SUPERIOR COURT

FOR THE STATE OF CALIFORNIA

FOR THE COUNTY OF LOS ANGELES

TRANSWESTERN PIPELINE COMPANY,

Plaintiff,

vs.

NO. BC 026959

MONSANTO COMPANY AND DOES 1 THROUGH 200 INCLUSIVE,

Defendants.

COPY

- - - - -

Deposition of E. SCOTT TUCKER, Ph.D, taken by the Plaintiff, pursuant to notice and/or agreement, before Beth Byce, Court Reporter and Notary Public, at The Law Offices of Haynsworth, Marion, McKay & Guerard, C&S Bank Tower, 75 Beattie Place, Eleventh Floor, Greenville, South Carolina on the 23rd and 24th days of June, 1992, commencing at the hour of 2:00 o'clock, p.m., and 9:10 o'clock, a.m., respectively.

- - - - -

WATER_PCB-SD0000041677

APPEARANCES:

MIR SAIED KASHANI, Esquire
JANET M. GRADY, Esquire
Shearman & Sterling
21st Floor, 725 South Figueroa Street
Los Angeles, California 90017
Attorneys for Plaintiff.

DONALD F. ZIMMER, JR., Esquire
Bronson, Bronson & McKinnon
505 Montgomery Street
San Francisco, California 94111-2514
Attorney for Defendant.

- - - - -

STIPULATIONS:

1. The deposition was taken pursuant to the California Rules of Civil Procedure.

2. Deposition will be submitted to the Witness for reading and signing.

- - - - -

WATER_PCB-SD0000041678

INDEX OF EXAMINATION

	PAGE
6/23/92	
DIRECT EXAMINATION: BY MR. KASHANI	6
6/24/92	
CONTINUATION OF DIRECT EXAMINATION	188
THERE WAS NO CROSS-EXAMINATION	

- - - - -

INDEX OF EXHIBITS

	PAGE
PLAINTIFF'S EXHIBIT NUMBER 317	10
PLAINTIFF'S EXHIBIT NUMBER 318	29
PLAINTIFF'S EXHIBIT NUMBER 319	29
PLAINTIFF'S EXHIBIT NUMBER 320	61
PLAINTIFF'S EXHIBIT NUMBER 321	72
PLAINTIFF'S EXHIBIT NUMBER 322	84
PLAINTIFF'S EXHIBIT NUMBER 323	84
PLAINTIFF'S EXHIBIT NUMBER 324	85
PLAINTIFF'S EXHIBIT NUMBER 325	85
PLAINTIFF'S EXHIBIT NUMBER 326	96
PLAINTIFF'S EXHIBIT NUMBER 327	106
PLAINTIFF'S EXHIBIT NUMBER 328	126
PLAINTIFF'S EXHIBIT NUMBER 329	140
PLAINTIFF'S EXHIBIT NUMBER 330	156
PLAINTIFF'S EXHIBIT NUMBER 331	163

WATER_PCB-SD0000041679

INDEX OF EXHIBITS

	PAGE
PLAINTIFF'S EXHIBIT NUMBER 332	171
PLAINTIFF'S EXHIBIT NUMBER 333	180
PLAINTIFF'S EXHIBIT NUMBER 334	209
PLAINTIFF'S EXHIBIT NUMBER 335	224
PLAINTIFF'S EXHIBIT NUMBER 336	226
PLAINTIFF'S EXHIBIT NUMBER 337	247
PLAINTIFF'S EXHIBIT NUMBER 338	248
PLAINTIFF'S EXHIBIT NUMBER 339	250
PLAINTIFF'S EXHIBIT NUMBER 340	253
PLAINTIFF'S EXHIBIT NUMBER 341	257
PLAINTIFF'S EXHIBIT NUMBER 342	257
PLAINTIFF'S EXHIBIT NUMBER 343	261
PLAINTIFF'S EXHIBIT NUMBER 344	265
PLAINTIFF'S EXHIBIT NUMBER 345	266
PLAINTIFF'S EXHIBIT NUMBER 346	270
PLAINTIFF'S EXHIBIT NUMBER 347	287
PLAINTIFF'S EXHIBIT NUMBER 348	294
PLAINTIFF'S EXHIBIT NUMBER 349	315
PLAINTIFF'S EXHIBIT NUMBER 350	324
PLAINTIFF'S EXHIBIT NUMBER 351	329
PLAINTIFF'S EXHIBIT NUMBER 352	333
PLAINTIFF'S EXHIBIT NUMBER 353	349

WATER_PCB-SD0000041680

INDEX OF EXHIBITS

	PAGE
PLAINTIFF'S EXHIBIT NUMBER 354	349
PLAINTIFF'S EXHIBIT NUMBER 355	360
PLAINTIFF'S EXHIBIT NUMBER 356	370
PLAINTIFF'S EXHIBIT NUMBER 357	385
PLAINTIFF'S EXHIBIT NUMBER 358	389
PLAINTIFF'S EXHIBIT NUMBER 359	392
PLAINTIFF'S EXHIBIT NUMBER 360	409
PLAINTIFF'S EXHIBIT NUMBER 361	419

- - - - -

The letter **"A"** *accompaning the Exhibits is pursuant to request from the counsel of the Plaintiff to aide them as a work reference.*

WATER_PCB-SD0000041681

E. SCOTT TUCKER, Ph.D,

being first duly sworn, was examined and deposed as follows:

DIRECT EXAMINATION

BY MR. KASHANI:

Q. Dr. Tucker, could you please state your full name for the record?

A. Earl Scott Tucker, III.

Q. And what is your current address?

A. 261 North McAlister, Liberty, South Carolina. Let's see. 29657.

Q. And where are you presently employed?

A. I'm employed at the Clemson Technical Center, Incorporated in Anderson, South Carolina at the Clemson Research Park.

Q. And what is the nature of your employment?

A. I'm a Senior Director of Analytical Programs.

Q. Could you describe that briefly?

A. I direct all of the analytical laboratory programs associated with our efforts in the mixed waste area.

Q. And could you define "mixed waste" for the record, please?

WATER_PCB-SD0000041682

A. "Mixed waste" is defined as a combination of radioactive and/or hazardous waste.
Q. Dr. Tucker, have you ever been deposed before?
A. Yes.
Q. Do you recall when?
A. I'm trying to remember what year it was. Had to be sometime prior to 1978, and sometime after --- let's see; it was somewhere between 1978 and 1985. I can't remember. It had to do with PCB litigation.
Q. And how many times were you deposed?
A. Once.
Q. And do you recall what that case was?
A. It was Outboard Marine, Monsanto EPA.
Q. And, other than that case, have you ever been deposed in any other case?
A. No, sir.
Q. Have you ever given sworn testimony of any other kind, such as in a courtroom?
A. Yes, sir.
Q. When did that take place?
A. At the toxic substances at --- I believe that was --- yeah, that was sworn

WATER_PCB-SD0000041683

testimony. And it was a hearing, clerk-type routine.

Q. Do you remember when that took place?

A. I believe that was 1972.

Q. And was the subject matter of that testimony PCBs?

A. Yes, it was.

Q. Was that before the U. S. Congress?

A. No, it was like a hearing clerk; it was a finding situation in which companies like Monsanto and other people were --- testified and --- and were questioned with regard to PCBs.

Q. And at that proceeding did you testify under oath?

A. Yes.

Q. Do you recall where that took place?

A. Washing --- Arlington, Virginia, Washington, D.C. area.

Q. And was it an adversarial-type hearing? Was there someone examining you?

A. I testified as an expert witness in PCBs. I wouldn't necessarily qualify it as adversarial. There were people for certain positions and against certain

WATER_PCB-SD0000041684

positions there, but it was mostly question and answer.

Q. Were you represented by counsel at that hearing?

A. Yes.

Q. Was that counsel provided by Monsanto?

A. Yes.

Q. When you testified at that hearing, were you testifying on behalf of Monsanto?

A. Yes, I was employed with Monsanto at that time.

Q. And who conducted the hearing, and who was the sponsoring body?

A. There was a --- I --- I don't know. I'd have to look up and get the details for you. I think we can provide that.

MR. ZIMMER: He has a copy of the transcript.

THE WITNESS: Okay.

Q. Just for the record, I believe I have a copy of the transcript. Monsanto has provided a copy of a transcript, which --- with the cover page and so forth removed. I'm going to show you that copy and ask if you can identify it.

WATER_PCB-SD0000041685

A. (The Witness peruses the document.)
MR. KASHANI: Let's go off the record for a second.
(OFF RECORD)
Q. I'm going to hand you what should be marked Plaintiff's Exhibit ---
MR. KASHANI: Let's go off the record for a second.
(OFF RECORD)
(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 317-A.)
Q. Doctor, I've handed you what appears to be a transcript of your testimony. I was wondering if you recognize this transcript?
A. I would agree it appears to be a record of the testimony.
Q. Which testimony is this a record of?
A. It's the record of the testimony that was given in behalf of the Toxic Substances Act in Washington that we were discussing earlier.
Q. Do you recall the date this testimony was given?

WATER_PCB-SD0000041686

A. As I said earlier, I thought it might be 1972, but I could be wrong.
Q. And I'm going to ask you again. I'm not sure if this was answered. Who was the sponsoring body for the hearing?
A. I believe it was EPA or government.
Q. Turning to what's numbered page TRAN; that's all caps, T-R-A-N 028524, there are some names referenced here. Who was Judge Sweeney, S-w-e-e-n-e-y?
A. I believe he was the --- the executive clerk or whatever that was running the hearing.
Q. Was he an administrative judge?
A. Yeah, that's it. I believe that --- that sounds familiar.
Q. Was he employed by the EPA?
A. I think so.
Q. And who is Mr. Eckert, E-c-k-e-r-t?
A. I would assume it --- it was a lawyer for --- you know, I don't remember, frankly.
Q. Down on this same page, 028524, there's a reference to Cross-Examination. And under that it reads, "By Mr. Eckert." Does that refresh your recollection as to

WATER_PCB-SD0000041687

who Mr. Eckert was?
A. No, sir.
Q. Could he have been the lawyer for the government?
A. Yes, sir.
MR. ZIMMER: Could he have been? Do you know, or he was? He could have been a lot things.
A. He probably was.
Q. Okay. Who is Mr. Park?
A. Phoecan Park was the lawyer for Monsanto.
Q. How do you spell that?
A. Which, Phoecan or Park?
Q. Phoecan.
A. I think it's P-h-o-e-c-a-n, but that --- I don't --- it's been a long time since I've spelled his name.
Q. Did Mr. Park represent you at this hearing?
A. Yes.
Q. Without revealing the contents of any privileged communications, did you have discussions with Mr. Park prior to this hearing ---
A. Well ---

WATER_PCB-SD0000041688

Q. --- or with any other attorney?
MR. ZIMMER: He's not entitled to know that. Any discussions that he had with Mr. Park or any other Monsanto attorney are privileged. The fact of them, the extent of them, et cetera; so, let's move on to something that matters. Don't answer the question.
MR. KASHANI: The contents are privileged, but the fact is not. The fact of discussions is not privileged.
MR. ZIMMER: Okay. Take it up with the judge, then.
Q. Are you refusing to answer?
MR. ZIMMER: I instructed him not to answer. So, let's move along.
Q. Dr. Tucker, are you not answering based on the instructions ---
A. I've been instructed not to answer, so I'm not answering.
Q. Was Mr. Park present during your entire testimony?
A. I --- as I recall he was, yes.

WATER_PCB-SD0000041689

MR. ZIMMER: What possible difference does that make?

MR. KASHANI: Well, it has an affect on the usability of this testimony and current hearing, whether Monsanto was represented or not, what Monsanto's position was.

Q. During the course of this testimony did you feel that if you had any questions or problems you could consult with Mr. Park?

A. Yes.

Q. Okay. We'll come back to this later. Other than this testimony before the, apparently, EPA hearing, and the testimony in the Outboard Motor (sic) case --- is that Outboard Motor or Outboard Marine?

A. Outboard Marine, I believe.

Q. Outboard Marine, I'm sorry. Have you given sworn testimony on the subject of PCBs at any other time?

A. Not --- not to my recollection, no.

Q. Have you ever assisted in any case involving PCBs in the capacity of an expert or expert witness?

WATER_PCB-SD0000041690

A. No, sir.
Q. Outside the context of your work, aside from the time when you were working at Monsanto, have you ever been asked or engaged or hired to formulate or give an opinion in a case involving PCBs?
A. No.
Q. Have you had any involvement in cases involving PCBs, other than Outboard Marine and this case?
A. I have had no involvement in any cases, other than Outboard Marine, regarding PCBs from a legal viewpoint.
Q. Dr. Tucker, what is your educational background?
A. I have a --- a Ph.D in Analytical Organic Chemistry.
Q. From?
A. From the University of Iowa and ---
Q. What year?
A. 1968 was when the degree was officially decreed.
Q. And what was your undergraduate degree?
A. I have an Associates Degree from the University of Michigan Extension located

WATER_PCB-SD0000041691

in Flint, Michigan, and I have a Bachelor's Degree from Michigan State University.

Q. What were those degrees?

A. In --- you mean a specialty or what?

Q. What field?

A. The Bachelor's Degree was in Chemistry and --- and the Associates Degree was in Sciences.

Q. What was the subject of your dissertation?

A. Oh, gosh, what the hell was it. In Analytical Investigation of Mono-2-Azaarylhydrazones, believe it or not. Sorry, it took me a little bit to remember that.

Q. Serves me right for asking. I forgot to ask this. What were the years you received your Associate Degree and Bachelor's Degree?

A. Let's see. The Associate's Degree was in 1961, and the Bachelor's Degree was in 1963.

Q. And what did you do between 1963 and the time you received your Ph.D?

WATER_PCB-SD0000041692

A. Went to school ---
Q. Educationally?
A. --- at the University of Iowa.
Q. So, you were working on your Ph.D for those five years?
A. No, I left the University of Iowa in 19 --- I believe 1967. The typist didn't get my thesis done in time to be turned in, so I would join Monsanto in 1967. Then I went from --- while I was at Monsanto I went back and defended the thesis in '68.
Q. So, when did you joint Monsanto?
A. I believe I joined them in 1967.
Q. Do you recall the month?
A. Truthfully, no.
Q. I mean, was it after school? Could it have been after June?
A. Probably was. It was probably --- probably third or fourth quarter, in that range, yeah.
Q. And what was your position?
A. I was a Senior Analytical Chemist.
Q. Where did you work?
A. I was hired to work at their Queeney

WATER_PCB-SD0000041693

Plant located down on South Second Street in St. Louis, Missouri.

Q. And what did you do?

A. I functioned as an Analytical Chemist in a analytical chemistry group that provided analytical chemistry support for an Organic Division.

Q. And what did that entail, analytical chemistry support?

A. Developing methodologies for measuring different kinds of constituents in --- in products and in various kinds of samples and things of that sort.

Q. Were you aware that Monsanto was divided into product groups at that time?

A. Yes.

Q. And what group were you in?

A. Organics Division.

Q. Were you in any subcategory of that group?

A. I was in the Applied Sciences section of the Organics Division. I think that's what we were.

Q. And to whom did you report at that time?

A. I reported to a Dr. Robert Keller.

WATER_PCB-SD0000041694

Q. Did anyone report to you?
A. Not initially.
Q. Was there anyone else you worked with?
A. Yeah, 56,000 other employees. Could you be more specific, please?
Q. How about in your lab?
A. The Queen --- at the --- on South Second Street, the --- the building we were in was an eight-story building; so, there were a lot of folks in there. The rest of the people that were in the Analytical Section were in there. So, there were a variety of folks and --- and, yes, I worked with a variety of other folks there.
Q. Do you recall any of those individuals?
A. Yes.
Q. Who were some of them, whoever you can remember, in the Analytical Section?
A. Just ones that come to mind, or is there a purpose to the question?
Q. Ones that come to mind are fine.
A. Well, Dr. Keller was one person. Let's see. Who else? There was --- probably Martin Dietrich was there, I think, at

WATER_PCB-SD0000041695

that time. To be truthful the --- with you, I remember a large number of people. I don't remember whether they were there when I got there, when I initially got there, or they came after I was there, or things of that sort. So, I mean, unless you just want me to sit here and recite a huge number of names --- is that what you would like me to do? I can recite a lot of names, but in what context? Worked in the lab I was in, worked in the building I was in, worked in the section I was in, worked in the division I was in.

Q. Maybe we can move forward in time a little bit, then ---

A. Okay.

Q. --- and get a picture that way. So, for how long did you hold this position in Analytical Chemistry?

A. As a Senior Analytical Chemist?

Q. Yes.

A. I think it was about three years.

Q. When you first joined Monsanto did you have any involvement with Aroclors or PCBs?

WATER_PCB-SD0000041696

A. Prior to joining Monsanto?
Q. Yes.
A. No.
Q. What about when you first joined Monsanto?
A. Not initially.
Q. When did you first have involvement with PCBs or Aroclors?
A. I think it was within six months or so, probably, some time frame in the first --- during the first year.
Q. And what happened then?
A. I believe Dr. Keller discussed with me an assignment in terms of developing analytical methodologies in the wherewithal of making polychlorinated biphenyl measurements.
Q. Do you recall when that conversation took place?
A. Not exactly.
Q. Was it in 1967?
A. '67 or '68.
Q. Would it have been early '68 if it was '68?
A. Probably.

WATER_PCB-SD0000041697

Q. Was there anyone else present at that discussion?
A. I don't remember the discussion specifically.
Q. Were you the only person who was given that assignment initially, or were there other people who were given the same assignment?
A. In terms of developing the analytical methodology, I believe I was the only one assigned to that part.
Q. Do you know why Dr. Keller approached you to do that work?
MR. ZIMMER: Calls for speculation.
A. No.
Q. Could you describe a little bit more about the assignment Dr. Keller gave you?
A. Well, the initial assignment, as I remember it, there had been an indication from Monsanto Europe that PCBs were being found in environmentally-related samples. And they were concerned about that and wanted to develop the wherewithal to verify and validate that information.

WATER_PCB-SD0000041698

Q. Okay. Go back a step. Dr. Tucker, it's not my purpose here to trip anyone up; it's just I have here a copy of a transcript of a deposition, which was provided to us by Monsanto. And I do not want to introduce the whole thing as an Exhibit right now, but I need to show you the transcript and see if you recognize it.

MS. GRADY: Before you show it, counsel, can we have an agreement? This transcript has my work product on it. Can we have an agreement that I'm not waiving any work product?

MR. ZIMMER: Why don't we hear what it is first before. I haven't seen it either, obviously.

MS. GRADY: Why don't you just ---

MR. ZIMMER: Well, is it Dr. Tucker's testimony?

MS. GRADY: Why don't you just represent to him what ---

MR. KASHANI: Yes, it's Dr. ---

MS. GRADY: --- what he has

WATER_PCB-SD0000041699

testified to previously?

MR. KASHANI: And that's the way to proceed.

MR. ZIMMER: Is it from Outboard Marine?

MR. KASHANI: Yes.

MR. ZIMMER: Okay. Well, what's the ---

MR. KASHANI: Well, the only --- . I'm referring to page 5 of this deposition.

MR. ZIMMER: Yes, I'll stipulate that he take her Post-it off it, the pages he looks at that don't have that on them, we'll waive her work product. That's fine. If you don't want him to see it, then we'll take it off.

MR. KASHANI: It's just a --- I think the same purpose can be accomplished by my simply reading the testimony.

Q. Down here on page 5, Dr. Tucker, you were asked what year you received your Ph.D, and your response was, and I quote, "It

WATER_PCB-SD0000041700

was officially given to me in 1967, but I left school in '66." Then the next question is, "When you left school in 1966, did you find a position of employment?" And your answer was, "Yes. At that particular time the market was pretty good, so I had a choice. But I chose Monsanto." And then a little ways down on page 6, there's a question, "When you joined Monsanto in 1966, what was your job?" And your answer was, "I was hired as a Senior Research Specialist." Does that --- and again, I mean, time has passed and obviously people are not always clear about dates 25 years down the line, but does that alter your recollection, refresh your recollection about when you joined Monsanto?

A. You know what I'm going to do? Tonight when I get home I'll pull out my diploma and look at it. Very frankly, what we're talking about here is a year or so. And I'd be happy to refresh my memory appropriately and return and tell you when it is.

WATER_PCB-SD0000041701

Q. I'd appreciate it if you could do that.
A. Sure.
Q. Does that testimony, which you gave on Outboard Marine, alter your recollection in any way about when Dr. Keller approached you to conduct the PCB work?
A. I think the time windows involved are the same. And I think what we need to do is just put the appropriate years to it, and that's dependent upon when I graduated, and I'll be happy to check. It's been a long time.

(OFF RECORD)

Q. Dr. Tucker, you just mentioned time frames. By that do you mean that --- you had earlier testified that six months after you joined Monsanto, or approximately six months after you joined Monsanto, Dr. Keller approached you with the PCB project. By time frame, and that being correct, do you mean that that six months after you joined Monsanto, whenever that was, Dr. Keller approached you with the PCB project?
A. It was at least six months before I was

WATER_PCB-SD0000041702

approached with that project, to the best of my recollection at this point in time.

Q. Could it have been longer?

MR. ZIMMER: His prior testimony was it was six months to a year, I believe. So, I mean, you can answer.

A. Yeah, I --- I believe I did say six months to a year. So, it could have been longer, but six months feels good. Certainly less than six --- yeah, I wasn't --- it wasn't given that assignment less than six months, I'm sure.

Q. Was it more than a year after you joined?

A. I don't think so, but I don't know, very frankly.

Q. Was it before you defended your Ph.D?

A. I don't think so.

Q. Do you remember when you defended your Ph.D?

A. Whatever the next time that I could was after the one I missed, so my guess is '68 is probably the year that we're talking about. But I'll --- I'll have to

WATER_PCB-SD0000041703

check for you.
Q. So, I'm trying to go by events here rather than specific dates. Would you say that Dr. Keller gave you this assignment before you defended your Ph.D?
A. I don't know.
Q. Was it before you ---
A. I can't place it that definitively, so I don't know.
Q. Before you received your Ph.D?
A. I don't know.
Q. Do you recall what triggered Dr. Keller's --- or do you recall what triggered your assignment to look into analysis of PCB?
MR. ZIMMER: Calls for speculation.
A. Did you want me to speculate?
MR. ZIMMER: You can answer if you know something other than speculation. He doesn't want you to speculate, though.
THE WITNESS: Oh, he doesn't want me to speculate?
A. I don't recall what --- what prompted Keller to give me the assignment, no.
Q. Did he mention some work done by Swedes

WATER_PCB-SD0000041704

involving PCBs?

A. There was some work done by Sjorn Jensen and Gunnar Widmark regarding PCBs in environmental samples in Europe.

Q. Did you ever see a report of that work?

A. Yes.

(Thereupon the Court Reporter marked a pertinent document as PLAINTIFF'S EXHIBIT NUMBER 318-A.)

Q. I'll show you Exhibit 318. It's a document that has been provided by Monsanto.

A. (The Witness peruses the document.)

Q. Is this the Swedish work that you saw?

A. I don't recall whether this was the first thing I saw.

(Thereupon the Court Reporter marked a pertinent document as PLAINTIFF'S EXHIBIT NUMBER 319-A.)

Q. How about this document, Exhibit 319?

A. (The Witness peruses the document.)

MR. ZIMMER: What was the question?

Q. Was this the work that you saw?

A. I --- are you trying to establish was this the first thing I saw or ---

WATER_PCB-SD0000041705

undoubtedly I saw those documents. The exact sequence or when, I'm not sure of.

Q. But do you remember when you first became aware of the Swedish work, meaning the work of Jensen and Widmark?

A. When I first was given the assignment by Keller was when I was made aware of that particular work.

Q. And what did you find out about the work at that time?

A. Basically, that they had detected PCBs in environmental samples.

Q. Do you know how they went about detecting that, those PCBs?

A. Yes, that was delineated, and they had used a couple of approaches, analytical methods; gas chromatography with an electron capture detector, and gas chromatography with a mass spectrometer as a detector.

Q. Could you describe gas chromatography, please?

A. To --- sure. Gas chromatography is an analytical technique that's used to separate constituents that can be

WATER_PCB-SD0000041706

vaporized from each other.
Q. Constituents of?
A. Anything that can be volatilized and made to exist in a gaseous state.
Q. And what about the electron capture?
A. An electron capture is a detector that is used in conjunction with a gas chromatograph, one of a variety of different kinds. And it's based upon the theoretical concept that if you have electrons passing through a chamber, that certain kinds of molecules will capture those electrons with high efficiency.
Q. What about the mass spectrometer?
A. A mass spectrometer, again, can and is used as a detector for a gas chromatograph. And it operates upon the principle that when a constituent goes into it, it's bombarded with an electron beam. And the molecule or whatever goes into it is fragmented into a variety of pieces. The masses of those pieces are then measured, and that information can be used to reconstruct the molecule.
Q. So, can both of these techniques or one

WATER_PCB-SD0000041707

or the other --- can the gas chromatograph with electron capture be used to determine the components of the mixture?

MR. ZIMMER: What kind of mixture?

MR. KASHANI: Any mixture.

MR. ZIMMER: Well, the question is so vague, an incomplete hypothetical. Go ahead if you can answer it.

A. "Yes" and "no."

Q. How did Jensen and Widmark use this equipment to run their tests and get their samplings?

MR. ZIMMER: Calls for speculation.

Q. And if you know.

A. I know what was outlined in information that they provided in terms of how they used it. And I believe I can describe fairly accurately the manner in which they used the equipment.

Q. Could you do so, please?

A. Yes. The samples that you're interested in analyzing, or that they were interested in analyzing, were first

WATER_PCB-SD0000041708

prepared in some manner in which the constituents of interest were obtained in an organic solvent solution, fairly volatile solvent, usually. And in that portion, a known portion of that solvent containing whatever constituents were extracted into it were injected into the gas chromatograph, vaporized, and separated into the components to the best of the instrument's capability. Those components are then fed sequentially into the detector, whether it be an electron capture or a mass spectrometer.

Q. And analyzed?

A. Yes.

Q. Do you know what samples they used, where they got their samples that they dissolved in the solvent?

A. The only thing I really remember is something about eagle feathers. But I know the general type of matrices they were dealing with, and they were environmental.

Q. Have you personally done any of this sort of work or work similar to what Jensen

WATER_PCB-SD0000041709

and Widmark had done prior to your conversation with Dr. Keller?

A. No.

Q. Had you ever used the gas chromatograph?

A. No.

Q. What about a mass spectrometer?

A. No.

Q. How about the electron capture device?

A. No.

Q. Had you ever seen such devices?

A. Yes.

Q. Where had you seen those?

A. We had a mass spectrometer at the university.

Q. Is that the University of Iowa?

A. Uh-huh (affirmative).

Q. Do you know when the university got that equipment?

A. No. We also had one at Michigan State.

Q. Do you recall when you first saw that equipment, the mass spectrometer, at the University of Iowa?

A. I know for sure that I saw a mass spectrometer at Michigan State, and it was an old-time --- a flight instrument

WATER_PCB-SD0000041710

used by one of the Inorganic professors. I cannot specifically remember a mass spectrometer at University of Iowa, but I'd be surprised if they didn't have one.

Q. Why is that?

A. Why I can't remember it or why would I be surprised?

Q. Why would you be surprised?

A. I would be surprised if they did not have one?

Q. Yes, why is that?

A. Because universities and academic-type folks were doing research, and mass spectrometry was one of the areas that they did research in. It just so happened that I did not use it in my work at University of Iowa.

Q. Do you know how long the mass spectrometer had been used in the field?

A. Total?

MR. ZIMMER: In the field? Wait, wait. In the field where? At the university?

MR. KASHANI: At any ---

Q. You mentioned that this is something that

MR. ZIMMER: That is used at universities.

Q. --- used at universities. Do you know approximately how long the mass spectrometer had been in use?

MR. ZIMMER: At any university or at that university?

MR. KASHANI: At any university.

A. No.

Q. What about the gas chromatograph? Have you ever encountered that piece of equipment before?

A. Yes.

Q. Where was that?

A. Again, I believe I saw the first one of those at Michigan State University.

Q. Do you recall when that was?

A. When I attended there, which would probably have been from 1961 --- sometime between 1961 and 1963.

Q. Is that when you encountered the mass spectrometer as well?

A. Probably.

Q. What about the electron capture device?

WATER_PCB-SD0000041712

A. I did not encounter an electron capture device until I was at Monsanto after I was given the assignment. And I checked with the chromatography people, and they had one that they were not using that they had purchased; I don't know why.

Q. Had you ever used any of this equipment at Monsanto? And by that I mean the gas chromatography equipment with the electron capture or the mass spectrometer.

A. No.

Q. To your knowledge did Monsanto have any of this equipment at the time you were given the assignment by Dr. Keller?

A. Yes.

Q. Do you know when Monsanto obtained the equipment?

A. Which?

Q. Let's start with the gas chromatograph equipment.

A. Monsanto had a number of gas chromatographs. They had a group of people who ran gas chromatography instruments under --- so, they had them

WATER_PCB-SD0000041713

before I got there.

Q. Do you know what they used them for, what the group used the gas chromatograph equipment for?

A. Mainly process support work, product characterization.

Q. Tell me about process support work.

A. If you're manufacturing a product and you want to know its purity, you might use gas chromatography if it was appropriate. That's an example.

Q. Were they using gas chromatography to analyze competitors' products?

A. Yes.

Q. What about the mass spectrometer? Do you know when Monsanto first obtained the mass spectrometer?

A. No.

Q. Did they have one at the time Dr. Keller gave you your assignment?

A. I'm unclear on that. I cannot really recollect for sure whether they did or didn't.

Q. Do you recall whether Monsanto had an electron --- well, you mentioned the

WATER_PCB-SD0000041714

electron capture. Do you know when they had obtained the electron capture equipment, when Monsanto purchased it?

A. No.

Q. Are you familiar with gas liquid chromatography?

A. Yes.

Q. How does that differ from gas chromatography?

A. It's a general subset of gas chromatography.

Q. How ---

A. It's gas solid chromatography, gas liquid chromatography; it's gas chromatography. Gas chromatography is a generic term.

Q. And what is, then, the gas liquid chromatography?

A. What that usually implies, if it's being used appropriately, is that the solid phase in the column is coated with a liquid, coated with a material that's liquid at the temperatures that it's used to do gas chromatography.

Q. Was there something special about Jensen and Widmark's work in using the gas

WATER_PCB-SD0000041715

chromatography in combination with either the mass spectrometer or the electron capture equipment?

A. Yes.

Q. How so?

A. It was probably one of the first examples of combining a direct combination of a mass spectrometer with a gas chromatograph.

Q. Do you recall if there were any examples prior to that?

A. To my knowledge, none.

Q. Was Monsanto doing any work combining the two pieces of equipment, meaning the gas chromatograph with either the electron capture or the mass spectrometer?

A. No.

MR. ZIMMER: Lacks foundation. You can answer, that's fine.

A. Not to my knowledge.

Q. Did using the gas chromatograph in conjunction with the mass spec --- I'll use "mass spec" for "mass spectrometer" --- or the electron capture. Did that require any special equipment other than

WATER_PCB-SD0000041716

the two component parts, meaning the gas chromatograph equipment and the mass spec equipment?

MR. ZIMMER: For what kind of test?

MR. KASHANI: For the test that Jensen and Widmark were doing.

MR. ZIMMER: Specialized equipment.

A. Yes.

Q. Did Monsanto have that equipment when you were given your assignment from Dr. Keller?

A. No.

Q. And did Monsanto obtain that equipment?

A. Let me clarify equipment. You need knowledge to operate these instruments, and you need to put them together. Okay. So, those things had not been done.

Q. You mean, no one had put the two pieces of equipment together?

A. We just established earlier that Jensen and Widmark had put the two pieces of equipment together for the first time, to my knowledge.

Q. I guess what I'm driving at is, you have the chromatography equipment, and then

WATER_PCB-SD0000041717

you have your mass spec. And can you simply run the test on the gas chromatography and take the constituent --- take the results of that test and put them into, and take them over even, say, to a next room and put them in the mass spectrometer?

A. No.

Q. How does it work, then?

A. The way it works is they have to build a special interface that connects the gas chromatograph to the mass spectrometer, and allows the constituents that are separated in the gas chromatograph to enter the mass spectrometer in a fashion that allows the mass spectrometer to operate the way it's supposed to. So, that's why you have to have an interface.

Q. So, when we run the two pieces of equipment in conjunction with this interface, is it correct to say that the gas chromatograph will resolve the sample into different component parts, and then the mass spectrometer will further resolve these components into additional

WATER_PCB-SD0000041718

component parts?
A. Not exactly.
Q. Well, what's wrong with my description?
A. Okay. The gas chromatograph, to the extent that it's capable, depending upon the liquid phase and all the conditions that are used, will resolve the sample to the best of its ability in the conditions that are used into multicomponents. The components enter the mass spectrometer, and the mass spectrometer does not separate them any further. If the two components enter the mass spectrometer at the same time, then they're both subjected to the electron impact beam and ionized. They ion fragments that then are produced, and they're swept into the analyzer from the source, are then detected based on their mass. So, I guess that could be viewed as a separation, but in reality it's not.
Q. By "detect it according to their mass," you mean that heavier fractions are separated from lighter fractions?
A. Correct.

WATER_PCB-SD0000041719

Q. In the mass spectrometer?
A. Correct.
MR. KASHANI: Let's go off record for a second.
(OFF RECORD)
Q. Did Dr. Keller or anyone else --- and this is approximately the time when Dr. Keller gave you your assignment, and I suppose we'll have to establish tomorrow when exactly that was --- at that time did Dr. Keller or anyone else at Monsanto suggest that this was important work that you would be doing, that there was some urgency to it?
A. Yes.
Q. Do you recall anyone telling you the reason why?
A. Well, frankly, I wasn't used to be sign --- being assigned unimportant work. So, I assumed that it had interest and priority to the company. And the company, of course, was always concerned about any of its products.
Q. Were you taken off other assignments to work on this assignment?

WATER_PCB-SD0000041720

A. No. This assignment was given priority. We worked on multiple things. It's more efficient to --- to work on multiple things, 'cause not everything always works, you know, very well. You have to wait on certain items.

Q. And you set up the experiment and let it run, and then set up another one?

A. Right. Or buy some equipment and wait for it to be delivered and things of that sort.

Q. Do you recall who it was that told you this work you were doing was important and had priority? Was it Dr. Keller?

A. Yes.

Q. Did Dr. Keller tell you that Monsanto was concerned that Jensen and Widmark had apparently found PCBs in the environment?

A. Yes.

Q. Do you recall approximately the words he used or what he said in that regard?

A. I don't think that it was so much a concern is a --- as a lack of understanding why they were finding PCBs in the environment, and if what they were

WATER_PCB-SD0000041721

finding was really PCBs.
Q. Did he tell you why they were unsure whether these were PCBs?
A. Actually, no; they just asked to have the information reviewed and to have an independent verification.
Q. You mean an independent verification of Jensen and Widmark's work?
A. Correct.
Q. And how did you go about that? How did you go about verifying the work?
A. Well, I read what they did, and then, to the best of my ability, obtained the equipment and the wherewithal to repeat what they did on known materials.
Q. How did you obtain that equipment?
A. Purchased it from manufacturers, use of some existing equipment that we had that had never been used.
Q. Did you have to go out and purchase the gas chromatograph with the mass spectrometer and the interface?
A. No.
Q. Did Monsanto have that equipment with the interface?

WATER_PCB-SD0000041722

A. No.
Q. How did you obtain that equipment?
A. The gas chromatograph --- the initial gas chromatograph I purchased with a gas chromatograph with electron capture detectors.
Q. Do you recall when that was purchased?
A. Oh, gosh. In the time frame that we're talking but not exactly.
Q. That would be about the time Dr. Keller gave you your assignment?
A. Sometime after that.
Q. What about a mass spectrometer?
A. I do not recall when the mass spec was purchased.
Q. Just so I know what we're talking about here, I guess we're talking about a single piece of equipment that consists of a mass spectrometer with an electron capture? I'm sorry. A gas chromatograph with an electron capture; is that a single piece of equipment?
A. Can you say that again, please?
Q. Is the gas chromatograph with electron capture a single piece of equipment?

WATER_PCB-SD0000041723

A. Yes.
Q. And this is one of the pieces of equipment that you purchased or had purchased about that time?
A. Initially, we had a gas chromatograph, and we had an electron capture detector that had never been used on it. I took that piece of equipment and put them together to get an idea about how they worked. Then I --- since that gas chromatograph was really used for other things, I purchased a system that would be dedicated to gas chromatography electron capture work.
Q. Do you recall how much that system cost?
A. I know what they cost today. I don't recall.
Q. Was it on the order of $100,000?
A. No.
Q. What about the gas chromatograph with the mass spectrometer and the interface? Is that a single system?
A. Yes.
Q. Do you recall when or if that was purchased?

WATER_PCB-SD0000041724

A. I don't recall the exact date that was purchased, and I don't recall if the instrument was there when I got there. It was not an instrument that I personally used. It was an instrument that I eventually used in the absolute identification of materials. So, no.

Q. Would it refresh your recollection if I mention that we took Dr. Keller's deposition about two weeks ago, and he said that the gas chromatograph equipment with the mass spectrometer was purchased, I believe, around 1967? I'll have to check and find out. Does that sound right?

A. Sounds okay to me.

Q. Dr. Keller also testified that it cost around $250,000. Does that sound right?

A. That's correct. That's about the price of --- of those, that kind of equipment at that point in time. Today they are $150 to $450,000.

Q. Was that a relatively new piece of equipment?

A. Yes. Let me clarify something that I

WATER_PCB-SD0000041725

think is particularly important. The mass spectrometer was probably purchased. It's very doubtful if a GC and an interface were purchased since they weren't available; the interfaces, that is.

Q. Dr. Keller referred to a unit or a system called the GC-mass or GC-mass system in reference to this equipment that was purchased. Does that ring any bells with you?

A. GC/MS is what's known as a hyphenated analytical technique, which is a terminology that used now; it was not used then.

Q. He used a GC-mass, m-a-s-s.

A. Same thing. The more appropriate terminology used now is GC/MS. That was not terminology used back in the '60s.

Q. Could Dr. Keller's use of GC-mass, m-a-s-s, refer to the gas chromatography with the mass spectrometer equipment?

MR. ZIMMER: Calls for speculation as to what Dr. Keller meant.

Q. I mean, was that terminology that you

WATER_PCB-SD0000041726

used back then to refer to the equipment?
A. No.
Q. Dr. Keller also mentioned that Monsanto purchased a computer later on to work with the gas chromatograph and mass spectrometer in combination? Do you recall that?
A. Correct.
Q. Do you remember when that was purchased?
A. No.
Q. Did the equipment work without a computer?
MR. ZIMMER: For what purpose?
Q. For your --- whatever you used it for. I mean, you used it for the purpose of verifying --- well, let's start with verifying Jensen and Widmark's studies. Were you able to do that work without a computer?
A. Yes.
Q. Do you recall when it was that the computer was purchased?
A. No.
Q. So, how did you go about verifying Jensen and Widmark's work on PCBs found in the

WATER_PCB-SD0000041727

environment?

A. As I indicated, the first thing I did was to purchase --- the first thing I did was to look at what we had in-house, and --- which was the older GC and the electron capture system, and had the chromatography people show me how the things worked and put them together and work with them. Then I decided to --- on purchasing the instrument that was specifically dedicated to that, which that was done, an F&M 402, Model 402 Gas Chromatograph, biomedico gas chromatograph, was purchased with electron capture detectors. And then that equipment, when it was received, was set up. Also, during that period of time I accumulated the glassware and, you know, the standards and all the necessary things for preparation that were required to prepare samples and --- and to make sure that the equipment was verified and --- and validated as working.

Q. What do you mean by "standards"?

A. Well, at that time there probably weren't

WATER_PCB-SD0000041728

standards. What I obtained were known quantities of Aroclor products with known lot numbers and known history, and documented, validated, where they came from, why, what and all that kind of good stuff so that we would have that --- that material.

Q. And what did you do with those standards?

A. What did I do with them?

Q. Yes.

A. A lot of things. I obtained them, stored them, labeled them, dated them, took portions of them to make up diluted standards for actual injection in the instrument and confirmation that it was working correctly.

Q. Did you use them to establish base lines?

A. I used them to establish appropriate chromatographic conditions, and typical chromatograms of these materials, but not base lines.

Q. You're right. Would a "typical chromatograph" be a better term?

A. Yes.

Q. Does that mean you would run, say, a pure

WATER_PCB-SD0000041729

sample of a certain Aroclor and determine what reading the equipment gave?

A. Yes.

Q. And then if you later found that same reading in a sample you could conclude that this Aroclor was present in the sample?

A. To a certain degree, yes.

Q. What was your limit of detection of PCBs in samples?

A. The electron capture detectors are probably one of the most sensitive pieces of equipment around, and in general they are capable of detecting things on an order of about ten to the minus twelfth grams absolute.

Q. With your typical sample how would that translate to parts per million or parts per billion?

A. In a --- let's talk about a standard, since there's no such thing as a typical sample. In a standard, which is free from interferences and only has the --- the PCBs in question in it, a nanogram, one times ten to the minus ninth grams,

WATER_PCB-SD0000041730

was easily detected.

Q. What about dilution? I mean, could you detect down to --- again, looking to the standards, could you detect down to parts per million, parts per billion?

A. A nanogram, when you put it --- when you put a denominator on it, becomes a unit like parts million, parts per billion. So, one times ten to the minus ninth over --- in a kilogram of material would be whatever; I'd have to get a piece of paper and calculate it for you. Let's see, one (whispering under breath). It would be ---

Q. Something parts per trillion. That doesn't sound right.

A. That's correct.

Q. Parts per trillion?

A. Uh-huh (affirmative).

Q. So, with this equipment you could detect PCBs down to parts per trillion?

A. Correct. Standards.

Q. I understand. What about samples from the environment and --- well, let's go back a bit. At what point did you start

WATER_PCB-SD0000041731

analyzing samples from the environment?
A. I don't remember the exact date.
Q. But at one point did you start collecting samples from the environment and testing them?
A. Would you restate that again, please?
Q. At some point in time, did you begin to collect samples from the environment ---
A. Yes.
Q. --- and start testing them?
A. Yes. I didn't hear you.
Q. Sorry.
A. That's all right.
Q. And do you recall when that was?
A. After we had gotten the equipment set up and after we were satisfied with its performance on standards. The specific date I do not remember.
Q. Do you recall approximately how long it was after Dr. Keller had given you the assignment?
A. Three, six months, somewhere in that region.
Q. So, between three and six months after Dr. Keller gave you the assignment you

WATER_PCB-SD0000041732

were ready to --- you started analyzing samples from the environment?

A. I would say that we were ready to begin looking at what problems we would encounter, looking for PCBs in real life samples.

Q. And what were those problems?

A. Matrix interferences, other chlorinated hydrocarbons that give similar responses and cause confusion, a variety of things. There were a lot of preparative steps that were required for getting ready for matrixes interferences. Some affected the PCBs, some didn't. The ones that didn't were the ones you wanted.

Q. What do you mean by "matrix interferences"?

A. Any other environmentally naturally occurring constituent that has electron capture activity, other type of chlorinated hydrocarbons that are manufactured for use as pesticides, DDT, DDE, toxaphene, chlordane, dieldrin, anything; any of the kinds of chlorinated hydrocarbons that had the same kinds of

WATER_PCB-SD0000041733

properties as PCBs and that produced electron capture response.

Q. What is DDE?

A. That's a metabolism of DDT.

Q. What do you mean by "metabolism"?

A. It's a product that when an animal has been exposed to it or --- or a bug or something of that sort, it acts on the original molecule and changes it.

Q. So, after an animal has been exposed to DDT, what, it may produce DDE?

A. Correct.

MR. ZIMMER: Could we take a break here?

MR. KASHANI: Okay. Sure.

(OFF RECORD FOR SHORT BREAK)

Q. Dr. Tucker, you had mentioned that Dr. Keller appeared surprised at some of Jensen and Widmark's results. Were these the results that they found in terms of finding PCBs in animal samples and samples from the environment?

A. I don't think I said surprised.

MR. ZIMMER: Yes, I didn't recall that either.

WATER_PCB-SD0000041734

A. I believe I said that they didn't understand why they were finding these constituents where they were, and that the interest was to confirm or deny it independently.
Q. By "constituents" ---
A. In other words, verify or validate it.
Q. By "constituents," do you mean PCBs in the environmental and animal samples?
A. By what?
Q. Constituents?
A. Constituents, yes.
Q. This is referring to the PCBs in eagle feathers and so forth?
A. Whatever they were analyzing.
Q. What did you think about Jensen's work when you first read it?
A. Didn't have a hard opinion one way or the other. I really was in the process of proving it one way or the other, so it didn't matter what my opinion was at that point.
Q. Did anyone at Monsanto express --- and this is about the time you received your assignment from Dr. Keller. Did anyone

WATER_PCB-SD0000041735

at Monsanto express an opinion, to your knowledge, about Jensen and Widmark's work, one way or another?

A. Not specifically, no.

Q. Any commentary in general, any discussions in general, about whether people believed this work was valid or invalid?

A. Well, I think Jensen and Widmark were bona fide scientists, and to the extent they were capable of it, what they were saying was true from their viewpoint. Our concern was to validate that. It was certainly not a clear-cut issue, nor was it something that everybody did by twisting their fingers together and things of that sort. So, the situation was indeed very complicated.

Q. Let me go back to the time when you were ready to start working on the samples from the environment. Do you recall where those samples were collected?

A. No.

Q. Were they water samples from around Monsanto's plants?

WATER_PCB-SD0000041736

A. I don't recall what we collected first.
Q. Do you recall who did the collection?
A. No.
Q. Do you recall any of the samples that you collected or where they came from?
A. Can you define "recall"?
Q. As you sit here today, do you remember where you got samples that you analyzed?
A. I can remember a variety of locations over the years that we studied PCBs while I was with Monsanto, where we obtained samples. I don't remember specifically in terms of exact dates, times, days, morning, noon, night, things of that sort. There's a --- there should be documentation of that anyway.

MR. ZIMMER: He has all that.

(Thereupon the Court Reporter marked a pertinent document as PLAINTIFF'S EXHIBIT NUMBER 320-A.)

Q. I hand you what has been marked Exhibit next in order, I guess 320. Is that your signature down at the bottom?
A. (The Witness peruses the document.) Yes.
Q. Do you recall preparing this document?

WATER_PCB-SD0000041737

A. I would agree that I prepared it; I don't recall specifically preparing it. I mean, that's ---

MR. ZIMMER: Just answer his question, if you recall preparing it.

A. No.

Q. The second sentence of the second long paragraph reads, "The EC/GC ---" that's all capitalized "--- traces of the sediment were unmistakably Aroclor 1242." What does "EC/GC" refer to?

A. Electron capture gas chromatography.

Q. And what were you referring to when you said "sediment"?

A. Sediment ---

MR. ZIMMER: Calls for a foundation. You can go ahead.

A. To me "sediment" is a general term that's used to describe soil that's obtained from the bottom of a body of water.

Q. Would that be Snow Creek in the case of this sample?

A. Yes.

Q. Where is Snow Creek?

WATER_PCB-SD0000041738

A. To the best of my recollection, it's located somewhere near Monsanto's Anniston, Alabama plant.
Q. Did Anniston, Alabama plant manufacture Aroclors?
A. Yes.
Q. In that second sentence, the end of it reads, "the traces of the sediment were unmistakably Aroclor 1242." How were you able to say that the traces were unmistakably Aroclor 1242?
A. Okay. The electron captured GC traces of the sediment were unmistakably Aroclor 1242. The gas chromatograph, as we've discussed earlier, separates mixtures that can be vaporized into multiple components of which they consist; not necessarily 100 percent, but to the best of its ability into the components. And it does it in a reproducible fashion, as long as you're doing it over and over again in a reproducible fashion. So, you get a fingerprint or a pattern as these components elude through the detection system and are detected. That

WATER_PCB-SD0000041739

fingerprint is characteristic of --- or can be characteristic, of what you're looking for. So, you would use what I would call pattern recognition techniques; that's what they call it nowadays. Back then they called it, you know, you compared it to compare the two traces and see that they were equivalent.

Q. Let's ask a general question, and we can get more specific. So, by use of this equipment, the electron capture and the gas chromatography, you were able to reliably determine whether a sample contained, in this case, Aroclor 1242?

A. In this particular instance.

Q. And were you satisfied with the reliability of the test? Were you satisfied that Aroclor 1242 was, in fact, present in these samples?

A. Yes, especially since I knew they manufactured it at the plant.

Q. This mentions that the sample was taken or was received --- I'm referring to the first sentence of Exhibit 320. This mentions that the samples were received

WATER_PCB-SD0000041740

on 9/6, I believe that's '68. Do you recall receiving those samples?

A. No.

Q. It says that the water and sediment were sampled on 8/27/68. Do you recall when those samples were taken? Do you recall these dates?

A. No.

Q. Do you have any reason to doubt that these dates are correct?

A. No.

Q. Do you recall the purpose in sampling these particular samples from the other plant?

A. I would --- the purpose would be to analyze them and --- and see if Aroclors were present.

Q. Was this particular memo, this Document 320, was this prepared in the ordinary course of your work at Monsanto?

MR. ZIMMER: He's already indicated he doesn't remember preparing it, so how is he going to answer that?

MS. GRADY: He could tell by looking at the format.

WATER_PCB-SD0000041741

MR. ZIMMER: Well, he's not going to speculate like that while I'm sitting here.

MS. GRADY: That wouldn't be speculation, counsel.

MR. ZIMMER: Are you taking this deposition or is Mr. Kashani?

MS. GRADY: I'm not taking this deposition.

MR. ZIMMER: Okay. Thanks.

MS. GRADY: I thought you were addressing your question to the crowd. I guess not.

MR. ZIMMER: I didn't realize there was a crowd here. Is there another question?

Q. Is this the sort of document that you prepared while working at Monsanto ---

A. Yes.

Q. --- in the ordinary course? And, I mean, there's no reason to believe that there's anything false in this document, is there, Doctor?

MR. ZIMMER: Well, there's no reason to believe it's false, true

WATER_PCB-SD0000041742

or otherwise because he doesn't even remember preparing it. There could be typographical errors in it. I mean, I don't want to go through the litany of problems that ---

MR. KASHANI: Counsel, if you're going to testify, you should be sworn in.

MR. ZIMMER: I'm not going to testify, nor am I. But you're arguing with him about something you haven't laid a foundation for.

MR. KASHANI: It's his document; it's his signature.

MR. ZIMMER: And he's identified his signature, and otherwise he's told you he doesn't remember preparing it. That should be the end of it unless you can refresh his memory about things in it. That's the way it works.

Q. Do you remember taking these particular samples and analyzing them?

A. No.

Q. Do you remember sampling any animal

WATER_PCB-SD0000041743

tissues for PCB content about this time, this would be 1968 or 1967?

MR. ZIMMER: This memo is in '69.

A. Uh-huh (affirmative). This is February of '69.

Q. I know. The samples were taken in '68.

A. Would you state that question again, please?

Q. Do you remember sampling any animal tissues, chicken tissues or rat tissues for PCB detection?

A. Okay. The question is did I specifically remember sampling myself any tissues for PCB analysis; correct?

Q. That's the first question, right.

A. No.

Q. Did you supervise that work done by others?

A. Yes.

Q. Who did that work?

A. Which?

Q. Sampling of animal tissues for PCB content.

A. Which animal tissues?

Q. Let's start with rats.

WATER_PCB-SD0000041744

A. Industrial Bio-Test.
Q. I guess we should define "sampling." What do you think I mean when I say "sampling"?
MR. ZIMMER: Well, why don't you tell him what you mean when you say "sampling"?
MR. KASHANI: Well, we had a --- I believe Dr. Tucker was giving a very specific answer and a very careful answer.
A. Correct.
Q. Based on my use of the term "sampling"?
A. Correct.
Q. And that's why I'm asking that, particularly what you mean or what you think I mean by "sampling" when you give that answer.
MR. ZIMMER: Well, it's fair to ask him what he means by it.
A. You would like to know what I mean by "sampling" so that we're talking about the same thing?
Q. Exactly.
A. Okay. And I would like to answer your

WATER_PCB-SD0000041745

question honestly. That's why I was trying to clarify.

Q. I understand.

A. A sample is something that's usually provided to an analytical chemist to make a measurement on. That sample as received may be a subsample, or broken into smaller parts or aliquots for subsequent multiple analysis or different kinds of analyses. The original sample is not usually taken by the analytical chemist that does the measurement.

Q. So, by sampling you mean obtaining the sample from --- the physical obtained the sample from the environment or from the animal or whatever?

A. Correct.

Q. Okay. That's fine. We'll use that in terms of sampling. Let's define another term. When I use the term "testing for PCBs content," I mean injecting the sample into the machinery and determining whether PCBs are present.

A. Okay.

Q. Is that a proper term, "testing," or

WATER_PCB-SD0000041746

which term would you prefer?

A. "Testing" is fine, but you test an extract of the sample. Okay. In other words, the sample goes through a sample preparation step that gets it in a form that's introducible to the instrument in question.

Q. Okay. Now, do you remember testing any --- well, I'm going to use that word "sample" again. Do you remember testing any prepared samples of animal tissues for PCB content?

A. Yes.

Q. And do you recall when that work was done?

A. Which work?

Q. The ---

A. What animal tissues?

Q. Well, let me start with the ones from Bio-Test, Industrial Bio-Test Labs.

A. The year or ---

Q. Let me see if we have something here.

A. I believe in the 1970s we initiated some studies at Bio-Test, but that would have to be checked with appropriate

WATER_PCB-SD0000041747

documentation. That's my memory of it.

Q. Okay.

(OFF RECORD)

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 321-A.)

Q. It's Exhibit 321. I'll ask you to review that.

A. (The Witness peruses the document.)

Q. Are you finished reviewing the Exhibit?

A. Yes.

Q. Do you recall ever seeing this document before?

MR. ZIMMER: He means except as shown by counsel when I showed it to you.

A. I don't recall specifically seeing this document.

Q. Do you recognize Dr. Wheeler's signature on the second page?

A. I recognize that there's a signature that --- there was some initials that would indicate that it's Wheeler's signature. But I don't recall Wheeler's signature, very frankly. I have no reason to doubt

WATER_PCB-SD0000041748

that it --- it might not be Wheeler's signature, but if you're asking me if I remember that signature, I don't.

Q. On the first page there's some names after what appears to be a small "c" and a colon. Does that indicate that those individuals received or should have received copies of this document?

MR. ZIMMER: Lacks foundation and calls for speculation. I think this is the "c" he's referring to here.

THE WITNESS: Oh, this?

MR. ZIMMER: Yes. The question was does that indicate that these people received copies.

Q. Or should have received copies.

A. Yeah.

Q. The first numbered paragraph here mentions that Dr. Calandra --- is that Dr. Calandra of Industrial Bio-Test Labs?

A. Yes.

Q. Do you recall, did you ever meet Dr. Calandra?

A. Yes.

Q. Do you remember when you first met him?

WATER_PCB-SD0000041749

A. Oh, gosh. I remember the circumstances. I met him at, I believe, Industrial Bio-Test.
Q. In Chicago?
A. Yes. North Brook, Illinois. When we were discussing animal studies and things of that sort that were being proposed to help understand what was going on.
Q. What were those animal studies?
A. The laboratory --- Industrial Bio-Test, did a number of general toxicology-type studies with various strains of rats and beagle dogs and, I think, then white leg horned chickens. They had a place up in Wisconsin; they --- they looked at all different kinds of laboratory tests to animals, avian, mammalarian, and aquatic, in terms of normal toxicity testing for FDA approvals and --- and for things of that sort. So, those were the kind of animals.
Q. Turning to the ---
A. Birds and fish.
Q. Turning to this Exhibit, Exhibit 321, this appears to be after the line

WATER_PCB-SD0000041750

"Subject" is ---
A. Pardon me?
Q. After the line "Subject."
A. After the line "Subject"?
Q. Or the term, "Subject."
A. Okay.
Q. So, it's, "Aroclors - Minutes of Our discussion with Dr. Calandra." Do you remember this discussion that appears to be referenced here?
A. No.
Q. Do you remember meeting with Dr. Calandra in 1968 or before?
A. Could have been before, could have been after. I remember meeting with him; I don't remember when.
Q. The first numbered paragraph says, "Dr. Calandra is to dose several chickens with the Aroclors to make available sample tissues for analysis by Scott Tucker." Did that take place?
A. Yes.
Q. Do you recall what the purpose of that procedure was?
A. The purpose was to provide real --- well,

WATER_PCB-SD0000041751

pseudo real-life tissues that could be run through the procedures that we had been working on for isolating PCBs from animal tissues, and to see whether or not we could indeed see the materials.

Q. Was the purpose, therefore, to see if PCBs could be retained in animal tissues?

A. No, the purpose was merely to test the analytical methods, and to see what you would see in tissues from animals that were dosed at real high levels with PCBs.

Q. Do you remember the results of your tests?

A. Only in general.

Q. What were they in general?

A. We saw error. We saw the PCBs in the tissues.

Q. Now, Dr. Tucker, we have --- I don't know what Fritz has told you, but we have some documents ---

A. Fritz?

Q. Mr. Zimmer.

A. Okay.

Q. Has told you. We have some documents, obviously, and in an effort to remember

WATER_PCB-SD0000041752

you mentioned that some documents would be useful. We have some documents, and I'll try to show you what we have, but I don't think we have everything.

MR. ZIMMER: Please don't do that since we've provided you with well over 100,000 pages of documents.

Q. Are there any other documents, any records, that you might have kept during this period? I mean, starting in 1967 or whenever it was that Dr. Keller came to you with the assignment that might reflect some of these studies and work that you did?

A. Any number of types of records were --- were kept. Those were all and have been kept by Monsanto and were turned over to legal people ages ago.

MR. ZIMMER: He means do you have anything.

A. Oh, no; I have nothing.

Q. Did you keep a lab notebook?

A. When I left Monsanto or while I was at Monsanto?

Q. I see. Okay. Let me use a different

WATER_PCB-SD0000041753

term. Did you write, make notes, in a lab notebook while you were doing the work?

A. At Monsanto?

Q. At Monsanto, yes.

A. No, I did not use a lab notebook as a rule.

Q. Did you ever use a lab notebook?

A. Well, I used one at the University of Iowa, and when I was doing original research where inventions or --- or things like that were involved, I would use a laboratory notebook. For the analysis of samples, those were recorded by technicians and other kinds of books and things of that sort. That wouldn't be something that I would log into a notebook.

Q. These analyses of samples, where would they have been recorded?

A. In a --- in a sample receipt log whenever that was instituted.

Q. What's a sample receipt log?

A. It is a log that documents the receipt of samples.

WATER_PCB-SD0000041754

Q. Was this a log that was kept at the Monsanto lab where you worked?
A. I think at some point in time a log of that sort was initiated.
Q. Do you remember approximately when?
A. No.
Q. And how many samples are we talking about here? I mean, how ---
A. When?
Q. Let's start the first year after Dr. Keller gave you the assignment. Do you remember approximately how many samples you tested?
A. What's your definition of a "sample," please?
Q. I'll use the same. Well, let's use as a definition a quantity of either soil or sediment or water or animal tissue.
A. In the first year or so, most of the analyses that was performed was not done on what you're classifying as "samples," which I would call like real samples. You know, most of the analyses were done on synthetically prepared samples, including rats that were intentionally

WATER_PCB-SD0000041755

exposed to PCBs and that kind of stuff. And I'm not sure exactly when those samples were actually analyzed, but that's --- so, the first year or so there weren't a lot of actual environmental samples that were analyzed because we weren't prepared to do so.

Q. What about the second year?

A. I'm sure there were some done the second year. By that time we were probably prepared to do some.

Q. Do you recall approximately how many?

A. No, sir.

Q. Were they hundreds?

A. Certainly that many.

Q. And would these samples and results of the testing be kept in a sample receipt log?

A. No.

Q. Where were they recorded?

A. They were usually recorded in special study reports or memo reports.

Q. What did the memo reports look like? Did they look like, let's say, Document or Exhibit ---

A. I believe you showed one earlier ---
Q. --- 320?
A. --- regarding Snow Creek.
Q. Was that a memo report?
A. Yes.
Q. Who was working with you in doing the testing?
A. When?
Q. Let's start when Dr. Keller first gave you the assignment.
A. No one.
Q. Did you ever get any help?
A. Yes.
Q. Do you remember when that occurred?
A. Not specifically.
Q. Well, here's where I'm going to ask you some names of people who --- just what names you can remember of people who worked on the testing of samples for PCB content.
A. Okay.
Q. And what names do you remember?
A. Oh, you want me to name the people?
Q. Sure.
A. Jerry Litschgi, Bill Meaz, Jim Mieuer.

WATER_PCB-SD0000041757

Q. Could you spell that, please?
A. M-i-e-u-r-e, I believe, Mieure; something like that. You --- it's in the documentation you have; that's spelled. M-i-e-u-e-r, something like that.
Q. Anyone else?
A. Let's see. There were other people involved, but those are the ones that come to mind.
Q. Was a Dr. Munch involved?
A. Ralph Munch, yes.
Q. What was his role?
A. Ralph Munch was a senior tenured scientist with the company at Monsanto, and hardly worked for me. He was in charge of Dielectrics and --- and the development and research associated with those.
Q. By "dielectrics" in this context, do you mean the PCBs that were used in capacitors and transformers?
A. Correct. Dielectric fluids which included PCBs.
Q. Did you work with Dr. Richard at all?
A. Yes.

WATER_PCB-SD0000041758

Q. What about Dr. Wheeler?
A. Yes.
Q. Dr. Kelly?
A. Yes.
Q. Did you work with Norman Johnson?
A. Yes. They did not, however, work for me. All worked in the laboratory. Don't want anybody rolling over in their grave.
Q. Turning back to --- well, I'll come back to that. Do you remember who developed the protocols for the tests in terms of dosing animals with Aroclors and testing them that are referred to Exhibit 321?
A. Industrial Bio-Test.
Q. Were they the only ones?
A. Are you talking specifically about the protocols for dosing animals?
Q. Well, we can start with that.
A. They would have been the ones who were the expert in that and who would have recommended the appropriate protocols for the toxilogical (sic) dosages, and for the dosage techniques, whether it be gravage or whatever for animals.
Q. What about preparing the samples? Was

WATER_PCB-SD0000041759

that done in your lab?

A. Preparing what samples?

Q. The samples of tissues for testing in the machine.

A. The animals after sacrifice were excised by the IBT people, and only portions of the tissues representing muscle, whatever, liver, were then provided to us for analysis. Does that answer your question?

Q. Yes. So, these portions that came, then they were prepared for testing in the machine, in the equipment?

A. At --- by us?

Q. You being Monsanto?

A. Yes.

Q. And by IBT you meant Industrial Bio-Test?

A. That's correct.

Q. I'll show you our next Exhibit, which appears to be two documents. One may be a draft of the other. Let's tag them separately as Exhibits 322 and then --- well, on a number of documents.

(Thereupon the Court Reporter marked the pertinent documents as

WATER_PCB-SD0000041760

PLAINTIFF'S EXHIBIT NUMBERS 322-A and 323-A.)

Q. Let's begin with 322 and go on. There seem to be four separate documents.

A. Can you clarify what you're tagging?

Q. Yes. There's four separate documents. The top one that is primarily handwriting on the first page ---

A. Okay.

Q. --- will be Exhibit 322. The next one is Exhibit 323; that's the one that begins on page TRAN 007542.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 324-A.)

Q. And the next one is 324 and begins with TRAN 07544. I don't believe you have that document.

MR. KASHANI: Could you just mark that 325?

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 325-A.)

(OFF RECORD)

Q. Referring to Exhibit 322, have you ever

WATER_PCB-SD0000041761

seen this before?
A. I don't specifically recall seeing it.
Q. Do you know whose handwriting that is at the top where it says, "Plans, Electrical Fluids - Air and Water"?
A. No.
Q. Over on the side there's a date, 1/14/69, and under that it says, "REK/ST." Would that "REK" be Robert E. Keller?
MR. ZIMMER: Calls for speculation.
Q. And the "ST" would be Scott Tucker?
A. (No response from the Witness.)
Q. Can you recognize the handwriting under the "REK/ST"?
A. No, sir.
MR. KASHANI: Could the record show that the Witness signified assent to my previous two questions about "REK" and "ST."
MR. ZIMMER: I didn't hear an answer given.
A. What was that? Would you say that again, please?
Q. You were shaking --- you were nodding when --- we can go back and you can

WATER_PCB-SD0000041762

answer audibly ---

MR. ZIMMER: Well, I'd like --- 'cause I wasn't looking at him.

A. Okay. The only answers I'll be giving will be audible. Movements of my head, as I think we instructed earlier, are, you know, not ---

Q. Well, I didn't give you any instructions.

A. Okay. Well, I'll give some instructions. Actually, if I move my head, it's not affirmative or a positive or a negative or any of that kind of good stuff. Okay?

Q. Okay.

A. So, if you want an answer you need to ask for it, please.

Q. All right. Then, let me ask them again. But does the "REK" refer to Robert E. Keller?

MR. ZIMMER: Same objection. Lack of foundation, calls for speculation. And let me just point out --

A. It could.

MR. ZIMMER: Yes, that this is ---

A. I mean, obviously.

WATER_PCB-SD0000041763

MR. ZIMMER: --- fruitless and we go through this all the time. Those are Dr. Keller's initials. I will stipulate to that, as is "ST" Scott Tucker's initials. But how is he going to know what the person who wrote this had in their mind? It's just a waste of our time to go through these kinds of things. That's why I keep objecting about it because it's just --- I don't know why we do it.

Q. What about the "ST"?

MR. ZIMMER: Same objection.

Q. Do you know what that means?

A. It could stand for Scott Tucker.

Q. Have you ever seen this document before?

A. I don't recall seeing it specifically.

Q. What about Exhibits 323, 324 and 320 --- I'm sorry. Yes, 323, 324, and 325?

A. Right now I do not specifically recall seeing any of these; specifically, I do not recall seeing these.

Q. Do you recall seeing anything similar?

A. I'm sure I may have seen them, but I do

WATER_PCB-SD0000041764

not recall these documents. I have no reason to call these out in particular.

Q. Turning to page TRAN 005800 of Exhibit 322 ---

A. 322, second page?

Q. Right.

A. Okay.

Q. Within the first column we have a column labeled "Priority." Do you know what that means?

A. Do I know what "priority" means?

Q. In the context of this document?

A. I think order of importance, probably.

MR. ZIMMER: He doesn't want you to guess or speculate. He's asking if you know what it means in this document.

A. I would be guessing.

Q. Looking on the fourth column, you see a column labeled "Justification." And if you see the first table, it's a priority one. I mean, the first row, it says "Priority 1," then lists some Aroclors under "Product," including Aroclor 1242. It says, "Job/Project" with some

WATER_PCB-SD0000041765

description under there. Then "Justification" is, "Provide backup data needed for toxicity studies by Calandra to show biological fate of Aroclors." Do you know what that's referring to?

A. Yes.

Q. What is that referring to?

A. The development of the GC/ECD methods in these particular matrices is to develop a methodology to analyze these matrices for the PCBs, and to see what happens to them when they are incorporated in the animals in a manner --- in a normal manner; for example, in food or whatever.

Q. Do you mean if the, for example, if the PCBs decay over time in the animal or decomposed?

A. I don't think decay or decomposed is appropriate terminology. Whether they're altered, whether their molecular structure is altered.

Q. You mean whether the PCB ---

A. "Decay," for example, refers to like in radioactive materials when, you know, they decay radioactively. And

WATER_PCB-SD0000041766

"decompose" refers to biological systems where the system falls apart, putrefies. These were intended to show what happened to these materials in biological systems from a chemical viewpoint or a biochemical viewpoint. So, it would be like metabolism or --- or something of that sort.

Q. Do you recall if studies were eventually taken to determine what happened to PCBs in biological systems?

A. Yes.

Q. Do you remember the results?

A. Yes.

Q. What were the results?

A. In general, the results were that the lower chlorinated PCBs were metabolized and/or altered biochemically. And, in fact, all of them were to a certain degree. The resistance to biochemical reaction increased as did the degree of chlorination. That was the general consensus.

Q. Well, let's introduce some new terms. Why don't we go back for a minute? As I

WATER_PCB-SD0000041767

understand, Monsanto sold a product called Aroclor or Aroclors; is that correct?

A. They had a product line that was referred to as Aroclor or Aroclors.

Q. And these Aroclors consisted of PCBs?

A. Yes.

Q. And the Aroclors were assigned a number. For example, there was an Aroclor called Aroclor 1242; is that correct?

A. Correct.

Q. Do you know what the number signified?

A. Yes.

Q. What did it signify?

A. The 1200 referred to the fact that it was a biphenyl. The next two digits that appeared after that referred to the degree of chlorination.

Q. Meaning?

A. Meaning that Aroclor 1242 was a biphenyl that had been chlorinated to --- to 42 percent, to contain 42 percent by weight chlorine.

Q. So, you had a base compound or compound --- not in that sense a base, but you had

WATER_PCB-SD0000041768

a compound called biphenol (sic) which had no chlorine?

A. Biphenyl.

Q. Biphenyl, which had no chlorine?

A. Correct.

Q. And then chlorine was added to it through some chemical process?

A. Correct.

Q. Resulting in a chlorinated biphenol (sic)?

A. Biphenyl.

Q. Biphenyl.

A. Correct.

Q. Which we refer to as PCB?

A. Correct.

Q. And Aroclor 1242, then, consisted of biphenols (sic), which had been chlorinated to consist of 42 percent chlorine?

A. Biphenyls.

Q. Biphenols (sic).

A. Biphenyls are different than biphenols.

Q. That's right. You're right.

A. Okay. So, just so we know what we're talking about. 'Cause if you're talking

WATER_PCB-SD0000041769

about biphenols ---

Q. I understand.

A. --- the answers are different.

Q. I understand.

MR. ZIMMER: You should probably explain the differences in the spellings of that to the Court Reporter.

MR. KASHANI: Okay.

Q. I'm always meaning to say biphenyl with a "y." I pronounce ---

A. P-h-e-n-y-l.

Q. That's correct. That's what I mean to say, and that's --- I mean, the transcript should reflect that. However, I'm pronouncing it in a way that sounds like a different word.

A. P-h-e-n-o-l-s.

Q. That's right. But I don't mean to ---

A. There's a difference in molecular structure.

Q. --- say that.

A. Okay. I just ---

Q. But I don't mean to say that, and I will ---

WATER_PCB-SD0000041770

A. It's a very important point.
Q. And I will work on the pronunciation. I understand.
A. I mean, I don't care how you pronounce it, but it's extremely important that I understand what you're talking about.
Q. Now, I'll be referring to biphenyl.
A. All right.
Q. So, if you go back to Aroclor 1242, which is 42 percent chlorine by weight ---
A. Correct.
Q. --- is that 42 percent average or 42 percent --- every single molecule is 42 percent?
A. Average.
Q. In fact, I mean, is it possible for a PCB molecule to be 42 percent chlorine?
A. Yes.
Q. How many chlorines would that be?
A. I think I --- if I remember correctly, I think it corresponds to four, but I'd have to calculate it. I don't memorize things that I can calculate unless I'm working with them very frequently.
(OFF RECORD)

WATER_PCB-SD0000041771

MR. KASHANI: Let's mark this Exhibit 326.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 326-A.)

Q. I'll let you take a look at it, and I'm going to ask you, Doctor Tucker, are you familiar with how Aroclors for manufactured?

A. Yes.

Q. Would you describe that briefly?

A. Yes.

Q. Could you please describe how ---

A. Sure, absolutely. The pure biphenyl is heated up to a temperature where it's molten or liquid, and then chlorine gas is bubbled through the mixture with stirring and things of that sort until the appropriate amount of chlorine has been reacted with the biphenyl.

Q. So, the chlorine atoms will combine with the biphenyl molecules ---

A. Correct.

Q. --- during this process?

A. Correct.

WATER_PCB-SD0000041772

Q. And do you know when Monsanto started manufacturing Aroclors?
A. Monsanto really didn't start manufacturing Aroclors. As I recall, they purchased a company that had been manufacturing Aroclors. And I believe that they purchased that company, which was Swan Chemical Company, back in about 1935. But those folks had been in business since maybe 1927 or something like that, manufacturing polychlorinated biphenyls.
Q. And had they been using approximately this same process since, let's say, the 1930s to manufacture Aroclors?
A. I don't know.
Q. According to this document, Exhibit 326, so I can get some names down. Let me refer you to what's numbered page one, but under our numbering is TRAN 006987.
A. 006987.
Q. Well, first of all, have you ever seen a document like this before, like Exhibit 326, or have you ever seen this document before?

WATER_PCB-SD0000041773

A. I've seen a document like this before, yes.
Q. Do you know what these are used for at Monsanto?
A. To document processes.
Q. Does this describe how to make Aroclors, essentially?
A. Correct.
Q. So, if you look at ---
A. And any other things they made. I mean, I'm sure they used these for all of them.
Q. Look at page TRAN 006987; on the second paragraph down near the bottom it says, "Many isomers are formed." What is an isomer in the context of PCBs?

MR. ZIMMER: Well, do you mean in the context of this document, I suppose?

MR. KASHANI: No, I mean in the context of PCBs.

MR. ZIMMER: Okay. Well, I just want to make sure he's not interpreting the document.

A. Okay. What is an isomer?
Q. In the context of PCBs?

WATER_PCB-SD0000041774

A. In the context of PCBs. It's any combination of chlorine and biphenyl, and there are 209 different permutations ranging from monochloral all the way up to decachloral biphenyl.

Q. Does this mean that there are more than different numbers of chlorines on the biphenyl molecule?

A. Not only different numbers but different positions.

Q. And the isomers refer to those, to the different molecules with different numbers of chlorines in different positions?

A. Correct.

Q. So, two isomers could have, for example, different numbers of chlorine on the biphenyl?

A. Or the same.

Q. Or the same. So, an isomer could have, you know, four --- one isomer might have four or five chlorines or six chlorines, and another one might have two chlorines? Is that what you mean by "isomer"?

A. One isomer might have four chlorines, one

WATER_PCB-SD0000041775

isomer might have five, one isomer might have have six. One isomer might have four chlorines with the four chlorines in different positions, so there are multiple tetrachloral isomers. There are multiple pentachloral isomers.

Q. When the Aroclors are manufactured, are different isomers produced?

A. Yes.

Q. When Monsanto was manufacturing Aroclors --- and I guess we can refer to in 1968 --- did Monsanto ---

A. Refer from 1935 to ---

Q. 1935, sure.

A. --- today, if you feel like it.

Q. Okay. The whole time, then, while Monsanto was manufacturing Aroclors did Monsanto use any process or filter of some kind in ---and I'm using "filter" in a lay sense, and obviously not in a chemical sense --- to restrict a number of isomers that were being produced?

A. No.

Q. So ---

A. Not to my knowledge.

WATER_PCB-SD0000041776

Q. So, Monsanto would run the process, would bubble the chlorine through the biphenyl, and the result would be different isomers with different numbers of chlorine atoms?
A. Correct.
Q. On the biphenyl?
A. Correct.
Q. And a batch, say, of Aroclor 1242 would have different isomers, but on average there would be 42 percent chlorine?
A. Correct.
Q. Let me refer to page TRAN 007034 of this document. At the top it refers to Aroclor 1242.
A. Right.
Q. Have you ever seen documents like this before?
A. Yes.
Q. Have you ever seen this particular one referring to Aroclor 1242?
A. I don't recall it specifically.
Q. I think the second row says, "Molecular Weight." Second row of the table, and it says, "257 average;" I think that's "a-v-g," average. Do you know why that's

WATER_PCB-SD0000041777

listed as an average?

MR. ZIMMER: If that's indeed what it says. Our copy of it is a very poor reproduction

MR. KASHANI: Well, maybe my copy is a little better.

MR. ZIMMER: Looks the same.

A. It says, "a-v-g," which is generally used as a abbreviation for "average."

Q. Do you know why it says average?

A. Yes.

Q. Why is that?

A. Because if you add up all of the molecular weights of all the isomers present in a biphenyl that's been chlorinated to 42 percent, and you divide it, then the average is 257.

Q. And 257, is that --- if we go back up to where it says, "Formula," without getting too technical, but ---

(OFF RECORD)

Q. If you go back to the 257 average, by using the term "average," does that indicate that not every molecule in the mixture is going to have this same

WATER_PCB-SD0000041778

molecular weight, but on average the mixture has that weight?

A. That's correct.

MR. ZIMMER: Calls for speculation.

(OFF RECORD)

Q. We were discussing the production process for Aroclors, and I guess my question is that is it inherent in the production process that when you say you are trying to make Aroclor 1242, you would end up with a mixture of biphenyls with different numbers of chlorines on them?

A. Yes.

MR. ZIMMER: Calls for speculation.

Q. Have you ever watched the process go? Did you ever watch at the plant where they were making Aroclors?

A. Only time I ever saw the plant was to climb up on top to sample it, and so I've never seen the process really run.

Q. But you understand how it works?

A. As a chemist.

Q. I asked you if Aroclor 1242, as manufactured by Monsanto, consisted of a mixture of biphenyls with different

WATER_PCB-SD0000041779

numbers of chlorines. Did you have to analyze a sample of 1242 to know that, or is that something that, as you said, is inherent in the process?

A. The answer to that is both. Theoretically, yes, confirmed by analysis, yes.

Q. So, it is both inherent in the process and something that can be confirmed by analysis?

A. Yes.

MR. ZIMMER: Just so I'm clear. Are you asking him about a matter of degree or percentages or ---

MR. KASHANI: There's no question pending.

MR. ZIMMER: No, I know. I'm asking you whether that's what you meant.

MR. KASHANI: I'm not here to answer your questions.

MR. ZIMMER: That's fine. I guess he can have an unclear question on the record. It's up to you, counsel.

WATER_PCB-SD0000041780

Q. Let's go back to Jensen and Widmark's work, and the question attributed to this particular line of inquiry, the issue of the higher and lower chlorinated PCBs. Do you recall which PCBs it was that Jensen and Widmark apparently found in the environment?

A. No.

Q. Do you recall if it were higher or lower chlorinated PCBs?

A. No.

Q. Do you recall if they found certain specific Aroclors?

MR. ZIMMER: Assumes facts not in evidence.

A. No.

Q. So ---

A. Let me clarify that. I recall that they did not find Aroclors.

Q. What did they find?

A. PCBs.

Q. And that goes back to your testimony that an Aroclor consists of a mixture of different PCBs?

A. Correct.

WATER_PCB-SD0000041781

Q. And Jensen and Widmark had found certain PCBs in the environment, meaning certain biphenyls with numbers of chlorine atoms on them?
A. Yes.
Q. Do you recall which PCBs it was that Jensen and Widmark had found?
A. No.
Q. You mentioned earlier that one of the aspects of your assignment was to verify Jensen and Widmark's work. Do you recall when it was that you were confident that you had verified their work?
A. No, because the verification was a gradual situation.

MR. KASHANI: I'll introduce an Exhibit. Let's label this Exhibit 327.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 327-A.)

Q. Have you ever seen this document before?
A. Do I recall now ever seeing this document specifically before; is that your question?

WATER_PCB-SD0000041782

Q. Well, it was do you recall seeing --- have you ever seen this document before?
A. I don't recall specifically seeing this document right now. I mean ---
Q. Is your handwriting anywhere on this document?
A. (The Witness peruses the document.) No, sir.
Q. On the first page of the document is listed, it says, "Rough Draft." And then apparently someone has made some corrections on it. Do you recognize the handwriting of those corrections? Are those your corrections?
A. They are not my corrections, and I do not recognize the handwriting.
Q. Let's go to the second page and in the second paragraph, that first full paragraph, it says, "It now becomes evident that the PCB problem and the CHC pesticide or DDT problem are nearly one and the same." Do you recall writing that or words to that effect?
A. No, sir.
Q. Do you know what is meant by CHC?

WATER_PCB-SD0000041783

A. In general that's an abbreviation that's used for chlorinated hydrocarbons.

MR. ZIMMER: Did you mean, counsel, in general or as used in this document?

MR. KASHANI: I think it would be the same in this case because, as far as we can tell, and Dr. Tucker doesn't remember, but apparently the draft, according to the document, it's Dr. Tucker's name at the end.

MR. ZIMMER: Yes, I see that too, but I just want to know why he'd be speculating since he doesn't remember writing it. But, in general, certainly he can tell you and has apparently.

A. Yeah, well, CHC, pesticides are chlorinated hydrocarbons, so CHC would be ---

Q. The date at the end of this document is 11/10/69, December (sic) 10, 1969. And referring you to the second page, it reads --- this is the third full paragraph, "Based upon the data we and

WATER_PCB-SD0000041784

other outside workers have generated since our confirmation of the Swedish findings, analogous statements can be made about the higher chlorinated biphenyls (CL5 --- that's CL and then subscript 5 and above)." Does that refresh your recollection as to when, by what time, you had confirmed that the work of Jensen and Widmark --- what time you had verified the work of Jensen and Widmark?

A. Yes, but I'd like to clarify what "confirmation" means.

Q. You mean in ---

A. "Confirmation" means that we reproduced their techniques in our laboratory and they worked on samples that we analyzed. We did not exchange samples of Widmark and folks and verified what they found in the samples they analyzed was what they found. So, there's a --- you know, there --- there's a subtle difference there, but I think it needs to be clarified by the way you're asking that question so that I can answer it honestly.

WATER_PCB-SD0000041785

Q. Do you mean confirmation as it is used in this document?
A. Yes.
Q. I thought you said you don't remember this document or writing it. I mean, how do you know what the author meant?
A. I know what I meant in terms of the question that you were asking me relative to confirmation of Widmark's and --- and Jensen's work, which is, I believe, what you said. Now, why don't we have the reporter read back what you said just prior to my qualifying my answer to you, please?

(OFF RECORD)

(At this time the Court Reporter read back the pertinent question.)

A. Just so there's no question, let me be risky ---
Q. I understand.
A. --- and tell you what I thought I said to you. Okay. My comment was not in reference to this document, which I don't specifically remember. My comment was in reference to your comment, was my

WATER_PCB-SD0000041786

recollection of confirmation, the definition of confirmation, refreshed by this document. My definition of confirmation relative to the Jensen Widmark work was that we reproduced the analytical techniques that were employed in our laboratory using similar equipment, not exact equipment, and that we demonstrated that that equipment was capable of doing and producing the information that Jensen and Widmark had produced if it was operated by people who were trained and who knew what they were doing. We did not, however, exchange samples with Jensen and Widmark, with appropriate chain of custodies and things of that sort, and actually verify what they found in their samples.

Q. So, by "confirmation" you mean that you were able to find PCBs in the same range, the same everything, the parts per million range in your samples as well?

A. In the samples that we made up, yes.

Q. What about the samples you obtained from the environment?

WATER_PCB-SD0000041787

A. Eventually that was true, yes.
Q. Do you recall if that was true as of the date of this document, December (sic) 10, 1969?
A. No, I do not.
Q. I'm sorry. November 10. I'm sorry. I've been referring to this document incorrectly as December 10, 1969. Document Exhibit 327 is November 10, 1969.
A. It would appear it's either October or November since the date has been stricken through. The "10" has been converted into an "11." Is that correct on your copy?
Q. Apparently.
A. Okay.
Q. Let me refer to the second paragraph on page two of Exhibit 327. Midway it reads, "The major concern is the long range effects of these persistent materials, for it is known that these materials can and do ---" but "and do" is crossed out --- "accumulate in increasing quantities in adipose tissues." What are

WATER_PCB-SD0000041788

"adipose tissues"?

A. Fat, lipid.

Q. Do you know what is meant by "accumulation in adipose tissues"?

A. It means that the chlorinated hydrocarbons are hydrophobic; they don't like water. And, therefore, they, when exposed to lipid, would have a tendency to go toward the lipid materials and to concentrate there.

Q. You mean that PCBs have a tendency to dissolve in fat?

A. Correct.

Q. Fatty tissues?

A. Chlorinated hydrocarbons in general including PCBs do, yes. And this statement here, I would surmise, refers to both PCBs and chlorinated hydrocarbon PCBs or pesticides, as it states. So, it's a general property of chlorinated hydrocarbons.

Q. So, the PCBs are building up in fatty tissues of animals in the environment?

A. You would expect them to, yes.

Q. Is that what is meant by "accumulate" in

WATER_PCB-SD0000041789

this sentence?

MR. ZIMMER: Well, he doesn't remember preparing this, so you are asking him to interpret something that lacks foundation. If you know, Doctor, tell him.

A. It basically says what it says, that they can accumulate in increasing quantities in adipose tissues.

Q. Is that a problem?

A. Not to me.

Q. I mean, the fact that PCBs build up in fatty tissues of fish and animals?

MR. ZIMMER: It doesn't say that they do; it says they can.

A. Is that a problem? I mean, what context do you mean is that a problem?

Q. Well, let's go back to when you were doing this work in 1967 and 1968.

A. Uh-huh (affirmative).

Q. Was that perceived as a problem by Monsanto, or a potential problem, that PCBs could accumulate in the fatty tissues of animals?

A. It was generally perceived by the

WATER_PCB-SD0000041790

scientific community that the accumulation of chlorinated hydrocarbons in adipose tissues was not good. However, there was little, if any, proof or any validation, nor has there been. And, in fact, some of the claims that were made have subsequently been disproven in terms of the impact of this. So, whether or not it's a problem, I don't know, and I'm not qualified to confidently comment on that because I'm not a toxicologist.

Q. I understand. I want it to be clear. I'm not asking you for your opinion today as to whether this is a problem or not. I'm asking you whether at the time --- let's start with 1967 when you were working at Monsanto, did anyone at Monsanto express a concern over this, or even an interest in this situation? This situation being that PCBs might be building up in fatty tissues of animals?

A. Yes.

Q. Was this a similar problem that was being noted at about approximately the same

WATER_PCB-SD0000041791

time with DDT?

A. I --- I'd like to refrain from the use of the word "problem." I've already characterized myself.

Q. Let's say "situation."

A. I'm not a person that can define a toxilogical (sic) problem, which I believe you're implying.

Q. I understand. Let's say ---

A. Was that an observation? Yes. Restate your question, please.

Q. Right. The situation that was noted with PCBs in that they could be building up in fatty tissues of animals, at the time we're talking about which is --- my question was 1967. Was this problem also --- this situation also being noted with respect to DDT?

A. Yes.

Q. So, DDT was also being seen as accumulating in fatty tissues of animals?

A. Yes.

Q. In 1967?

A. Yes.

Q. Were the two situations linked in any way

WATER_PCB-SD0000041792

in your mind, speaking again in 1967?
A. Define "linked," please.
Q. Did information pertaining to --- again, speaking of 1967. Did information pertaining to DDT have any relevance to your investigations with PCBs, or was it a completely separate thing that you could ignore?
A. DDT was a separate issue.
Q. I'm going to refer you back to Exhibit 327, page three, first full paragraph, the third sentence reads, "If we can prove that Aroclor 1242 is biodegradable then with sufficient care the manufacture and use of this material can continue." Do you recall writing that?
A. I do not specifically recall writing that or this document, as I've stated earlier.
Q. Do you know what is meant by "biodegradable"?
A. I have an opinion with regard to it, yes.
Q. Are there different meanings?
A. On biodegradability, yeah, a variety.
Q. What is your opinion?
MR. ZIMMER: Do you mean as it's

WATER_PCB-SD0000041793

used in this sentence or just as he uses it generally?

Q. Well, let's go back to 1967. If you use the term "biodegradable," what would you mean back then in the context of Aroclor and PCBs?

A. It would mean that it --- it was --- or in the context of anything, it would mean that it was biologically decomposed.

Q. Does that mean it would break down in the environment?

A. Yes, through biological action, organisms or --- or whatever.

Q. Does that mean in the context of PCBs that you'd start with PCBs, and if they escaped into the environment, they would eventually, through natural means, break down into something other than PCBs?

A. Well, what it means basically is that the environment has a certain capability to use chemicals and other kinds of constituents as energy and food sources, and to recycle them basically. And so that's what biodegradation is.

Q. Do you recall doing any investigations as

WATER_PCB-SD0000041794

to whether Aroclor 1242 was biodegradable?

A. Yes.

Q. Was that a priority?

A. Relative to?

Q. Relative to, say, investigations, if any, into the biodegradability of higher numbered Aroclors, like 1254, 1260?

A. The general investigation of the biodegradability of PCBs was --- was a priority with everything relative to this kind of stuff.

Q. Do you know why it was a priority?

A. Yes.

Q. And why was that?

A. Biodegradability was important because if a constituent is biodegraded, then it just wouldn't continue to build up ad infinitum if it were released in the environment.

Q. And by "building up," do you mean building up, among other places, in the fatty tissues of animals --- in the case of PCBs, of course?

A. Yes.

WATER_PCB-SD0000041795

Q. Do you recall what tests you took to determine if Aroclor 1242 was biodegradable?
A. Yes.
Q. What were those tests?
A. We looked at three tests ourselves, but there were four tests in general that were used to evaluate the biodegradability of materials. These tests were originally used for water soluble constituents that were intended for release into the environment, especially the aqueous environments, soaps and detergents and things of that sort. And we had a resident expert, a Dr. Robert Swisher who had pioneered a biodegradation testing of water soluble compounds. And we took those techniques and applied them to water insoluble compounds, which PCBs were, for the very first time.
Q. Dr. Fischer (sic), was he a Monsanto employee?
A. Swisher.
Q. Swisher?

WATER_PCB-SD0000041796

A. Yes.
Q. Do you know if he's still alive?
A. No, sir.
Q. He is not?
A. I don't know if he's --- the question was do I know if he's still alive, and I said, "No, sir."
Q. I'm sorry.
A. Not wishing anything on him. He was a nice man, and I liked him a lot. If he --- I still like him if he's alive. I --- I don't know. The tests that were employed were called the River Die-Away test, the semi-continuous activated sludge test. There was an ultimate degradation test, and then there were also what was called soil biodegradation tests.
Q. Would you describe the River Die-Away test?
A. Yes. You take a --- a sample of water from a river that has a natural biological or primarily bacterial population in it, and you divide it up and you spike it with the constituent

WATER_PCB-SD0000041797

that you are interested in seeing if it's biodegradable.

Q. In this case, PCBs?

A. In this case it would have been PCBs, although we looked at a variety of things. And then you monitor it over a period of time to see if the --- if the material disappears.

Q. And what are we talking about in terms of monitoring? Do you monitor it down to the parts per million, the parts per billion?

A. In the case of water insoluble compounds, you're monitoring it down in the part per billion range.

Q. When you first, as you said, spiked the medium with PCBs, what's the concentration? How much PCB do you put in it?

A. In the River Die-Away test, the biological activity or the biological population, the population of the bacteria is very low if it's a nice river. And as such, there's not a lot of bacteria around to use synthetic

WATER_PCB-SD0000041798

molecules as carbon sources and energy sources, so you intentionally keep the amount that you put in low. Then you try to keep it low enough such that it represents reality and such that it doesn't have any bactericidal affects or impacts on the --- on the bug population, so the bug population can work on it and degrade it.

Q. So, by "low," do you mean parts per billion?

A. Yes, parts per million, parts per billion, depending upon what you're dealing with.

Q. You mentioned you wanted to keep the bug population alive. If the PCB concentration is too high, will it simply kill off all the bugs in it?

A. I don't think it's simply PCBs; I think it's --- in fact, quite frankly, with PCBs the water solubility of PCBs is so low that the PCBs just played out as a layer on top that probably would keep oxygen from getting into the water, which would kill the bugs ultimately, the lack

WATER_PCB-SD0000041799

of oxygen. But I don't know, the point is, is that at some point, especially with water solubility --- water soluble compounds, you do reach a concentration at which, for anything, that you'll have a toxic effect or an inhibitory effect on bacterial growth. So, you like to keep it down at realistic levels. Realistic levels would be at or near the solubility of the constituents in question. For PCBs that had to be something below parts per million.

Q. Did this reflect the concentrations that were being found in your samples that you pulled from the environment, say the samples you pulled from the plant?

A. Yes.

Q. And then how did the test proceed after spiking the sample?

A. After spiking the --- the samples, you would seal them up and then periodically you would sacrifice it and extract a sample and isolate the PCBs and analyze what was left.

Q. So, it would determine how much PCB was

WATER_PCB-SD0000041800

left after a certain period of time?
A. Uh-huh (affirmative). Yes.
Q. Do you recall the results of that River Die-Away test with respect to Aroclor 1242?
A. In general.
Q. What were the results?
A. That --- that isomers that were present in Aroclor 1242 were degradable.
Q. Do you mean some of the isomers were degradable?
A. Correct.
Q. Were all of the isomers degradable?
A. No.
Q. So, when you were testing Aroclor 1242 in the River Die-Away test, some of the PCBs would degrade and some wouldn't?
A. Correct.
Q. So, there would always be some PCB left that would not degrade?
A. Correct.
Q. And this is from Aroclor 1242?
A. It's true of all the Aroclors.
Q. So, with ---
A. Including Aroclor 1242, yes.

WATER_PCB-SD0000041801

Q. So, with respect to all the Aroclors, including Aroclor 1242, they would never degrade completely?
A. I don't know that to be a fact. You have a little thing called time in there and ---

(OFF RECORD)

MR. KASHANI: Mark this next in order.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 328-A.)

Q. Doctor, do you remember when you had the results on the River Die-Away test for Aroclor 1242?
A. Not specifically.

(OFF RECORD)

Q. I'd like to show you Exhibit 328. Do you recall this document?
A. (The Witness peruses the document.) Not specifically.
Q. We have a number of documents that are the same type in the sense that Monsanto up at the top in the upper left-hand corner. Then they have some lines for

WATER_PCB-SD0000041802

"From," "Date," "Subject," "Reference," and so forth. Is this format familiar to you?

A. Yes.

Q. What is this format?

A. It's a general memo format that was used at Monsanto.

Q. This is while you were working at Monsanto?

A. Yes.

Q. Do you recall how these memos were prepared? I mean, you'd sit down and type them out yourself or ---

A. No.

Q. --- have that done? How were they prepared?

A. Generally, write them up by hand and give them to the secretary, and the secretary would write them up and give them back. And we'd look at them and correct them and give them back to the secretary, and the secretary would correct that and give them back to us. And at some point we achieved a state of grace that we'd consider was good enough and they were

WATER_PCB-SD0000041803

distributed.
Q. And they were distributed to the people who are listed as "To" on the document and copies were sent ---
A. That was the intention.
Q. And copies were sent to the people listed after "cc" in the document?
A. That was the intention.
Q. Do you know how the documents were routed, how they were delivered?
A. No.
Q. Did you have messengers going around?
A. I just said I don't know how they did it. I --- it wasn't my job to worry about that kind of routine, so I didn't concern myself with it. It seemed to get done but I didn't verify it or anything.
Q. So, if you'd put down "To" on one of your memos, you'd expect that the document would be sent to these people?
A. Correct.
Q. And if you identified some people under the "cc" column, you would expect that copies would be sent to these people?
A. Correct.

WATER_PCB-SD0000041804

Q. Were they real carbon copies in those days?
A. No.
Q. Xerox copies?
A. Yes.
(OFF RECORD)
Q. Now, was it important to the operation at Monsanto that these sorts of memos be truthful and accurate?
MR. ZIMMER: Calls for speculation.
MR. KASHANI: Oh, I'm sorry.
Q. Was it important to the operation at Monsanto to the extent you were aware that these sorts of memos be truthful and accurate?
MR. ZIMMER: Same objection.
A. I --- you know, I mean ---
Q. If you received ---
A. From my viewpoint I never wrote memos that were not truthful and accurate. That's all I can talk about. I would assume if I were running Monsanto, that I would want the memos to be truthful and accurate, and I'm sure they were, very frankly. It's a standard practice; I

WATER_PCB-SD0000041805

mean, that's --- I guess I won't comment on understanding the question.

Q. I'm not suggesting that anyone would put something in a memo that's not truthful and not accurate. And I understand that that's your testimony as well.

A. In this particular one, that's for sure and the things that I wrote, yes.

Q. Have you received memos of this type with that Monsanto at the end and date, subject, and reference, and to? Was it your understanding that they were prepared in the same way that you prepared your memos?

MR. ZIMMER: Calls for speculation.

A. It's my speculative understanding that that was probably true.

Q. And was it important to your work that the memos you received of this type also be truthful and accurate? By this type I mean the format that was represented by Exhibit 328.

A. I'm confused. Is it --- are we talking about the format or the content?

Q. Format. Memos that you received on this

WATER_PCB-SD0000041806

format, was it your understanding that they were also truthful and accurate?

A. Well, I --- I never doubted it one way or the other; never had any reason to be concerned. Yes, I mean ---

Q. Thank you. This particular memo, Exhibit 328, refers to electron capture fingerprints. Do you know what is meant by "electron capture fingerprints"?

A. Yes.

Q. What is meant by that?

A. Electron capture fingerprint is the chromatographic trace that you obtain when you inject a sample into the --- into an instrument, a gas chromatograph, that has an electron capture detector on the end.

Q. You mean, this is the readout that the machine gives?

A. Correct.

Q. And from this readout you can determine what is in the sample? I mean what is in the sample?

A. Some types. Some types that's not enough information; it really depends on the

WATER_PCB-SD0000041807

situation.

Q. This particular memo reads, "The electron capture fingerprints of the extracts from each sample do not show any indication of biodegradation." Do you recall writing that?

A. No, sir.

Q. Do you recall these tests or samples that were taken?

A. No, sir.

Q. This memo refers to sample numbers. Do you know where we might look to find out what those samples were? Might it be in that sample log or sample receipt log you mentioned?

A. I don't know.

Q. This mentions --- the second paragraph refers to the NCR plant.

A. The second paragraph?

Q. Second paragraph, second sentence, I suppose.

A. Okay. First sentence starts, "The decrease in ---" Okay. All right.

Q. Did you ever obtain samples from the NCR plant?

WATER_PCB-SD0000041808

A. I'm sure we did.
Q. What were the samples?
A. I don't remember specifically.
Q. Any particular reason why you got samples from NCR?
A. I would assume that they may have been using the Aroclor product at that point, and they wanted to know what was in the samples relative to Aroclors, if there were any Aroclors in it.
Q. Do you recall which Aroclor they were using?
A. To the best of my knowledge, I think they used Aroclor 1242 primarily. But there are probably other ways to verify that than asking me.
Q. Do you know if they were using the Aroclor 1242, or the Aroclor that they were using, for their carbonless carbon paper?
A. I believe they used Aroclor 1242.
Q. And do you know what was the purpose of sampling, taking samples and testing samples from near the NCR plant?
A. Yes.

WATER_PCB-SD0000041809

Q. What was that purpose?
A. I analyzed them and I used electron capture gas chromatography. I was probably looking for chlorinated hydrocarbons, specifically Aroclors.
Q. Meaning PCBs?
A. Correct.
Q. Was NCR or anyone at NCR aware of the fact that you were taking samples from that plant?
A. First, I wasn't taking samples from the plant. Secondly, I have no knowledge of that. Samples would arrive, and we would analyze them.
Q. Did you ever send your results to anyone at NCR?
A. Not to my knowledge.
Q. Going back to this numbering system or these numbers under the samples, is there any particular way that the samples were numbered that you recall?
A. In this particular instance, it could be the numbers that were on the samples we received.
Q. This memo is written as, "To: C. Paton."

WATER_PCB-SD0000041810

Do you recall if Cumming Paton, C-u-m-m-i-n-g, was involved in this effort, in this --- well, let's start with taking samples from NCR. Do you know if Cumming Paton was involved in that?

A. There's a question --- there's a pony in there; right? There's a question in there; what is the question?

Q. What was Cumming Paton's involvement in getting and analyzing these samples from NCR?

A. I don't know.

Q. What about J. T. Garrett?

A. I don't know.

Q. Who was M. W. Farrar, F-a-r-r-a-r?

A. Martin Farrar was the Director of the Plasticizers Group.

Q. And did that group use Aroclors?

A. I think it's made a record that Aroclors were used as plasticizers.

Q. And what are plasticizers?

A. A plasticizer is a material that's used to impart flexibility to plastic systems.

Q. Was it being used for packages of food

WATER_PCB-SD0000041811

products and so forth, potato chips, that sort of thing?

A. I don't know.

Q. Earlier you said that you had concluded that not all the PCBs in Aroclor 1242 would degrade in the environment. Do you recall when it was that you came to that conclusion?

A. No. Let me back up to your preambles to these questions. The preamble in this particular situation implies that I, at some point in time, said that all PCBs were not biodegradable. The way I feel about that particular situation, if I were asked the question directly in terms of the biodegradability of PCBs, is that it is dependent --- the degree and the rate at which PCBs are biodegradable is dependent upon the degree of chlorine substitution. Biphenyl itself degrades very rapidly; no problems whatsoever. And monochloral, et cetera; di, tri, et cetera. Tetra, it slows down a little bit, but pretty much they will degrade. Penta, it looks like in the time frames

WATER_PCB-SD0000041812

that we were able to observe the systems, which were not what I call protracted lifetime situations, we didn't see a lot. Okay. Same thing with hexa; same thing with hepta; same thing with, you know, the whole works down the road. The point that --- that within the distance or the time that we were able to observe these tests and to keep these accelerated systems alive, that we didn't necessarily see any biodegradation, does not mean that in the overall time frame of, you know, the environment, that there aren't degradation techniques that --- and things that occur and that biodegradation can't occur. It's a probability situation. So --- and the other thing is, is that if you want to ask that question without the preamble, well, I'll be glad to ask --- answer that question. So, can you restate that question?

Q. I don't know if we --- we have to go back. But why not take it a subject at a time. So, what you're saying is in the tests you ran, some of the PCBs would

WATER_PCB-SD0000041813

degrade and some wouldn't?
A. In the time frame that we looked at, I mean, yes.
Q. In the tests you ran. I'm only referring to the tests you ran.
A. Okay.
Q. Did you run additional tests which showed that some of these PCBs that did not degrade in your initial tests did, in fact, degrade?
A. No. We never ran what I would consider equal lifetime tests. In fact, we had indications from samples that were very weathered that the lifetimes of these materials were indeed long.
Q. How long? How long were these samples?
A. I haven't the faintest idea. I will say another thing, that there were some degradation techniques that we didn't look at, that subsequently learned about, and it was called anaerobic degradation, just for the record.
Q. Did you ever run those tests?
A. No, sir.
Q. So, did you run any tests? Did you ever

WATER_PCB-SD0000041814

run any tests in which these PCBs that you are --- there were tests that you didn't run, obviously. And the tests that you did run indicated that some PCBs degraded and some did not?

A. It indicated that the rate of biodegradation was proportional to the degree of chlorination, and that information has been published in the open literature, and it's been peer reviewed. So, if you --- if you look at that, what it basically says is, is that as you increase the degree of chlorination, the rate of biodegradation gets to the point where maybe it's not observable. But it doesn't answer the question as to whether or not they can ultimately be degraded at some point long enough down the road.

Q. But if we can stick to the tests instead of --- if we can stick to the tests that you ran and not speculate on the basis of those tests.

A. I'm not speculating. What I'm saying is, is that the rates that we observed were

WATER_PCB-SD0000041815

proportional to the degree of chlorination, and if you plot that information and look at it, you can see that it --- it shows you that as you --- the degree of chlorination increases, the rate of biodegradation decreases. It doesn't necessarily say that given enough time that decachloral biphenyl wouldn't degrade.

Q. But how much time is enough?

A. I don't know; we didn't answer that question.

Q. We'll look at this next Exhibit, Exhibit 329.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 329-A.)

(OFF RECORD)

A. (The Witness peruses the document.)

Q. Do you recall this document?

A. Not specifically.

Q. The first paragraph is referring to the "biologically populated river water degradation study." Is that the River Die-Away test?

WATER_PCB-SD0000041816

A. Yes, sir.
Q. Do you recall that test?
A. Yes, sir.
Q. And it says here that the results or --- well, it says here, "Aroclors 1242, 1248 and 1254 remained unaffected after an exposure period of five weeks." Was that the result of the test that you recall?
A. Where are we reading?
Q. I'm reading from the first paragraph; that was the third sentence.
A. (The Witness peruses the document.) Okay. And your question was?
Q. It reads, "Aroclors 1242, 1248 and 1254 remained unaffected after an exposure period of five weeks." Was that the result of the test?
A. At five weeks this test --- that's what it says.
Q. Does that mean that there was no biodegradation of these Aroclors after five weeks?
A. No. What it means is there was no observable biodegradation.
Q. I see. And do you recall the limit of

WATER_PCB-SD0000041817

your observation, how far you could observe?

A. I would guess in the range of, if you were very, very careful, five, ten percent, something like that was a pretty good reproducibility; ten percent would be the norm.

Q. You mean ten percent reduction or ten percent biodegradation?

A. Ten percent reproducibility.

Q. Okay. It was a different --- saying different things. You mentioned earlier that you had equipment that could measure PCBs to the parts per trillion?

A. Correct.

Q. Did you have this equipment at the date of this memo, which is January 29, 1970?

A. Yes.

Q. And using that equipment, what you are saying is that you were unable to measure any degradation in these samples after five weeks?

A. Correct.

Q. The second paragraph goes into the second test you mentioned, which is the semi-

WATER_PCB-SD0000041818

continuous activated sludge degradation. How did that work?

A. The semi-continuous activated sludge system --- okay. In the, for example, let's --- let me explain. The River Die-Away test is a --- a real small hammer. The activated sludge test is a --- a real large hammer. The bug density --- now, the bugs are the operating vehicles here; the bugs are the things that chew things up and use PCBs as a carbon source, or any other chemicals that are in there. Okay. Or an energy source. All right. The bug population in the water --- I mean, you can hold the water up and you can see it; you can see nothing. It's nice and transparent clear. Activated sludge, if you --- if you hold it up, it looks --- it's --- it just exactly that, sludge. Okay. So, that the difference in bug populations between these two are millions and billions. Okay. And so, the River Die-Away test is a --- a real lightweight. And, in addition to that,

WATER_PCB-SD0000041819

there's no attempt to maintain the viability of the bugs in a --- in a River Die-Away test. Okay. There's no replenishment of key nutrients and other kinds of --- of things that the bugs need to live. So, it dies away fairly quickly. In the acti --- semi-continuous activated sludge test, what you do is you go get a sewage from a sewage treatment facility, you go get an activated sludge. And "activated" means that you are feeding that sludge a nutrient source, sugar, to keep it nice and viable and --- and going good. In that test, on a daily basis, you add the constituent that you're interested in in terms of seeing if it degrades. You add more on a daily basis; you continuously feed it to it. Okay. And so, you monitor that continuously over a long period of time, and you make sure your bugs are nice and healthy and that you've got a lot around. So, you have got a big hammer here. Okay. In addition to that, the bugs in there, because of their short lifetime,

WATER_PCB-SD0000041820

in other words, the --- from generation to generation they are able to genetically mutate to the point where they can use different things as carbon sources. For example, if they've never seen them before they might not have the enzymes to break them down. If they see them and they start to see them often enough, and they have to use that as a carbon source or an energy source to survive, then they can genetically mutate. One or two of them might have the --- the enzymes to --- to use as a carbon source; the other ones die out. The one or two that have that proliferate, and so a population that's capable of degrading the material comes --- comes around. Okay. And it becomes dominant. So, what you'd expect is if something is very readily degradable in --- in an isolated situation where you pull it out, the river water, and in a period of time you can keep it viable, you'd expect to see it degrade. So, it's a real lightweight. Sugar, you know, it

WATER_PCB-SD0000041821

--- if something degrades in an RDA test you --- you're putting it in the same classification with sugar, with, you know, real just standard stuff. I mean, that kind of thing. If it --- semi-continuous activated sludge test is a more accelerated test that's tougher, and makes things happen in a shorter time frame. Okay. And so, you'd expect that things that might not necessarily degrade in an RDA test would degrade in a --- in a semi-continuous activated sludge test in the time frame that you're able to observe it.

Q. So, is it fair to say that the semi-continuous activated sludge test is more likely to show degradation, if degradation is occurring, than the River Die-Away test?

A. Correct.

Q. And that a substance --- in other words, if it ---

A. Let me --- let me say this. It --- it --- it displays the ease of biodegradation, how easy something's

WATER_PCB-SD0000041822

accomplished. Okay. And if it's done in the RDA test, it's very easy, the molecules are very biodegradable. But this takes activated sludge and not in the RD test and it's --- it's still biodegradable. It's just a little bit harder for the bugs to use it. I mean, if you've got your choice ---

Q. I ---

A. If you have carrots and spinach and steak, you're going to eat steak. Okay. If you take the steak away you'll eat the spinach to survive; that's the way bacteria are. Okay.

Q. I understand. I mean, I understand what you're saying, though.

A. Okay. I just want to make sure.

Q. I'm trying to put this in terms of the eventual reader of this transcript. And I understand --- I guess what you're saying here --- is it fair to say that --- how can I put this? That if passing the test means a substance is biodegradable, if we define that as passing the test, or degrades, meaning

WATER_PCB-SD0000041823

that --- and by a substance being biodegradable, I mean that you can detect biodegradation within the time limit of the test. Let's define that as passing the test. Is it fair to say that it's easier for the substance to pass the semi-continuous activated sludge test than the River Die-Away test? "Passing" meaning that you can detect biodegradation within the time of the test.

A. That's your definition ---

Q. Yes.

A. --- of passing; not my definition.

Q. That's right. That's my definition.

A. In the context you've described, yes.

Q. So, again, taking my definitions, the semi-continuous sludge test, or semi-continuous activated sludge test, is easier to pass than the River Die-Away test, using my definition?

A. I can't ---

Q. The substance being ---

A. I can't understand why anybody would want to express it in that way. And I guess

WATER_PCB-SD0000041824

that's what I'm having trouble accepting what you're saying.

Q. I'm just trying to put this in terms ---

A. I mean, we can --- we can define ---

Q. We're trying to put this in layman's terms. I mean, a substance can be a lot --- what you're saying is --- what you're telling me is that a substance can be less biodegradable and degrade in the semi-continuous sludge test and not degrade into the River Die-Away test?

A. That's what I'm saying, yeah. In other words, what I'm saying is, is that the time required for an event to occur --- when you test things --- when you wonder how --- what happens to something in a lifetime, your lifetime, we --- we can't do that. So, what we do is we develop accelerated tests that allow us to get a relative feeling. And so, if you were using something like naturally occurring sugar, sucrose, as your standard and it degraded at a certain rate by this test, and you looked at something else and it degraded at the --- at the same rate as

WATER_PCB-SD0000041825

sucrose, then you could probably say that you could release to the environment that material at the same rate sucrose goes through the environment. 'Cause the environment takes care of it like that, and should you see any problems with it at any point in time, you can quit making it and the environment would clean itself and you wouldn't have any problems. Okay. If you saw materials that were taking much longer to degrade, or didn't show evidence of it with these accelerated tests, then you'd have to be very careful about only using those things if you had to use them in systems that were closed and didn't leave much to the environment and things of that sort. That --- is that making any sense to you at all?

Q. Yes, it does. I mean, let's say if you use --- okay. No, that makes sense. And were the PCBs degrading --- I'm trying to get a relative scale. Were they degrading as fast as sugar or as readily as sugar does?

WATER_PCB-SD0000041826

A. Some.
Q. Which ones?
A. The lower chlorinated ones. Biphenyl, for example, is quite rapidly.
Q. It's a pure biphenyl without any chlorine?
A. That's correct.
Q. Is that a PCB?
A. No. Monochloral biphenyl quite rapidly, too, though.
Q. That's with one chlorine in it?
A. That's correct. Dis did too. And, as I said, theres a publication in the literature that plots the degree of degradation, or rate of degradation, versus the degree of chlorination. So, it's --- you know, it's clearly been published in the literature; it's peer reviewed and it --- it's just there for everybody to look at.
Q. Well, what about the higher chlorinated PCBs, the ones with five and six chlorines atoms on them; were those degrading?
A. In the time frames that these tests did,

WATER_PCB-SD0000041827

we did not see significant degradation or detectable levels of degradation.

(OFF RECORD FOR SHORT BREAK)

Q. Dr. Tucker, you mentioned that you had been deposed before, so I didn't go through some of the standard instructions prior to the deposition. But I'm going to go --- I'll just go through those now than skip back to them afterwards. You know that the Court Reporter is, through some electronic means here, taking down everything that's being said. And she will prepare a bound volume and transcript of everything that was said at this deposition. And you'll be provided a copy of that, and you will be able to make corrections in that copy. But the parties to this case, or the attorneys or if and when this case goes to trial at some point, we will be permitted to make comments on those corrections that you made. Do you understand that?

A. Yes, sir.

Q. Did you understand that at the beginning of the deposition?

WATER_PCB-SD0000041828

A. Yes.
Q. And the oath you took at the beginning of the deposition is identical to an oath that you might have taken to testify --- you might take to testify in trial in a courtroom before a judge and jury. Do you understand that?
A. Do I understand that I'm supposed to tell the truth, the whole truth, and nothing but the truth? Is that what you're trying to say to me?
Q. The effect of the oath that you took?
A. Yes.
Q. Did you understand that when you were taking the oath?
A. Yes.
Q. And I guess the last thing is, I don't think I'm having any problem on this, but obviously if there's any question I state this is inaudible, which you know this is a problem, or that you don't understand, I hope that you'll tell me and give me an opportunity to rephrase the question, if you don't understand my question.
A. Thank you.

WATER_PCB-SD0000041829

Q. Is that understood?
A. Yes. Appreciate it.
Q. Did you understand that at the beginning of the deposition as well?
A. I must have.
Q. Thank you.
A. I think --- yeah, I --- yeah, I understand that.
Q. I understand you've taken a deposition before.
A. Okay.
Q. You've been deposed before, so ---
A. Well, I'm not a --- I mean, I don't do it for a living.
(OFF RECORD)
Q. Referring to the River Die-Away test and the semi-continuous activated sludge test, what was the soil test? That was the third test that you mentioned.
A. The soil was the fourth test. And it's just a test where you spike biologically active soils with --- with constituent in question and monitor the degradation. We didn't perform those.
Q. Is there any particular reason why you

WATER_PCB-SD0000041830

did not do soil tests?

A. They're difficult, and it's very difficult to get a standard soil with a standard bug population. It's very difficult to keep the bugs alive. There's not a lot of historical comparable data, things of that sort. So ---

Q. What about the ultimate degradation test? And, I'm sorry; that was your third test.

A. That was one of the four tests. And ultimate degradation involves monitoring the complete mineralization of the constituents in question by monitoring the CO2 produced by the oxidation in the material, by the bacteria.

Q. And did you perform those tests?

A. Yes.

Q. And what were the results?

A. I don't recall.

Q. Do you recall if PCBs were degraded at all in that test, the ultimate degradation test?

A. I don't recall specifically. I would have to go back to the original

WATER_PCB-SD0000041831

information and/or publications to --- to comment.

Q. By "original information" do you mean the notes that were taken at the lab?

A. I think there's some papers and publications and things of that sort.

Q. Were these your own papers, your papers and your publications?

A. They were Monsanto's papers.

Q. Do you know where we could go to obtain those?

A. Nope. The paper, publication, I mean, has been published in the open literature. So, that's referenced. I mean, you can look in *Chem Abstracts* under my name ,and you'll find it as an author, so I would be surprised if you didn't already have it.

Q. If you turn to the next Exhibit, Exhibit 330.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 330-A.)

Q. Do you recall this document?

A. I'll need a chance to complete reading

WATER_PCB-SD0000041832

it. (The Witness peruses the document.) I do not recall this document specifically.

Q. Do you have any general recollection of it?

A. General recollection of the content and things of that sort, yes.

Q. I'm going to ask that same question about the previous Exhibit, Exhibit 329. Can you turn back to that? You mentioned you had no specific recollection of that document either, but do you have a general recollection of it?

A. Yes.

Q. Turning back to Exhibit 330 ---

A. We're going forward and not backwards? Okay. Whoops.

Q. Is that your signature down at the bottom?

A. Yes.

Q. Who is Mr. Lidgett, L-i-d-g-e-t-t?

A. Ron Lidgett, I believe, if I remember correctly, was the night manager or plant manager at Monsanto's Ruabon facility and ---

WATER_PCB-SD0000041833

MR. ZIMMER: That's R-u-a-b-o-n.

A. --- in --- in Britain.

Q. And do you remember why you sent this document to Mr. Lidgett?

A. It would appear after reading the document that we were exchanging information with regard to the biodegradability and --- and other kinds of information that were being generated relative to Aroclors.

Q. Was Mr. Lidgett working on the same project?

A. Yes. I --- I struggled there because of your --- what's the definition of the "same project"? I mean, you know, he obviously was in England and we were obviously in the United States so ---

Q. The second paragraph, second sentence starts, "We have exposed Aroclors 1221, 1242, 1248 and 1254 to biologically populated river water (8 weeks) and to lab sludge in semi-continuous activated sludge units ---" and they have a paren; I believe that sign means approximately?

A. Uh-huh (affirmative).

WATER_PCB-SD0000041834

Q. "Approximately 2 months)." Is the first part of that sentence, the reference to biologically populated river water, is that referring to the River Die-Away test?

MR. ZIMMER: In this memo that he doesn't recall writing?

MR. KASHANI: Well, he says he had a general recollection of it.

MR. ZIMMER: If you know, go ahead and tell him.

A. Yes.

Q. And is the second part of the sentence referring to the semi-continuous sludge test?

A. Yes.

Q. I'm sorry, activated sludge test?

A. Yes.

Q. And then the sentence goes on to read, "Only Aroclor 1221 has shown significant degradation and this is probably due to its high biphenyl content." Do you recall that that was a result of these tests?

A. Not specifically.

WATER_PCB-SD0000041835

Q. Do you recall if any other Aroclor showed significant degradation?
A. I recall the publication that we published in the *Peer Review Journal*, and it indicated that observable degradation was observed for other Aroclors besides Aroclor 1221.
Q. Is that consistent with this sentence?
A. It could be.
MR. ZIMMER: Argumentative. Come on, you don't need to get into that with him. Let's move on.
Q. Does Aroclor 1221 have fewer chlorine on average? I mean, less chlorine on average than Aroclor 1242?
A. Yes.
Q. Could that explain why Aroclor 1221 appeared to be more biodegradable?
A. Yes.
Q. And it mentions here that Aroclor 1221 has a high biphenyl content. Is that your understanding?
A. Yes.
Q. Is biphenyl referring to the molecules without any chlorine on them at all?

WATER_PCB-SD0000041836

A. Correct, and it's also referring to an interesting observation that's made with bacteria, and it's a little thing called co-metabolism in the sense that a particular molecule that's similar to, or another molecule that's available for bugs to chew on, they'll chew on both. And I --- this appears to be a precursor to something we observed later on.

Q. So, if an Aroclor contains a higher proportion of biphenyl, meaning a molecule without any chlorine at all, it would tend to be more biodegradable because of this co-metabolism?

A. It would tend to be more biodegradable because it contained more biphenyl, plus the chlorinated materials in there might be more biodegradable because of co-metabolism associated with the fact that the organisms were being familiarized with the basic structure, molecular structure, of the --- of the thing. In other words, if you had taken a bug population and --- and fed it Aroclor 1242, and concurrently you fed it

WATER_PCB-SD0000041837

higher levels or additional levels of biphenyl, you may be able to induce co-metabolism of the material.

Q. And this would result in more biodegradation than without biphenyl?

A. Correct.

Q. Is biphenyl --- I want to pronounce it correctly. Is biphenyl a substance that's normally found what --- I'm sorry. Did you find biphenyl in the samples that you pulled from the environment of river water or sediment, or was that something you added to test?

A. We did not look for biphenyl in these tests. An electron capture detector is completely blind to biphenyl. In other words, when we were monitoring by electron capture, we were only monitoring the chlorinated species. So, if we talk about degradation of Aroclor 1221 ---

Q. But you knew that 1221 had a relatively higher biphenyl content?

A. Correct. Yes.

Q. This concept of co-metabolism, do you remember when you became aware of that?

WATER_PCB-SD0000041838

You mentioned this as a precursor. This document that's dated February 1970, is that when you became aware of this concept of co-metabolism?

A. I don't recall specifically, but I know it was during this period of time that co-metabolism began to appear in the literature for other types of hydrocarbon and chlorinated hydrocarbon systems.

Q. By "this period of time," do you mean in February of 1970?

A. I mean in the years 1970, '71, in that area.

Q. Did you hear about the concept before 1970, if you recall?

A. I don't recall.

Q. Let's turn to our next Exhibit.

A. Pardon me?

Q. Let's turn to the next Exhibit.

(Thereupon the Court Reporter marked the pertinent document as PLAINTIFF'S EXHIBIT NUMBER 331-A.)

Q. It's Exhibit 331. After you've had a chance to read it, I wonder if you would recognize this document?

WATER_PCB-SD0000041839

A. (The Witness peruses the document.)
Q. Do you have any recollection of this document?
A. Not of this specific document.
Q. Do you recall documents of this type?
A. No.
Q. Do you recall, have a general recollection of documents called Monthly Summary in this particular format, or similar format?
MR. ZIMMER: From the Functional Fluids group or any department in particular?
MR. KASHANI: Well, similar to the document we have.
A. I don't recall this specific document. I wrote Monthly Summaries for Keller in the Applied Sciences Section.
Q. Could this have been one of the Monthly Summaries you wrote? And, unfortunately, we haven't been provided with every page, I think.
MR. ZIMMER: How do you come to that conclusion?
MR. KASHANI: That we haven't been

WATER_PCB-SD0000041840

provided with every page? The fact that the last sentence on the last page is cut off.

MR. ZIMMER: Well, I guess you're right.

A. What was the question?

Q. My question was did you have any involvement in the preparation of this particular Monthly Summary?

A. Let's see. This particular Monthly Summary, no. The information that's in it I may have supplied to Keller through a different vehicle.

Q. Do you remember ever receiving documents of this type labeled Monthly Summary and had this sort of format?

A. Not this one. Not these --- not this format, no.

Q. Was there another format for a Monthly Summary?

A. I told you that we published an internal monthly form. I would publish monthly reports, some of which, you know, you've asked me if I was generally familiar with it. I've indicated I was, that went to

WATER_PCB-SD0000041841

Keller. I reported to Keller. I did not publish in this particular Monthly Summary format.

Q. I guess what's the second page of this document, Exhibit 330, at TRAN 024395, at the top, a phrase, "Aroclor Defense." Does that phrase mean anything to you in the context of your work at Monsanto? Is that a phrase ---

MR. ZIMMER: No foundation. Calls for speculation.

Q. Is that a phrase that you ever heard used while you were at Monsanto?

A. Yes.

Q. What did you mean by "Aroclor Defense" when you used the term "Aroclor Defense" while you were at Monsanto?

A. First of all, you asked me if I've heard it, not if I used it. And I agreed that I heard it. Now, you want to ask me if I used it?

Q. Yes. Did you ever use it?

A. I may have used it, yes.

Q. And what did you mean by this phrase when you used it?

WATER_PCB-SD0000041842

A. I --- I would probably have used it conjecture, to talk about what we were doing to whoever coined the phrase, "Aroclor Defense."
Q. Do you know who coined the phrase, "Aroclor Defense"?
A. No, I do not.
Q. What about when you heard Aroclor Defense? What did you understand that to mean?
A. From my viewpoint it would be understood to mean to understand what was --- what was happening environmentally with Aroclor.
Q. Was there any concept that Monsanto had to defend the use of Aroclors, given the studies and results of studies that were coming out about that time? I mean the time 1967, 1968.
A. What was the question? I know there's a pony in there.
Q. Was there any notion at Monsanto at that time that you had to defend the use of Aroclors or defend the production and sale of Aroclors?

WATER_PCB-SD0000041843

A. There were people who were making extrapolations and projections based on unverified and not very extensive information, who were making accusations that there might be problems associated with Aroclors. But I suppose you could assume that one needed to defend it. I don't think it had been shown that were really any problems yet.

Q. So, people were making accusations, some of which were believed to be unfounded by Monsanto?

A. Well, I don't think any of them were particularly founded at that point in time.

Q. What point is that?

A. What's the date on this document?

Q. 1970.

A. There was a lot of speculation in 1970, and there hadn't been very much accumulation of information. And I think if you'd like to verify that for yourself, if you do a literature search on things like pesticides and herbicides and then do a literature search of

WATER_PCB-SD0000041844

Aroclors, you'll see the difference.

Q. Are you familiar with Monsanto's Corporate Management Committee?

A. Yes.

Q. Are you aware that at the beginning of 1969, the Corporate Management Committee began making different plans for --- well, let's just say plans with respect to the continued production and possible withdrawal of Aroclor and Aroclor-containing products?

MR. ZIMMER: Assumes facts not in evidence.

A. Nope.

Q. Did you ever attend a meeting of the Corporate Management Committee?

A. I may have once, and that context is in review of a presentation that was made to the President's Council on Environmental Quality in a Departmental Task Force on PCBs.

Q. Do you recall approximately when that was?

A. Oh, gosh.

Q. I mean, was it ---

WATER_PCB-SD0000041845

A. 19 --- just had to be probably no earlier than 1972. But I could --- that can be documented because, I mean, the information with regard to when that presentation occurred I'm sure is documented.

Q. This is a presentation Monsanto made to what body?

A. They made it to the President's Council on Environmental Quality Interdepartmental Task Force, if I remember correctly.

Q. Do you remember who was involved in that presentation?

A. Yes.

Q. Who was that?

A. Myself, Ralph Munch. I don't remember who the other folks were. There were others.

Q. Let me refer you back to Exhibits --- I guess these are 329 and 330. And we've discussed these tests to some extent. Do you remember any tests you might have taken prior to the dates of these memos, which indicated that a greater

WATER_PCB-SD0000041846

biodegradability for Aroclor 1242 than what's reflected in these tests?

A. No.

Q. Do you recall any tests you took on biodegradability prior to these memos at all, biodegradability of PCBs?

A. Not specifically.

Q. Do you have any general recollection of conducting such tests prior to the date of these memos?

A. No, I really couldn't pin it down. I know tests were performed, but I don't know whether it was prior to this memo or that kind of routine.

Q. Do you remember undertaking any tests after the date of these memos that indicated that Aroclor 1242 was more biodegradable than was indicated by these tests, the tests referenced in these memos?

A. No.

(OFF RECORD)

Q. This is Exhibit 332.

(Thereupon the Court Reporter marked the pertinent document as

WATER_PCB-SD0000041847

PLAINTIFF'S EXHIBIT NUMBER 332-A.)

(OFF RECORD)

A. (The Witness peruses the document.)

Q. Do you recognize this document?

A. No.

Q. There appear to be two types of handwriting on it. Do you recognize the handwriting, either type?

A. No.

Q. Do you know what this document refers to?

A. I was just thinking on saying at the moment, I don't understand it.

MR. ZIMMER: Well, that pretty well will foreclose any other questions about it.

Q. Were any of these terms terms that you were using about the time? And by "time," I mean there is a date on this document January 15, 1970.

MR. ZIMMER: What terms are you referring to?

Q. I'll start with "Found in Wildlife" and "Not Found in Wildlife." Were those terms that you used in the context of PCBs?

WATER_PCB-SD0000041848

A. No.
Q. If you'll look at the line under ---
MR. ZIMMER: Let me tell you in advance that he is not going to interpret this document for you. So, if you're going to ask him to do that, it's going to be a waste of time.
MR. KASHANI: Is that an objection?
MR. ZIMMER: It's a ---
MR. KASHANI: An objection in advance?
MR. ZIMMER: In advance.
MR. KASHANI: It's a preempted objection?
MR. ZIMMER: Right. I am trying to save some time. Because I can tell where you're going, and it's not going to happen.
Q. The line under Aroclor 1242, we have the bottom graph is labeled, "Number of Chlorine." And the side, the vertical axis is labeled, "Percent chlorine." I think that's chlorine, although the "C" is cut off. This line to me seems to

WATER_PCB-SD0000041849

represent in a distribution of the number of chlorines, average number of chlorines, or the different number of chlorines in Aroclor 1242. I'm not asking you if that's what it means. But I'm asking you if this, based on your knowledge, if this distribution is correct. In other words, does this --- assuming, take my assumption that this line represents the number of chlorines on average in Aroclor 1242, or the different components of Aroclor 1242, is that line correct based on your knowledge?

MR. ZIMMER: Well, he's not going to answer that. Because, first off, this is a handwritten memo, which he's indicated he did not prepare; he's never seen before. I can't tell where that particular line that you refer him to ends up on this chart, if indeed the left-hand column refers to chlorine despite the absence of the letter "C."

MR. KASHANI: Well, let's ---

WATER_PCB-SD0000041850

MR. ZIMMER: Let me finish. And so, he's not going to get into guessing where this ends up and what it means. It's as simple as that.

MR. KASHANI: I didn't ask him what it meant, counsel. Just listen to my question.

MR. ZIMMER: I did.

MR. KASHANI: Well, we can take it step by step.

Q. To me the first line under Aroclor 1242 seems to indicate that a relatively small percentage, say about under five percent of the PCBs in Aroclor 1242, have one chlorine atoms on them. Is that consistent with your knowledge?

MR. ZIMMER: That you can answer. You don't need to refer to the document for that. He's just telling you what his understanding of it is.

A. No. Okay. Yeah, that's ---

Q. Actually, you don't have to refer to the document.

A. State it again.

WATER_PCB-SD0000041851

Q. Is ---
A. Please, so I can make sure that accurately understand what you're saying.
Q. Well, let's start at the top. This seems to indicate to me that the majority or most of the PCBs present in Aroclor 1242 have three chlorine atoms on them. And I'm wondering, is that consistent with your understanding?
A. That's consistent with Aroclor 1242, that the dominant species present in Aroclor 1242 is trichloral biphenyls.
Q. Meaning it has biphenyls with three chlorine atoms on them?
A. That's correct.
Q. And this also seems to indicate to me that Aroclor 1242 has some, a lesser percentage, of biphenyls with more than three chlorine atoms on them. Is that consistent with your understanding?
A. Yes.
Q. And that Aroclor 1242 also has a, again, lesser percentage of biphenyls with two, one, or zero chlorine atoms on them?
A. Correct.

WATER_PCB-SD0000041852

Q. All right.

MR. ZIMMER: See, we didn't even need the document.

THE WITNESS: That's right.

MR. KASHANI: I needed the. document.

MR. ZIMMER: You've got a lot of others that I've seen you use before that talk about that same issue. Some with fancy tables and charts and everything.

(OFF RECORD)

Q. Dr. Tucker, did you ever go to Europe to meet with Jensen and Widmark?

A. No.

Q. Did you ever meet them?

A. No.

Q. Do you know if they are still alive?

A. No.

Q. Do you know of any researchers or scientists at Monsanto that did go?

A. Yes.

Q. Do you remember which ones and when?

A. Bob Keller.

Q. Did he go about 1969?

WATER_PCB-SD0000041853

A. If you say so.
Q. Did Dr. Richard ever go to Europe to your knowledge?
A. Bill was a world traveler. I'm sure he went to Europe many times.
Q. Well, I'm sorry.
A. Could you be more specific?
Q. Yes, I'm sorry. Did Dr. Richard ever go to meet with Jensen and Widmark in Sweden?
A. I don't know. I don't remember specifically, but it is possible.
Q. Do you remember if Dr. Wheeler went to meet with Jensen and Widmark?
A. I know for sure Keller , went and let me think about Ralph. I remember an anecdotal routine that would verify for me that Keller and probably Richard went. It had to do with somebody carrying a tape measure and measuring the width on seats and stuff like that. So, that's how I remember that one.
Q. Is this on an airplane or something?
A. Yeah. I'm --- I was surprised somebody carried a tape measure. They were

WATER_PCB-SD0000041854

worried about the difference between the two different airplanes and the size of the seats or something like that; so, that's why I remember that very specifically.

Q. This was when ---

A. So, I think it was Wheeler and Richard and Keller. Keller for sure 'cause Keller had the tape measure. And those would have been the logical people to go over there.

Q. Why Dr. Wheeler?

A. Why not?

Q. No, no. What was his responsibility? Why was he a logical person to go?

A. Elmer was --- was a toxicologist, that kind of person. If I remember correctly, that was his background and, you know, he --- he managed all the Bio-Test stuff and things of that sort, from what I remember.

Q. Was he an industrial hygienist?

A. I think so. I never checked his credentials.

Q. I don't think he's still alive, but I

WATER_PCB-SD0000041855

just wanted to ask.

A. That's too bad. He was a good guy.

Q. Did you ever see any of Dr. Keller's notes or descriptions of his European trip?

A. Nope.

(Thereupon the Court Reporter marked a pertinent document as PLAINTIFF'S EXHIBIT NUMBER 333-A.)

(OFF RECORD)

Q. I'll show you the next Exhibit, Exhibit 333. Have you seen this document before?

A. I don't recall seeing it.

Q. Referring to what's numbered to page eight of this document, which is page TRAN 022103; there are no paragraphs. But just about three-quarters of the way down, referring to Dr. Widmark, I think, at least on its face. I can only go by its face, obviously. It reads, "His theory on findings observed is that the 5, 6, ---"

MR. ZIMMER: Hold it. I'm not finding where you're at.

MR. KASHANI: I'm sorry.

WATER_PCB-SD0000041856

MR. ZIMMER: Okay. I'm with you. Thank you.

Q. Is that the "5, 6 and 8 chlorinated biphenyls are not metabolized because not many below 5 are found. For his work, the German chlorinated 50% biphenyl was used as a reference standard." Do you know what he's referring to in 5, 6 and 8 chlorinated biphenyls?

MR. ZIMMER: Who is the "he"? Dr. Keller, who apparently wrote this, or ---

MR. KASHANI: Dr. Keller, yes.

MR. ZIMMER: --- Dr. Widmark, who he is apparently reporting had a theory to this effect?

MR. KASHANI: Dr. Keller, who wrote this.

MR. ZIMMER: Okay. If you know what Dr. Keller meant.

A. Do you want my opinion as to what this statement refers to? I don't know what Dr. Keller thought.

Q. Okay.

A. I always had a difficult time figuring

WATER_PCB-SD0000041857

out what my bosses thought. Still do today.

Q. Does this mean anything to you, or did this mean anything to you when ---

A. Yes.

Q. What ---

A. It means something to me now when I read it, yes.

Q. What does it refer to?

A. It says --- it seems to imply that someone's theory --- I think keyword here, theory --- on findings that they've observed to that point in time and whatever they'd done is that five, six and eight --- I don't know what happened to seven, which is amusing. I guess maybe he had --- don't know if it was an unlucky number for him or something. Chlorinated biphenyls are not metabolized because not many below five are found. So, I suppose you could extrapolate from that in looking at the age of the samples that he was looking at, if they were talking about weathered PCBs and things of that sort that things above 1254

WATER_PCB-SD0000041858

didn't metabolize from his viewpoint, and things below 1254 did.

Q. But five and six are referring to the number of chlorines?

A. Yes.

Q. On the biphenyl?

A. And 1242 was trichloral with three chlorines. 1248 would be four, 1254 would be five. So, what he's saying is, is that relative to American PCBs, these guys were talking about --- this is German so they were using a Prodelec, whatever those PCBs, and they chlorinated to slightly different levels than we did. They like even numbers for some reason. What he's saying is, is that equivalent to the American standards, the 1254, 1260 and 1262 --- I don't think there was an eight, really. 1262 is more like a seven, apparent seven, that their findings say that those things are recalcitrant, and that --- that things like 1248, 1242, 1232, 1221 were not recalcitrant, that they meta --- that they were metabolized and --- and

WATER_PCB-SD0000041859

biodegraded.
Q. But you said that there wasn't quite a seven, or that there wasn't quite an eight mentioned. Is that referring to the fact that each of these Aroclors consist of a mixture of ---
A. No.
Q. --- biphenyls with different numbers?
A. No. I --- there --- there's no seven. I mean, that could have been a dictation error or ---
Q. No, I ---
A. --- something of that sort.
Q. What I meant was --- I'm sorry.
A. There is --- there is in reality seven. I mean, there is a heptachloral biphenyl.
Q. I think you said there wasn't a 1262, there wasn't a 1268; is that referring to the fact that ---
A. There was --- there were never large commercial amounts from the American viewpoint of 1262 or 1268. Every manufacturer had any applications. 1260 was about the highest one that had any particular significant applications or

WATER_PCB-SD0000041860

production, from the best of my recollection.

Q. Referring back to these numbers, though, let's --- I mean, we discussed earlier how that each Aroclor would consist of a mixture ---

A. Correct.

Q. --- of differently chlorinated biphenyls?

A. Correct.

Q. And the predominant biphenyl, as I understand your testimony, in Aroclor 1242 had three chlorines on it?

A. Correct.

Q. Predominantly?

A. Correct.

Q. But it also consisted of biphenyls with more than three, and biphenyls with fewer than three chlorines on them?

A. So far so good; correct.

Q. All right. So, when you were referring to three or five, say, as Aroclor --- was that 1250, 1254?

A. 1254; correct.

Q. 1254. That means that the predominant biphenyl in Aroclor 1254 had five

WATER_PCB-SD0000041861

chlorines?

A. Correct.

Q. But there was some biphenyls, and there was some PCBs in Aroclor 1254, which had more than five chlorines, and some that had fewer than five chlorines?

A. Correct.

Q. Okay. Does this terminology of using the numbers, five and six, was that used to refer to Aroclors, or is that used to refer to the number of chlorines on the biphenyl?

A. Number of chlorines on the biphenyl.

Q. So, for example, if you use five that refers to a pentachlorinated biphenyl?

A. Correct.

Q. Whereas Aroclor 1254 refers to a mixture of biphenyls, which has predominately pentachlorinated biphenyl, but other biphenyls as well?

A. That's correct. As I said earlier, Jensen and Widmark never found any Aroclors.

Q. Did you ever use the five and six, just the numbers, as shorthand for the

WATER_PCB-SD0000041862

biphenyls?

A. Did I?

Q. In this context, in the context of Aroclors and ---

A. For Aroclors, no.

Q. Do you know if they used it in the lab?

A. No. We would not call Aroclor 1254 pentachloral biphenyl.

Q. But what about referring to the PCBs? I mean, would you ever just use the numbers alone, you know, five chlorinated --- five PCB or five and six referring to the different ---

A. I'm sure there were times when we did.

Q. So, in the context of the Aroclors and biphenyls you might use five as a shorthand ---

A. No.

Q. --- to refer to --- no, I'm sorry. In the context of the PCBs, you might use five as a shorthand to refer to pentachlorinated biphenyl?

A. Yes.

Q. And six as a shorthand to refer to hexachlorinated biphenyl?

WATER_PCB-SD0000041863