phrased their recommendations in a way that gives Finch and Agriculture Secretary Clifford M. Hardin room to maneuver. The commission found "adequate evidence concerning potential hazards to our environment and to man's health to require corrective action." But in the covering letter to Finch, Mrak writes in behalf of the commission, "Chemicals, including pesticides used to increase food production, are of such importance in modern life that we must learn to live with them."

The commission, in fact, makes several suggestions which affect administrative rather than scientific problems, including a recommendation that the Delaney amendment be altered so that the HEW secretary would be permitted to "determine when evidence of carcinogenesis justifies restrictive action concerning food containing analytically detectable traces of pesticides."

Finch's own view is expressed in this excerpt from the statement to the press when he made his DDT announcement of 12 November.

"The Delaney Amendment was conceived in high purpose and has served a useful function. The Department's General Counsel has pointed out that the Delaney Amendment does not apply to pesticide chemical residues in raw agricultural commodities or in foods processed from lawful crops. Nor does it apply to the unavoidable environmental contamination of foods. The unbelievably sophisticated and sensitive measuring devices now in the skilled hands of our laboratory technicians can measure one twentieth part of one unit in a billion. Measurement techniques have improved 1000-fold since the Delaney Amendment was enacted eleven years ago. If the Delaney Amendment, as it is now written, were to be strictly enforced for pesticide residues it would convert us to a nation of vegetarians. Much of our red meat, many dairy products, some eggs, fowl and fish—all parts of basic food groups deemed necessary to a balanced diet—would be outlawed because of very small pesticide residues from the ecological chain."

What appears to be shaping up is a battle over the issue of "zero tolerance" for DDT—in effect, a ban on the pesticide.

Aligned against those who take Finch's view are conservationists and scientists active in the cause of environmental protection. They regard DDT as a primary enemy because of its persistence in the food chain. To justify their apocalyptic vision they cite the damage to some species of animals, birds, and fish that has already been traced to DDT and the ominous reports of tests on lab animals.

Proponents of a zero tolerance level for DDT argue that Agriculture Secretary Hardin should immediately order that DDT be "deregistered," since the law provides for administrative review procedures which will allow manufacturers, in practice, to gain long delays while the scientific case on DDT is examined. The environmentalists are better organized and increasingly sophisticated in their tactics these days, as was shown by the recent petition of four conservation groups for government action against DDT (*Science*, 7 November). Whether they will now go to court to press their point probably depends on what action Hardin takes.

Still unsettled, of course, are the arguments as to whether carcinogenesis is "dose related" and whether causing cancer in small animals with a chemical substance proves there is real danger for humans. It will be interesting to note if more light is thrown on these questions by Part II of the Mrak report, particularly by the comments of the panel on carcinogenesis.

Other practical questions seem to defy categorical answers. Farmers, particularly in the cotton belt, are reportedly worried about finding a replacement pesticide that matches DDT's long-lasting, broad-spectrum action and its low cost. Partisans of DDT argue that studies by the World Health Organization show there is no practical substitute for DDT in malaria control in underdeveloped countries. The question of whether DDT might be replaced by biological controls or other pesticides or by a combination of these elicits conflicting answers from responsible scientists. And these conflicts help to explain the difficulty of carrying out a satisfactory risk-benefit analysis of DDT use.

Establishing or disproving long-term effects of chemical exposure—whether it be the carcinogenic effects of tobacco or DDT, teratogenic effects of 2,4,5-T, or the genetic effects of LSD—has become one of the troublesome scientific-political problems of the day. Secretary Finch has shown a greater willingness to deal with the problem than did his predecessors, but his performance can be judged only by the advice he gets and the advice he follows in the coming months.—JOHN WALSH

Herbicides: Order on 2,4,5-T Issued at Unusually High Level

White House science adviser Lee A. DuBridge took the highly unusual action on 29 October of announcing partial curtailment of the use of a herbicide—2,4,5-T (2,4,5-trichlorophenoxyacetic acid). Although this defoliant is widely used in the United States, its most controversial application is on plant life in Vietnam. The decision was taken quickly after the attention of the White House was called to scientific studies indicating that there was strong evidence that herbicides such as 2,4,5-T and 2,4-D (2,4-dichlorophenoxyacetic acid) caused birth malformations in animals.

The herbicide industry was taken completely by surprise by the White House announcement. The reason for the abrupt governmental action seems to be that members of the scientific community had warned the government that the results of these scientific studies would soon become widely known and would result in a torrent of criticism because of the intensive use of these herbicides in Vietnam.

A substantial group of scientists has long tried to reduce the widespread application of herbicides in Vietnam. For the past 3 years, the AAAS Board of Directors and the AAAS Council have tried to force extensive scientific studies on this subject. For the most part, these requests have been met with Defense Department stalling. In the past, the primary worry of scientists has been that extensive use of herbicides in Vietnam would cause highly detrimental effects to Vietnamese forests and crops and would disrupt the ecological balance of the country. This recent study commissioned by the National Cancer Institute is the first sub-

stantial evidence of harmful effects to animal life, which, of course, also raises the question of possible danger to humans.

In this as yet unreleased study, two compounds, 2,4,5-T and PCNB (pentachloronitrobenzene), were called "probably dangerous" and were judged worthy of condemnation because their administration caused increased fetal malformations in mice and rats. The study was done by Bionetics Research Laboratories of suburban Washington, D.C.

Several compounds were labeled as having "potentially dangerous" teratogenic (fetus-deforming) effects but as "needing further study." These are: 2,4-D (isooctyl ester), Captan, piperonyl butoxide, ethyl carbamate, ethyleneimine, Amitrol, and 2,4-dichlorophenol. Seven other herbicides were classified as adversely affecting fetal development but were termed "probably not teratogenic."

One Yale biologist, Arthur W. Galston, a critic of herbicide use in Vietnam who has examined these data with the aid of several scientist colleagues, has estimated that human beings in Vietnam could possibly ingest 50 or more milligrams of 2,4,5-T or 2,4-D per day per kilogram of body weight by drinking water from rain-fed cisterns and ponds exposed to aerial spraying.

A Hazard Suggested

"There is a possibility that the use of herbicides in Vietnam is causing birth malformations among infants of exposed mothers. . . . It cannot be said that the margin for safety is adequate," Galston said in an interview. "Although the laboratory tests do not prove that 2,4,5-T and 2,4-D are able to cause birth malformations in humans at the dose levels experienced in Vietnam, the tests do suggest this possibility. While individual exposure to these chemicals in the United States is lower than in Vietnam, it too may represent a hazard."

A Yale embryologist, Clement L. Markert, chairman of the Yale biology department, agrees, saying that "there is no question about 2,4,5-T; it certainly showed a high order of toxicity." Markert, who has also examined the study, said that "the concentration is real in Vietnam" and posed "an unacceptable risk" to the people of Vietnam. Markert, who said he was "basically very offended about its [2,4,5-T] continued use," added that, even if the heavy concentrations used in Vietnam did not cause overt malformations in children, they could lead to hidden malformations such as a lessening of brain capacity.

Some scientists interviewed were also offended by the continued use of 2,4-D, one of the compounds listed as having "potentially dangerous" teratogenic effects. After having praised the White House for its partial curtailment of the use of 2,4,5-T, Galston warned that the "danger from 2,4-D is so great that more extensive tests are needed."

The herbicide 2,4-D presents a more difficult problem than 2,4,5-T for governmental decision-making. It is much more widely used, both in Vietnam and in the United States. In this country, 2,4-D is one of the six best-selling pesticides with annual sales of more than $25 million. In this country, 2,4-D is used on corn and wheat, whereas 2,4,5-T is used as a pasture herbicide and for brush control and clearance of rights-of-way. In high-level negotiations U.S. military leaders reportedly fought hard to prevent any curtailment in the use of 2,4-D. The White House also had reason to expect a much more significant protest from U.S. pesticide producers and agricultural interests if it had acted against 2,4-D.

Last summer, several South Vietnamese newspapers printed photographs and stories about deformed South Vietnamese babies. The stories generally related an increase in defects to the American presence in South Vietnam; some specifically attributed such defects to the defoliation program.

DuBridge announced that the Defense Department would hereafter restrict the use of 2,4,5-T "to areas remote from population." One knowledgeable scientist interviewed pointed out that this loosely worded directive probably would still permit spraying of extensive vegetated areas. Another exclaimed, "There aren't really any large areas in Vietnam which are remote from population!"

The ambiguity of the White House statement was revealed later when the Defense Department said that no change would be made in the policy governing use of 2,4,5-T because the Defense Department felt that its present policy conformed to the White House directive.

However, according to an article by Washington *Post* reporter Richard Homan, an early Pentagon explanation differed markedly from a later written version. The early version stated that 2,4,5-T was used against enemy "training and regroupment centers." This statement, the *Post* reported, was expunged after a reporter asked how such usage was compatible with the directive against the use of 2,4,5-T in populated areas.

In other actions related to 2,4,5-T, DuBridge announced:

- That the Agriculture Department will cancel registrations of 2,4,5-T for food crops effective 1 January unless the Food and Drug Administration (FDA) has found a basis for establishing a safe legal tolerance in and on foods.
- That the Department of Agriculture and the Department of the Interior will stop using 2,4,5-T in their own programs in populated areas or where the residue from use could otherwise reach man.
- That the Department of Health, Education, and Welfare will complete action on a petition requesting that a finite tolerance be established for 2,4,5-T residues on foods prior to 1 January.

DuBridge, a physicist, added: "It seems improbable that any person could receive harmful amounts of this chemical from any of the existing uses of 2,4,5-T and, while the relationships of these effects in laboratory animals to effects in man are not entirely clear at this time, the actions taken will assure safety of the public while further evidence is being sought."

Use in Vietnam

DuBridge said that 2,4,5-T had helped save lives in Vietnam. He also added that almost no 2,4,5-T was used by home gardeners or in residential areas. (This statement seems to be in error. A spokesman for the Monsanto Company in St. Louis, one of the manufacturers of 2,4,5-T, indicated that combinations of 2,4,5-T and 2,4-D were widely used on residential lawns in this country.)

In the Bionetics study of the effects of 2,4,5-T on mice, there was an increased incidence of abnormal fetuses, regardless of the dosages, routes, and strains of mice used, except in the case of the lowest dosage used, 21.5 milligrams per kilogram of body weight. Outside scientists, who have studied the experiments in which 2,4,5-T was given to rats, find these data especially striking: In comparison to the usual proportion of abnormal fetuses (7 to 13 percent), a dosage of 4.6 milligrams of 2,4,5-T per kilogram induced 39 percent abnormal fetuses; at 10 milli-

grams per kilogram the proportion of abnormal fetuses was 78 percent; at 21.5 milligrams per kilogram it was 90 percent, and the proportion rose to 100 percent if a dosage of 46.4 milligrams per kilogram was administered between the 10th and the 15th days of pregnancy.

The study on the teratogenic effects of these compounds will be published in a few months. The study is said to need further statistical elaboration. D. W. Gaylor, a federal statistician who has examined the study, said in an interview that the teratogenic effects were "somewhat overstated on some compounds and understated on others."

Commenting on these studies, columnists Frank Mankiewicz and Tom Braden thundered: "Not since Romans salted the land after destroying Carthage has a nation taken pains to visit the war upon future generations." While such a statement may be an exaggeration (this observer does not believe that the U.S. government began use of 2,4,5-T and 2,4-D in Vietnam with the knowledge that they would have teratogenic effects in humans), the whole 2,4,5-T matter does raise important and unsettling questions to the scientists who have studied it. Why were these herbicides allowed to be widely used in Vietnam before scientific studies on animals had been performed? Why has Fort Detrick, the Army's biological and chemical warfare research center, failed to impose some control in the use of these herbicides?—BRYCE NELSON

A former member of the Science *news staff, Bryce Nelson is now a reporter for the national news staff of the Los Angeles* Times.

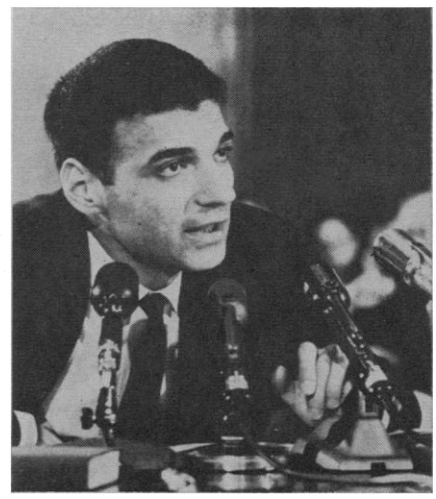
Nader: From Auto Safety to a Permanent Crusade

Five years ago Ralph Nader emerged from the obscurity of a Connecticut law firm to gain national prominence with a book, *Unsafe at Any Speed*, which challenged General Motors on the safety of one of its cars, the Corvair. In the ensuing years Nader has moved on from the issue of auto safety to become not only a champion of the American consumer but a forceful critic of traditional relations between industry and government. In Washington he has come to be regarded as a man on a permanent crusade.

Nader's *modus operandi* resembles that of the Washington lawyers whose objectives he often opposes. He is likely to consult scientific and technological sources as often as legal references in doing research, and he seldom if ever enters a courtroom. Nader has become a familiar figure at congressional hearings and has testified on such subjects as radiation health hazards, coal mine safety and health, and, fairly recently, the dangers of artificial food sweeteners, including cyclamates. His influence in persuading Congress to pass an auto safety bill and tougher amendments to federal meat inspection legislation is generally recognized. And his interest in federal regulatory agencies and the law firms which specialize in dealing with regulatory issues has made him the scourge of the bureaucracy.

Last year the Nader phenomenon proliferated when a group of students collaborated with Nader on a summer investigation of the Federal Trade Commission (FTC) and came up with a scathing critique of the policies and staff work of the agency, which Nader characterized as "the government's better business bureau." Interestingly, a task force of the American Bar Association appointed by President Nixon this spring arrived at a number of the same conclusions about the FTC.

This year the volunteer effort was institutionalized with the establishment of the Center for the Study of Responsive Law, in modest quarters near Dupont Circle in Washington. Nader recruited five young lawyers to serve as staff and this past summer enlisted about 100 students in law, medicine, and political science, called "Nader's raiders" by a friendly press, to help with the investigations. Five book-size reports are in the works and will be out in December in manuscript form. Among other topics, the books will explore what Nader calls the "Damon-and-Pythias relationship" between government and industry. Nader's group investigated primarily the Department of Agriculture's Pesticides Regulation Division, the Food and Drug Administration, the national air and water pollution control administrations, the Civil Aeronautics Board, and the Interstate Commerce Commission.



Ralph Nader

Although he is now the center of a group effort, Nader's style remains a highly personal one, which has changed little from his early days in Washington. Nader, who is 35, dislikes the idea that there is an entourage forming around him. His spartan mode of living is proverbial, and his investigative methods are carefully guarded. For example, he has made himself almost inaccessible, except by letter, to people wishing to see him. His phone numbers and office locations are known only to a few trusted friends. He takes pains to protect his sources, many of whom would suffer if they were identified. He refuses to discuss how or from whom he receives his information, but it is known that he gets tips from dissidents and from journalists to whom he may give leads for stories, and that he has access to a number of congressmen on Capitol Hill. It is well known that he has good rapport with senators Gaylord Nelson, George McGovern, Frank Moss, and Abraham Ribicoff, and with representatives Benjamin Rosenthal and