

1. EVIDENCE OF PROBLEM

For the last fifteen years there has been growing world-wide concern regarding the persistence of chlorinated pesticides (particularly DDT) and their universal presence in man, food, animals, fish, birds, air, water, and soil. DDT and its metabolites have been found in virtually every living organism and matter around the globe--including penguins in the Antarctic and the polar ice cap.

As analytical techniques for measuring the residues have improved, interfering substances have become apparent and raised doubts as to the quantitative validity of reported concentrations. Gas chromatograph techniques, making possible determination in the parts per billion and parts per trillion range are particularly sensitive not only to DDT but also to its metabolites DDE, the insecticides Dieldrin and Aldrin, and polychlorinated biphenyls (PCB's), isomers of which have similar retention times ("peak locations") in the gas chromatogram.

Identification of some of the major interfering substances as PCB's was announced by Professors Widmark and Jensen of the Institute of Analytical Chemistry at Stockholm in November, 1966. With the identification (confirmed by mass spectroscopy) Widmark and Jensen announced finding PCB's in fish, birds, eggs, pine needles and childrens' hair. Samples analyzed were all from Sweden and the Swedish coastal areas.

Subsequently, PCB's were identified in fish and wildlife in Great Britain (1967), the Rhine River and Netherlands estuaries (March, 1969).

In August of 1968, Professor Risebrough of the University of California at Berkeley presented a paper at a private meeting of toxicologists indicating he had found PCB's in fish and wildlife along the coast of California. The first reference in the American public press followed the publication of Risebrough's paper in Nature, February, 1969. At that time the San Francisco Chronicle carried a "scare" story concerning PCB's after an interview with the author.

In the last six months, PCB's have been reported in:

- a. Milk in Georgia
- b. Waters of Lake Michigan
- c. Fish in Connecticut
- d. Sea food along the Gulf Coast (toxic--fatal to shrimp at Pensacola)

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1. EVIDENCE OF PROBLEM (Continued)

- e. Electric dishwashing compounds
- f. Milk in Maryland
- g. Bald eagles from the mid-west and
- h. Mother's milk (rumor--not confirmed) in Denver.

After investigation--not complete in all cases--the committee has concluded:

1. That the identification of the PCB's as contaminants of the environment is certain;
2. There is no question as to the non or low biodegradability of the PCB's--particularly the higher chlorinated members of the series including Aroclors 1254 and 1260 and probably 1248;
3. The possibility of natural origin of the PCB's (such as biological or chemical degradation of other chlorinated hydrocarbons by natural processes or metabolism in the eco-system) is so remote that it is not a satisfactory explanation of their presence;
4. As discussed in the following section, these may be significant toxicological effects in some species of living organisms; and,
5. Aroclors 1254 and 1260 are the compounds which are found and reported in the literature by the Aroclor trade-names or as the "biphenyls with predominantly 5 to 8 chlorine atoms". We believe that references to Aroclors 1242 and 1268 (and chlorinated terphenyls) in several letters received reflect early non-definitive efforts of the analysts.

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2. TOXICOLOGICAL ASPECTS

- A. Man--Data available at present indicate that PCB's may be "moderately toxic" to man. Safe industrial usage has been based on a recognition of possible toxic effects and control of exposures to minimize the hazard. There have been a limited number of cases of occupational disease where workmen have been exposed to excessive vapor inhalation or repeated and prolonged skin contact with subsequent development of skin manifestations ("chloracne") or more serious involvement of the liver and kidneys.
- B. Animals--Chronic toxicity data for animals (which would allow a better extrapolation of "safety" levels for humans) has been meager. In May, 1969 chronic (two year) feeding studies in rats and dogs were initiated at our consultant's Industrial Bio-Test Laboratories in Chicago. A three generation rat reproduction study is also underway. The purpose of the research is to make available to the U. S. Food and Drug Administration and other federal and state agencies data which will confirm that the levels of PCB's being found in nature--and particularly in human food--do not constitute a serious threat to the public health.
- C. Fish--The proven presence of pesticides (and PCB's) in fish is beginning to cause concern for two reasons. In Sweden and other Scandinavian countries where fish make up a large portion of the daily diet, the use of DDT has been temporarily or permanently banned. Similar action has been taken in several states in the United States and bills have been presented in Congress to outlaw the sale and use of DDT. This summer the U. S. Food and Drug Administration seized and destroyed Coho Salmon caught in Lake Michigan because of DDT content.

This highlights the particular problem with fish which can concentrate/accumulate persistent chlorinated hydrocarbons in their tissues. For example, trout raised in water containing 1 part per billion will contain 1 part per million in their tissues in six weeks. Other marine species exhibit a similar "concentrating" propensity. Although no scientist has maintained that these accumulated levels in fish are toxic per se, the question of the desirability of having such fish in the human diet has caused concern--and in some minds, alarm.

2. TOXICOLOGICAL ASPECTS (Continued)

A second consequence of the chlorinated pesticide presence in fish, is the alleged effect on species of coastal and other fish-eating birds. There is evidence interpreted by a number of scientists (and seized upon by the conservationist-pseudo-scientists) that several species of birds face elimination or absolute extinction because of persistent chlorinated hydrocarbons in fish which make up the major portion if not all of their diet. Included in the United States are the Peregrine Falcon and the brown pelican. (At a meeting in October, 1969, of the Association of Official Analytical Chemists, will be a paper presented entitled, "The Determination of PCB's in Two Bald Eagles". This is based on work done by the Fish and Wildlife Laboratories of the U. S. Department of the Interior at Patuxent, Maryland. Now the emblem of the heritage of the United States is threatened!)

- D. Birds--The effect in birds appears to be due to an upset of enzyme metabolism in the liver leading to the laying of eggs with thin or no shells at all. On Anacapa Island, near Oxnard, California, only three of one thousand brown pelican eggs were found this year with shells and only ^{one} bird was born. This was due allegedly to anchovies--the main diet of the pelican--containing "DDT and hundreds of parts per million of PCB's".

Preliminary results from studies at Industrial Bio-Test Laboratories indicate that 100 ppm of Aroclors 1242, 1254 and 1260 in the diet of white leghorns causes a reduction in egg shell thickness and an effect in chick embryos which prevents hatching.

- E. Shrimp--In August, 1969, West Florida State University at Pensacola reported to our Pensacola Plant that PCB's (Aroclor 1254) had been found in the Escambia River below our outfall. The amount was reported as 40-45 parts per billion one quarter mile below the plant and 1 ppb at the bridge over the river as it enters Pensacola Bay.

The Gulf Breeze Laboratories of the Bureau of Commercial Fisheries (U. S. Department of Interior) at Pensacola next reported that 40 ppb killed baby shrimp in 96 hours. Further study indicated that 5 ppb killed 18 of 25 baby shrimp in 18 days.

Plant investigation revealed that one to three gallons per day of Aroclor 1254 was being lost to the river from the use of Pydraul AC in air compressors.

2. TOXICOLOGICAL ASPECTS (Continued)

F. Summary of Toxicity Considerations

- a. The PCB's are "moderately" toxic to man. A probable safe level for Aroclor 1254 and 1260 in the diet will be something less than one part per million.
- b. Although only "moderately" or "slightly" toxic to adult birds and fish on the basis of acute exposure, the "safe long term" or "chronic dose" is less than 100 ppm insofar as reproduction is concerned.
- c. In the case of shrimp, the "safe" or no effect" level for Aroclor 1254 is less than 5 parts per billion.

It thus appears that, while we may be able to show some kind of reasonable numbers for "safe levels" of Aroclors 1254 and 1260 (and other lower chlorinated biphenyls) in some species, there are other species of life in the ecosystem where a zero to 5 parts per billion limit for Aroclor 1254 and 1260 (and possibly other more highly chlorinated biphenyls) will be the tolerance level.

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3. PERSISTENCE OR LACK OF BIODEGRADATION

Evidence for the persistence of Aroclors 1254 and 1260 in the environment includes:

- a. The chemical stability of most of the chlorinated aromatic hydrocarbons.
- b. The identification of Aroclors 1254 and 1260 in the environment as itemized in Section 1.
- c. Reports from Sweden indicating the presence of Aroclors 1254 and/or 1260 or competitive equivalent products in the sludge from municipal waste treatment plants.
- d. The lack of data up to now indicating that lower chlorinated PCB's are interfering in the pesticide residue analysis in spite of the equivalent usage of some of them (e.g. Aroclor 1242) and undoubted losses to the environment depending on use applications and ultimate disposal. (Comfort in this conclusion is tempered by some evidence that the preparation of samples for GC analysis--destroying the DDT and metabolites--may be causing destruction of Aroclor 1242).
- e. Literature evidence that other lower chlorinated hydrocarbons in a series of compounds (e.g. mono and di-chlorophenols) are subject to biodegradation whereas increase in chlorination makes them more refractory (penta-chlorophenol).
- f. Early reports of research in Monsanto's Ruabon Laboratories that indicate that Aroclor 1242 is indeed subject to biodegradation in biological waste treatment plants (research scale).

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4. PRESSURES WHICH WILL AFFECT SALES AND USE OF AROCLORS
1254 AND 1260

As of this date (October, 1969), there are no restrictions which control the current uses of our Aroclors or PCB's. We are faced instead with pressures being applied relative to persistent chlorinated hydrocarbon pesticides in general and specifically DDT. The evidence proving the persistence of these compounds and their universal presence as residues in the environment is beyond question. Although the significance of these residues is subject to wide difference of opinion among reasonable scientists, the development of "lunatic fringe" post-Rachel Carson has led to a domination of the media by scare publications in the public and scientific press. Only the most myopic individual in the business world could be unaware of the overwhelming interest and influences being directed at preventing contamination of the environment. The principal groups with an apparent avowed mission of providing a world of pristine pure food, water and air include many in academic and political fields who recognize the headline value of statements supporting these ideals.

In the case of the PCB's as environmental contaminants, the committee believes that Monsanto is faced with a barrage of adverse publicity in all elements of the news media--including those with national coverage. Factual basis will be sparse or non-existent but guilt by association (with DDT) will provide background and prevail.

As indicated in the earlier sections of this report, it will be impossible to deny the presence and persistence of Aroclors 1254 and 1260 at least. The public and legal pressures then to eliminate or prevent global contamination are inevitable and probably cannot be contained successfully.

In defense of the chlorinated pesticides, their manufacturers will not be loath to incriminate the PCB's as being culprits in the development of misleading data relative to their concentrations as residues. Secondly, the manufacturers of competitive products will seize any opportunity to point out to our customers their potential problems if they continue to use products containing Aroclors. This has already occurred in the case of our Pydrauls.

There are pertinent federal laws and regulations relating to environmental control as discussed in the following section.