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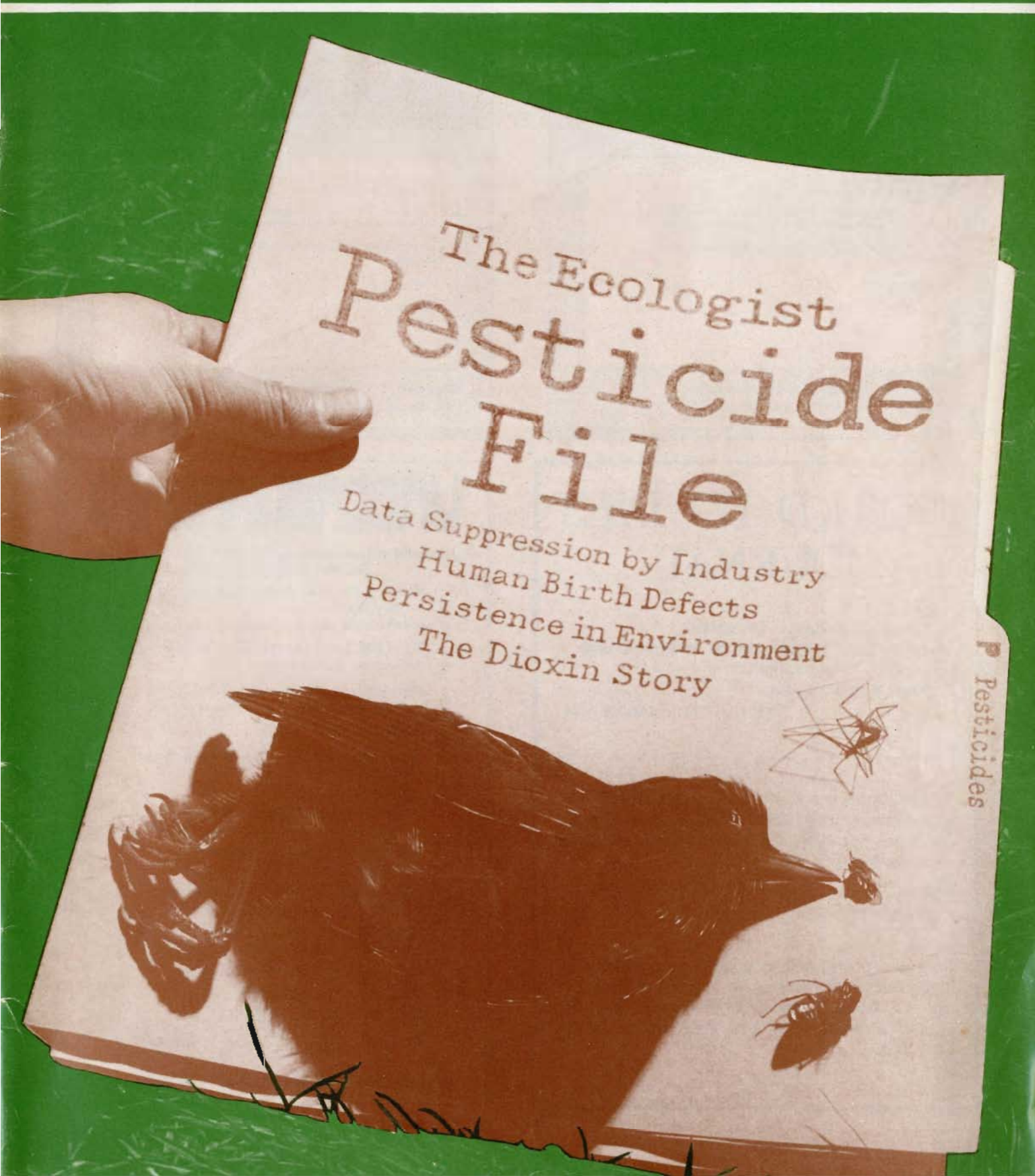

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Editorial

Feature Articles

Ecopolitics

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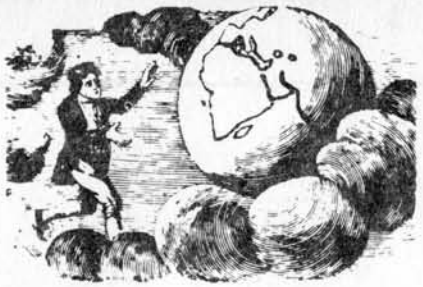
Editorial



The Scapegoat Principle.

The French have an expression for it: "Reculer pour mieux sauter'. It's a good piece of tactical advice. Rather than defend a weak position, it is better to withdraw, consolidate and then launch a counter-attack from a position of strength. If the enemy can be confused by diversionary tactic, so much the better.

The pesticide industry have learnt those lessons well. No more so than in their defense of the phenoxy herbicides, a group that includes 2,4,5-T and 2,4,D. Of the two 2,4,D is by far the biggest money-spinner. According to Jay Lewis, co-author of *The Other Face of 2,4,D**, over two billion dollars worth of 2,4,D are sold each year in North America alone — and that figure is rising as restrictions of the use of 2,4,5-T begin to bite. Indeed 2,4,D is probably the most widely used herbicide in the world — and, not surprisingly, the pesticide industry is more than anxious to prevent its reputation from being tarnished.

Developed in the early forties, the phenoxy herbicides kill by promoting uncontrolled expansion and division of cells. Effectively they give the plants cancer. It was not until the late sixties that the first reports began to trickle out indicating that both 2,4,D and 2,4,5-T might be teratogenic. By the early seventies, those initial reports had been confirmed by such bodies as the US National Institute of Environmental Health Sciences, the US Food and Drug Administration and the Canadian Food and Drug Directorate. The only dissenting voice was Dow Chemicals — a major producer of both herbicides — who claimed that they had found 'no treatment-related teratogenic responses' for 2,4,D although their tests had proved positive for 2,4,5-T. Such a conclusion was somewhat bizarre considering that the Dow research documented evidence of increased subcutaneous oedema (abnormal accumulation of fluid beneath the skin), incomplete bone formation, misplaced ribs and a host of other birth defects amongst rats dosed with small quantities of 2,4,D.

With the evidence accumulating against both 2,4,D and 2,4,5-T, the principal manufacturers of both the herbicides began to lay down an effective smokescreen to confuse those fighting for a ban on their products. The card they played was brilliant, both because it forced their opponents to fight on terms laid down by the industry and because it effectively disarmed many of their arguments. The birth defects observed in experiments, it was claimed, were caused by dioxin impurities in commercial grades of 2,4,5-T. Pure samples of the herbicide, it was argued, were beyond reproach, and provided the level of dioxin contamination could be contained, there was nothing to worry about. To that end, the British Advisory Commission on Pesticides set a permissible level of dioxin in commercial 2,4,5-T at one part in 10 million. By setting that standard, all the evidence of birth defects caused by the spraying of Agent Orange in Vietnam was effectively ruled 'out of court' because the phenoxy herbicides used contained higher levels of dioxin. Game, set and match to the industry.

Note too that by blaming dioxin, 2,4,D (which is not contaminated by TCDD, the most toxic form of dioxin) appeared, at least to the public, to have been given a clean bill of health. Like a mother bird protecting its young by flying away from the nest, the herbicide industry had cunningly drawn the fire of environmentalists away from their most profitable product onto a scapegoat. Not that one should underestimate the power of dioxin: one drop is capable of killing some 1200 humans. But rather one should remember that research has consistently shown that even the purest forms of 2,4,5-T and 2,4,D are capable of causing cancer, birth defects and genetic damage. In 1976, Dr. Melvin Reuber of the US National Cancer Institute published evidence that 2,4,D is carcinogenic in rats. Studies of the cells of wheat and barley sprayed with 2,4,D have shown 'highly significant' abnormalities of chromosome behaviour during cell division. Tests on farm workers in British Columbia have revealed a 25 per cent increase in chromosome damage after exposure to 2,4,D. And the US Food and Drug Administration has recently published a report showing how purified samples of both 2,4,5-T and 2,4,D cause birth defects in chicks. Alarmingly, the purified samples proved more teratogenic than impure ones.

Those are only a handful of the cases documented in *The Other Face of 2,4,D,* a book I cannot recommend highly enough. The point, however, is made: dioxin contamination is not the central issue. The phenoxy herbicides are dangerous in themselves and must be banned for that reason. All of them. Not just the one that has been singled out as a scapegoat.

Nicholas Hildyard

The Other Face of 2,4,D by J. Warnock and J. Lewis is published by the South Okanagan Environmental Coalition, Box 188, Penticton, British Columbia, V2A 6K3, Canada. Price $7.00 plus postage ($2.00 extra for airmail). The book is highly recommended.

The Witch-hunt of Rachel Carson

by
Frank Graham Jnr.

SILENT SPRING was the subject of vitriolic attacks by the pesticide industry

"The 'control of nature' is a phrase conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man. The concepts and practices of applied entomology for the most part date from that Stone Age of science. It is our alarming misfortune that so primitive a science has armed itself with the most modern and terrible weapons, and that in turning them against the insects it has also turned them against the earth". *Silent Spring*, 1962.

"*Silent Spring* is now noisy summer". This headline appeared over a story in the *New York Times* on July 22, 1962. *Silent Spring* was not yet between hard covers, but the uproar in government, chemical, and agricultural circles was intense. The serialized and abbreviated version of Rachel Carson's book in *The New Yorker* had created a greater stir than anyone earlier had imagined.

On August 2, the Velsicol Chemical Corporation of Chicago addressed a five-page registered letter to Houghton Mifflin, suggesting that the company might wish to reconsider its plans to publish *Silent Spring*, especially in view of the book's "inaccurate and disparaging statements" about chlordane and heptachlor, two chlorinated hydrocarbon pesticides manufactured solely by Velsicol. The letter was signed by Louis A. McLean, Secretary and General Counsel of Velsicol. The letter's sentiments reached their climax in the following paragraph:

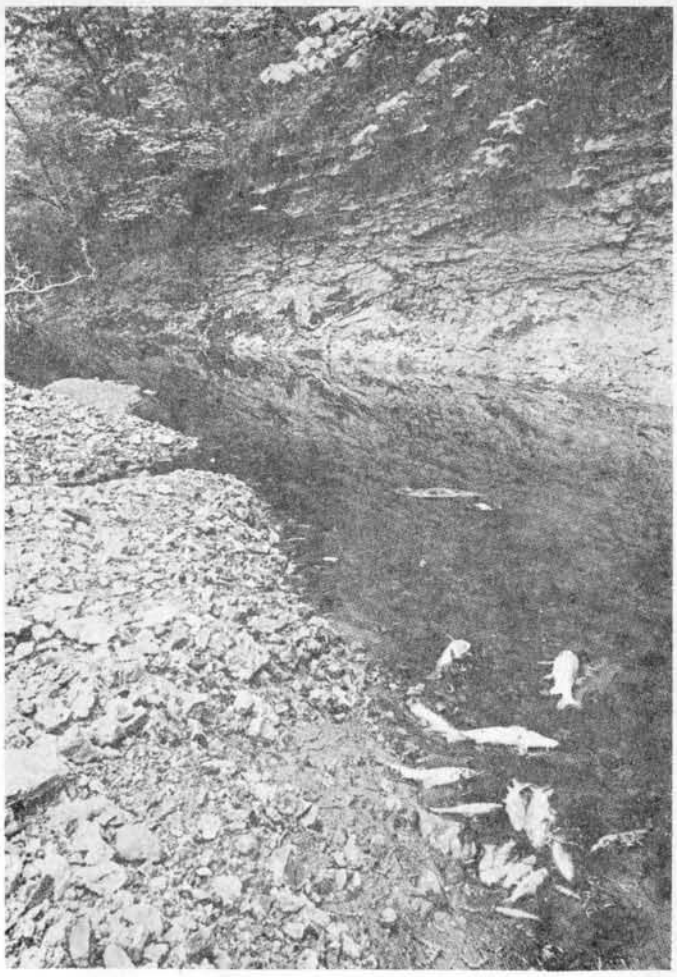
> "Unfortunately, in addition to the sincere opinions by natural food faddists, Audubon groups and others, members of the chemical industry in this country and in western Europe must deal with sinister influences, whose attacks on the chemical industry have a dual purpose: (1) to create the false impression that all business is grasping and immoral, and (2) to reduce the use of agricultural chemicals in this country and in the 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."

Shock Tactics

In style and content, Rachel Carson designed *Silent Spring* to shock the public into action against the misuse of chemical pesticides. She described the poisons, pointed out the failure to grasp biological principles that allowed us to direct broadsides of these poisons against the environment, and detailed the resulting fiascos and disasters. (Her book included fifty-five pages of notes on her source materials.)

The chemical and agricultural industries saw *Silent Spring* not as a scientific challenge, but as a public relations problem. Their champions in the scientific world (many of them, in reality, were paid consultants to the industries) attacked the book on much the same grounds that, a century before, Louis Agassiz had challenged Darwin's *Origin of Species:* "A scientific mistake, untrue in its facts, unscientific in its method, and mischievous in its tendencies."

Many books of genuine quality might have been destroyed by the fury of an assault launched by powerful enemies. *Silent Spring* was able to survive



DDT tends to accumulate in the fatty tissue of wildlife. In 1957, the waters of California's Clear Lake were found to contain only .02 parts per million of DDD, a close relative of DDT. Microscopic plants and animals in the water stored residues at five parts per million. Yet fish, eating large quantities of microscopic organisms, concentrated these residues to over 2,000 parts per million. Grebes which fed on those fish died in great numbers.

the onslaught and takes its place as an American classic partly because of the ineptness of the attacks on it by the agricultural-chemical clique, and partly by the skill of the prominent scientists who spoke out in its favour. The arguments of Rachel Carson's critics were characterized chiefly by the very "emotionalism" of which they had accused her, as well as by a reluctance to meet the issues.

Ludicrous Accusations

Some of the criticism aimed at *Silent Spring* makes amusing reading. F.A. Soraci, director of the New Jersey Department of Agriculture, had this to say in the *Conservation News* at the time of the book's publication: "In any large scale pest control programme we are immediately confronted with the objection of a vociferous, misinformed group of nature-balancing, organic-gardening, bird-loving, unreasonable citizenry that has not been convinced of the important place of agricultural chemicals in our economy."

Ironically, many of the attacks on Rachel Carson were prefaced by a bow to her "graceful writing." It was with this sort of gallantry that P. Rothberg, president of the Montrose Chemical Corporation of California (a manufacturer of DDT) introduced his remarks on *Silent Spring*. He went on to say that Rachel Carson wrote not "as a scientist but rather as a fanatic defender of the cult of the balance of nature." And William B Bean, M.D., writing in *Archives of Internal Medicine*, went even further by sayng he was sympathetic to Rachel Carson's cause. He added, however, that *Silent Spring*, "as science, is so much hogwash . . . I was made curious again and again by her disregard of the rubrics of evidence, of a nice regard for scientific validity, or of any feeling that what she presented should be unbiased."

But the only sentence in *Silent Spring* that he quotes to show her disregard of evidence is this one from Chapter 3 (page 13): "For the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals from the moment of conception until death." Dr Bean found this "an astonishing statement." Even more astonishing, however, were his own circumscribed views about the mobility of DDT residues. They have been discovered in remote regions of the world where spray planes have never intruded; they have been discovered even in mother's milk.

Withdrawal of Advertising

The chemical industry presented an almost united front against what it considered the menace of Rachel Carson. There were allegations made at the time that certain chemical companies threatened to withdraw their advertising from gardening magazines and newspaper supplements that gave favourable mention to *Silent Spring*. In November, 1962, the Manufacturing Chemists Association began mailing monthly feature stories to news media, stressing the "positive side" of chemical use. Similar material was mailed to about 100,000 individuals. The National Agricultural Chemicals Association doubled its public relations

Buying in Poisons

DDT may be banned in the US but that doesn't prevent Americans from eating food contaminated by it. A recent report by the General Accounting Office of the President (GAOP) warns that a large proportion of imported food contains residues of pesticides in excess of US limits or, worse still, of pesticides banned in the United States.

Under US law, there is nothing to prevent a company from manufacturing and exporting pesticides that are banned in the United States. Moreover, pesticides destined for export do not have to be registered with the Environmental Protection Agency. In 1976, over 552 million pounds of pesticides were exported of which over a quarter were unregistered. Twenty-eight per cent of those exports were sent to Latin American countries — from which the US obtains 38 per cent of all imported agricultural commodities.

The exported pesticides included aldrin, dieldrin, kepone, heptachlor and DDT — all prohibited in the US because of their proven dangers to human health and the general environment. Once they reach their destination, those and similar pesticides are used profigately:

- Brazil, Ecuador and other South American countries apply benomyl — a pesticide suspected of causing cancer, birth defects and genetic mutations — to their banana crops from 12 to 20 times each year.
- Milk from Guatemala was found to be contaminated with DDT residues at levels 90 times in excess of US limits.
- Spraying of DDT, dieldrin, toxaphene, endrin and parathion on cotton crops in Nicaragua, Honduras, El Salvador and Guatemala has led to the destruction of wildlife and the wholesale contamination of food.
- Over 7 per cent of all US agricultural imports come from these four countries.
- In 1976 the US Department of Agriculture refused entry to about half a million pounds of DDT-contaminated beef from El Salvador. Some of the beef contained residues about 19 times higher than permitted US levels.

Even when the Food and Drug Administration — whose job it is to keep food with unsafe residues out of the country — does discover imports that violate US standards, the food has often already been marketed and consumed. The law does not permit perishable food to be impounded whilst it is cleared by FDA laboratories, a loophole in the law that is frequently exploited by cowboy importers. By the time samples of suspected food cargoes have been tested, the bulk of the shipment has already reached the supermarket shelf and been sold. Provided a reasonable attempt is made to recall the food, the importer cannot be prosecuted.

The GAOP report charges the FDA with negligence in policing importers. It points out that in several cases food that was clearly in violation of standards was still allowed through customs. In 1977, for instance, 66 shipments of Mexican peppers were found to be heavily adulterated with pesticides. Yet only one third were denied entry.

Better Regulation of Pesticide Exports and Pesticide Residues in Imported Food is Essential. A Report to the Congress of the United States. July 1979.

budget. It distributed thousands of copies of reviews that were critical of *Silent Spring*.

This was the gist of the message: "A serious threat to the continued supply of wholesome, nutritious food, and its availability at present-day low prices is manifested in the fear complex building up as a result of recent unfounded, sensational publicity with respect to agricultural chemicals." In the face of even the mildest criticism, the chemical industry has resorted to this theme over and over in the intervening years.

Meanwhile, an attack began to take shape from what at first appeared to be another quarter. Its source in this case was an organization called The Nutrition Foundation. This organization had been incorporated in 1941 to support fundamental research and education in the science of nutrition. As part of its educational activities early in 1963 it put together a "Fact Kit" on the subject of *Silent Spring*. The kit consisted of a defense of chemical pesticides prepared by the New York State College of Agriculture, and several book reviews that were critical of *Silent Spring*. It was accompanied by a letter, written by C.G.King, the president of the Foundation, which stressed the "independence" of those who attacked Rachel Carson's book, and described the book itself as "distorted".

"The problem is magnified", King said, "in that publicists and the author's adherents among the food faddists, health quacks, and special interest groups are promoting her book as if it were scientifically irreproachable and written by a scientist."

Silent Spring was an enormous undertaking, as any work is that tries to bring together many disciplines to create a workable synthesis. Rachel Carson saw what most "pest control experts" had not seen — that the specialized view cannot solve the many problems posed by the large-scale use of pesticides. Indeed, such a limited view contributes to the problem. The variety of forms in nature baffles and blinds even scientists, just as the wealth of vegetation in the deep woods shuts off a man's view of all the surrounding forms except those closest to him. It is natural for the specialist to resent the overview. For her temerity, Rachel Carson bore the burden of a great deal of this sort of resentment.

We will leave it to Robert Rudd, whose own exhaustive book, *Pesticides and the Living Landscape* appeared shortly afterward, to define the essence of Rachel Carson's book:

"*Silent Spring* is biological warning, social commentary and moral reminder. Insistently, she calls upon technological man to pause and take stock."

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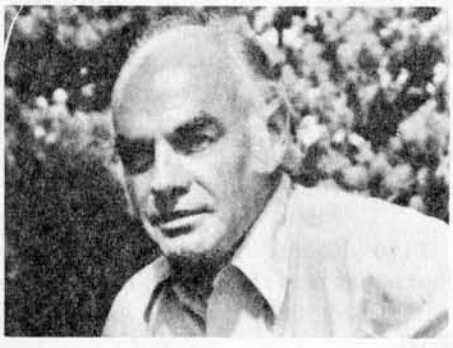
The Pesticide Mafia

by
Robert Van Den Bosch

Reports critical of pesticide use are suppressed. Those who wrote them face dismissal and an end to their careers. The corruptive and coercive influence of the Pesticide Mafia is widespread . . . .



Robert Van Den Bosch died in 1978 whilst jogging. He was Professor of Entomology and Chairman of the Division of Biological Control at the University of California, Berkely. His insisive mind and his determination to seek the truth will be sadly missed by ecologists throughout the world. This article is taken from his book, *The Pesticide Conspiracy*, to be published this Spring by Prism Press.

There is a pro-pesticide "mafia", whose members operate much in the manner of those in its Italian namesake. It has its *famiglie*, its *capi*, its *consiglieri*, its *soldati*, its *avocati*, its lobbyists, its front organisations, its PR apparatus, and its "hit men". It owns politicians, bureaucrats, researchers, county agents, administrators, and elements of the media, and it can break those who don't conform. In other words, it is a virtual duplicate of the other "*mafia*" that pervade and dominate so much of contemporary American society.

It took me a long time to recognise the existence of the pesticide mafia, and if I had done so earlier in my career I might have been intimidated by it and retreated into my burrow. But now I am too old to care and so I just rear back and blast away at the obscenity. I suppose that this is a dangerous game, but what can a *mafioso* do to an old bombardier beetle except step on it? There are worse fates!

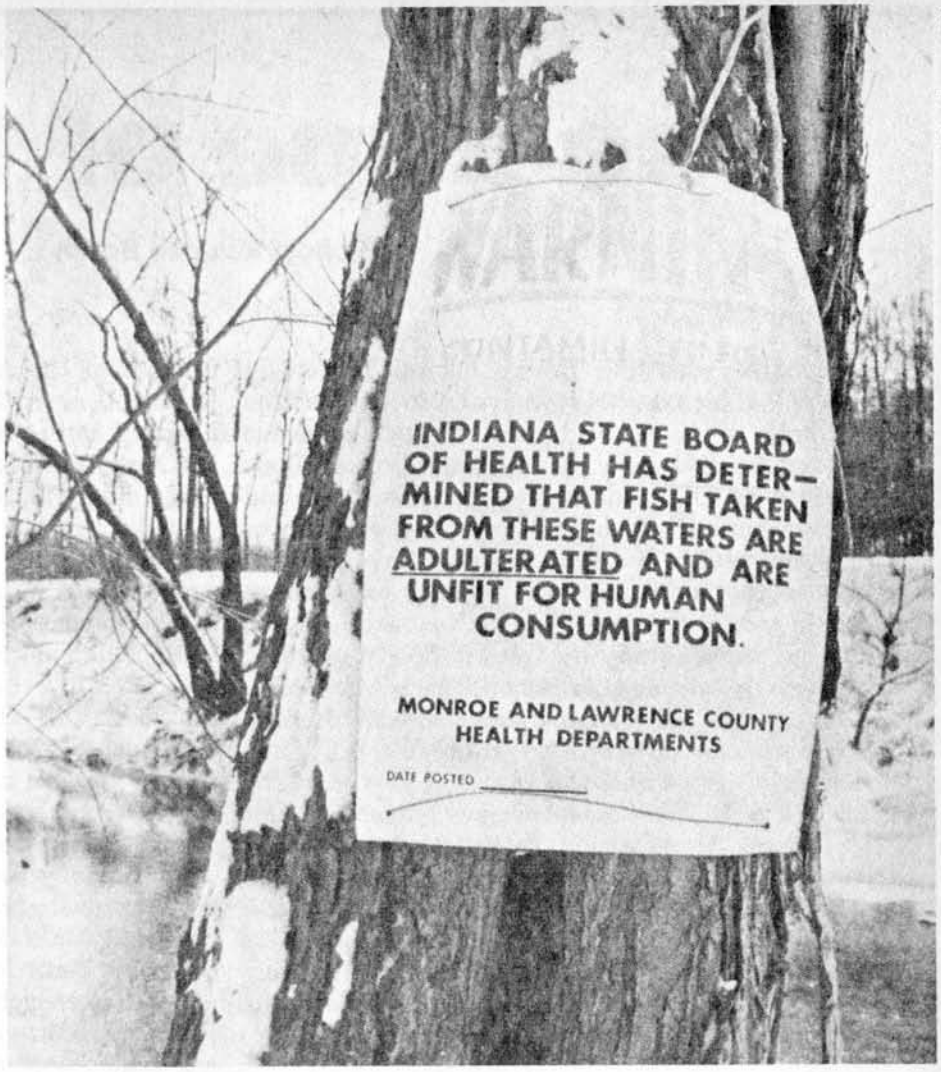
The greed of the pesticide mafia, then, has turned contemporary pest control into a practice in which chemical merchandising has become the name of the game. In fact, the merchandising imperative has assumed such overwhelming influence in our pest-control system that it has made a mockery of scientific pest management. In other words, pest control has become as much or more a matter of moving merchandise as it has of bug killing. As such, it has taken on the major characteristics of the market place: (i) fierce competition between producers of proprietary materials as well as pesticide formulations for a share of the market, (ii) intensive product advertisement by the various companies and the employment of a large sales force to push the merchandise.

As a result of all this, pest control has become a very big business. As best I can determine, over-all insecticide sales in California alone annually approximate $400 million, and application costs probably add another $100 million to the bill. Double these figures to accommodate all pesticides (e.g. herbicides, fungicides, rodenticides) and California's annual chemical control bill adds up to $1 billion, while by my reckoning the national figure totals about $5 billion. Clearly, the pesticide industry has become an enormous one, which in the pattern of our free enterprise economy is compelled to grow. Market stability or regression will not be tolerated in the boardrooms of the American agri-chemical industry, or for that matter, those of Japan, England, Germany, France, Italy, Switzerland, or wherever else pesticides are produced.

Some time ago, a top executive of Chevron Chemical Company made industry's position crystal clear when he told me that unless his firm expanded its markets at a certain annual rate and realized a stipulated profit, the parent corporation (Standard Oil of California) would divert its capital input from pesticide manufacture to other areas of chemical production. Little wonder that under this kind of pressure the pesticide company executive fights to increase his firm's markets and profits. Unfortunately, this market-expansion/profit-making drive, though perhaps commendable in the merchandising of ball point pens, toothpaste, or underarm deodorants, is the worst possible way to go about the business of pest insect management. It is an approach

fraught with economic, social, and ecological hazard, and it is a gut issue in the politics of pest control.

It is clear, then, that the agrichemical industry and its allies have a vested interest in the pest-control status quo (this explains their fierce defence of DDT, which they consider to be the first victim of a conspiracy to banish all pesticides[1]). They have a lot going for them, for they have immense influence over pest-control — legislation, pest-control advertisement, and pest-control philosophy. Their political muscle is used with great force whenever industry's interests are questioned or challenged. Little wonder, then, that as the dominant stud in the pest-control pasture, the pesticide mafia has compromised or corrupted most of the herd.



Pesticide run-off is a major threat to the health of aquatic ecosystems.

The Land Grant Universities

The corruptive and coercive influence of the pesticide mafia is widespread in the land-grant universities, where much of the nation's pest-control research is conducted and from which most of the pest-control recommendations emanate. In the agricultural experiment stations and the Agricultural Extension Service, deans, directors, department chairmen, division heads, or whatever titles they go by, too often knuckle under to the political pressures directly or indirectly generated by the agrichemical industry and its allies. At their most brazen, those interests have not hesitated to use politically sensitive university administrators to harass fractious researchers. For example, L.D. Newsom, of Louisiana State University, one of America's outstanding entomologists, has been aggressively attacked by four chemical companies in incidents extending over the past twenty years.[2] In each case, industry tried to work its harassment through the highest levels of university administration. The first issue involved Newsom's discovery that one company's insecticide had lost its effectiveness against the cotton boll weevil. Company officials wished to suppress this information and became incensed when Newsom refused to do so. In the other incidents, including a very recent one, the chemical companies' wrath was incurred when Newsom refused to recommend proprietary products for use on major crops. Fortunately, he is so highly respected in the field and in his university, that the attempts to "get" him have failed. But some of the political bullets, fired with lethal intent, have come close to their mark. Furthermore, even though he has survived, Newsom has had to stand up to virtually continuous badgering for two decades and to commit energy to the time-consuming and mentally wearing defence of his principles.

The second researcher, Denzel Ferguson, formerly of Mississippi State University, was pressured by certain administrators of that institution's College of Agriculture to cease and desist in his opposition to the fire-ant eradication program, and on the same issue was subjected to heavy flak from the Mississippi State Commissioner of Agriculture and from the State Chemist.[3] Ferguson stated in a letter to me that "the President of the University and my immediate supervisors said nothing, because I was tenured and funded with several grants. I would, however, point out that a younger or less well-known person could not have survived the mirex battle. I was simply too well entrenched."

In California, Robert Rudd, author of the highly regarded book *Pesticides and the Living Landscape* did not fare so well. Certain high administrators at the University of California, Davis, objected to his book's message and, following its publication, stripped Rudd of his agricultural-experiment-station title and passed him over for promotion.[4]

Professor Charles Lincoln, of the University of Arkansas, was attacked because he opposed an intensive, season-long cotton pest-control program advocated by a major chemical company.[5] A representative of the company tried to bring

The Rape of E.P.A.

by Robert Van den Bosch

The trouble with the Environmental Protection Agency (EPA) is that it tried to live up to its mandate. Accordingly, in the pesticide area it took aggressive action and banned such environmentally hazardous insecticides as DDT, aldrin-dieldrin, chlordane, and heptachlor, none of which is critical to the economy or to the public health. But these insecticides *are* of vital interest to the companies that produce and market them. So, too, is the prevailing pest-control system, which is dominated by pesticide marketing imperatives and chemical salesmen. This is where EPA got into trouble, for the American chemical industry wields enormous power in Washington, D.C., and EPA's activities stirred the wrath of this powerful giant. EPA might have escaped heavy punishment if it had stopped its pesticide cancellations with the banning of DDT. But certain of the other hard organochlorines are, if anything, more hazardous, and so the agency quickly banned them, too. This infuriated the chemical giant and turned its thoughts to rape. EPA was raising hell with the pesticide status quo and it had to be stopped and stopped quickly.

Bullying Tactics

EPA infuriated the pesticide mafia when it banned DDT. The first sign of rage came in 1974, when EPA Director Russell Train was bullied into permitting the use of DDT against the Douglas-fir tussock moth in the Pacific Northwest. But Train is a stubborn or, perhaps, obtuse man, for he ignored or failed to read the real message in the tussock-moth rip-off: "Cool it, Russ! Forget about banning pesticides." Instead, in rapid order he issued decisions banning aldrin-dieldrin, chlordane, and heptachlor. Here he stomped squarely on the toe of the chemical giant, and the giant reacted with uncontained fury, for these insecticides are the big breadwinners of certain of the country's major agri-chemical companies. One of the greatest uses of these materials has been in soil treatment to "control" rootworms in corn. This is an enormous program, in which insecticides are spread over about 50 per cent of the nation's 66 million acres of field corn as an insurance measure against possible damage by rootworms. Insurance treatment for corn rootworm control is an extremely wasteful and environmentally hazardous practice, since in actuality only a small fraction (less than 10 per cent) of each year's crop is economically threatened by rootworms, and can be readily identified. In other words, tens of millions of acres of cornland are annually laced with highly hazardous insecticides to "insure" that a small fraction of the crop will be protected against root-feeding insects. This is an incredibly sloppy way to handle a rather minor insect problem, but it typifies the American way of killing bugs, and the pesticide mafia dearly loves the huge revenues it generates.

Little wonder that Russell Train's cancellation orders provoked the "mafia" into all-out warfare against EPA. Almost immediately following Train's announcements of the aldrin-dieldrin, chlordane, and heptachlor bannings, a fierce barrage of complaints, criticisms, and threats began to pour in on EPA from a multitude of directions. The then Secretary of Agriculture, Earl Butz, the ag mags, the rural media, certain of the urban press, agri-business, growers groups, and corn-belt and corn-zone politicians all rained their grenades on the embattled agency. And Train, again wilting under immense pressure, threw another bone and some more of EPA's teeth to the pesticide mafia; the bone: establishment of the EPA director's Pesticide Policy Advisory Committee. This committee, which can only be described as a tragic joke, has been established to "advise, consult with, and make recommendations to the Administrator of the Environmental Protection Agency on matters of policy relating to his activities and functions under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Members will be appointed from farm organizations and other pesticide user groups, from the pesticide chemical industry, from private organizations demonstrating an interest in environmental protection, from appropriate state governmental agencies, from among persons known for their expertise in the field of health, and from the general public."

But this isn't all. The pesticide mafia is now committed to open rape, and it has tried in the process to break just about every bone in EPA's body. Its main thrust was a bill, HR 8841, amending FIFRA, coauthored by that old friend of the environment Congressman W.R.. Poage of Texas, which, as passed in a somewhat modified form by the Congress, severely compromises EPA's pesticide-regulating capacity. The major effect of HR 8841 is to give the Secretary of Agriculture veto power over EPA's pesticide regulation and cancellation decisions. In its original version HR 8841 would have given the Secretary outright veto power, but this rip-off was too gross even for the most jaded congressmen, and so a compromise was effected to seemingly soften the U.S. Department of Agrigulture's overseeing role.

"Hell, Van, what could I do? I was just a little guy raising a family and up for promotion. You'd better believe I tore up that manuscript."

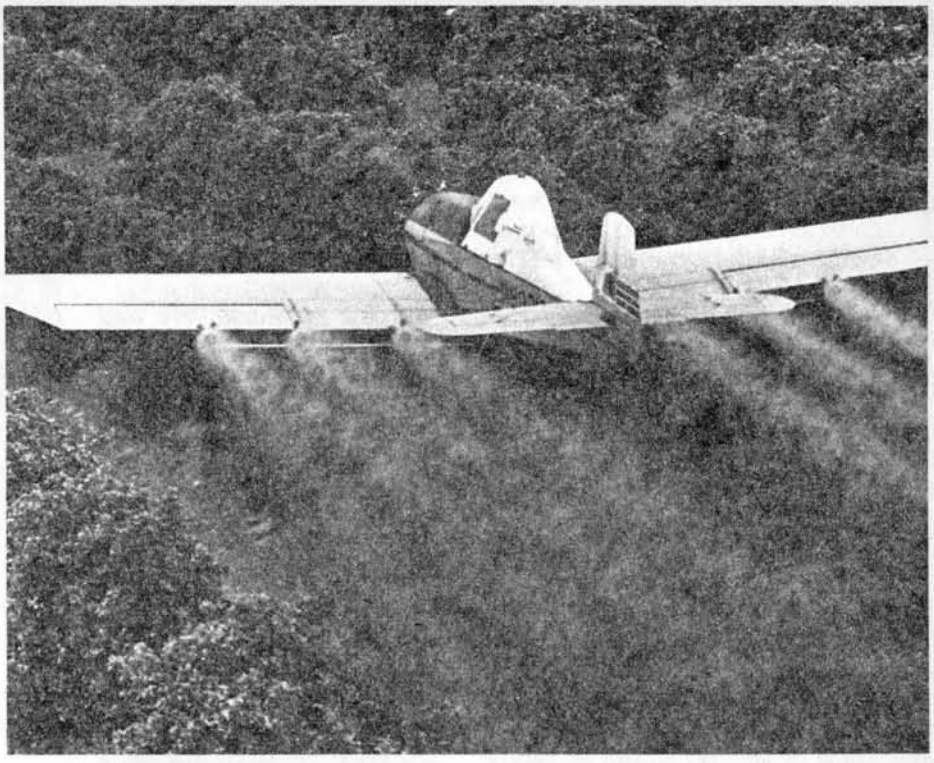
pressure against Lincoln through a university vice-president and through a member of the state legislature. Lincoln was also viciously attacked in certain newspapers and farm magazines. Again, as did Dale Newsom, Charles Lincoln survived the ordeal, but one wonders what scars it left.

Further Coercion

In a different version of the political pressure game, the Southeastern Branch of the Entomological Society of America was coerced out of promulgating a resolution against the fire-ant eradication program when politicians in Mississippi, reportedly tipped off by a Society member, threatened to cut the Mississippi State University Entomology Department budget and even the entire university budget, were the resolution to be adopted.[6] Not wishing to have a colleague's department and university suffer such punishment, the Southeastern Branch dropped its proposed resolution.

In another incident, when staff members at the University of Arizona initiated and supervised a pesticide-reducing, cost-saving pest-management program in cotton, the state agri-chemical-company organization brought enormous pressure to bear through the highest level of university administration in an attempt to force university withdrawal from the program.[7]

At Texas A & M University, Robert Fleet, a graduate student in the Wildlife and Fisheries Department who opposed the fire-ant eradication program and coauthored an article criticizing it, feels that he lost his research assistantship, was kicked out of his office-laboratory space, and was otherwise hassled and hounded by his superiors, because of his opposition.[8]



Over half a million tons of pesticides are used each year in the USA.

Toeing the Line

What I have just cited is only a sample of the kind of pesticide politics that go on in many, if not most, state agricultural experiment stations; the tip of the iceberg, as the old cliché would have it. What does not show is the implied pressure, even political reprisal, that keeps many, if not most, of the researchers silently toeing the line.

Two incidents will serve to illustrate this point. The first involved a University of California colleague who had become greatly concerned over the heavy spraying schedules forced onto tomato growers by the excessively stringent insect contamination standards set by the food processing industry. This entomologist knew it was impossible to attain the industry-stipulated insect contamination levels in processed tomato products and that, in fact, tiny bits and pieces of insects routinely occur in commercially canned tomato juice, catsup, and spaghetti sauce despite heavy crop spraying. To prove his point he set up an experiment in which he deliberately infested tomatoes with insects, processed and canned them, and then compared the level of insect contamination in his bugged tomato juice with that in canned juice available in the supermarket. He found no difference.

Next, as we university types do in order to inform science and society of our findings and get promoted, he set out to publish the results of his study. But the tomato canners got wind of this and sent a delegation to the university administration to complain about the manuscript and to threaten withdrawal of their grants were the paper to be published. The university brass, upset by this prospect, suggested to the entomologist that he back off. His description of his reaction to this subtle administrative arm-twisting reflects the widespread reality of life in the agricultural experiment stations: "Hell, Van, what could I do? I was just a little guy raising a family and up for promotion. You better believe I tore up that manuscript."

The second incident occurred during the EPA hearings on DDT, and related to the efforts of the Environmental Defense Fund to obtain testimony from aggie-college entomologists for its case against DDT. It began when I received a phone call from Dr Charles F. Wurster, of the State University of New York at Stonybrook, an EDF heavyweight. I had worked with Wurster in previous DDT hearings (Wisconsin and California) and was scheduled to testify on EDF's behalf in the Washington, D.C., hearings. However, Wurster felt that EDF

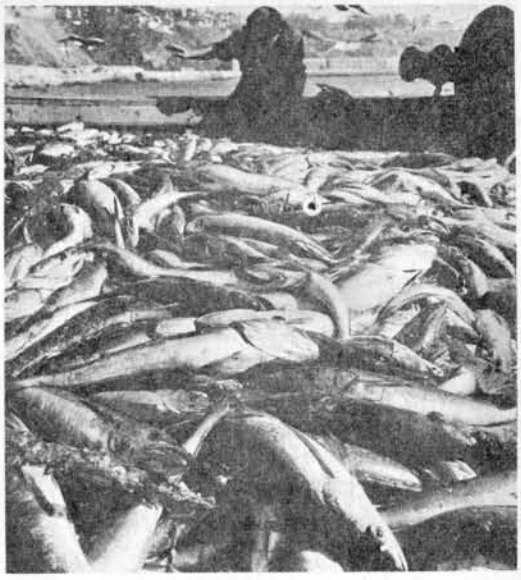
"In February 1978, over one hundred residents of Allegany jammed the community hall to discuss spraying and to hear the explanations of forest service and industry personnel.

Lionel Youst, a lifelong opponent of herbicides, recalls the event. "The Weyerhaeuser representative really established rapport right away when he drew a graph on the blackboard with 'alarm' on one axis and 'knowledge' on the other. Then he drew a line, showing how the more knowledge you had, the less alarm you had."

The meaning was perfectly clear, at least to Youst. "He was saying to this bunch of concerned people, 'You're all dummies'".

The presentation of the Oregon Fish and Wildlife representative didn't help matters either. He steadfastly maintained that herbicides couldn't be responsible for fish kills. 'Henry Crump was sitting on an empty drum of herbicides and he stood up and put it on the table right in front of the guy and asked him to read the label. The guy was stunned: it says right there on the label, 'Toxic to Fish'."

Phil Keisling
Williamette Week, *31.12.79*



needed additional research entomologists to support its case, and asked if I knew of several whom he might approach. This was all he asked: Did I know several entomologists who would simply be willing to discuss with him the possibility of testifying?

I told Wurster that I thought there were a few entomologists around who were brave enough to talk to him, and agreed to feel them out on this possibility. So I went to work on the telephone and lined up about a half dozen bug men who expressed their concern over DDT, felt that it should be banned, and indicated a willingness to talk with Charlie about the possibility of testifying in the DDT hearings. Now, these were all old personal acquaintances; good, solid integrated-control types who, in the close circle of long-standing camaraderie and the glow of a bellyful of beer, bourbon, or burgundy, shake their fists and stomp the floor in their resolve to go out and turn the pest-control scene around. When I talked to them on the phone, they were really charged up with a willingness to voice their anti-DDT convictions on behalf of Charlie Wurster and EDF.

But then, evidently, after they had rung off and their adrenalin had dribbled out, they got to thinking "rationally", and by the time Charlie called them they didn't want to have a thing to do with the DDT hearings.

Why? Because, as Wurster later told me, to a man they expressed fears either of administrative reprisal or of threats to existing or proposed research grants.

Believe me, in the agricultural colleges many if not most play the game according to the pesticide mafia's rules!

Notes & References

1. N. E. Borlaug (undated). "Mankind and civilization at another crossroad," 1971 McDougall Memorial Lecture, presented on November 8, 1971, to the Seventh Biennial Conference of the Food and Agriculture Organization of the United Nations, Rome, Italy. Reproduced by American Breeders Service, Allis-Chalmers Corporation, J.I. Case Company, and Oscar Mayer & Co. Distributed by Wisconsin Agri-Business Council Inc. 48 pp.

2. I have had several conversations with Dr.Newsom concerning his recurrent clashes with the chemical companies. The account that I have given is essentially a distillate of these conversations. Dale Newsom is a remarkable person: an outstanding scientist, a man of complete honesty who will battle for principle, and a person of warmth and good humour. We have often differed in matters of approach and style, but we are in strong agreement on a number of points regarding the problems of contemporary pest control. Life would be easier if there were more Dale Newsoms in the pest control field.

3. Letter from Denzel Ferguson to Robert van den Bosch, dated March 30, 1973.

4. F. Graham, Jr., 1970. *Since Silent Spring.* Fawcett Publ. pp 158-59. Dr. Rudd has also related this story of harassment to me, as have certain of his closest associates.

5. Letter from Charles Lincoln to Robert van den Bosch, dated April 2, 1973.

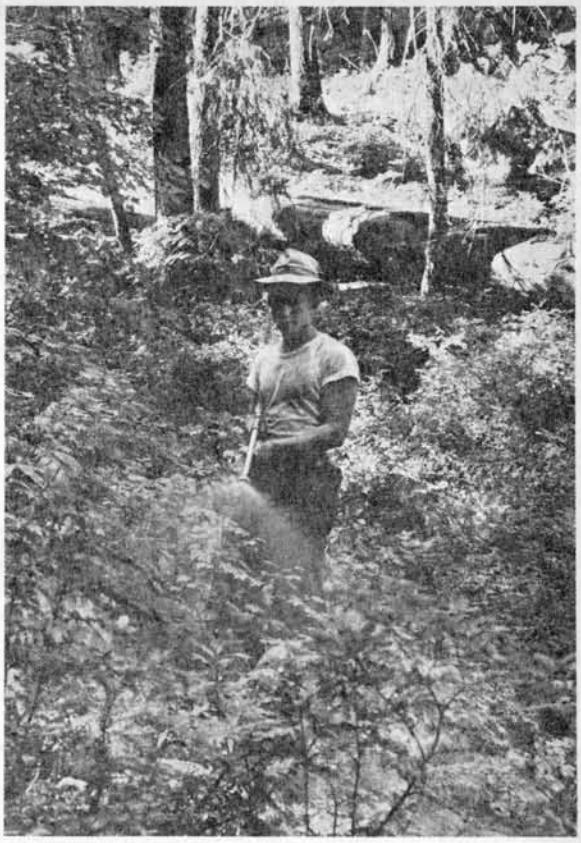
6. This incident occurred during the joint meeting of the Entomological Society of America and the Society's Southeastern Branch, in Miami, Florida, Nov.30 to Dec 3, 1970. Several persons directly involved in this incident related the details to me and to others.

7. This information was related to me by Theo F. Watson and Leon More, entomologists with the University of Arizona.

8. An undated, handwritten note to Dr. R. van den Bosch from Bob Fleet. This note was accompanied by a typewritten account of Fleet's tribulations.

How Pesticides affect the soil

by
David Pramer and Richard Bartha



Residues of certain synthetic pesticides are known to attach themselves chemically to organic matter in soil. This would seem to be desirable, because it results in a temporary immobilization and detoxification of the residues. But according to a 1969 report from the U.S. National Research Council, "There is relatively little information about the ultimate fate of persistent pesticides in soil or in other parts of any ecosystem..." Does this mean that we should be concerned because the pesticide residues may ultimately break away from the humus and create an environmental hazard?

Many factors are known to influence the behaviour and fate of pesticides in soil. Among them is the process of leaching — the deposit of pesticides into lakes and streams from soil runoff. Pesticides can be absorbed from soil by plants and consumed by soil animals. They can be degraded chemically or microbiologically, or they can be lost from soil by volatilization into the atmosphere. Pesticides also interact with both the clay and organic fractions of soil. In assessing the effects of any of these processes, it is important to know the chemical nature of the pesticide as well as the characteristics of soil involved. From the perspective of pest control, it is necessary to know the tendency of a pesticide to be degraded or volatilized in order to recommend effective rates of application. From an environmental perspective, it is important to understand how pesticides interact with microorganisms and with the clay and organic fractions of soil in order to know if controls are required.

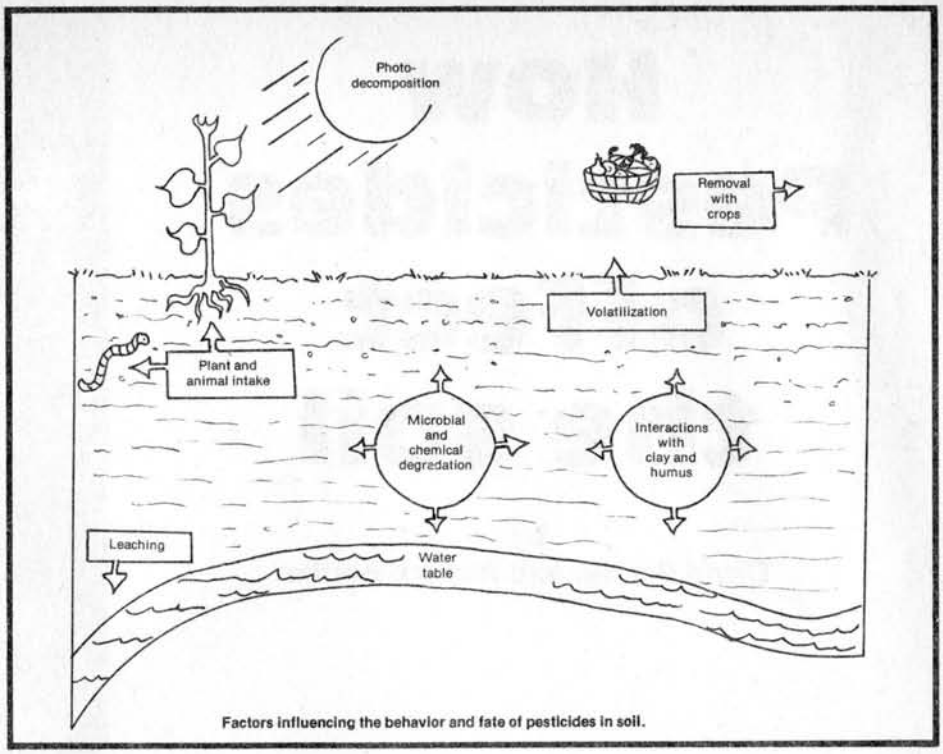
The chemical structure of a pesticide determines its actions in the soil environment and directly influences both its susceptibility to microbial degradation and its affinity for clay particles and humus. It also determines the tendency of the compound to volatilize and leave the soil as a vapor. Solubility, or the capacity of a pesticide to dissolve in water, is a major factor determining its persistence in the soil environment. Compounds that are very soluble in water are rapidly leached into lakes and streams, whereas highly insoluble compounds, such as the chlorinated hydrocarbon pesticides, DDT and dieldrin, are not rapidly leached, but rather persist in soils for many years. Moreover, a lack of water solubility appears to increase a pesticide's resistance to microbial degradation and it often serves as the chemical basis of the process known as "biomagnification."

Biomagnification

Some pesticides and other environmental pollutants such as PCBs, because of their water insolubility, tend to accumulate in the fatty tissue of plants and animals as they move through the "food chain." For example, low levels of a pesticide in water may contaminate plankton, whose fatty tissue would then accumulate higher levels of the pesticide than exist in the water environment. The pesticide would accumulate to an even greater extent in the fatty tissue of fish feeding on the plankton; and ultimately, the visceral fat of predaceous fish, and the fat of birds feeding on the fish, may contain toxic or debilitating levels of the

pesticide.

An actual case of biomagnification involving the compound DDD occurred in Clear Lake, California, where the compound was added to the water at levels of fourteen parts per billion to control gnats. Although this treatment relieved the lakeside of its gnat problem, the compound ultimately became part of the aquatic food chain, and was concentrated to levels 80,000 times greater than the original — a concentration strong enough to kill fish-eating birds. A study designed to trace the movement of the pesticide used to control Dutch elm disease has revealed that biomagnification through terrestrial food chains is very similar to the process which occurs in aquatic environments.



Factors influencing the behavior and fate of pesticides in soil.

Persistence

Pesticides like DDT persist in soil for years, but other pesticides in soil are degraded rapidly and completely. For example, the herbicide 2,4-D which is metabolized by soil microorganisms into carbon dioxide, water, and salt, has a half-life in soil of only three weeks or less. A teaspoon of soil contains a billion or more microorganisms, including bacteria, fungi, algae, and protozoa. The ability of microorganisms to decompose organic matter in soil is essential to the formation of humus, and it is these same microorganisms which attack organic pesticides in the soil.

Of course, the large majority of pesticide compounds are neither rapidly nor completely decomposed. They do not persist without change, but their transformation is only partial. When compounds added to soil are changed as a result of being acted upon by the chemical environment and by soil microorganisms, the resulting transformation products are referred to as "residue." Residues can be innocuous, they may retain the toxicity of the parent compound, or they may be toxic in their own right, adversely affecting plant and animal life. However, of particular concern to us is the fact that pesticides and pesticide residues are chemically reactive and tend to have an affinity for humus.

The chemical interactions of pesticides and pesticide residues with humus molecules are exceedingly complex. They are influenced by the nature of the pesticide, soil type, amount of moisture present, acidity of the soil environment, and soil temperature. Nevertheless, the subject has been attracting the attention of researchers throughout the world, and we at Rutgers University are involved in a programme to determine what finally happens to pesticides after partial degradation transforms them into residues that interact with humus.

Residues in Soils: a case study

We have selected for detailed study a pesticide named "propanil", which is used at levels of one to six pounds per acre of soil for the control of weeds in rice-growing regions throughout the world. When propanil is sprayed from aircraft, some of the compound falls directly on soil, while some reaches the soil indirectly either as runoff from treated plants, or in the dead tissue of weeds which fall to the ground after being killed by the herbicide.

Although propanil is biodegradable, microbial decomposition of the compound is not complete. A series of investigations in the Department of Biochemistry and Microbiology at Rutgers University and elsewhere has revealed that the propanil molecule is metabolically split by soil microorganisms into two new compounds known as propionic acid and 3,4-dichloroaniline (DCA). The propionic acid is further metabolized to carbon dioxide and water, but the DCA residue is inherently toxic and capable of damaging not only soil microorganisms, but also plants and animals.

DCA

DCA is such a reactive substance that its molecules react with one another to form new substances that are chemically more complex and have different kinds of activities than the parent compound. We have isolated and characterized some of these substances and have found that they belong to a group of chemicals called "azo compounds". The products we have identified are chemically complex and have such formidable names as 3,3',4,4'-tetrachloroazobenzene and 4-(3,4-dichloranilino)-3,3'4'-trichloroazobenzene. In addition, DCA is capable of combining chemically with various sugars, and it has an affinity for cellulose and other substances that occur in plant tissue.

It should not be surprising, therefore, to learn that DCA and other pesticide residues react with humus. In fact, the absorption of the pesticides themselves by humus is a key factor in their behaviour in soil, and the same is true for pesticide

residues. Pesticides and their degradation products differ greatly in their relative affinity for humus and in the tenacity with which they will bind themselves to it. For example, some pesticides such as diquat and paraquat are strongly attracted to humus and tightly held, while such compounds as 2,4-D have little affinity for humus and are readily decomposed or washed from soil.

Interaction of Pesticides and Humus

A large number of pesticides commonly employed today are built around an aniline core. Chemists have found the aniline molecule to be a useful starting point for the design and synthesis of many different compounds that serve as herbicides and insecticides. Propanil is one such compound. Our studies with propanil have demonstrated that the aniline portion of the herbicide molecule is released as a result of the activity of soil microorganisms, thus freeing it to undergo a number of different possible reactions. Propanil, therefore, can serve as a model of what can be expected from other aniline-type pesticides and pesticide residues in soil.

We have focused our study on the binding of pesticide residues to humus in order to determine their ultimate fate and significance as environmental pollutants. Our work has encountered many unforeseen obstacles, and progress has been slow. However, we do know that the attraction of humus for many pesticides and pesticide residues is strong, and that the two often undergo spontaneous and rapid interaction.

This binding of pesticide and pesticide residues to humus can be a strictly physical phenomenon, or it can involve chemical bonding. Some chemically bound pesticides will be released by humus following treatment with acid or alkali, and sometimes even by heat. Usually, however, release is incomplete and there is a residue of pesticide which is never recovered. We have worked primarily with propanil, but other researchers have demonstrated humus to react with the quarternary ammonium insecticides diquat and paraquat, with organophosphate insecticides such as parathion, with the phenoxyalkonoic acid herbicide 2,4-D, and with the carbamate insecticide known as sevin.

Inability to Detect Residues

Whatever the mechanism by which a pesticide binds to humus, it becomes inaccessible to detection by chemical methods generally used to detect pesticides in the environment. This means we cannot depend on conventional analytical procedures to monitor the fate of humus-bound pesticides.

Instead, it is necessary to somehow tag the pesticide molecule so it can be located and identified. We can do this with radioactive carbon atoms. Once the pesticide is labelled, we can determine its fate in soil by observing what happens to the radioactive atoms, rather than by trying to measure changes in the pesticide molecule as a whole. Radiochemical techniques can tell us if a pesticide which can no longer be detected by conventional chemical procedures has been bound by humus, or whether it is undergoing complete or partial degradation, or experiencing other types of transformations in soil. In the past, those unaware of the need to use radiochemical techniques have often interpreted their inability to detect pesticide residues by chemical analysis as evidence that the compound had been chemically or biologically degraded to carbon dioxide and water. In fact, until recently, pesticides were licensed for use in the United States on the assumption that failure of chemical procedures to detect pesticide residues in soil extracts meant the pesticide had undergone degradation and would, therefore, not accumulate in soil and produce long-term undesirable environmental effects.

As already indicated, humus itself undergoes some decomposition, but, since its transformation takes place very slowly, humus is best viewed as a highly resistant substance. We know that compounds, including pesticides, combined with humus are at least partially protected from decomposition. But is there anything unique about the binding of pesticides to humus? Does this phenomenon influence soil fertility, or can "bound" pesticides eventually be released, making them a source of contamination for food crops?

Pesticides like DDT persist in the soil for years.

Release of Pesticide Residues

From our attempts to design and perform experiments to answer these and related questions, we have found that binding to humus usually causes a marked decrease in the biological activity of pesticides. Humus has a remarkable capacity for soaking up pesticides and other organic substances much as a sponge absorbs water. Fortunately, humus detoxifies pesticides, and even extremely high levels of pesticides bound to humus fail to adversely affect soil microorganisms. Pesticides in the bound state do not seem a major concern. But there exists evidence — both circumstantial and experimental — that the bound state is not permanent. *This means that pesticides associated with humus can, under certain conditions, be released and constitute a source of crop contamination and environmental pollution.*

For example, a survey revealed that rice sold in supermarkets throughout the United States contained DCA, a degradation product of propanil which we have already discussed. In soils used for the cultivation of rice, some of the DCA molecules released by the microbial degradation of propanil would interact with others to produce azo compounds, and some would combine with humus, but none of the DCA would remain free. As a result of our experiments using radiolabeled DCA, we know that some of the pesticide residue in soil is first stabilized by forming a complex with humus. Later, however, because of the action of microorganisms, the compound is

remobilized and the DCA is freed to enter the roots of rice plants and move up into the grain.

Work in our laboratory has confirmed that soil contains various fungi and bacteria capable of metabolically liberating DCA from humus complexes. Other researchers have shown that the humus-bound insecticide parathion is also liberated by the action of microorganisms, and when it is freed, it can adversely affect earthworms and other life in soil. Similarly, Canadian investigators have demonstrated that while the insecticide methoxychlor combines with humus, a fungus named *Marasmium oreades* is capable of separating the insecticide from the humus, leaving it free to act.

Conclusion

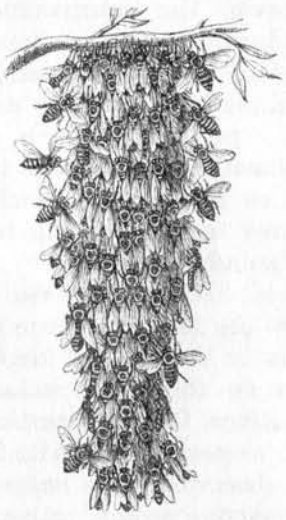
Humus-bound pesticides and pesticide residues pose an intriguing problem for those concerned with regulating environmental quality. It is difficult for them to know or obtain expert opinion on the ultimate fate of pesticides in soil. Are pesticides combined with humus detoxified and therefore of little or no concern, or should they be viewed as potential hazards which can be released at any time? The formation of humus-pesticides complexes does not appear to reduce the benefits derived from humus, but humus does protect the bound pesticide from degradation. If, as indicated in preliminary laboratory studies, bound pesticide residues may be released by microbial metabolism in an intact and biologically active form, they can become sources of crop contamination, even if the crop was not directly treated with the pesticide but was only grown in soils treated during previous seasons.

It is not clear at this time whether or not humus-bound pesticides or pesticide residues have any significant public health or ecological implications, but there is little doubt that this area needs further exploration before it will be possible to solve the risk-benefit equation of pesticide use.

Bees: an Alarm Signal?

by Vincent Gobbe

President, Nature et Progrès



Time and again we have talked of the damage caused by pesticides, and yet once more I find myself constrained to bring up this question because of recent events in Belgium. This time, however, the subject has a different slant.

This particular story bean in June 1977, with a court case brought by Raymond Hauglustaine, a beekeeper in the Naumur area, a member of Nature et Progrès, and a victim of spraying by farmers.

Both expert and police witnesses confirmed the death of approximately 1 kilo of bees per hive, which represents 10,000 bees, or at that time of year, one fifth of every colony. Nineteen of his colonies had been affected, that is, 190,000 bees had died. Four other beekeepers in the area had noted deaths during the same period, and all took court action. All the deaths were caused by the spraying of herbicides on wheat fields which were infested with mustard and groundsel in flower.

From then on, Raymond Hauglustaine did not rest until he had studied all the specialist literature available, and added to it laboratory analyses and his own knowledge and experience. This wearisome and painstaking task culminated in a report, *Herbicides Kill Bees,* which was recently awarded the Silver Medal at the 27th International Congress on Apiculture.

The literature shows clearly that the accidents in 1977 in Belgium were by no means isolated cases, and that similar (sometimes even more serious) disasters have arisen in many countries.

Haroun Tazieff writes in his introduction to Hauglustaine's report: "That a government may permit harmful use of pesticides, herbicides and medicines through ignorance, we can understand. That the same government should refuse to take account of the evidence, so as not to upset powerful financial groups which have every interest in seeing the widest possible use of these dangerous and polluting chemicals, that they should allow plants, animals, people to be poisoned, is not acceptable in a democracy."

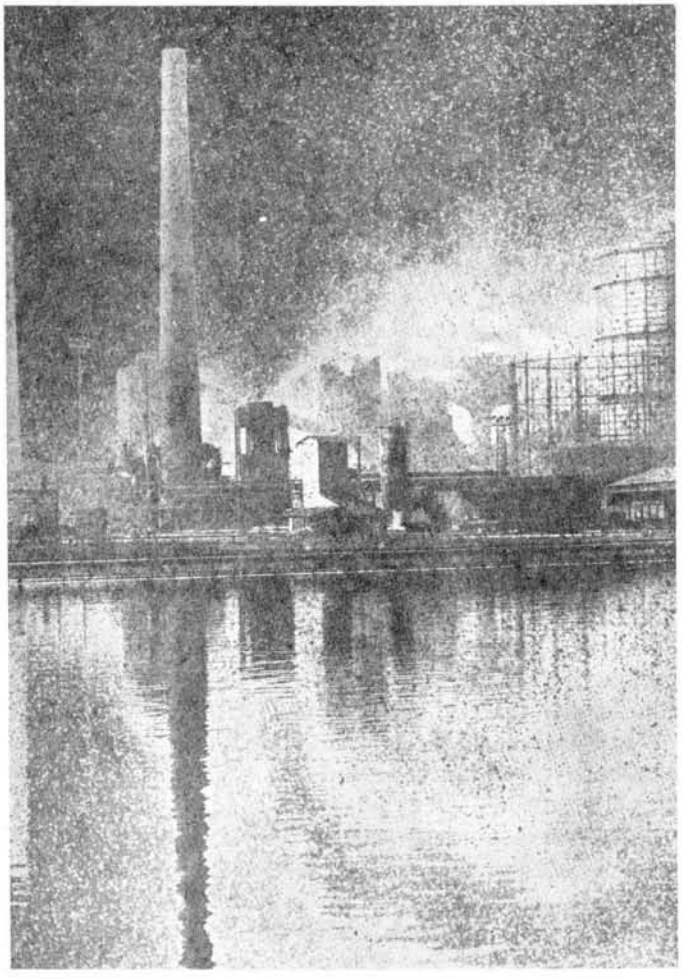
Why go out of one's way to protect bees? For their honey? Naturally beekeepers care about that, but could there not be a more serious reason? A document prepared with the collaboration of the National Institute for Agricultural Research (INRA), the National Federation of Multiple Crop Farmers and the National Institute for the Popularisation of Fruit and Mushrooms, underlines the fundamental importance of pollinating insects. For example crops of Bigareaux-type cherries may be increased by 20 times, even 50 times, with good pollination by pollinating insects. You do not have to be an agricultural expert to see that wild flowers are disappearing from our countryside. They are disappearing because of use of herbicides, and also because of a change in the chemical composition of the soil following excessive use of fertiliser. While it is difficult to define the percentage of pollination carried out by bees or other pollinating insects, we can be certain that the disappearance of all pollinating insects will in the long run be a real catastrophe.

In fact, production of seed for agriculture requires cross pollination. It is essential for most fruit trees, as well as for such crops as lucerne, clover and plants grown for their oil, and those used as fodder for cattle from which we take meat and milk.

The alarm sounded by beekeepers is not just because of their love of bees, or the products they get from them, but for the sake of nature and mankind: the more you think about it, the more clearly you can see, this is a question of survival.

The report "Herbicides kill bees", published by Infor-Vie-Saine, Nature et Progrès Belgique, Friends of the Earth (Belgium) and AVES, will be on sale from February 1980.

(Vincent Gobbe, President, Nature et Progrès *translation by Elizabeth Mapstone.)*



Dioxin: the Lingering Controversy

by
Janice Crossland

We know little about the long-term effects of Dioxin, an inevitable contaminant of some phenoxy herbicides. Must we wait for a disaster to find out the answers?

One of the most toxic substances known to man is the chemical dioxin, an unavoidable contaminant in the production of certain commercial products, including the popular herbicide 2,4,5-T. Dioxin, a shorthand term for a chemical called 2,3,7,8-tetrachlorodibenzo-p-dioxin, has been singled out as the cause of occupational illnesses in several industrial accidents, has been found to cause birth defects in experimental animals, and has been cited as a potential carcinogen. Most recently, the United States Environmental Protection Agency linked the spraying of certain Oregon forests with 2,4,5-T with an increased incidence of spontaneous abortions in women in those areas of that state. Because of dioxin's highly toxic nature, 2,4,5-T has been partially banned in the U.S. but it continues to be widely used as the debate about its safety goes on.

In the United States today, two questions about dioxin stand out: In the face of widespread use of 2,4,5-T on crops and rangelands, does dioxin accumulate in the environment, and if so in quantities that would pose a health threat to humans at the top of the food chain? Critics say that the excessive toxicity of dioxin could make even minute quantities in the environment harmful.

The second question plaguing U.S. health officials is whether the symptoms of ill health reported by thousands of veterans of the Vietnam War and claimed by them to be a result of dioxin poisoning indeed stem from their exposure to Agent Orange, a 2,4,5-T-containing preparation used as a defoliant in Vietnam.

2,4,5-T Production and Use

2,4,5-T belongs to a group of pesticides called the phenoxy herbicides, which today includes such commercial products as Silvex, MCPA, and 2,4-D. Scientists who first studied the phenoxys were interested in their ability to regulate plant growth. To a limited extent some phenoxy chemicals are used as plant growth regulators today. 2,4-D, for example, is sometimes used to control the ripening of bananas. But in the early 1940s scientists discovered that when applied in larger doses the phenoxys had the ability to selectively kill certain plants and since then this group of chemicals has found wide application as herbicides. The phenoxy herbicides kill broad-leaf weeds and because they are effective against hardwood trees are useful in controlling undergrowth in conifer forests. 2,4,5-T, first registered as an herbicide in the U.S. in 1948, has had wide application on farms, forests, rangelands, and utility and transportation rights-of-way. Millions of pounds of 2,4,5-T are used each year.

According to the industrial proponents of 2,4,5-T, this herbicide replaces more costly manual and mechanical weed control measures. It reduces by 5 per cent the cost of growing certain crops and overall saves farmers 1 per cent of total agricultural costs. The herbicide also kills plants such as larkspur which are poisonous to cattle. It is claimed that consumption of this plant alone can reduce livestock by 3 to 5 per cent annually. (CAST, 1978).

Under the code name "Agent Orange", an herbicide

made up of equal parts 2,4-D and 2,4,5-T, was also employed as a defoliant in Vietnam. Between 1962 and 1970 about 10 per cent of South Vietnam was the target of defoliation missions. As a defoliant, rather than routine weed killer, it was applied at 30 times the normal application rate. Not only was more applied per acre but it is estimated that the formulation used contained 100 to 1,000 times the amount of dioxin now found in 2,4,5-T.

And of course it is the dioxin, much more toxic than 2,4,5-T itself, that is controversial. Dioxin, discovered as a contaminant of 2,4,5-T in 1957, is produced when trichlorophenol, the starting chemical for a number of commercial products, including 2,4,5-T and hexachlorphene, reacts with itself. The dioxin molecule may contain up to eight chlorine atoms but the most toxic form has four chlorines (at the 2,3,7, and 8 positions) and is the form of dioxin referred to in this article (unless otherwise noted).

When first manufactured in the late 1940s, 2,4,5-T contained 30 to 40 ppm (parts per million) dioxin. After 1969 manufacturing methods were improved so that by 1971 2,4,5-T contained less than 1 ppm. Today most 2,4,5-T contains between 0.05 and 0.1 ppm dioxin.

Toxic Effects

There is no question about the toxicity of dioxin. It is one of the most toxic substances known. The LD_{50} (dose needed to kill 50 per cent of a group of experimental animals) for guinea pigs is 0.6 micrograms per kilogram while the LD_{50} for mammals for 2,4,5-T ranges from 100 to 2,000 milligrams per kilogram. Depending on the species tested, dioxin may be 5,000 to 500,000 times more toxic than 2,4,5-T.

A sublethal dose of dioxin can cause damage in various body tissues. In a series of experiments in which rats, mice, and guinea pigs were fed dioxin, the thymus gland consistently showed a decrease in weight and a decline in thymocyte production. Degeneration and necrotic changes in liver cells were also observed. A less consistent change, but often present, was haemorrhaging in the gastrointestinal tract, heart, and brain. Analysis of the tissues of rats fed dioxin showed that the chemical becomes localized in fat and liver tissue, (Harris, 1973; Gupta, 1973).

The toxic effects of dioxin on animals have been demonstrated outside of the laboratory as well. In 1957 millions of commercially raised chickens were poisoned, half fatally, in a mysterious episode that was later attributed to dioxin poisoning. The affected chickens had droopy and ruffled feathers and difficulty in breathing. Autopsies showed fluid accumulation (edema) in the membrane surrounding the heart, beneath the skin, and in the abdominal cavity; liver and kidney damage was also evident. The substance causing the disease was called the "chick edema factor" until it was identified in 1966 by x-ray crystallographers as hexachlorodibenzo-p-dioxin (the form of dioxin with six chlorines). It was hypothesized that dioxin in 2,4,5-T or pentachlorophenol (another pesticide which may be contaminated with dioxin) that had been sprayed onto corn and later processed into oil found its way into animal feed. (Nut. Rev., 1968; Yartzoff, 1961; Chem. Eng. News, 1967; Douglass, 1961.)

More recently, experiments in monkeys have shown that long-term exposure to low levels of dioxin can have serious effects. In one series of experiments eight Rhesus monkeys received 500 ppt (parts per trillion) dioxin in feed daily for nine months. Death occurred in five of the eight animals within seven to twelve months, with pancytopenia (a reduction in the number of erythrocytes, all types of white blood cells, and platelets) cited as the immediate cause of death. Two of the symptoms shown by the monkeys were anaemia and internal haemorrhaging. In addition, there were changes in the number, size, and/or structure of epithelium cells of the bronchial tree, bile ducts, pancreatic ducts, salivary gland ducts, and renal pelvis as well as keratination and loss of hair and nails. (Allen, 1977).

What is most significant about this study is the fact that very low levels of dioxin led to dramatic results. The monkeys received a total body burden of 2 to 3 micrograms dioxin per kilogram body weight over a nine-month period, less than the LD_{50} for monkeys of 50 to 70 micrograms per kilogram. And yet the lower dose, given over an extended period of time, turned out to be lethal.

This brief summary of the toxicity data for dioxin must also note that new experiments now show that dioxin is carcinogenic in animals. In a 1977 study 10 groups of 10 Sprague-Dawley rats per group were given 0, 1, 5, 50, and 500 ppt or 1, 5, 50, 1,000 ppb (parts per billion) dioxin in their diet. At the higher doses (50, 500, and 1,000 ppb) the animals died in two to four weeks and at 1 and 5 ppb the animals died in the 90th week. For the six lowest doses 57 per cent of the animals that died had tumours of some kind, among them tumours of the ear, lymph nodes, kidney, skin, and liver, (Van Miller, 1977). This experiment tells us that dioxin not only has the potential to produce cancer, but at very low doses.

Human Exposure

In the mid-1970s women living within 12 miles of the small town of Alsea, Oregon began to suspect that the spraying of nearby forests with 2,4,5-T was affecting their capacity for normal childbirth. Eight women reported that they had had 13 miscarriages between 1972 and 1977. Most of the miscarriages occurred eight to ten weeks after conception and four to six weeks after the spraying.

Because so much data had accumulated on the adverse effects of dioxin on the unborn in animal studies, the Environmental Protection Agency (EPA) carried out an epidemiological study to determine if there was a relationship between the miscarriages and 2,4,5-T exposure. EPA workers compared hospital data for the spontaneous abortion rate of women from the rural area of Oregon that was routinely sprayed (study area), a non-sprayed rural area (control) and an urban environment. They found that between 1972 and 1977 the study area showed more spontaneous abortions, 80.8 per 1,000 live births, than the urban setting (43,8 per 1,000) or the control, area (65.4 per

Birth Defects: the legacy of 2,4,5-T

Ecology Party

In March 1979 the Environmental Protection Agency (EPA) placed a temporary ban on spraying the herbicides 2,4,5-T and Silvex to control weeds in forests, along roadsides and under power lines. The ban followed new evidence linking the chemicals to a high incidence of miscarriages in Oregon.

"Studies show a high miscarriage rate immediately following the spraying of 2,4,5-T in the forests around Alsea, Oregon" explained an EPA spokesman.

The miscarriage rate in Alsea peaked dramatically in June, roughly three months after the area was sprayed with herbicides to control forest weeds. From 1972—78, the spontaneous abortion rate was 130 per 1,000 births in Alsea. in unsprayed areas it was 46 per 1,000 live births.

As early as 1968, tests on mice showed 2,4,5-T and its sister compound, 2,4-D, to be teratogenic. The fetal mortality rate for 2,4-D ran as high as 74 per cent, while the abnormality rate rose to 100 per cent for high doses. The tests carried out for 2,4,5-T yielded similar results. After studying this data — known as the Bionetics Study — the Advisory Panel on Teratogenicity of Pesticides recommended that 2,4-D and 2,4,5-T "should be restricted immediately to prevent risk of human exposure."

The Bionetics Study was later challenged when it was discovered that the samples of 2,4,5-T contained high concentrations of dioxin. Subsequent experiments with relatively pure samples, however, confirmed the earlier tests. Studies by Dow chemicals — using low doses of 2,4,5-T — showed a sevenfold increase in skeletal abnormalities. Meanwhile the National Institute of Environmental Health found a significant increase in the number of cleft palates and kidney malformations.

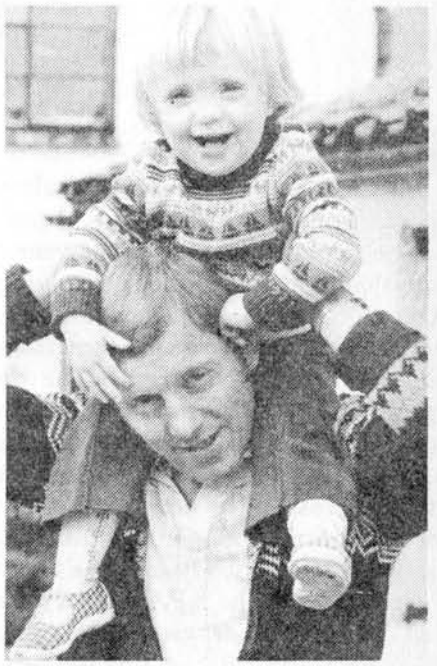
Despite the 1979 ban, 2,4,5-T and Silvex are still permitted for spraying on rice paddies and open ranges: the EPA claims that such uses do not affect a significant number of people. For its part Dow Chemicals — major manufacturers of 2,4,5-T and Silvex — argues that the Alsea data is "unscientific".

E. H. Blair, Dow's director of Health and Environmental Sciences, told *Science* that he considered the ban "an example of government at its worse — basing a hasty product suspension on data which has not been subjected to scientific review." He added that "the bulk of scientific data gathered over three decades of use demonstrate that there has never been a single documented incident of human injury resulting from normal agricultural use of these products."

Further evidence of spontaneous abortion as a result of spraying comes from Australia, New Zealand and Sweden. In Britain, 5 cases have recently come to light — largely due to the efforts of the Ecology Party and the National Union of Agricultural and Allied Workers:

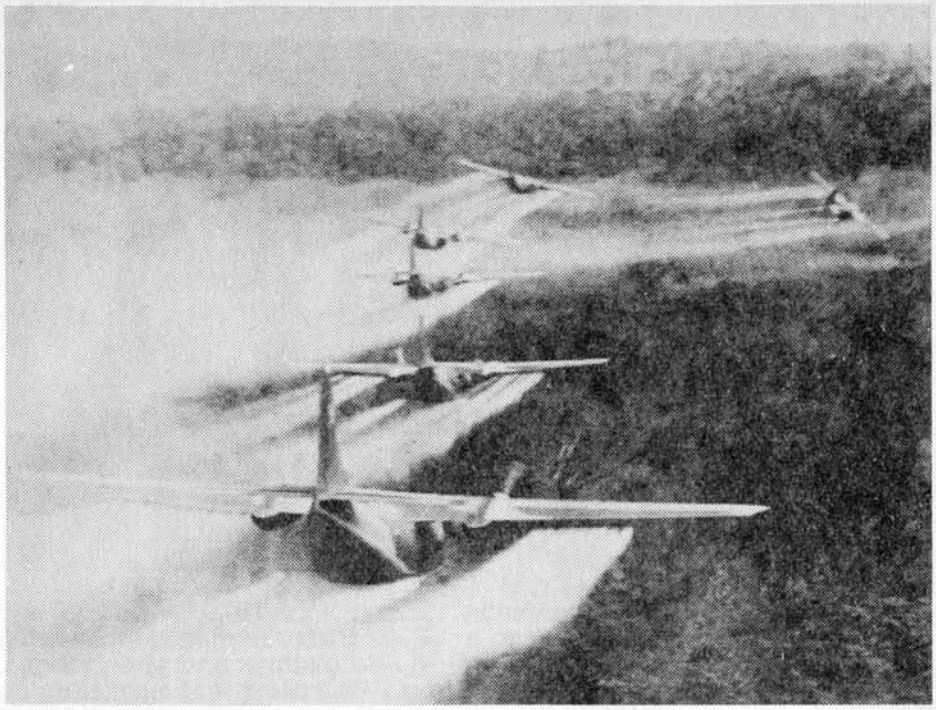
- In Wales, Mrs Sheltinga — wife of a Forestry Commission worker miscarried after the Forestry Commission sprayed 2,4,5-T near their home. She was assured by officials that it was safe to eat blackberries from the sprayed area. In Somerset, Mrs Cobbledick, had a five month miscarriage and another Forestry Commission worker, Mr Chidgey, blames his daughter's birth deformities on dioxin transmitted through his sperm.

- Mr Dally and Mr Helliar, both of whom farm in Somerset, lost much of last year's flock of sheep after the Forestry Commission sprayed 2,4,5-T on land next to their farms. In Mr Helliar's case 29 ewes died, others aborted and many lambs were born without ears, tails or mouths. On both occasions the local Veterinary Investigation Centre denied that 2,4,5-T was to blame. They admit, however, that they do not have the facilities to test for 2,4,5-T poisoning.



Both the NUAAW and the Ecology Party are pushing for a total ban on 2,4,5-T. A Committee of the Trade Union Congress have also asked the government to re-examine the evidence on 2,4,5-T and birth defects.

For further information contact Tony Charles of the Ecology Party, (60 Sylvan Road, Wellington, Somerset) and the National Union of Agricultural and Allied Workers, (308 Gray's Inn Road, London WC1)



American Airforce jets (right) spray the jungle in Vietnam to defoliate trees and deprive the Vietcong of cover. The spray, known as Agent Orange, is a mixture of the herbicides 2,4-D and 2,4,5-T and is contaminated with 50 parts per million of dioxin. Almost ten per cent of the forests of South Vietnam received at least one application of the spray.

Five hundred veterans have now sued the US government for injuries they claim were caused by the spraying programme. The veterans report illnesses ranging from chlorachne to liver cancer, birth defects, chromosome breaks and mental instability.

Hospitals in the Hue district of North Vietnam, repeatedly sprayed with Agent Orange, reported that the rate of stillbirths rose to 48.5 per cent and congenital malformations were found in 8 per cent of children. There were also a significant increase in Downs syndrome or mongolism.

1000), (U.S. EPA, 1979).

But the most dramatic results were seen when spontaneous abortions for June and July were compared with the rest of the year. These months are significant because most spraying is done in the spring, in March and April, and the women who first reported the increase in miscarriages stated that the abnormal births occurred in the weeks following the spraying. The EPA confirmed their suspicions. In the study area the spontaneous abortion rate was 130.4 per 1,000 live births in June and July while the June and July rate of the urban area was 44.9 per 1,000 and for the control area 46.0 per 1,000. On the basis of the epidemiological study and the findings in animals, in February 1979 the EPA put an emergency ban on the use of 2,4,5-T in forests, pastures, and rights-of-way. Permanent cancellation proceedings were then set into motion.

Legacy of Vietnam

Though the conflict in Vietnam ended some time ago, questions about the war continue to plague Americans. Still unanswered is whether symptoms reported by the Vietnamese people as well as American veterans of the war are a result of exposure to the massive amounts of Agent Orange dropped on South Vietnam during the 1960s.

In the U.S. it is possible that thousands of veterans may have become ill because of exposure to dioxin in Vietnam. The problem became a national concern when a federal worker in the Veterans Administration in Chicago began processing benefit claims for veterans who said they were ill because of herbicide poisoning. By February 1978 Maude De Victor, the federal employee, had compiled a list of 30 veterans from the Chicago area who had been exposed to Agent Orange and who had complained of, among other symptoms, persistent rash, numbness, reduced libido, fatigue, and psychological problems, (Commoner, 1978) .

A case in point is Julio Martinez whose story was recently told to a New York Times reporter. Martinez served in Vietnam in 1970 and 1971 in an area in which Agent Orange spraying occurred. Immediately after being sprayed Martinez developed a skin rash and tumours on his legs and his feet became swollen. Since his return home other symptoms have developed: fatty tumours on his hands and breasts; weakness in his wrists, hands and legs; loss of sex drive, and loss of hair. He has had four children who were born dead or deformed or are emotionally disturbed. Martinez now lives on a Veterans Administration partial disability pension, (Severo, 1979).

By September 1979 more than 700 veterans had filed claims against the U.S. government and 4,800 had requested medical treatment for what they claim are dioxin-related illnesses. But the government has not yet designated any disease resulting from Agent Orange poisoning and thus will not pay benefits for those claims. Prodded by the veterans and numerous activist groups that have sprung up, the Air Force, the Department of Health, Education and Welfare, and the Veterans Administration are now carrying out studies to reassess the records and learn if there is, indeed, a link between Agent Orange exposure and the veterans' illnesses.

In the meantime a General Accounting Office report released in November, 1979, accused the Defence Department of underestimating the number of soldiers who were exposed to dioxin. While the Defence Department maintains that most veterans did not re-enter the sprayed areas until six weeks after spraying, the GAO contends that at least 5,900 marines were within one-third mile during or shortly after the spraying and over 16,000 were within one-third mile of the spraying within four weeks, (Weinraub, 1979).

Dioxin in the Food Chain

Taken together, what scientists have shown in animal studies and direct human experience with dioxin confirms the deadly nature of the chemical. The

Thirteen Days in July

Saturday July 10th, 1976.
Shortly before lunch a piercing whistle shatters the silence of Carlo Porta, a housing estate a few miles outside Seveso, Northern Italy. Local residents rush into the street to see a cloud of white gas spiralling its way across towards them from the direction of the nearby Hoffman-La Roche chemical plant. Most are dismissive of the incident: after all, no warnings have been given and similar clouds have been produced before when the company burnt its waste residues. They return inside to finish preparing lunch, gagging slightly at the dreadful smell but nonetheless unconcerned by the chemical fog that is now choking their houses.

Monday, July 12th.
The leaves begin to wilt on trees. Doctors receive complaints of diarrhoea, itching eyes, burning faces, nausea and headaches. Vegetables in local gardens wilt, and look as if they had been burnt with cigarettes.

Tuesday morning, July 13th.
Michele Iurata, a medical student from Milan University goes to his chicken coop only to discover that his new batch of chicks have all died, their bodies contorted and withered. Others find birds on the streets that have literally dropped dead in mid-flight. Dogs too begin to keel over and die.

Wednesday July 14th.
Men from the chemical factory visit the estate, dressed from head to toe in protective clothing and wearing gas masks. The company issues its first assurance that there is nothing amiss and that all will be well. Nonetheless, the residents of the state are advised not to eat fruit or vegetable produce from their gardens. Few take the warning seriously.

Thursday, July 15th.
Residents march on the offices of the municipal health authorities in Seveso. Again they are assured that the gas cloud poses no health threat. The residents turn to the Mayor for help; he immediately orders all those children who have been affected to be admitted to the Marino Comense Hospital near Como.

Friday, July 16th.
A notice appears with the headline: *Area polluted by Poison. It is forbidden to eat or to touch garden produce. Avoid contact with grass, vegetation and the earth.* The poster goes on to advise residents "not to touch vegetation, grass, the earth or animals in the polluted area and to observe scrupulous cleanliness of the hands and clothes, which should be washed in tap water with good quality detergent." Officials from the local chemical company still insist that there is no danger to those living on the estate, provided they keep indoors.

Saturday, July 17th.
One week after the initial explosion. Still the residents are unable to discover the nature of the chemical that was released. An order is issued from the Mayor's office: destroy all garden and farm produce from the polluted areas.
The first account of the accident appears in the local Milan newspaper, *Il Giorno.*

Wednesday, July 21st.
Residents learn that the chemical factory had not been producing scents and flavouring products as they had been led to believe but chemical warfare agents. Still they are assured that 'nothing serious' had occurred in the accident. An inevitable contaminant of those chemical warfare agents was dioxin.

Friday, July 23rd.
Residents in the area are evacuated.

* * *

A wall six-feet high now surrounds the contaminated area around the Hoffman-La Roche factory. Only those wearing gas masks and special clothing are permitted to enter. Those who lived there before the world's worst chemical disaster have been barred, perhaps forever, from returning. After the evacuation order was given 70,000 animals were destroyed, furniture was taken from all affected homes and burnt, crops were incinerated and tons of topsoil were removed. The soil took three years to burn in a high temperature incinerator at a cost of some £15 million.

There has been an increase in the number of birth defects in the Seveso area, from 38 in 1977 to 53 in 1978. When those defects first began to appear it was denied that they were connected to the Seveso accident. The director of health for the Lombardy region told reporters that "it was not possible to link the deformations with dioxin contamination."

On Wednesday, February 6th 1980, Signor Paolo Paoletti, Hoffman-La Roche's chief of production at the Seveso factory, was assassinated by Front Line, an offshoot of the Red Brigade. He was charged with 'crimes against the people.'

Sources: The Superpoison by Tom Margerison, Marjorie Wallace and Dalbert Hallenstein (Macmillan 1979).
The Pendulum and the Toxic Cloud by Thomas Whiteside. Yale University Press 1979.
Both are excellent accounts of the Seveso disaster and are highly recommended.

question now is whether dioxin is accumulating in the environment to an extent that will affect the average consumer who may come into contact with contaminated food products or game.

In defending the continued use of 2,4,5-T proponents say that today's formulations of the chemical contain only tiny quantities of dioxin (0.05 to 0.1 ppm) unlike formulations of the past and certainly less than was contained in Agent Orange. Spread out over vast areas of rangeland and forests there is not enough dioxin to accumulate to a dangerous level in food chains.

Those who view the use of 2,4,5-T with more caution point out that exposure to low levels of dioxin over a long period of time may prove to be as harmful as exposure to a higher, short-term dose as suggested by the results of the long-term studies on Rhesus monkeys cited above. According to one critic, routine treatment of land with 2,4,5-T could result in the accumulation in local animals of a potentially harmful body burden of dioxin. According to his calculations, the amount of dioxin that might be found is only one or two orders of (26 to 260 times) the quantity that proved harmful in the monkey study (Westing, 1979). Thus say the critics, 2,4,5-T should not yet be presumed to be safe, despite the low level of dioxin found in modern preparations of 2,4,5-T.

The behaviour of dioxin in the environment has long been established. Dioxin is insoluble in water and is not translocated in plants. While experiments have shown that dioxin is rapidly decomposed in sunlight in an alcohol solution, it is not readily photodecomposed in soil. It is not leached into groundwater and is generally immobile when attached to soil. Studies have shown that dioxin can remain in soil for many months. For example, when researchers applied three concentrations of dioxin (1, 10, and 100 ppm) to sandy soil

SOEC Photo

and clay loam, they found that after 350 days 54 per cent of the 1 ppm sample remained on both types of soil; 56 per cent of the 100 ppm sample remained in sandy soil and 71 per cent of the 100 ppm sample remained in clay soil (Kearney, 1972).

Another group of researchers devised a model ecosystem to determine if dioxin would be taken up by a food chain. They added carbon-14 to a quantity of dioxin that might result from normal application of 2,4,5-T and placed the dioxin in aquarium soil. They then added algae, snails, diatoms, protozoa, rotifers, daphnids, mosquito fish and catfish to the aquarium. After a period of equilibration, dioxin, which had been added to the soil at a rate of 0.1 ppb, was recovered from the water in the parts-per-trillion range. Dioxin was recovered from algae and other organisms in the parts-per-billion range (accumulating in one mosquito fish up to 63,000 times the amount found in water) showing that bioaccumulation of dioxin can occur in food chains, (Isensee, 1975).

Actual evidence for the accumulation of dioxin in the environment, however, remains hard to come by. Backers of 2,4,5-T cite numerous environmental studies in which researchers have failed to recover dioxin in food-chain organisms. One group of researchers, for example, found no dioxin in fish or humans in the area of the San Angelo Reservoir of the North Concho River in Texas where 2,4,5-T had been sprayed at a rate of one-half pound per acre. Neither was dioxin found by these scientists in organisms inhabiting a 125-acre pond in a rice-growing area of Arkansas which was routinely used to flood rice fields that had been sprayed with 2,4,5-T, (U.S. EPA, 1978).

In another, earlier study, tissue from 19 bald eagles from 15 states were analyzed for dioxin but none was found. At the time the samples were analyzed, however, methods for measuring dioxin were accurate only at the 0.05ppm level. Traces of dioxin might have been found using today's methods for measuring dioxin at lower concentrations.

For instance, dioxin has been measured in the parts-per-trillion range in the fat tissue of cattle grown in Kansas, Missouri, Oklahoma, and Texas. Eleven out of fourteen samples of fat tissue from these cattle that one research group received from the U.S. Environmental Protection Agency contained dioxin. The four highest samples had 70, 24, 20, and 12 ppt while no dioxin was found in the control sample (taken from cattle grazed on land not treated with 2,4,5-T) or from beef purchased at a supermarket (Meselson, 1978).

As for humans, these scientists also analyzed breast milk from eighteen women who lived in areas where 2,4,5-T spraying occurred and six from a city environment. Four positive samples (at 1 ppt) were found in the 2,4,5-T group; no dioxin was found in the city group. Despite positive results, the researchers caution that not enough women were sampled to give statistically significant results. More testing will be needed.

Conclusions

Over the years the uses of 2,4,5-T have been curtailed in the U.S. as adverse evidence about the toxicity of dioxin mounts. In April 1970 the use of 2,4,5-T was banned for lakes, ditch banks, homes and on some food crops. The EPA has held lengthy hearings and studied the possibility of banning all uses of 2,4,5-T but that plan was abandoned in 1974. Since then the EPA has focused studies on monitoring residues in soil, water, wildlife, humans and commercial meat products. In 1979, as a result of the findings in Oregon, the EPA proposed a ban on 2,4,5-T for forests, rights-of-way, and pastures.

But 2,4,5-T is still used on rangelands and for rice growing and it is certain that the chemical companies and the EPA will fight over the proposed final cancellation for forest spraying in the courts, and out, for many years to come.

During this period it can only be hoped that answers to the many questions about dioxin's toxic properties come to light. We don't yet know what the long-term effects of low doses are in humans. Could it cause cancer, as animal studies and the fragmentary data on humans suggest?

Furthermore, scientists need to learn more about the various routes of exposure for humans. For one thing, 2,4,5-T is not the only pesticide contaminated with dioxin. Pentachlorophenol, a fungicide and wood preservative, also may contain dioxin (Crossland, 1973). What happens to the dioxin when products impregnated with this chemical are disposed of or incinerated? Dioxin from unknown sources has been found in ash from refuse incinerators, fossil fuel power plants, and charcoal grills, (Smith, 1978). Could exposure to a variety of sources of dioxin add up to a health hazard for the average consumer?

In discussing dioxin we should remember that most pesticides contain chemical contaminants. Though dioxin is an exceptionally toxic example, it should serve as ample warning that when it comes to chemicals there may be more than meets the eye.

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FAO

Pesticides Create Pests

by Edward Goldsmith

Shell chemicals currently run an advertisement which states that 30 per cent of the world's crops is consumed by pests. The implication is clear: more and more pesticides must be bought from Shell to spray over the world's crops in order to make more food available for the starving millions. If it could be shown that the millions of tons of pesticides that have been released into our environment in the last thirty years had actually had some effect in reducing pest depradations, then this would, indeed, be the correct implication. The opposite, of course, is true. According to the National Academy of Sciences pest damage in the US has increased from an estimated 8.4 billion dollars (31.4 per cent of the total crop) in the period between 1940 and 1950, to an estimated 9.9 billion dollars (33.6 per cent of the total crop) in the decade between 1951 and 1961.

Figures derived from the Environmental Protection Agency (EPA) tell the same story. In spite of the fact that farmers in the USA today use 2.265 tons of pesticides — which is twelve times more than they did thirty years ago, the proportion of the crops lost before harvest has almost doubled (Lappé & Collins *Food First,* Penguin Books.)

The Shell advertisement, rather than make out a case for using more pesticides, in fact, simply illustrates *the total failure of pesticides to make any impact whatsoever on world pest depradations. Let us look into this a little more closely.*

It is in the tropics that the counter-productiveness of chemical pesticides is most apparent. The reason is that the tropical climate favours the development of great ecological diversity. Thus, whereas a forest in a temperate area may contain no more than a few species of trees per hectare, one hectare of tropical rain forest can contain anything between 60 and 100 different tree species together with thousands of other plants, mammals and reptiles. There is also a correspondingly vast diversity of insects which leads to a high incidence of disease among livestock, and which, as Biswas points out, is one of the reasons why beef and veal production in the tropics is more than five times lower than in temperate areas. (Biswas, M. & A. *Food, Climate and Man,* Wiley & Son.)

A further factor is that in tropical countries there are no winter frosts to reduce pest populations as in temperate areas and pests are thereby assured of a permanent habitat.

In these conditions, pest-control is correspondingly more difficult. Indeed while pesticides might be able to control a limited number of target species, to expect them to control the vast numbers of potential pests harboured by a tropical ecosystem is simply asking too much. If a pesticide succeeds in reducing the population of a target species, it creates an empty niche, which is immediately filled by another form of life, one that may even be more harmful to the crops than was the former. Also since pesticides are increasingly non-specific, they must upset the particularly delicate system of checks and balances which previously prevented a *population explosion* in any one species — and in this way, create a *pest*

outbreak.

Dr.B.J.Wood has drawn up, in a local Malaysian agricultural journal, an extensive catalogue of the instances in which large scale crop spraying programmes have had to be abandoned because they were leading to an increase, rather than a decrease in plant losses. This is well demonstrated in the experience of cocoa growers.

Cocoa

In Sabah (North Borneo), cocoa plantations were established in clearings in a primary forest, in which saplings were commonly retained for shade. The plants were almost immediately attacked by borers, especially *Endoclita hosei*, the caterpillar ring-bark borer. Planters applied dieldrin, at first, with apparent success. However, this led subsequently to a proliferation of leaf-eating caterpillars, and spraying was increased, this time using other pesticides. When, in consequence, still more pests of various groups appeared, the planters could find nothing better to do than to increase the amounts of pesticides. Finally, an outbreak of psychid bagworms caused total defoliation. The planters had now learnt their lesson. They drastically reduced spraying and shifted to more specific pesticides, and the situation slowly came under control.

In Ghana there have been similar experiences. Although the use of broad spectrum organosynthetic pesticides largely suppressed the cocoa pests that had been most harmful locally in the past, it also led to the destruction of the enemies of certain other pests, which were then able to proliferate. The pests involved were husk-mining caterpillars, cossid branch-borers and web-forming bark-ring caterpillars. The last two of these showed a clear infestation gradient — from high numbers in the sprayed areas to extremely low (normal) numbers one mile away.

Rice

In Vietnam, Laos, Cambodia and Thailand the brown rice plant hopper, *Nilaparvata lugens* is at present causing havoc with the rice crop. The insect sucks the plant's juices and the rice dries up. Fields become brown, the damage is referred to as 'hopper burn'. Attempts to control it with chemical pesticides has killed off its natural predators and have little effect on the pest itself. In any case pesticides are increasingly difficult to obtain as is the spray equipment for which spare parts are very scarce. The result is widespread hunger. The government in Hanoi last year appealed for food relief for 1,700,000 people whose food supply had been affected by the pest outbreak. The *New Scientist* points out "The upsurge of this pest is particularly embarrassing to the international group of agricultural experts dedicated to insect control. For it appears that certain fundamental changes in agricultural practices, . . . , to make the most of the new high-yield rice varieties may be responsible." (*New Scientist* 2.11.1978.)

Indeed the brown rice plant hopper was never as destructive as this in the past, it is only in the last ten years that its numbers have increased so dramatically. The reason is that farmers now plant three not two rice crops a year so the plant hopper has food all the year round. Also, irrigation ditches are never drained so the wholly mobile plant hopper uses these 'water highways' to travel from field to field. Nor do they have to fear their traditional enemies, as increased use of pesticides has killed them off. In addition it is very difficult to get at the plant hoppers with pesticides because the new rice varieties developed by the famed International Rice Institute in Manilla are leafier and provide more top cover and protection. Nor have they developed any resistance against this pest as did the traditional varieties once grown in these areas and efforts to breed resistance artificially into the new variety have been unsuccessful.

These few examples are in no way exceptional. Other efforts to eliminate the pests that devastate agriculture in the Third World, have, on the whole, been no more successful. Consider how vain have been all efforts to stamp out locusts and weaver-birds. They have never been more populous than they are today and the devastation they cause has never been greater, while the anopheles mosquito that transmits malaria and the snail — vector of schistosomiasis, are proliferating as never before, in spite of the thousands of millions of dollars that have been spent on frenzied efforts to eradicate them.

Pest Control in Temperate Areas

Though pesticides should be more effective in temperate areas where there are far less potential pests to control, their use in these areas has not been very much more successful. In the US , a large proportion of all pesticides, in the last decades, has been used against a relatively small number of pests, in particular against the spruce budworm, the douglas fir tussock moth, the gypsy moth, the fire ant, the boll weevil and a few other pests of cotton. I showed in a previous article (The Future of Tree Diseases, *The Ecologist,* July/August, 1979 nos. 4 and 5) just how counter-productive have been the massive spraying programmes undertaken against the first three of these pests. In each case, as I noted, the main effect of the spraying programme was to perpetuate epidemics which, if left alone, would have died a natural death. Let us briefly consider the experience of attempts to eradicate the other major pests.

The Fire Ant

The fire ant, *Solenopsis invicta* was introduced into the south eastern states of the USA probably from South America between 1933 and 1945. It has a powerful sting and builds mounds which slightly interfere with agriculture. This has provided an excuse for vast spraying programmes using a pesticide called Mirex in a completely vain effort to eradicate it.

In 1967 a National Academy of Sciences Committee was set up to examine the feasibility of other spraying programmes. It concluded that the fire ant was not an important pest, that the eradication effort was unlikely to succeed and that limited local control measures would be adequate. However, the US Department of Agriculture completely ignored these

Pesticide Poisoning: How many really Die?

According to the World Health Organisation (WHO), over half a million people are poisoned each year by pesticides and five thousand of those die.

WHO's figures for worldwide pesticide poisonings have been hotly disputed by, among others, Professor Kenneth Mellanby. In a letter to *New Scientist*, he maintains that the figures are exaggerated and that "the number of deaths from insecticide poisoning in 1977 and 1978 was probably measured in hundreds and not hundreds of thousands, and the number of people so seriously poisoned as to merit the description 'incapacitated' was not much larger."

Mellanby's claim has been challenged by many field workers. In a subsequent letter to *New Scientist*, Dr. Lines, Director of Trinidad and Tobago's Bureau of Standards, pointed out that Trinidad and Tobago alone — with a population of slightly over a million — had 293 *confirmed* cases of pesticide poisoning during 1977 and 1978.

Indeed far from being exaggerated, WHO's figures are probably a gross underestimate. A 1975 study by the US National Academy of Sciences estimated that pesticide-related illnesses in California — where notification by doctors is obligatory — were underestimated by almost one half. A 1969 study amongst workers of Tulare Country, California, found that 25 per cent of farmworkers had seen a doctor for pesticide-related illnesses, but less than 1 per cent of those cases found their way into the official statistics. And the only official survey of pesticide poisonings throughout the United States was found to have greatly distorted the figures by only taking into account those who had been admitted into hospitals, ignoring those who visited private doctors or who attended hospitals as out-patients. As for the Third World, many cases fo unreported because workers fear that they will lose their jobs if they go to the doctor (assuming there is a doctor) or because they do not connect their illnesses to pesticide use.

Other cases are unrecorded because the authorities classify them as 'anecdotal evidence'. If, for example, the wife of a forestry worker who uses 2,4,5-T has a miscarriage, it is difficult to prove (using present scientific criteria) that the herbicide is responsible. Her case thus becomes 'anecdotal evidence'. So too, if an agricultural worker dies of cancer, it if difficult to prove that his death was caused by his work with carcinogenic sprays maybe thirty years beforehand. His case too becomes 'anecdotal evidence'. Or again, if a worker complains of feeling ill after using a pesticide whose toxicity is disputed, his case will also be downgraded as 'anecdotal evidence'.

Many of the symptoms of pesticide poisoning are sublethal, causing headaches, testiness, loss of drive, difficulties in concentration, mental confusion, drowsiness and skin complaints. Inexperienced doctors often confuse such symptoms with influenza or, worse still, dismiss them as psychosomatic or the result of depression. Either way, they go unrecorded. Where children have been poisoned — wither before birth or afterwards (see box: From the Canister to the Womb) — the sublethal effects are still less likely to be recognised. How many doctors will connect poor performance at school to an incidence of pesticide exposure during early childhood? And if they do, will the case-history be dismissed as 'anecdotal evidence'?

It is unlikely that we shall ever know the true extent of pesticide-related illnesses and deaths. What we do know is that accurate figures are not available in either the United States or Europe and what figures we do possess are probably underestimates. Still more so in the case of statistics from the Third World. Even allowing for 25 per cent under-reporting of incidents, the number of cases of pesticide poisoning would run into the millions, not the thousands. In all probability, the true figure is higher still.

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recommendations and ordered more spraying. It was no more successful than the previous programmes. Recently it has been estimated that to eradicate the fire ant another five hundred million dollars would be required and even then success could not be guaranteed.

As George Allen, insect pathologist at the University of Florida writes, "the worst thing we ever did was to use the word eradicate. We couldn't eradicate this thing with an atom bomb.." Yet if it is not eradicated, spraying will simply serve to select tougher and more resistant strains. Quite clearly, as Allen admits, "the thing people in this country have to learn is that they're going to have to live with the fire ant." (*US News and World Report* Jan 17 1977).

The Boll Weevil

One of the most serious agricultural pests that the US has to contend with is the boll weevil. It is said to cost cotton growers two to three hundred million dollars each year. In 1958, the cost of boll weevil depradations together with the cost of controlling it, are said to have amounted to ten billion dollars. Twenty five per cent of all agricultural insecticides in the US are used for boll weevil "control". What makes the boll weevil particularly invulnerable is its ability to survive on plants other than commercially-grown cotton, in particular on a variety of wild cotton and also on an ornamental plant called "Althea". If the boll weavil is to be eradicated then these plants must go too, but this is by no means easy. Advocates of continued spraying admit today that it could cost as much as six hundred and fifty million dollars to eradicate the boll weavil and it is increasingly clear that even such expenditure would have very little effect. (The Last Boll Weevil by Kevin P. Shea, *Environment* vol.6 no.5).

Theoretical considerations

It is interesting to note that simply on theoretical grounds, these programmes had to fail. One of the main reasons is that resistance to pesticides inevitably had to build up. The only way we could have prevented this would have been to repeal the law of natural selection which even ICI and Shell and the other giants of the agro-chemical industry would have been incapable of doing. Natural selection assures that the fittest survive. The fittest are those that are best adapted to

the environment in which selection occurs. Pesticides totally modify the environment and those that were previously the fittest no longer are in the changed conditions. Those that have become the fittest and will now become selected to the exclusion of all others are those that have developed resistance to the pesticide used. What is more resistance among insects who often have a new generation every two weeks, builds up very quickly.

Already according to the United Nations Environment Programme's (UNEP) "State of the Environment Report", released on the 5th June, 1979 there are 364 arthropod pests which are now resistant to nine of the major groups of pesticides and these include "major pests of major crops, such as the cotton boll worm, the boll weevil, the leaf worm of cotton, the rice stem borer and the brown plant hopper, the Colorado beetle of potatoes, spider mites of fruit and glass house crops, and cut worms and weevils of cereals." (*Nature* vol. 279 24 May 1979).

What is more, as Newsom points out (Eradicating the Boll Weevil, *Science* Feb 8th 1973), "The heavier the pressure put on a species the more likely you are to bring about inherent resistance." The more we spray, in fact, the more rapidly will resistance develop and resistance has actually doubled since 1965 and at the current rate will have become generalised among major agricultural pests in but a few decades. Once a pest develops resistance to a particular insecticide, the normal procedure is to switch to a new pesticide, but this requires constantly developing new pesticides which the chemical industry is finding increasingly difficult to do. The costs of meeting toxicological and ecological standards are growing very rapidly. Let us not forget too, that to amortise the development costs, the pesticides must be saleable worldwide, not just in one country. In many countries, though not in the UK, controls on their use are increasing. It is estimated today, that the cost of obtaining worldwide registration has increased at a rate of 30 per cent per annum, and it is now supposed to cost between 10 and 15 million pounds to bring a new pesticide on to the market. Also, because of the rapid build up of resistance among pests, the pesticides may only be effective for a few years, nothing like enough to pay for development costs. Not surprisingly fewer and fewer new pesticides are being developed. According to WHO, no manufacturer submitted a new pesticide for testing in 1978 and this organisation is now cutting down its field staff involved in the testing of pesticides.

For these reasons above, and there are others, it is but a question of time before pesticide use becomes fairly peripheral.

We will have been forced to use subtler means of dealing with agricultural pests. The crude blunderbus approach of spraying crops with a witches brew of toxic chemicals is going to be ever less feasible. To quote Van den Bosch, "the harsh reality of the situation is that we must live with pests — be they insects, mites, snails, worms, fungi, bacteria, viruses, epiphytic plants, allergens, or weeds. Rarely do we eradicate them; the best we can do is to co-exist with them."

The Economic Consequences of Abandoning Pesticide Use

by John Krummel and Judith Hough

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The number of active pesticide ingredients deliberately introduced into the environment in the United States now exceeds 1,200 (FCH, 1978). The possible detrimental effects of certain chemical pesticides on human health concerns many researchers (Pimentel et al., 1979a). In addition, the action of pesticides and other chemicals on the nontarget biota could have long-term deleterious effects on ecosystem functions (Woodwell, 1978). Thus, a careful assessment of benefits and risks should be a prerequisite to the continued use of chemical pesticides.. We present here an analysis of the benefits of pesticide use.

Benefits of Pesticide Use

There is no doubt that considerable direct dollar benefits are derived from the use of pesticides. Previous analyses have estimated dollar returns at from $3 to $5 for every $1 invested in control by pesticides (PSAC, 1965: Headley, 1968; Pimentel, 1973). Nevertheless, the benefits of pesticides in the U.S. agricultural system are sometimes overstated. For example, a recent USDA publication states that "pesticides have been responsible for much of the yield gains in modern farm production" (USDA, 1978). Concerning losses without pesticide use, Norman Borlaug suggested that if pesticides were completely banned, 50 per cent of current crop production would be lost, and food prices would increase 4- to 5-fold (Borlaug, 1972). Statements like this are found in the popular press as well. In a recent issue of *Newsweek* magazine, J.W. Hanley, president and chairman of the board of Monsanto, quotes U.S. Department of Agriculture sources as stating that crop production would decline 30 per cent and food prices go up 75 per cent "if farmers quit using modern pesticides" (Hanley, 1979).

These estimates are probably serious overstatements. First, a relatively small percentage of crop acreage is treated with pesticides; second, nonchemical pest control practices are currently used effectively on more acreage than chemical control practices; and finally, losses to pests are already substantial, even with current chemical and nonchemical control methods.

Current Use of Pesticides

Since the introduction of the chlorinated hydrocarbons in 1945, pesticide production has increased dramatically, and there has been no apparent slowdown in the rate of increase (USDA, 1978). Presently, over 1 billion pounds of pesticides are used in the United States, with about 660 million pounds applied to agricultural land (USDA, 1978). Despite the use of large quantities of pesticides, the actual percentage of crop acres treated remains small. Only about 9 per cent of U.S. crop acreage is treated with insecticides: 22 per cent with herbicides; and 1 per cent with fungicides (USDA, 1978). If agricultural land devoted solely to pastures is discounted, these figures increase to about 18 per cent of crop acreage treated with insecticides; 56 per cent with herbicides; and 2 per cent with fungicides. Only about half of all U.S. farmers use any pesticides at all on their land.

Certain large-acreage crops (such as corn, soybeans, rice, peanuts, and cotton) have more than 80 per cent of their acreage treated with herbicides (USDA, 1978). Of the major food crops grown in the United States, however, only corn and peanuts have more than 30 per cent of their acres treated with insecticides. The nonfood crops, tobacco and cotton, have 76 per cent and 60 per cent of their acres treated with insecticides, respectively. Peanuts, tobacco, and certain fruits and vegetables are the only crops that have over 10 per cent of their acreage treated with fungicides (USDA, 1978).

The amount of pesticide applied to U.S. crop acres increased 38 per cent from 1971 to 1976 (USDA, 1978). The intensified use of herbicidal weed control accounted for most of this increase. Agricultural use of herbicides climbed from 207 million pounds in 1971 to 374 million pounds in 1976 (USDA, 1978). A substantial increase in the acres treated and the amount of herbicide applied per acre on the nation's corn crop contributed 64 per cent of this increase. In fact, 57 per cent of the additional 186 million pounds of all pesticides applied in 1976 as compared to 1971 can be traced to increased herbicide use on corn. In contrast to herbicide use, the amounts of insecticide and fungicide applied to crops increased by only 4 and 1.7 million pounds, respectively, over this same time period (USDA, 1978). Cotton and tobacco accounted for more than 40 per cent of all insecticides used on farms in 1976 (USDA, 1978). Peanuts, sugar beets, potatoes, and certain fruits and vegetables used over 95 per cent of all fungicides applied to crop land.

The percentage of acreage treated with pesticides for an individual crop often differs in different growing regions in the United States. For

example, 78 per cent of wheat grown in the lake states received herbicide treatments, while only 10 per cent of the wheat acreage in the Southern Plains was treated (USDA, 1978). Insecticide treatments were applied to 99 per cent of the cotton acreage in the Delta states, while only 30 per cent of cotton acreage in the Southern Plains was treated. Also, 48 per cent of the soybean land in the Southeast received one or more insecticide treatments per year, compared to only 1 per cent in the Corn Belt. In the Southeast, nearly all early potato plantings received at least one insecticide treatment, while only 65 per cent of the extensive potato acreage in the Mountain states was treated (USDA, 1978). Much of this geographical variation undoubtedly reflects the more favourable pest conditions that develop in warmer, wetter climates.

Nonchemical Pest Control

The figures cited above refer to chemical control. To put them in perspective, nonchemical pest controls are actually used more extensively than chemicals. For insects, nonchemical controls are widely used on certain large-acreage crops. For example, corn rootworms are controlled on about 60 per cent of all corn acreage by crop rotation (Pimentel et al., 1977a). In addition, over one-third of U.S. corn acreage, or 21.5 million acres, is planted to varieties that are resistant to the European corn borer. About 10 million acres of corn are planted to varieties resistant to the chinch bug (Schalk and Ratcliffe, 1976). Plant resistance is also important in the

Table 1. Comparison of annual pest losses (Dollars) in the USA for the periods 1904, 1910-1935, 1942-1951, 1951-1960, 1974, plus an estimate of losses if no pesticides were used and some nonchemical alternatives were employed.

		Percentage of pest losses in crops				Crop value	
Period	Source	Insects	Diseases	Weeds	Total	$ x 10^9	Source
Without pesticides*	Pimentel et al, 1979b	18.0	15.0	9.0	42.0†	77	USDA, 1975a
1974	Pimentel, 1976	13.0	12.0	8.0	33.0	77	USDA, 1975a
1951-1960	USDA, 1965	12.9	12.2	8.5	33.6	30	USDA, 1961
1942-1951	USDA, 1954	7.1	10.5	13.8	31.4	27	USDA, 1954
1910-1935	Hyslop, 1938	10.5	NA ★	NA	NA	6	USDA, 1936
1904	Marlatt, 1904	9.8	NA	NA	NA	4	Marlatt, 1904

* Includes the substitution of some nonchemical alternative controls.
† Does not total because of rounding error.
★ Not available.

control of insect pests of alfalfa, barley, and grain sorghum. The major insect pest of wheat, the Hessian fly, is almost entirely controlled by the use of resistant varieties and the manipulation of planting date (PSAC, 1965). Natural enemies are important in the control of insect pests of many orchard crops, such as citrus and olives, which are grown on about 2 million acres in the United States (Sweetman, 1958; van den Bosch and Messenger, 1973). Overall, it is estimated that nonchemical insect pest control methods are used on about 9 per cent of U.S. crop acreage (Pimentel, 1976), the same percentage on which insecticides are used.

Weeds are still controlled on most U.S. crop acreage by tillage and cultural practices, sometimes in combination with the use of herbicides (NAS, 1968a). Thus, nonchemical weed control methods are used on an estimated 80 per cent of all crop acreages (Pimentel, 1976), while herbicides are used on only 22 per cent of crop acreage.

For diseases, the primary means of control are nonchemical, especially the use of resistant varieties and cultural manipulations. Disease-resistant varieties are used on about 75 per cent of all crop acreage, and most of the major crop varieties now in use incorporate some degree of resistance to one or more important diseases (NAS, 1968b). Another important nonchemical disease control technique is the use of disease-free propagated material. Thus, most bean, pea, and potato seed planted in the United States is relatively disease-free (Pimentel et al., 1979b). Crop rotations are another very important means of controlling many diseases. Overall, nonchemical methods of disease control are used on an estimated 90 per cent of all U.S. crop acreage (Pimentel, 1976), compared with 2 per cent for fungicides.

Current Crop Losses

An analysis of the benefits of pesticide use must take into account the fact that large acreages of crops are grown successfully without pesticides, and that certain nonchemical methods of pest control are widely and successfully used. Such an analysis must also take in to account the fact that current crop losses to pests are quite substantial, even with the use of pesticides and other control methods. Although it is difficult to estimate losses of potential crop production, the U.S. Department of Agriculture has suggested that nationwide about a third of potential production is lost to pests: 13 per cent to insects, 12 per cent to plant pathogens, and 8 per cent to weeds (USDA, 1965; Pimentel, 1976). USDA survey data from the 1940s to the present suggest that production losses from weeds have declined over that period, probably due to improved herbicidal and mechanical control technologies. Losses from plant pathogens have increased slightly. Losses from insects, however, have increased substantially, from about 7 per cent in the 1940s to about 13 per cent today (Table 1).

A number of factors have undoubtedly contributed to this increased loss. A very important factor concerns the substantial changes that have occurred in farming practices during the last 30 years, including large increases in the size of farms, and a considerable decline in labour input. Thus, many crops are now grown in extensive monocultures, and may be more likely to be discovered and heavily damaged by certain insect pests (Pimentel, 1977). Crops are also being grown in new areas, where pest pressure may be greater. For example, since 1961 soybean acreage in the United States has more than doubled, to over 55 million acres, and much of the expansion has occurred in Southern states. While insect pest problems are of little importance in the Midwest and North Central states, in the South a large number of pest species attack the crop (Newsom, 1978). Crop breeding is another factor that may have increased losses to pests. Until recently crop breeding has emphasized yield, so that in some cases varieties have been developed that are more susceptible to insects, while natural resistance has been lost or reduced (Lupton, 1977). In other cases, sanitation, including destruction of crop residues, has been decreased, which can allow greater build-up of insect pest populations. Finally, "cosmetic" standards that emphasize the external appearance of foods, especially fruits and vegetables, have become more stringent in the last 30 years (Pimentel et al., 1977b). For this reason, dollar losses due to insect pests may be greater today, even

where actual yield losses have not changed.

An Analysis of Pesticide Benefits

A general analysis of the benefits of chemical pesticides, including current patterns of pesticide use and estimated additional crop losses that would occur if pesticides were no longer used, was recently carried out by an interdisciplinary group of workers at Cornell University (Pimentel et al., 1978, 1979b). For each crop, the following information was sought: acreage grown in the United States; dollar value of the crop; food energy, in kilocalories, of the crop; percent of agreage currently treated with pesticides, and the cost of that treatment; current estimated losses to pests; additional losses that would be incurred if pesticides were no longer used, but if certain readily available alternatives were used; and the cost of using those alternatives. The results of that study, summarized in Table 1, indicate that without insecticides dollar losses would increase by about 5 per cent above current losses to insects. Without herbicides, there would be only a 1 per cent increase in crop losses due to weeds. This is because weed control can be achieved relatively effectively by mechanical and cultural methods, especially in the large-acreage row crops. For diseases, additional crop losses without fungicide use were estimated at about 3 per cent.

Overall, then, the study concluded that dollar crop losses would amount to an estimated total loss of about 9 per cent. Thus, current pest losses (about 33 per cent) would increase to about 42 per cent of potential crop production. If nonfood crops like cotton, tobacco, hay, and pasture, are excluded, the loss estimate increases to 11 per cent of current production. This is considerably lower than the 50 per cent loss forecast by Borlaug (1972), or even the 30 per cent loss quoted by Hanley (1979).

These figures are based on dollar value. As a rough estimate of loss of food energy, we converted our estimates to kilocalories. Total loss on this basis would amount to only about 1 per cent of all crops, or 4 per cent of food crops (Pimentel et al., 1978). These losses are lower than those based on dollar value, because high-calorie crops such as wheat and corn would be less affected by pesticide loss than lower calorie crops such as fruits and vegetables. The contrast between these two estimates points out the difficulties in trying to summarize data for very different kinds of crops, such as apples and field corn. An estimate based strictly on kilocalories probably undervalues the importance of fruits and vegetables in our diet, as they are one of our major sources of essential vitamins and minerals. At the same time, estimates based strictly on dollar value probably overestimate their importance.

No Serious Food Shortage

The results of this analysis indicate that there would be no serious food shortage in the United States without pesticide use, even with only limited use of available alternative control techniques. The estimates do suggest that serious shortages of certain fruits and vegetables, including apples, peaches, onions, and tomatoes, might occur if pesticides were no longer used. However, in making these estimates, we accepted current grading standards, which in many cases are based at least in part on external appearance of fruits and vegetables. Thus, we most likely would experience a shortage of "perfect" fruits and vegetables rather than a loss of all produce, if pesticide use were restricted. In support of this contention, in 1909, when pesticide use was much less intense than it is today, per capita consumption of fresh and processed fruits was 130 lb per year, compared with 136 lb in 1975; consumption of fresh and processed vegetables was 204 lb, compared with 206 lb in 1975 (USDA, 1966; 1975b). Some of the "loss" predicted by the analysis, then, can probably be attributed to the more stringent quality and cosmetic standards that are followed today (Pimentel et al., 1977b).

Under Control?

by Edward Goldsmith

Do the laws regulating pesticide use in Britain really protect our health and environment?

In the last thirty years there has been a veritable explosion in the use of synthetic organic pesticides. Over 800 formulations are now used in the UK alone. They include insecticides, nematocides, fungicides, herbicides, and rodenticides. They are sprayed on cereals, fruit, vegetables and grassland. They are used on golf courses to kill weeds, in paints to ward off fungi, on building timber to prevent wood-worm, on woollen carpets and clothes to kill moths and in our larders and kitchens to kill beetles, flies and other insects. Some of these chemicals such as DDT, have now become global contaminants. Traces are to be found in the bodies of Antarctic penguins, in the rain, in our drinking water, and in just about all commercially produced food. Each one of us has, in his body fats, traces of hundreds of different pesticides. They are in human milk, they even find their way into fertilised eggs and contaminate foetuses in their mothers' wombs. Very few efforts are made in Britain to find out the precise biological effects of these chemicals, though in the light of available objective knowledge, they undoubtedly make a considerable contribution to our disease-load and are probably responsible for many cancers and child malformations. Government and industry try to assure us that their use is under control, but it is increasingly clear that this is untrue.

In the USA, attempts by the Environmental Protection Agency (EPA) to regulate the use of hazardous pesticides have been systematically sabotaged by the chemical industry. In 1972 major amendments to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) were passed which would theoretically have permitted the proper testing of new pesticides and the re-registration of existing ones. As Ian Nisbet[1] points out they were never implemented. Although the amendments stipulated that all existing pesticides should be re-registered within two years, four years after the statutory deadline not one of the 33,000 registered pesticides had met new approval. Although in 1969, a Commission of the Department of Health and Welfare (HEW) singled out 26 pesticides as health hazards and recommended that their use be controlled, nine years later, the use of only nine of these dangerous chemicals had been restricted, and only about half of the others had been examined. Although too, in 1972, the EPA published a list of a further 100 pesticides which it termed "suspect" and which it regarded as requiring priority action, of these only a couple of dozen have been examined, and only a bare handful regulated.

The EPA has proved incapable of acting effectively against the chemical companies. As Nisbet notes, however toughly the EPA acts against a suspect pesticide "the wrath of the agro-industrial community descends upon key congressional leaders, who lose no time in conveying their displeasure to the Agency." Thus the EPA is always under pressure to postpone decisions — and nothing gets done. Yet the Congressional Committee on Oversights and Investigations tells us that at least 25 per cent of all pesticides on the market have shown cancer-causing potential. Every day the entire population of America is exposed to these pesticides in the air they breathe, the water they drink, and the food they eat — and the cancer rate continues to soar.

Increased Use of Pesticides

Unfortunately information on the use of pesticides in the UK is not as easily available as in the US. Even the Royal Commission on Environmental Pollution[2] was unable to obtain all the information required to draw up its recent *Report on Pollution from Agriculture.* "The data we have obtained to illustrate growth in the production and use of pesticides in either financial or tonnage terms" writes the Commission "are . . . without as much meaning as we would have wished."

The British Agro-Chemicals Association (BAA) appears to have no data at all on sales before 1974 and has only conducted two surveys of the quantities of active ingredients sold, one for 1966 and one for 1975-76.

These figures suggest that sales have increased dramatically in this country, from about £10 million worth in 1940 to £143 million worth in 1975 (see Figure I). About 50 per cent of sales in 1976 were for export and 90 per cent for horticulture and agricultural use. The BAA sees the trend as continuing into the future: if they are right this means that pollution by pesticides can only get worse unless controls are tightened — assuming of course that such controls can be effective.

Policy

If one considers how dangerous these chemicals are one would suppose that it would be Government policy to minimise their use by every possible means. Such a

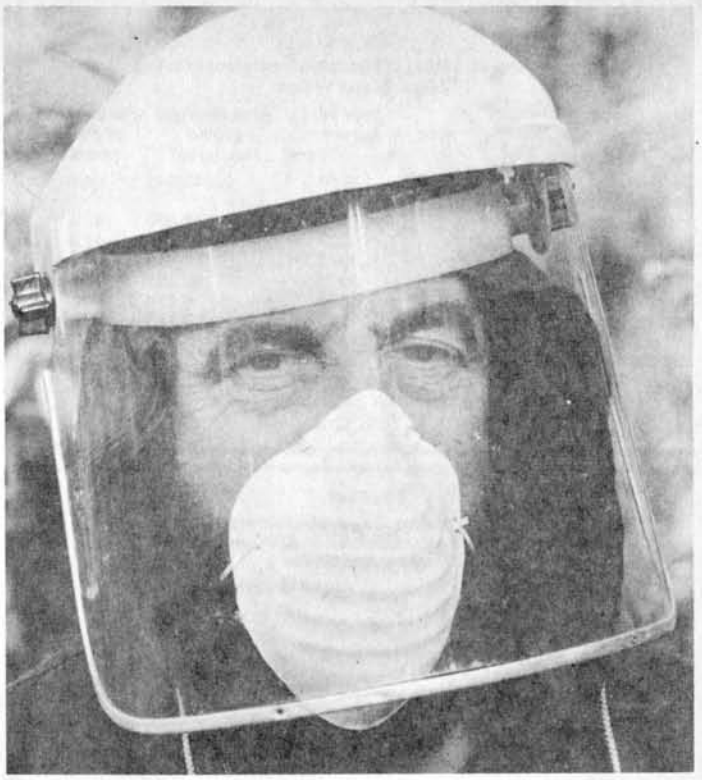
Who Cares about Precautions?

"If the proper precautions are taken — and they are clearly written out on the label — no harm should come to workers using pesticides." So argues an official of a large pesticide company. His view is clearly shared by, among others, the World Health Organisation which blames the majority of cases of pesticide poisoning on ignorance of safety precautions. But will those precautions *ever* be effective?

Agricultural workers complain that the recommended safety precautions for most pesticides take little account of the realities of work on the land. "Imagine wearing full protective gear on a hot sunny day — when a lot of spraying is done," says Chris Kaufman, Research Officer for the National Union of Agricultural and Allied Workers. "It is so uncomfortable that many farm workers don't bother. Many don't have access to the gear or to washing facilities. An extensive survey carried out near Cambridge found that only 27 per cent of workers on fruit and vegetable farms wore the stipulated protective clothing."

Even when full precautions are taken, they do not always afford the worker with adequate protection. In 1976, eleven people were hospitalised in the Hereford and Worcester area due to organo-phosphate poisoning. The majority of them had been wearing the recommended protective clothing.

If safety precautions are ignored in the West, the situation is far worse in the Third World. Robert Van Den Bosch, for instance, recalls coming across a Mexican farm worker spraying Parathion — a deadly nerve gas derivative — without any precautions at all. "Here was this smiling, bare-chested labourer, his body frosted with Parathion dust, breathing it in and licking it off his sweat-moistened lips, totally ignorant of his peril." The Mexican had no idea what he was spraying because he couldn't read. He thought it was simply 'medicine for the pulgones (pests).' WHO reports



similar incidents from other Third World countries, including several cases where workers simply mixed solutions of pesticides with their bare hands

So long as the realities of farmwork are ignored by those who manufacture pesticides and draft the precautions for their use, those precautions will be flouted. It is naive enough to expect workers on hot days to wear stuffy protective clothing. It is naivity itself to expect an illiterate peasant to read the labels on pesticide canisters. Surely it would be saner to adopt safer methods of pest-controls rather than hope against hope that dangerous chemicals will be used safely?

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policy has indeed been adopted by the US Government, though as we have seen, it has proved very difficult to implement, as it has in the Netherlands and in some prefectures of Japan. However as the Royal Commission notes "there is . . . no such policy in the UK, nor does the possible need for it appear to have been considered, notwithstanding the great increase in the use of these chemicals."

The official view of the Ministry of Agriculture, Fisheries and Food (MAFF) is that pesticides are quite safe so long as they are properly applied and that their high cost discourages excessive use. The members of the Royal Commission do not accept this view: "We have considerable misgivings" they write. "Farmers feel themselves to be on a treadmill with regards pesticide usage, compelled by circumstances to depend on chemicals to an extent that they, as countrymen, intuitively find disturbing." Also "in the great majority of cases there was incorrect perception of the likely losses due to pesticide damage and the effectiveness of the pesticide applications in reducing the losses was overestimated." The Commission also deplores the practice of "calendar spraying" i.e. of spraying systematically at different times of the year in anticipation of possible pest attacks, a practice which the chemical industry encourages in every possible way. Spraying crops for cosmetic purposes is also condemned by the Royal Commission. To ensure that carrots are unblemished, it points out, an amount of pesticides "well beyond what would be needed to protect essential crops" is used. It is not even Government policy to discourage this practice which would seem almost impossible to defend. Yet MAFF defends it, and insists that it is not possible to separate the protection of appearance from that of the crop — which is obviously quite untrue.

The Agro-chemical industry, on the contrary, seems to be under the impression that it is Government policy to encourage the maximum use of pesticides. Thus in *Industry's Statistics (1976),* it complains about the recent fall in the use of herbicides ". . . in a period when Government is actively trying to encourage greater productivity from grasslands. It is obvious that education programmes to this end are not achieving full success, and the potential value of herbicide usage in contributing to improved profit is not being taken up within the industry. This causes some concern, particularly in view of the past and continuing investment in research and development into the use of herbicides in grassland systems."

At all Agricultural Colleges in this country students continue to be taught to spray crops with pesticides of

TABLE 1
Recent data on extent of pesticide treatment of crops England and Wales

Crop Group	*Year of Survey*	*Area of crops grown (hectares)*	*Percentage of crops treated*
Cereals	1974	3,245,845	99.5
Potatoes, sugar beet & field beans	1974	434,439	98.4
Fodder, forage & seed crops	1974	1,649,484	44.8
Vegetables	1972	221,433	94
Orchards	1973	50,355	92
Hops	1975	6,414	100
Soft fruit	1975	13,123	99
Glasshouse crops	1972	3,639	97.1
Hardy nursery stock	1971	6,500	87

(*Source:* Ministry Pesticide Surveys)

TABLE 2
Types of pesticides used in agriculture and horticulture Estimated annual average quantities of active ingredient 1971-5 England and Wales

Pesticide group	*'Spray hectares'* (a)	*Tonnes of active ingredients per year*
Insecticides		
Organochlorine compounds	148,105	132
Organophosphorus compounds	844,011	419
Other insecticides	117,232	779
Seed treatments	3,717,621	565
Fungicides	1,896,538	2,194
Herbicides	6,020,624	15,712
Other pesticides	49,438	1,960
Total	12,645,212	(b)

(*Source:* Ministry Pesticide Survey)

NOTES:
(a) Each application of pesticide to one hectare of land counts as one 'Spray hectare'. Thus 10 spray hectares could mean one application to each of 10 hectares of 10 applications to one hectare.

(b) Because the active ingredients in each pesticide group are dissimilar it is meaningless to relate tonnages of one to another. We have therefore omitted the total.

hundreds of different varieties on the slightest possible provocation, though it is encouraging that the students themselves are beginning to doubt the sanity of what they are being taught and the objectivity of their lecturers. At Cirencester Agricultural College, they have formed the William Cobbett Society of which there are almost 100 members, and they periodically invite critics of modern agriculture to address their meetings.

The Scale of Spraying

In the US, contrary to what one might suppose, only a relatively small proportion of food crops are actually sprayed; 5 per cent with insecticides, 15 per cent with herbicides and 0.5 per cent with fungicides. Of the 543,600 tons of pesticides — 30 per cent of the world's production — that was used in America in 1977, 50 per cent was sprayed on golf courses, parks and lawns. Of the amount used for agricultural purposes nearly half (47 per cent) was used on cotton.[3]

In Britain, on the other hand, practically all food crops are sprayed with one pesticide or another, as can be seen from Table 1.

Multiple Spraying

Worse still, crops are often not only treated with one pesticide but with many at different periods of the year (calendar spraying). Thus according to the Agro-Chemical Industry[4], of the 367,000 acres of potatoes grown in this country in 1976, 310,000 are treated with herbicides, 114,000 with granular insecticides and nematocides, 218,000 with foliar insecticides and 265,000 with fungicides. In order to protect potatoes from pests the normal procedure that is tacitly advocated by the industry is to spray the soil with an insecticide/nematocide before planting the potatoes, spray it once again with herbicides before the potatoes emerge, spray the crops from 2-6 times with a "protectant" fungicide to prevent potato blight, spray them again with foliar insecticide against late aphid attacks and then spray them a final time with a desicant herbicide so as to burn off the tops in order to facilitate mechanical harvesting. In this way one acre of potatoes, the industry boasts, can be treated from 2-11 times with different pesticides.

It must be pointed out, of course, that the potato will retain residues of each of these different pesticides, which means that a portion of potato chips is likely to contain a veritable cocktail of dangerous poisons. The Agro-Chemical Industry of course insists that the levels are so low as to be of no consequence, but this is a purely gratuitous statement based on no satisfactory evidence of any kind. On the contrary, the evidence suggests that exposure to very low levels of pollutants over a long period to be as biologically damaging as exposure to very high levels over a short period. (See *The Ecologist*, Can we Control Pollution, November and December 1979).

Aerial Spraying

What is particularly shameful in Britain is the prevalence of aerial spraying. One million acres of agricultural land are sprayed each year, which involves 34,000 flights. Controls on this practice are practically non-existent. Admittedly operators are required to give advance notice, but only, as the Royal Commission points out, in so far as this is "practicable", which means, "when it does not interfere with economic priorities." Often the police are not even warned. Nor are bee-keepers, and let us not forget that the bee population of this country has been very seriously affected by spraying, in some areas bee populations having been almost annihilated. Moreover, farmers whose land adjoins an area being sprayed often find it impossible to obtain the information and advice that would enable them to know how to protect themselves or their livestock. Nor, as the Royal Commission points out, does there appear to be any controls on the type of spraying equipment used as is the case in other EEC countries.

The Types of Pesticides Used

Even more worrying is our continued reliance on the use of the most environmentally harmful pesticides, in particular the organo-chlorine and organo-phosphorus compounds, (See Table 2). Many of the organo-chlorine pesticides — the highly persistent ones that have had such a devastating effect on our wildlife such as DDT, aldrin, and dieldrin — have now been banned from most uses in the USA, and it is generally assumed that their use has been more or less phased out in the UK as well. However, this is not so. There has been a voluntary limitation on their use which has had some

effect, but 132 tons are still used every year in agriculture and horticulture (See Table 2).

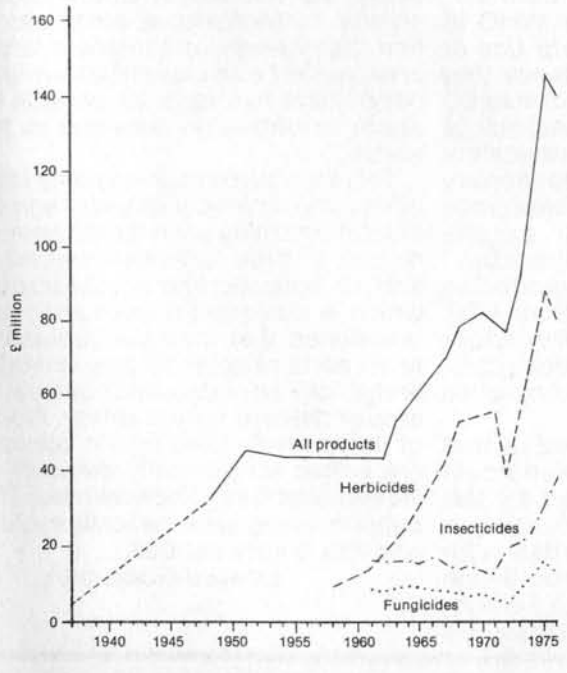
In addition, the effectiveness of the voluntary limitation on the use of dieldrin and aldrin,[5] which came into effect in 1965, is limited by the fact that a large number of special uses are still approved. In certain circumstances, they are still allowed on winter sown wheat, on sugar beet seed, on potatoes, brassicas, narcissus bulbs, hop roots, barley, strawberry seed, bean seed, onion seed, ornamental plants and spinach. This of course covers a considerable proportion of the uses to which dieldrin and aldrin were put in the first place. Nor is there a method of assuring that farmers only use these pesticides in the special circumstances allowed. On winter sown wheat, for instance, they are only supposed to be used up until the end of December when there is a real danger of attack from wheat bulb-fly. But who is check that farmers do not use these pesticides in January or February? The answer is nobody. How too can one determine whether the danger of attack by wheat bulb-fly is real or imaginary? The answer is that one cannot.

Non-agricultural Use

What the public doesn't realise is that larger amounts of many of the most dangerous pesticides are used for non-agricultural purposes, more so, in fact, than for agricultural ones.

Thus whereas in 1974, 7 tons of dieldrin were being used in agriculture, 22.2 tons were used for non-agricultural purposes, in particular in the woollen industry. Most woollen carpets and woollen garments sold in this country are in fact impregnated with this cancer-causing substance. So too in the same year only 1 ton of malathion was used by farmers, whereas 10.3 tons were used for non-agricultural purposes mainly by public authorities who tipped 7.6 tons of this poison on refuse tips and used it for "public health and hygiene purposes", and also as a wood preservative.

Fig 1. **Sales of Pesticides by UK Manufacturers for Home and Export use — all at 1976 values**



In a recent Department of the Environment report on the non-agricultural use of pesticides in this country[6], it was stressed that little is known of the implications of using hazardous pesticides in this manner. We do not know for instance what is the fate of dieldrin that is volatised in the house from recently treated timber, nor do we know what is the significance of the volatisation of dieldrin from industrial moth-proofing. No effective mechanism exists for providing users with advice, though it might be pointed out that the manufacturers of Dielmoth, of which 15,600 kilogrammes of active chemical (dieldrin) are used every year in the textile industry, advises against treating children's clothing and underwear with this poison. Since the DOE report came out, the use of pesticides for wood preservation has been examined and is now covered by the Pesticide Safety Precautionary Scheme (PSPS) applied by the Advisory Committee on Pesticides (ACP), though as we shall see this means precious little.

Pesticides in the Home

It is when pesticides are used in the home that human exposure is maximised. If levels of DDT in human fat are 4-5 times higher in certain tropical areas, including parts of India, than they are in temperate areas, it is as a result of WHO's anti-malarial spraying programmes, during the course of which the inside of peoples' houses or huts were systematically sprayed at regular intervals. Needless to say this doesn't happen here, although about 40 different pesticides found in 230 different products are used in the home, 75 per cent of which are insecticides of some sort. A survey carried out by the DOE, for instance, found that 51 per cent of households made use of at least one of the 93 different fly killers currently sold in British shops and a considerable proportion of households (between 6-31 per cent) also used ant killers, general insecticides, wood preservatives, moth-killers, rodenticides, fungicides, etc.[6]

Wildlife

The general view today, fostered by the British Agro-chemical Industry, is that the reduced use of organo-chlorine pesticides has permitted decimated bird populations to recover.

Professor Mellanby tells us, for instance, that bird-kills caused by aldrin and dieldrin in the fifties are over; "once stricter controls of insecticides had been introduced the process has been reversed."[7] The Royal Commission does not share this view. "The evidence" it notes "suggests that the decline in the level of organo-chlorine compounds in the environment has not been as rapid as envisaged."[2] Studies on the eggs of sparrow hawks from 14 areas of Britain from 1971-77 "have not demonstrated a marked decline in organo-chlorine residues and in some cases there has been some evidence of increase." How does one explain this? Either the effect of these chemicals is greater than one thought or the use of these chemicals is more extensive than is generally admitted. Both may well be true.

Pesticides in our Food

Practically all the food eaten in this country, as in America, contains pesticide residues. In the last available survey,[8] levels of different pesticides in different foodstuffs that were regarded as being of any significance (reporting levels) were noted. Only one foodstuff — 14 samples of honey — was free of residues of organo-chlorine pesticides. A large percentage of foods had levels that contained residues above reporting level — 41 per cent of samples of hard cheese for instance, 28 per cent of soft cheese, 45 per cent of butter, 33 per cent of infant food, 65 per cent of strawberries. The average daily intake of organo-chlorine pesticides from the consumption of 1,700 grammes of food was .056 milligrammes.

With regards organo-phosphorus residues, 11 per cent of peaches, 19 per cent of grapefruits, 17 per cent of strawberries contained residues above reporting levels.

A working party on pesticide residues at MAFF is supposed to carry out monitoring. However, it does not publish detailed studies of chemicals in different foodstuffs, only a periodic estimate of the total amount of pesticides in the average diet. The Royal Commission comments on its inability to obtain information on monitoring activities. "We find it difficult" it writes "to establish how much monitoring . . . is carried out. MAFF was unable to estimate readily the resources allocated to it because many laboratories are involved and the work is linked with other activities."

What is certain is that it is not done at all systematically. Routine sampling of foodstuffs on the market is not carried out as it is in other EEC countries, nor are consignments of food found to contain residues exceeding prescribed limits removed as is again done in other EEC countries. As the Royal Commission notes "successive UK Governments have resisted the EEC approach." The excuses given are as usual vague and totally unconvincing.

The Control of Pesticides

We are all led to believe that the use of pesticides is already under strict control. Dr Schuhmann[9] is an industry sponsored book *Pesticides and Human Welfare* writes "I wish to emphasise here that legislation in all advanced countries has reached a standard which, given the proper use of pesticides ensures that the consumer of agricultural products suffers no risk to his health or well being."

In Britain, the only control on the safety of pesticide

A Bureaucratic Smokescreen

In a recent issue of *The Ecologist* (July/August 1978), we published an article which described an outbreak of Reyes Syndrome which occurred in New Brunswick, almost certainly as a result of the spraying campaigns with a pesticide called Fenitrothion, designed to eradicate the Spruce Budworm. We mentioned that the Forestry Commission was using the same deadly chemical in an attempt to eradicate the Pine Beauty Moth which was infesting Lodge Pole Pine plantations in Scotland.

Mr. G. Stewart from the Forestry Commission wrote to us insisting that Fenitrothion is not deadly. "It is registered", he wrote, "in the 1978 Approved Products for Farmers and Growers under the Agricultural Chemicals Approvals Scheme for use with a variety of food crops."

This sounds very impressive but to the initiated it means very little. The Agricultural Chemicals Approval Scheme (ACAS) is not even concerned *with the safety of chemicals* (as Mr. Stewart should know), but only with their effectiveness for specific uses. What is more their effectiveness is not judged by any objective scientific body but by the British Agro-Chemical Association (BAA) itself which operates this scheme.

"Before the British operation received the necessary clearance for use in forestry" Mr. Stewart went on, "all aspects were subject to close scrutiny under the terms of the PSPS by the Advisory Committee on Pesticides which gave a very high degree of assurance on the safety of its use." This does not mean very much, however, since the data that is scrutinised by the ACP is provided by the chemical industry itself: the 'close scrutiny' is nothing like close enough, tests are made over far too short a period for them to provide very much relevant information: and the objectivity of the ACP is not established.

Fenitrothion as it happens is very much more dangerous than Mr. Stewart admits. Even the WHO in their brochure on *The Safe Use of Pesticides* admits for instance that "this product is at the limit of acceptable toxicity for conventional indoor application. Its relative narrow safety margin calls for strict precautionary measures and regular cholinesterase monitoring of exposed people throughout the spraying operation." This suggests that it is regarded as very much more toxic than DDT which is regularly used for indoor application in WHO's fruitless campaign to eradicate the anopheles mosquito.

Mr. Stewart also assured us that the entire spraying operation would be extensively monitored by the appropriate bodies "including a survey of birds, fish and other wildlife, for any circumstances which could affect future use of Fenitrothion in this country." This too sounds impressive but as the Royal Commission points out it was never done. To quote the Royal Commission: "When spraying began there was little known of the normal populations of wildlife in the Lodgepole pine forests with which observations could be compared, neither were unsprayed areas established. The overall assessment of the effects on wildlife was that, within the limits of the observations made, these were small or unimportant."

This conclusion was largely guesswork. Serious effects were not unlikely. As the Royal Commission admits: "insectivorous birds which find themselves well inside a large area treated with insecticides might not be able to forage far enough to reach an untreated area and might starve."

This little incident gives some idea of how the chemical industry and its institutional allies can mask the true nature of their activities behind a sort of bureaucratic smokescreen which is designed to persuade the uninitiated that they are subjected to all sorts of scientifically devised and strictly implemented controls to assure their complete safety. None of the controls cited by Mr. Stewart are either scientifically devised or indeed effectively implemented. The public is being systematically misled, and this is very serious.

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use is that provided by the Pesticide Safety Precaution Scheme (PSPS). When a manufacturer wishes to produce or import a new pesticide, he must get prior official agreement from the Advisory Committee on Pesticides (ACP) which is part of the Ministry of Agriculture, Fisheries and Food (MAFF). To obtain this, he must submit test data relevant to the safety of the product to independent expert scrutiny. The data together with the opinion of the experts are then examined by appropriate Government departments with the assistance of the ACP supported by its Scientific Sub Committee (SSC). The ACP is regarded as the principal source of advice on the use of pesticides and to assure its objectivity none of its members have any commercial interests in the Agro-chemical industry.

This body with the help of the SSC, if they judge fit, give a product limited clearance for use in a limited area and for a couple of years only. During this time long-term tests are carried out after which the product is cleared for general use.

The procedure appears to function smoothly. That is the impression of the Royal Commission. It is also the impression I obtained from conversations with the scientists who work it. They are very helpful and appear highly competent. But if this system really works the use of dangerous pesticides would not go on increasing as it is doing today. What then is wrong with the system?

Industry Provides the Data

Most of the data used for judging the safety of pesticides is provided by industry itself and quite obviously the industry cannot be expected to be objective about the safety of an individual pesticide that may have cost them £10-15 million to develop. The data are likely to be biased in some way.

In America it has now become public knowledge that much of the data provided by industry are false, indeed fraudulent. This was revealed in 1976 when the Food and Drug Administration (FDA) did an audit of records kept by the Industrial Biological Test Laboratory of Northbrook, Illinois. This laboratory, which as it happens was owned by a chemical company, had been widely used by pesticide manufacturers to conduct tests and collect data for submission to the Environmental Protection Agency (EPA) in support of applications for registration and to determine residue tolerance levels. The FDA audit covered 4,300 tests involving 123 pesticides and 160 applications for residue tolerance levels. The audit disclosed "false reporting and great discrepancies between test results and the data submitted to the EPA".[10] In March 1978 EPA officials confirmed that the test results had been deliberately distorted.

That scientists cheat in this country is also well established. A survey conducted by Dr Ian St James Roberts and published in *The New Scientist*[4] shows that cheating is fairly current; "The most frequent kind of cheating is data 'massage' (74 per cent of the total) where findings are eased and stretched to fit the desired result."

Independent Experts

As far as can be gathered the scientists, to whose independent expert scrutiny test data relevant to the safety of products is submitted, are chosen by the chemical industry itself. It is unlikely that they would choose scientists who in the past have been critical of pesticide usage in this country. One can take it for granted that they will be carefully chosen from among those who can be counted upon to back up the manufacturer's claims.

Secrecy

The ACP and its SSC might well be able to tell the difference between true and false data, though then again they might not. The EPA in the US was taken in for a long time. In any case there is no way of checking the value of the data. The reason is that all the information provided in connection with the PSPS is *strictly confidential.* Commercial interests must be protected at all costs and the costs are considerable. Indeed as the Royal Commission remarked, there is evidence that scientists trying to determine the effects of pesticides on living things can be "hindered in their scientific work by this confidentiality being carried to unnecessary lengths."[2]

The Royal Commission itself was refused information by a manufacturer on the effects of pesticides it produced on the grounds "that toxicological data when quoted out of context could easily be used to mislead

From the Canister to the Womb

Research on rats fed a low-protein diet treated with DDT revealed a striking increase (65 per cent) in the incidence of infant mortality, retarded growth and altered brain functions. Those abnormalities may have been due to DDT and its breakdown products being concentrated in the mothers' milk and then passed onto the offspring.

That conclusion has particularly alarming implications. DDT has been found in the milk of Western mothers at levels two times higher than those recommended by WHO as an 'acceptable daily intake' for *adults*. Levels of dieldrin were seven times higher. Traces of dioxin have been discovered in the milk of women in Oregon after the spraying of 2,4,5-T: it is now known that dioxin can cause loss of blood cells and fatal haemorrhaging at levels as low as 500 parts per trillion. The levels of DDT in milk of mothers living in Asia, Africa and South America are higher still and the problem is compounded because babies are often breast-fed in those countries for two to three years.

Other research, undertaken by Dr. James O'Leary and colleagues at the Jackson Memorial Hospital in Miami reveals that the levels of DDE in premature babies were three times higher than those in babies born after the normal period of gestation. Previously Dr. Leary had found that relatively high concentrations of both DDT and DDE were transported across the placental barrier to unborn children and that levels of DDE were as high as 200 ppb in the pasty covering protecting the skin of the foetus.

Sources: Coevolution Quarterly, Spring 1979. Questions for an Old Friend by Julian McCaull, Environment, July 1971.

the public and create unnecessary concern." This is the sort of argument we have heard from the nuclear industry, the asbestos lobby and all the other principal industrial polluters.

The Royal Commission also informs us that a member of the SSC is also a member of the National Water Council, but as the Royal Commission points out, he is not allowed to discuss the potential risks of chemicals with expert colleagues in the water industry because of "the confidentiality placed on data submitted by manufacturers to the PSPS".[2]

Objectivity of the APC and SSC is Questionable

Although the members of the ACP can have no commercial interests in the chemical industry this does not assure their objectivity. The objectivity of Dr James Busvine who is currently a member of the ACP is clearly in doubt when one reads the following words from one of his recent articles: "Sensitive and perhaps emotional individuals in temperate climates", he writes, "may call for the abolition of pesticides, but the double need of protecting crops and reducing disease transmission will override their anxieties for most people."[12] These are not the words of a person likely to apply pressure to control the use of hazardous pesticides in our environment.

The objectivity of Dr J.M. Barnes, currently a member of the SSC, is clearly also in doubt when he tells us that "the minute traces measured in parts per million that are sometimes found in food are of no toxicological significance even in the case of the poorly biodegradable organo-chlorine compounds."[13] He clearly talks the same language as Professor Mellanby who tells us that the levels "cannot be called pollution for they are so low as to cause no detectable effects on living organisms."[14]

Both these statements we know to be totally gratuitous and contrary to all the currently available literature on the sub-lethal effects of pollutants (See Can we Control Pollution, *The Ecologist*, November and December 1979).

Duration of the Tests

The final decision to authorize the use of a pesticide is given after "long term" tests that are carried out over a period of two years. But two years, of course, is hopelessly insufficient. Cancers tend to appear 20-30 years after exposure to a carcinogenic agent, mutations can appear generations after exposure to a mutagen. Relevant information on the long term effects of a pesticide can only be obtained in such a short period from the results of laboratory tests on animals with a very short life-span, such as insects or bacteria. Such information could be of value in predicting likely effects on the human population because the genetic material, whose modification by a chemical agent is the main cause of cancer and infant malformations, is the same throughout the animal world. But the chemical industry has always refused to admit that a chemical shown to be carcinogenic or mutagenic to a laboratory animal can be considered to be so to humans. Unless this is admitted, these very short "long-term tests" cannot yield any usable information.

Safe Levels?

The control of pesticide use both in the US and in Britain is based on the notion that there is a safe level below which a chemical causes insignificant biological damage. It is becoming increasingly evident that such a threshold doesn't exist. Also vulnerability to specific poisons varies from person to person. Children, even more so foetuses, are very much more vulnerable than adults. What is more people are not exposed to a single pesticide but to a vast number of different ones — 800 in this country alone — and these, in turn, make up a small proportion of the three million or so chemicals that have been introduced into our environment, very few of which have been tested for their ability to cause cancer and other long term damage. All these chemicals are likely to affect us differently in different combinations. Apart from their additive effects, synergic effects are likely to be present more often than not. As Dr Von Rumker, an EPA consultant notes "surprisingly little information is available on the inter-action between different pesticides and between pesticides and all other elements of the crop

WHO publishes lists of tolerable levels for several

hundred different pesticides in our food. One can be certain that nobody has ever examined the biological effects of eating food containing the acceptable levels of *all* these different pesticides. Yet it is this knowledge that is relevant, not knowledge about the biological effects of a single pesticide used in isolation from all others. The scientists from the ACP to whom I talked did not even seem to understand the critical importance of this consideration which makes absolute nonsense of all the figures they publish on this subject. In addition we know little about the impurities that are often associated with specific pesticides, still less about their decay products, and let us not forget that it is the decay products of DDT more than DDT itself that seems to be so damaging to wildlife.

This means that there is simply no scientific way of establishing a level of any specific pesticide that can be regarded as causing negligible biological damage. The acceptable levels published by WHO in fact are fixed largely on economic grounds. They tend to be the minimum ones that can be achieved without compromising economic priorities. This could not be better illustrated than by the following passage from the *Report of the Food Additives and Contaminants Committee on Aldrin and Dieldrin Residues in Food.* "We should like to recommend" write the authors of this document "that no aldrin and dieldrin be permitted in milk and baby foods but we are aware that with the great sensitivity of analytical methods it has become possible to detect very low residues of aldrin and dieldrin in food and also that at present *it would be impossible to produce milk or baby foods that were entirely free from aldrin and dieldrin.* For these reasons we reluctantly decide against a zero tolerance and recommend that a limit of 0.003 p.p.m. be placed on aldrin and dieldrin in liquid milk, this being the lowest practicable limit of analysis. We recommend a corresponding limit of 0.02 p.p.m. in baby foods (including dried milk) which would take account of the difference in residues likely to be found in liquid and dried products. We also recommend that all ingredients for baby foods should be chosen by manufacturers with a view to keeping the aldrin and dieldrin content to the lowest possible level. While these limits seem to us realistic, we do not accept them readily or with equanimity. With greater restraint in the use of aldrin and dieldrin, significantly lower statutory limits should be feasible in two years' time."[5]

Statutory Testing

In addition it is important to note that the PSPS — the only body operative today for controlling the safety of pesticide use in this country — *is purely voluntary.* There is no law which forces a manufacturer to test the pesticides he proposes to put on the market, no law which forces him to submit them for examination to the ACP and the SSC, no law which obliged him to have them examined for their long term effects on living things.

The Royal Commission pointed out just how anomalous it was that "at a time when there is concern about the hazards posed by toxic chemicals in the environment and when statutory controls designed to ensure adequate testing of new chemicals have been introduced or are envisaged in most industrial countries, the control of pesticides (in this country) should continue on a non-statutory basis."

It is difficult to see how this argument can be countered. Indeed it seems incredible that no law has been passed to control the use of the thousands of tons of dangerous chemicals that are systematically sprayed on all the food crops in this country, when at least a quarter of them are suspected, on good grounds, of being carcinogenic and mutagenic. Yet such legislation is feverishly opposed by the ACP and the agro-chemical industry. They assure us that it would be too costly, too time consuming, that it would involve engaging too many new civil servants, and that it would lead to decisions being taken on "political as opposed to scientific considerations."[2]

This matter is soon due for consideration by the Government. The debate on the Royal Commission Report began a short time ago in the House of Lords, but the chances are that the ACP and the agro-chemical industry will prevail and that, in spite of the Royal Commission's recommendations, pesticide use in this country will remain in effect uncontrolled by law.

But even that would be grossly insufficient. It would just bring us into line with the USA, and as we have seen, pollution control in that country is not much more successful than it is here. Contrary to the Royal Commission's recommendations, it is the standards themselves that must be improved, not just the way they are implemented. Also very severe punishments — not just fines but prison sentences — must be imposed on those who violate the law and in particular on those who subvert it.

What is more, standards must be set increasingly high as the use of these dangerous poisons is slowly phased out and safer and more effective methods are gradually introduced to control potential pest populations.

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AMAZING POLITICS

Sweden's raging debate over the perils and pitfalls of nuclear power has split government and public opinion in half. At present, their Prime Minister, Thorbjorn Falldin, stands against further nuclear development, a stand which is supported by a slim parliamentary majority of 175 seats to 179. However, several key members of parliament, together with many senior civil servants and a government committee (formed to assess the consequences of a nuclear programme) have all come out firmly in favour of a nuclear future for Sweden. Not surprisingly nuclear power has become the number one political issue in Sweden and will continue to be so until it is voted on in a referendum in March 1980.

At present there are six reactors operating in Sweden, with another two due to come on stream in the near future. By 2005, the Swedish nuclear industry plans to have 30 reactors in operation.

It seems likely that the Swedish electorate will be given three choices at the March referendum: (1) phase out all existing nuclear power plants in 10-15 years (while implementing a diversely based energy supply); (2) continue the present development programme to include 12 reactors "only"; or (3) embark upon a full-bore nuclear development programme, which could include uranium mining and nuclear fuel fabrication facilities and construction of a nuclear fuel reprocessing plant.

Given these options, opinion polls indicate that the majority will vote "middle of the road", allowing the Swedish government to build at least 12 reactors. The referendum's outcome is far less certain however if the electorate is given a straight choice between accepting a full nuclear programme or abandoning the atom altogether. In that event, the vote might go either way.

The situation has been further complicated by a report from the Swedish parliament's Consequences Committee, formed by the preceeding Prime Minister Ulsten (who is a staunch supporter of nuclear power). It's brief was to report on the consequences of nuclear and non-nuclear energy supplies options. The Committee's report was originally intended to provide factual information for the public before the March referendum.

That plan has been abandoned after accusations that the committee was unfairly biased in favour of nuclear power. More than three-quarters of its eighteen members were known to favour nuclear power before the committee began its investigations. Against that powerful lobby were 3 "undecideds", but their number was reduced to one after two of them resigned, disillusioned by the committee's obvious bias.

Peter Steen was thus left as the only dissenting voice on the committee and has since published a minority report criticising the committee's findings. He argues that its recommendation to support nuclear power was a foregone conclusion, and alleges that the committee selected data and used assumptions that effectively made a nuclear power programme appear the only option for Sweden. One of Steen's major criticisms focused on the committee's use of high assumptions for future economic growth and consequent high projections for Sweden's energy demand in the 1990's. No alternative assumptions were considered, nor were reasons given for chosing these high assumptions. As a result, it appeared that future energy demand in Sweden could not be met without further nuclear development.

The committee's report also concludes that coal fired power plants, (which would be used in lieu of nuclear power plants and which are clean enough to meet even the very stringent California air quality standards) would be so expensive as to be prohibitive, and thus not a viable alternative to nuclear power. Peter Steen stated in his minority reports that both the projected total cost of coal power plants and the costs of coal itself were highly overinflated, the latter by 25-50 per cent over the current rate of inflation. Indeed, recent comparisons of coal and nuclear power plant costs done by other institutions in the U.S. and the U.K. fail to support the Consequences Committee's conclusions on this matter.

Sweden has, however, dealt with the nuclear fuel waste storage question in some detail. Their Nuclear Stipulation Act of 1977 stipulated that an "acceptable, absolutely safe" method of "final nuclear waste storage" must be developed before new nuclear reactors could be loaded with fuel or operated. This year the government announced that it was satisfied that the technical demands of the Stipulation Act were met. Although seven out of eight geologists consulted by the Nuclear Power Inspectorate concluded that the government's 1978 interpretation of the law was not satisfactory.

No other country in the world claims to have an "acceptable", "absolutely safe" method of "final waste storage," but Sweden seems to have found a solution in just one and one-half years. On the face of it, this seems like remarkable politics, but not a remarkable breakthrough in the containment of high-level nuclear wastes.

Meanwhile, the "Folkkampanjen Nej till Karnkraft", Sweden's anti-nuclear organisation, is growing by leaps and bounds. At present it numbers about 100,000 and by March of 1980 they expect to have 150,000 to 200,000 members that can be mobilized for a door-to-door, grass-roots campaign. This may prove to be a formidable force in the outcome of the referendum.

Opposing the Folkkampanjen are the utilities, the nuclear industry, big business interests, Sweden's largest labour union and a large faction that think nuclear power will cure Sweden's energy woes. Members of this pro-nuclear lobby have been posting large advertisements in the major newspapers and providing, among other things, a "nuclear hot line" telephone service for people who are wavering about nuclear energy. The pro-nuclear interests can definitely out-spend the grass-roots "Folkkampanjen". By the end of the campaign, money will have possibly tipped the balance.

Even if the Swedes do vote for a limited programme, this will not be the end of the battle. Saying "yes" to twelve reactors now might finally result in the siting of many more conventional reactors, breeder reactors, and reactor fuel fabrication and reprocessing plants. The political, bureaucratic and institutional momentum that will accompany a programme for twelve reactors may prove to be unstoppable. Indeed the vital question is whether the referendum will be used as another opportunity to placate the people and bolster a Swedish nuclear future. Will it be nuclear politics or Swedish democracy which wins the day? Only March will tell.

Eric Woychik

Books

Getting it Together

PROGRESS FOR A SMALL PLANET by Barbara Ward, M.T. Smith, £8.85.

Barbara Ward, DBE and life peer, is one of the most distinguished supporters of the ecological movement and surely the most level-headed. She sees the dangers of our profligate, pollutionary course as clearly as anyone, but her remedies are practical and commonsensical. Not for her the apocalyptic 'about turn — or else', nor even homespun self-sufficiency with guru Seymour or Morris; instead she suggests a series of relatively small, simple changes the collective effect of which would be a very much safer, cleaner, less wasteful world.

But still an essentially familiar world. There would be plenty of cars, for instance, but their average life would be doubled, to 20 years, and fewer would reach the cities because public transport would be greatly improved. Similarly our reliance on (other people's) oil would be reduced progressively not by swingeing cuts and bans but by across-the-board savings which would have little effect on real living standards. The great merit of Barbara Ward's proposals is that they are politically and economically acceptable to most governments and most shades of opinion.

For the most part, too, the proposals are based on proved, existing technology rather than optimistic, in-20-years-we'll-have-fusion forecasts. Even when she does make assumptions, such as the gradual cost reduction of photo-voltaic cells and other energy alternatives, she errs on the side of caution.

The book, in fact, contains little that is new. There is a strong *humanitarian* case for helping the world's poor; it can only be weakened by appeals to self interest and self-preservation which are specious, disreputable and, at bottom, cynical. This is a useful summing up of the threats to our planet and of the best ways to counter these threats. The first part devotes a chapter to each of the main dangers to the developed 'North' and demonstrates over and over again how it was essentially the rock-bottom price of oil before 1973 which tempted us off 'the course of wisdom'.

The author is equally concerned about the course of wisdom for the under-developed 'South'. Here again she looks at the problems of the poorer and poorest countries and comes up with practical solutions — for example biogas to break the catastrophic wood fuel/land deprivation cycle, and above all land reform.

The doubtful area in this book is its implied connection between northern affluence and southern poverty. The developed world may enjoy avocados and employ uranium from the Third World, but it does not depend on them and never has. Industrial civilisation was created for good and ill by the inventive brilliance of a few generations of northerners; colonial products, bartered honestly or ruthlessly plundered, were incidental. If there had been no empires and no trade with the South, 'we' would still be rich and developed while 'they' would still be poor and underdeveloped (and almost certainly poorer than they are now). By the same token our wealth isn't the cause of their poverty: over-population, greed, and corruption are the culprits. Nor do our shame and guilt prove any sort of causal relationship between their condition and ours.

There is also confusion about poverty and war. Politically every region and each country poses a threat to world peace, but as a general rule the richer the country the bigger the threat. For example it is because Iran is oil-rich that the present crisis has so many highly dangerous international vibrations, and it's because Uganda was poor that Amin was only a local disaster. The fashionable view that our planet would be safer if the Third World were richer is fallacious. It would be just as — possibly more — dangerous, and much more polluted.

None of this destroys the urgent *humanitarian* case for helping the world's poor, a case which is also much more respectable than self-interest. Barbara Ward's ideas on

the forms of help which are really effective should be pondered throughout the international aid industry, just as her way ahead for the industrial north should be compulsory reading for politicians, economists, businessmen, bureaucrats, shop stewards — the chapter on industrial democracy is one of the best — and particularly for the student generation.

Victor Gordon

A glimpse of joy

DOCKLANDSCAPE by Hilary Peters. Watkins, £3.00.

What are you doing? Why are you doing it? Is it money-making? Is it community-oriented? Is it ecology-oriented? Is it educational? These were just some of the questions thrown at Hilary Peters by visitors to her urban farm in London's Surrey Docks. In the late 1960s, she had a job as a gardener in the East End, although she soon found herself involved in a three-cornered fight in this urban desert. "The Developer", she explains, "wanted surburbia. The Architect wanted concrete. I wanted jungle."

And the people of Dockland never really knew what they wanted. "Dockland has a disease", Hilary Peters says in her opening paragraph, "as evident in its people as in its landscape." This disease, which she dubs "Dockland disease", stems from an inner estrangement felt by all city-dwellers — much more acutely by those whose employment has been removed and who are left stranded, jobless and purposeless, in the inner city.

However, the friction of that three-cornered fight generated a small number of diminutive, uneven pearls. The first of these was a Japanese Garden, but the real success has been the Surrey Docks Farm. As time went by, Hilary Peters became increasingly involved in the life and problems of the area, becoming by turns a landscape and market-gardener, a promoter of allotments, a poultry-keeper, a goat-herd and, eventually, a full-time farmer.

Then, in the summer of 1976, her farm was the focus for People's Habitat — and was almost swamped in the process. The very idea of holding an alternative technology festival in the heart of an area suffering massive urban dereliction was crazy, although those involved hoped that the festival would catalyse some longer term projects in the Surrey Docks. It might have worked, it was certainly worth trying but, in the end, the chasm between the alternative technologists and the East Enders proved unbridgeable, at least in the time that the alternative technologists were prepared to devote to the exercise.

Ironically, the only lasting contribution to the area was a brick windmill, illustrated on page 70 of Hilary Peters' book. As a member of the organising committee for People's Habitat I well remember the derision with which some of the committee's more radical members greeted the windmill proposal. Yet, long after the long-hairs had left, the local people were fighting the Council for the right to keep that windmill — to pump water from the Thames to their allotments in Surrey Docks.

In the end, as Hilary Peters herself concludes, the point of urban farming is less in the end product than in the doing of it. The keeping of goats in the Dock was a symbolic gesture, the Surrey Docks Farm an attempt to give the children of the Abyss a glimpse of the forest in the midst of the city wasteland. The farm, as the last line of the book says, "is not a cure, but a pointer. It does no more than suggest a different direction in which to look for a cure". This short, highly readable book deserves to be widely read.

John Elkington

Letters

Unkind Cuts

Dear Sir,

I wish to protest about the way my letter, published in your October/ November issue has been abridged and altered. A couple of the cuts are quite justifiable, but the longer ommissions change the balance and distort the meaning of what I was trying to say. If my letter was too long, I could have shortened it by return of post. I can only conclude that the habitual misrepresentation of humanism in the ecological press is the result of prejudice as well as ignorance. However I don't want to get involved in a silly quarrel, so what I shall do is wait until the next attack on humanism in The Ecologist *and then use some of the discarded material in a further letter.*

Yours faithfully,
Michael Walter,
New Humanist,
London, N.1.

Editor's note

We are sorry that so many cuts had to be made in Mr Walter's last letter; space for readers' letters is unfortunately very limited, and we gave him 50 per cent of what we had available for the issue.

Anthropo-eccentricity

Dear Sirs,

In his letter in the Oct/ Nov issue Nicholas Walter of the New Humanist *states that some of us who are working to elucidate the problem of comtemporary humanism are confusing rather than clarifying the issue. It is, however, difficult to follow an argument maintaining that (1) The prevailing form of humanism is* not *anthropocentric yet (2) is centered upon basic allegiance to* Homo Sapiens as *opposed to other species of evolving life or to divine reality. When both biocentric and theocentric forms of humanism are renounced, what is left but man at the center? To place man first, to believe he is the measure of all things, and at the same time to discard all irrational elements of vitalism, teleology, and religion surely represents the quintessence of anthropocentricity. Were new humanists to turn aside, however briefly, from atheistic free thought in order to relate their ethical and ecological concerns to their own spiritual evolution, I believe they would more readily recognize the real issue at stake.*

Catherine Roberts,
Berkeley, California.

Classified

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