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PESTICIDES

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GENERAL

The local health officer should have sufficient information on pesticides ~~chemicals~~ to understand his role and responsibility as well as the responsibilities of other agencies in the area of pesticide control. The local health department is one of a number of federal, state, and local agencies having some share of responsibility for the proper regulation and application of such chemicals to prevent public health problems from arising in connection with their manufacture, formulation, packaging, transportation, storage, sale, or use. The potential for such problems is inherent in the nature of such chemicals inasmuch as all are poisonous to some degree, and potentially harmful to public health and conservation interests. Beneficial as well as harmful effects of pesticides may occur in conjunction with such environmental factors as

land, water, air, food, or shelter,

whether in

homes, businesses, vehicles, industries, institutions,

or recreational facilities.

Pesticides, therefore, might be considered a program area in one sense, or an integral portion of all environmental health programs in another.

Prepared for ~~the~~ U.S. Conference of City Health Officers, [redacted] 1969

The potential for benefit or harm arising from the use of such chemicals goes far beyond the immediate potential for acute health problems and carries over into such areas as fish and wildlife conservation, recreation, ecological relationships, nutrition, natural beauty, esthetics, and chronic disability. The health official, while having a prime interest and responsibility in human health, must be aware of these other implications arising from the use or mis-use of pesticides.

Regardless of geographic location or degree of urbanization, local health officials have a responsibility with regard to pesticides. This responsibility involves the health department's role as

1) a disseminator of chemicals through its vector control activities,
2) an agency which frequently promotes the application of pesticides on an individual or community basis to control insects, rodents, or weeds, and prevent nuisances and disease,
3) an agency having an interest in environmental management beyond the pure health aspects,
4) an agency obligated to disseminate unbiased technical and scientific information to the public,
5) an agency which may have to resort to regulatory activities to control pesticides,
6) an agency to participate in research to protect and promote the public health,

7) an agency having functions of surveillance of all environmental pollutants, and

8) an agency which frequently operates or utilizes laboratory facilities to identify and measure chemical pollutants whether in air, water, soil, food supplies, plants, or animals.

The use rates and patterns of pesticides will vary greatly by the nature of the pest to be controlled, location, weather conditions, economic base, and population density, but the basic public health potential remains in any community. Some cities include vast agricultural or relatively primitive areas, while other population groups may be utilizing pesticides for residential insect control, gardens, or house plants.

RATIONALE FOR PESTICIDES

There is no doubt that pesticides are necessary to the production and protection of our food supply. There is no doubt that such chemicals have accomplished wonders in protecting and promoting the public health, and contributing to the joy and comfort of living. There is no doubt that pesticides have been an asset to fish and wildlife conservation and have protected areas of natural beauty. Conversely, there is no doubt that such chemicals have been over-used and mis-used, thereby adversely affecting human and animal health, ecological relationships, and balance of nature. Pesticides have been used with insufficient research or regard for side-effects and chronic effects on man and his environment; however,

large scale research is now being conducted.

Pesticides can appropriately be described as weapons against hunger, plant and animal disease, nuisances, and discomfort. They are valuable tools for environmental management. However, they have also been considered a panacea when other alternatives for environmental management would provide the greatest good for the largest number of people over the longest period of time. Health officials must consider the important interests and goals of those interested in conservation, agriculture, natural beauty, and recreation when considering methods and alternatives to reach a health objective. While health objectives should be the major consideration for a health official, it is usually possible to develop effective alternatives which will prove harmonious to other segments of our society. Such alternative methods may include biological, cultural, or engineering control measures, or use of selective chemicals.

Health officials should also be knowledgeable enough concerning interests of other segments of our society to attach rational priorities to the need for any program in balance with the effect it may have on the interests of others. Example: balancing the public health need and/or methods for controlling mosquitoes in a swampy area gainst the needs of those interested in protecting the fish and wildlife in the area; or balancing the need for controlling insects in an area at the risk of harming birds, bees, or fish. Health officials sometimes feel that "health" is an

ultimate goal or an end unto itself, but others may feel that it is only one objective of our society which, at times, may not be as important as objectives relating to recreation, conservation, or ecological relationships. The challenge to the health officer is to have sufficient creativeness to insure the development of alternatives which will attain health objectives without conflicting with rational objectives of other agencies or segments of our society. Automobiles are an environmental hazard, but no serious attempt is made to prohibit the manufacture or appropriate use of properly-designed automobiles. The problem of automobiles is analagous to the problem of pesticides -- the challenge to health officials is to help insure that proper pesticides are appropriately used when there is no other practical, effective alternative, and when such use will result in the greatest good for the largest number of people over the largest period of time.

TYPES OF PESTICIDES

Pesticides are designed primarily for use in 1) Agriculture, 2) Public Health, and 3) Wildlife Conservation. Pesticides are those agricultural chemicals designed to kill undesirable animal and plant life. The name of another related group of agricultural chemicals is descriptive, these being plant growth regulators.

Pesticides may be classified as follows:

Insecticides: designed to protect growing plants and stored crops from insect damage

and destruction, and protect people and animals from disease-carrying insects.

Fungicides: designed to protect stored products against fungi and to control funcicidal infestation and infection of living plants.

Herbicides: designed to control vegetation.

Rodenticides: designed to control rats, mice, and other rodent pests.

Nematocides: designed to control nematodes which occur in the soil.

Molluscicides: designed to control snails and slugs.

BACKGROUND, VOLUME, AND VARIETY OF PESTICIDES

DDT, the first of the modern synthetic insecticides, was commercially introduced in 1945. Organic phosphate insecticides was commercially introduced in 1945. Organic phosphate insecticides were introduced in the late 40's and early 50's; and systemic insecticides and plant antibiotics soon followed. The use of such pesticides has now increased to a massive annual dispersal of nearly one billion pounds. There are some 900 basic chemical pesticides and some 45,000 pesticide formulations registered with the United States Department of Agriculture's Pesticides Regulation Division. An estimated $1.7 billion worth of pesticides are distributed each year, of which $255 million worth are for household and garden use,

and another $255 million worth for industrial and institutional use. This $1.7 billion is even more significant when compared to the 1965 total of $1 billion.(9)

A. Classes of Pesticides

1. The chlorinated hydrocarbons containing carbon, hydrogen, and chlorine have in the past been the pesticides used in greatest tonnage. This class includes DDT, dieldrin, aldrin, endrin, toxaphene, lindane, methoxychlor, chlordane, and heptachlor.

2. The organic phosphorous compounds, composed of phosphorous, oxygen, carbon, and hydrogen, and in some other elements such as sulfur and nitrogen, which are used primarily as insecticides and miticides. This class includes parathion, DDVP, phosdrin, diazinon, guthion, and tetraethyl pyrophosphate (TEPP). Malathion, not so toxic as the preceding, also is an organic phosporous compound. The organic phosphorous compounds vary widely in their toxicity

3. Other organic compounds including the carbamates (such as carbaryl and zectran), dinitrophenols, arsenicals, organic mercurials; such natural products as rotenone, pyrethrum, nicotine; strychnine; and the anticoagulant rodent poisons.

4. Inorganic substances such as copper sulfate, arsenate of lead, calcium arsenate, compounds of chlorine and fluorine, zinc phosphide, and thallium sulfate.

E. Herbicides, both organic and inorganic, including such compounds as 2, 4-D and 2, 4, 5-T for the control of broad-leaved weeds in lawns, pastures, cereal crops, brush growth along highways and fences, and industrial areas.

F. Fumigants are another type of pesticide for which there are specific uses and needs. The use of soil fumigants has continued to increase in order to obrain top agricultural yields. Liquid grain fumigants use has decreased due to a reduction in the amount of grain being stored, but still totalled 19,200,000 pounds in 1967.

G. Rodenticides sales have increased due to increasing public concern about rats, particularly in urban areas. These include the anticoagulants such as warfarin, fumarin, and pival; and other materials such as red squill, zinc phosphide, sodium, fluoracetate, and strychnine.

H. Other types of pesticides include attractants for trapping insects, and repellants as protective agents.

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PUBLIC HEALTH USES OF PESTICIDES

Pesticides, particularly the chlorinated hydrocarbons, have tremendously improved the health of mankind throughout the World through controlling such scourges as malaria, cholera, typhus, yellow fever, Rocky Mounten spotted fever, plague, encephalitis, schistosomiasis, and other major communicable diseases having an animal host or vector. Most successful disease control programs have been preventive measures directed at eliminating a link in the chain of transmission, rather than attempting to treat man after he

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B. Mode of Action on Humans, and Symptomatology.

Organic phosphorous insecticides are absorbed by the skin as well as by the respiratory and gastro-intestinal tracts. They act as more-or-less irreversible inhibitors of the enzyme cholinesterase and thus allow the accumulation of large amounts of acetylcholine. Symptoms include headache, giddiness, nervousness, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest. Signs include sweating, miosis, hearing, salivation and other excessive respiratory tract secretion, vomiting, cyanosis, papilledema, uncontrollable muscle twitches, convulsions, coma, loss of reflexes, and loss of sphincter control. Following a massive oral dose associated with murder or suicide, death has occurred in five minutes, or less, after ingestion. Following smaller doses, onset of illness was delayed an hour or more. In occupational exposure, illness is frequently delayed several hours.

While poisoning from organic phosphorous pesticides is the most common, this as well as other pesticide mode of action and symptomatology is discussed in the publication, "Clinical Handbook on Economic Poisons."(19)

has contacted the disease. Some of the vector-borne diseases are still responsible for large numbers of deaths. Additionally, they are the cause of world-wide human sickness, poverty, misery, and lack of economic development. Reservoirs of vector-borne disease still remain world-wide, thus requiring a continued capability and effort to control them. Pesticides are an indispensable tool in the continuing effort for eliminating vector-borne diseases.

OTHER USES OF PESTICIDES

1. Controlling plant diseases: many of the 50,000 plant diseases are due to infection by bacteria, viruses, nematodes, or fungi which may be effectively controlled by appropriate agricultural chemicals such as pesticides.

2. Controlling undesirable vegetation is a problem for the home gardener, large agriculturalists, insect control specifialists, parks maintenance agencies, fire prevention personnel, highway departments, reclamation agencies, and industries. While there are many methods of weed control, the use of herbicides is among the most effective, but other environmental measures should still be practiced where practicable.

3. Protecting animal health: livestock and poultry diseases are not only serious, but are costly. Insect pests not only cause disease, but may decrease milk and meat production and cause irreparable damage to hides. Appropriate use of pesticides is a proven method of preventing such problems. There is increasing interest in adding anti-helminthic agents to plant foods.

HAZARDS OF AGRICULTURAL CHEMICALS

Agricultural Chemicals pose a continuing threat to human health and conservation interests in that

1) these chemicals, if improperly used, may be toxic to man, animals, and plants.

2) they may be mis-used, either accidentally or through lack of sufficient information.

3) they may be disseminated in the environment at points remote from the site of application.

4) some persist in the environment for lengthy periods and have cumulative biological effects,

5) there is insufficient public knowledge of their potential harm to man and his environment, and

6) there may be unknown chronic effects.

The hazards are apparent from the manufacturing process through packaging, transportation, storage, sale, mixing, application, and environmental biological accumulation.

A. Environmental Pollution and Biological Accumulation

Pesticides have caused incalculable damage to our planet's fish and wildlife resources. They have caused serious and subtle changes in our environment. Certain chlorinated hydrocarbons, particularly DDT, have been detected in air, soil, water and wildlife all over the World. It is suggested that such pesticide distribution and accumulation may 1) be harmful to certain marine plankton, 2) be harmful to marine crustaceans, 3) be responsible for large numbers of fish kills, 4) be responsible for the widespread loss of robins and other birds,

5) be severely hampering the reproduction of certain birds, and 6) have been responsible for many instances in which frogs and snakes as well as wild and domestic animals have been killed. (9,11)

Most of the foregoing listed examples have been associated with DDT due to its widespread use, its persistence, and its accumulation in the environment; however, DDT is only one of the chlorinated hydrocarbons -- the so-called "hard" insecticides -- which also include Dieldrin, Aldrin, Heptachlor, Endrin, Benzene-hexachloride (including Lindane), and Chlordane. DDT has been found in the Antarctic Ocean, in fish life in the deep oceans, in the eggs of eagles, ospreys, and falcons, in human fatty tissue, and in human milk. DDT has been dispersed by winds, water, and small organisms in food chains. (9 11)

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B. Biological Effects

Certain biological effects are well recognized and highly significant. Cholinesterase inhibition from organic phorphorous compounds have killed people as well as interfered with other functions such as vision and mental alertness. Thallium, mercury, and arsenic compounds have well recognized effects. These are primarily acute effects from relatively heavy exposure though they may have similar, less dramatic effects, as a result of long continued exposure to lower concentrations. There has been much concern about other chronic effects from continued low level exposures. These include carcinogenesis, genetic changes, metobolic effects, and others. Some of these have been demonstrated in laboratory

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A total of 11,591,000 fish were reported killed by identifiable pollution sources in 40 states during 1967. This was an increase of 2,476,000, or 21 percent over 1966 when 9,115,000 fish were reported killed in 46 states.(25) It must be remembered that such reporting is not accurate or complete; nor does it indicate possible losses due to pesticide interference with the food chain or reproductive cycle.

animals. More of them have been proven to occur in man under normal exposure conditions. This does not prove that they will not occur, since they would become apparent epidemiologically only after a prolonged period. Over-emphasis on the fact that such effects have not occurred in practice or on their potential have resulted in a serious public controversy. Decisions must remain conservative and flexible. Essential uses should not be blocked because of unproven hazards, but less important uses should be discouraged.

C. Pesticide Residues on Foods

The 1959 cranberry incident, various reports involving pesticide residues in milk and milk products, and numerous fish kills, including the 1969 controversy over residues in coho salmon in Lake Michigan, serve as reminders of the fact that the Nation's food supply is a potential source of toxic pesticides. With but few noteworthy exceptions, interstate food supplies are not known to be hazardous. Residues may not be so consistently low for intrastate food supplies. The Pesticide Monitoring Journal [23] routinely reports results of the Food and Drug Administration's market basket survey. Residue tolerances established by the Food and Drug Administration must be continuously reviewed and re-evaluated.

D. Accidents and Gross Mis-Uses of Pesticides.

Pesticides have frequently been accidentally or grossly mis-used, thereby being the immediate cause of human illness, death, or damage to food supplies, domestic animals, crops, or wildlife. In this respect, knowledge about proper storage and use of pesticides is an important component of a health

agency's accident prevention and training program. Accidental injury or death may occur during stages of pesticide manufacture, formulation, packaging, transportation, storage, sale, or application, whether in the locale of the industry, vehicle, business, home, farm, or institution.

ROLE AND RESPONSIBILITY OF THE LOCAL HEALTH DEPARTMENT

In addition to an overall interest and responsibility regarding all matters of public health and environmental management, there are a number of specific responsibilities for which the local health must assume leadership. These include:

1) taking the leadership in insuring the public needs are represented through coordinating efforts to minimize harmful effects on man and his environment. The local health officer may wish to create committees comprised of representatives from various agencies and groups having responsibilities in controlling pesticides. Such groups might include such interests as conservation, pollution control, public health, agriculture, chemical industry, reclamation, water supply, fire departments, and accident prevention.

2) Insuring prompt reporting of any illness or death alleged to be caused by pesticides. This, of course, is a basic public health responsibility. Here, however, information may need to be directed to select groups such as the Medical Society, to insure understanding and cooperation. Improved reporting is a "must" if hard facts on the incidence of

morbidity and mortality resulting from pesticides are to be obtained. The local Health Officer has an obligation to assure that physicians are aware of the importance of prompt and accurate diagnosis, treatment, and reporting of pesticide poisoning cases. The medical examiner system should be encouraged. Listing pesticide poisonings as legally required reportable incidents is also worth considering.

3) Participating in epidemiological investigation to accurately determine causes of illness or death and attendant methods of application, dosages, etc.

4) Insuring that environmental and biological surveillance is being conducted on a continuing basis by an agency or agencies not having a prime mission of applying pesticides. It is important to remember that a number of official agencies and groups are created with a prime mission of promoting and protecting the interests of a specific industry or segment of our society, rather than protecting the public through being a consumer protection agency.

5) Making decisions and recommendations as to which chemicals should be or should not be used. This will require considerable technical staff knowledge and frequent consultation with technical experts from other agencies.

6) Making decisions and recommendations as to whether chemicals or alternative methods of control should be utilized.

7) Use of the health department's police power in properly regulating pesticides where necessary. This may include

regulatory provisions in laws, regulations, rules, codes, and ordinances relating to pesticide manufacturing, formulation, packaging, labeling, advertising, transportation, storage, sale, or application, as well as including appropriate requirements in codes relating to food protection, milk sanitation, pest control, pest control operators, housing, accident prevention, waste disposal, water supplies, institutional sanitation, occupational health, water pollution control, and air pollution control. In numerous instances, local health officials have discovered food products and pesticides being stored, transported, or stocked in such proximity or condition as to pose an obvious and immediate threat to the public health. If specific legislation is not available, the health officer can generally remedy such flagrant violations through aggressive use of his general powers and through application of nuisance laws. Public disclosure of such hazards also proves to be a very effective method of remedying such hazards.

The health officer should ordinarily contact the Pesticides Regulation Division of the U. S. Department of Agriculture in instances involving possible mis-labeling. However, the health officer may choose to impose additional labeling requirements in some instances.

8) Providing the public with unbiased, technical information should be directed not only to the public-at-large, through mass communications media, but also to select subgroups as physicians, applicators, farmers, gardeners, and

conservationists. This service should be coordinated with other agencies having responsibility for the control of pesticides.

9) Advising the public as to alternative methods of pest control for those pests involving vector-borne diseases.

10) Provision of laboratory facilities having the capability of pesticide analyses in biological or environmental samples and specimens. Such laboratory facilities should be an operation of an agency dedicated to the public interest such as a health agency or a university.

11) Sponsoring training for individuals or groups having or causing an occupational exposure to pesticides. Training efforts may be sponsored by the health agency sponsoring and utilizing the talents of other technical experts when necessary. Training is essential for anyone engaged in the commercial application of agricultural chemicals. The Health Officer can contribute significantly to improving the knowledge & elevating the operational standards of pest control operators.

12) Performing research, or filling the role of a provacateur in insuring that necessary research is conducted. Rational questions and reservations articulated by professional health personnel will aid in insuring that questions are answered and funds dedicated to research.

13) Insuring the establishment of well-staffed poison control centers.

14) Insuring the availability of adequate facilities and advise on the disposal of waste pesticides and used containers. Improper disposal of waste pesticides and used containers is

a major unsolved problem having particulaly serious implications in major agricultural areas. This is one of the many important ways in which pesticides enter the environment and many human deaths have been associated with inadequate disposal of "empties". Assurance that the local community has reasonable disposal facilities and that the local citizen is aware of the facilities and the problem is an extremely important function. Improved methods will require additional research financed by the federal government.

15) Identifying and promoting the need for improved or additional federal, state, and/or local legislation. The Federal Trade Commission's Regulations regulating packaging, spillage, and dosage may need to be strengthened.

Many areas are currently considering regulating the sale and use of certain of the chlorinated hydrocarbons. This question has many facets and ramifications, and should be handled on an objective basis. The chlorinated hydrocarbons pose a problem due to their persistence, volume of use, and world-wide application and distribution. However, the organic phosphates are more acutely dangerous. Organic phosphates kill insects just as efficiently and break down quickly in water, but have been known to be the cause of many deaths among humans and other animals.

16) Formulating a well-worked-out plan for handling pesticide emergencies such as highway or railroad spills, warehouse fires, etc. These are local problems even if the local health officer decides to call on outside experts.

Many major chemical companies have "flying teams" of experts who will provide advice and assistance in cleaning up spills or correcting other emergency situations involving pesticides.

In short, the local health agencies' responsibilities include coordination, consultation, public information, regulation, leadership, training, sampling and surveillance, analyses, research, and epidemiology.

FEDERAL RESPONSIBILITIES

The statutory authority for the control of pesticides and pesticide residues entering interstate commerce has been adopted by the Federal Congress.

The Federal Insecticide Fungicide and Rodenticide Act, enacted in 1947 (as amended and interpreted) and administered by the U. S. Department of Agriculture, controls registration and labeling of pesticides. Additionally, the Federal Food, Drug, and Cosmetic Act, enacted in 1938 (as amended and interpreted) and administered by the Food and Drug Administration, Consumer Protection and Environmental Health Service (HEW), provides for tolerance levels and controls for pesticide residues in raw agricultural products. Both the FIFRA and the FDCA apply only to pesticides or food involved in interstate commerce.

Additionally, the Pesticides Program within the Food and Drug Administration (HEW), has been established as a focal point within HEW for assessing the total impact of pesticides upon human health.

FIFRA (as amended and interpreted), administered by the USDA's Pesticides Regulation Division, provides that a manufacturer or shipper of a pesticide which is to be in interstate commerce, must apply for registration and labeling. The Pesticides Regulation Division requires statements from the manufacturer regarding composition of product, uses for which intended, and conditions of application. The manufacturer must submit experimental data on relative safety of a product to man in relation to its intended use. Such applications are also reviewed by the Food and Drug Administration and Department of the Interior. Approval is usually granted if the proposal meets standards of good agricultural practice and the product does not constitute a public health hazard under conditions of the application. Registration approval, however, does not imply safety under conditions varying from these in the application. Therefore, registration by the USDA does not provide or imply public protection except under conditions stated in the application. Both FDA and Department of Interior only advise USDA, and there have been serious questions raised about the efficacy of the relationship.

The Federal Food, Drug and Cosmetic Act (as amended and interpreted) provides that tolerances be established for pesticide residues in foods where such pesticides are deemed necessary for the protection and production of the food supply. However, a comprehensive set of tolerance levels has never been produced due to unclear procedural guidelines, divergent points of view, and changing methodology. FDA and USDA have

now abandoned the concept of "no residue" or zero tolerance registrations of pesticides as far as possible (for example, only zero tolerances can be established for known carcinogens), and have replaced "no residue" and zero tolerances with small finite tolerances, i.e., negligible residue tolerances. The term "negligible residue" means any amount of a pesticide chemical remaining in or on a raw agricultural commodity or group of raw agricultural commodities that would result in a daily intake regarded as toxicologically insignificant on the basis of scientific judgement of adequate safety data. Ordinarily this would add to the diet an amount which will be less than 1/2,000 of the amount that has been demonstrated to have no effect from feeding studies on the most sensitive animal species tested. Such toxicity studies usually include at least 90-day, and sometimes two-year feeding studies in two species of mammals.

It is important to remember that efforts to improve controls in the interest of public and environmental protection frequently run into opposition from agencies and groups having divergent interests. It is important that legislation be designed to protect the public and to do more than create procedural delays. Industry may be helpful and provide useful information.

Serious questions have also been raised about the effective administration of provisions of existing federal laws. Critics contend that the reason for ineffectiveness relates to the fact that USDA's basic responsibility is to the

farmer and food production rather than to the public and consumer protection. The Division of Community Studies of the Office of Product Safety within FDA conducts long-term epidemiological studies and biological and environmental monitoring. Technical training courses relating to pesticides are made available to State and local health department personnel.

THE ROLE OF STATE AND LOCAL AGENCIES

Various state agencies administer laws providing for certain control over distribution and sale of foods and pesticides in intrastate commerce. Also, most states have laws regulating the use and application of pesticides. There is a great divergence of use, application, coverage, and effectiveness among the states. This divergence can be explained by the varying needs and desires in different areas, inadequate budgets, and pressures of industry. There is a need to upgrade technical competency and have modern sophisticated equipment for analyses.

OTHER INVOLVED AGENCIES

The list of other official agencies involved in the problem of pesticides is almost endless, but does include water pollution control, air pollution control, conservation, agriculture, forestry, recreation, reclamation, highways, natural resources, food and drugs, consumer protection, environmental resources, and public safety agencies. The local health officer should determine the exact composition in his own area.

BIBLIOGRAPHY AND REFERENCE MATERIAL

1. The President's Science Advisory Committee: Use of Pesticides. The White House, Washington, D. C., May 15, 1963.

2. National Academy of Sciences, National Research Council: Pest Control and Wildlife Relationships, Part I, Evaluation of Pesticide - Wildlife Problems, Publication 920-A. Division of Biology and Agriculture, National Academy of Sciences - National Research Council, Washington, D. C. 1962.

3. U. S. Dept. of Health, Education, and Welfare, Public Health Service: Pesticide Laws and Legal Implications for Use. National Communicable Disease Center, Atlanta, Georgia, 30333.

4. U. S. Dept. of Health, Education, and Welfare, Public Health Service: Pesticides and Public Health. Public Health Service, Washington, D. C., 1966.

5. American Public Health Association: A Survey of Pesticide Problems and Control Activities. American Public Health Assoc., 1790 Broadway, New York, New York, July, 1965.

6. Hoffman, C. H., How Should Agricultural Pollutants be Controlled. Biological Problems in Water Pollution. Public Health Service, Cincinnati, Ohio, 1965.

7. U. S. House of Representatives Committee on Appropriations Sub-Committee on Department of Agriculture: Effects, Uses, Control, and Research of Agricultural Pesticides. 1966.

8. Simmons, Samuel W., PHS' Pesticide Program. National Agricultural Chemical News and Pesticide Review. Vol. 27, No. 5: 10-12, May-June, 1969.

9. Conservation Foundation Letter. April 25, and May 5, 1969. The Conservation Foundation, Washington, D. C., 20036.

10. American Public Health Association: Safe Use of Pesticides. American Public Health Association, 1790 Broadway, New York, New York, July, 1965.

11. MacMullan, Ralph A., The Case Against Hard Pesticides. Michigan Department of Conservation, Lansing, Michigan, 1969.

12. Manufacturing Chemists Association. Agricultural Chemicals. Manufacturing Chemists Association, 1825 Connecticut Ave., N.W., Washington 9, D. C., 1963.

13. Commoner, B., Science and Survival. Viking Press, 1966.

14. Woodwell, G. M., Toxic Substances and Ecological Cycles. Scientific American, 216 (3): 24-31, 1967.

15. American Chemical Society. Cleaning our environment--The chemical basis for action, ACS, Washington, D. C., 1969.

16. Food and Agriculture Organization. Evaluation of the toxicity of pesticide residues in food. FAO Meeting Report No. PL/1965/10/1.

17. Lehman, A. J., Summaries of pesticide toxicity. Association of Food and Drug Officials of the U. S. Kansas, 1964.

18. Food Protection Committee, Food and Nutrition Board. Problems in evaluation of carcinogenic hazards from use of food additives. NAS-NRC, Washington, D. C., 1959.

19. Hayes, W. J., Clinical handbook on economic poisons. Public Health Service Pub. 476, 1964.

20. World Health Organization. Toxic hazards of pesticides to man. WHO Tech. Rpt. Series 227, Geneva, 1962.

21. World Health Organization. Pesticide residues in food. WHO Tech. Rpt. Series 370, Geneva, 1967.

22. U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service: The Pesticide Review, 1968. U. S. Dept. of Agriculture, Washington, D. C., 20250

23. Pesticide Monitoring Journal. Federal Committee on Pest Control. Food and Drug Administration, 1600 Clifton Road, N.E., Atlanta, Georgia, 30333.

24. U. S. Dept. of Agriculture, and U. S. Dept. of Health, Education, and Welfare: The Regulation of Pesticides in the United States, 1968. Food and Drug Administration, Washington, D. C.

25. Federal Water Pollution Control Administration: Fish kills by Pollution, 1967. Federal Water Pollution Control Administration, Washington, D. C. 20242.