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FDA PAPERS

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Industrial Chemicals and FDA

by Henry Fischbach, Ph.D

Those responsible for the public health have good reason for their increasing concern about chemical substances that may pollute the environment and, among other things, ultimately find their way into man's food. The recent discovery of toxic amounts of mercury in fresh water fish as a result of contamination of bodies of fresh water is a case in point. Recently there also has been steadily growing concern about the release of polychlorinated biphenyls (or PCB's) in the environment and speculation about why and how these chemical substances enter the environment and eventually man's system through the food chain or through other means.

To assure the safety, purity, and wholesomeness of our food supply, FDA has directed its regulatory and scientific activities to those areas where the possibilities of contamination are most apparent. As new formulations and uses of pesticides and other economic poisons were introduced for agricultural and health purposes, the Agency has concentrated on detecting and identifying these substances in or on foods.

Under its food additive regulations, FDA has sought to assure that substances used in formulating, processing, and packaging foods do not contaminate the food with toxic amounts. Through its responsibility for foods in interstate commerce and imported foods, FDA has inaugurated regulatory, educational, and scientific safeguards to assure that food products in storage or transit are not contaminated by toxic chemicals.

The development of highly sensitive instrumentation and ingenious physico-chemical techniques has enabled man to detect, identify, and measure minute residues of chemicals, both in his own body tissues and elsewhere in the environment and of particular interest in FDA's case, in foods. That these residues exist is a reflection of man's genius for synthesizing new chemical substances to advance his many technologies. Until recent years little consideration has been given to the potential impact of these chemicals on our total environmental cycle. But as these substances become ever more sophisticated and continue to proliferate, it has become essential that man, in his decisionmaking, take into consideration a factor that becomes more and more obvious: these chemicals, many of them in highly stable forms and many others in forms that may combine with other chemical substances to produce toxic materials, cannot be dispersed from our planet and thus must become a part of the environment. Earth and its atmospheric envelope is a closed system!

In this country our control over industrial chemicals is largely in the field of pesticides and food additives simply because of the statutory powers conferred on the U.S. Department of Agriculture and the Food and Drug Administration in these areas. Because of these obligations, the FDA in particular has developed highly sensitive and characterizing methods and equipment with which to monitor pesticides in foods.

It is thus mainly in the food area that we have some data on the extent of pesticide residues in our environment as well as some rather incomplete data about residues in the tissue of man. Little is known about the many residues that result from processing the industrial chemicals used in modern industry, simply because man has not looked for such residues; nor has he developed the appropriate, sensitive methodology by which they can be detected and identified.

Much of the publicly voiced concern over the past years has been aimed at reducing the "known" toxic residues in the environment. This concern is certainly appropriate and efforts are being made to minimize these potential hazards (see article, February 1970 issue, FDA PAPERS, about the report by the Secretary's Commission on Pesticides and Their Relationship to Environmental Health). It is an essential activity, but at least of equal concern should be the planning and deliberation needed to minimize future contamination of the environment.

Chemical substances that are neither pesticides nor food additives are present in our environment and may cause hazardous residues in food and feed. Since some of these industrial chemicals are closely related in chemical structure to stable pesticides and may interfere with our measurement of pesticide residues, the FDA must maintain an awareness of this potential interference and continue evaluating the validity of its methodology for detecting, identifying, and measuring pesticide residues in food. We must recognize that any stable industrial chemical related in structure to the stable pesticides and used in significant tonnage in industrial processes will become a part of the environment and is likely to find its way into food. Aside from man, I consider fish and the sedentary shellfish to be the greatest bio concentrators of certain chemicals. We must determine the nature and extent of this potential hazard and, if necessary, act to minimize it.

A pertinent example of such industrial chemicals in the environment is the PCB's, manufactured by the Monsanto Chemical Company under the trade name,

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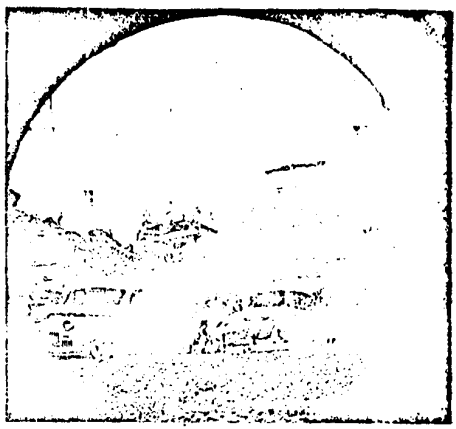
"Aroclors." Several other companies in Europe manufacture similar products under other trade names. These industrial chemicals have certain valuable attributes that are attractive to the many technologies developed by modern man: low vapor pressure, high dielectric constant, beneficial flow property, fire retardance, high stability, etc.

Thus these chemicals have many nonagricultural uses: in paints, transformer fluids, plastics, adhesives, asphalt, tile, etc. With such wide usage it should be expected that traces of these chemicals will enter our watersheds and become concentrated in fish as do such other related chemical structures as DDT. The widespread presence of PCB's in our environment has been established. They were first reported in fish-eating birds and now have been found in fish in the Great Lakes and, in a few instances, in milk and dairy products and even in human fatty tissues.

PCB's are only one of the many industrial organic chemicals undoubtedly present in our environment in such quantity or under such conditions as to cause residues in food and in man himself. We should consider ways to collect sound scientific information on these materials so that decisions can be made based on the net "benefit" to man versus the "deficit."

Among the industrial organic chemicals requiring scrutiny, perhaps the halogenated compounds, such as those containing chlorine, should be studied first. For example, the chlorinated naphthalenes and chlorinated paraffins are widely used in much the same way as PCB's. An FDA food additive regulation (121.2572) permits the use of chlorinated paraffins as cross-linking agents in resins used in coating packaging materials for dry foods. Many other chlorinated industrial chemicals are widely used. Chlorothiophenes, chlorinated pyridines, and chlorinated phthalate and phosphate esters are only a few. The *Federal Register* of April 15, 1970, carried an FDA notice that a food additive petition (FAP0H2519) has been filed by Dow Chemical Company for 2,3,5,6-tetrachloro4-(methylsulfonyl) pyridine as a preservative for food-packaging adhesives. There is an existing food additive regulation (121.2520) permitting use of tri-8-chloroethyl phosphate in adhesives used in food packaging. Hexachlorocyclopentadiene is a building block for chemical compounds that impart fire-retardant features. Chlorendic anhydride in resin-based laminates suppresses combustion and imparts self-extinguishing properties to nonflaming, film-forming resins. Such compounds reduce the hazard to man from fires resulting from an electrical short circuit that starts a blaze in a printed circuit board. On the other hand, these compounds are related to such pesticides as dieldrin and endrin and should be evaluated from the standpoint of a future hazard in the environment, namely, their net benefit or deficit to man.

A host of chemicals are used as plasticizers, a use which seems a very likely source for residues eventually becoming part of the food supply. The leaching of plasticizers from plastic objects in trash disposal





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sites and volatilization when plastics are incinerated may result in contamination of streams through scrubbing of the atmosphere by rains, and residues may thus enter the food chain. Many plasticizers are rather stable derivatives of phthalic acid. Almost 784 million pounds of phthalic anhydride esters were produced for plasticizer use in the United States in 1967, according to the U.S. Tariff Commission report, "Synthetic Organic Chemicals," for 1967. A variety of phosphates and other chemicals are also used.

Another likely source of environmental contamination and subsequent residues in the food supply is chemicals used in rubber processing. Aside from waste from processing plants, rubber worn from tires on the highways and subsequent washing of the additive chemicals into storm sewers and streams may result in eventual residues in our food chain. Production of rubber processing chemicals in the United States in 1967 amounted to 264 million pounds, according to the Tariff Commission report. Examples: Total production of thiazole derivatives for this use was over 56 million pounds. Total thiuram derivatives (related to pesticides) was over 14 million pounds.

Only a few examples of widely used industrial organic chemicals have been cited. In 1967, U.S. production of all synthetic organic chemicals totaled almost 105 billion pounds. Of this total, pesticides and related products constituted less than 1 percent, or about one billion pounds. This leaves a huge quantity of synthetic organic chemicals with a wide variety of industrial uses.

Except for PCB's, about which only limited information is available, essentially nothing is known about possible residues of these many nonpesticidal industrial chemicals in man's food supply and in man himself. Furthermore, there is a dearth of information on the toxicology of these chemicals. In most cases, little is known about the toxic effects of low levels ingested over long periods. The only other group for which adequate pharmacology is available is the synthetic



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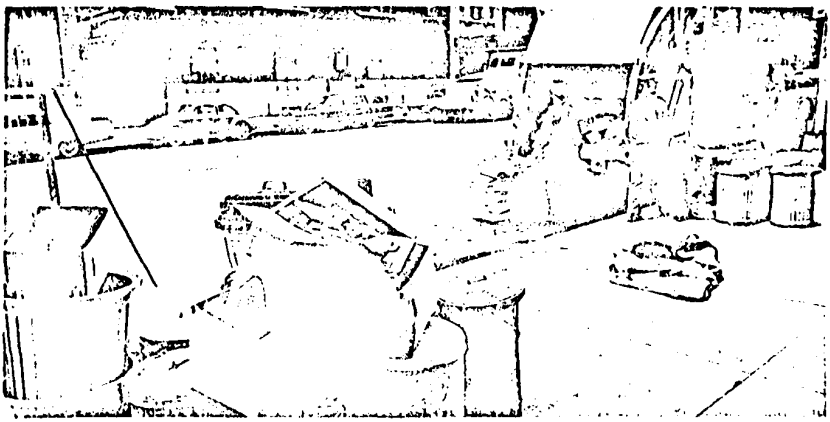





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medicinal chemicals, but the total 1967 production of these chemicals (active ingredients) was only 180 million pounds, less than 0.2 percent of total U.S. organic chemical production.

The evolving PCB's situation is an example of the potential environmental problems associated with man's rapid strides in various technologies. In evaluating the full extent of such ecological complexities, I feel that all available information should be assembled on the volume of use, chemical stability, and toxicity of industrial chemicals related to pesticides. The initial efforts might be directed at the halogenated cyclic chemicals since we have methodology based on years of work detecting pesticide residues containing such compounds. From this information a knowledgeable selection might be made of the chemicals most likely to cause hazardous residues in food, feed, or in man himself. At this point the chemical and physical properties of these chemicals should be evaluated, methods should be developed for measuring the residues in biologic material, and surveys should be made to determine the extent of their presence in the environment. If one of these industrial chemicals is found in food or feed, pharmacological studies at low levels would be essential to determine the potential hazard.

The industrial and scientific community should consider the development and adoption of a mechanism for pretesting new industrial chemicals prior to their introduction into the environment. Stable chemicals that may be used in significant tonnage should be scrutinized by an appropriate panel for their net "benefit" to society when the proposed new chemical is presented to the U.S. Patent Office. Such an evaluation at this point in time should fit into the framework of our economic system with a minimum of disruption.

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