Environment: Focus on DDT, the "Uninvited Additive"

Since mid-October, the federal government has ordered a halt in production of the artificially sweetening cyclamates and announced timetables for restricting use of the herbicide 2,4,5-T and the pesticide DDT. In each instance, disturbing results of laboratory tests on animals had preceded the announcements, but the most obvious common factor in the three cases seems to have been growing public concern about environmental hazards.

The outburst of official activity served to focus attention on the difficulties of determining long-term effects on humans of chemicals introduced into the environment. And the government finds itself faced with serious questions about the adequacy of testing procedures and of the machinery for setting "tolerance" levels for chemicals.

The most important pronouncement was the one on DDT. It called, in effect, for a phasing out of most domestic uses of the pesticide over a 2-year period. DDT is the particular target of conservationists because of its persistence in the food chain, but it is widely relied on for its relatively low cost and its vast contribution to the control of disease and the production of food.

The Delaney Amendment

In purely legal terms, the banning of cyclamates involved the most clear-cut decision. Secretary of the Department of Health, Education and Welfare (HEW) Robert H. Finch ordered cyclamate production halted after lab tests indicated that cyclamates caused cancer in the bladders of rats exposed to amounts of cyclamates equivalent to about 50 times the normal dose. To do so he invoked the food additive amendment of the Food, Drug and Cosmetic Act. This amendment, sponsored by Representative James J. Delaney (D–N.Y.) and passed in 1958, provides that "no additive shall be deemed to be safe if it is found to induce cancer when ingested by man or animal, or it is found, after tests which are appropriate for the evaluation of the safety of food additives, to induce cancer in man or animals. . . ."

At the time Finch made a point of saying that no evidence had been advanced that cyclamates caused cancer in humans, but he was acting "because it is imperative to follow a prudent course in all matters concerning public health."

The action on 2,4,5-T followed the report of findings (see story which follows) that offspring of mice and rats given large doses of the herbicide while pregnant showed a relatively large number of deformities at birth. Presidential science adviser Lee A. DuBridge, in announcing a series of government actions to restrict use of 2,4,5-T, said that "while the relationships of these effects on laboratory animals to effects on man are not entirely clear at this time, the actions taken will assure safety of the public while further evidence is sought." One step taken was a Defense Department order to restrict use of the herbicide, which has been heavily used as a defoliant in Vietnam, to "areas remote from the population," a move that may well have been hastened by a desire to forestall possible charges that the United States was waging chemical warfare against pregnant women in Southeast Asia.

Domestic regulation of pesticides is based on the registration provisions of the Pesticide, Fungicide and Rodenticide Act originally passed in 1947 and administered by the Department of Agriculture. When a proposed use of a pesticide will result in residues on or in food or feed crops, registration which makes the sale of the chemical legal will not be granted until a "tolerance level" has been established. The task of determining a safe level is delegated to the Food and Drug Administration (FDA) in HEW.

The FDA's responsibilities are set forth in a pesticide chemical amendment of the Food, Drug and Cosmetics Act which provides for the seizure and destruction of agricultural commodities that contain pesticide residue in excess of established tolerances. The burden of proof of safety has rested primarily on manufacturers, who must present convincing evidence of laboratory testing programs when they wish to market a new chemical.

Critics of the system say that one major flaw is that there is no group that monitors what's already on the market. They also complain that emphasis in testing has been placed primarily on establishing acute toxicity levels and that long-range chronic effects on humans of low doses (particularly of persistent chemicals like DDT) have been relatively ignored.

Establishing long-term effects of chemical residues is, of course, acknowledged to be very difficult. An analogy exists with the problems of determining biological effects of various levels and kinds of radiation. But experts say that it is probably easier to obtain quantitative results on biological effects of radiation than on chemicals because of the changes chemicals cause inside the body. For example, the behavior of breakdown products, synergistic effects, and variation in the bacterial population inside the bodies of different individuals could all affect the results. And obviously, most testing on humans is precluded.

Advance in Technology

Although it is still impossible to provide scientific proof of the long-term effects of chemicals such as DDT, advances in technology in recent years have made it possible to detect minute traces of DDT and other chemicals in food and in animal and human tissues (2,4,5-T, incidentally, seems to be regarded as nonresidual in humans).

This new capacity to detect the presence of chemical substances like DDT and recent research results that show DDT in large doses producing cancer in laboratory animals have caused some to ask why the Delaney amendment should not be applied to DDT, which former Interior Secretary Stewart L. Udall has called "the uninvited additive."

One study of carcinogenic effects of pesticides and industrial chemicals that gained wide notice last spring was commissioned by the National Cancer Institute and done under contract by Bionetics Laboratories. A "preliminary note" on "tumorigenicity in mice" was published in the June issue of the Cancer Institute's journal. But the study had attracted attention earlier, and an

NEWS IN BRIEF

• **DRAFT REFORM VIRTUALLY ASSURED:** Senate passage of the draft lottery bill seems assured now that supporters of broad reform have agreed to wait until next year. Senator John Stennis (D–Miss.), chairman of the Senate Armed Services Committee, had earlier refused action unless Senate debate could be limited to the lottery provision only. Stennis did not want amendments to the bill made without careful committee consideration. Draft reform supporters have agreed to limit debate, and in return Stennis has promised to hold broad reform hearings before 15 February. The bill, passed by the House earlier, repeals a section of the 1967 draft law that bars a lottery.

• **TYCOON COOLS STEAM CAR:** Industrialist William P. Lear, after an expenditure of $5.5 million, has quit the steam car business. The creator of the Lear jet had said he planned to produce 1000 engines a day by the end of 1970 (*Science*, 24 January 1969), thus allowing steam cars to compete economically with internal combustion engine cars. Steam engine cars produce about 1 percent of the pollutants that an uncontrolled internal combustion engine emits. Lear now says that steam cars are too costly and too complicated to be feasible. He plans to shift his attention to the gas turbine.

• **ABORTION LAW REFORM:** Litigation aimed at eliminating antiabortion laws is expected in federal courts across the country following a decision in the District of Columbia that struck down its abortion statute. A U.S. District Court judge ruled that any licensed doctor could perform an abortion without legal limitations, because the 1901 law restricting abortions in D.C. was unconstitutionally vague. Roy Lucas, director of the James Madison Constitutional Law Institute in New York, and leader of a nationwide antiabortion law group, said he plans to use the D.C. ruling as a precedent in test cases to bring the issue before the Supreme Court quickly.

• **DRUG MAKERS DELAY FDA:** Litigation initiated by drug manufacturers has kept on the market at least one drug, Panalba, found harmful by the Food and Drug Administration in 1968, and about 175 other drugs found ineffective. Last week the FDA further admitted it had taken no action yet on another 1700 brand-name drugs found ineffective 2 years ago by the National Academy of Sciences–National Research Council. FDA officials say Panalba is the only drug found harmful still on the shelf (*Science*, 29 August). In court, the manufacturers are arguing that the FDA's withdrawal procedures are unfair. William Goodrich, FDA chief counsel, predicted that a setback in the courts could delay the withdrawal of drugs for up to 10 years.

• **TORREY CANYON SETTLEMENT:** American owners of the giant tanker *Torrey Canyon* have agreed to settle oil pollution claims filed by Britain and France for $7.2 million. The ship had rammed the Seven Stones Rocks off the southwest tip of England in March 1967, spilling 35 million gallons of oil and fouling British and French beaches. The payment constitutes final settlement of the governments' claims, but owners have set aside another $60,000 to compensate private claimants.

• **MERCURIAL PHEASANTS:** Montana's Department of Health and the State Fish and Game Department warned hunters that game birds in the state contain more mercury than humans can tolerate. The high mercury content is believed to come from the organic mercury fungicides used to treat grains. Mercury contents in the birds range from 0.05 to 0.47 part per million; the tolerance level suggested by the World Health Organization is 0.05 parts per million. The state agencies said that probably no acute or long-term chronic effects would occur from eating one or two birds, but cautioned against regular consumption.

• **AAUP RATING SCALE REVISED:** The American Association of University Professors has replaced its eight-step letter grade rating scale for compensation with a ten-step numerical scale. As before, separate levels are established for universities and technical institutions, liberal arts and teacher colleges, and junior colleges. The new system, designed for operation beginning in 1970, will allow more accurate comparisons between pay scales at different institutions.

"interim report" had even been inserted in the *Congressional Record* for 1 May by Senator Philip A. Hart (D–Mich.). The researchers reported that 11 of the 120 compounds tested induced a "significantly elevated incidence of tumors, mostly hepatomas."*

One of the researchers involved in the study said that there had been debate within the group on whether to use the word "tumorigenic" or "carcinogenic." R. R. Bates, a National Cancer Institute researcher on the project said in an interview with Bryce Nelson, former member of the *Science* news staff, "I would use the word carcinogenicity. I am no longer satisfied with the word we used." The journal article did point out that the use of the word hepatomas (liver tumors) "should not be considered as implying that these tumors are benign."

The background to the government's initiatives on DDT is too complex to analyze in detail, but actions by states and foreign governments this year (*Science*, 23 May) probably created some momentum. Last spring, shortly after the government found it necessary to seize a quantity of coho salmon in Michigan because of elevated concentrations of DDT, Secretary Finch appointed a Commission on Pesticides and Their Relationship to Environmental Health. Chairman of the commission is Emil M. Mrak, a former chancellor of the University of California at Davis and a food scientist of wide reputation. Membership is drawn mostly from among recognized university experts with a ballast of government representatives. HEW provided the staff.

The commission undertook a broad review of the research on active pesticide chemicals used in the United States. Only the first section of the report containing recommendations and summaries has been released; details of the study will follow in Part II and will include the findings of advisory panels on carcinogenesis, interactions, mutagenesis, and teratogenesis.

The commission asked that DDT and DDD be restricted "within two years to those uses essential to preservation of human health and welfare and approved unanimously" by the secretaries of HEW, Agriculture, and Interior. On this point and in its recommendations generally, the commission tactfully

* These 11 compounds include 5 insecticides: *p,p'*-DDT, Mirex, bis(chloroethyl)ether, Chlorobenzilate, and Strobane; five fungicides: PCNB, Avadex, ethyl selenac, ethylene thiourea, and bis(2-hydroxyethyl)dithiocarbamic acid potassium salt; and the herbicide *N*-(hydroxyethyl)hydrazine.

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-