IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

THE UNITED STATES OF AMERICA,	)	
	)	
Plaintiff,	)	
	)	
vs.	)	No. 78 C 1004
	)	
OUTBOARD MARINE CORPORATION AND MONSANTO COMPANY,	)	
	)	
	)	
Defendants.	)	

January 15, 1981,

1:15 o'clock p.m.

The deposition of DR. WILLIAM R. RICHARD, JR., resumed pursuant to noon recess at 200 East Randolph Drive, Chicago, Illinois 60601, before Thea L. Urban.

PRESENT:

MS. ELIZABETH STEIN,

MR. GEORGE PHELUS,

MS. ROSEANN OLIVER,

MS. JOANNA NEW,

MR. JAMES H. SCHINK,

MR. ROBERT SHAPIRO.

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MS. STEIN: I think we agreed before we went to lunch that the first thing we would do when we went back on the record this afternoon was to mark the organizational chart that Dr. Richard drew for me as Richard-Plaintiff Deposition Exhibit No. 1 for identification.

(Richard-Plaintiff Deposition Exhibit No. 1 was marked for identification, 1/15/81, TLU.)

W I L L I A M R. R I C H A R D, JR., called as a witness herein, having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION (Resumed)

THE WITNESS: As part of the record, you know there is no reason that Monsanto shouldn't furnish some historical dates as to when the organizational changes took place. That must be a matter of public record.

MS. STEIN: If Jim would agree to produce those or give them to us, you do not have a recollection of the dates?

MR. SCHINK: We might ask when Organic and Inorganic meshed and went to MIC.

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THE WITNESS: Part of it went to MPR.

MS. STEIN: Could we have one copy of this made so that the reporter can take the original and actually if you want one today as well, but I would like to have one to take back with me.

MR. SCHINK: Take it with you and bring it back tomorrow.

BY MS. STEIN:

Q Before we broke for lunch, Dr. Richard, we were discussing the process of formulation of Pydraul 50-E and you told me that Pydraul 50-E was a phosphate ester hydraulic fluid which you were developing. You described some of the characteristics that you were looking for.

My next question is what was the difference between Pydraul F-9 and Pydraul 50-E in terms of chemical composition?

A The phosphate ester is different and the Pydraul F-9 contains Aroclor.

Q I don't want to get into trade secrets, but could you give me an approximate percentage of the composition of Pydraul F-9, what that was in Aroclor or the weight?

A I said I didn't remember. It was appreciable,

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an appreciable amount; 30 percent, something like that, 40 percent.

Q What was the difference?

I believe that Monsanto also produced a Pydraul F-9A, isn't that correct?

A Possibly a reformulated product. When did they produce it?

Q I believe that was in the mid-'60s.

A In the mid-'60s?

Q Yes.

A I don't remember the difference between Pydraul F-9 and F-9A. Maybe it is a lubricating agent or something.

Q We were talking earlier about toxicity testing for Pydraul 50-E and I believe that you indicated that Younger Labs had conducted some acute toxicity tests.

A I said this was a normal practice to screen, probably did.

Q This was done for products other than Pydraul 50-E, Younger Labs generally were given a contract to conduct acute toxicity tests?

A Yes.

MS. OLIVER: Could I ask a clarification?

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Your testimony, Doctor, was what generally was done in the formulation of manufactured products, is that right?

THE WITNESS: Yes. This is an example, was with Pydraul 50-E, but I said normally that Medical would screen all sorts of toxicity with Younger.

MS. OLIVER: Thank you.

THE WITNESS: Not just this product.

BY MS. STEIN:

Q Did you ever see the test results that came back in conjunction with Pydraul 50-E? Did you see the test results that came back from Younger Labs yourself?

A I'm sure copies of those must have been addressed to me.

Q When the functional fluids group proposed a new product, was it usual for you to see the results of toxicity tests that were done by the lab that had conducted the tests?

A I wouldn't say every one, but I'd say the majority, I would, probably.

Q During the time that you were the Director of Research of the Functional Fluids Group, was acute toxicity testing done on every product that was

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proposed?

A On every product that was proposed, is that the question?

Q Yes, that is the question.

A I would say that I can't guarantee every product but probably. It might have been covered by component testing, the products that went into the blend.

Q And the tests were carried out under the supervision of the Medical Department of Monsanto?

A Yes, they would contract out from the Medical Department.

Q Did you in the Research Department have responsibility for any kind of toxicity testing at all?

A The only direct responsibility we had was for analytical results and we did biodegradation studies.

Q On what substances did you do biodegradation studies?

A Pertinent Aroclors, some phosphate esters.

Q During what time frame did you conduct the biodegradability studies on Aroclors?

A Starting about May or June of '69 in England

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and a few months later in the United States.

Q Who was responsible for conducting the biodegradability tests in stabilizers in England?

A The Director of Research was Dr. Baxter.

Q He was associated with Monsanto?

A He is a Monsanto employee in England.

Q Who else?

A Dr. Mainprize, M-a-i-n-p-r-i-z-e, or something like that.

Q This was in England?

A Ruabon.

Q Which were the Aroclors with respect to which biodegradability studies were carried out both in the United States and in England?

A Approximately, I can't verify every one of these, but Aroclor 1221 through Aroclor 1260.

Q Could you give me each number in the series, please?

A Don't hold me to the exact, but I would say 1221, 1242, probably 1254, 1260 and then we did a whole bunch of others.

Q Which ones were they?

A Or at least 200 micrometers. I don't remember which ones we actually picked, but we picked

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those with 2, 3, 4, 6 chlorine atoms on them.

Q Who developed the protocol for the biodegradability studies?

A These were adapted from soluble kinds of, let us say biodegradability studies in Monsanto that had never been done for compounds with low solubility. They had been done for water soluble compounds.

Q You were looking for biodegradability generally in water or in air?

A No, we were looking for them in water and the problems were to develop test methods that were suitable for compounds with low solubility and also to develop methods, analytical methods for handling low concentrations.

Q What were the sources or references that you used to develop these test methods for biodegradability for low solubility compounds and for compounds where you were looking in low concentrations?

A Ruabon had some background in running biodegradability, soluble water biodegradability and plant effluent.

Q What was that background, how had they gotten it?

A I couldn't tell you. And in the United

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States, we consulted with Dr. Swisher, who is a Monsanto employee.

Q What is his area of expertise?

A Biodegradation but his expertise was on high water soluble compounds, mainly detergents, and so the protocols and test methods had to be developed by our applied sciences section.

Q Under the jurisdiction of what working group is applied sciences section?

A The manager is Dr. Keller.

Q Was that in the office or the division of Research and Development?

A Yes.

Q In the functional fluids group?

A No. We contracted services from; he served all of the Organic Division and then when it became MIC, we still continued. He was part of MIC, contracted services from him but he served all groups, all plasticizers and rubber, so forth, that needed analytical work, especially analytical work that was not routine.

Q So the applied sciences section did the leg work for all of these various groups within the Organic Division?

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A I wouldn't call it leg work. I would call it analytical collecting and analytical development.

Q What is Dr. Keller's background?

A He is an analytical chemist. I don't know the educational background; from Iowa.

Q Is he still a Monsanto employee?

A Yes.

Q And he was during the entire time you were in the functional fluids group?

A Right.

Q Did you work with him in the development of these protocols and test methods for biodegradability?

A I did not work directly with him. I asked Dr. Keller to undertake that work and supported it through budgets and so forth.

Q Do you know who worked with him to develop these test methods for the biodegradability in the Aroclors?

A I think the principal, one of the principals was Dr. Sager.

Q How do you spell that name?

A S-a-g-e-r.

Q Is Dr. Sager also a Monsanto employee?

A Right.

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Q Is he also a chemist?

A Yes. And I think Dr. Scott Tucker was doing a lot of the analytical work. I think Sager reported to Tucker.

Q Did Dr. Tucker report to Dr. Keller?

A Keller, I believe so.

Q Is Dr. Tucker still there?

A No.

Q Do you know where he is now?

A I am not quite sure. He's not with Monsanto.

Q Do you know when he left Monsanto?

A Not precisely, but probably the late '70s.

Q What was his background, educational background?

A Ph.D. in Analytical Chemistry.

Q How long did the biodegradability studies continue?

A On specific compounds?

Q Yes.

A Might be months.

Q With respect to Aroclor 1221, Dr. Richard, first of all, could you briefly describe what an Aroclor is and then the significance of each of the numbers?

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A Yes. Arochlorinated biphenyls, is that sufficient?

The 21, 32, 42, 48, 54, 60 refer to the chlorine content. There is one exception and that is Aroclor 1016.

Q How is that different?

A It was named for its MCS number.

Q What is an MCS number?

A Monsanto Chemical Sample.

Q Is it common to designate a product by a MCS number?

A No. It was called Aroclor 1016 but in developing chemicals, we would make compounds and when we got close enough to think we had a possible chance at a product or something we wanted to send outside for testing, we gave it a MCS number.

So it was not a product, it was a product in development and these were just assigned numerical numbers.

The functional fluids group used the title MCS and then numerical number and these went in sequence.

Q So the 1,015 that had preceded it were samples that had been developed in the functional

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fluids group?

A Over the course of years, yes.

Q What was the product at which MCS 1016 was aimed?

A It was aimed at a dielectric lubricity replacement for Aroclor 1242 in capacitors.

Q What was the reason you were seeking a replacement for Aroclor 1242?

A What we wanted to do was cut down the amount or the number of high chlorinated or high arochlorinated compounds to the very minimum we could get and still retain some fire-resistance or with sufficient dielectric properties.

Q What physical differences in the various Aroclors resulted from the different degree of chlorination?

A They went from mobile liquids to semi-viscous solids at room temperature.

Q Were there any solid forms?

A 1248 was pretty solid.

Q Did the color change as well?

A Slightly. It went from usually water-white to amber.

Q The darker color then being associated with

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a higher degree --

A No, just ability to get maybe a trace of saturates out or something like that. No, it is not a function of the chlorine content.

Q Were there other Aroclor-containing compounds that were not these liquids that were produced by Monsanto?

A Would you repeat that, please?

Q Were there other Aroclor-containing products from Monsanto other than these liquids that you have described were Aroclors 1221 and the series?

A 1221, 32, 42, 1016, 48, 54, 60 and on rare occasions, 1268. I don't know whether we ever sold that or not.

Q Was that a liquid also?

A No, it was a solid.

Q What would that have been used for?

A I am not quite sure whether it was ever used by us.

Q Were you aiming at using it in particular?

A No, I think people had made it and it was the highest chlorination number we had ever gotten to.

Q Which Aroclor was in Pydraul F-9?

A I think -54.

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Q You mentioned also another Pydraul number, I believe Pydraul 625 you mentioned earlier.

Which Aroclor was in that?

A It might have been either Aroclor 1254 or Aroclor 1260, I'm pretty sure I am correct. All the Pydrauls were hydraulic fluids or air compressor fluids.

Q Air compressor fluids?

A F-9 was used.

Q You also mentioned Pydraul AC.

A Air compressor.

Q Air compressor?

A Yes.

Q Which Aroclor was used in that?

A I don't remember.

Q And Pydraul 312?

A Hydraulic fluids.

Q Which Aroclor was used in that?

A I would say -42.

Q And Pydraul 8200, which Aroclor was in that?

A There were two, -42 and -48.

Q What Aroclor was used in the Therminol products?

A I think mainly two. I don't know if that

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was exclusive or not. You ought to be careful here though. All Therminol products were not chlorinated hydrocarbons.

Q What was the other component of some of them?

A There were some that contained none.

Q Which contained none, do you remember?

A Therminol 66, Therminol 77 and Therminol 55.

Q Were those developed during the time you were the Director of Research at the functional fluids group?

A I think so.

Q Were the results of the biodegradability studies on these various Aroclor compounds ever published?

A With the biodegradability studies, yes.

Q For all the compounds that were tested?

A For all the compounds tested, I can't swear to that, no, but the Ruabon work was later published by Drs. Baxter and Mainprize.

Q What were the results of the biodegradability studies for Aroclor 1221?

A Showed biodegradability.

Q Was it expressed in terms of a percentage of product which degraded and the component into which

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it degraded?

A We tried. However, we couldn't separate all the isomers but we tried to look and separate and watch the rate of degradation with the different isomers.

Q What did it show with respect to the different isomers?

A The general conclusion overall in looking at these things is molecules of chlorinated biphenyl contained four chlorine atoms, showed biodegradability and at the time frame of days, weeks and months. There are some chlorine, five isomers that also degrade and I think the other general conclusion is that for some reason if you had mixtures of isomers, they degraded faster than if you were studying single isomers.

It is also true, I think, that it takes the bugs, microbes a period of time to adjust to the varying chlorinated biphenyls so if you have an effluent that contains other organic compounds, the bugs can feed partly on it, partly on the Aroclor, that your transition is easier and better.

Q What was a degrading agent, if you will, that accomplished that transfer from a chlorinated

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biphenyl to whatever these other products were?

A I don't know which microbes were doing it. We did take sewage sludge, adapted, let the bugs in that and let it adapt. We didn't do any genetic engineering.

Q You did not analyze the composition of sewage sludge you were using?

A No. We didn't know what microbes were in there. Baxter did some special work with some strains that had been developed by Professor Evans, but in general, we used St. Louis sludge.

Q Who is Professor Evans?

A I don't know his title, but he was -- you know, at universities, Ruabon and in England, oftentimes universities worked with and to some extent tried to support the industries in their areas. So Baxter and Evans knew each other and were helping each other.

Q What were the compounds into which the Aroclor, are we still talking about 1221 Aroclor?

A 1221. What I gave you was a summary of Aroclor. Look at 1221, 42, 54.

Q What would be the component into which these isomers degraded, chlorine over here and hydrogen

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over here, or did the benzene ring split up, did the chlorine atoms knock off?

A We were not in a position to do the metabolic components at which they went to. It was about all our expertise and analysis could do to watch the disappearance of known isomers.

In other words, we didn't try to do the metabolic pathology for degradation. It is a very difficult job.

Q Did you ask anybody to do that?

A I think not. We talked about it, felt that the analytical problems were so difficult that time and money and energy, we didn't have the ability to do it.

Q Do you know who made the ultimate decision not to pursue studies on the ultimate metabolic products of Aroclor breakdown?

A I think it would be Dr. Keller telling me and probably the Medical Department that it was a very, very difficult job.

Q Do you remember the results of Aroclor 1248 biodegradability studies? Were they any different from, say, the 1260 studies?

A Yes, probably.

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Q Do you remember what those differences were?

A Well, the results were that isomers containing four chlorine atoms which is what, that is where 48 is, those isomers would degrade and there were only a few isomers in the five and above that wouldn't degrade in the time frame that we were talking about: days, weeks and months.

Q In the higher chlorinated ranges, did the biodegradation take a longer period of time than the lower, is that what you are saying, that the 1260 would take longer to degrade, for example, than the 1221?

A Well, I don't know the isomers, the lower isomers. You understand that these are all smithers or cuts so that the four, if you put 1260 in there, there were very many fours, threes or fours, we would expect, and I think those would degrade, but the bulk of these other ones would remain unattacked in the time frame with the bugs that we had.

Q And the degree of chlorination increased then?

A The total amount of degradation would decrease.

t6 Q And with the higher chlorinated compounds,

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there was a higher degree of, say, pentachloro-hexa, 6, they went up?

A I guess they went up.

Q But, say, Aroclor 1221 would not have?

A Very few.

Q So the mixture of isomers would be different depending on the Aroclors, is that correct?

A That is correct.

Q Do you remember when you got the results of those studies?

A I would say we started getting some results back in '70, '71 somewhere.

Q To whom in Monsanto did those results go?

A Came to me. I suppose they went to Medical.

Q Would they have gone to the marketing people?

A I don't think the results would have gone to the marketing people directly. The conclusion might have been translated to them, but certainly they wouldn't get all, I don't think they got all the day-by-day reports.

Q I believe you mentioned that the work that was done in Britain was published. Was the work done in the United States published?

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A It was given to the PCB task force, the Government task force, and they did a lot of work on tissue work in animals.

Q Could you describe what that work was and who did it?

A Yes. The ones that I have been describing are sewage sludge, or in some cases, special strains.

The second thing we tried to do was feed test the animals, chickens, rats, dogs and then tissue from these animals would be sent back to Monsanto and after we got the hang of it, we would analyze the tissue results for Aroclor concentrations and isomer distribution.

Q Who made the decision to do these animal tissue studies?

A I think it was done in conjunction with the Medical Department. Our charge and responsibility was to do the analytical work.

Q On the tissues after they came back?

A Yes.

Q Who determined which animals would be used for this test?

A The Medical Department.

Q Do you remember what the duration was? Did

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the duration differ depending on which animals were used?

A Depended on the test.

Q Which were the tests, specifically?

A Some of them were chronic work up to two years. Some would be 30-day tests. Some would be 90-day tests. Some would be mutagenic tests and different protocols for watching different effects, different lengths of time.

Q What company or companies conducted these tests?

A In the main, Industrial Bio-Test.

Q Do you remember the time frame in which these were being conducted?

A Yes. The preliminary discussions were mid-'68 and some of the more final protocol discussions were in the end of '68. Tests were probably under way, actually, in '69.

Q Was this before or after the biodegradability studies were done?

A The analytical test results were coming out simultaneously, but we started, the Ruabon work in, I guess, June of '60, so the results were coming out from both programs during '69 and 70.

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Q And your department was concerned with evaluating the biodegradability studies and the data that was coming out of the biodegradability studies and drawing conclusions?

A Well, we drew conclusions on the microbe biology, sludges and so forth. That was just a question of disappearance and it was analytical work.

The medical interpretation, the work with animals was being interpreted by the Medical Department in conjunction, I guess, with the analytical results that came from applied sciences.

Q But there were two different testing programs?

A Yes.

Q One was biodegradation carried out by you and one --

A One is metabolism in animals; chickens, rats and dogs.

Q And the metabolic testing was different than toxicity testing?

A Well, it is part of the toxicity testing. It is part of the toxicity.

MS. OLIVER: Is that part of the tissue testing that you talked about?

THE WITNESS: The tissue testing in which test

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animals were being fed in controlled conditions in the Bio-Test and they would sacrifice animals or whatever and take various parts of the animals and then we would come back and analyze those things.

BY MS. STEIN:

Q For concentrations in various tissues?

A For concentrations and isomer disappearance.

Q Were you also looking for any kind of mutagens that occurred or deformities in the tissue?

A Well, you have to ask, the tissues were examined by a pathologist. I know nothing about that.

Q Who developed the protocols for the metabolic testing?

A The Medical Department and Industrial Bio-Test.

Q Did your department pay for part of these?

A Yes, we probably were billed.

Q Did you have any input into those protocols?

A No, not the details. I certainly did not. A little bit, maybe in the selection of what compounds we were going to run, but not in the protocols themselves.

Q Do you know whether anyone in your department had input into the protocols themselves?

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A Insofar as tissue work is concerned, we told them roughly how many we could do and tried to learn, or well did learn how to handle tissues and so forth. And we did learn how to do an extract and handle them, so if this is part of the protocol, yes, that is the part that the Research Department did.

Q Were the results of toxicity testing, the metabolic studies, were the results of those metabolic studies ever published?

A They were given to the Government. They were presented to the PCB task force. I have forgotten who was on that.

Q Do you remember when that was?

A I guess around '72.

Q Earlier you mentioned that Monsanto had not looked at the biodegradability of low soluble compounds before, I believe?

A Had not?

Q Had not looked.

A Had not looked.

Q At the biodegradability of compounds that had --

A I don't remember ever looking in general, yes.

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Q Do you know what the reasons were for not looking at those kinds of compounds?

A I don't think anybody looked at those sort of compounds.

Q Does your department have some kind of a mechanism for the chemists or the engineers to keep up with literature in a particular field?

A Yes.

Q What is that mechanism?

A There is an automatic circulation of abstracts.

Q Who does that circulating, do you have a service?

A Library, the Monsanto Library, Monsanto Technical Reports Library.

Any chemist can go to the library and ask for subject matter.

Q Are abstracts of articles or titles of articles in a biography form of some sort circulated to your department or to the Research Department?

A Each person has a profile of what he wants to see and the library will circulate the titles of articles and so forth to fit your profile.

Q Is that an automatic service?

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A You have to figure your profile each year and it is not automatic because you have to pay for it.

Q Does the department budget pay for this service?

A Yes.

Q To another portion of Monsanto?

A We have to pay the library. It depends on how many subscribers and so forth. There is a certain charge for the circulation, just to pay for it, that's all.

Q Was a mechanism like this in effect at the time you were Director of Research of the Functional Fluids Group?

A I believe it's been in effect a long time. I can't give you the exact date.

Q Did you have chemists who had a profile, if you will, indicating that they would be interested in polychlorinated biphenyls who were on this list from the library?

A I don't know whether the profile would be that specific.

Q Did you ever --

A It might be aromatics or something like that, that would be more likely, or maybe chlorination.

It would be more general.

Q Did you have a topic like that on the profile for you at any time?

A My guess is yes. I see a number of abstracts or titles; really, not so much the abstracts but the titles, and see some patent abstracts that appear to be printed.

Q Do you remember when you first started to see titles or abstracts that related to chlorinated biphenyls?

A There are articles, I mean going back into when I first came with the fluids group which would be '63 or '64.

Q When did you first see an article on their presence in the environment?

A I didn't see the article but it was referred to me, probably I saw it in the early part of '67.

Q Do you remember whose article it was?

A I think probably you are referring to the first one I heard about, would be Jansen-Widmark.

Q Do you remember how that was drawn to your attention?

A I really don't. Whether it was a report from our operations or how we got that, I don't remember.

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Q Do you remember whether that report specifically mentioned Aroclors?

A I doubt if it did. It was probably in the realm of chlorinated biphenyls.

Q When did someone at Monsanto first come to you and indicate there had been articles or publicity about the widespread presence of PCBs or Aroclors in the environment?

A There was no one time. Jensen and Widmark had taken samples, limited samples.

Q A limited --

A A limited number of samples from one particular area of Sweden. I have forgotten where they got their samples from, but they were looking for DDT residues and in fish samples.

Q Were there samples: water, tissue, sediment?

A I think they were fish samples, tissues. And the amount of business that we did in Sweden was limited so I don't think we knew or we were certainly not aware whether it was widespread or not. We weren't even sure that it was with chlorinated biphenyl at that time.

Q Could you describe what you meant by we?

A Well, Dr. Keller and I talked about it. I

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went to him and said, "Do you think this is true or not?" and Dr. Keller didn't know whether Jensen's work was correct or not.

Q Did either of you take any steps to try to follow up to verify the accuracy of those reports?

A Well, what we decided to do was to see whether we couldn't begin to -- Jack, or I shouldn't say Jack, to improve our analytical capability so that we could in fact determine whether this report was accurate or not.

Q What steps did you take to improve your analytical capability to see whether the report was correct?

A I think Dr. Keller would have to describe that, but one of the main problems was to get a mass spectrometer that was sensitive in the right molecular mass weight range and hook it to a gas chromatograph, a very sensitive gas chromatograph so you could begin to tell in a very complicated inspection what the mass numbers were and then analyze those patterns later, once you got the economic equivalent. Sample preparation would be very difficult and you have to analyze whether the spectrometer cracking patterns would fit.

So we didn't really feel comfortable

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with the methodology until '70, really.

Q What mass range were you looking for for sensitivity on the mass spectrometer?

A You have to ask Keller that question or some of the guys down there that run the mass spectrograph. I don't know the cracking patterns. You have to know the cracking patterns.

You start with a molecular weight, but then you start ripping the molecule apart so you start going down in steps.

Q When did Monsanto first obtain mass spectrometry equipment?

A I honestly don't remember, but probably somewhere around '68. We had mass spectrographs but the mass spectrometers, you always fiddle around for the right mass range and they were also a very difficult instrument to analyze. It wasn't until the spectrometers, mass spectrographs got better and until the analysis, until you had the computers and so forth so that the analysis came out better and you had to have gas chromatographic separations in complicated cases because you couldn't unscramble the mass if you don't unscramble the compounds first. The isomers and environmental data is still more

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difficult than if you start with chemical compounds. It is not an easy analytical job.

Q What are the reasons that you think it is more difficult than when you are using environmental samples?

A You don't know what's there. You have to separate other organic compounds. You have to separate for proteins, but the details of this you need -- I don't know the details. You need to ask somebody else. That is a whole science in itself.

Q But you got the first one which you were comfortable with in 1968, you say?

A No, I said we got working on it but I said I didn't really feel comfortable with the analytical methodology until 1970. A lot of the work with ASTM Committees and Ruabon, we got some analyses, probably in '68, the end of '68, '69.

Q What else did you do to follow up on improvement in analytical capability other than getting MSGC capabilities?

A I think the isolation procedures. Of course then the environment itself is important.

Q What do you mean by isolation procedures?

A Well, depending on the sample, you put it

through a series of extractions and concentrations. Sometimes you use acids and sometimes you don't. There are all sorts of handling techniques to make sure it is not adsorbed on glass, make sure the laboratory itself doesn't have any quantity in the air, things like that.

Q Who would, Dr. Keller on the developing of these analytical techniques including isolation procedures, et cetera?

A Dr. Tucker and I guess Sager worked on it, too. I don't know whether Dr. Mieure was involved. Dr. Kelly later on, but I guess the development really fit in with the first two.

You keep refining the methods and I'm not sure when Kelly came and Mieure came.

Q Do you know how Dr. Kelly spells his name?

A K-i-e-h-l-e?

Q Did Dr. Tucker report to Dr. Keller and Dr. Keller report to you, is that correct?

A Only in a functional way. I don't hold administrative control on Keller. We went over that already. He was head of applied sciences.

Q I am trying to get exactly the conversations that were about these findings.

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A The findings, yes, but --

Q The findings he discussed with you.

A But administratively, I didn't have -- way out of the picture.

Q Do you know with whom, with what other people Dr. Keller discussed these findings?

A I'm sure Mr. Wheeler, I guess Dr. Kelly, Dr. Levinskas.

Q Could ycu tell me who Mr. Richard Davis is?

A Davis? First, he's a Monsanto employee, chemical engineer from Pittsburgh,Polytechnic.

He was hired Product Manager.

Q For what products?

A Probably the hydraulics, and I don't know if he transferred or not. Maybe he transferred.

Q Did you work with him?

A Yes.

Q How did you relate to each other, was one a superior or was it --

A No, he was in a different function. He was in the marketing organization. I was in research.

Q Did you have any marketing responsibilities at all?

A No.

Q When did you first start working with him?

A Probably '64, but I'm not sure Dick had the exact title. I think he had been in the fluid area and either marketing or development jobs.

Q Did you work with him on the development of Pydraul 50-E?

A I don't believe he had the job at that time.

Q Do you know whether he was involved in the development of Pydraul A-200?

A I couldn't tell you that.

Q Were you involved in the development of Pydraul A-200?

A No.

Q Were you involved in the development of Pydraul A-200B?

A Yes.

Q Can you tell me what Pydraul A-200B was, what chemical composition it was?

A I think it is Santicizer 140.

Q Pardon?

A Santicizer 140, Santicizer 711 and Aroclor 5432.

Q What does the 54 stand for?

A That is the terphenyl.

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Q Terphenyl means three benzenes?

A Yes.

Q What is Santicizer 140? Are there any polychlorinated biphenyls in it?

A No.

Q And Santicizer 711?

A Phthlate ester.

Q Could you describe for me from the beginning the process of development of Pydraul A-200B. When did you first start to develop it? Did the idea come from your department?

A Probably. It must have been about '69 or '70, in that time frame.

Q What was the impetus for developing Pydraul A-200B?

A We wanted to keep Aroclor out of the environment.

Q Keep all Aroclors out of the environment?

A Probably interested in keeping the chlorinated biphenyls out of the environment.

Q What are the chemical differences other than the third benzene ring we were talking about with a terphenyl? Was a terphenyl as effective as a biphenyl for, say, fire-resistance in a hydraulic

fluid?

A Well, the difference is that molecular weight is higher with less chlorine on it.

Q What is the significance of that?

A What we were trying to do is to keep the chlorine content low enough so that it would not be an environmental hazard and still retain some of the solubility parameters it needed to put the fluid together for fire-resistance.

Q How did you make PCTs?

A We made them by chlorination of terphenyl.

Q Were there any biphenyls in the reaction?

A There were some, maybe a tenth of a percent or some low amount which we couldn't separate, but relatively small amounts.

Q Did you take benzene rings and infuse them? I am not exactly sure what the chemical reaction is you followed.

A You take a benzene and make biphenyl and make terphenyl and you separate them by distillation.

Q Did you use some kind of catalyst or distillation agent in that or heat or some kind of fracturing mechanism? How did you do that?

A The natural reaction is that high temperature

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to make the benzene give off hydrogen and make biphenyl and terphenyl and make some water phenol. Then you do water distillation and make separations.

Q What happened to the PCBs that were created during that process of the experiment?

A There is no chlorine in that.

Q Just a reaction in the benzene rings?

A Yes.

Q And you later chlorinate?

A We later chlorinate, yes.

Q After the fracturing of distillation?

A After the fracturing of distillation.

Q Now, I believe you said you were doing the terphenyls because you were trying to keep the chlorine low enough so there would not be an environmental hazard.

Did you have some data that indicated it was the chlorine content that was the hazard?

A Remember I told you that the biodegradability work we had done at Ruabon and biodegradability work we had done on Aroclor at St. Louis indicated that the four chlorines out -- in other words, the lower the chlorine content, the easier it was to biodegrade.

So we thought that the bugs could chew

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on compounds if they weren't too highly chlorinated. And in fact, others, other reports from other laboratories began to confirm this and we in fact went to Sweden and in Sweden couldn't find Jansen, but we went to see Widmark in '69.

And he told us the same thing, that at least his analytical results seemed to indicate things that looked like Clofin 50.

Q What is Clofin 50?

A It is the equivalent to Aroclor 1254 and it is a germing product.

Q Who manufactured it?

A I think probably Baird, but they supply, I don't know whether all, but at least a share of the Swedish market.

Q Let us back up a minute.

On the polymerization, you said you did studies in which you did not follow through all the way on what the metabolic products were?

A We watched the disappearance of chlorinated biphenyl plasticizers.

Q You were just seeing whether or not there was, how long these two benzene rings with chlorine on them stayed in this sample, is that correct?

A Yes.

Q Over a given period of time without following through on the compounds into which they might have degraded?

A Yes.

Q Just whether or not there would be X number of them in a given millimeter of water and after a specific time frame?

A Yes.

You realize that to go further, we were pushing the state of the art then, and to do a metabolic study the parts were billion range and the compounds they could degrade to was a very formidable task, a very formidable task.

Q You said there were other studies that were being done along these same lines. Do you remember who was doing those same studies on the biodegradability? Were those simply directed towards Aroclors or towards PCBs under different trade names by different manufacturers?

A Well, I guess nobody knew who was Aroclor or chlorinated biphenyl but they might take an environmental sample or might take river water samples and look and see what was there.

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Q Do you remember who was doing some of these other studies and when they were being done?

A Keller and Wheeler, one specific trip, went to Europe in '69, early 1969 after Keller had felt they had gotten somewhere in the analytical methodology and went to various labs. He went to Shell, I think in England. He went to Scotland and I don't know whether he went to Holland. He may have, but those were the places that we knew were working on pesticide residue.

Q Who was doing work in Scotland, do you remember?

A I think it was Holden's lab, but I never met Holden.

Q Do you know where that was located?

A Scotland, I don't know. Bob said it was cold.

Q Let us go back to Pydraul A-200B. Were the PCTs, were they as stable as PCBs?

A I think they were slightly less stable.

Q Do they divide into PCBs?

A I don't know that, but I would be very much surprised if they did. I don't think they would.

Q What is the basis for your supposition that

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they would not degrade into PCBs?

A I think it would be very difficult to split just one ring off.

Q Is that because of the nature of the bonds between the rings?

A Yes. I think if you split it, you leave some oxidized fragment on the place where you are splitting it. Again, that is a metabolic kind of thing or oxidative kind of thing. I don't know that much about it.

Q I believe you said it was in 1969 or 1970 when you started making Pydraul A-200B.

MR. SCHINK: I think he said began to develop it.

BY THE WITNESS:

A Yes.

BY MS. STEIN:

Q When you began to develop it.

A I think it was issued. We began to sell it in '71.

Q Who was involved in the initial discussions that led to the development and ultimate marketing of A-200B?

A Initial discussions would probably be

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Lou Stark and perhaps John Herber.

Q Was there anyone else?

A Possibly myself, I don't know.

Q Was there anyone from marketing who was involved?

A I would say that this is research. We have already indicated that Medical was involved and obviously that marketing would have to begin to agree so that marketing was involved.

Q How about manufacturing?

A Manufacturing, too. Could they manufacture, certainly the business director, in this case Larry Birch, would be coordinating this whole effort because no single function was going to make a decision on making or marketing a new product.

Q Who is Lou Stark and what is his title?

A He is a group leader, worked on the formulation and testing of heat transfer and hydraulic fluids.

Q Testing for performance specifications?

A Yes, not all performance specification, but a good many.

Q Which ones was he specifically involved in?

A Normally on oxidated stability, pump corrosion,

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viscosity and control, additive control.

Q Who else was testing on products to see whether that met certain performance specifications?

A People that work for him.

Q What was his title then, group leader?

A Group leader.

Q For formulation and testing?

A I don't know if we had much of a title beyond group leader.

Q Who from Marketing was involved?

A I don't know for sure, timewise, but Norm Johnson, probably Don Olson. Davis may or may not have been in.

Q Do you remember who was involved from the Medical Department?

A I would think Wheeler, basically.

Q Do you know whether Dr. Kelly was involved?

A Yes, he had to be because Wheeler reported to Kelly. Bergen didn't make his decision on his own either. He had to take it upstairs.

Q Upstairs would mean who?

A His boss.

Q To Minkler?

A I think by this time it was Minkler and he

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would probably have to take it to John Mason.

Q Was Mr. Mason a general manager, was that his title?

A Here again, I think he was Assistant General Manager in Organic. Don't pin me down to all these titles at this time. He was not the big boss.

Q Was there anybody higher in the hierarchy than Mr. Mason who was involved?

A If it was still Organic, and I don't know where it was, it would be Minkler and if it wasn't, I might have -- let me stop there.

Q Would that have been an executive vice president who had responsibility over this unit or did Monsanto have an executive committee who had a liaison of some sort?

A Yes.

Q Do you remember who that was?

A No.

Q While you were at the functional fluids group, who had the ultimate decision-making authority as to whether or not a product came on the market?

A That is what we just discussed. I don't think there was any single person.

Q The highest level in the company? I realize

there are a lot of people you will be involved with, but I am trying to --

A I don't know. I would have to remember the hierarchy at that particular time and I don't honestly remember it.

Charlie Summer was Chairman and chief executive or whatever. I'd have to see the dates, timetable. I don't have it.

Q But do you know whether the Chairman of the Board of Monsanto had to approve every product that the company manufactured?

A I doubt it. He probably was held accountable, but he would certainly depend on the managing director or the general manager, depending on which organization we are talking about.

Q With respect to Pydraul A-200B, was any toxicity testing done?

A I'm sure there was. I don't specifically know what was done.

Q Who would know the answer to that?

A I would think it would be the Medical Department who may have been component testing, too. I think I indicated that earlier.

Q It might have been on Santicizers?

A Santicizers were already on the market; 140, 711 and 5432 were already on the market so there were plenty of known compounds.

Q Are you saying because they were known compounds they might not have been tested?

A I don't know whether the combinations were tested or not.

Q When was the Pydraul A-200B put on the market?

A Probably '71.

Q Was it used to replace A-200 or any other fluids?

A I'm sure it was designed to replace A-200, but anybody else that wanted to use it I'm sure could consider it.

Q It would be compatible with or suitable to replacing, say, Pydraul 312 or Pydraul 625?

A You will have to ask somebody else on that. I don't remember. Some of them were, some of them were not.

There were procedures that had to be used and in replacing fluids and some were compatible, some were not.

Q Who would be the person who would know the

answer to that?

A I think Lou Stark would probably remember best. It was his technical responsibility anyway.

Q Did you have any association with any of the sales force in the functional fluids group?

A Ever call on customers, do you mean?

Q That wasn't the question, no.

Did you ever work with any of the sales representatives who worked with particular customers while you were in the functional fluids group?

A The chief function of the sales representative was to call on customers and then relate back to the Marketing Department in Monsanto through the Product Manager, the Marketing people in St. Louis and the Product Managers and Marketing, so in general, I was removed from the field sales people. Except if I went out on a call, I never -- I guess I think almost never, never made a sales call on a hydraulic customer.

Q Did any of the sales representatives in the functional fluids group ever contact you directly by telephone?

A I would not say never, but the normal thing

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would be to contact Lou Stark. If they wanted anybody in Research, it would probably be Lou.

Q Were you ever copied in on correspondence?

A Oh, yes.

Q Who copied you in, the sales representative directly or the product manager or the marketing representative?

A I'd say yes.

Q All three?

A Yes.

Q What kind of information was passed along to you from sales people, problems particular customers were encountering with the products?

A Yes, I would say so. We receive a lot of information. I don't think it was culled and segregated.

Q Did you ever work with the marketing people in trying to resolve specific problems of any customers?

A Where?

Q Let us say in hydraulic fluids.

A I never made any direct calls on hydraulic customers.

Q No, that was not the question.

The question was whether or not you worked with the sales people to respond to a particular

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problem that a hydraulic customer had, not whether you made a call on a specific customer.

A Can you be more specific? Can you give me an example?

Q Did anyone contact you with respect to Johnson Motors Corporation?

A Contact me direct?

Q Yes.

A Sales rep?

Q Yes.

A A sales rep and not a product specialist?

Q A sales representative.

A I would say I won't say never, but in general, no.

Q Were you ever copied in on correspondence from sales representatives?

A Yes.

Q Did product specialists contact you?

A Yes.

Q Who was the Pydraul product specialist between 1965 and 1972?

A Not one man, I don't know.

Q I would be happy if you could give me the names of any that you remember.

A '65?

Q Yes.

A Probably Dale Smith. I'm not sure of the dates. It would probably be Dick Davis, later on, or Larry Bradford, but he wasn't in the sequence. He was later.

I don't know whether Roger Hatton was involved.

Q Are any of these people still with Monsanto?

A Hatton is. Davis is.

Q Is Mr. Bradford?

A No, he's with a paper company or left for a paper company.

Q Do you know which one?

A No, Boise-Cascade -- no, don't put that down. I am guessing.

Q If you don't know, fine.

A Jerry Davidson is another person.

Q Is he still with Monsanto?

A No.

Q Do you know where he is?

A Left for a car-crushing company.

Q Do you know how long ago he left?

A No.

Q Who would have been the product specialist when Pydraul A-200 was put on the market?

A Whoever it was at the time, Davidson or Bradford, I guess. I don't know.

Q Do you know whether PCBs just in hydraulic fluid degraded into phenol compounds?

A Under normal circumstances, no.

Q What would be circumstances under which they might?

A I would think youwould have to have a, run a pump reaction, water or something like that. In the presence of water, probably not even that; very unlikely, extremely unlikely is a more correct answer.

MS. STEIN: I think this might be a convenient point for a short break.

(Brief recess had.)

BY MS. STEIN:

Q Dr. Richard, do you have any responsibility for the preparation of Monsanto technical bulletins?

A I guess we have to furnish some of the content, but I would guess that each of the functions has to be responsible for that part of the document that they write and furnish. But there has got to be

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a normal procedure after the thing is all put together. Marketing would normally put the document together and Medical would put their section, Patent would read it and Legal would read it and I don't know, you'd have to put -- that would be a general procedure.

Q Was that the procedure when you were in the functional fluids group as well?

A Yes, I think so.

Q Are drafts circulated to the various groups that have responsibility and did your group have responsibility?

A I can't swear that this happened in every instance. Sometimes there is no controversy or no technical information and it might not be circulated. If there is just visual property data, then that information would come from the Research Department, physical research. Originally that would either have to come from the literature or from prior determinations or from the Technical Department.

Q From the literature from outside of Monsanto, just general literature?

A Chemical literature, if it is there.

Q Was the Research Department involved in the development during the time that you were in the

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functional fluids group of sales brochures for various products?

A Again, when you said sales brochures, primary function would be to the Marketing Department.

Q I am distinguishing between sales brochures and technical bulletins. I am not sure what the difference is in-house.

A The Marketing Department would do both of them and if there were any technical information in it, yes, we would have to read it. If not, it could come from literature; we might not.

Q Do you know what audience the technical bulletins were aimed at as opposed to the sales brochures?

A I cannot really answer that with authority, no.

Q Was the Research Department of the Functional Fluids Group involved in the development of warning labels or labels on products?

A In general, no. That is not our function.

Maybe we would furnish input, some input, but our department would not be putting the labeling together or the warning.

Q What department would have that responsibility?

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A Marketing and to some extent, environmental people like Papageorge.

Q Did the Medical Department have any input into that?

A I'm sure they did.

Q During that time do you know what considerations would go into the development of a warning label?

MR. SCHINK: I think he said Research was not involved. That calls for speculation.

I object to the form of the question.

BY MS. STEIN:

Q Do you know whether or not any Pydraul labels were ever changed during the time you were Director of Research at the Functional Fluids Group?

A I have no direct knowledge.

Q You had discussed earlier, the fact that your department was involved in the input for toxicity tests to the extent of saying what intended exposure would be from a product, isn't that correct?

A Intended exposure?

Q Or the intended uses.

A We would indicate to the Medical Department it was a hydraulic fluid or a heat transfer fluid, that is what I am talking about.

Q Were there any particular considerations that you would give to potential exposures? Who developed the hypothetical situation that it might drop out in somebody's eye, might be sprayed in the air? Did you examine those things?

A No.

Q Do you know who did in Monsanto?

A Medical would have the prime responsibility of industrial hygiene.

Q Was there a particular individual in those departments who had responsibility for that with respect to functional fluids?

A Yes, I think Wheeler had the prime responsibility over a good share of the time, and Levinskas was involved later.

Q From your experience as the Director of Research at the Functional Fluids Group, was there an average time that it took to do a proposal of a product to its actually getting on the market?

A It could vary.

Q Could you give me a range?

A Two to seven years, maybe.

Q Can you tell me what some of the factors were that would affect the time it would take from

the proposal of a product until its actually getting on the market?

A Yes, the number of things you had to invent.

Q Could you specify?

A If you had, for example, invented a new base stock and you had to invent a new catalyst and make the base stock, if you had to make or invent one of the components that went into it and you had to line up a manufacturing facility that you didn't have, if there were any problems anywhere along the testing application, medical line, you had to start back over again.

Q What kind of problems?

A An incredible number of things that can happen.

Q What about the budget within the Research Department? Did that have any impact?

A What about the budget?

Q Would that have had an impact on the time of the product getting on the market?

A Sure, the number of people you have available.

Q How many research chemists did you have in the Research Department in 1966, in your Research Department?

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A Functional Fluids Research Department?

Q Yes.

A In '66, there were maybe 15, 20 maybe.

Q How about in 1968?

A It was the same directly reporting, in around the same number, but we were probably running a bigger deal than, say, applied sciences in '69 than we did coordinating with three or four people in our group.

Q How about 1970? How many research chemists did you have reporting directly to you?

A Same order of magnitude, 20, 25 possibly.

Q Did the Research Department of the Functional Fluids Group contract out some of its studies or any of the tests for proposed products during the period 1966 to 1970?

A Some of the tests like maybe a specific pump test or two, if we didn't have the equipment, we might have requested elemental analysis outside Monsanto for some reasons.

Q What were the criteria that were used for the reasons for contracting out? You indicated for example a specific pump test?

A Usually we didn't have the equipment and it wasn't frequently used and therefore, we would request

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somebody else to do it.

Elemental analysis, we went outside just because it was a way of getting more help than the routine way, routine test.

Most of the time we had to do test development ourselves and I think we were reasonably good at it.

Q Who has responsibility for choosing the firms through which work is contracted out?

MR. SCHINK: You are still talking about performance testing and research?

MS. STEIN: Performance in Dr. Richard's department when he was in functional fluids, yes.

BY THE WITNESS:

A That depends on the size of the test. If it was within my budget authority, I could usually contract it provided it was. If it was something regarding a secrecy agreement, the Legal Department would have to okay the secrecy agreement if it came to that.

If it were beyond my function of the budget authority, I would have to go to the Business Director for approval.

BY MS. STEIN:

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Q Is the time that the company wants to get a particular product, the time frame for getting a product on the market a factor in determining whether or not the work is contracted out?

A It is such a general statement. If you are talking about functional fluids, outside of medical staff, we are not talking about that, right?

Q We are still talking with the testing in the Research Department.

A We are talking about making base stock and formulating base stock and figuring testing, I'd say there weren't very many places that we could conceive of doing that work, having the capability of doing that work, and no real place to go to to do all those three things, the three functions and making them mesh.

Q What are some of the companies that you have contracted with to do some of the product testing as opposed to the toxicity testing?

A The AIT test like the Computer of Minds would be placing special explosion on a special apparatus, maybe phenol, or once in a while we had to go to an insurance, fire test at an insurance outfit in Boston if we wanted to run a particular

hydraulic fluid, but we had our own fire test facilities as well. It would be more to get approval.

Q If it were above a particular dollar amount, that would impact the time frame because of the different approvals?

A No. I would just have to get budget approval, but if it had to be done, that was normally granted.

Q Were there, during the time you were Director of the Research Department in Functional Fluids Group, any products that there was a lot of pressure on you to do the testing quickly to get them out in the marketplace?

A There is always pressure.

Q Any particular great pressure like I want to get X out before Y date from, say, the marketing people?

A I think it would be the other way around. I think it would be pressure on ourselves to see what we could do and more likely, we would say okay, this is the target date when we think we can get it done.

Q Did you ever work out these target dates in conjunction with marketing people, medical people or anybody else?

A It would be worked out within the business

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group, most likely, a combination of the business director and Marketing man would be present, Commercial Department man might be there. Manufacturing would be there, Research would be there trying to make these things dovetail.

Q Were there regular meetings among the various functions, representatives of these various functions?

A Yes.

Q About how often?

A I don't know, at least once a week and maybe more often depending on the project, what was going on.

Q And you discussed the priorities within each of your group and tried to coordinate them, is that correct?

A Yes.

You understand on approvals. From UL, for example?

Q Yes.

A Some of the fire tests and things like that had to be tested outside.

Q How long did it usually take to get UL approval on a proposed product?

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A I think UL was reasonably good as long as you foretold, told them when you were going up there and made dates ahead, things like that.

Q While you were there, did you send hydraulic fluids to UL?

A More dielectric fluids than hydraulic fluids, but hydraulic fluids also went up there for approvals. I have forgotten Factory Mutual. Factory Mutual was one of the big ones, they had approval for testing, fire approval.

Q When you did product testing in the functional fluids group, did you keep records of the data?

A Yes.

Q For how long?

A Probably still in existence.

Q Who would have control of those documents or would know where they are?

A Technical Reports Library.

Q That is in the Research Department or is that --

A In the Research Center.

Q That is also in St. Louis?

A Yes.

Q What is the address?

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A 800 North Lindbergh.

Q If you contract outside, do the contractors turn the raw data over to Monsanto and then Monsanto keeps that raw data?

A In most of the testing, the fire testing, for example, we would go up there and be there when the tests were conducted, most times.

Q Who has access to the data from the tests that were conducted in the Research Department during the time you headed the Functional Fluids Research?

A Access?

Q Could I walk up and say I would like to see the data, please?

A I would think you would have to place a request, a formal request for it.

I am sure people within Monsanto could get that information unless it was labeled restricted. And people on the outside couldn't get it unless there was a reason to show it.

Q What kind of information would be marked restricted?

A I don't know. People, Government contract work might have some restrictions on it. We do work for the Government, things like this.

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I doubt if anything would be marked restricted in the test area we are talking about.

Q After a product got on the market, during the time that you were in the functional fluids group, was it common to do any kind of testing after the product was on the market?

A Well, it was normal, common to do testing before it was a prepared product. It was assigned a MCS number and then taken out, done in our own shop, what we could do and so forth and then it was often tested as a development chemical, development product under a MCS number, but before any formal declaration or anything going over to the marketing was done by a combination of research and development.

You don't put a marketing label on something unless you are pretty sure it is satisfactory and normally it would go through to the MCS number stage.

Q This is the performance testing, is that right?

A All kind of testing.

Q What about toxicity testing?

A Same way. If we want something outside, we would put an MCS number on it or it could be for

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toxicity testing, could be for performance testing.

Q During the time that you were a Director of the Research Department of the Functional Fluids Group, do you know of any instances in which toxicity testing was carried out for products produced by that group after the product had already been on the market?

A Sure. I mean if you found that something was happening outside, you might be testing a component, biodegradability of an Aroclor.

Q Were there any other products other than the Aroclor toxicity studies that were run?

Were there any other hydraulic fluids, for example?

A Well, sure. If you ran into an application where you felt that there was a hazard, why you would come back and run tests and try to find out what the limit should be, what the warning should be on the product.

Q Do you know of any products on which further testing was done such that the product was removed from the market, toxicity testing?

MR. SCHINK: Or where the toxicity test was the cause of the product being removed?

MS. STEIN: Or a cause of the product being

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removed from the market.

BY THE WITNESS:

A In the fluids area, you are talking about, or just in general?

BY MS. STEIN:

Q Any of the product produced by the functional fluids group during the time you were Manager of Research there.

A If you are talking about broad toxicity testing now or what kind of toxicity test are you talking about?

Q Acute or chronic.

A Acute or chronic, I think the decision to replace certain hydraulic fluids were based on a combination of things.

I think principally elemental problems in the case of the Aroclors --

Q Who was involved in that decision? What was your role in that decision?

A Gathering information.

Q From whom?

A Legal, analytical, biological, biodegradation work, contributing thoughts on whether it would be persistent in the environment, working would be a

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combination of myself, the Medical Department, Marketing, Business Director and his boss. It might be a function of higher, a still higher management before final decision was reached one way or the other.

Q Did you ever make any personal recommendation that a specific product should be removed from the market due to a potential adverse health or environmental effect?

A As far as health, I think we did not. Let us see -- adverse circumstances as far as environmental presence, the answer would be yes.

Q What were those products?

A The chief environmental issue was with chlorinated biphenyl and compounds, or I should say products that those compounds were in and a lot concerned the higher chlorinated species which we were finding in the environment.

Q Were you involved in the decision relating to the timing of the withdrawal of those products from the market?

A Timing? What we did was try to find out whether the environmental samples were in fact chlorinated biphenyl first. We had to develop an analytical method, and secondly, we tried to keep

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track of the extent of environmental spread; in other words, whether or not at a particular location in the world where they were widespread.

That information was coming back to us around '69, '70.

Q Were you involved in any efforts or projects to determine the sources of PCBs in particular locations?

A We saw how they got into the area off Sweden where Jensen had found them or any other area.

One of the reasons we went to Sweden was to try to find Jensen. I don't know where Jensen was, but we talked to Widmark, his professor, and Widmark had talked to the Swedish transformer people and apparently had decided that that wasn't the source of Aroclor, and what he told us, he thought it was coming from paint on the bottom of ships, anti-fowling paint.

Q Did he tell you what the basis was for that conclusion?

A Other than what was contained in those coatings and, of course, it would be contact with water.

Q Had he analyzed some of these paints?

A I don't know that. He analyzed the fish

and I guess he had contacted Baird to find out what Clofins they were making and perhaps what they were selling in Sweden.

Q Did the Research Department or any other part of Monsanto undertake an investigation to determine the sources of chlorinated biphenyls in other places?

A We did sampling, yes, we talked with WARF.

Q Who is WARF?

A Wisconsin Alumni Research Foundation and Wheeler and sometimes Keller would visit the laboratories we thought or knew were engaged to try to find out where the materials were located.

WARF did a study on the Great Lakes. We did some samplings in smaller numbers of samples trying to check our methods and see whether we thought those studies were correct or not. We had no team big enough to spread around the world to take analytical, take samples and do all the analytical work. There were hundreds of people throughout who seemed to be doing this.

Q What year was this?

A I would say the date that they began had to be back in '69, early '70.

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Q When did you first start your effort or when did Monsanto first start its effort to locate PCBs in the environment?

A I said that the first report came back on the possibility of it, but I read it in early '67. We began to try to find out whether this was an analytical truth or not. I think some of the first work that was present in the United States came from Risebrough and analyzing fish samples and some bird samples on the West Coast.

That was the first story on the U.S. reports and then I think WARF was in early '69 and I don't know when they published their information, but later than that.

Q Did you contact them or did you initiate any kind of studies or contract any outside work to try to --

A We might have contracted a little with WARF. We talked with them or may have informed WARF if we had asked them to visit Monsanto. We asked Risebrough to come and talk with us.

Q Did you ever talk to Risebrough?

A Yes, we spent two days with Risebrough.

Q Did you talk to him personally?

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A Yes.

Q What were your conversations essentially?

A We told him some of our findings, about biodegradation. We told him about the production of the Aroclors, how much was being made and he wanted to know how much they were being sold for.

Q Pardon?

A He wanted to know the price. They were shocked at how little money we were making.

(Richard-Plaintiff Deposition Exhibit No. 2 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, I am going to show you what has been marked as Richard-Plaintiff Deposition Exhibit No. 2 for identification and ask you if you have ever seen this document before.

A The answer is yes.

Q Did you review this document before you came here today?

A Yes.

Q Did Dr. Davis write this memo to you as a result of an inquiry from you?

A Yes.

Q Could you tell me, please, what the inquiry was?

A In mid-'68 the FDA, Glasgow, contacted me for samples of various Aroclors.

Q Go on.

A And I wrote a letter pointing this out to Davis and asking him a "what if" question, what if Aroclor is in the environment, how is it getting out, how might it be getting out and what might be done about it.

Q Was this his response to your "what if" question?

A I think that's right.

Q Did you have any discussions with him about this subject?

A I don't recall specifically.

Q Had you asked him about fluid recovery systems as well?

A I was aware that Findett was reclaiming, was aware that Findett was reclaiming heat transfer fluids, Aroclor heat transfer fluids.

Q But did you ask him specifically about reclamation for hydraulic systems?

A No, I don't think I asked him specifically

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about it. Dick came back with this letter spelling out that Findett worked with some customers to actually not reclaim so much, not to collect, but to filter and lower acidity and so forth and reclaim fluid for a certain customer.

Q Did your department have any role in the development of fluid recovery for reclamation systems?

A On occasion, we worked with Findett and discussions, technical discussions took place on occasion with Findett. Later on in '71, '72 area, Monsanto considered setting up reclaimed facilities for hydraulic fluids.

Q Were you involved in determining what would be the acceptable level of removal of a contaminant and whatever of reclaimed fluids, or did you ever test any fluids that had ostensibly been reclaimed so as to determine whether they met performance specifications?

A We did. This was one of the most difficult jobs, is to reclaim fluids and bring them back up to new product specifications. It is a very difficult job, but we were sometimes involved in setting specifications, trying to set the specifications.

Q Did your department ever work with the

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customers or conduct tests for customers to see whether or not reclaimed fluid met specifications?

A Yes, on occasion.

Q Did they ever do it for Johnson Motors?

A The specific question, did we set specifications on reclaimed --

Q Did you ever test any reclaimed fluid to see if it met specifications?

A For Johnson Motors, I cannot say specifically whether we did or not.

Q Who would have actually conducted the tests in your department? Would you?

A It would be more likely through Lou Stark than anyone.

(Richard-Plaintiff Deposition Exhibit No. 3 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, I hand you what has been marked as Richard-Plaintiff Deposition Exhibit 3 for identification, and ask you if you have ever seen that before?

A Yes.

Q Did you write this memorandum?

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A Yes.

Q What was the purpose for writing this memorandum?

A The purpose was to report a conversation I had with Mr. Francis Coon.

Q How did you know who Mr. Coon was? Had he contacted you before?

A My recollection is not clear on this. My guess is that Coon either came before or after this to Monsanto. I know we talked about the subject matter.

Q Do you know whose writing is in the margin, "circulate file Aroclor," and then something under it like "general"?

A No.

Q Do you know who placed the stamp on the left-hand side of the document?

A No, that I don't know.

Q Did you have a stamp that had those various categories?

A That's not my stamp.

Q What determined the choice of the cc's on this for you?

A The circulation copy?

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Q Yes.

A I've forgotten what Robson was doing at the time.

Q Who is Mr. Hosmer?

A Normally a manufacturing man concerned with plant effluents and manufacturing operations.

Q Was he also a chemist, did he do sampling?

A I think he was a chem engineer, I would guess.

Q Did he design the system for controlling effluent or did he do sampling kind of work?

A He was a man that had manufactured Aroclor in Anniston, had been plant manager. He was in charge of, I think, or set up the East St. Louis water treatment unit.

Q Who was he while --

A I can't think who he was.

Q In this memorandum, you mention Mr. Coon had customers. What do you mean by customers of Mr. Coon?

A Well, the Wisconsin Alumni Research Foundation worked for either other companies or agencies.

Q Was it a non-profit research organization?

A Yes.

Q That got grants to do certain kinds of studies?

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A Right, or took money under contract to do certain kinds of studies.

Q Who was Walter W. Dykstra, whom you have mentioned in the first paragraph?

A Whatever he is in the case of Wild Life Research, Department of Interior. I don't think I ever met Dykstra.

Q Were you saying here that the customer, meaning the Department of Interior or the U.S. Department of the Interior, had contracted with Coon and it was as part of his research that he contacted you?

A I think probably Mr. Coon was looking for further support of this residue, pesticide residue kind of work.

(Richard-Plaintiff Deposition Exhibit No. 4 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, handing you what has been marked as Richard-Plaintiff Deposition Exhibit 4, I ask you if you recognize that document?

A Yes.

Q You will notice that the first full paragraph says that you and Mr. Wheeler reviewed background

WATER_PCB-SD0000022264

on Aroclor properties.

Does that mean physical properties?

A Probably, yes.

Q Then further down in the same paragraph, it mentions "legal and scientific findings on Aroclor and its products."

Who discussed the legal findings?

A I don't remember specifically. In fact, I cannot remember what the legal findings were.

Q Did you review this document before today?

A I looked at it.

Q When was that, yesterday?

A Yes.

Q It is indicated here that you "asked for consideration of the problem from Public Relations, DDT Wisconsin hearings, legal actions and scientific aspects."

Were these requests for consideration directed toward particular people?

A You are talking about the second paragraph?

Q Yes.

A Well, this was just discussed with Calandra, Fancher, Keplinger and so forth, and we just wanted to be brought up to date on that, on the subject.

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Q Do you remember the conversation at all?

A I do not remember the specifics of the conversation.

Q Can you give me the general recollection behind it?

A Well, the reason that we wanted to find out about the DDT was that Aroclor was being found in the environment along with DDT or DDT residue. And it was being found in the same general concentration range.

Q What was that range?

A Parts per million.

Q Low parts per million, high parts per million?

A I don't know, it depends on what it was, but normally low parts per million and we knew that DDT was an insecticide.

We also knew that Aroclor was not, and so we were trying to find out of any relationship between the two, if they knew of any.

Q Could you explain what you meant by, in the last two lines of that page, the "logistics of Aroclor exposure and likelihood of contamination not discussed enough."

Not discussed enough by whom?

A Frankly, we couldn't understand. We could understand DDT. It is spread all over. That is its function.

But we could not understand how Aroclor could be spread around because it was normally used in concentrated machinery and so forth.

We did not know how it was getting exposed or I guess that is the logistics of Aroclor exposure, we didn't understand it at all.

Q Have you read any of the Monsanto publications on Aroclor called the Aroclor Compounds, various versions of those documents?

A I must have read some of them.

Q Let us get back to that.

The Aroclor compounds, you said your department had input on technical data. Would it have had any input with respect to uses that might be suggested for a particular product?

A Normally not.

Q Do you know who would have prepared a portion of the document like that relating to the potential uses of a product or products discussed in such a publication?

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A You have to go on a case-by-case basis of who did.

Q I am sorry?

A You would have to go on a case-by-case basis of who wrote the document.

Q All right.

A I don't think it was any one function.

Q On the next page of that same document, in the middle of the page, the second sentence of that paragraph, "The job of educating Monsanto consultants, and getting permission, to fall to E. Wheeler and W. Richard."

Could you tell me what you did as a follow-up to this job that fell to you and what permissions you got and for what purpose?

A We didn't understand the problem that we apparently were getting into and so we tried to find people that might understand better than we did and we actually contacted Mehler at Marketing and contacted Robert Metcalf to advise us and give their possible directions and knowledge.

Q Were you to work with Mr. Wheeler in developing these contracts with these people and develop appropriate consultants for the kind of work they do,

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the depth, the scope of the work and the questions they would answer?

A No, I think it was a question of arranging a consultant-type contract. That's about it.

We didn't want them to do physical work. We wanted them first to do mental work, understanding the problem, trying to understand the problem.

Q The problem of dispersion of PCBs?

A Yes.

Q Further down that page, there are ten categories of studies. Did you work with Mr. Wheeler in developing those studies at all, or was he going to share his results with you?

A He said in here that development of the program and protocols was between Medical and Industrial Bio-Test. I was present at one or two meetings where some of these were discussed, but the main responsibility was between Medical and Industrial Bio-Test.

Q Did Monsanto perform all the studies that were listed here?

A I'm not sure how it came out exactly. I'm not sure if we did 1254, 1260. I would have to check.

We started fish toxicity studies later

WATER_PCB-SD0000022269

on. We ran into trouble with the test.

Q What was the problem?

A We couldn't get the right concentrations of the dispersions in the water and fish. That was the technical part.

The other part, you will have to talk with Elmer about with regard to the results on the fish, but I know we were unhappy with the fish test.

Q I am not sure I understand what you mean by we couldn't get the right dispersions.

Are you saying the right concentrations?

A Right. It is very difficult, you just don't dump chlorinated biphenyls into water and in the right grams and the right amount of water. It just doesn't dissolve like that and oftentimes it goes to the wall, the glass wall of the container, the wall of the tank or vessel that you are dealing with. And so that what you calculate you are putting in there doesn't always turn out when you try to analyze it. It doesn't always come out the same.

So you have a problem in terms of pumps and handling and aquariums and size of equipment.

Q Is that because it adheres to the sides?

A Apparently it adsorbs.

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Q On the following page there is a defense that is discussed. Could you tell me what the sources were of the information that made up each of these five components of the defense?

Do you know for a fact that Aroclor was used in closed systems, not in open systems?

A The first statement, I think that is correct that Aroclor in our uses at that time was not intended to be spread around in the sense that it was not an insecticide. It was not spread around the countryside.

It was intended to be used as far as the functional end, in mainly closed systems.

Now, I modify that statement to most but not all our uses meet the above descriptions. I was trying to separate out these that by function had been closed and if they were functioning correctly, should not wind up in the environment.

Q Do you have any personal knowledge of hydraulic systems in die casting operations?

A I never visited a hydraulic shop, a die cast shop.

Q Do you know whether anyone in your department did?

A Yes.

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Q Who did?

A Lou Stark, Wayne Pogue.

Q Do you know which plant or plants they visited?

A Probably many.

Q Do you know whether they visited the Johnson Motors Division?

A I'm sure they did.

Q Did they ever discuss with you their visits there?

A Not in detail.

Q Did they tell you whether or not there was any leakage of hydraulic fluid from that facility?

A I think there are reports from Mr. Pogue and Mr. Stark trying to identify where Pydraul fluid could be recycled in the Johnson Motors facility.

Q Did any of these people discuss with you whether or not the material was escaping into the environment from the Johnson die casting operation?

MR. SCHINK: Are you asking after he wrote that document or before he wrote the document?

MS. STEIN: I am going to ask before he wrote that document.

BY THE WITNESS:

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A Oh, no. This document is '69 and what we are talking about is '72.

BY MS. STEIN:

Q I am sorry. Are you saying that Mr. Stark and Mr. Pogue went there in 1972, as far as you know?

A Roughly, yes. That's when they were looking, talking about recycling fluids.

Q Would any of the sales people have gone and examined the Johnson Motors facility, the die casting operation?

A At this time?

Q Before this document was written.

MR. SCHINK: What aspect are you talking about, visited the place or something else?

MS. STEIN: Visited and saw what the Pydraul usage was and whether there was any leakage.

BY THE WITNESS:

A The salesmen would call on Johnson Motors, but I can't answer your question any further.

They certainly knew what the demands of the fluid were of Johnson.

BY MS. STEIN:

Q The following page, did you prepare this table that is on the back, Aroclor in Wildlife?

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A Possibly.

Q If you didn't, do you know who might have?

A The in vitro and in vivo and PCB plus Phenobarbital, that might or might not have been my notes.

Q Did you discuss with them, with anyone, the content of the memorandum before you wrote it?

A Did I discuss the content?

I wrote this apparently after the meeting with Industrial Bio-Test Laboratories so that some of this information must have been discussed at that meeting.

Q Did you circulate a draft of this to anybody?

A I doubt it.

Q Thank you.

(Richard-Plaintiff Deposition Exhibit No. 5 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, I am going to show you what has been marked as Richard-Plaintiff Deposition Exhibit 5 for identification and ask you if you recognize that document?

A By recognize, what do you mean?

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Q Have you ever seen it before?

A The answer is probably yes, but of course, I didn't write it.

Q Did you review it before coming here today?

A Pardon?

Q Did you review it before coming here today?

A Not in detail.

Q Do you remember when the last time was you looked at it?

A No.

Q Do you recognize the handwriting up at the top where the notes "Aroclor toxicity" have been written in?

A Yes. I don't know whose handwriting it is.

Q Do you know why you would have been cc'd on this?

A Yes. Because it concerned Aroclor, I would guess.

(Richard-Plaintiff Deposition Exhibit No. 6 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, I am going to show you what has been marked as Richard-Plaintiff Deposition Exhibit

WATER_PCB-SD0000022275

No. 6 for identification and ask you if you recognize that document?

A No.

(Richard-Plaintiff Deposition Exhibit No. 7 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, I am going to show you what has been marked as Richard-Plaintiff Deposition Exhibit 7 for identification and ask you if you have ever seen that document before?

A Yes.

Q Did you review that document before coming here today?

A Yes.

Q Did you have any role in the preparation of this document, this management plan that is the subject of this document?

A The direct memo, no.

Some of the material and thoughts that might have been incorporated into it, yes.

Q Which would those have been? Were you involved in the development of the strategy section of this document?

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A The specific writing is either Mr. Papageorge, possibly some of the early ideas.

Q Yes, but he would have had to consult with somebody to develop --

A That's what I said, some of the early ideas might have been incorporated from the technical section, R&D function.

Q Did he talk to you about the basic strategy?

A This was, you know, we are trying to evolve a plan of action that was appropriate, and so the many discussions could have gone on between various departments and individuals.

Q Would he have had to consult with you with respect to the information under basic strategy, for example, where he says:

"Some of our efforts are being expended seeking information to help better understand and control the problem and some effort is being expended to find alternate products which we may or may not require as indicated by new research data or other developments."

Would that have been information that would have come from you?

A Yes. I'm sure Bill knew what the Research

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Department was trying to do.

Q On that same page, the next paragraph --

A You are on Page 2?

Q Yes, the sentence: "Consequently, a decision was made to plan to discontinue the manufacture of Aroclors 1254 and 1260," and that is based on these reports which he referenced in the first two sentences.

Would he have gotten that information from you?

A He wouldn't have gotten the decision to discontinue 1254 and 1260 fromme. I couldn't make that decision.

Q But he would have gotten the information referred to in the first two sentences from you, "Early reports had indicated that the polychlorinated biphenyls with five and six chlorines..."?

A Yes, and also in notes from and publications from other sources.

Q Does Mr. Papageorge have technical background as a chemist?

A I think he is a chem engineer.

Q On the next page, Page 3, one of the objectives has been deleted, the first one.

Do you happen to know what that objective

might have been?

A On Page 3, no.

Q Did you have any role in developing the objectives of this plan?

A I had a role in trying to develop, in developing what the Research Department was working on.

Q Would you be more specific?

A I initiated work on a biodegradation program. I initiated through Keller, really, the analytical program to try to find whether the materials were out in the environment or whether they were not.

Now, I initiated some work and thought of going into an incinerator, whether or not it could be incinerated. This was my responsibility, was given to CED. That was Bob Kuntz.

Q What is CED?

A Central Engineering Department.

Q What division was that in?

A Central Engineering Department served all companies within Monsanto and Kuntz. I think this was an assigned responsibility for Functional Fluids or Specialty Products.

Q Is he a chem engineer?

A He is a mechanical engineer.

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Q On Page 6 of this memorandum, you see there are some objectives. No. 3: "Develop products to replace Aroclors."

The responsibility for that rests with the Manager of Research?

A And the department for functional fluids and plasticizers group, great majority by year-end.

Q This was 1970. Did you have replacement products developed by the end of that year for those? First of all, I would like to know what criteria was used for determining those uses in which Aroclors had been demonstrated to be harmful to the environment and cannot be prevented from escaping into the environment.

A The Aroclors at this stage had not been demonstrated to be harmful. It was obvious that by '70 they were out there, but the question of harm had not been established.

Now, the second part, "cannot be prevented from escaping into the environment," the most obvious things were plasticizers and National Cash Register carbonless carbon paper; those uses because almost by definition, they were spread in many places and disposed of in dumps and things like

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this.

Q When you are saying that Aroclors hadn't been demonstrated to be harmful, are you saying you didn't think --

MR. SCHINK: He didn't say any of this. This is Papageorge.

MS. STEIN: Just now the witness stated he hadn't been quoted as of this --

MR. SCHINK: But you are quoting.

MS. STEIN: But the witness did, I believe, state that they had not been demonstrated to be harmful as of the date this had been written and I was going to ask whether that was his opinion or he had some sort of information that led him to state that they hadn't been demonstrated to be harmful as of March of 1970.

BY THE WITNESS:

A I think you have to define what you mean by harmful.

BY MS. STEIN:

Q What do you mean by harmful?

A This is a subject that I can't define in a few words and I don't think that there is any definition that it is possible to agree on.

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Q I am only asking for yours.

A I think it is a question of stating the risk of the situation and you have to state harmful to whom.

Q Go ahead. You have any further definition?

A No.

Q Did you develop any replacement products for the paper applications?

A Yes.

Q By the end of the year, by the end of 1970?

A I don't remember the timing on that, but yes, we did replace Aroclor.

Q Were you involved in any decision to go to terphenyls?

A Yes, partly in 200B.

Q Pardon?

A Pydraul 200B.

Q How about on the paper applications?

MR. SCHINK: That is not relevant to this litigation. I object to the question.

I will direct the witness not to answer.

MS. STEIN: You direct the witness not to answer?

MR. SCHINK: Yes.

MS. STEIN: Then I think we should certify the

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question.

MS. STEIN: I have a few more and there is one document I am having trouble locating. If I can reserve the right to come back when I pull that document out of the file, I am finished.

(Richard-Plaintiff Deposition Exhibit No. 8 marked for identification, 1/15/81, TLU.)

BY MS. STEIN:

Q Dr. Richard, I'm going to show you what has been marked as Richard-Plaintiff Deposition Exhibit No. 8 and ask you if you recognize that document?

A Yes.

Q Who was Dr. Alan Mehler?

A He was one of the consultants, possible consultants we contacted. He was a specialist from Milwaukee.

Q Do you know what he was a specialist in?

A Chemist, organic chemist.

No, I don't know his age from school. He was interested in enzymes and biochemistry, but his exact background, school background, I don't know.

Q Were you the Monsanto contact for him?

A I think Wheeler contacted Mehler. I believe

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he did.

Q Did Mr. Wheeler convey the notes to Dr. Mehler to you?

A They seem to be addressed to me. Whether he consulted with me, or Wheeler and I were both there, maybe he sent them to me directly.

Q Did you review this document before you came in today?

A In a cursory manner, yes.

Q Was it yesterday?

A Yes.

Q Who developed the list of questions to which Dr. Mehler responded?

A I think he was developing them himself.

Q Monsanto did not ask him any questions?

A It was just a general discussion on the subject and he must have been asking himself, trying to make it logical.

Q Had you had a conversation with him?

A Yes.

Q Before this was prepared?

A Yes. We did outline the problem and pose it to him. I think he is asking in these questions of himself, the problem.

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Q Did you actually have a contract with him at any point?

A I'm sure we must have because we certainly consulted with him and I'm sure he was paid for it.

Q Do you remember whether or not you asked him to do any studies of any kind or whether Mr. Wheeler asked him to do any studies on PCBs?

A I don't think we did. I think as I indicated earlier, we are trying to mentally understand the problem and understand what we might be able to do about it.

Q Did he discuss with you any of the sources of information behind his answers?

A No.

Q Did you discuss any of these answers with him?

You have just said you discussed with him the possibility of doing a contract. Did you discuss this particular document?

A Of doing a contract?

Q No, did you discuss these particular comments and questions with him?

A I don't recall a specific conversation with him. What is being proposed here is a very difficult,

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not some of the early part, but some of the things that are in this would be very difficult to carry out. And we just felt that we couldn't, didn't have the technology, the money to complete such a difficult program.

Q Specifically which of the ones were difficult?

A Discussions on hormones and what specific enzymes and where the metabolic products, what the possibilities were for metabolic products and so forth, indicated that we didn't feel at that stage that we were in a position to take on such a tough problem, a difficult problem, detailed problem.

MS. STEIN: The document that I wanted is not here so I will have to get it tomorrow.

MR. SCHINK: You have completed your interrogation except with respect to this document?

MS. OLIVER: Off the record.

(Discussion off the record.)

(At 4:55 o'clock p.m., the deposition was adjourned to 9:30 o'clock a.m., Friday, January 16, 1981.)

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