way to control unwanted plants is with other plants, widespread and indiscriminate spraying continues. "Selective spraying" can eliminate only the unwanted plants and give the beneficial plants a chance to thrive, but this method has been largely ignored. The selective method is also much less costly than the method of blanket spraying, and it minimizes the amount of chemical residue that remains in the land.

The widely-used herbicides 2,4-D, 2,4,5-T, and their relatives are extremely poisonous. People exposed to them even briefly have become very ill. These chemicals can change the metabolism of plants, making toxic plants suddenly more appealing to animals, resulting in severe illness or death for the animals. A number of examples are given of this unintended effect on livestock and wild animals, as well as a technical explanation of the effects of these chemicals on the physical processes of animals. Essentially, the chemicals alter the blood so that oxygen is not carried to the lungs; the animals die from lack of oxygen. Gases released by stored grains that were treated with these chemicals have killed humans.

Rather than using chemicals, Carson advocates using the existing relationships and interactions among different kinds of plants to control the plants we do not want. Marigolds can be used to combat nematodes, for instance. Wild habitats are needed as barometers of our larger environment. Chemical spraying can, in some cases, produce the result we want initially but later result in a takeover by the desired plant, which then itself becomes a "weed." Blanket spraying against a particular plant can actually result in an increased growth of that plant, defeating the purpose of the spraying. Battles against crabgrass provide an example of this situation, for crabgrass can grow only in an unhealthy lawn, and repeated spraying will make the lawn unhealthy. An example of controlling unwanted plants intelligently is the case of the Klamath weed, or goatweed, which was unintentionally imported from Europe to the U.S. In the 1940s, efforts to control this unwanted plant with its natural beetle enemies began; by 1959, a survey showed that these efforts had been hugely successful. No chemicals were used. Likewise, an imported variety of cactus was controlled in Australia by introducing a moth that is its natural enemy. This non-chemical control of the cactus was thorough and extremely inexpensive. Further use of such natural controls is warranted, not only because it eliminates the need to put dangerous chemicals on the land, but because it is so much cheaper an alternative.

Chapter 6 "Earth's Green Mantle" Analysis

Carson continues to build her case with example after example of the havoc wreaked by indiscriminate application of chemicals to the environment. In this chapter, she also ventures further into her overall argument by beginning to relate examples of natural control of unwanted plants by means of insects that are the plants' natural and exclusive enemies. The positive note of this chapter is a welcome change from the barrage of negative, horrific examples given earlier in the chapter and in previous chapters. Carson is effectively using stark comparisons between the horrible effects of chemicals and the beneficent use of existing relationships between certain organisms. She continues building her case that the use of chemicals is out of control and unnecessary, while the use of naturally occurring and highly effective control mechanisms is largely ignored.

Chapter 7 "Needless Havoc"

Chapter 7 "Needless Havoc" Summary

Carson lists some of the ways humans have done great damage to other life forms: the slaughter of buffalo, the massacre of shorebirds, and the near-decimation of egrets for their feathers. Now the chemical killings join this litany of destruction. Chemical insecticides applied to the land and water are killing every conceivable kind of creature. Birds, fish, and mammals of all sizes are dying, along with the targeted insects. Citizens must discern for themselves who is telling the truth: the wildlife biologists and forestry experts who decry the mass killing of so much life or the chemical-wielding entomologists who overlook the terrible flaws in their programs of blanket spraying. Carson encourages her readers to examine the evidence for themselves.

Wildlife is unlikely to bounce back after sprayings that kill large numbers of their kind. Spraying tends to be repeated, resulting in completely poisoned environments, where not only resident creatures are killed, but also those that migrate into the environments. This contamination spreads to areas outside the sprayed regions, resulting in more destruction of life. Numerous examples of drastic chemical applications are given. Large areas of Michigan were sprayed in 1959, purportedly to control the Japanese beetle. Widespread devastation of life resulted; numerous birds died, house pets sickened and sometimes died, and many people became ill as well. Nevertheless, spraying of aldrin and other deadly chemicals has continued, despite the fact that the population of Japanese beetles remains largely unchanged - and unthreatening to other species. Dieldrin was applied to a large area of Illinois over an 8-year period, resulting in huge losses of numerous kinds of animals, including pets. Meanwhile, in the East, the Japanese beetle was fought by the introduction of its natural insect predators and bacterial diseases. These predators and diseases affect only beetles of that family and so are not dangerous to any other living thing. In the eastern states, the beetles are under control, and nothing else had to die. Carson reports that research on these natural beetle controls have just begun in Illinois; perhaps this will result in eliminating unnecessary chemical spraying.

Carson ends this chapter by posing the question: How can we as moral beings continue to allow such rampant and unjustified killing of so many innocent and beneficial creatures?

Chapter 7 "Needless Havoc" Analysis

In this chapter, Carson continues in the vein she began in Chapter 6. She provides further evidence that chemical spraying results in widespread death and destruction and presents numerous examples of heartbreaking environmental devastation. She concludes with a vivid and disturbing word picture of the agonizing death suffered by a poisoned animal, and moves from the mode of layering scientific evidence into morality.

Her moral question is not simply a matter of whether man has the right to destroy other creatures in his environment, but whether silently acquiescing to such destruction diminishes each of us as a human being.

Chapter 8 "And No Birds Sing"

Chapter 8 "And No Birds Sing" Summary

In more and more areas of the U.S., spring begins without the once-familiar sound of birdsong. Birds are disappearing from communities that once enjoyed seeing multitudes of migrating birds. Spraying against such things as Dutch elm disease and fire ants has destroyed birds by the thousands. Spraying for Dutch elm disease began in the 1950's, with the immediate and devastating result of the death of the robins and other birds that lived and nested in the elms. The birds were eating their usual diet of earthworms. The earthworms had, as usual, dined on the mulch of elm leaves that fell each autumn and the DDT used against the elm disease that would not wash off of the leaves. The DDT collected in the earthworms in high concentrations, so that when the robins ate the worms, the birds were killed. Robins that escaped death became sterile, so that they could not produce healthy young. Large numbers of deaths have occurred for 90 species of birds as a result of DDT spraying of elm trees. Mammals also feed on earthworms and may be affected, and thus also the owls which feed on the mammals. Owls and hawks have been found in convulsions or dead. Treetop birds have also died as a result of the elm spraying. The loss of so many kinds of birds is devastating, not only for people who love to see them, but for the more practical reason that the birds had previously provided natural insect control. The insects come back from the spray attacks, but the birds do not - and then the insects are more numerous than before. Meanwhile, in areas of the country where natural controls of the elm disease have been undertaken, many more elms have been saved, without any destruction of bird and insect life.

Another bird that has suffered extensive population reduction is the eagle. Several studies suggest that this is largely due to pollution of the eagles' environment by DDT and other chemicals, which causes sterility and other devastating consequences. Studies on robins in areas previously sprayed with DDT have confirmed that DDT remains in the birds at least one generation after the spraying. Studies on the eagles suggest that contamination of fish, their main food, is killing them and preventing them from successfully reproducing healthy young.

In England, the treatment of seeds with chemicals has resulted in widespread bird deaths. The seed-eating birds, which survived long enough to be eaten by foxes, then became poison to their predators, which also died terrible deaths. In the U.S., the same problem has occurred with chemically treated rice; pheasants and waterfowl have been killed by eating the DDT-treated rice. In some cases, birds deemed "pests" are being targeted with chemicals directly, so that the bird losses because of chemicals include both accidental and intentional killings. Workers applying malathion have barely escaped death after becoming extremely ill.

All these examples have resulted from the inattention of millions of people on whose behalf those in power have authorized these mass killings and poisonings.

Chapter 8 "And No Birds Sing" Analysis

Carson continues to raise the stakes as she piles on the evidence against the use of chemicals. Here she returns to the theme suggested by the book's title, emphasizing the sudden silencing of so many birds. She introduces the idea that biodiversity is not only more interesting to look at but truly vital to life; part of the problem with the elm trees is that entire communities have been filled with nothing but elms, leading to mass devastation when a disease specific to those trees has invaded. She also briefly touches on some examples she will return to later in the book, such as fire ants. The theme of individual culpability by silent assent is underscored again at both the beginning and end of this chapter.

Chapter 9 "Rivers of Death"

Chapter 9 "Rivers of Death" Summary

For many thousands of years, salmon have returned from the Atlantic each year and traveled up the rivers in which they were born to spawn and perpetuate their kind. In 1953 in the Miramichi River of New Brunswick, the salmon migration happened as usual. By spring 1954, these tiny fish, along with their older relatives of the previous year's hatchings, were suddenly besieged by the Canadian government's widespread spraying program, which was meant to combat the spruce budworm. Along with all the insects and most of the birds in the millions of sprayed acres, the entire 1954 hatch of salmon died; five-sixths of the 1953 hatch died; and one-third of the 1952 hatch died. The budworm populations, on the other hand, continued to thrive. Repeated sprayings took place, despite evidence that spraying does not effectively combat budworm. Other places have also killed fish in their attempts to control forest insects. DDT may cause blindness in fish. Even if the fish survive the spraying, the virtual elimination of the insects that they feed on may kill them, or the fish may die some time after the spraying when they draw upon their fat stores for energy and release the DDT stored in their bodies. Efforts to coordinate sprayings to reduce fish mortality have been largely ineffective.

Natural parasites can be much more effective at controlling budworm, and fish will not be killed. It is impossible that with such widespread application of chemicals to the land, no chemicals will make their way into waterways. Destruction of fish and fish habitats are great losses in themselves, but they are also a loss to the millions of Americans who enjoy sport fishing. Commercial fisheries will also be affected because poisoned fish are not a source of food, and reduced numbers of fish reduce the fishermen's income and the amount of fish available as food. Numerous examples of fish kills across the U.S. are given. Many attempts to control fire ants have resulted in massive fish kills. Insecticides used against insects that feed on cotton have killed many fish in the South because of heavy rains following heavy application of chemicals to the cotton fields. Farm ponds are particularly susceptible to poisoning because of their proximity to chemically treated fields. In some parts of the world, fish from farm ponds are a vital source of food for humans. Where large spills of chemicals have migrated into streams and rivers, the deadly effects have occurred hundreds of miles away because the water has carried the chemicals downstream and into the sea. Creatures other than fish have been killed in devastating numbers; one example is the fiddler crab, which plays a vital role as a source of food to numerous other creatures, as well as a scavenger, mud aerator, and source of bait for fishermen. Some chemicals can kill animals such as shrimp at nearly undetectable levels, even half of one part per billion.

The ultimate effects of the pollution of virtually all of our waterways with chemicals, some of which are unknown because they are formed by the interaction of different substances, are unknown and unpredictable. If even a small fraction of the money spent

developing increasingly toxic chemicals would be diverted to research on natural methods of environmental control, perhaps our waterways could be saved.

Chapter 9 "Rivers of Death" Analysis

As she did with the birds in the previous chapter, Carson uses numerous examples of fishery devastation to build her case. The examples are shocking and convincing. The reader is left to wonder how his drinking water and favorite swimming or boating location can possibly be safe, considering the havoc wreaked on the poor fish. Carson is piling on the devastating facts as she mounts a thorough attack against any further use of deadly chemicals upon the environment. Once again, she calls on her readers, the public, to educate themselves and demand action and conscience from the authorities who are poisoning the environment. She repeats her theme of alternatives to deadly chemicals.

Chapter 10 "Indiscriminately from the Skies"

Chapter 10 "Indiscriminately from the Skies" Summary

Carson recalls the World War II origin of widespread spraying of chemicals as a result of the new organic insecticides and a surplus of airplanes. Before the war, such chemicals had been handled with extreme caution, and now they were dropped from the sky, in many cases without warning to the people living below. This chapter details two examples of spraying campaigns that had widespread and devastating consequences.

The first example is that of the gypsy moth. Despite successful natural controls of the moth in the northeast, a program of "eradication" of the moth by chemical spraying was begun in 1956. The program began with the spraying of nearly 1,000,000 acres. Despite complaints and strong opposition, the next year's spraying included 3,000,000 acres. Many of the areas sprayed were residential, despite the fact that the gypsy moth is strictly a forest insect. People and animals were sprayed directly. Milk from cows in and near sprayed areas was contaminated. Garden produce was ruined. Many lawsuits were pursued, and some were won by those whose produce, land, and livestock had been contaminated. The number of acres sprayed was severely reduced by 1961, but evidence showed that the gypsy moth had not been affected at all.

In the South, a program was launched against fire ants. Despite the fact that the fire ant posed no real problem to anyone, other than as a minor annoyance, a massive program of "eradication" was begun, preceded by a program of government-disseminated information about the "killer" fire ant. Some 20 million acres were to be sprayed. The claims made by the U.S. government about the fire ant were later entirely discredited. The fire ant does not destroy crops; in fact, it is known to eat insects that do destroy crops. The fire ants' mounds actually serve to aerate soil, and despite government claims at the time, fire ants do not kill people or birds. Despite numerous protests from environmental experts, conservationists, and entomologists, the spraying program was begun in 1958. In many areas sprayed, almost every form of life was killed. Carson gives numerous specific examples from different areas where the spraying was done. Farm animals stopped producing healthy young. The prescribed precautions issued by the government are by no means adequate to protect people and animals from contamination by the deadly chemicals. The government ignored existing findings which showed the chemical used to be deadly. Heptachlor, one of the chemicals used, changes form once it enters the environment or an animal to become heptachlor epoxide, which is even more deadly than its original form. The states in the sprayed area began protesting the continuation of the program. In many areas, there are more fire ants than before the spraying began. Florida has abandoned broad eradication in favor of local control. Local control, which is 90 to 95 percent effective, costs $.23 to

$1.00 per acre; the mass spraying costs about $3.50 per acre, is terribly destructive, and does little to combat the fire ants.

Chapter 10 "Indiscriminately from the Skies" Analysis

Here Carson uses two of the most egregious examples of out-of-control government spraying to show the far-reaching consequences of such programs. In both cases, the pest in question was not controlled even after massive chemical attacks, whereas countless other creatures were killed or sickened. This chapter concentrates on building up highly specific evidence and ends with a reminder that methods other than spraying millions of acres at a time are more effective and much more cost-effective. Carson leaves the moral conclusions to her readers this time instead letting the gruesome and appalling facts speak for themselves.

Chapter 11 "Beyond the Dreams of the Borgias"

Chapter 11 "Beyond the Dreams of the Borgias" Summary

This chapter is titled Mass spraying is not the only source of chemical contamination of our world. Indeed, most people's chemical exposure comes little by little, day by day, rather than all at once as a result of mass spraying. Most people have no idea what dangerous chemicals they are encountering in their daily lives. The insecticide aisle at the store is presented as innocuously as the rows of pickles and laundry detergents, and many poisons are even sold in glass containers which, if dropped, could expose people to highly toxic levels of deadly chemicals. Package warnings are printed in tiny type and have been found to be largely ignored by consumers. Household poisons include products such as insect sprays, insecticide-impregnated shelf paper, insect-repelling body lotions, insect-killing floor wax, bug-killing clothing applications, and electronic devices that emit odorless poisons into the air. Gardening poisons are available for every imaginable purpose, with increasingly easy-to-use devices available to apply the poisons to lawn and garden. One survey indicated that fewer than 15 percent of consumers were aware of the warnings printed on chemical packaging. Most consumers see only the pictures on the packages, which portray happy families romping on their chemically treated lawns.

Chemical residues in food are another source of gradual buildup of lethal chemicals in human body tissues. Only the most remote locations (such as near the Arctic Circle) remain immune to chemical contamination. Because almost all foods contain some level of such chemicals as DDT, human exposure is enormous in the aggregate. Meats and foods derived from animal fats contain the largest amounts of these chemicals because the substances are fat-soluble. Fruits and vegetables are also contaminated, and washing does not remove the chemicals. Cooking does not destroy them.

The government establishes legal limits for chemical contamination, but these limits are meaningless; the "safe" residues in or on all the foods we eat quickly add up to unsafe levels as we eat the foods and the chemicals are stored in our bodies. Also, there is little enforcement, so the allowable levels are frequently exceeded, either intentionally, ignorantly, or accidentally. Only interstate commerce is regulated, and most states' laws about chemical contamination are grossly inadequate - so food grown and sold within a state may be highly contaminated. The total exposure of each person to the most dangerous chemicals cannot be measured, so "safe" levels in individual foods are truly meaningless. Also, some chemicals are released for general use before their effects are known. With government oversight severely limited, even going to a "zero tolerance" policy is meaningless because the force of inspectors is far too small. Public education and awareness must be increased, and less-toxic chemicals must be used in place of

the highly toxic and deadly chemicals. Non-chemical methods of insect and weed control must be explored and put into wide use. Until that time, human beings live as if guests of the Borgias.

Chapter 11 "Beyond the Dreams of the Borgias" Analysis

Carson's two references to the Borgias - a medieval Italian family whose members were known for their murdering, poisoning ways - serve as thematic bookends for this chapter. Carson extends her previous call to action to consumers by providing evidence of the extreme ignorance with which most people use deadly chemicals. Having accumulated the disturbing facts about chemical contamination of the environment in previous chapters, here Carson concentrates on the most basic human need - food - and the enormous and largely unknown threat chemicals pose to our food supply. As if the silencing of birds and the widespread destruction of wildlife and ecosystems has not served as enough of a wakeup call, here Carson begins to build her case by concentrating on the direct effects of the deadliest chemicals on human beings. She again concludes by reiterating the need to eliminate the use of deadly chemicals altogether in favor of more natural controls.

Chapter 12 "The Human Price"

Chapter 12 "The Human Price" Summary

This chapter is titled Public health problems used to be caused by diseases such as smallpox, cholera, and plague. Infectious disease has been largely controlled through improved living conditions, better sanitation, and miraculous drugs, but now we have caused a new kind of public health crisis by introducing dangerous radiation and chemicals into our environment in huge quantities. The results of our actions in bombarding our planet with these unpredictable substances are equally unpredictable. Previous chapters have shown how pesticides have already drastically affected the water, soil, and food, as well as many species of wildlife and livestock - and how pesticides affect people in both the short term and long term. Long-term effects are easy to ignore as long as they are invisible, but they are there nonetheless.

Our individual bodies have a kind of ecology, just as the larger environment does. The effects of tiny amounts of chemicals on this minute ecology can be enormous. One changed molecule can affect the entire body system. It may be impossible to tell what is "cause" and what is "effect" because there may be years between the two. Chemicals that store themselves in fat may affect many processes in the body, right down to cellular function. The human liver filters many of the poisons to which we are exposed; over time, the liver may become damaged by these poisons from which it protects the body and thus become less capable of performing its function. Hepatitis and cirrhosis are increasingly common. The nervous system is highly susceptible to damage by the chlorinated hydrocarbons and the organic phosphates. Individual sensitivity to the various toxic chemicals is extremely variable, making the establishment of "safe" levels meaningless. Human beings are exposed to many different substances, some of which interact with each other in unpredictable ways, sometimes increasing their toxicity enormously. Carson gives a number of specific examples of drastic effects of chemicals on individuals' nervous systems. The temporary elimination of some insects will continue to result in horrific and permanent physical trauma, as long as we choose to use chemicals that directly affect the human nervous system.

Chapter 12 "The Human Price" Analysis

Once again Carson uses the technique of accumulating greatly detailed examples to make her point. Here she cites a number of instances of the severe effects of chemical poisoning on individuals, many of whom were permanently disabled by their exposure to allegedly "safe" substances. She begins by drawing the comparison between the ecology of the outside world and that of our individual bodies and pointing out that the intricacy of the planet's ecosystems is at least matched and likely exceeded by the minute and largely mysterious intricacy of our bodies. In previous chapters she has convincingly portrayed the eventual doom of the earth's various environments as a result of widespread chemical use; here she extends the reach of destruction to our

very selves, and again points the finger back at humans for being the agents of that doom.

Chapter 13 "Through a Narrow Window"

Chapter 13 "Through a Narrow Window" Summary

The narrow window referred to in the chapter title is the tiniest structure in the human body. Seen from far away, it reveals only a sliver of light - nothing more, but viewed at extremely close range, the smallest molecule reveals a whole universe of relationships and understanding of the incredibly intricate structure of the entire world - not merely the organism that houses that molecule.

Only recently has research revealed the indispensable function of cells in producing the energy required for life to continue. Without functioning cells, even our organs are useless, for cellular oxidation is the basis of all life function. Many of the chemicals we apply indiscriminately to our environment act to disrupt the vital cellular function that keeps us alive. This field of study is so new that those who were medically trained prior to 1950 may not be able to realize its extreme importance and the terrible hazards involved with widespread use of chemicals.

Every cell in the body is involved in producing energy. Our cells are tiny chemical factories, taking in carbohydrate fuel and converting it in a complex process of many tiny steps into energy. Only since the 1950s have mitochondria, the minute structures within cells that do so much of the work, been understood and appreciated for their extreme importance. Mitochondria contain enzymes that accomplish the work of energy production. Adenosine triphosphate (ATP) is the form of energy produced at each stage of the mitochondrial process; its ability to transfer energy from one place to another within the body is the secret to physical life. It is the "currency" of the life process. Without ATP, life would cease; essentially, organisms would burn themselves out because energy would be burned but not transferred, halting the cycle that keeps living things going.

Radiation and a number of chemicals easily serve to disrupt the energy-transferring process. There are a number of ways these substances can adversely affect the enzymes involved in the cycle of oxidation. An increase in such disasters as congenital deformities and the cessation of fertilized egg cell division has been noted, and as of 1961 the Office of Vital Statistics was conducting studies based on the increase in malformations at birth. The reproductive systems of all creatures are adversely affected by DDT and other chemicals, so that this drastic disruption of the "universal currency of energy" affects the capacity of all living things - including humans - to reproduce successfully.

The problem is not merely one of reduced reproduction, but of possibly severe damage to our very genes. Our genes carry thousands of years of adaptation and evolution to us, so that in theory each successive generation is more successful than its predecessor. Chemicals that act upon our genes can cause sudden mutations, producing new and undesirable changes in subsequent generations. Cell division is the

basic process of life creation for everything from amoebae to humans, but mutations as a result of the sudden influx of chemicals into our environment threaten this process that builds upon millennia of gradual adaptation to infinitesimal change. At the cellular level, life cannot cope with the onslaught of chemicals. Our understanding of chromosomes is extremely new from the perspective of the millions of years life has taken to reach the present, and our understanding of the effect of chemicals on chromosomes barely exists. Nevertheless, we bombard our environment with these chemicals; and now we are seeing the drastic effects they have on the most fundamental processes of all life. A number of examples are given of drastic mutation because of chemical exposure. Various chromosomal abnormalities discovered in humans are examined. We are now filling our environment with chemicals that have the power to alter our chromosomes and so alter the path of our genetic heritage, which is the result of millions or even billions of years of evolution. Chemical makers are not required to test their products for their effects on genetics, so they do not - at our peril and the peril of future generations.

Chapter 13 "Through a Narrow Window" Analysis

Carson again uses the technique of moving from a micro view to a macro view. She begins this chapter by focusing on the tiniest pieces of life, the cells and mitochondria and enzymes that function to keep energy flowing and life going. She builds upon previous chapters' emphasis on the drastic effects of chemicals on living things, now explaining the intricate processes of the cells and microscopic biological "factories" that enable us and all creatures to live. Having explained the complex and finely tuned process, she then explains the drastic effects radiation and chemicals have on the process. Then she builds further upon that foundation, explaining the newly understood function of chromosomes and the potentially dire effects of chemicals upon these building blocks of life. She ends this chapter as she has ended previous chapters, with a call to action that points out how we are only killing ourselves with our indiscriminate use of chemicals, but she builds upon this, too, by pointing out that damaging our chromosomes hurts not only us but also generations to come. Our irresponsible actions affect not only our present and future, but the very existence of humanity in the long term.

Chapter 14 "One in Every Four"

Chapter 14 "One in Every Four" Summary

Cancer has existed for so long that we do not know when it was first recognized. There are naturally occurring substances that cause cancer, such as radiation and arsenic. Life adapted to these threats, which are relatively few, but human beings alone among the planet's creatures have the ability to create carcinogens, which cause cancer. Soot is one carcinogen. The industrial era has brought many more. Because life, including human life, adapts to environmental changes extremely slowly, the carcinogens that man has created relatively recently in the span of history can have drastic effects on humans, as well as other creatures. Only since 1775 has the connection between external agents and the existence of cancer been recognized, and it was not until the latter part of the nineteenth century that various cancers were traced to exposure to certain chemicals. There has been a huge increase in the incidence of malignancy, and in our awareness of it, in fewer than 200 years. The American Cancer Society estimates that two out of three families will be stricken with cancer. Only 25 years ago, cancer in children was rare; now more American children die from cancer than from any other disease.

Animal experiment evidence has shown that as many as six of the pesticides Carson has been discussing are carcinogens. Others are thought to produce leukemia in humans. Still others may be indirect causes of malignancy. Arsenic is one cancer-causing substance. It has entered water supplies as a result of gold and silver mining and has caused regional outbreaks of numerous disorders, including malignant tumors. The widespread use of arsenic compounds as pesticides begs the question of when more such regional outbreaks of arsenic-related cancers and other diseases will occur. Not only humans but other animals, from sheep and deer all the way down to bees, have been known to develop arsenical diseases.

A chemical widely used to kill mites and ticks was eventually shown to cause cancer, but meanwhile, many thousands of people and other creatures were exposed to it. Several years elapsed before the Food and Drug Administration instituted a zero-tolerance policy on the chemical; before then, residues of this known carcinogen were allowable in food. DDT and other chemicals have been shown to cause cancer, yet these substances are still in use (in 1962). Some of these chemicals take many years to produce cancer, so that what may seem a "safe" level is really a level that will, eventually, rather than immediately, kill those exposed to it.

Unlike most cancers, Leukemia is a cancer that develops quickly. Since modern pesticides began to be used, the occurrence of leukemia has been increasing. Other cancers also have been shown to be the result of chemical exposure. Several examples are given of individuals who developed leukemia after direct exposure to pesticides.

The mysterious origins of cancerous cells are explored. Cancer appears in many different forms, and it is assumed that there are many different causes. One theory, the Warburg theory, is discussed involving damaged cells that survive through fermentation rather than respiration. This theory accounts for many of the huge differences among different species' experiences with cancer, such as variable cancer growth rates. It also may explain why repeated small exposures to chemicals may be more dangerous than one single blast. The latter might kill cells completely, while the former may damage them only to the point that they become cancer-creating cells. The standards Warburg established show that most pesticides are perfect carcinogens because they interfere with the process of oxidation so vital to continued cell health.

Another theory of cancer involves damaged chromosomes. Again, chemicals can easily damage chromosomes and so contribute to cancer creation and growth, or chemicals may cause mutations, which then foster cancer growth. Many chemical pesticides cause chromosome doubling, which can cause major physical problems, including cancer. Certain chemicals are drawn to bone marrow, and thus are very likely to cause leukemia in people exposed to them. Children who are growing quickly provide ideal environments in which malignant cells can multiply.

Cancer may be caused by a chemical indirectly. Some chemicals affect sex hormones, which in turn adversely affect the ability of the liver to resolve hormonal imbalances. This can lead to an excess of certain hormones, which at elevated levels will cause cancer. Even exposure to very low amounts of the chemicals may affect the liver's ability to keep hormones in balance.

Human beings are exposed to multiple chemicals that cause cancer. These exposures are uncontrolled. Exposure to certain substances may happen in many different ways, each one of which alone may be insufficient to cause harm; but in the aggregate result in cancer. Other substances may cause no harm until a person is exposed to both of them, so that their effects are combined, or one chemical may increase the danger of another substance - even something apparently innocuous, such as laundry soap. Cancer may be caused in a two-step process involving exposure to radiation and later to a chemical. Public water supplies are now frequently contaminated with detergents, which alone are not carcinogenic but can increase the susceptibility of certain body tissues to chemicals that cause cancer.

We live in a "sea of carcinogens," and some people approach this dire situation with the fatalistic view that we should concentrate on finding a cure for cancer because it is inevitable many people will develop the disease in our contaminated environment, but the better approach is twofold: cure as well as prevention. Just as we conquered many infectious diseases by improving sanitation and producing miraculous drugs, we must conquer cancer by finding a cure and eliminating the environmental poisons that cause cancer. Medical experts believe that even if a cure were found, the rate of new cancers would far outstrip the rate of cured cancer patients. The good news is that humans have the ability to remove carcinogens from the environment, in contrast to a rampant infectious disease that humans did not introduce into the world. By eliminating most of the carcinogens from our environment, we could greatly reduce the "one in four" statistic

of cancer affliction. The search for a cancer cure must continue for the sake of those who have already been exposed, in some cases over decades, to dangerous chemicals likely to cause cancer. For those not yet affected and for those not yet born, we can help prevent cancer by removing the substances that so clearly cause it.

Chapter 14 "One in Every Four" Analysis

Having developed the theme of chemical destruction to living cells in the previous chapter, Carson here elaborates by discussing the proven link between chemical exposure and cancer. For many people in 1962, this connection would have been relatively new because extremely dangerous chemicals were still being sold for household use as though they were innocuous to all but the targeted insects or unwanted plants. Once again, Carson uses extensive scientific evidence, including figures and quotes from medical experts, to build her case. She explains how chemicals are understood to cause cancer in cells - again, relatively new information at the time. The major point of this chapter is that many cases of cancer could be avoided simply by eliminating many of the man-made carcinogens from the environment. Carson is again pointing out the obvious solution, which also happens to be the best moral choice: humans must stop poisoning themselves and the generations of the future.

Chapter 15 "Nature Fights Back"

Chapter 15 "Nature Fights Back" Summary

Despite our efforts to control insect populations by mass application of new chemicals, the insects keep coming back. Insects are genetically adapting to the chemicals we use - they are becoming resistant, but even worse than that, our chemical attacks on insects have weakened entire ecosystems, so that the natural enemies of the targeted insects are destroyed, along with the targets. This creates an ideal environment for the unwanted insects to reinfest an environment where their unfettered reproduction will not be challenged. Humans have been ignoring the powerful forces at work in the balance of nature and arrogantly asserting their dominance, which actually shifts the balance against them. Humans have overlooked two critical facts: first, nature provides the best ways to control insects; and second, a chemically weakened environment opens the door to explosive insect repopulation.

Insects are controlled by limitations on the amount of food available to them and by other insects - often an ongoing struggle for survival that is completely invisible to most humans. Our lack of understanding has contributed to our arrogant and grossly overzealous application of chemicals to the problem of insect control. If we worked at understanding the balance of nature, we could use its secrets to control unwanted insects without doing harm to our environment and ourselves. Some insects hunt others; some insects are parasites to others; some feast on aphids by the hundreds. Many insects are our friends, yet we have killed them along with the unwanted insects by broadcasting lethal chemicals across thousands of acres of insect habitat. The balance of nature has already turned against us and will continue to do so as long as we continue to kill the good along with the bad.

Chemical battles against spider mites, red-banded leaf rollers, codling moths, and cotton-feeding insects have resulted in explosions in their populations. Likewise, chemical attacks on insects such as the fire ant and the Japanese beetle (see Chapters 10 and 17) resulted in sharp increases in the crop-destroying enemies of those insects: the sugarcane borer and the corn borer. Trying to eliminate one destructive insect in these cases resulted in a huge increase in an even more destructive insect. Ironically, the extremely destructive corn borer is easily controlled by the introduction of its natural insect enemies - which cannot survive intense chemical attack. In the 1870's in California, a scale insect highly destructive to the citrus crop was controlled by the introduction of vedalia beetles, a parasite of the scale insect. Then in the 1940's, chemicals began to be used for insect control in the citrus orchards, wiping out the vedalia in many areas. The scale insect quickly reasserted itself, and many expensive crops were destroyed. Similar examples are given of cases involving disease-bearing insects, in which the insects' natural enemies were destroyed by manmade chemicals applied indiscriminately.

Chemical companies give enormous amounts of money to universities to support further chemical research, but hardly any money is given for research on natural, biological controls. Natural controls do not provide the chance of making a fortune, but they are the only way the planet will survive in balance. A program of natural controls in Nova Scotia has proven that expensive chemicals are not necessary. Human beings must give up their arrogance and learn to work with nature rather than battling against it.

Chapter 15 "Nature Fights Back" Analysis

Here Carson returns to the theme of natural insect control, building upon it by pointing out how poorly chemical control has worked. Indeed, in many cases chemical "control" has resulted in renewed and even greater outbreaks of unwanted insects. Carson continues using the technique of piling fact upon fact and example upon example to build her case. She continues to add examples of the arrogance and apparent stupidity of those who apply huge amounts of chemicals with disastrous results - even in some cases after natural controls have been instituted and used with great success for many decades. The chapter ends on a positive note, with a glowing example of natural insect control that has the added advantage of being much cheaper than chemical control. She again sounds the warning that humans must stop poisoning the world and instead must learn to work with the amazingly intricate checks and balances provided by nature.

Chapter 16 "The Rumblings of an Avalanche"

Chapter 16 "The Rumblings of an Avalanche" Summary

As humans continue to subject the entire environment to intensive chemical spraying, weaker insects are being killed off, and stronger insects are becoming resistant to the chemicals. Earlier, pre-DDT-era chemicals had become ineffective against some insects; Carson cites several instances. Post DDT, insects began to become resistant to chemicals more quickly. Now people interested in combating disease-carrying insects are realizing the seriousness of the situation because insects carrying deadly diseases grow to be immune to chemicals. This chapter's title comes from a quotation by a scientist who says the rapidly growing list of insects that have developed resistance to chemicals may be the "early rumblings of what may become an avalanche in strength." Resistance can develop very quickly.

Many insects carry infectious diseases that are deadly to humans: mosquitoes (malaria, yellow fever), houseflies (dysentery and eye diseases), lice (typhus), fleas (plague), tsetse flies (sleeping sickness), ticks (fevers), and many more. The use of chemicals to control these insects is no longer working, and indeed may have destroyed the natural forces that could be put to use in combating these disease carriers. The insects persist in developing resistance to each successive new chemical. A number of examples are provided of insects repeatedly developing resistance to multiple chemicals. In many cases the diseases the insects carry have regained a foothold because of the failed chemical control of the insects. In some cases, application of the chemicals has actually increased the population of the chemical-resistant insects.

Many cases of chemical-resistant insects have cropped up in the U.S., including the salt-marsh mosquito, house mosquito, wood tick (vector of spotted fever), brown dog tick, and German cockroach. Agricultural pest insects have also begun to develop resistance to chemicals intended to control or eradicate them. It is unrealistic to expect to stay one chemical step ahead of the insects forever, yet that seems to be the approach of many in the chemical industry and farming.

The development of chemical resistance is a perfect illustration of natural selection. The weak insects are killed while the "tough" insects survive and propagate, creating more insects with the "tough" characteristics. Scientists do not really know how insects develop resistance. Some develop resistance within a few months, while others take up to 6 years. Some people ask whether humans could develop resistance, but this is completely unrealistic; human generations last about 33 years, while several insect generations come and go within a month or so. Humans simply don't have time to wait hundreds or thousands of years until they are able to develop resistance. We must change our approach to the use of chemicals for attempted insect control.

Chapter 16 "The Rumblings of an Avalanche" Analysis

This chapter serves as the denouement or crucial turning point in Carson's carefully crafted argument: not only do chemicals harm the environment and human beings, but ultimately they do not even work against the insects they are intended to destroy. As in earlier chapters, she augments her argument with layers and layers of frightening facts. She pounds home the conclusion that the only outcome to greater and greater application of chemicals is total decimation of the planet's life, and she quotes a Dutch scientist as a sort of voice in the wilderness, proclaiming the desperately needed switch from chemical to natural means of insect control. The quotation asserts that humans' arrogance and ignorance will be their downfall, and that what is needed is patient cooperation with the powers of nature.

Chapter 17 "The Other Road"

Chapter 17 "The Other Road" Summary

In our use of ever-increasing levels of dangerous chemicals in our environment, we have been traveling a road that seems easy but will end in disaster. The other road of this chapter's title is the path of non-chemical control of unwanted insects and plants. Only by this "other road," the "one 'less traveled by,'" can we ensure our planet's survival. It is up to us to assert our right not to be poisoned.

A huge variety of alternatives to the dangerous chemicals used ineffectively against insects is available. Whether they are already in use or in laboratory development or exist so far only in the imaginations of scientists, they are biological solutions based on the whole of nature and its intricate network of so many different kinds of life. It is becoming increasingly clear that insecticides are more harmful to humans than to the insects we have sought to control with these chemicals.

One alternative method of insect control is sterilization, in which sterilized males of the species are introduced into the environment. When the sterilized males mate with females, the life cycle is interrupted, and a whole generation of insects is eliminated. Populations of pest insects such as the screw-worm have been wiped out with the method of disseminating large numbers of sterilized males. A number of other species are being tested for susceptibility to control by sterilization, in hopes that populations of disease-carrying insects, such as the tsetse fly, may be greatly reduced, thus improving healthful living conditions for thousands of humans and livestock. Experiments are being conducted to test various methods of insect sterilization, some of which are chemical. We must exercise extreme caution, however, because widespread use of these new chemicals might put us in even deeper trouble that we are already in.

Other biological means of insect control being studied include methods that use insects' own processes - such as venoms, attractants, and repellants - against them. Scientists are studying the chemical makeup of these substances, as well as of insect hormones. One success story is the creation of an artificial gypsy moth male-to-female lure; the fake lure is used to bait traps that capture the males for census work. Such a false lure might also be used to control the moths' population. Another possible way to control some insects is through manipulation of their extreme sensitivity to certain sounds.

Still other biological means of insect control have been around for many years. These involve manipulating the diseases and infections to which insects are susceptible. As mentioned in previous chapters, the hunter-and-prey relationship between certain kinds of insects can be used against the undesirable insects. Similarly, bacteria and viruses and other microscopic creatures can be used to attack particular insects. A number of tests are being conducted on various crop-destroying insects around the world. Such methods are safe for humans because insect diseases are highly specific to insects; they are completely different from diseases that affect people. Since 1888, about 100

species of insect predators and parasites have been introduced and established in the U.S. to combat unwanted (often accidentally imported) insects. Only California has a formal program in biological control of insects; unfortunately, such research does not receive the monetary support that continues to be lavished on chemical research programs.

Forests offer an incredible opportunity to cooperate with nature in controlling unwanted insects. Canada and Europe have gone much further than the U.S. in developing real "forest hygiene" practices, especially the strong support of birds through nesting box programs and the like. In Germany and Italy, red ants have been used very successfully to protect reforested areas. Spiders are a huge part of the work of a pioneer in the field of natural forest protection, Dr. Heinz Ruppertshofen. Incredible insect control can be achieved by maintaining an adequate spider population. Canada has used small mammals for similar purposes. A single shrew can eat up to 800 sawfly cocoons in one day.

The key is to be imaginative, creative, and cooperative with nature's inherent balances. The use of poisons has failed terribly and continues to fail despite ever-increasing efforts to find new and better poisons. We must stop trying to beat nature with the club of man-made poisons and learn to work within the intricate structure of the earth. If we do not, we will destroy the earth and ourselves.

Chapter 17 "The Other Road" Analysis

Carson ends her book with a strong, positive call to action. She provides a spark of hope by providing details about numerous efforts at natural insect control that in many cases have succeeded beyond expectation, even where chemical application has failed miserably. She emphasizes the miraculously interwoven relationships among the thousands of species on the planet and the hope that we humans can give up our arrogance and brutality before it is too late. In contrast with the nightmare-fairytale described in the first chapter, with its "once upon a time" tone that suddenly twists into a macabre reality, this chapter provides a hopeful but realistic possibility for the future - if only we listen and demand change.

Characters

The Chemical Industry

Because Carson refrains from naming particular corporations, the pesticide makers assume the monolithic shape of an evil empire in *Silent Spring*. Yet Carson does not preach at the industry .Yes, it develops hundreds of new deadly toxins a year, and, through disinformation and pressure on government agencies, it promotes their widest possible use□the book is very clear about these things. But Carson seems to view such activity as natural to the commercial enterprise and wastes no time calling on pesticide producers to reform themselves.

The Government

The government is the other great villain in Carson's story, and though one might think it is the chemical industry that bears primary responsibility for what has occurred, she is much more critical of public servants. Her thinking seems to be that more is to be expected of government. In succumbing to political pressure and helping pesticide makers promote their products, she argues, government has lost sight of its *raison d'etre* (reason for being), protecting the public interest. Carson holds that instead of echoing industry disinformation and spending taxpayers' money on reckless pest eradication programs, agencies like the Department of Agriculture and the Food and Drug Administration ought to impose stricter controls on the development, sale, and use of dangerous chemicals and to fund more research.

Nature

An overview of key figures in *Silent Spring* that did not mention nature would be quite incomplete. In terms of the amount of attention that is devoted to them, plant and animals are the most important "characters" in the book, surpassing humans by a wide margin, who are the focus of just a few chapters. Still, despite the almost infinite variety of life forms that Carson mentions, there emerges a single image of nature that has a crucial function in Carson's case against pesticides: nature as a fabric of life in which all things are connected, from the smallest of soil microbes to human beings and other large mammals. If readers accept such a view, they must also agree with Carson that the sledgehammer-like approach of current pest control□introducing large amounts of extremely toxic chemicals into the environment to eradicate a few species of insects□ is indefensible.What poisons one part of the fabric of life poisons the whole.

The Public

Along with wildlife, the public is a major concern in *Silent Spring*. The image the book projects of this collective entity is that of a victim of the chemical industry, betrayed by

irresponsible public officials and exposed to toxic pesticides at every turn. As the terrible side effects of pesticides become clearer, the public begins to ask questions, demand answers, and insist on greater responsiveness from government agencies.

The Visionaries

The heroes of *Silent Spring* come from several walks of life: scientists laboring patiently in an often tedious and seriously underfunded area of research to determine the precise scope of the pesticide threat; birders and other amateur naturalists, whose careful observation of wildlife in the field yields essential information about the problem; activists driven by a deep concern for their communities and the natural environment to challenge industry and government to behave more responsibly; and philosophers, writers, and other thinkers who help citizens understand the cultural sources not just of the pesticide problem but of the whole range of trouble that modern civilization has stirred up with technology .What all of these individuals share is an uncommon power discernment. Simply recognizing the broad impact of pesticides on the environment and health is a significant achievement. What makes Carson's visionaries even more remarkable is their having probed this tricky problem with great precision in the face of widespread disinformation and obstruction.

Themes

The Science of Pesticides

One of the great insights of *Silent Spring* is its grasp of the pesticide problem as a compound one. On one hand, there are the intrinsic dangers of these chemicals: their capacity to disrupt basic biological processes, their persistence in the environment, and so forth. But Carson knew that the manner in which a dangerous substance is also crucial. To understand how compounds like DDT and malathion have come to threaten life on a global scale, one has to examine what has been done with them. Each of the major themes of *Silent Spring* belongs then to one of two lines of argument; the first concerns the raw toxicity of pesticides, the second the recklessness with which they have been employed.

Along with atomic fallout, the synthetic pesticides that came into wide use after World War II are the most dangerous substances man has ever created. The heart of the problem, science has shown, is the pesticides' unique capacity for disrupting critical biological processes like metabolism and cell division. Acute exposure can cause catastrophic systemic problems□paralysis, immune deficiency, sterility, etc.□and small doses repeated over time can lead to grave illnesses like cancer.

Carson attributes this radically disruptive potential to the distinctive molecular structure of synthetic pesticides. Part carbon, they mimic the substances that are crucial to life (enzymes, hormones, etc.) and so gain entrance to sensitive physiological systems. Once inside these vital systems, the elements to which the carbon is bound (chlorine and other deadly materials) wreak havoc on the organism.

Two other properties that increase the hazard of pesticides are, first, the slow rate at which they break down and become less toxic, and, second, their tendency to accumulate in fat tissue. It is these characteristics that make even low-level exposure to pesticides so dangerous. A dose that is too small to cause immediate harm is stored in the body and remains active for a considerable period; with each subsequent exposure the cumulative "body burden" increases, and along with it the chance of serious illness. These properties also put species at the top of the food chain at special risk because they absorb large amounts of pesticide from the lower organisms they consume, a process called "biomagnification."

The Culture of Pesticides

Carson takes great pains to show that it is the imprudent use of pesticides, as much as their intrinsic properties, which makes them one of the worst health threats of the twentieth century. Dosing blankets with DDT, spraying densely populated neighborhoods from the air, and pouring pesticide into ponds to kill mosquitoes might have poisoned the planet if not for *Silent Spring*. From the vantage point of a more

environmentally conscious age, it is difficult to understand how such practices could have been so popular. Years ahead of her time, Carson was dumbfounded.

As nearly as Carson could figure, mid-twentieth-century attitudes toward synthetic pesticides were warped by a trio of interacting forces: the chemical industry, government, and what she calls "Neanderthal science." In calling science "Neanderthal," she has two characteristics of contemporary methodology in mind. The first is the extraordinarily high degree of specialization. Knowledge might appear to advance at a faster pace along the narrow paths of modern research, but it has also become more fragmented; the entomologist developing a pesticide to control the hungry gypsy moth, for example, is unlikely to know much about the chemical's harmful effects on non-targeted organisms such as birds and fish. The second defect of science, especially in the applied areas, is its habit of conceiving problems in military terms, an outlook it shared to some degree with culture as a whole in the aftermath of World War II. Solutions are always seen to depend on exerting the greatest possible force over an "enemy." This logic expresses itselfin pest management strategies that advocate applying the most lethal substances available in saturating quantities to eradicate entire species. As an alternative to the "total war" approach to solving problems, Carson proposes an approach that exploits the natural tendency of systems to seek balance; with a little help, it has been proven time and time again, the natural environment can solve its own problems cheaply, safely, and effectively. *Silent Spring* recounts some elegant, low-intensity, "biotic" interventions, such as cultivating certain plants to encourage species that compete with pests or introducing a pest-specific disease into a blighted area.

The second major culprit behind the overuse of pesticides is the chemical industry itself. The corporate giants use their enormous political leverage to co-opt government agencies and engage in large scale disinformation campaigns to defuse growing public concern about synthetic poisons. To a certain degree, the short-sightedness of science described above is itself a product of industry influence: because pesticide makers are the largest funders of research in the field, most investigation tends to harmonize with corporate interests; hence the paucity of knowledge about the risks of synthetic chemicals and the limited effort to develop safer, "biotic" alternatives. It is worth noting that, as outrageous as the posture of the industry might appear to some, Carson eschews moralistic argument to make a case that is all the more compelling for its sheer pragmatism. Pesticide makers, she concedes, will always have as their sole concern the profitable sale of pesticides. But if it is absurd to expect them to take a broader view, she concludes, it is just as unreasonable to allow them any role in the process by which public policy on pesticides is determined, a process in which the primary concern must always be saftey.

Style

Clarity

A writer's style is always at some level shaped by her purposes, and these can usually be identified without too much difficulty in a work of nonfiction. Indeed, in the case of *Silent Spring*, Carson really only has one aim: to raise public awareness about the dangers of pesticides with the ultimate goal of bringing about more prudent pest-management practices. What stylistic necessities does this task im pose on the writer? The first is accessibility. If her message is aimed at the public, then she must write in a manner that is suitable for the widest possible circle of readers.

The second imperative arises from her determination not merely to inform readers but to motivate them to activism. Carson must put the case in such a way that individuals feel obliged to get involved.

Finding a style that is suitable for a general audience is tricky in writing a book like *Silent Spring* where so much technical information must be presented. The writer must make the complex comprehensible but avoid doing so in a manner that oversimplifies and therefore undermines the authority of scientific information. Carson had been doing just that for over two decades, first as a science writer for the federal government, then as a bestsell-ing interpreter of marine biology. Not surprisingly, her technique is easiest to examine in those sections of *Silent Spring* that focus on the most complicated matters□chapters like "Elixirs of Death" (on pesticide chemistry) and "Through a Narrow Window" (on cell biology).

In these two chapters readers find chemical nomenclature ("dichlor-diphenyl-trichloroethane"!), passages on neurophysiology, debate about toxicity reckoned in "parts per million," and exotic terminology drawn from cell biology. Though one might think it counterproductive to include such language in a book aimed at a general audience, Carson is careful not to go too far, and the ultimate effect is quite positive. Not only does the scientific nitty-gritty lend the argument an irresistible objectivity and authority, but the author's own ease with this complicated material builds trust in the reader. What keeps readers afloat in this tide of esoterica (knowledge or information known only to a small group) are Carson's clear explanations. Never does she touch on a technical subject without a clarifying digression, even if it requires a paragraph or two. The unfailing success of these passages lies mainly in her ability to make the abstract concrete. For example, organic chemistry is elucidated through metaphor; the component substances are described as "building blocks" that chemists assemble into more elaborate "Lego"-like compounds. The effects of pesticides on cellular metabolism are likened to the overheating of an engine.

Persuasiveness

Carson hopes to incite her readers to action, and the scientific data, no matter how well explained, lacks the requisite emotional appeal. To get readers to care about problems like the estrogenic properties of organic chemicals and the depletion of adenine triphosphate, Carson must make them not only understandable but also meaningful.

Carson's solution is to use highly charged language to keep the human implications of the pesticide problem in the foreground. For every use of the word "herbicide," for example, there is one of "weed-killer." The following fragments are culled from just the first few pages of *Silent Spring*: "Lethal," "battery of poisons," "endless stream" of new chemicals, "violent crossfire" of pesticide use, "fanatic zeal" of pest-control agencies, "tranquilizing pills" of chemical industry disinformation, "agents of death," "havoc," "indiscriminate " spraying.

Still more striking are those passages in which Carson uses such language to paint unsettling images of acute poisoning in animals and humans: birds losing balance, suffering tremors and convulsions, and then abruptly dying; a baby vomiting, experiencing a seizure and unconsciousness, and ending up a "vegetable"; a housewife wracked by fever and never-ending joint pain. Few things affect readers as powerfully as the specter of death, and Carson conjures it again and again in *Silent Spring*. Pesticides are associated with some of people's worst fears, and she does not hesitate to exploit the connection, evoking among other things the long agony of cancer and the heartbreaking spectacle of children plagued by birth defects.

In such a fashion, the writer virtually assures that readers will become anxious about the problem. Many commentators have noted that Carson very cannily draws an analogy between pesticides and radioactive fallout, a comparison that could not have failed to unnerve readers at the height of the Cold War. But there is quite enough haunting imagery in *Silent Spring* for it to have stirred up the public even without that powerful association.

Historical Context

The Rise of Synthetic Pesticides

So influential a role did Carson's *Silent Spring* play in the quickening of concern about pesticides that it is often assumed that she was the first to call attention to the problem. But pesticides had been in wide use since the nineteenth century, and debates about their effects on health had been going on for decades. But the nature of the chemical threat changed dramatically after World War II, and Carson was the first popular writer to explain this development to Americans.

During the early twentieth century, the most commonly used chemical pesticides were arsenic compounds. They were deadly enough to cause a few health scares, but a far cry from the poisons that wartime chemical weapons research bequeathed to the world□an entirely new and ever expanding family of man-made toxins called organochlorines, the most notorious of which was DDT. The new pesticides were more lethal than their predecessors, more numerous, and more widely used. They also stayed toxic over a long period, accumulated in the body, and concentrated in the food chain. By the late 1950s, a handful of scientists, naturalists, and attentive citizens could hear the "rumblings of an avalanche"; ecological and public health problems of unprecedented proportion were beginning to come into view. Rachel Carson was the first to bring this emerging crisis to the attention of the general public in a compelling way.

Science, Technology, and Nature

Since the very first days of the industrial revolution, technology has always been a mixed blessing. It has helped humans to create and to destroy; it has both enriched life and impoverished it. Until perhaps the present moment, which has seen such extraordinary breakthroughs in information science, genetics, and astrophysics, the mid-twentieth century was the most dizzying era of all time on the technological front. The pace of progress, the breadth of innovation, and the size of the strides were quite unprecedented. It was the age in which humanity got its first taste of ultimate power in areas such as organic chemistry where scientists created substances that never occurred in nature, and physics, which spawned the atomic bomb.

Rapid progress has always been intoxicating, and the mid-century boom was no different in this respect. In the heady early years, it seemed that the new know-how would allow civilization to solve all of its problems. But soon this optimism disintegrated in the usual way: the physical universe turned out to be more complicated than it had appeared, and once-powerful tools rapidly exhausted their usefulness. What set this particular phase of disillusionment apart from earlier ones was civilization's recognition that, for the first time in history, technology could threaten life on a global scale. The end result was not just more modest expectations about what science could achieve at that

moment, but a series of major social movements (environ-mentalism, the anti-nuclear movement, etc.) that saw humanity's only hope for survival in a radical reconception of its relationship to the natural world. *Silent Spring* sprang from this loss of faith in science and technology and also intensified it.

Critical Overview

Critics writing about *Silent Spring* when it first appeared disagreed very little about the author's literary gifts. An anonymous reviewer for *Life* magazine called the book vivid, a work of great "grace" by a "deliberate researcher and superb writer." *Time's* reviewer echoed much of this praise; once again, Carson was said to be a "graceful writer" who demonstrated considerable "skill in building her frightening case." In assessing the book's claims, however, the early reviews were sharply divided. Periodicals aimed at birders and other nature-oriented readers, who likely already knew something about dangers of pesticides, found Carson's argument unassailable. The mainstream press, on the other hand, was skeptical on the whole. Some of the resistance stemmed from a natural reluctance to accept what was, after all, a shocking proposition□the technological "miracle" of pesticides, long claimed to be safe by the chemical industry and trusted government officials, was a Trojan horse that threatened life on a global scale. For example, the reviewer for *Life* found much that was compelling in Carson's "amply buttressed" argument, anxiously hoped that she had "overstated her case" in predicting widespread destruction.

The scenes she describes so vividly□the neighborhood where all the robins perished after eating DDT-engorged earthworms, the woman who died of leukemia after repeatedly spraying spiders in her cellar, the salmon streams emptied by seeping poisons□are all true enough. But they are isolated examples.

One can only conclude that the critic was groping for reassurance here in turning away from the obvious point of Carson's catalog of pesticide disasters, which was that the incidents alluded to were harbingers of worse, more widespread trouble. That he largely shared the author's concerns is clear enough in the review's conclusion where he called for the very same remedies that *Silent Spring* urges: tougher restrictions on pesticide use and more government funding for research.

Not all of the skeptical reviews were as friendly as *Life* magazine's; *Silent Spring* was the target of a well-funded smear campaign by the chemical industry, and a startling number of the early critics align themselves with that effort in one way or another. Indeed, in a magazine as influential in the shaping of public opinion as *Time*, there appeared a review that so harmonized with the position of pesticide makers that its author, if he was not in fact an industry hatchet man, might as well have been. Calling Carson a "hysterical" woman, the reviewer employed the industry's favorite attack on her and then presented fragments of some of the harshest passages of *Silent Spring* in an attempt to make its author seem unbalanced. For example, he cited her "emotion fanning" claim that DDT is found in mother's milk and her claim that people "can't add pesticide to water anywhere without threatening the purity of water everywhere." Elsewhere the distortions are even more pronounced, as where he called the writer's advocacy of biologic pest management "reckless primitivism." So egregious are the misreadings and lapses that it is hard not to conclude that the review's object was damage control, not rational debate about the issue.

Since the publication of *Silent Spring*, critical opinion of the book has changed in three important ways. First, no one questions the soundness of Carson's argument anymore; forty years of scientific research has confirmed virtually all of the book's major claims. The second change is related to the historical importance of *Silent Spring*, often called the *Uncle Tom's Cabin* of modern environ mentalism. In "The Reception of *Silent Spring,*" Craig Waddell offered one of the most concise assessments of the book's significance.

Ernest Hemingway once wrote that "[a]ll modern American literature comes from one book by Mark Twain called *Huckleberry Finn."* It would not be too much of an exaggeration to make a similar claim for *Silent Spring's* relationship to the modern environmental movement. Although the American environmental movement traces its roots to such nineteenth-century visionaries as Henry David Thoreau, George Perkins Marsh, and John Muir□all of whom were concerned with the preservation of the wilderness□ the modern environmental movement, with its emphasis on pollution and the degradation of the quality of life on the planet, may fairly be said to have begun with one book by Rachel Carson called *Silent Spring*.

Today, more and more critics are turning their attention to historical considerations. Several examples of such work appear in a recently published anthology of essays called *And No Birds Sing*; for instance, Ralph Lutts argues that the book's initial popularity was in some large measure attributable to the panic over atomic fallout, and Cheryll Glotfelty shows how Carson's critique of "man's [pesticide] war against nature" exploits the tropes of Cold War discourse.

The third major change in the criticism of *Silent Spring* might be guessed from comparisons of Car son's book to *Uncle Tom's Cabin* and *Huckleberry Finn*. Having earned a place among the American classics for its historical significance, it is now the object of the close textual scrutiny always given to such works. *Silent Spring* is treated as a literary text across the usual range of interests: in "An Inventional Archaeology," Christine Oravec looks at Carson's manuscript to learn about the book's composition; Edward Corbett's "A Topical Analysis" examines the argument through the lens of classical rhetoric; and "*Silent Spring* and Science Fiction" by Carol Gartner points to its generic kinship with science fiction. Given Carson's considerable talents as a writer, this recent interest in literary dimensions of *Silent Spring* seems on the whole a promising development.

Criticism

- Critical Essay #1
- Critical Essay #2
- Critical Essay #3
- Critical Essay #4
- Critical Essay #5

Critical Essay #1

Hart has degrees in English literature and creative writing, and she is a copy editor and published writer. In this essay, she examines Carson's references to potential human suffering as a result of the overuse of chemicals as presented in her book Silent Spring.

Given time, states Carson in her book *Silent Spring*, nature will heal itself. "Life adjusts." At least this was true through the previous millennia. But in the modern world, humans are quickly running out of time. Carson even says that "there is no time" left, because modern-day humans are creating havoc at a pace too fast for nature to heal. Modern civilizations are not only quick in creating devastation, they are also broad-ranged, as they are creating synthetic substances that have "no counterparts in nature." Nature will need generations of time to cleanse herself from the toxic pollutants. Carson wrote her book in 1962 as a warning, and since then, things have only gotten worse.

It is through no fault of Carson's that people have not heeded her warnings. Actually, many people have heeded them, but still the chemical companies prevail. Carson died in 1964 of cancer. Who knows if the source of her illness was the chemical carcinogens in her environment. Maybe she sensed her own fate, and tried with her writing to save the generations that were to come after her. How she did this can be found in her book in which she carefully lists all the chemicals that were beingproduced in her lifetime, as humanity made every attempt to control nature. But her book is not just a catalog of deadly poisons; it is a book about suffering, potential as well as actual. It is about nature suffering in all levels of her myriad forms. It is also a book of what people are doing to one another and to themselves.

Humans are subjected to "dangerous chemicals, from the moment of conception until death," Carson states. Chemicals are everywhere. They are in the soil, water, and air. They are found in almost every household: under the bathroom sink in the form of cleaners, on shelves in the garage in forms of paint thinners and glues, in the kitchen in form of insecticides, in the bedroom in the forms of hair sprays and other cosmetics. They are present in food and drink, even in the milk that mothers produce from their own bodies; they are even present "in the tissues of the unborn child."

The chemicals that Carson focuses on are those whose prevalence began during World War Two, "in the course of developing agents of chemical warfare," and were first promoted on a commercial level when it was discovered that these chemicals were useful in killing insects. But what Carson believed was the worst element of these chemicals was not that they were capable of poisoning but that these new chemical discoveries were capable of making potent and irreversible changes on a deep, biological level in every living thing on earth. These new synthetic chemicals could enter the plants as well as animals and "change them in sinister . . . ways. . . . They prevent the normal functioning of various organs, and they may initiate in certain cells the slow and irreversible change that leads to malignancy." Carson was ahead of her time. She sensed scientific truths that would not be proven until after her death. She sensed the cancers that would become more and more commonplace.

Carson warns mankind in part by listing details of the incredible number of new chemicals that are being produced each year. She lists their names and their effects, explaining that "if we are going to live so intimately with these chemicals□eating and drinking them, taking them into the very marrow of our bones□we had better know something about their nature and their power." But it is not until she gets very up close and personal in her discussions that the full power of her book takes effect. The lists of chemicals and their potential power are daunting, nightmarish material, but names don't make the same impact as the fear of suffering and pain. Andthe source of some of that potential suffering might be as close as the nearest water fountain. For example, it is alarming to know that chemists are creating excessive quantities of chemical compounds in their laboratories, but it is even more frightening to find out that even more deadly compounds are being created in the water that people drink. Runoffs from various chemical sources meet one another in the water resources of this earth, such as when fertilizers mix with insecticides in ground water and create "mingled chemicals that no responsible chemist would think of combining in his laboratory." Even if chemists know the effects that their chemical compounds might have on the living things of nature, they do not, Carson warns, know the effects of the compounds being created on their own in the rivers, the lakes, and the sewers.

Another interesting but scary fact that Carson presents is that chemicals from insecticides and fertilizers can remain in the soil more than twelve years after they have been applied. What does this imply for the farmer who wants to grow foods organically? Just how organic can food be if there is no virgin soil left in which to plant crops? Even if the ideal of organic produce is discarded, oftentimes a chemical used to control insects on one plant kill the rotating crop that is planted the following season, and the season following that one, too. For instance, in the state of Washington, farmers successfully used a chemical to kill a bug that was harming a grain called hops. Later, when grapes were planted in these same fields, the roots of the grape vines died. When planted again the next year, the result was the same. Carson was very concerned that applying these chemicals without fully realizing their potential for destruction was courting ecological disaster.

Carson talks about all kinds of potential disasters, some more severe than others. On the lighter side, she mentions a more aesthetic kind of disaster, one that wipes out the beauty of nature. Using the excuse of traffic control and safety, there was, in Carson's time, and largely remains today, the practice of spraying weeds with an herbicide along all the country's roadsides and highways. In a poetic voice, Carson declares that in those rare places where herbicides had not been sprayed, she would drive along the country roads and her spirit would be lifted by "the sight of the drifts of white clover or the clouds of purple vetch with here and there the flaming cup of a wood lily." These are not weeds that need to be controlled, she says. They are places of great, wild beauty. There is seldom a need to kill back the wildflowers, especially in the dimensions that are employed. In some states, the height at which the spraying occurs is from road level to eight feet above the road. This is needless overuse, Carson contends. She also cites other abuses like the contractor who was caught discharging the herbicides from his trunk into a protected wood side area, a place where no spraying had been authorized. Another contractor's negligence was a little more severe. He purchased chemicals from

a "zealous chemical salesman." The herbicide contained arsenic, which eventually ended up killing twelve cows. This was all done in the name of killing weeds. Herbicides, states Carson, "give a giddy sense of power over nature to those who wield them." In the process of using them, herbicides destroy natural beauty. They leave behind a "sterile and hideous world."

More important and much more painful for humans, is the effect of chemicals on their own bodies. In particular, Carson expresses her views on some very serious, life-threatening diseases that have been linked to the use of man-made chemicals. She begins by explaining that cancer-causing agents are as old as the earth. Radiation from the sun and certain rocks in earth's crust has always been capable of producing malignancies. Over time, human biology adapted to these radiations in varying degrees. But with the rapid development of man-made carcinogens, a medical term for cancer-producing substances, human biology has not been able to keep pace. "As a result these powerful substances could easily penetrate the inadequate defenses of the body." Added to this problem is the inadequate research done on the causes of cancer. Chemical use is approved without fully understanding the potential complications. Often it takes years of use before the slow but steady buildup of chemicals in a human body results in a malignancy. Admonishing the government as well as the chemical companies who produce the insecticides and pesticides, Carson writes, "Our recognition of the agents that produce it [the cancerous malignancies] has been slow to mature."

All humans are susceptible to cancers. No age is immune. As a matter of fact, Carson reports that in the beginning of the nineteenth century, it was a rarity to find cancer in children. But by the time her book was published, not only was it not considered rare for children to have cancer, children were being born with cancer already growing inside their bodies. Apparently the developing fetus is the most susceptible to cancer-producing agents. Whereas the pregnant mother may not be affected, the agents may penetrate her body and the placenta and "act on the rapidly developing fetal tissues." As newer and more powerful chemicals are used in the production of food, pregnant women, who eat this food, pass on the carcinogens to their children unaware. Chemicals are used on food without full knowledge of their effects as well as without full disclosure of their potential danger. The result is that cancer rates climb.

There has also been a rise in cases of leukemia, a malignant blood disorder. Whereas malignant cancerous growths may take years to develop, leukemia can occur soon after exposure to radiation and toxic chemicals. In 1960, the Mayo Clinic, a world-famous medical institution, published an opinion that stated that the increase in leukemia could almost definitely be linked to an over-exposure to pesticides. Some of the case studies involved people doing simple tasks around their homes, such as the woman who tried to rid her house of spiders or the man who tried to kill the cockroaches in his office. Both used commercial bug sprays. Both were afflicted with sudden painful symptoms that were eventually diagnosed as leukemia. Both died. Another case involved two farm workers whose job it was to unload bags of insecticide. In all these cases, death was swift.

The world is quickly becoming a sea of carcinogens, says Carson. And carcinogens are linked to death. But unlike the last century, where mankind's biggest health concern was contagious disease, carcinogens could be easily removed from the earth's environment. At least a majority of the man-made carcinogens could. She suggests that in addition to looking for a cure for cancer, people should be re-evaluating chemical use. How much is really necessary? Chemicals, she writes, "have become entrenched in our world in two ways: first, and ironically, through man's search for a better and easier way of life; second, because the manufacture and sale of such chemicals has become an accepted part of our economy and our way of life." In other words, if mankind put them here, mankind surely could get rid of them. And along with ridding this earth of chemicals, civilization would rid their own bodies of cancer.

Carson ends her book with a bit of irony and finally with a hint of hope. The irony is that in mankind's efforts to control nature, people are poisoning not only themselves, their food, their water, but their future generations. Added to this is the most ironic fact of all. In an effort to rid the world of pests, to make this world a better place to live, mankind has tried to kill every insect that gets in the way. As a result, insecticides have killed the weak. Stronger insects have not only survived, they have created insecticide-resistant offspring. Added to this is the fact that in killing the insects that were detrimental, mankind has also killed the beneficial insects that helped to maintain a balance in the sheer numbers of insects. So now the earth is suffering through stronger and more powerful plagues.

But there is hope. Carson discusses in her last chapter some of the research that was going on in the 1960s, research that is continuing today. There is the research in the relationships between different kinds of insects in the hopes that by encouraging one type of benevolent insect, a farmer might curb the propagation of destructive types without the use of chemicals. Some researchers were looking into the possibility of sterilizing male insects as a way of controlling their numbers. Others were working on the creation of natural lures or introducing natural predators.

Carson encourages her readers at the end of her book to take a holistic approach to life. She reminds people, who are trying to create favorable environments for themselves, that they are not the only ones living in that environment. Humans are not the only creatures on earth. "Only by taking account of such life forces and by cautiously seeking to guide them into channels favorable to ourselves can we hope to achieve a reasonable accommodation between the insect hordes and ourselves," she writes. A lot of suffering has been caused by the rush to use man-made chemicals, a rush to find a quick fix to stop mosquitoes from biting, stop cockroaches from raiding trash cans, stop grubs from consuming the roots of that all-perfect lawn. The suffering is everywhere, in the fish in the water, the birds in the air, the people who live in the cities, the people who live on farms. Carson's book is a portrayal of that suffering. It is also a portrayal of the causes of that suffering, and its very simplistic cure. Curb the use of chemicals.

Critical Essay #2

In the following essay, Garb explores how Silent Spring's *emphasis on "natural balance and the web of life" rather than politics led to its wide acceptance, and impacted the book's logic.*

Scattered reports of problems with pesticides had appeared in the technical literature from the fifties onwards, but it was only in 1962 that a wide-ranging critique of pesticides was published for a popular audience. Brought out by a major trade press, this book charted the tremendous increase in the production and use of these chemicals since World War II, and documented their failings. Focusing on chlorinated hydrocarbons and DDT in particular, it described their physiological effects, their impact on human health and wildlife, and the inadequacy of existing pesticide regulation. The book demonstrated how pesticides were not only harmful, but ultimately self-defeating, since pests soon developed resistance while beneficial insects and animals that helped keep them in check were killed. Further pesticide applications to counter a resurgence of the targeted species and infestations of new insects that weren' t a problem before began an escalating cycle. The book proposed replacing this hubristic attempt to master nature, which was destroying the earth's capacity to support human life, with a philosophy of wise management of ecosystems and the development of ecologically sound biological control of pests. These changes, the author stressed, should not jeopardize nutrition and the American economy, and pesticides should not be banned, only used very selectively.

The book flopped, it received short negative reviews in the literary supplements of the *New York Times* and the *Times* of London, and not much else, and soon disappeared. I doubt many of you have heard of its author, Lewis Herber, or remember its title, *Our Synthetic Environment*. A few months later, however, in three June issues of the *New Yorker* magazine and then in the fall as a book, Rachel Carson's critique of pesticides was published. Her *Silent Spring* contained in amplified form every one of the charges against pesticides I have just listed for Herber's work, but no substantially new ones. Yet Carson's critique created an immediate storm of media and governmental attention. There was much praise, as well as angry rebuttal and attacks, including a fierce and well-funded campaign by the chemical industry to counter Carson's message. Within a year of its publication, *Silent Spring* had prompted programs for scientific research into the hazards of pesticides, brought significant changes in their regulation, spurred public debate on environmental practices more generally, inspired a younger generation of environmental activists, and made ecology a household word. Carson's initially embattled viewpoint on pesticide problems rapidly became absorbed into public sentiment. It is standard in the historiography of environmentalism to speak of the book as a□ perhaps the□watershed of the modern environmental movement.

Why did these two works have such a different fate? What enabled *Silent Spring's* critique of pesticides to become so broadly accepted in middle-class America? Part of the answer lies, no doubt, in luck and in the *New Yorker* forum. Also contributing to the book's success were Carson's standing and skills as a gifted writer and her biological

training, which Herber lacked. She was able to offer a terrifyingly eloquent portrait of what it would mean to inhabit an increasingly toxic landscape. Building on postwar anxieties about technological excess and radioactivity, Carson's novel descriptions of our vulnerability to new chemicals that acted in eerie and unexpected ways were shocking and galvanizing.

In this essay, however, I want to consider how *Silent Spring's* success depended on its politics and, relatedly, its conception of nature. By not grappling head on with the political and economic factors that led to the entrenchment of pesticides in postwar America, and by centering its arguments instead on conceptions of natural balance and the web of life, the book was made palatable to a wide audience. I want to explore the mixed results of this success. The book's broad acceptance gave it considerable if circuitous political-economic impact. At the same time, its avoidance of politics troubled the logic of Carson's argument.

Herber's unnoticed book can scarcely serve as a model for a more politically desirable intervention, but it does highlight another conception of politics and nature that was possible, if not broadly acceptable, in that moment. Written pseudonymously by the journalist and anarchist theorist Murray Bookchin, who later became well known as the founder of social ecology, *Our Synthetic Environment* briskly covered almost all of the substance of Carson's critique of pesticides in less than twenty pages. The rest of the book documented the many other ways in which human health was compromised by the industrialized, urbanized way of life that increasingly characterized postwar America. Chemical hazards to human food supplies other than pesticides (synthetic hormones, antibiotics, and additives) were described in detail, as was the degradation and erosion of soil by large-scale agriculture, and the deterioration of the nutritional quality of crops raised on synthetic fertilizers. And beyond these problems of the food system, Bookchin described how health was endangered by a polluted, stressful, and dehumanizing urban environment; by the radioactive byproducts of nuclear testing and energy production; and by the rise in heart disease and cancer associated with lifestyle and environmental causes.

This range of assaults to human well-being and nature, claimed Bookchin, were of a piece, and originated in unviable social arrangements. They demanded a return to rural and agricultural communities of human scale through deindustrialization, decentralization, and a reining in of the profit motive, so that the "most pernicious laws of the market place" were not "given precedence over the most compelling laws of biology." Individual action or even remedial legislation were not, in his mind, sufficient to get at the heart of these problems; a sound ecological practice was synonymous, for Bookchin, with shaping a satisfying social life. Bookchin's pill was clearly too big, bitter, and unfamiliar for most Americans to swallow at that time. His book was dismissed as "nice sentiments, only impossible," as "numbing" or "unmanageable" in its scope, and as offering only "incoherent," "intangible," or hopelessly utopian proposals.

Critical Essay #3

Whereas the focus of Bookchin's analysis was "the relationship between human and human," *Silent Spring's* center of gravity lay in Carson'sreworking of deeply conventional conceptions of balance of nature and the web of life. When the president of the chemical manufacturing company Monsanto characterized her as "a fanatic defender of the cult of the balance of nature," he was reacting to what is indeed the book's central metaphor. Carson's nature□a "complex, precise, and highly integrated system" characterized by relations of "interdependence and mutual benefit," and regulating checks and balances□was the new science of ecology's rendition of a conception that goes back to antiquity. In its explicitly theological eighteenth-century form, for example, the harmony and order underlying nature's economy had a divine source: God's providence ensured a system of perpetual balance among all living things, in which each creature had its allotted place. The "balance of nature" provided Carson with a norm against which human interference could be assessed and challenged. The existing "system of relationships between living things," she claimed, "cannot be safely ignored any more than the law of gravity can be defied with impunity." A second guiding metaphor in the book is the related notion of an "ecological web of life" whose "threads" "bind" together organisms and their environment so that even minute changes in one area reverberate over space and time.

These notions□the balance of nature, the ecological web, "the natural"□do a tremendous amount of persuasive work. Nature whole is the basis for *Silent Spring's* unsettling tidings of balance lost. It allowed Carson to invert a tradition of nature writing that celebrated harmony and connectedness to cast pesticides as unnatural and sinister. Thus the book is dense with images of dislocation: a living world "shattered," landscapes "bludgeoned," threads "broken," fabric "ripped apart," delicate processes "uncoupled." Carson brought a tone of elegy into conventions of wonder by introducing her reader to the unseen dynamics and relations of the natural world (a hidden sea of groundwater, invisible bird flyways and fish migration paths, teeming microscopic soil life) through portraying their disruption by pesticides. And by including the delicate internal realms of human and animal physiology within nature's balanced and interconnected system, she seamlessly and chillingly joined inner and outer landscapes, ecology and human health, launching a new phase of environmental concern.

But although it provided Carson with a versatile conceptual framework and familiar stirring images, there are difficulties in founding a treatment of environmental destruction on a depoliticized notion of "nature." Terms like the "natural," or the "balance of nature" can obscure the social relations and priorities that go into evaluating environmental practices. Take, for example, Carson's preference for biological rather than chemical methods of pest control as less disturbing of "nature's balance." This term reifies judgments about the respective benefits and costs□to humans□of these methods, creating internal contradictions in Carson's account. Why, for instance, is the importation of an exotic pathogen (a bacteria) to kill the Japanese beetle a "natural" means of control? Is this intervention□ which Carson notes in passing kills not only the

target species but at least forty other species in the scarabaeid family□more respectful of the balance of nature than certain pesticides?

Similar questions could be asked about each of the biological control technologies Carson celebrates: juvenile hormones, chemical attractants, repellent sounds, microbial and viral infection of insects, introduced predators and parasites. For example, she enthusiastically endorses the dispersal of X-ray-sterilized male screw-worms and heralds the "complete extinction of the screw-worm in the Southeast" as a "brilliant success" and "a triumphant demonstration of the worth of scientific creativity." Slipping into the militaristic imagery she objects to in the proponents of pesticide spraying, she talks approvingly of research that turns "insect sterilization into a weapon that would wipe out a major insect enemy." But surely the difference between this celebrated method and the chemical practices Carson castigates lies not in their inherent degrees of "naturalness" but in (human) judgments about their respective impacts. Had Carson chosen to cast the X-ray sterilization of males as unnatural, the rhetorical resources she uses to disparage pesticides could easily have been redirected, as in the following imagined rendition of the same facts Carson gives in her celebratory account.

Rather than seeking to understand the intricate life cycle and ecology of this tiny insect, scientists invented a scheme that would allow them, by infiltrating the very heart of their natural reproductive cycle, to sever the link between generations. Day after day, in huge "fly factories," technicians bombarded male insects with mutagenic radiation and then, using 20 light planes working 5 to 6 hours daily, these insidious carriers of genetically altered material were dispersed over huge areas. Unsuspecting females mated with these seemingly normal products of the laboratory. While these unions produced eggs, these were, without exception, sterile. In less than two years, the species had vanished.

The ease with which a creative triumph becomes a tragedy of technological hubris highlights the instability of the categories of natural and unnatural.

Bookchin's analysis in *Our Synthetic Environment*, which didn't rest on notions of "the balance of nature," is spared these particular paradoxes. As part of nature, humans are justified, claims Bookchin, in making the world's fate up as they go□if they do so with an eye first and foremost toward "promoting human health and fitness." There is, he argues, no preordained state that must be preserved forever, and the "quasi-mystical" and unreserved valorization of "nature" and the "natural" is misguided, "an impediment to a rational outlook." For him human emotions in the presence of nature are not an indication of nature's special metaphysical status (as they were for the Transcendentalists with whom Carson sympathized), and reticence in using technology to remake nature in service of our needs should not be sentimentalized. "Our nostalgia," he claims, "springs from a growing need to restore the normal, balanced, and manageable rhythms of *human* life□that is, an environment that meets *our* requirements as individuals and biological beings" (emphasis mine). (Note that having forgone biological nature as a guide for human action, Bookchin immediately recovers another nature: the "normal" and "balanced" rhythms of human life.)

Critical Essay #4

The massive adoption of synthetic pesticides in the postwar decades in America was facilitated by a densely interrelated network of factors. The dynamics of the competitive free market pressured farmers, suppliers of farm technology, and food processors toward pesticide use. In addition, pesticides were first tested and mass produced during a period when priorities were skewed by wartime agendas; they were institutionally and culturally entrenched at the war's end. Existing standards and legal procedures were not fitted to enforce the regulation and testing of this new technology, nor to establish liability for damages it caused. And a pest-control method that was chemical-based, fast-acting, broad-spectrum, and seemed to offer total eradication accorded well with certain American cultural values. In the face of these forces, the underfunded and mismanaged biological control methods that had shown great promise in the decades prior to the war did not stand a chance, and were soon eclipsed.

Silent Spring, however, made visible only a tiny part of this network of factors. This is because Carson cast the entrenchment of pesticides and the call for their replacement as primarily an epistemic and moral problem, rather than a political-economic one. This, I believe, is a large part of what allowed her work to be so broadly accepted.

The book's muted political stance was in part a consequence of its author's background. Carson came to her book as a biologist, as an author immersed in the nature writing tradition since adolescence, and as a former writer and editor of public information publications for the Fish and Wildlife Service. (Bookchin was steeped in the writings of the Frankfurt School, in anarchist theory, and Marxism.) But an avoidance of overt politics was also a strategic choice, one of several Carson made in carefully shaping a defensible challenge of pesticide practices. Linda Lear in her forthcoming biography of Carson shows, for example, how Carson chose to include only a small amount of the extensive evidence she had for the environmental origins of cancer, and declined to mention organic gardening for fear of being associated with food faddists. Nor did Carson invoke the biocentric convictions about the inherent worth of other forms of life that she expressed in other writing. Similarly, while it is clear from her remarks in interviews and from her collaboration with the politically outspoken director of the U.S. Department of Agriculture Biological Survey, Clarence Cottam, that Carson was keenly aware of the financial incentives that skewed the development, use, and evaluation of pesticides, she kept this out of the book.

Carson had been warned of the hostility her pesticide work would invoke. She wrote in a period that some have called the "McCarthy era of the environmental movement," in which those who questioned the use of pesticides were specifically branded as being against the spirit of free enterprise. After the appearance of the *New Yorker* articles, for example, Louis A. McLean, secretary and general counsel of Velsicol, the sole manufacturer of chlor-dane and heptachlor, sent a five-page registered letter to Houghton Mifflin suggesting that it might want to reconsider publishing *Silent Spring*. His letter built up to the following statement:

In such a climate even some members of theUnfortunately, in addition to the sincere opinions by natural food faddists, Audubon groups and others, members of the chemical industry in this country and in Western Europe must deal with sinister influences whose attacks on the chemical industry have a dual purpose: (1) to create the false impression that all business is grasping and immoral, and (2) to reduce the use of agricultural chemicals in this country and inthe countries of Western Europe, so that our supply of food will be reduced to east-curtain parity. Many innocent groups are financed and led into attacks on the chemical industry by these sinister parties.

In such a climate even some members of the Sierra Club's board of directors opposed the appearance of a positive review of *Silent Spring* in the Club Bulletin. A more forthrightly "political" analysis would probably not have survived to have *Silent Spring's* political impact. At the same time, however, Carson's avoidance of politics left unchallenged the structural underpinnings of pesticide use that are with us still.

One concrete way in which politics was avoided in her text was through the circumloçutions she substituted for the names of chemicals, their manufacturers, or other delinquent parties in order to avoid lawsuits. With the exception of the Army Chemical Corps, Carson did not name a single manufacturer of chemicals or pesticide brand name. For example, her extended description of the biological havoc caused by pesticide wastes dumped over the course of ten years by "a chemical plant" doesn't say which. Her discussion of a new carcinogenic chemical used against mites and ticks requires a stream of nonspecific designations: "a chemical;" "this chemical," "the chemical," "the product," "the suspected carcinogen," and so on, rather than Aramite, the product's name. Even when protesting the fact that certain innocuously named weed killers sold for suburban lawns didn't list their ingredients, including chlordane and dieldrin, nor mention their dangers, she withheld the names of these products at this tantalizingly apt point, when mentioning them would have worked directly to end their facade of benignity. But even in the absence of potential legal action, claims Linda Lear, Carson might not have mentioned specific names; contention about specific culprits, Carson felt, would have distracted from her central message.

On a larger scale, Carson downplayed the political implications of her account through a consistently elliptical capping of its descriptions of irrational pesticide use. Repeatedly she argued that the instances of spraying she describes were not only harmful to humans and wildlife, but unjustified even in terms of biological effectiveness or economic payoff to farmers. Why did spraying take place nonetheless? Carson's scenarios demand an answer, but hers is vague or often lacking altogether. Readers are left to make their own inferences or, more likely, to ignore the troubling questions these narrative lapses signal. This kind of hanging question is most comfortably accommodated at the end of sections. "The science of range-management," she says in the last sentence of chapter six, "has largely ignored [the] possibility [of biological control of weeds by plant-eating insects] although these insects ... could easily be turned to man's advantage." She concludes another section with the observation that "there is no dearth of men who understand these things... but they are not the men who order the wholesale drenching of the landscape with chemicals." Elsewhere she describes how "funds for chemical control came in never-ending streams, while the

biologists . . . who attempted to measure the damage to wildlife had to operate on a financial shoestring." Why the marginalization of effective biological control? the distance between those who know and those who order? the discrepancy between budgets for inventing chemicals and for studying their damage? Carson's silence on these questions buries the problem of the democratic control of science, technology, and production.

To the extent that Carson does trace the origins of the destruction whose "irrationality" she has exposed, her account of agency is feeble and diffuse, her blame mild. Destruction of the environment stems from people's failure to "read" the "open book" of the landscape; facts about pesticides' destructiveness are denied out of "shortsightedness;" spraying continues because of "entrenched custom," or "surely, only because the facts are not known." "We are walking in nature like an elephant in the china cabinet," she quotes a scientist whose "rare understanding" she respects, implying "our" problem to be one of clumsiness.

Even at the level of single sentences Carson frequently masks agency and blame through passive or negative sentence constructions. She tells, for example, of farmers who chose to spray crows rather than switch to a variety of corn that didn't attract birds because they ' *'had been persuaded* of the merits of killing by poison" (emphasis mine). Her excision of the subject here closes down a crucial line of inquiry. A similar negative formulation lessens blame even as it assigns it. "Because the spray planes were paid by the gallon rather than by the acre," Carson says, "there was no effort to be conservative." How much more powerful would this sentence have been had its latter part been directly and positively phrased: "there was incentive to use as much as possible"? (It would also have helped had she unreified "spray planes" to make more visible which *people* were paid.)

Carson's reticence about the political and economic forces encouraging heedless pesticide use made it hard for her to talk about fundamental social interventions as part of a solution. Her proposals, therefore, gravitate toward the only resource left to her: a respect for the balance of nature and ecological interconnectedness, to be achieved through atti-tudinal reform and the technologies of biological control. Her call for new attitudes is a reasonable, even inspiring, repudiation of human arrogance in favor of an attitude of cautious "guidance" reasonable "accommodation," sensitive "management," and an ethic of "sharing" rather than "brute force." These are valuable orientations in themselves, but their mildness and abstraction bespeak the book's missing politics.

Carson offers the biological control of pests as the technical manifestation of this more humble attitude. One could not hope for a more symbolically-appealing solution: Yankee ingenuity in service of a pastoral ideal. By pastoral here I am referring to what Leo Marx points to as the most long-lived Western model for an appropriate relation to nature, which proposes a middle ground between the wild and the over civilized. *Silent Spring* opens with such a middle ground in its rustic idyll of "a town in the heart of America where all life seemed to live in harmony with its surroundings." This prosperous town is far from the trouble of cities, but also safely removed from wild nature, signified by the barking of foxes in the distant hills. Pesticides are an evil blight disrupting this harmony,

killing the town's birds and animals and bringing a strange stillness, a silent spring. At the end of the book, in the last chapter, entitled "The Other Road," Carson offers her proposal for regaining this lost balance through various forms of biological pest control. It too is structured as a middle ground, a way of navigating between the technological hubris of pesticides on the one hand, and a vulnerability to nature's wild-ness in the form of pests on the other. It embodies the pastoral vision of enjoying the best of human artifice and inventiveness while preserving a closeness to natural cycles and creatures.

Yet Carson had evidence suggesting that humility and artifice alone often did not determine the choice of pest control methods. She herself describes the repeated bypassing of forms of biological control *known* to be cheap, effective, and harmless in favor of harmful chemicals. And she knew that for decades prior to World War Two, before they were eclipsed by faster acting and profit-producing insecticides, biological methods had been investigated and adopted not because they offered a more "natural" or ethically superior solution but because they were cheap and effective. Nor were the many problems that plagued chemical pesticides (resistance, resurgence, toxicity, bioaccumulation) a surprise that surfaced with their widespread agricultural use in the postwar years; most were recognized decades before *Silent Spring* was published.

Carson mentions some of these early successes as well as several contemporary "shining models" of nonchemical methods of pest control in her chapter on biological control. And in her next chapter, on the problems of chemical control, she describes prominent early disasters and the intensification of pesticide side effects in the late fifties. Once again, she has juxtaposed facts that pose a pointed question: why has a problematic form of pest control replaced an effective one? Here she offers the book's sole explicitly structural analysis, consisting of the two paragraphs about chemical industry funding for university research mentioned earlier, whose impact is soon diluted with more idealist explanations. The chapter continues to talk of people being "slow to recognize" problems withpesticides, and of chemical research drawing the best people because it seems "more exciting," and Carson concludes it with a quotation that exemplifies the book's dominant message.

We need a more high-minded orientation and a deeper insight, which I miss in many researchers. Life is a miracle beyond our comprehensions, and we should reverence it.... The resort to weapons such as insecticides to control it is a proof of insufficient knowledge .... Humbleness is in order; there is no excuse for scientific conceit here.

Bookchin makes a different use of the past in his somewhat broader and more forthright account of how vested interests have shaped the directions taken by modern agriculture. He discusses, for example, how the food industry undermined enlightened standards for food purity in place at the beginning of the century, and nibbled away at the Delany clause protecting consumers from carcinogens. For Bookchin, these early achievements are not simply models for what could be achieved again in the future; his description of the eclipse of sane ways of doing things points his readers to the political struggle necessary to establish and upbold these.

Critical Essay #5

Silent Spring presented facts that brought its readers to the threshold of difficult questions about how pest control might be guided by biological knowledge and democratically determined priorities, rather than the logic of capital accumulation. But Carson's avoidance of politics, abetted by her conceptions of nature, helped lead them away again. Through these she taught her readers to see pesticide problems as resulting from oversight and carelessness, or at the most arrogance, rather than from greed or systemic structural factors. By casting the problem of pest control as primarily an issue of achieving a harmonious relationship to "nature," with little reference to the social criteria embedded in the term, nor the changes in social institutions necessary to achieve this harmony, Carson stripped her book of overtly political analysis or claims. She seemed to believe that it was enough to present the facts and let public opinion take over.

My goal, however, is not to judge the book politically ineffective or undesirable, only to highlight the limits of what could be said and widely heard in that particular moment. The disappearance of Bookchin's work and the furor over even the politically restrained *Silent Spring* suggest that Carson stood close to these limits. A broadly understandable and persuasive challenge to the pesticideparadigm had both to criticize and placate, to extend and maintain existing worldviews. Carson's book did not call for nor achieve a fundamental democratization of research, technology, and production. But it did frighten people, link health to nature for the first time as a topic of heated public debate, and draw on familiar conceptions of nature to undermine the postwar aura of pesticides as a marvelous technical achievement and cast them as sinister and stupid instead The book's political consequences are complex, and still unfolding. It prompted a debate that led to legislation banning some pesticides and tightening the procedures for testing, registering, and using others. But with political-economic ground rules remaining intact, agriculture and the chemical industry could respond to these developments relatively easily. Restrictions placed several years later on organochlorines, the earliest generation of synthetic pesticides such as DDT, for example, didn't halt their continued manufacture for export, nor the development and profitable production of other pesticides, nor recent attempts to genetically engineer profitable and hazardous pest and pesticide resistant crops. More generally, these reforms did nothing to stop the trend toward increasingly mechanized and large-scale agriculture that made pesticides unavoidable. On the thirtieth anniversary of *Silent Spring's* publication the executive director of the National Coalition Against the Misuse of Pesticides could still describe America as standing at the crossroads between "promoting safer alternative pest management techniques or simply substituting less toxic inputs into conventional pesticide-intensive practices."

At the same time, however, other longer term and more subtle effects of the sea-change Carson helped initiate are only now beginning to surface. For example, the cost of approving a new pesticide and the demand for "organic" produce have both grown to a point where alternative forms of pest management are now becoming economically

feasible. Curiously, it may have required an "apolitical" challenge to pesticides to initiate this process.

Source: Yaakov Garb, "Rachel Carson's *Silent Spring*," in *Dissent*, Fall 1995, pp. 539-46.

Adaptations

The documentary *The "Silent Spring" of Rachel Carson*, produced by CBS Reports in 1963, captures the mood of the times when the book first appeared.

In 1993, PBS produced and presented *Rachel Carson's "Silent Spring"* as part of its "American Experience" series. The film features interviews with several of the writer's colleagues and critics.

Durkin Hayes published an abridged version of *Silent Spring* on audiocassette in 1993. The text is read by actress Ellen Burstyn.

Topics for Further Study

Look carefully at the material on pesticides at the web site of the Environmental Protection Agency (http://www.epa.gov/ebtpages/pesticides. html). Does the government's attitude toward these products seem different today than it was in 1962, as described in *Silent Spring?* Report your findings in a one-page summary.

Imagine that it is 1962. Write a one- or two-page letter using what you learned from the book to persuade your state representative or senator to do something about the problem Carson describes. Be sure to tell your representative specifically what you would like him or her to do.

Identify three passages in *Silent Spring* that seem particularly compelling. Does Carson's language (word choice, tone, images, etc.) contribute something to the force of these excerpts. How? Summarize your observations in a brief essay.

Examine the labels of some pesticide products around the house, taking note of their active ingredients. At http://www.epa.gov/pesticides/ info.htm, see what you can find out about the health hazards of these products. Report your findings in a one-page summary.

Compare and Contrast

1962: Thalidomide, often prescribed for morning sickness, is suspected of causing birth defects, adding to already widespread concern about the dangers of synthetic chemicals.

Today: The Environmental Protection Agency requires pesticide makers to submit data that will allow the agency to determine the special risks of their products for children.

1962: Watson, Crick, and Wilkins win a Nobel Prize for describing the molecular structure of DNA.

Today: Scientists complete a provisional map of the entire human genome.

1963: President Lyndon Johnson signs the Clean Air Act, legislation designed to protect air quality in the United States.

Today: The United Nations agree to the Kyoto Protocol, a plan for reducing emission of greenhouse gases.

What Do I Read Next?

Before she published *Silent Spring*, Rachel Carson wrote three popular works of natural history on the ocean, the best known of which is *The Sea Around Us* (1951).

Jonathan Harr's *A Civil Action* (1995) tells a powerful story about one community that looked to the law to protect it from dangerous chemicals. Another classic work of environmental literature is John McPhee's *Encounters With the Archdruid* (1971), an engaging meditation on the then-current conflict over land use.

In *Losing Ground: American Environmentalism at the Close of the Twentieth Century* (1996), Mark Dowie chronicles the history of the movement with an eye to the errors that have kept it from realizing its full potential.

Further Study

Graham, Frank, *Since "Silent Spring*," Houghton Mifflin,1970.

Graham's book offers a detailed account of the pesticide controversy that followed the publication of *Silent Spring*.

Lear, Linda, *Rachel Carson: Witness for Nature*, Henry Holt & Co., 1997.

Rachel Carson: Witness for Nature is widely regarded as the definitive biography of Carson.

Waddell, Craig, ed., *And No Birds Sing: Rhetorical Analyses of Rachel Carson's "Silent Spring*," Southern Illinois University Press, 2000.

The essays in this volume all focus on the language of *Silent Spring*, not always from the standpoint of the rhetorician, as the title suggests, but in the manner of literary critics more generally one examining Carson's manuscripts for clues about the her intentions, another attempting to classify the book in terms of genre, etc.

Wargo, John, *Our Children's Toxic Legacy: How Science and Law Fail to Protect Us from Pesticides*, Yale University Press, 1996.

As the book's title indicates, Wargo asks whether current pesticide regulations adequately safeguard children, but *Our Children's Toxic Legacy* also provides an excellent overview of the pesticide problem, including a detailed description of the contemporary regulatory process. Along with Steingraber's *Living Downstream*, Wargo's book is essential reading in this area.

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Steingraber, Sandra, *Living Downstream: An Ecologist Looks at Cancer and the Environment*, Addison-Wesley, 1997, pp. 31-117.

Waddell, Craig, "The Reception of *Silent Spring*: An Introduction," in *And No Birds Sing: Rhetorical Analyses of Rachel Carson's "Silent Spring,"* ' Southern Illinois University Press, 2000, pp. 1-16.

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Introduction

Purpose of the Book

The purpose of Nonfiction Classics for Students (NCfS) is to provide readers with a guide to understanding, enjoying, and studying novels by giving them easy access to information about the work. Part of Gale's□For Students□ Literature line, NCfS is specifically designed to meet the curricular needs of high school and undergraduate college students and their teachers, as well as the interests of general readers and researchers considering specific novels. While each volume contains entries on

□classic□ novels frequently studied in classrooms, there are also entries containing hard-to-find information on contemporary novels, including works by multicultural, international, and women novelists.

The information covered in each entry includes an introduction to the novel and the novel's author; a plot summary, to help readers unravel and understand the events in a novel; descriptions of important characters, including explanation of a given character's role in the novel as well as discussion about that character's relationship to other characters in the novel; analysis of important themes in the novel; and an explanation of important literary techniques and movements as they are demonstrated in the novel.

In addition to this material, which helps the readers analyze the novel itself, students are also provided with important information on the literary and historical background informing each work. This includes a historical context essay, a box comparing the time or place the novel was written to modern Western culture, a critical overview essay, and excerpts from critical essays on the novel. A unique feature of NCfS is a specially commissioned critical essay on each novel, targeted toward the student reader.

To further aid the student in studying and enjoying each novel, information on media adaptations is provided, as well as reading suggestions for works of fiction and nonfiction on similar themes and topics. Classroom aids include ideas for research papers and lists of critical sources that provide additional material on the novel.

Selection Criteria

The titles for each volume of NCfS were selected by surveying numerous sources on teaching literature and analyzing course curricula for various school districts. Some of the sources surveyed included: literature anthologies; Reading Lists for College-Bound Students: The Books Most Recommended by America's Top Colleges; textbooks on teaching the novel; a College Board survey of novels commonly studied in high schools; a National Council of Teachers of English (NCTE) survey of novels commonly studied in high schools; the NCTE's Teaching Literature in High School: The Novel;and the Young Adult Library Services Association (YALSA) list of best books for young adults of the past twenty-five years. Input was also solicited from our advisory board, as well as educators from various areas. From these discussions, it was determined that each volume should have a mix of □classic□ novels (those works commonly taught in literature classes) and contemporary novels for which information is often hard to find. Because of the interest in expanding the canon of literature, an emphasis was also placed on including works by international, multicultural, and women authors. Our advisory board members□educational professionals□ helped pare down the list for each volume. If a work was not selected for the present volume, it was often noted as a possibility for a future volume. As always, the editor welcomes suggestions for titles to be included in future volumes.

How Each Entry Is Organized

Each entry, or chapter, in NCfS focuses on one novel. Each entry heading lists the full name of the novel, the author's name, and the date of the novel's publication. The following elements are contained in each entry:

- Introduction: a brief overview of the novel which provides information about its first appearance, its literary standing, any controversies surrounding the work, and major conflicts or themes within the work.
- Author Biography: this section includes basic facts about the author's life, and focuses on events and times in the author's life that inspired the novel in question.
- Plot Summary: a factual description of the major events in the novel. Lengthy summaries are broken down with subheads.
- Characters: an alphabetical listing of major characters in the novel. Each character name is followed by a brief to an extensive description of the character's role in the novel, as well as discussion of the character's actions, relationships, and possible motivation. Characters are listed alphabetically by last name. If a character is unnamed□for instance, the narrator in Invisible Man-the character is listed as □The Narrator□ and alphabetized as □Narrator.□ If a character's first name is the only one given, the name will appear alphabetically by that name. □ Variant names are also included for each character. Thus, the full name □Jean Louise Finch□ would head the listing for the narrator of To Kill a Mockingbird, but listed in a separate cross-reference would be the nickname □Scout Finch.□
- Themes: a thorough overview of how the major topics, themes, and issues are addressed within the novel. Each theme discussed appears in a separate subhead, and is easily accessed through the boldface entries in the Subject/Theme Index.
- Style: this section addresses important style elements of the novel, such as setting, point of view, and narration; important literary devices used, such as imagery, foreshadowing, symbolism; and, if applicable, genres to which the work might have belonged, such as Gothicism or Romanticism. Literary terms are explained within the entry, but can also be found in the Glossary.
- Historical Context: This section outlines the social, political, and cultural climate in which the author lived and the novel was created. This section may include descriptions of related historical events, pertinent aspects of daily life in the culture, and the artistic and literary sensibilities of the time in which the work was written. If the novel is a historical work, information regarding the time in which the novel is set is also included. Each section is broken down with helpful subheads.
- Critical Overview: this section provides background on the critical reputation of the novel, including bannings or any other public controversies surrounding the work. For older works, this section includes a history of how the novel was first received and how perceptions of it may have changed over the years; for more recent novels, direct quotes from early reviews may also be included.
- Criticism: an essay commissioned by NCfS which specifically deals with the novel and is written specifically for the student audience, as well as excerpts from previously published criticism on the work (if available).

- Sources: an alphabetical list of critical material quoted in the entry, with full bibliographical information.
- Further Reading: an alphabetical list of other critical sources which may prove useful for the student. Includes full bibliographical information and a brief annotation.

In addition, each entry contains the following highlighted sections, set apart from the main text as sidebars:

- Media Adaptations: a list of important film and television adaptations of the novel, including source information. The list also includes stage adaptations, audio recordings, musical adaptations, etc.
- Topics for Further Study: a list of potential study questions or research topics dealing with the novel. This section includes questions related to other disciplines the student may be studying, such as American history, world history, science, math, government, business, geography, economics, psychology, etc.
- Compare and Contrast Box: an □at-a-glance□ comparison of the cultural and historical differences between the author's time and culture and late twentieth century/early twenty-first century Western culture. This box includes pertinent parallels between the major scientific, political, and cultural movements of the time or place the novel was written, the time or place the novel was set (if a historical work), and modern Western culture. Works written after 1990 may not have this box.
- What Do I Read Next?: a list of works that might complement the featured novel or serve as a contrast to it. This includes works by the same author and others, works of fiction and nonfiction, and works from various genres, cultures, and eras.

Other Features

NCfS includes □The Informed Dialogue: Interacting with Literature,□ a foreword by Anne Devereaux Jordan, Senior Editor for Teaching and Learning Literature (TALL), and a founder of the Children's Literature Association. This essay provides an enlightening look at how readers interact with literature and how Nonfiction Classics for Students can help teachers show students how to enrich their own reading experiences.

A Cumulative Author/Title Index lists the authors and titles covered in each volume of the NCfS series.

A Cumulative Nationality/Ethnicity Index breaks down the authors and titles covered in each volume of the NCfS series by nationality and ethnicity.

A Subject/Theme Index, specific to each volume, provides easy reference for users who may be studying a particular subject or theme rather than a single work. Significant subjects from events to broad themes are included, and the entries pointing to the specific theme discussions in each entry are indicated in boldface.

Each entry has several illustrations, including photos of the author, stills from film adaptations (if available), maps, and/or photos of key historical events.

Citing Nonfiction Classics for Students

When writing papers, students who quote directly from any volume of Nonfiction Classics for Students may use the following general forms. These examples are based on MLA style; teachers may request that students adhere to a different style, so the following examples may be adapted as needed. When citing text from NCfS that is not attributed to a particular author (i.e., the Themes, Style, Historical Context sections, etc.), the following format should be used in the bibliography section:

□Night.□ Nonfiction Classics for Students. Ed. Marie Rose Napierkowski. Vol. 4. Detroit: Gale, 1998. 234-35.

When quoting the specially commissioned essay from NCfS (usually the first piece under the □Criticism□ subhead), the following format should be used:

Miller, Tyrus. Critical Essay on □Winesburg, Ohio.□ Nonfiction Classics for Students. Ed. Marie Rose Napierkowski. Vol. 4. Detroit: Gale, 1998. 335-39.

When quoting a journal or newspaper essay that is reprinted in a volume of NCfS, the following form may be used:

Malak, Amin. □Margaret Atwood's □The Handmaid's Tale and the Dystopian Tradition,□ Canadian Literature No. 112 (Spring, 1987), 9-16; excerpted and reprinted in Nonfiction Classics for Students, Vol. 4, ed. Marie Rose Napierkowski (Detroit: Gale, 1998), pp. 133-36.

When quoting material reprinted from a book that appears in a volume of NCfS, the following form may be used:

Adams, Timothy Dow. □Richard Wright: □Wearing the Mask,□ in Telling Lies in Modern American Autobiography (University of North Carolina Press, 1990), 69-83; excerpted and reprinted in Novels for Students, Vol. 1, ed. Diane Telgen (Detroit: Gale, 1997), pp. 59-61.

We Welcome Your Suggestions

The editor of Nonfiction Classics for Students welcomes your comments and ideas. Readers who wish to suggest novels to appear in future volumes, or who have other suggestions, are cordially invited to contact the editor. You may contact the editor via email at: ForStudentsEditors@gale.com. Or write to the editor at:

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