ATTORNEY-CLIENT PRIVILEGE

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INTERVIEW WITH EIMER P. WHEELER

ON MAY 12, 1972

Smith - Were the first feeding tests conducted by Industrial Bio-Test Laboratories, Inc. at 1, 5, 10 and 100 ppm?

Wheeler - No; 1, 10 and 100.

Smith - And the result was "no effect at 1 ppm" and was an effect at 10 ppm?

Wheeler - Yes -- in chickens administered 1242.

Smith - And then you asked what effect 2, 4 and 8 ppm have.

Pogue - The effects of 10 ppm are only in specific areas.

Wheeler - I don't think there was any effect on weight gain or birth, or that sort of thing. But there was an effect on hatchability.

Smith - Then the run gave you some concern because apparently there was an unusual mortality in the control group so you said let's run it again.

Wheeler - Industrial Bio-Test said they would repeat the test at their expense. One reason being that Industrial Bio-Test has said that preliminary consideration of the data indicated there was no effect at 2 and 4 but there was at 8 ppm. They said this publicly. When you actually get to looking at the data and put it in form for publication, the support for no effect at 4 ppm was not certain.

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Smith - What was the effect at 10 ppm? While he is getting that, I would love for you to run past it again for me because I'm going to have to try to explain it to a judge at a pre-trial conference and argue it to a jury at some stage and write it in a brief. Can you give me this capsuled? Give me the history whether it is capsuled or not. The state of the knowledge of PCB's toxicity, and in particular any knowledge that Monsanto had ahead of the state of the art. Sort of start at the beginning again because...

Wheeler - The literature and our records indicate that some time in the mid 30's, 1935 or 1936, there was introduced a waxy compound for use in coating the fabric on copper wire -- for insulation, to make it weatherproof and longer lasting. The material was known as far as I know as Halowax. This was a mixture of chlorinated naphthalenes which I believe at that time were produced by Union Carbide. Several of the Aroclors produced by Monsanto -- the number I don't recall specifically -- but some of the Aroclors were in that product. I think there was some diphenyl oxide of Dow -- these three classes of compounds were the major ingredients...This made a waxy material somewhat similar to candle wax. It was used by putting the wax into a vat and heating the vat to the point where it was molten. The copper wire then having been wrapped with fabric, was by mechanical means pulled down through the wax where it picked up the coating of wax. When the wax cooled, you had a good piece of insulated wire.

Not long after use of the process had begun, men working around the open vats began to get sick. I don't know which symptoms first

occurred. I expect it might have been the skin condition called chloracne. The men had two opportunities of getting exposure. One was skin contact -- although because the stuff was hot I imagine that this would be pretty limited and the other was inhalation of the vapors coming off the heated vats. I believe this operation was being done principally in the Northeast -- in Connecticut, New York and Pennsylvania. The State Health and State Labor Departments very quickly got involved because symptoms proceeded then from the skin manifestations to a group of pretty sick people. I have read various estimates as to the number of people affected. In some cases it was claimed that six had died from this exposure. Others may indicate eleven. The number of people affected with even mild skin symptoms could have been as many as 100.

Smith - Anyway, these were all people who were engaged in the manufacture of this Halowax.

Wheeler - In the use of it.

Smith - In the use of it?

Wheeler - In the use of the Halowax for the coating of this wire. Not in manufacturing the Halowax.

Smith - In the manufacture of the wire. How about linemen in the field?

Wheeler - No history of any trouble.

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Smith - That's what I meant by the manufacture of the wire.

Wheeler - The manufacturers of the materials and components of the Halowax sponsored a project at the Harvard School of Public Health to try to determine -- using experimental animals -- what the toxic effects would be depending on the exposure, and to try to establish what would be the safe working level for people working with this process. Along with this, the means for controlling the exposure were developed. The obvious solution was to supply proper ventilation so that the vapors coming off the heated wax did not reach the breathing zone.

The whole practice of Occupational Health and Industrial Hygiene was stimulated about that time because under the Roosevelt programs money became available from the Social Security funds as grants to states around the country and particularly health departments to initiate occupational health programs. Programs for inspections of plants, control of exposures of all kinds were initiated. This particular incident happened to coincide with a mushrooming of interest in occupational health. A number of states issued bulletins from time to time about the toxic hazards of certain chemicals. At least New York, Pennsylvania, Connecticut and possibly Massachusetts, all highlighted the fact that the Halowax incident had occurred.

Smith - Did they refer to Aroclors as such?

Wheeler - I believe so. I'm not sure without looking at the literature references.

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Smith - Did they refer to...

Wheeler - The titles usually were something like "The Effects of Chlorinated Naphthalene or Chlorinated Biphenyls". In some cases they would omit the chlorinated biphenyls and they would refer only to the chlorinated naphthalenes.

Smith - When did the phrase "PCB" come into the language?

Wheeler - 1967-1968.

Smith - In other words any literature in the 30's and 40's or 50's and even early 60's would not contain that phrase but they might refer to chlorinated biphenyl?

Wheeler - Chlorinated biphenyl or chlorinated diphenyl.

Smith - But not polychlorinated biphenyl?

Wheeler - Not at that time.

Smith - Now prior to the Halowax experience in the mid 30's had there been any experiences published or generally known only within the industry of any industrial illnesses produced in the manufacture of Aroclor or chlorinated biphenyl?

Wheeler - Not to my knowledge.

Smith - In other words from the beginning of the manufacture until then everybody assumed that it was inert matter and no problem.

Wheeler - I don't know. I was just getting into the business as a 20-year-old kid so...by my training I would have suspected that Aroclors had some aspects of toxicity because few-if-any-chlorinated hydrocarbons are completely non-toxic. Among the professionals there would have been some concern. Consider carbon tetrachloride, it's deadly. Chloroform, chlorinated benzenes have known toxic characteristics. So among the professionals it would have been considered material that could have possible toxic effects at some level of exposure.

Smith - Was there any kind of caution statement on the product in the 30's put there by Monsanto, or do you know?

Wheeler - I don't know.

Smith - I noticed in this bibliography which has just come out from the Oakridge National Laboratory there is reference to PCB having a bibliography going back to 1881. What does that mean?

Wheeler - Somebody may have published the fact that they made it... a piece of research...someone may have even applied for a patent on it as a new compound, I don't know.

Smith - I got the impression the first time when I talked to you that 1929 was the beginning point in the manufacture of PCB's.

Wheeler - This is the figure that I have heard around the Company. Swann Chemical Company started making it in 1929 I believe. Monsanto purchased the company subsequently.

Smith - Now we're up to the 40's and State Industrial Commission's having bulletins published on the industrial hazards of the Halowax coating for wire.

Wheeler - I think the next publication was the Public Health Service bulletin in 1944, which again reported on some animal toxicity studies that they had done in the federal laboratories. I think this was a piece of work that was picked up by the government labs to extend the work that had been reported in the Harvard studies. The results of the Harvard studies were published in the technical journals '37 through '39, a series of five articles I think. In the September, 1937 issue of the Journal of Industrial Hygiene and Toxicology, Monsanto is mentioned because there was a meeting of the sponsors of the study (which included Monsanto) at Harvard. The reports of the findings were given to the sponsors and then there was a discussion period. The discussion period was reported also in the journal. Our Dr. Kelly who was a part-time physician for Monsanto at the time was there and is quoted as having said that Monsanto had been making these for a number of years and that he was aware that we had one experience of a series of skin eruptions in our plant. The incident was never related to the specific cause. There has been some comment made -- there are two types of comments that I have seen. I was told that we had obtained raw material -- benzene -- from someone other than our usual supplier, and that it was possible that this had impurities in it that our usual material didn't have -- perhaps this had been the cause of the incident. I

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have heard also that at that particular time we were trying to make a decachloro -- a very highly chlorinated biphenyl and that this had possibly led to impurities. It created some problems in handling and it was suggested that maybe this was the cause of the incident.

I came to Monsanto in 1947; Dr. Kelly rejoined the Company when he got out of the service in 1946 and there was never really a lot of concern about any problems with Aroclors because manufacturing and use experience was satisfactory. The exposures in our plant were limited and our records at that time did not indicate that our customers were having any problems. There was really no need to be concerned. On the other hand, starting in 1949, the Company began to press for some of the plasticizer uses which then introduced these materials to people who had not been accustomed to using them. I think up to that time practically all of the material had been for the electrical industry.

Smith - You say in 1949 Monsanto began to promote the sale of Aroclors outside the electrical industry?

Wheeler - This is my recollection. There had been some use before then I know. Maybe in heat transfer applications. I think the functional fluids use came along then. I think our records indicated then, don't they Don, that about that time somebody started using Aroclor 1248 as a heat transfer medium without that use being stimulated by Monsanto.

Pogue - That probably is about the time the first articles came out and Paul Benignus co-authored the first article, I believe.

Smith - When was...you mentioned functional fluids...plasticizers that's a different use...is that also about 1949? I just want to be sure that I got what you said.

Wheeler - That's my recollection. There is a memo around that Paul Benignus wrote about that time about the potential market for Aroclors in the many, many applications that then developed.

Smith - But actually Monsanto didn't start promoting its own direct sales for heat transfer fluids, did it? Certainly not under the name, Therminol, for another ten years.

Pogue - I don't know.

Smith - Still in the area of health hazards, did you have any warning?

Wheeler - Well, it was sometime in the '49, '50, '51 period that we began to get increasing inquiries about toxicity of these materials and the safe handling requirements and since we did not have good experimental data to establish a threshold limit value -- are you familiar with that term? Threshold limit value being that concentration that you can have in the working environment 8 hrs. a day, 40 hrs. a week for a working lifetime without causing injury to employes.

Smith - That is a pretty good technical term. Give me that one more time. TLV - Threshold limit value - that means?

Wheeler - That's the concentration of a material that you can have in the breathing environment of a workroom 8 hrs. a day, 40 hrs. a week for a working lifetime, without causing injury.

Smith - What's a working lifetime?

Wheeler - 40 years.

Smith - Without any injury?

Wheeler - Yes.

Smith - And if you have more than that, then it's too high, if you have less than that, then the workmen are safe. Is there a margin of safety in that?

Wheeler - Yes, it varies depending upon what the compound is. At that time the TLV's were called Maximum Allowable Concentrations (MAC). There are two professional societies in the field of industrial hygiene - one is the American Industrial Hygiene Association which has about 1500 members now, and requires that their members have specific background in the field -- some kind of technical degree... it is made up of people in industry, universities, government agencies, etc. There is an independent group called the American Conference of Governmental Industrial Hygienists and this does not permit members from industry.

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Smith - But does it have it from universities?

Wheeler - Yes, this is ACGIH and it is that group that established a committee -- I don't know when this happened -- it probably was... I expect it was post-war -- anyway, that group took unto itself the responsibility for publishing maximum allowable concentration lists. They established an MAC committee which does have representation from government agencies and universities, to try to give some official status to the MAC list. I think this really developed because the only list prior to that time had been published by a couple of oldtimers in the field, representatives of state agencies or insurance companies. It was a question of assembling from the literature numbers that appeared to be good numbers based on the animal and human toxicity data then available. The Aroclors were not on that list. When we began to get an increase in customers' inquiries, I started pressing for getting animal inhalation data, to allow that committee to establish numbers that were appropriate for specific Aroclors.

Smith - What was the significance of Aroclor not being on that list? Was that because they were thought to be non-hazardous or that they were so hazardous that there was no limit?

Wheeler - The reason that they were not on the list was that these were a series or "mixtures" of compounds. For good reasons, the limits set should be more specific, e.g. for Aroclor 1242, 1248, 1254 and so on. Secondly there was not sufficient data in the literature to support a number for these specific products. The original

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work done in 1937 by Harvard did suggest that a maximum allowable concentration of 0.5 milligrams per cubic meter was appropriate. I have forgotten which specific Aroclor that was, but it certainly wasn't 1242.

Smith - How would .5 milligrams per cubic meter compare with the parts per million limit? Is that convertible?

Wheeler - Yes, I can get it but I don't have it on the tip of my tongue. But it frightens you to mention it on the basis of parts per million because it is something like .02 ppm. The reason is the milligram per cubic meter historically has been used for materials that would be in the air normally in a non-gaseous form. Lead fume for example; mercury, although when in the air that is a vapor, but it is a heavy metal. Probably a better way to explain it would be large molecular weight compounds, and this would include PCB's, are commonly expressed in terms of a weight per volume basis where historically the lighter compounds would be expressed on a parts per million basis which is a volume per volume relationship. Depending on molecular weight, the ppm equivalent of a milligram per cubic meter, could vary from 1 to several thousand. On the one hand, for a light gas, 5 ppm might equate to 5 milligrams per cubic meter; on the other you get something like the Aroclors - I think in the case of 1242, 1 milligram per cubic meter is equivalent to something like .02 ppm.

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Smith - Well you said .5 milligrams per cubic meter.

Wheeler - That was one of the early MAC's suggested by the Harvard studies, yes. And it was suggested after we had done the inhalation work on 1254. There is a difference in the toxicity of the two i.e. Aroclor 1242 and 1254. Anyway, we finally got permission to underwrite the inhalation toxicity work at the University of Cincinnati, Lettering Laboratories. When that work was published, the people that did the work suggested the threshold limit value of 1242 of 2 milligrams per cubic meter, and one milligram per cubic meter for 1254. The ACGIH looked at the paper and did not feel that this provided enough of a safety factor. So they cut the values in half.

Smith - Did the ACGIH then publish this?

Wheeler - Yes, they had progressed to the point where they annually published a list of MAC's. The Committee -- there are about 12 people on the Committee generally, gets together once or twice a year and they look at the list published previously; they examine any data that has been published in the interim to see if the numbers on the lists should be modified, raised or lowered or left alone. There is a good reason for doing this. I think it makes a lot of sense from a technical standpoint to keep it up to date. Historically, it is very rare that a TLV or MAC has been raised. Each year for about the last ten years, they publish an addition to the official list, an addendum which indicates those compounds that they are considering either changing or adding to the present list at their next annual meeting.

Moore - Well, now has this 1242 MAC limit of 1 milligram per cubic meter been changed?

Wheeler - No.

Smith - And that was really a cut from the Cincinnati recommendation of 2. Have they put PCB's on the list for changing or...

Wheeler - Not to my knowledge. They have been criticized a lot particularly by industries and universities over the years for some of these numbers and particularly when they tended to lower a number. They were finally forced to publish what is called the Documentation of the Threshold Limit Values and this is a brief summary with references to the literature as to why they think in the case of 1242 the number should be the 1 milligram per cubic meter.

Smith - When did they publish this documentation?

Wheeler - I don't know when the first time was. Again this changes frequently, I don't know when the first time was; we have the current edition downstairs.

Smith - But it was several years after '57?

Wheeler - I can't say that.

Smith - Well, you said they <u>finally</u> were...

Wheeler - Well yes, but you see they have been publishing these MAC lists since the mid '40's I think.

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Smith - Oh, I see. But they didn't have Aroclor in them until after 1956, and so they could have published the documentation for other items even before 1957. And the documentation for the 1242 would have to be the Cincinnati studies, there was no other documentation...

Wheeler - They did make reference to the 1937 work and also to the 1944 work. But the numbers were based really on the Cincinnati work because they only published them for the two Aroclors 1242 and 1254.

Smith - Did the Cincinnati studies include a safety factor?

Wheeler - Yes. When you are considering the health of people it is a question of what safety factor would be appropriate. It's like the FDA. If you want to put something into food, if you do two-year animal studies as a general rule of thumb, the FDA will allow a 100 to 1 safety factor.

Smith - This idea of doubling it to be on the safe side reminds me of the story of the contest where they gave you the first prize of one week's paid vacation in Philadelphia and the second prize was two week's paid vacation.

Wheeler - Well, in the 50's with the expanded use of Aroclors our correspondence with customers grew and this continued through the 60's.

Smith - _____ food application. So you have these values established around 1957, and publications since

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then. In the meantime have there been any industrial accidents or other studies?

Wheeler - No other studies that I'm aware of, no significant accidents; I think the only ones we could find Don indicated in his summary.

Smith - So from 1956 when the Cincinnati studies were done, when was the next time any kind of toxicity studies were made? On Aroclor or PCB?

Wheeler - I think it was 1961 when we got the report from the University of Missouri that they thought they had isolated Aroclor 1242 as a component in paint on chicken coops which had caused some problems in chickens.

Smith - You say you got the reports. Did you ask them for them?

Wheeler - I think originally there was some correspondence addressed to one of our scientists in our Agricultural Chemicals Division.

Smith - Was anything done as a result of the Missouri studies in 1961?

Wheeler - If there was, I can't find any reference to it. I think in all honesty we didn't take it too seriously.

Smith - Did it effect any of your toxicity statements that were furnished to your salesmen and customers?

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Wheeler - No. Now historically we were trying to get Aroclor 5460 approved as an indirect food additive. Polychlorinated terphenyl. And the anticipated use was for adhesives in food packaging.

Moore - If you wanted to get it approved, who do you sent it to?

Wheeler - The U.S. Food & Drug Administration. We talked to the FDA first as to what they would require in the way of toxicity data and they agreed that only 90 days work would be sufficient. The FDA representative I believe was Arnold Lehman at that time, since retired -- possibly Garth Fitzhugh who just retired a few months ago. We have plenty of correspondence on this.

Smith - What time are you talking about now?

Wheeler - Mid 60's maybe. They did suggest that we do some work with chickens. And that work was done. The work did indicate that at high levels 5460 could have some effect on chicken reproduction, including hatchability. As has been the custom, you go down to the FDA and present the data, have them look at it and ask for their suggestions as to what you incorporate in the petition you then submit to get approval. They suggested that some of the data relating to the chicken work not be submitted to them. I don't have any basis for it, but I suspect that the reason was that this was an effect at very high doses, unrealistic doses in terms of the food adhesive application and their reaction was probably, "well, don't let's confuse the issue." But I can't validate that.

Smith - Did you go ahead and prepare a petition?

Wheeler - We filed a petition including all of the data that was requested. At that time we had a letter from the FDA indicating that they had done some recent work with chickens and the Aroclors -- including 1242. It showed some positive effects. I think in relation to the chickedema factor -- when petitions get to the FDA they are reviewed by several different branches and apparently the petition reached the people interested in the chicken work. They then reported by letter the effect they found with 1242. They then asked how much PCB is in the 5460. I think we had specified in the petition that there wouldn't be more than 1% or some such thing. We had not actually tested the amount of PCB in the 5460 that had been tested in the animals. We then found some difficulties in the methodology. There was some internal discussion about the economics of removing the PCB from the 5460 and we eventually withdrew the petition...

Smith - Was this called Aroclor 5460?

Wheeler - Yes.

Smith - Then if you removed the PCB's it wouldn't be an Aroclor, would it?

Wheeler - Oh yes. We have two kinds of Aroclors. We've got the 1200 series which are the PCB's and we've got the 5400 series which are the polychlorinated terphenyls.

Smith - Terphenyls are not three times as bad as biphenyls though.

Wheeler - No, they're less toxic.

Smith - How about explaining that to me. Just right off the bat it sounds like you're going into something with more phenyls in it.

Wheeler - (at blackboard) When you compare biphenyls with terphenyls you're increasing the size of the molecule which probably has a drastic effect on the absorption of the material from the intestinal tract.

Smith - I know that sounds like a stupid question, but that was the argument of another lawyer just as stupid as I am...and I'd like to know how to answer it.

Elmer - (At blackboard)

Smith - These would be PCT's as opposed to PCB's. Was there ever _____ biphenol or biphenyl use?

Wheeler - Yes.

Smith - Is there a difference in biphenyl and diphenyl?

Wheeler - No. I don't know whether this comes under the International Union of Pure and Applied Chemistry but I believe it is this international group that dictates the preferred nomenclature for chemicals. "Di" is abbreviation for "two". In the U.S., the "biphenyl" is customarily used, whereas in Europe the "diphenyl"

terminology would be more usual. I don't know who instigated the "PCB" abbreviation rather than "PCD".

Smith - Thank you for clearing it up. But I take it then the whole idea then of using PCT's as agents in food packaging was a bad one?

Wheeler - Yes. Not so much because we didn't feel we could answer the question of PCB in PCT but the business group wasn't really ready to agree as to what limit of PCB should be prescribed and in the meantime, the PCB environmental issue mushroomed.

Smith - What time was that?

Wheeler - '69 or '70.

Smith - Now you taught me something this morning that I should not refer to Aroclor as a synonym for PCB.

Wheeler - No.

Smith - And how would you define an Aroclor? I know that it is a trade name...

Wheeler - PCT's are being used to designate the materials with the tradenames for Aroclor 5400 series, the 54 indicating it is a terphenyl. There is the 1200 series indicating that it is a biphenyl but they were all called Aroclor. An Aroclor may be polychlorinated biphenyls (PCB) or polychlorinated terphenyls (PCT) -- two generic names within the tradename Aroclor.

Smith - Does that now include all of the Aroclors? Or either terphenyl or biphenyl?

Wheeler - At one time we were making a 2500 series and two of the 4400 series which were mixes of PCB's and PCT's. As you know any Aroclor is a mixture of isomers -- a biphenyl or terphenyl chlorinated to a specific percentage of chlorine. Aroclor 1242 has some of the isomers more common to 1232 or 1254. 1242 is actually a mixture with a preponderance of 4 chlorines, but some 5 chlorines, 1 chlorine, etc. and 5 or 6% biphenyl without any chlorines.

RAS - That is what they call a homolog?

Wheeler - Aroclor 1016 resulted from an effort to remove the higher chlorinated components of 1242. It is a PCB, but a variation of 1242.

Pogue - Here is the illustration where I have seen it best explained. For example, in the case of 1242 it is basically like your bell curve where the largest concentration in 1242 would be the 4 chlorines in a molecule. What Elmer was driving at in the case of 1016 was that everything higher on this bell curve would be 5 chlorines and above and these higher chlorinated fractions are removed during the manufacturing process.

Smith - It is a very complex manufacturing process. Extremely complex procedure.

Wheeler - The real reason for doing it was not so much a possible change in toxicity but the fact that the lower chlorinated ones

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show a greater degree of biodegradation whereas the high ones are more persistent.

Smith - When you bought the plant from Swann Chemical in 1930 _____ was the environment you _____ at that time _____? Or is this very recent in technology?

Wheeler - Well, this thing here we haven't even started working on. This is an interesting group of compounds and Carbide the same thing -- the same chemistry in that polychlorinated naphthalene _____ benzene_____you end up with a fewer number of carbons and these things link _____.

Smith - All right. Is this such a difficult thing that no one would go into competition with you? Is naphthalene so different from biphenyl?

Wheeler - You start with a different raw material.

SEVERAL PEOPLE TALKING -- MUDDLED CONVERSATION

Wheeler - Unlike carbon tetrachloride, we have always had this mixture of many isomers rather than specific chemical identification. It is quite possible that over the years we have had differences in the relationship or the numbers of 5, 6, 4 and 3 chlorines and these could have varied within certain limits.

Smith - In your advertising you say Therminol is a very high quality Aroclor or something like that. If you made no changes and you

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don't know how to tell which is which how can you say we are getting the high cut?

Pogue - First of all you asked a question earlier and didn't get an answer about what is the definition of Aroclor. The standard is chlorinated polyphenyl. In the case of Therminol you don't have nearly as much flexibility in the transfer fluid application in the use and production of the product as you would for example with plasticizers. If you don't watch production controls, you could have low boiling fractions in 1242 which would mean that at less than 600 degrees much of the product in use would distill off in the heat transfer system. We assured uniform product in the Therminol FR series fluids.

Smith - Did you know how to do that? Was this just a sales pitch or was it to get rid of the _____?

Pogue - Through good product specifications we insured that it was of uniform quality. There were separate sets of product specifications for Therminol and the corresponding Aroclor product.

Smith - Now I am glad to know that because I had the impression that Aroclor 1242 was made in bulk and you just put different labels on it depending where it was going. Therminol 1 is the same as Aroclor 1242. And now you are telling me that there are controls within that will distinguish between Therminol 1 and Aroclor going through the electrical manufacturing.

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Pogue - Yes.

Smith - What is the _____ quality of 1242 for electrical uses; in Therminol? In other uses?

Pogue - Dielectrics require tighter Aroclor specifications and include tight moisture and electrical properties controls. Therminol FR grade Aroclor and plasticizer grade Aroclor are less concerned with moisture and electrical properties.

Smith - We used the term _____ meaning low quality _____ the plasticizer_____.

Wheeler - What grades do we use in the Montars?

Smith - What are you talking about now?

Pogue - Montars are the least commonly known Aroclor type products manufactured by Monsanto. These were undistilled chlorinated polyphenyls off the bottom of the Aroclor still.

Moore - What applications was that used in, do you know?

Pogue - I'm not too familiar with those, those were plasticizer oriented applications.

Smith - All right, now we're up to I gather somewhere about the mid 60's, the last thing you mentioned was the effort to get the FDA approval to use 5460, the terphenyl for food packaging and you gave up on that.

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Wheeler - Backing up just a moment, during the '59, '60, '61 period a couple of the Aroclors were on the FDA list for food adhesives.

Smith - Which were they?

Wheeler - 1242, I believe, for adhesives for food packaging.

Smith - Don, why would it be good as an adhesive. Because it would preserve the adhesive characterisitcs for a long period of time?

Don - The product was unique in that it was compatible with a lot of different chemicals in adhesive formulations and it provided tackiness, adhesion, excellent chemical and moisture resistance.

Smith - You mean you could bend it without it breaking?

Pogue - Yes. Aroclors had characteristics that were extremely valuable, for that type application.

Wheeler - Wouldn't an example be the backing on a paperback book? You pick up a cheap paperback and the minute you open it up the adhesive back cracks. Now if you took that adhesive and put some Aroclor in it you would get an adhesive backing that wouldn't be likely to crack. Is that right?

Pogue - That is a good application. Also cardboard box adhesives.

Smith - I think anything we can get that will document the FDA, USDA or any state or federal agency approval of 1242 or any other Aroclor whatsoever that was like Therminol FR-1 will help us.

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Wheeler - Well, you then come back to the point, why was it taken off the approval list? The fact is that when the 1958 Food & Drug Amendment became effective, the FDA was authorized to regulate the various materials that could contact food either directly or indirectly. There were a number of trade associations that submitted to the FDA long, long lists of materials that they knew were being used and the Aroclor showed up on the approved list because it had been submitted by the adhesives manufacturing association as a component of adhesives for food wraps. It then took a period of several years for the FDA to look at each of these several hundred materials, and agree that it was appropriate that they all remain on the list. Monsanto made no effort to provide "safety" data -- which would be animal toxicity and migration data, to allow the continued listing of the Aroclor as a component of adhesives for food wrapping. I think this was for two reasons; one being one that you will probably not like and that is that we didn't think that it was necessarily good to have Aroclors around food.

Smith - Who is we?

Wheeler - The Medical Department.

Smith - You and Dr. Kelly?

Wheeler - Yes.

Smith - Why did you not think it was good to have Aroclors around food?

Wheeler - Well, these things are not as innocuous as a lot of other materials.

Smith - Did you keep these thoughts to yourself or did you share them with others?

Wheeler - We shared them certainly within the Company, and I think in explanation to any customers of the adhesives manufacturers as to why we didn't push for the continued listing of Aroclors, I don't know if we ever expressed the fact that we didn't think it was a good application. But I am sure that we said we didn't have data to support its safety. Two, we had no intention of spending the money to get the data.

Smith - You really didn't know the dangers and therefore didn't want to be in the position of pushing it without data.

Wheeler - You get intuitive feelings about what's the smart way to proceed on these things.

Smith - Well now, did you express these feelings, albeit intuitive to anyone else in the management of the Company as to the use of Therminol in the cooking of food?

Wheeler - Do I have to answer that?

Smith - Well, maybe the way to approach it, is was Therminol promoted for cooking before 1965? Cooking foods. How did Monsanto get into the heat transfer fluid business? And did it start with foods or come back to foods later? Foods are obviously featured in your films that we saw yesterday. When did that emphasis begin?

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Pogue - The only person who is going to be able to answer the question, "How did we get into that specific application, and why it spread so rapidly", is probably Paul Benignus, Since Paul is the only one in the Company from that era who knows how it got started.

Smith - Elmer, you were here that whole period of time before heat transfer fluids were promoted and before heat transfer fluids for food processing applications were promoted, go ahead and tell me if you can, whether this appeared to be a danger or whether you relied on the good practice of safety or the stuff not escaping...

Wheeler - Well, our records indicate that we eventually became aware of these things getting into food applications from a telephone call from an outfit in New Jersey that was heating fat for frying doughnuts. I think I got the call asking about the dangers of doughnuts becoming contaminated with Therminol in terms of toxic effects. I believe I replied that it was unlikely because of the off-taste that anyone who ate enough doughnuts with Therminol in it to have any toxic effect. But more importantly, no one should be selling doughnuts with Therminol in them because they would be subject to seizure because of adulteration. I suspect we have said the same thing to Campbell Soup although I'm not sure. I know we have subsequently to people like Kellogg who was building a plant in Japan, and asked us about using Therminol. We were also on record with the business group as saying, "if it is going to be used

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in food, is there not some way that a leak can be detected? -- other than relying on the off-taste?" I discussed -- with I don't recall whom -- the fact that wouldn't there be some engineering means of having a sight glass that would be sensitive enough to detect even a minute leak of this stuff into a food product. They even looked at the possibility of adding weak radioactive material to the Therminol where they could detect very sensitively the loss of any fluid. We took a dim view of that. You know, "let's not get to the point where we are adding radioactivity to food." I believe there was a memo from Bob Keller relative to efforts to monitor any leaks in a heat transfer system.

Smith - Keller?

Wheeler - Bob Keller - Scott Tucker's boss.

Smith - Give me some time reference for this now. Because I've got the impression that you are up to 1966 or 1967. The '58 Food and Drug Amendment required listings of various products that were approved. The product they included was Aroclor 1242 for food adhesives for food packaging and it was approved. Then they were dropped from the list, when?

Wheeler - We will try to check it, about '61 or '62.

Pogue - September 12, 1961.

Smith - So they would draw from a sort of grandfather list and Elmer was saying that Monsanto made no effort to help the product manufacturers keep the product with Aroclor 1242 on the list

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because they had no data to support the safety and were not going to spend the money to get the data and he had an intuitive feeling that it was not a good idea to have Aroclor 1242 around food.

Wheeler - Well, I think that's putting it a little bit stronger; I did not think that this application when there was intimate contact with food or pretty intimate contact with food was smart.

Smith - Now, was Aroclor 1242 or any other PCB additive of food packaging withdrawn from food packaging? After September 1961?

Pogue - As a result of Aroclor not appearing on the next list? Do you mean did they actually cancel sales?

Smith - Yes.

Pogue - I don't think so at that time.

Wheeler - I don't know either, I would say that sales were cancelled in that customers could no longer use them and stopped using them. But I can't swear to that.

Smith - Was there ever any time from '61 to now where it was used in any kind of packaging for food?

Wheeler - Not that I know.

Smith - In other words it was off the list and there was no effort to get it back on the list. Then I shifted the question to if it was the feeling that Aroclor should not be intimately connected

with food, when did Monsanto push the use of PCB's for cooking food? We are a little vague about the sequence, but certainly by the sound track of that film we saw 2 days ago, cooking was one of the main uses. And that was being shown in 1966 and perhaps at the meeting in September 1970.

Pogue - Here is an area where perhaps Stan Shaw has as good a knowledge as anyone about the period of time you are talking about, the period of time Joe Lowe Corp., a major manufacturer of doughnut frying equipment first said that Therminol was the fluid that they preferred for their equipment, and also about that time the Frito-Lay installation kick started because there were a series of plants built and these were before I went out in the field so it had to be prior to 1965 or 1966.

Wheeler - Who did the potato frying, frozen potato things.

Pogue - I think that was a little later, about '67 or so -- this was the Mrs. Paul's Kitchen type thing, when the instant frozen food application started to kick in.

Smith - Elmer, did you ever recommend, or did Dr. Kelly ever recommend, that Therminol not be sold to food processes? When did you first do that?

Wheeler - I'm not sure, it was probably early '70 because I think I made reference to the Japanese experience.

Smith - And it was that recommendation that led to the policy

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decision that is represented by the Fallon letter of May 25, 1970. That and maybe other things. But it wasn't any earlier than the first part of 1970?

Wheeler - I don't think so, it could have been 1969, but I don't think so.

Smith - O.K. now we're up to the mid 60's as to toxicity data on PCB's. You want to go and bring me right up to date now?

Wheeler - Well, we first heart of the Swedish identification of the PCB's. I think one of our people got a letter from Professor Widmark December '66 or January '67. In the next two or three months there was an exchange of correspondence about the identification. Somewhere mistranslation got involved and we understood they were talking about biphenols, which means that somewhere here in the ring structure (at the blackboard) there is an OH which would mean a completely different compound.

Smith - So a man who was working in a phenol plant like Jenkins would not be a person who is experienced in working in a phenyl plant.

Wheeler - I don't see how he could be.

Smith - What I'm getting at is if he had a respect for the toxic effects of the product he was working with when he was a foreman in a phenol plant. Would this make him worried about the toxicity of PCB?

Wheeler - No. Because straight phenol is a poison.

Smith - Unless he was, they were the same thing.

Wheeler - Phenol is a poison. A corrosive poison. And if you start putting chlorines on here, you still have a pretty toxic material. Now, this is benzene, a liquid in gasoline. It is largely used as a solvent and one of the largest building blocks in chemistry. It is a fairly volatile liquid. In the old days, people used this as a solvent in shoe cements, inhaled the vapors and were poisoned. Most of the chlorinated phenols are not classified as "poison" but are highly toxic materials. You put two of these (benzene rings) together to make biphenyl, and you've got a completely different animal. Relatively -- from the hazard standpoint, I wouldn't call it more than mildly toxic. In fact it is approved for use in food wraps for citrus fruits as a fungistaph. Parenthetically, it has a TLV of 1 milligram per cubic meter and to further confuse you, the TLV for phenol is 19 milligrams per cubic meter.

Smith - When you say this is approved, what do you mean?

Wheeler - Biphenyl. Biphenyl is approved by the U. S. Government and even the World Health Organization. It is incorporated in a waxy material that is used in one of two ways. One is to take the tissue that is used in wrapping oranges, lemons, etc. and incorporate it in that tissue. It helped preserve the fruit -- extending the shelf life of citrus being shipped all over the world.

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Smith - Now that is the biphenyl - not chlorinated.

Wheeler - Yes.

Smith - Is it the chlorination that makes it dangerous?

Wheeler - "Danger" being a relative term. Because you can chlorinate that and from our standpoint as an industrial chemical it is still not highly toxic. You can inhale enough gasoline vapors and it will kill you or make you drunk.

Smith - It is fair to say that up until January of 1967 your concern with toxicity had been only as to industrial accidents and industrial exposure? And the adhesive for packing for foods? Where Aroclor 1242 was a component.

Wheeler - In the heat transfer system application, as far as we in the Medical Department were concerned, the system had to be so engineered such that adulteration of the food would not occur.

Smith - So you had had some concern about the heat transfer system in cooking but you were insisting that it be a closed and isolated system so it wouldn't get into the product.

Wheeler - Yes.

Smith - Then with January of 1967, you took a different view because of the possibility that unclaimed PCB's might be or lost PCB's might be damaging environment channels.

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Wheeler - No, not quite that soon.

Smith - The Swedish studies suggested that.

Wheeler - Suggested it as a possibility.

Smith - Yes, I didn't mean that you immediately _____ but that was the beginning of a new concern.

Wheeler - Yes. It was the concern originally for chlorinated biphenol, though.

Smith - Did you have any concern at that time though of the polychlorinated biphenyl?

Wheeler - I would say that we were told that the material that the Swedes had identified was specifically polychlorinated biphenyl in probably March or April 1967.

Smith - But until March or April 1967 you didn't know whether it was phenol or phenyl?

Wheeler - There was that question, yes.

Pogue - Elmer, wasn't there at that time based on correspondence, among people within Monsanto and so on, the definite concern about whether or not the tests they had done had actually identified the compounds they said they had?

Wheeler - We couldn't believe that they had actually identified chlorinated biphenyls in the birds' eggs and the fish and the stuff the Swedes reported.

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Smith - Because of the difficulty in identification. Elmer, before I leave this, because I think this is a watershed we are talking about. You had been concerned about the use of heat transfer fluid in cooking. But you had not expressed the view that the danger was so great that it should not be used in connection with cooking of foods only that the system should be protected against leakage because leakage would cause adulteration of the food and make the product unsaleable. But there was no evidence to support your view that human beings might be poisoned. Is that correct?

Wheeler - Yes. Part of that was based on a very unsophisticated test that we ran. This was before we moved out here so it had to be in '55 or '56, it couldn't have been later than November '57 because that is when we moved out here. We had an inquiry from some customer, I think in Tennessee. Anyway, the question was: "Could PCB be used in some part of packaging for 'bake and serve' biscuits and rolls?" My memory is a little foggy but I think we actually had them ship us a package in which the PCB had been used. I'm not sure now whether this was in an adhesive, proposed to be used in film wrapping for bake and serve rolls, or whether it was a component of the aluminum foil, but I think by odor we could detect the PCB. We then took a flask of tap water and added enough Aroclor 1242 to give us one part per million in the beaker. We shook the beaker and let it sit over night. We tasted some of the water the next day. There were still visible little bubbles or droplets in the water at the bottom of the flask which indicated that the concentration in the water itself was something under one part per

million. Then we drank the water, by either smell or taste we could detect something foreign in the water. This indicated to us that the threshold taste level in water was under one part per million. We referred to this in correspondence with people a number of times, as a rough idea of what the identification would be to people who might get a food product with PCB in it. I referred to it when this doughnut inquiry came in a number of years back and we learned that they were doing something a little more sophisticated to try to get a better feel for what taste and odor threshold would be in a food product. I think I subsequently got a call from the man in New Jersey who said that they had doughnuts with up to 28 ppm before they could detect an off taste. I could see how that could happen because it's one thing to taste it in water and another to taste it in a highly flavored doughnut.

Smith - Why didn't you add an odorizer to the Therminol so that you would have an even greater assurance that there would be a terrible taste?

Wheeler - I don't know if that was considered in the previous consideration that I mentioned when they talked about putting radioactive traces in it or not.

Pogue - The problem in that case would be finding something that would work, that would be stable in each transfer system and not effect the performance of the fluid. It is difficult to find something more stable than Aroclor.

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Smith - All right, we're now up to '67.

Wheeler - Initially, we ignored the significance of the Swedish work. We just couldn't believe that based on the uses of the Aroclor, based on the stability of it and based on the lack of solubility, that these things could conceivably begin to show up in the environment as did the chlorinated pesticides, DDT, aldrin, endrin and so on, which in their use are broadcast all over broad areas. Almost a year following April 1967 the British published information that tended to confirm the Swedish work -- again, however, without being so specific in their analytical techniques that true identification was without question. I guess it was late February 1969 that the you-know-what hit the fan when Professor Risebrough out at Berkeley published his paper indicating thathe had found PCB's in birds and fish on the California coast.

RAS - 1969. Widmark was not published until late 1968 and Risebrough was not published until late '69. Risebrough did his work in 1968 if I recall.

Wheeler - Let me back up for a minute. The Risebrough work was published in December of 1968 and I can pin that down. In '68 I've forgotten what triggered it, but it may have been the British work, we have a memo that Emmett wrote (I think it was about May) to Constance saying that we ought to get together to sit down and talk about the ramifications of the apparent PCB presence in the environment.

Pogue - Constance Anagnostopoulus?

Wheeler - Yes. I think he was the one because he preceded Bergen as the functional fluids product group manager. This is May of '68.

RAS - Backing up for a moment. Widmark's study wasn't published until late 1967.

Wheeler - No, 1969. What happened was Widmark had a publication in the Journal of Official Chemical Analysis or Analytical Chemistry but this was only a summary, 6 or 8 paragraphs long. I believe that was in late '67. This is not a Journal that we see regularly. I don't know when...I don't think we were aware of the actual publication until sometime 1968.

RAS - What was the cause of the delay?

Wheeler - When we visited Widmark in 1969, Widmark's subordinate, Jensen, had left the Karolinska Institute of Analytical Chemistry. He had left apparently because there had been a big disagreement between Widmark and Jensen. Jensen wanted to rush into print with what they thought they'd found. Widmark did not feel, being a more honest scientist, that they had sufficient data to justify Jensen's conclusions. Widmark felt that the results from 200 samples were not sufficient to lead to Jensen's conclusion. Widmark thought perhaps 10,000 samples would be necessary. Widmark was in an editorial position such that he was able to keep the original Jensen paper from being published. When it was published in 1969,

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I think, it was without Widmark's name on it. This was after Jensen left Widmark and he was able to circumvent Widmark and published under the name of Jensen and some other co-authors, but not Widmark.

Pogue - Is this what you are referring to? My notes here show Widmark published the IUPHC Commission methods of pesticide analysis. This argicle began "FDA methods development program separates PCB's from formulated pesticides".

Wheeler - Yes.

Pogue - The date I have here is 1967. And this was extracted from an FDA chronology that was set up.

Smith - Tell me what was happening in Monsanto now.

Wheeler - Subsequent to the discussion with the product director, it was decided that number 1, we should embark on a program to convince ourselves that the analytical technique was positive for the identification of PCB's. I don't know when Scott Tucker got his assignment to proceed with that, but I suspect that it was June of July of 1968. I think that it was September that Scott and I went to Washington, to talk to people about what was being done in this country. This was stimulated to a degree at least by the fact that the scientific director -- Dr. Spencer -- of the National Agricultural Chemicals Association called our Washington office and said that they thought they had some information of interest to Monsanto on PCB's and was there anybody in St. Louis involved in

this that they could talk to. Scott Tucker and I went down and spent two days in Washington. What Spencer had -- and he gave it to us on a highly confidential basis -- was a copy of Risebrough's paper which had been presented at a closed meeting of invited scientists at the University of Rochester in June. This was a conference to discuss the apparent wide-spread dissemination of persistent chemicals in the environment and -- although it concentrated on the chlorinated pesticides, Risebrough had been invited and gave this paper which he then subsequently published in NATURE. My recollection is that there were about 25 or 30 people at that meeting. Again, this is skipping things a little bit but subsequently the proceedings of that conference were published in a book this thick called "Chemical Fallout".

Smith - Was Risebrough's paper in it?

Wheeler - Yes. We also talked to a gentleman in the Department of Agriculture because we had heard, and I've forgotten how we got word of this, maybe Spencer told us (incidentally, Spencer had been a member of the U. S. Department of Agriculture, had retired and joined the NACA). He gave us the names of one or two people in the Department of Agriculture and we went to see them, and the man who presumbaly had begun to show some concern about PCB's was not in. We talked to his boss and he said, "well, I don't know what the story is all about. We have had some reports from somebody in Idaho or Colorado or somewhere, but I'm not familiar with it." So our

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information-gathering from the Department of Agriculture was without results. We were also told that some work was going on at the Patuxent, Maryland, wildlife center for the U.S. Department of Interior and that we should talk with a Dr. Stickel. We went out there and found that Dr. Stickel is a woman; her husband is not a doctor but also works in the same laboratory. The Patuxent lab is charged with protecting fish and wildlife, throughout the country. They routinely are sent the carcasses of bald eagles and they showed us gas chromatograms from two eagles that had been sent to them where they thought they had positive identification of PCB's. There was no implication that the cause of the eagle's death was due to the effect of PCB but the point was that "yes, they had identified PCB's in these bald eagles." They subsequently gave a paper in Washington in September of 1970.

Smith - Well, that was two years later, because this is September of 1968.

Wheeler - No, September of '69.

Smith - Where was that paper given?

Wheeler - At the meeting of this group of official analytical chemists in Washington.

Smith - Official analytical chemists?

Wheeler - The OAC. Scott agreed that from his work up to that point with gas chromatograms, the Patuxent results did indicate that the

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eagles had 1254 in them. I have forgotten whether they had confirmed this with mass spec or not. I believe they had. I think this probably eliminated any doubts that we had as to the fact that the Jensen-Widmark method was, in fact, correct, in its identification even though the British work and the Risebrough work had not gone beyond the gas chromatographic stage of identification. This led us then to the fact that we had no defense in terms of good ingestion toxicity data as to the meaning of finding PCB's in birds and particularly in fish that were in the diet. We then began outlining the type of toxicity data that we thought we should obtain. The initial pilot studies began in December of 1968 which led subsequently to the two-year feeding studies in May of 1969. Our thought was that we should acquire product toxicity data of the type that would allow us to go to the FDA to get a petition for indirect food additive use, not that we had any intention of doing that, but looking on this as the minimum amount of data that would satisfy the FDA that PCB's were or were not a public health hazard depending upon the levels that might show up in the fish. We then included the work on the chickens because there was an earlier reference to work done in Missouri and the FDA but I think we did it instead to see if we could get data on the chickens that might be related to what the environmental hazards were to birds.

Smith - Now you say the work on chickens was included. Do you mean that the December 1968 pilot studies started out without including chickens?

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Wheeler - We had decided at some date, I don't know whether now this was December of 1968 or when, I suspect it was, what protocols we were going to use...

Smith - What besides chickens were you going to use?

Wheeler - The two-year rats and two-year dogs and the rat reproduction studies.

Smith - Did you start to use this first and then decide to add chickens?

Wheeler - No, we had decided from the beginning the types of studies that we were going to have done. And I used the term, "we included the chicken work", because normally if we brought out a new plasticizer that we were going to use in films for wrapping food, at that point in time no one was particularly concerned about studies with chickens.

Smith - Well, you wouldn't have _____ that film for wrapping food after 1961, would you?

Wheeler - No. Over a period of years there have developed a series of types of tests you do for specific purposes. Originally for a new chemical the FDA would require back in the old days only 2 years feeding studies with rats. And then somebody said "who knows that in every case the chemicals metabolize in human beings like they do in the rats. We'd better use another species of animals -- use a non-rodent". So it became a period of two years in rats and one year in dogs. Then it progressed to two years in rats and two

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years in dogs. This is in contrast to most pharmaceuticals where you eventually have to get into monkeys, something even closer to the human. But for most food additives you don't ever have to use monkeys.

Smith - And chickens are not normally included?

Wheeler - At that time chickens were not normally included.

Smith - A while ago when I said you would not think of a plasticizer for food wrap, I meant a plasticizer including PCB's. You might have other plasticizers.

Wheeler - Yes. In the last year we have gotten two plasticizers approved without chicken work. On the other hand, it has become necessary in the last five years at least, to do some work on birds for pesticides because of the interest in wildlife damage. If you spray a thousand acres of a pesticide on the corn in Minnesota, the great pheasant hunting country, what effect is it going to have on the pheasants? In some cases the work has had to be done with pheasants or quail on the basis that metabolism of a wild bird could be quite different than chickens. If you start to work with pheasants, it gets pretty costly. Quail are raised domestically and are cheaper, and this is fine. For pesticides used around the estuaries, as on rice, work has to be done on the water birds, and it has become necessary to include mallards. Originally, we thought we would include mallards in our bird work at Bio-Test. Eventually we decided to satisfy ourselves with chickens. Another point that

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influenced us was that at the September '68 meeting at Patuxent we learned they were doing some work with wild birds. They have facilities there for raising in captivity wild birds that are not available to commercial laboratories.

Smith - What was the difference between the pilot study and the two-year study?

Wheeler - Well, there is the question of what is the biggest dose you can give, mixed with food that the animal will accept. There is a question of heavy dosing for about thirty days, to determine the target organs, how drastic the effect is, before you can pick a level that you know you are going to have animals live substantially a full life span -- in rats, a two-year period. The same would be true with chickens except that the chicken work would be less than life span. We did some other very short-term work including feeding a couple of other chlorinated hydrocarbons including chlorinated naphthalenes to see if by any chance these other materials were being metabolized, to end up with PCB in the tissues. We were still mystified as to how the damned PCB could be getting into the environment. Was there a possibility that other chemicals were being changed by the animal or bird metabolism such that the gas chromatograms showed PCB's when the test animals had not been actually exposed to PCB's.

Smith - Have you ever gotten anything to support that?

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RAS - Yesterday McNeill, you recall one of the fellows saying that they have found no method of synthesizing PCB's in the environment. Elmer, does that jibe with your understanding? By synthesizing, I mean by metabolizing or by degradation of DDT, or DDE or what-have-you.

Wheeler - We've seen...

Smith - You mean is there no method for Nature to produce PCB?

Wheeler - There is a report that indicates that one of the DDT metabolites if subjected to an arc temperature of 300 or 400 degrees centigrade in methanol over a period of time, will form a PCB with a chlorine on one end and a chlorine on the other. Chlorinated biphenyl. But this is so far removed from the chromatographic fingerprint or pattern of what is found that it is just beyond anyone's conception now that Nature could synthesize these in the proportions as they are made by man and as they are now being found in the environment. With some exceptions -- I don't know if this is true, with the chicken work to the same degree, it was true with the 1254 in rats. Some of the lower isomers that show up on the gas chromatograms disappear once this material has gone into the silo paint and the silage goes into the cows and the material goes into the milk. The material that is in the milk is not completely identical so there is some of the isomer homologs metabolized and yet the fingerprint is still enough in agreement that you can prove that it was PCB.

Smith - Well, is the profile so clear, that you can say this is 1242, or another profile, this is 1254, I assume that it is.

Wheeler - That should have come out in your discussion with Scott Tucker on the tissue work because...

Smith - I got that impression. Didn't you?

RAS - I have had some detailed discussions with Scott Tucker (of which I am sending you some copies) in which you will find there is a question of judgment. For a person that's been in this business as long as Scott Tucker, he can by experience pretty much determine whether you are talking about 1242, 1248, or what-have-you. A man with lesser experience might have difficulty with the gas chromatogram. There is another more certain method which is mass spectrometer that does indicate with certainty as to the specific material that is involved. It's qualitative, not quantitative, You do not get from that computer device the quantities of the Aroclor or PCB, but you do get positive identification of the material involved.

Smith - Now my question is that in all the tests that have been run, is there a profile that can be said to be a PCB profile but not conforming to the particular chlorination of the products that your company makes? Do you understand my question?

Wheeler - Yes, I do. And again I think Scott would have that, because I think he told me in one of our telephone conversations

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in his tissue work to get his quantitation from the chromatogram even though the animal had been fed (and this may be 1242, you'll have to ask him) instead of 1242 he had to quantify the amount in the tissue as 1254. Or it was 1254 and he had to relate it to 1260. In other words, getting back to the profile of these things... Here's a 1242 chromatograph and here's a 1254...you have a bigger portion of the higher chlorinated ones and then the 1260 would be even more shifted in that direction. And I think it's either this one that does like this...after the stuff goes through the animal, or the 1254 looks like 1260 when it's gone through the animal because we have a shift of these things to the higher peaks. In other words, some of the lower chlorinated isomers are apparently "chewed" up in the body and are not stored so even though the animal was fed 1242 what you find in the tissue looks more like 1254.

Smith - Just hypothetically, has anyone found a profile that was 1215 or 1295 or something that no one has ever heard of being manufactured by anyone.

Wheeler - No, although I guess what you are saying is that when you find what is most similar to 1254, it might be more representative if we made it 1250, which we don't make.

Smith - What I'm trying to find in my question is whether or not the tests that have been run, the identification that has been made there could have been a PCB that is not conforming to any known human manufacture.

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Wheeler - No. These are the PCB's that are made 42, 48, 54 or what-have-you on this curve. Per cent chlorination is indicated and it is really a question of just stopping the chlorination or the manufacture anywhere between here and here as you desire.

As the pesticide residue methodology improved, scientists were finding peaks that did not represent DDT, DDE or DDD peaks and this is what Widmark and Jensen dedicated themselves to identifying. There are still some unidentified peaks which occur.

Smith - O.K., now, is there anything else to bring us up to date? You started the pilot studies, how long did they take?

Wheeler - I suppose the actual study dosing the animals began after the first of the year, I would have to say, January 1969. It was agreed about that time that Bob Keller and I should go to Europe and talk to the people who had published their findings. We had had some correspondence from the University of Utrecht in the Netherlands in addition to the Swedish people and our Monsanto people in England had been following the developments as published in Great Britain. We spent three weeks talking to the four laboratories in Great Britain which had done some work with PCB, Drs. Koeman and Voss and then Van Genderin at the University of Utrecht, Widmark in Sweden. We went to Bayer, a German producer, to see if they had developed any concern and we went to Progil, one of the French producers at Lyon. That would have to be confirmed though because I confuse Progil and Prodelac. We also visited Shell Research Labs in

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Great Britain because they had done some work on PCB. They fed 1260 to chickens for a year without any effect.

Smith - When was that?

Wheeler - April of 1969.

Smith - And they had just completed that study?

Wheeler - I am not sure they completed it, and I am not sure if they extended it beyond that. My recollection is that they told us that they fed 1260 at 100 ppm for a year without any effect.

Smith - Do you know of any other chicken studies that showed no effect of PCB's.

Wheeler - No, not chicken studies, but once our data had begun to develop, we would periodically take progress reports to Washington to the FDA and Department of Fish & Wildlife and make them aware of what we were finding. I guess it was September 1970 that Bill Papageorge and I were in Patuxent talking to the people there. We were giving them the final reports on the chicken work at 1, 10 and 100 ppm of the three compounds. When we told them of the effect on reproduction and egg shell thickness with 1242 they just about fell out of their chairs because they had been doing some work with pheasants or quail, wild birds, and 1254 had no effect at 40 or 50 ppm in the diet.

Smith - You say those were the final reports on chickens in September 1970?

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Wheeler - At the levels of 1, 10 and 100, yes.

Smith - I thought these were to be two-year studies.

Moore - The chicken has a much shorter growth span, life span.

Wheeler - You are not trying to simulate the life span of the chicken. You take young birds and feed them up to the point where they start to lay eggs and watch their weight and food consumption. You measure the egg production once they start laying, once they have settled down to laying normal size eggs, because I think when chickens first start laying, you get a small egg, a large egg, this and that and it takes them two weeks to a month to start laying in a normal pattern of eggs.

Smith - But it was the 1242 - the lower chlorination that was causing the trouble and that surprised the people in Patuxent. Did it surprise you?

Wheeler - Yes. Particularly since even that early the 1242 was clear in the rats and dogs whereas we had become suspicious of 1254 and 1260 at the higher levels of 100 ppm.

Moore - And there is apparently a difference between the domestic chicken and wild game fowl that had been tested.

Wheeler - Yes, although my recollection and this has been published -- when we told them our data --they said, "we were just ready to submit a manuscript on our negative results with our wild birds and we

would be remiss now -- knowing of what you told us -- if we didn't make reference to it in the publication. Is there any way you can let us make reference to your work?" We said that all we could suggest was that "you put what you think you want to say in a couple of paragraphs and submit it to us and we will have to clear it with our Law Department and our management before we can let you make reference to it." They subsequently did this and it really was not all that revealing because in March of 1970 in the paper given in the Society of Toxicology meeting these results were mentioned in a brief summary.

Moore - These are Bio-Test results?

Wheeler - Yes.

Smith - You have the dates of all of the reports and all the trips that were made, you have this pretty well lined up?

Pogue - With a few exceptions these are mostly lined up.

Smith - Now, are there any details that we haven't asked about this morning?

Wheeler - Yes, there are a couple of other major developments that influenced the decisions that were ultimately made. In August of 1969 we heard from the Bureau of Commercial Fisheries of the Department of Interior -- the federal lab in Gulf Breeze, Florida, which is charged with the protection of fish harvesting in the country for

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the benefit of the American people -- (They are research oriented, not enforcement of FDA regulations; their mission is to protect the fishing interests and protect the continuing availability of fish for the American diet). They called our plant at Pensacola and said that they had found some PCB, Aroclor 1254, in Pensacola Bay -- they had done some work with baby shrimp and they had found that 5 ppb killed 18 out of 25 baby shrimp in something like three weeks. Was there a possibility that the PCB was coming from our plant at Pensacola? The Pensacola plant called me and said what is in Pydraul fluids? I said find out what Pydraul you are talking about and they called back to say Pydraul AC which has 1254 in it. "How much are you using?" They said well, "we will have to check." They got in touch with the purchasing department to see how frequently they were ordering PCB's and it turned out the best they could estimate -- they were losing 2-4 gallons a day because their makeup of AC was 4-6 gallons.

Pogue - Pydraul AC -- air compressor lubricant.

Wheeler - And it is used because there had been so many fires and people killed by petroleum lubricated air compressors.

Smith - This is _____.

Wheeler - Yes, we are not talking about the size air compressor you find at the filling station, these are about the size of this room.

Smith - And people have been killed because of fires?

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Wheeler - They explode.

Pogue - This is what started that particular product.

Smith - Why did they explode? Were they connected with heat?

Wheeler - Well, heat is generated when you are running a piece of machinery. If it is lubricated with a flammable material and there is a chance of a spark...it blows your plant apart. At one time, they had used a non-fire-resistant oil in the compressors and, at that time, they stuck a settling tank in the sewer line from the drainage area of the compressors to a ditch that goes to Pensacola Bay. The purpose was to collect any liquid wastes from that area and let the oil rise to the top. The water then with very minimum amounts of oil was draining off into the ditch and river. Well, when they changed to Pydraul, they still had that system there but they weren't as careful about being sure that none of the lubricant was going from the ditch to the River and this is where their loss had been showing up.

Pogue - The oil goes to the top of the water-oil mixture. Pydraul sinks to the bottom in a water-PCB mixture.

Smith - And the Pydraul was not being made there, it was just being used there?

Wheeler - The Pensacola plant was a customer of the Organic Division. It was a Monsanto Textile Company plant but they were buying the stuff from the other division.

Smith - Pydraul is made at Anniston and Krummrich, just like the other?

Pogue - That is right. That is a mixture of half Aroclor 1254 and the remainder being phosphate ester which is also a highly stable fire-resistant chemical.

Wheeler - Anyway, within 24 hours the plant had the Pydraul out of their systems and had gone back to petroleum lubricants.

Smith - There was no way we could capture the 4 gallons per day?

Wheeler - They didn't think they could take the risk. Anyway, this was real alarming to find that Aroclor could be that toxic in such small amounts to a marine organism.

Smith - Did you have any reason to doubt the results of that?

Wheeler - No, because the Gulf Breeze lab has extended its work and published it. There was some effect on the growth of oysters at low levels.

Anyway, this could have been in July because in August there was a meeting in Corvallis, Oregon. The University of Oregon set up a seminar of 2-1/2 days to talk about the same subject that had been discussed in June of 1968 at Rochester. I think they thought there might be 40-70 people in attendance. It turned out there were 350 representatives from 25 states. They had Risebrough and Stickel on the program and they had Dr. Richardson from the Shell Research Lab in Great Britain. Again the emphasis was on chlorinated pesticides

but with Risebrough on the program there was some emphasis on PCB's. And it was decided that Marsh Magner who is one of our top entomologists should go because of the emphasis on pesticides and that I would go because we knew that PCB's would be brought up.

Smith - Now this was in 1969?

Wheeler - I think August 8 or something like that and Dr. Fancher who is Calandra's righthand man went out because Bio-Test does a lot of work on pesticides.

Smith - Well, when I get Corvallis in August and Gulf Breeze -- were they at the same time?

Wheeler - I think Gulf Breeze was mid-July because it had occurred prior to the seminar in Corvallis.

Smith - Don, do you have any way to pin these dates down?

Pogue - Yes, most all of them.

Smith - We probably should go back through this and get the exact dates in there.

Wheeler - It was an interesting meeting in that some of Risebrough's more vocal adherents were there including a couple from Cornell, Berkeley and University of Washington. Real hippy types with long hair, clean but raggedy jeans, sandals or bare feet and any time Risebrough would take a crack at industry, they would applaud and

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of course the local TV and press were just swarming around these activists every opportunity they had. The upshot of this meeting was that, on the evening of the first day, Marsh and I were having a drink before we went to dinner and Marsh said, "Elmer, these people are going to put Monsanto out of the PCB business" and I said "I'm beginning to think you are right." Fancher had the same reaction. We came back from that meeting and sat down with Bergen and Bill Richards, Keller and the people that were involved in what was going on in the PCB area at that time and out of that came a task force of 5 or 6 of us to put together the then current status of our knowledge about PCB's and predictions as to the future. We issued a report which was intended to be a preliminary draft of the deliberations of that group. That was about October 15. It got fairly wide distribution and subsequently we got a call from one of Dick Stohr's counterparts in the Law Department which said, "call back all of those reports and burn them." It was redistributed to some 12 people with the legend on the front "ATTORNEY CLIENT PRIVILEGE". This led to a review in November of the whole situation before the Corporate Management Committee which was the agency of the Board -- we had the financial committee and the CMC and they were charged with running the Company between the Board meetings.

Pogue - Was the first meeting around April or so of 1970? CMC?

Wheeler - No, November 1969.

Pogue - November 17, 1969.

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Wheeler - Yes, that is it. It was at that time that the business group was told to develop as quickly as possible a program about what we were going to do about PCB's and their uses. I don't know if I should discuss that further. There were decisions made then as to beginning to look for substitutes and we were back in Brussels in April-May of 1970 when we got an indication that CMC had accepted the proposals about phasing out. What were the specific dates?

Pogue - April 1970, PCB sales being terminated in open systems by our distributors. Sales will continue for transformer capacitor heat transfer uses which are closed systems which do permit control.

Smith - Are there any other discoveries that you want to mention? That led up to the Quails Roost conference in December?

Wheeler - I can't think of any.

Smith - During this entire period of your connection with the Company was there ever a feeling that you should change the label so as to warn the customer not to introduce the Therminol FR directly into a product?

Wheeler - When was the environmental statement added to our shipping containers?

Pogue - It was first published May 1970 in the form of a label. The wheels began to move before that.

Smith - When were the first letters issued to the customers?

Pogue - The first letters were issued in February 1970 by Don Olson.

Smith - My question is a little more specific than that. You might tell the top management of a customer that there are problems involved in the environment but when did it first occur to you to tell a user down the line -- the foreman who opened the can -- for Lord's sake don't dump this into the rubber or the potato chips?

Wheeler - Well, I think the first indication relying on our contacts with our customer facilities would be that February letter. But it had no specific reference to food.

Smith - Did you review all the labels?

Wheeler - Yes.

Smith - When you say this product must not be allowed to enter the environment did you believe that that would be sufficient to tell a man with a grammar school education, don't put it in animal feed?

Wheeler - No, I wouldn't expect it would get to that guy in those terms. On the other hand, I would expect that man would be responsible to somebody in authority who would know that it should not be allowed to get into the food. Because there are a lot more people than suppliers of the chemicals that have the responsibility for the product that they then introduce into the marketplace. We can only extend our authority beyond recommendation to a certain point. The ultimate responsibility then is not ours. I cannot guarantee that

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Company "X" is going to exercise the proper quality control of their products so they keep out of trouble any more than I can guarantee that if I make a brake fluid for an auto company that it is going to be put into the system in the car you buy that is going to be appropriate safetywise.

Smith - Well, your reference to don't allow it to enter the environment, was that designed to protect the _____ the waters and the air passages or was that designed to protect consumers of the food?

Wheeler - The former.

Smith - What on your label and you reviewed the label, was designed to warn someone not to put it into a food product?

Wheeler - I would say there was nothing on the label with that specific warning. To my recollection. Nor would I have recommended at that time that the label say it not be used because we still felt that heat transfer systems were "closed systems" and that use would prevent environmental problems. In connection with the food application, this was a different subject. The only problem that I could see in terms of food was the question of adulteration. Until such time as this Japanese incident which provided evidence that people would consume food with significant concentrations of PCB in it.

Smith - Now what is the date of that incident?

Pogue - '68 or '69.

Smith - Once you heard about that did that suggest to you that you should put a warning on the label in addition to the handling, and environmental warnings, don't let this get into food?

Wheeler - No.

Smith - Why not?

Wheeler - Because my participation in that sort of a program was to write a memo that we should discontinue the use of this material in food applications since it appeared that we could not insure that adulterated foods would not be consumed in levels that could cause problems. There was some confusion in the Japanese reports because on the one hand we read a translation which indicated that the level in the food was 2000 ppm and we saw another translation that said 300 ppm. It is one thing if you are consuming food at .2% and something else at .03%. The fact is that the higher number was the more accurate one. The rice bran oil that got into the food had 2300 ppm of the Japanese counterpart of our PCB in it.

Smith - All right, I am trying to see if I follow you. Now your theory was that if the Company decided not to sell to food applications, it wasn't necessary to put anything on the label.

Wheeler - Right. If people couldn't use it in food applications, what difference does it make what is on the label?

Smith - Even though you had had some experiences where people had used it in a way that you didn't know about. Did you have that experience or not? What I am thinking is if you shift the entire responsibility over to the sales department to cut off sales of food use was it necessary to notify all the salesman -- we are not going to put in on the label because we are counting on you to be 100% sure that nobody uses it in food?

Wheeler - I think you should know from a corporate standpoint our role is one of providing consultation, advice and recommendations to the operating units and it has been on very rare occasions that we have had to do something so drastic as to appeal to higher authority if you will, to get the kind of action or activity we want. I would say in this instance because of the involvement of so many and the concern of top management about the whole PCB situation and recognizing that you can't make a major policy decision such as this and accomplish what you want to accomplish overnight, you have to rely on the business group to develop some kind of program to develop what has got to be done.

Smith - Could you possibly have felt that it was never intended to be used directly in the product. You got warnings that in washing it off, in smelling it, in getting it on the skin and you have got a _____ on the label but some of _____it said just don't let it leak of _____those things together with the fact that it was never supposed to be used in the product was enough for you not to worry about being used in the product.

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Wheeler - Plus the fact that the people who are selling the ultimate product to the consumer whether it be feed or food have the responsibility to see that it is not adulterated.

Smith - Now that helps me to come back to that rather than to say well, we left it up to the business group.

Wheeler - As I said earlier, Monsanto cannot assume the responsibility of its customers in the quality control of that customer's product.

Smith - Now were any comparisons made between the toxicity of Dowtherm A as opposed to Therminol FR?

Wheeler - Not to my knowledge.

Smith - Well, there is some indication that the salesmen were confronted with questions on this subject and may have expressed a view. Do you have any basis for saying there was anything strange to making a comparison?

Pogue - I don't recall saying anything.

Smith - And you recall, Dr.? Now let's take Western Precipitation which is a big supplier to highly refined equipment in which Therminol FR has been specified. How would you answer one of their top salesmen if he were to say "we knew it wasn't intended to leak but we had no idea that it would be toxic if it got into food products which we were designing the equipment for and even as late as April or June 1971 when we had Pittsburgh Lab results showing that their holoflite units were corroded and the material was leaking from the inside out

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into the fishmeal it never occurred to us that it was an economic problem. We never thought that there was anything toxic about Therminol and we are your best promoters on the West Coast. We have designed this equipment and you never told us and we are PHD". I am not saying they said that...How do you answer them?

Wheeler - Well, I think I would answer specific questions first, and I wouldn't think this is based completely on hindsight but I think if I had been told that this could leak into fishmeal going into chickenfeed and they would ask me questions about 1242, I would have said that you were probably going to have problems other than palatability.

Smith - That is sort of suggestive. What are you suggesting?

Wheeler - I am suggesting that at that time we had data showing that 1242 was pretty toxic in chickens.

Smith - Had you told anybody?

Wheeler - Well, we gave a summary of the data at a public meeting...

Smith - Where was that?

Wheeler - In Washington in March of 1970. We told the FDA, the USDA and the Fish and Wildlife people; we told customers that asked us for specific toxicity data.

Smith - Well, had you told your own salesmen?

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Wheeler - Certainly the product group managers knew it.

Smith - Don had gotten the reports that were given in public in March of 1970?

Pogue - I wasn't in the field at that time.

Smith - Normally would the product groups send out to the salesmen what the Medical Department was telling the FDA and USDA?

Pogue - It would depend what the value was assessed at that time.

Smith - Now if Western Precipitation designers and top salesmen said "Look, you told us this was safer than Dowtherm" how would you answer that accusation?

Wheeler - I don't think I would have to answer the question, is Therminol safer or less safe than Dowtherm. I suspect if I had been asked from a toxicology standpoint, I would have gone to the literature to find what I could find on Dowtherm and would have then concluded that froma standpoint of possible effect in chickens the Therminol was less safe -- although I suspect there is no data reported on the effects of Dowtherm on chickens.

Smith - Now that would have been in May 1970. How much earlier than that would you have been able to come to that conclusion?

Wheeler - I would have to look back to see when we finished...maybe fall of 1969.

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Pogue - We weren't really aware until the East Coast incident occurred of exactly where all food systems were going nor where they had been installed. An effort was made prior to that time throughout of informing known food customers that the product should no longer be used. This was one case that we just were unfortunately not prepared to catch.

Smith - Because of the different names and the different locations.

Pogue - Right, it was actually sold at one area and shipped to another. The East Coast Terminal appeared for the first time on sales run credited to the Atlanta salesman.

Smith - If the name had been South Pacific Proteins on your customer list can you predict what the sales department would have done?

Pogue - I think Don Roush covered that field when he indicated that he did catch that.

Smith - He caught Commodity Pasteurizing, not South Pacific Proteins.

Pogue - You are right. Primarily because of the name I think, South Pacific Proteins is certainly more indicative of food rather than East Coast Terminals.

Smith - Now the name Baker Engineering would that suggest...But Baker Engineering never got the letter that came out in June.

Pogue - They got the February one. We sell the majority of our systems through engineering companies.

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Smith - I have the distinct feeling that the Sales Department was approaching this thing, well, we are going to get all the salesmen, tell them the problem, withdraw the food uses, work with the customers, help them make the transfer but it was no crash program and they never felt that anyone was putting the heat on them to make them realize it was a crash program. But from listening to you I get the feeling that you recognized that the fishmeal operation should have been stopped immediately. Unless you think that the thing was so leak-proof that there would be no danger.

Wheeler - Yes, but don't misunderstand me. I don't know if somebody said something about fishmeal -- unless they had said that the fishmeal was then going into chickenfeed, I would have been undisturbed. There are other uses of fishmeal -- I think it goes into adhesives, non-food adhesives.

Smith - That is another remoteness in the chain of _____.

Pogue - Isn't this a relative thing? For example there are people in the field...I remember one fellow saying this that these are people who are charged with selling - they have got to move in the marketplace and all of a sudden you drop a bombshell on them. You are reversing what they have been taught, what they do day in and day out and that is selling. All of a sudden they are told look stop selling, we have got to get our product out of all of these systems, those same systems you've worked so hard to establish.

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Wheeler - And in the meantime make your sales budget.

Pogue - Right. And there are fellows who for a full week, did nothing but call customers, screen lists and telephone St. Louis.

Smith - Was he being paid for that time?

Pogue - Yes, but also that is just that much time out of his career that he is not doing the job that it takes for success. If someone had told me that and I was in the field I would certainly do it but sure as hell wouldn't completely sacrifice the marketplace for two weeks. It is against the nature of the marketing man.

Smith - Well, did you view it as requiring a crash program?

Wheeler - For use in food and feed? No. Because I thought that these were closed systems anyway. And the only thing that I would emphasize in making the decision that we should stop the use was that Japanese incident but again this related to humans.

Smith - And the Japanese are always making mistakes in cheap human life.

Wheeler - No, I don't feel that way about any human life. Again I think in all honesty, unless someone had said that the fishmeal was going into chickenfeed, that they were using 1242, I would be so upset as to say "get the darn stuff out of there tomorrow if it is possible that it may leak."

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Smith - I think what we need to do is to line up the unforseeable factors which all combined to insulate Monsanto from taking more drastic action and this goes all the way from identifying the customer by name, in having him related to any salesman who knew what was involved, in tying up fishmeal with chickens and tying up 1242 with chickens until fairly late in the process and not ever anticipating that a sophisticated company like Western Precipitation would not recognize that the product should not have Therminol in it and not recognizing that an owner of an expensive piece of equipment like this or South Pacific Proteins would know it is going into animal food would say stop it. It is the idea that all of these people with great training -- more than Dean Morton had -- could stand around and see this leaking and not recognize it as a danger in view of the labels which you had on it relating to the environmental and handling whether you had food application mentioned or not. You have got about 10 possible stopping points and it is unforseeable to Monsanto that somebody wouldn't recognize the danger without saying it is all Monsanto's fault. Maybe there are more factors and we should make a list of them because I think it would make the most effective argument.

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