MONSANTO'S PCB PROGRAM

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I appreciate the opportunity to share Monsanto's PCB experience with you and I hope the information I have can help this committee plan and achieve its objectives.

We at Monsanto first heard of PCB's as potential environmental contaminants in early 1967 when we received copies of a talk given in Sweden by Professors Widmark and Jensen of the University of Stockholm. In their paper they described how they were able to identify a material which had been interfering with pesticide analyses as being polychlorinated biphenyls.

Our laboratories began work on the development of analytical methodology to confirm that PCB's indeed were being found in the environment. During 1968 and 1969 as methodology improved the evidence continued to indicate that the higher chlorinated biphenyls were being identified in the tissues of fish and birds.

During this period Monsanto mounted an extensive program aimed at acquiring more knowledge about PCB's and their effect on the environment. We perfected our analytical methods, we started animal toxicity studies, began biodegradation work and evaluated alternative materials for those applications we felt were contributing substantially to contamination.

Our animal toxicity work was similar to the type we would have undertaken if we had wished to have FDA approval for food use. Chronic toxicity and reproduction studies were made on leghorn chickens. Two year chronic feeding studies were started on rats and dogs. Three generation reproduction studies were made on rats.

The PCB's used in the tests were Monsanto's Aroclor 1242, Aroclor 1254 and Aroclor 1260. These were selected since they represented the more commonly used PCB mixtures. The animals were fed concentrations of 1 ppm, 10 ppm and 100 ppm in their normal diets, The results to date indicate that at the levels used the rats and dogs showed no effects with Aroclor 1242. At 100 ppm both the rats and dogs exhibited decreased weight gains and enlarged livers. The chickens were affected by Aroclor 1242 at the 10 ppm level. The hatchability of the eggs was significantly reduced.

To summarize what I've said about Monsanto's sponsored animal toxicity work the highly chlorinated polychlorinated biphenyls at 100 ppm in the animal diet does have some effect on mammals. The lower chlorinated polychlorinated biphenyls at 10 ppm in the diet has some effect on leghorn chickens, and I say specifically leghorn chickens because there is mounting evidence that there are definite species variations as determined by the Pautuxet Laboratories here in Maryland with four types of wild birds. There is a species variation noted which frustrates many scientists

I was asked what we know about the effect on marine life. Monsanto did sponsor static fish toxicity work and we were completely frustrated because these PCB's have the tendency to plate out on surfaces. Our information was garbled because in the static testing we were really exposing the fish to PCB environments a lot less than we thought we were. The data was so distorted it was meaningless. In the meantime, we found that there are many competent laboratories looking at fish and the effects on fish that we decided that maybe this is an area that is best left to the experts.

We have been in touch with laboratories such as the Water Quality Laboratory of Duluth, Minnesota. They have conducted studies which indicate there is some effect on some species. There has been some work done in the Columbia, Missouri Bureau of Interior Fish-Pesticide Laboratory which indicates, for example, magnification about 50,000 times. By that I mean that the amount of PCB detected in the fish tissues was 50,000 times that present in the water environment in which this fish was exposed.

There have been reports of fish kills and some very drastic effects attributed to PCB's. I've tried to get evidence that these things have occurred. I have not been able to confirm any reported incident.

We have talked with scientists at the Gulf-Breeze, Florida Commercial Fisheries Laboratory. They have conducted studies

with crab and shrimp. This is the laboratory that did detect a build-up in crab and also the lethal effect on juvenile shrimp. Very, very low concentrations - 5 ppb in the water - do destroy juvenile shrimp.

There is a growing thought among many of the responsible scientists that this environmental problem is most complex and it is not really any one insult that is the demise of any particular species, but it could be the cumulative effect of all insults a creature is exposed to and usually the last insult is the one that gets blamed. Dr. Tom Duke of Gulf-Breeze is a proponent of this theory and he is conducting studies to substantiate this. It could be the lack or presence of oxygen, the lack or presence of proper nutrients in the environment, the lack or presence of the proper temperature conditions, the exposure to a DDT or a cadmium or a mercury or an arsenic, and along comes a PCB and the fish dies. PCB might get blamed. This is the kind of thing that does happen in the environment.

There is a growing concern that we should be considering to a greater degree chronic effects of all these materials rather than relying on the old acute studies that used to serve as a screening for many, many chemicals. I have sketchy data on marine life. We know that it does build up in the marine environment and there is, of course, the published evidence that it does affect the fish eating birds.

There is some indication in the Duluth studies that reproduction and survival of the frye is affected. There seems to be minimal affect on adult fish.

It was suggested earlier that I might want to review the manufacture of PCB's, the many applications in which it was used and what our present program is. To the best of my information, it was 1929 that these materials were introduced as very attractive fluids for use in transformers, and there are many in this audience that are more familiar with this development that I am. PCB's were used in transformers as an insulating cooling fluid because they are more resistant to breakdown, less apt to explode and burst into flames and cause property damage and human injury.

Through the years, additional uses were found for these materials because of these properties that I mentioned earlier. They gradually at first, and of course with increasing amounts, ended up in applications that Monsanto through its in-house usage referred to as plasticizer usages. That is not a very good description, but it fit our needs for many years, and you'll find us using that expression. These are uses such as in paint formulations, the specialty ink uses, the plasticizer in sealants, adhesives, and paper coatings of all sorts.

There was a use that was a real thorn in our side and you'll see at least some of the earlier articles on PCB's referring to pesticide use. There were some studies conducted by the Department of Agriculture in which PCB's were used to extend the effect of

life of pesticides such as lindane. It was never intended for broadcasting as we visualize DDT was on food crops, cotton crops, or orchards. The only widespread use that I could find was a limited trial to help prevent or curtail the dutch elm disease, and that proved to be a failure. The other uses were extremely small in private formulations that were used to spray or coat hard surfaces - shelving, corners of floors and all for the typical crawling type insects such as the roach and silverfish. In fact it was so small that Monsanto did not market directly to pesticide formulators; we gave this business to our distributors. On the other hand, this use did cause considerable emotion and was used by some to explain the presence of PCB's in remote areas. We wrote to the Department of Agriculture suggesting that during 1970 when pesticides were being re-registered that PCB's not be approved. Finally in October they did put out a notice to that effect.

We have had questions raised, "Is it in my shower curtains at home? Is it in the draperies? In the Carpeting?" The answers to those is "not very likely". And I use those words because we really don't know. If it was put into these applications, it was so small we, Monsanto, were not aware of it. It was not used in automobile tires; it was not used in brake linings.

Other major uses include the use in hydraulic fluids which are fire resistant. Monsanto marketed these fluids under its trademark Pydraul. I am sure some of you remember the Livonia,

Michigan fire? This was a disastrous fire in terms of property damage and was really a high mark in terms of convincing industry that there was a need for fire resistant hydraulic fluids. But the application is not the type that is maintained to a degree where everything is leakproof. Many of these connections leak, hoses burst, and the tendency is to keep producing by adding more fluid. So it is conceivable that many of these hydraulic fluids ended up in the sewer. I do not intend to criticize the customers of our products. From the knowledge that we had at that time of the material the practice was considered acceptable.

Another fairly widespread application of PCB's is the use of these fluids as a heat transfer media to achieve high temperatures, have a fire resistant transfer fluid, and avoid the installation of high pressure equipment. These materials were ideally suited for this application. We thought at one time that these were adaptable to close control and proper maintenance where we could logically call them closed systems. Some recent evidence indicated that we were wrong and I'll get into that when I discuss our present applications.

One application that was a fairly significant one and one that in our thinking is associated with coatings is the use in carbonless reproduction paper. With the emphasis on recycling paper wastes and with the persistance of PCB's there is a problem developing in that PCB's are being found in many paper products and many of these paper products end up in food packaging.

Initially the evidence we were getting seemed to point to the higher chlorinated materials as environmental pollutants. As soon as we were aware of this, we sent a letter to all of our customers telling them that what little we knew indicated that these materials could be an environmental problem, and care should be exercised in handling. When the results came in on our chicken toxicity studies they indicated that the lower chlorinated materials might be a problem regarding birds. We decided, as a company, that we better place some restrictions on these materials because there were to us some uses that deserved to be kept in spite of the problems that we saw facing us.

We decided that we've got to get out of those applications where we felt there was no earthly chance or it was beyond our ability to control the introduction into the environment, so we got out of all the so-called plasticizer applications. August 30, 1970 was the targeted effective date.

We then went into a very active program of reformulating the hydraulic fluids. There again, it required a lot of testing. We had to run these new materials through the Underwriters Laboratories for approval on fire resistance. They had to be compatible with the machinery then in use. This is not easily done, but it was done.

We decided that we could and must continue to supply the transformer manufacturer, the capacitor manufacturer, and at that

time closed heat transfer systems based primarily on our concept that fire resistance was important in heat transfer.

To pick up the point that was raised earlier about foreign imports, we are to the best of our ability trying to monitor imports. To this day, we have no information that any have arrived in this country. On the other hand, we are getting some reports that some of our former customers have made inquiries of the foreign producers. I am also told by some Canadian provincial agency people that they had heard and were going to further investigate that PCB's were entering Canada and from there moved into the United States. I have talked to representatives of the Japanese producer, the Kanegafuchi Company, and I am led to believe that they are most reluctant to enter this business. On the other hand, the Japanese producers are the producers that are being accused of entering the U.S. market. I have talked to representatives of the French companies. They assure me that they don't want any part of this business.

In May, 1970 Congressman William Fitz Ryan introduced a proposed bill which would in essence place into law the very things that Monsanto had proposed doing on a voluntary basis. The bill provided that PCB's be banned except for those situations where the Secretary of HEW would give special permission or license.

We went through the latter part of '70 and early part of this year feeling, however, that we were still walking on thin ice.

But we thought that we had made some tremendous strides in the right direction to preserve those uses which we thought were essential while eliminating those uses which were grossly contaminating the environment. This summer our hopes of control in the heat transfer business vanished when we found that a user of PCB did not appreciate the problem, did not maintain his equipment and created the recent chicken, egg, fishmeal problem.

Because of this incident, Congressman Ryan withdrew the first bill that was submitted and has now placed before the same committee a bill which totally bans PCB and does not provide for any use whatever. And there are, of course, penalties for the marketing, manufacture, or use of PCB in this country. A very drastic measure which does cause or can cause a lot of concern among those of us who feel that PCB has a place in our society under proper conditions.

As a result of this incident, we were forced to re-evaluate our position. We decided that, although heat transfer systems could be closed units, we are still at the mercy of the attitude of the operator of the equipment and we continuously faced the situation where even a pinhole leak can create tremendous problems before it can be discovered. So we have taken, again, an arbitrary position and informed all of our customers in the food (whether it's animal or human food), packaging business, and the pharmaceutical business, that we will no longer supply them heat transfer fluids which contain PCB's.

In addition, we will no longer market to any new heat transfer applications. Our efforts will be concentrated on reducing those that we market today. This business should decrease as time goes on.

To get back to legislation ... as many of you probably know, there is before Senator Phillip Hart's committee a bill referred to as the Toxic Substances Act of 1971. The purpose of this bill is to prevent the introduction into our society of hazardous materials. It also provides for the review of materials now in our society and the curtailment of the use of the more hazardous ones. Initial hearings were held in August, to which a select few individuals were invited to testify. PCB was brought out as an example of a material introduced into society and thought at one time to be most valuable, but is now considered a serious threat to all of us.

The meetings will be resumed in October; I do not know the exact date as yet, and I'm led to believe that this would be the opportunity for industry to speak up in its behalf. I am assuming that since PCB's were brought up as an example of the type of substance this bill is supposed to prevent that Monsanto as sole producer in this country will be either invited or we may choose to ask to be invited (we don't know at this point just what is the proper approach here) to speak on the merits of retaining PCB's in transformers, capacitors and fire resistant heat transfer systems, non-food applications.

I mention this bill because it is our opinion, and we could be wrong, that rather than act on Congressman Ryan's bill, which is specific toward PCB's, we suspect that the Toxic Substances Act will have in it provisions which will refer to such materials as PCB's.

We feel we have good technical data to justify our staying in the business for limited applications. But we cannot overlook the emotions that have set in. And believe me there are many and they are deep. It is difficult to combat emotions, as you know, and the references in the popular press to hazardous poisons and birth defects, which have not been substantiated, are most difficult to overcome. Although we talk about persistant versions of PCB and degradable versions of PCB I suspect, and this is a personal opinion, that there would be many who just discount this kind of information. This is a very real problem; in my opinion it is a difficult problem.

As a little more background let me describe what I understood from a meeting we held last week with representatives of the Food and Drug Administration. It is my personal opinion that the Food and Drug people are as conscientious as can be in trying to cope with the PCB problem. They are objective people trying to work with a minimum of data. I suspect they are as frustrated as any group of people can be as to what is the right way to go. There are tremendous pressures on the Food and Drug people today as well as the Department of Agriculture brought about by critics.

These agencies are trying to objectively cope with the problem and at the same time trying to somehow live with these pressures that are being applied.

The FDA people really don't at this point in time have much information that will lead them to a regulation as to how much PCB should be tolerated in food. They have established some guidelines based on what little information they have from their own laboratories and the information that Monsanto has shared with them. The FDA will permit fish at 5 ppm on the marketplace; milk at .2 ppm or less; eggs .5 ppm; pountry (they have a double standard) 5 ppm in the fatty tissue and 5 ppm in the muscle tissue.

Another problem that is disturbing to the FDA, is the recycle paper problem. The cereal boxes, the cracker boxes, all of these boxes that are made from what is known as chipboard, are made from recycle paper. Fairly high levels of PCB's are being found in this recycle board. It probably comes from about three or four different sources. It may come from some ink application in the past, some adhesive application, some coating application, as well as the carbonless reproduction paper application. There have been some pilot studies made by the American Paper Institute to isolate the carbonless reproduction paper from the recycle batch. They still found PCB's in that batch. They are probably looking at maybe the second or third generation of recycle. And with the emphasis on recycle, I cannot see any way out of this dilema except that there will be more and more PCB's in these cartons.

A thought we must all keep in mind, too, is that we've got to live with the PCB's we introduced into the environment for the past 40 years. They have not disappeared overnight; they will not disappear overnight. We do not have any tests that tell us how long it will take. We can only made an educated guess and we might say they will be out there for another generation, 25 to 30 years yet. Hopefully, it will be a decreasing amount as time goes on.

Monsanto has conducted biodegradation tests on its products. We have three programs that are now active. One program we are conducting in our laboratories in Ruabon, Wales in which we are making what I would refer to as scientifically basic studies in terms of which isomers are most degradable and with what type of microbe. This is a little bit on the impractical side at this point in time. We have as a consultant, Professor Charles Evans of Bangor University in South Wales, who is a noted authority worldwide in this kind of activity. He has isolated at least three microbes that seem to thrive on polychlorinated biphenyls. These microbes he developed from soil that he obtained from his garden. What this tells us is that there are microbes out there in the environment that will eventually destroy these materials.

In the St. Louis area, we have two types of tests going. One is the use of river water with its normal biota in it, in which we introduced ~~these~~ polychlorinated biphenyls and look for the disappearance rate. It is a very quick and rather unsophisticated type of study. The other type of test is the one that simulates

those conditions which are apt to be found in a normal municipal sewage treatment plant. It's an aerobic test using an activated sludge from a St. Louis waste treatment plant. As a standard, we use a soft detergent because it is well known to other laboratories. What we are doing, really is using our expertize that we established back in the days when the hard versus soft detergent controversy was quite common. And we are using these soft detergents that do degrade as our controls and comparing the PCB's to these controls. The studies so far show that there are isomers within each of these mixtures that do degrade. The lower the chlorine level, the faster they disappear, the higher the chlorine level the more resistant they are. Which only confirms what many of us had suspected. We were not too surprised by this data.

I will attempt to summarize ... I think we can conclude that PCB's are in the environment. There is no question about it. Many of these PCB's are manmade and were introduced to the environment because of our lack of understanding of what these materials can do to the environment. In this country Monsanto, as sole producer, has attempted to improve the situation by limiting the applications to which these materials are used. Studies today would indicate that these PCB's are not and cannot be classified as highly toxic. There is still a lot of information that is needed to help us determine the long term effect on human beings. We feel that the properties of these materials make them, at least as of today, the most suitable material for use in transformers, capacitors and heat transfer systems. We also believe that under proper conditions we can control the amount of these

that do enter the environment to the point where the adverse effects are not great and that the benefits we derive far outweigh the minor adverse effects that we might notice. Now there are many of us in the transformer and capacitor application that have made tremendous strides in controling these materials. I suspect our objective is to further improve our ability to control this material. In my personal opinion the emotion that is now prevailing regarding PCB's is something that we must contend with. Whether we believe in it or not, there are many people that sincerely believe PCB's should be totally banned.

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