

Statement of Rachel Carson Before the
Subcommittee on Reorganization and International Organizations
of the
Committee on Government Operations
ENVIRONMENTAL HAZARDS
CONTROL OF PESTICIDES AND OTHER CHEMICAL POISONS

June 4, 1963

Mr. Chairman, I appreciate the opportunity to discuss with you this morning the problems of environmental hazards and the control of pesticides.

The contamination of the environment with harmful substances is one of the major problems of modern life. The world of air and water and soil supports not only the hundreds of thousands of species of animals and plants, it supports man himself. In the past we have often chosen to ignore this fact. Now we are receiving sharp reminders that our heedless and destructive acts enter into the vast cycles of the earth and in time return to bring hazard to ourselves.

The problem you have chosen to explore is one that must be solved in our time. I feel strongly that a beginning must be made on it now, -- in this session of Congress. For this reason I was delighted when I heard, Mr. Chairman, that you were planning to hold hearings on the whole vast problem of environmental pollution.

Contamination of various kinds has now invaded all of the physical environment that supports us -- water, soil, air, and vegetation. It has even penetrated that internal environment within the bodies of animals and of men. It comes from many sources: radioactive wastes from reactors, laboratories and hospitals, fallout from nuclear explosions, domestic wastes

from cities and towns, chemical wastes from factories, detergents from homes and industries.

When we review the history of mankind in relation to the earth we cannot help feeling somewhat discouraged, for that history is for the most part that of the blind or short-sighted despoiling of the soil, forests, waters and all the rest of the earth's resources. We have acquired technical skills on a scale undreamed of even a generation ago. We can do dramatic things and we can do them quickly; by the time damaging side effects are apparent it is often too late, or impossible, to reverse our actions. These are unpleasant facts, but they have given rise to the disturbing situations that this Committee has now undertaken to examine.

I have pointed out before, and I shall repeat now, that the problem of pesticides can be properly understood only in context, as part of the general introduction of harmful substances into the environment. In water and soil, and in our own bodies, these chemicals are mingled with others, or with radioactive substances. There are little understood interactions and summations of effect. No one fully understands, for example, what happens when pesticide residues stored in our bodies interact with drugs repeatedly taken. And there are some indications that detergents, which are often present in our drinking water, may affect the lining of the digestive tract so that it more readily absorbs cancer-causing chemicals.

In attempting to assess the role of pesticides, people too often assume that these chemicals are being introduced into a simple, easily controlled environment, as in a laboratory experiment. This, of course, is far from true.

My own studies in this field of environmental pollution have been confined largely to pesticides and I am glad,

Mr. Chairman, that you have chosen to begin with this highly important problem.

It seems to me that the most significant knowledge that has developed within the past year has been the piling up of evidence about the wide dispersal of pesticide chemicals, far beyond the point of application. I should like to cite some examples to illustrate this spreading contamination.

To begin on a small scale, we accept as fact the often repeated statements that it is not the deliberate intention to spray reservoirs. Yet studies by the Massachusetts Division of Fisheries and Game during the past year, covering to date 11 reservoirs that serve as public water supplies, show that fish in these reservoirs are heavily contaminated with DDT. The average amount found in the fish from all waters examined in the Sudbury, Assabet, and Concord regions of Eastern Massachusetts was 35.4 p.p.m.; the maximum concentration of 96.7 p.p.m. was found in two places, including the Framingham Reservoir, a source of drinking water for a large area. It might be pointed out that this is nearly 14 times the legal tolerance for DDT in foods.

Although it is not difficult to imagine the paths by which domestic water supplies become contaminated, there are now examples of a different sort that defy easy or comfortable explanation. Such, for example, is the situation on Prince of Wales Island in southeastern Alaska. I am told by the Fish and Wildlife Service that its biologists have sampled resident fish in four drainage systems on this island and have found DDT, sometimes with its metabolites, in two of them. There is no record of applications of DDT on this island. The nearest town, other than small native villages, is more than 50 miles away.

An even more remote region, not far below the Arctic circle, has been yielding extraordinary data to the Fish and Wildlife Service for several years. This is the Yellowknife region on the Upper Yukon River, in the Northwest Territory of Canada. It is an important waterfowl breeding area, wild, remote from any human settlements. No spraying of insecticides is known to have occurred within several hundred miles. Yet DDT and its metabolites have been found for several years both in the eggs of waterfowl and in their young. This alone might have been explained by the fact that the waterfowl are migratory and could easily have picked up the poison during their sojourn in the United States. Transfer to the eggs and young could then have followed. But there is no such explanation for the fact that native vegetation in this same area has now been found to contain residues.

The most disturbing of all such reports, however, concerns the finding of DDT in the oil of fish that live far at sea. Such residues have been found in fish caught off both coasts of North America, as well as off South America, Europe, and Asia. The species concerned include halibut living on the floor of the Pacific Ocean, and tuna, a fish of the open ocean that rarely comes close to land. Oil from some of these marine fish have contained DDT in concentrations exceeding 300 p.p.m.

All this gives us reason to think deeply and seriously about the means by which these residues reach the places where we are now discovering them. I must emphasize that no one can answer this question with complete assurance today, but I should like to call your attention to certain known facts that do have a bearing on the problem.

The ways by which pesticide residues may be transported over long distances are basically three: by air, by water, and

in the bodies of living organisms, either indirectly through food chains or directly.

A report last year by the U.S. Department of Agriculture established the fact that aerial spraying comprises about 22% of the total acreage sprayed in the U.S. Studies by Professor George Woodwell of the University of Maine (and which confirm earlier studies by Canadian biologists) show that of the DDT used in forest spraying, less than half falls directly to the soil. Of each 0.5 lb. released by the spray plane approximately 0.2 lb. reaches its target. The remainder is presumably dispersed as small crystals in the atmosphere. These minute particles are the components of what we know as "drift" -- the phenomenon that plagues every householder who receives contaminating spray from his neighbor across the street, or from his Government's spray planes several miles away. We are now beginning to wonder how vast the reach of "drift" may be. It was known a decade ago that the herbicide 2,4-D could drift as far as 15 or 20 miles in quantities sufficient to damage vegetation. The drift of insecticides is less readily observed, but when the matter is properly studied I predict we shall discover some startling facts.

It appears that little application has been made of our knowledge of atmospheric movements. Various factors influence the direction and speed of air currents. Among these is convection, or the upward flow of air which takes place when the ground temperature exceeds that of the air. Conceivably, this force could lift the very fine particles of spray materials to an altitude at which strong horizontal winds could come into play, effecting transport for long distances. We know this happens with other materials. Scientists of the Woods Hole Oceanographic Institute have studied the behavior of salt

nuclei, drawn from the surface of the ocean and lifted high into the atmosphere. These tiny particles are carried great distances -- at least as far as 400 miles. And we know that the upper atmosphere transports a whole assemblage of living objects -- seeds, pollen spores, tiny spiders and insects -- and through such transport oceanic islands are colonized. It is therefore a speculation that should be tested that the upper atmosphere may be carrying chemical particles as well as radioactive debris, and that the pesticide contamination of such remote places as those I have mentioned may be the result of a new kind of fallout.

Another factor that may contribute to atmospheric contamination is the tendency of DDT to be evaporated from the surface of water. Therefore aerial spraying may not be the sole source of chemical pollution in the atmosphere. Various studies by the Public Health Service over a period of years have clearly established the fact that rains washing over sprayed lands carry pesticides as runoff into ponds, streams, and rivers. From here, we may assume, there is further transport into the sea and into the atmosphere.

Little thought seems to have been given to the possibility of transport in dust. Yet, on a small scale, we had a vivid example of this last April, when health officials on Long Island charged that the airborne dust from potato fields, carrying arsenic and other insecticide residues, was a menace to public health. This dust had compelled the closing of a public school on several occasions, because it clogged the ventilation system. On a broader scale, it is only reasonable to assume that dust from heavily sprayed lands, especially in some areas where conditions are right, may carry insecticides for exceedingly long distances. The Dust Bowl of the 1930's gave us our most dramatic demonstration of the long range transport of soil

particles, but this is a phenomenon that goes on regularly in varying degree. When we remember that insecticides remain in soil for long periods, varying from months to a decade or more, the probability of this type of dispersal is increased.

A final and especially interesting means of pesticide transportation is that which occurs in living animals, whether directly or indirectly. Direct transportation may occur over many hundreds of miles, as when woodcock carry heptachlor from southern wintering grounds in the area of fire ant treatment all the way to breeding areas in the Canadian maritime provinces. A less obvious but exceedingly important method of transportation by living organisms is that which occurs when a chemical passes from one link to another in a natural food chain, usually becoming concentrated as it goes. We now have a number of impressive demonstrations of this phenomenon. Several have been studied by biologists in California.

At Big Bear Lake, for example, toxaphene, a chlorinated hydrocarbon, was applied at a dosage of only 0.2 p.p.m. Later it was found that the minute plankton organisms in the lake had picked up this chemical and had concentrated it to a level of 73 p.p.m. The buildup continued through the foodchain, with fish containing 200 p.p.m. and a fish-eating bird (a pelican) containing 1,700 p.p.m. The story does not end there. Plankton organisms collected at the lake poisoned hatchery trout when fed to them. Ten months after the insecticide was applied to the lake, fish were again able to live in these waters. The lake was accordingly re-stocked with trout. However, when fillets from the trout were analyzed, they were found to contain 3 p.p.m. of toxaphene. I might add that this experience convinced the California Division of Fish and Game that toxaphene is unsuitable for rough fish control, but the experiment did provide some very

instructive data on transfer of chemicals through food chains. The same sort of phenomenon has been worked out in detail at Clear Lake, California.

I should like to add a word about the concentration or build-up of the chemicals. There is nothing surprising about this -- especially about the initial concentration by the plankton. Aquatic organisms are well known to have marked ability to extract minerals and other substances from the water and concentrate them. Marine organisms in particular can do this. For example, the percentage of silica in rivers is 500 times that in the sea, because marine diatoms withdraw so much to construct their shells. Huge quantities of cobalt are extracted from seawater by lobsters and mussels, and of nickel by various mollusks, yet human chemists recover these elements only with difficulty. Oysters concentrate zinc at a level about 170,000 times that in the surrounding water. It should come as no surprise, therefore, to find some of these marine invertebrates collecting and concentrating such chemicals as DDT. As Secretary Udall reported to you recently, oysters exposed to levels of only one part per billion for one week then contained 132,000 parts per billion in their tissues. The implications for the human being who likes to eat oysters -- or other forms of marine life -- are obvious. A current publication by two Fish and Wildlife Service biologists contains this statement: "In the sea, there is the possibility of a continuous re-cycling and concentration of the more stable pesticidal compounds until they pose a real threat to man's own welfare."

All the foregoing evidence, it seems to me, leads inevitably to certain conclusions. The first is that aerial spraying of pesticides should be brought under strict control and should be reduced to the minimum needed to accomplish the most essential objectives. Reduction would, of course, be opposed on the

grounds of economy and efficiency. If we are ever to solve the basic problem of environmental contamination, however, we shall have to begin to count the many hidden costs of what we are doing, and weigh them against the gains or advantages.

The second conclusion that seems apparent is that a strong and unremitting effort ought to be made to reduce the use of pesticides that leave long-lasting residues, and ultimately to eliminate them. This, you will remember, was one of the recommendations of the President's Science Advisory Committee. I strongly concur in this recommendation, for I can see no other way to control the rapidly spreading contamination I have described.

There are several other recommendations. I would like to suggest, bearing on various specific aspects of the immensely complex pesticide problem. These are as follows:

1. I hope this committee will give serious consideration to a much neglected problem -- that of the right of the citizen to be secure in his own home against the intrusion of poisons applied by other persons. I speak not as a lawyer but as a biologist and as a human being, but I strongly feel that this is or should be one of the basic human rights. I am afraid, however, that it has little or no existence in practice.

I have countless letters in my files describing situations in which a person has been subject to personal injury or to the loss of pets or valuable horses or other domestic animals because poisons from a neighbor's spraying invaded his property. Residents of Norfolk, Virginia, have informed me that they were told last winter that the State had the authority to apply poisons to their land but assumed no responsibility for injury that might result. It is a matter of record that dairy farmers in New York State suffered contamination of their land by Federal-State

spraying for gypsy moths, with the inevitable result that their milk later contained illegal residues and was condemned by the State as unfit for market.

Under such circumstances, what is the citizen to do? You may recall the opinion of the United States Court of Appeals in the case in which a group of Long Island citizens sought an injunction to prevent a repetition of the spraying to which they had been subjected. Since no date for repeated spraying had been set the court could not grant an injunction, but it did make a significant ruling which I should like to insert in the record:

". . . it would seem well to point out the advisability for a district court, faced with a claim concerning aerial spraying or any other program which may cause inconvenience and damage as widespread as this 1957 spraying appears to have caused, to inquire closely into the methods and safeguards of any proposed procedures so that incidents of the seemingly unnecessary and unfortunate nature here disclosed, may be reduced to a minimum, assuming, of course, that the government will have shown such a program to be required in the public interest."

I have been informed by affected citizens in New York State that the current gypsy moth spraying has been done with no advance notice whatever. Some of these people learned of the spraying quite by chance two or three days before the planes began their work. They were told by their attorneys that in this limited time no appeal to the courts was possible. It is clear, therefore, that the intent of the Court as indicated above is thwarted in such cases.

As a minimum protection, I suggest a legal requirement of adequate advance notice of all community, state, or Federal spraying programs, so that all interests involved may receive hearing and consideration before any spraying is done. I suggest further that machinery be established so that the private citizen inconvenienced or damaged by the intrusion of his neighbor's sprays may seek appropriate redress.

2. In another area, I hope this Committee will give its support to new programs of medical research and education in the field of pesticides. I have long felt that the medical profession, with of course notable individual exceptions, was inadequately informed on this very important environmental health hazard. It was sobering to have the President's science advisors confirm this view by saying, "Physicians are generally unaware of the wide distribution of pesticides, their toxicity, and their possible effects on human health." The Panel also found a complete lack of any federally sponsored research to develop methods of diagnosing pesticide poisoning, especially when this takes the form of chronic, rather than acute illness. I am told that in the medical schools today, because of the many subjects to be taught, the attention given the whole field of toxicology is greatly reduced. Yet this is happening at a time when toxic substances are being introduced into the environment at a rate never before approached.

The plight of the person affected by these poisons is pitiful. Many case histories have come to me in letters. As a rule these people can find no physician who understands their problem. Indeed, I remember several cases in current medical literature in which the physician, even though told of the patient's exposure to such relatively common insecticides as malathion or lindane, had never heard of the chemical and did

not know the appropriate treatment. About ten years ago the American Medical Association had a special committee on pesticides which from time to time published authoritative information on the toxicology of these chemicals. I have seen none of these reports for several years. I do not know whether the committee is still functioning; if it is, it is hard to see why the American Medical Association last fall recommended that physicians seek information to allay their patients fears, not from unbiased scientific literature, but from one of the pesticide trade organizations.

I should like to emphasize, however, that many individual physicians are aware of the hazard and of the need for research in this field. Some of the most interesting letters I receive are from doctors. In what I believe to be the first recognition of this problem by a medical organization, the Illinois Medical Society on March 17th of this year approved a resolution directing attention to delayed and indirect effects of pesticides and calling for a thorough study of the problem. I should like to introduce a copy of this resolution into the record at this point.

RESOLUTION

STUDY AND EVALUATION OF TOXICANTS

WHEREAS the total consequences to man and his renewable resources from the present widespread and often unrestrained dissemination of toxic substances into the environment are only vaguely known and some effects cannot yet even be surmised; and

WHEREAS the indirect and untoward effects of pesticides, insecticides, rodenticides and kindred chemicals are frequently long delayed, difficult to trace and apparent safe minimal accumulations in air, soil, water, fiber, food and all tissues can in time accrue to harmful or even lethal levels; and

WHEREAS these toxicants often have a profound latent effect on flora and fauna not originally intended for suppression or eradication; and

WHEREAS these toxicants are among the most potent ever-known and such new incompletely evaluated substances are being developed annually; and

WHEREAS these lethal agents can be purchased by anyone, anywhere without adequate controls to guard against their misuse;

NOW THEREFORE, BE IT RESOLVED that the Board of Trustees of the Illinois State Medical Society go on record that efforts to manipulate ecologic balances by governmental agencies, private industry and individuals through the use of toxicants and radiation needs urgent and conscientious study for the development of wise and effective controls; and

BE IT FURTHER RESOLVED that in the opinion of the Board of Trustees of the Illinois State Medical Society the present state of knowledge dictates a policy of caution, inquiry, maturity of judgement and statesmanship; and

BE IT FURTHER RESOLVED that the Director of the Illinois Department of Public Health through the Bureau of Hazardous Substances and Poison Control be requested to undertake a study of all toxicants, current and future sold or used in Illinois, and prepare a report for appropriate distribution.

(Approved by Board of Trustees of the Illinois State Medical Society on March 17, 1963 in Chicago, Illinois.)

3. I should also like to see legislation, possibly at the state level, restricting the sale and use of pesticides at least to those capable of understanding the hazards and of following directions. To me it is shocking that these chemicals can be bought and applied by illiterate and even by mentally deficient persons. We place much more stringent restrictions on the sale of drugs -- which at least are not sprayed from powerful machines! Someone wrote me recently about a man who was thought to have contracted hepatitis from a spray he had been using, making the pertinent observation that the man could buy the chemicals that made him ill with no restrictions, but had to have prescriptions to buy the drugs to cure him.

4. I should like to see the registration of chemicals made a function of all agencies concerned rather than of the Department of Agriculture alone. The deficiency in the present law has been pointed out in the report of the President's Science

Advisory Committee. Many of the miscellaneous uses of chemicals, as in mothproofing, floor waxes, household sprays, and garden pesticides, have a direct relation to human health. It seems not only logical but necessary that the Department of Health, Education and Welfare should participate in decisions regarding the registration of chemicals so used. Similarly, many, probably the majority of pesticides are used at some time in such a manner that they affect wildlife and commercial and recreational fishery resources. The Department of the Interior needs to have a voice in the registration and labeling of such chemicals.

I have already trespassed upon your time and patience, and I shall mention only two more recommendations.

5. It seems to me that our troubles are unnecessarily compounded by the fantastic number of chemical compounds in use as pesticides. As matters stand, it is quite impossible for research into the effect of these chemicals on the physical environment, on wildlife, and on man to keep pace with their introduction and use. It is hard to escape the conclusion that the great proliferation of new chemicals is dictated by the facts of competition within the industry rather than by actual need.

I should like to see the day when new pesticides will be approved for use only when no existing chemical or other method will do the job.

6. In conclusion, I hope you will give full support to research on new methods of pest control in which chemicals will be minimized or entirely eliminated. You have heard from Secretary Freeman what some of this work is. One of the outstanding values of biological controls is that they are specifically adapted to a particular species or groups of species. Therefore, since our problems of pest control are numerous and varied, we must search, not for one super-weapon that will solve

all our problems, but for a great diversity of armaments, each precisely adjusted to its task. To accomplish this end requires ingenuity, persistence, and dedication, but the rewards to be gained are great.

/////