MAY 22 1974

P. S. PARK

# Transcript of Proceedings

UNITED STATES OF AMERICA

ENVIRONMENTAL PROTECTION AGENCY

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| In the matter of: | : | FWPCA (307) |
| TOXIC POLLUTANT EFFLUENT STANDARDS | : | Docket No. 1 |

Arlington, Virginia

Thursday, 9 May 1974

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EPA Conference Room
Room 1112
Building No. 2, Crystal Mall
Arlington, Virginia

Thursday, 9 May 1974

The hearing in the above-entitled matter was reconvened, pursuant to adjournment, at 9 a.m.

BEFORE:

WILLIAM J. SWEENEY, Administrative Law Judge

APPEARANCES:

(As heretofore noted.)

eb

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P R O C E E D I N G S

JUDGE SWEENEY: We have this room for the remainder of the month of May, except for the 14 and 15 of May. That's Tuesday and Wednesday of next week. Those two days we have hearing space in the Tariff Commission which is located on F Street North West between Seventh and Eighth, and the hearing room is on the third floor. It is right opposite the elevator.

MR. ECKERT: Is that North West?

JUDGE SWEENEY: Yes,

MR. PARK: Yesterday the point was made that apparently our Exhibit No. 9 had not been -- was not in the hands of the clerk. But apparently others did not have that also.

We'd like to change the status -- or I should say Reference No. 9, from being classified as an exhibit to simply a reference.

JUDGE SWEENEY: That's in --

MR. PARK: This is in our references cited.

JUDGE SWEENEY: This is in Mr. Papageorge's affidavit?

MR. PARK: Yes, sir. This is a great big bulky document and to disseminate a number of copies of that would be an enormous undertaking.

So that's simply a reference.

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Exhibit No. 1 -- again as I say, I think we just assumed that everyone interested in PCB would have one or more copies of that, but it was apparently an incorrect assumption and so we are having some of those delivered today which we will distribute, and I'm sure we can obtain additional copies as necessary.

I'd like to apologize to you, Judge Sweeney, and to those parties present for not having introduced to the hearing yesterday the two other persons who participated with our Mr. Papageorge in the preparation of Monsanto's testimony.

As I pointed out yesterday, Monsanto is in a position where it is not directly affected by these standards. They will not apply to our operations.

We are familiar to some degree with PCB and with their effects, such as they may be, on the environment. We felt a responsibility to come forward to participate in these hearings to try to do what we can to bring such knowledge and experience as we might have gained in our manufacture and association with this product before the hearing for use by the EPA in establishing the most rational and appropriate standards.

Now, these two men are Dr. E. S. Tucker, who has a Bachelor of Science Degree in Chemistry from Michigan State and a Doctor of Philosophy in Analytical Chemistry from the University of Iowa. He is currently a research group leader

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in our company.

For the last two years he's been an active member of the National Academy of Science, Ocean Affairs Board, and is at present the Chairman of the American Chemical Society of St. Louis, Society of Analysts.

Dr. Tucker could be classified as an expert in analysis of PCB.

The other man present today is Dr. Paul Wright, who is presently Manager of Toxicology at our company. He has a Bachelor of Science Degree with Highest Distinction from Purdue University and a Master of Science in Biochemistry and Ph.D. in Biochemistry from the University of Wisconsin.

He has both taught and has performed research in areas of toxicology and biochemistry.

These gentlemen, as mentioned yesterday, participated with Mr. Papageorge in preparation of this testimony which was submitted on behalf of the Monsanto Company. The testimony was signed on behalf of the company by Mr. Papageorge, who could be classified as the project leader. These other two gentlemen did prepare portions of this testimony and are expert in areas of examination, some of which took place yesterday. We feel that they can add a great deal to the development by the EPA ultimately of the most appropriate standards, reasonable standards. I think they can bring something to this hearing that probably no one

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else can bring.

I hope and I trust that full use will be made of their experience, education, and capabilities.

Judge Sweeney, I would like to have them sworn, if we could, so they can participate, please, in answering questions.

JUDGE SWEENEY: It all depends on whether Mr. Eckert wants to question them or not.

MR. ECKERT: Well, I'm sure you'll recognize that we have a problem here trying to find out who swore to what in this particular affidavit, since it's not identified on the face of the affidavit whether it was Mr. Papageorge, Dr. Tucker, or Dr. Wright who's speaking.

I didn't want to have this turned into a panel discussion either.

JUDGE SWEENEY: We don't have time for that, Mr. Eckert.

MR. ECKERT: That's right.

MR. RICHEL: That's the only lasting principle we have, I think.

MR. ECKERT: The only thing I can suggest is what I suggested yesterday. I have a number of questions that will get into chemistry, but I would like to examine Dr. Wright briefly on those questions when I am finished with Mr. Papageorge.

JUDGE SWEENEY: I thought it was Dr. Tucker.

MR. ECKERT: I mean Dr. Tucker.

MR. PARK: Judge, I would just point out: There is no difficulty, Mr. Eckert, whatsoever in who swore. I think the document shows that Mr. Papageorge swore to the whole thing. The other two gentlemen are prepared right now to swear to it.

You see, we prepared this on the assumption that the object during the hearings was not to attack the personal credibility of a given witness, but to try to obtain information, and we have looked on this as a presentation by the company by a group, if you will, and not by one person.

I used the analogy yesterday of Dr. Thompson's testimony in the early part of the hearings.

I think, if I may say so, the EPA has been educated in the passage of weeks here in some procedures that have come forward now after about a month with some affidavits from others who participated with Dr. Thompson in preparation of the EPA's initial direct testimony. We've had one day now. We've had Dr. Paul Wright come in last night. Since he was the third member of the group who put this together, I feel it would be very much amiss if the talents of all three of these people were not employed in this hearing and whatever knowledge they have on the subject of PCBs was not made use of.

JUDGE SWEENEY: Will you proceed, Mr. Eckert, and gain as much education as you think you need.

MR. ECKERT: Mr. Papageorge.

XXXXXX Whereupon,

W. B. PAPAGEORGE

resumed the stand and, having been previously duly sworn, was examined and testified further as follows:

XXXXX CROSS-EXAMINATION (Continued)

BY MR. ECKERT:

Q I'm going to be referring to page 11 of your statement.

A I have it.

Q In the second paragraph you state, "Not enough is known about the fate and effect of PCBs in the natural and diverse aquatic and marine environments to properly design laboratory studies."

I'd like to know how much more and what additional data would need to be known in order to design laboratory studies.

A The laboratory studies that I personally observed in both commercial laboratories, industrial laboratories, and EPA laboratories, appear to me to involve crystal clear water flowing either through troughs or contained in aquaria in static conditions.

I have been exposed enough to polychlorinated biphenyls to understand that they are the most complex group of chemicals that serve as industrial fluids, and by complex I'm

talking now of physical and chemical properties. I have yet to see any information that totally describes how these materials behave in the environment.

The environment, as I understand it, is a most complex set of conditions. It includes the sediments we've talked of and even within the sediments there are many different physical and chemical properties. Who can answer how these sediments affect PCBs? And vice versa?

In the natural environment we have many types of, I believe the term used is biota, plants and animal life that effectively contribute to the total situation.

The water itself has different chemical constituents. I don't know that anyone has totally described the impact of these chemicals on the effects or actions of PCBs. We don't know the effect of sunlight, for example, or darkness. I could go on and on. But the point I wish to make is that natural systems to me represent most complex types of conditions, and the chemicals we're concerned with are themselves very complex, so how can you take these materials in a laboratory, look upon them as complex mixtures under ideal conditions, if you will, or synthetic conditions that don't resemble the natural condition that arrive at responsible conclusions?

Q Well, let me ask you this: Are you suggesting that every possible variable be investigated and that every possible

experiment be run before we take any action to control these chemicals.

A I am submitting you, sir, that a responsible scientist will conduct enough studies under enough conditions that satisfy him that any extrapolation he makes is a valid one. He should not take what I would call giant leaps forward and jumping into conclusions.

Q Well, let's take the problem of extrapolation from lab data to environmental areas.

Have you seen any correlations with respect to differences which have been observed between effects of PCBs in the environment and effects in the laboratory?

A I don't remember if I've seen actual correlations where data is compared to data in a single report. But I do know that laboratory data has reported mortalities in the species studied. I don't recall any report that reports mortalities of these same species in natural situations.

Q Well, that may be, but then have concentrations of the same levels been reported in the environment as causative of mortalities in the laboratory?

A That's a good point. That's the very point.

This again emphasizes how synthetic the laboratory situation is where the levels studied are not typical of the natural situations.

Q . Well, but that doesn't quite answer the question.

I mean, have the levels recorded in the laboratory been observed in the environment or not. When you say extrapolate, can't you extrapolate from levels which have been observed to be harmful at levels which have not been observed to be harmful in the laboratory? Or levels which would probably be harmful and which might not be harmful in the environment?

A No. I would be most hesitant to extrapolate because the information that I observed in the laboratory may be meaningless, say, in the muddy Mississippi River.

Q Well, once again, you made a statement here that results from such studies are not extrapolatable. And in fact, as I understand it, you don't have any correlations, so this is an opinion unsupported by data or studies. Is that correct?

A No, that is not correct.

MR. RICHEL: Your Honor, I'd object to that question.

JUDGE SWEENEY: Your objection is overruled.

MR. RICHEL: May I give the grounds?

JUDGE SWEENEY: No.

MR. RICHEL: I love it.

JUDGE SWEENEY: Go ahead and answer the question.

THE WITNESS: If I recall the question correctly, it went something like this: I have no basis for claiming that the laboratory information cannot be extrapolated to

the real natural situation.

I believe if you read enough of the literature that is abundantly available, you will find in many instances the presence of PCBs recorded in the environment that exceed presences recorded in experimental studies, and yet the species observed seem to be thriving, multiplying, reproducing.

BY MR. ECKERT:

Q Could you be specific? Could you name,in fact, one such study?

A I can't recall the study, sir, but I think it is well known among those who studied coho salmon PCBs in Lake Michigan. There is no evidence that the coho salmon are being affected adversely in that environment. In fact, they are thriving. The problem is what to do with them since they contain PCBs in their tissues that exceed the tolerance level that FDA is permitting.

End 1A

1B eb1

Q Are you saying that there are lab data that indicate that the coho salmon would be dead at the concentrations that exist in Lake Michigan?

A There is data that was used by EPA in arriving at the proposed standard that refers to salmon eggs being affected by the presence of PCB's. This would imply that salmon cannot reproduce under certain conditions.

There is no evidence that in Lake Michigan coho salmon -- and I recognize these are possibly different species of salmon, but Dr. Hugh Thompson refers to trophic levels and similarities in trophic levels, so I think it is a fair conclusion to jump into, to say that there is no evidence that the coho salmon in Lake Michigan are not reproducing.

Q Now isn't that factor used by EPA a concentration of 0.5 parts per million in the eggs of the salmon?

A Yes. And it was related, as I recall, to .5 parts per million in the tissue of the adult salmon.

Q Have levels of 0.5 parts per million in the eggs of coho salmon be observed in Lake Michigan?

A I have seen no studies, no reports of studies, in which coho salmon eggs were analyzed.

Q Do you know what the concentration of PCB's is in Lake Michigan?

A I have seen reports. I don't recall exact numbers, but they are in the range of parts per billion, less than a

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part per billion, as I recall.

Q Isn't it in fact around 10 parts per trillion?

A I don't know. I don't recall it that specifically.

Q Now you have stated here that:

"Fundamental, scientifically-based data is lacking."

Yet you have cited in your affidavit some 43 exhibits. Wouldn't you call many of these scientifically-based data?

A Some of the references cited can be classified as scientific data of a fundamental nature, but you'll note it's of a varied type. Some of it refers to just presence of PCB's; some of it refers to the biodegradability of PCB's, or to disappearance of PCB's. Some of it refers to its effect on certain species, so it's a varied nature and I personally do not believe that there is enough data to give any scientist the confidence to impose a realistic standard.

Q Have you reviewed the affidavit distributed by EPA in this proceeding?

A I'm confused by your question because I received a mountain of paper.

Q On PCB's?

A On PCB's.

Q Yes.

MR. PARK: What are you referring to, Mr. Eckert?

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MR. ECKERT: I'm referring to the testimony--

MR. PARK: That came out yesterday?

MR. ECKERT: The material distributed yesterday was merely supplementary, unpublished material. The affidavits have been distributed for some time. I'm referring to affidavits of Dr. Duke, Dr. Nebakker, Dr. Veith, and Mr. Wilson.

MR. PARK: Well, I would like to point out that of course I'm the one who received those. I received them about a week ago, I guess; no earlier than that.

MR. ECKERT: So your staff hasn't had an opportunity to review them?

MR. PARK: They're reviewing those for their testimony which takes place in about a week or two in the future. They were not reviewed for this proceeding, as I understand.

MR. RICHEL: I think we should note part of that material was received, at least by the General Electric Company, on Friday.

MR. PARK: Judge, may I speak with Mr. Papageorge for a half minute?

JUDGE SWEENEY: Yes.

(Brief recess.)

MR. PARK: All right. Thank you, your Honor.

BY MR. ECKERT:

Q Now in the last paragraph on page 11, you refer

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to studies on bioaccumulation and you state:

"These data would support the selection of a factor considerably lower than the factors which were applied."

That's the last sentence in the paragraph.

To your knowledge, are any of the studies which you cite there bioaccumulation studies on a long-term basis, say over a several-month period of time?

A Well, as indicated earlier, this is an area in which Dr. Wright is much more capable of responding than I am, but I have to pass on to you that I personally received from Dr. WRight, to help me in my understanding of the general PCB situation.

Q Now on page 12, the next to the last sentence in the paragraph on the top of the page reads:

"These safety factors. . ."

and I assume you're referring to the .5 and .6 safety factors in the proposed standards --

". . .resulting in approximately twofold reductions are so small as to be of no beneficial toxicological consequence."

In your opinion, should an additional safety factor be utilized to account for the possible formation of furans through uncontrolled oxidation in the environment?

A Again, this is an area that Dr. Wright could

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respond to, but as I heard your question you want my opinion. Did I hear that correctly?

Q Well, yes; that's right.

A I know of no information available to anyone about the formation of these materials you referred to as furans in natural situations of the type we are discussing here, so I don't see how I can have any opinion on what kind of safety factor would be required, if any.

Q Well, let's take a look at Exhibit 8 which is attached to your testimony.

On page 374 at the very bottom of the page you will note a statement:

"Irradiation of chlorinated biphenyls dispersed in water, followed by GC/MS, revealed identifiable traces of 2-chlorodibenzofuran as a photolysis product. . ."

and so on.

Wouldn't that seem to indicate that some furans might be produced under irradiation, for example by sunlight?

A I'm not qualified to comment on that. Dr. Tucker might be able to.

MR. PARK: Judge Sweeney, one last thing on this point I made earlier. Can I ask Mr. Eckert:

Do you plan to examine these two people that we have present here on these subjects or not?

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MR. ECKERT: I'm going to examine Dr. Tucker. I don't know if I'm going to have time to get to Dr. Wright. It's a matter of timing.

MR. PARK: I would like the record to indicate that as these questions are asked we have two people we consider experts present here in this room. They are ready and willing to answer these questions.

JUDGE SWEENEY: We understand that. I think the record is clear.

BY MR. ECKERT:

Q In the third paragraph on page 12 you state that:

"Appropriate control is achieved. . ."

The last sentence:

"In our opinion, appropriate control is achieved using average stream flow rates."

If the average stream flow rate were used, what percentage of the time would the concentration in the stream exceed the desired target concentration?

A I have not made those calculations.

Q Well, wouldn't it be 50 percent of the time?

A Mathematically, yes.

Q Now if we used seven-day, ten-year low flow, what would that percentage be, do you know?

A No, I do not know.

I don't understand the point you're trying to make

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here.

Q I'm just asking whether or not you made this evaluation, and apparently you haven't, so I'll proceed.

1C

On the bottom of that page you state:

"Because of their chemical and physical properties, PCB's can be found in soils and waters at point sources long after a discharge has occurred."

Is this based on samples which the Monsanto Company has made?

A Yes.

Q Can you tell me where, for example, the soils and waters at point sources have been measured?

A At what locations?

Q Yes, at what locations.

A I can only speak for Monsanto's plant at which the polychlorinated biphenyls are produced.

Q That's at Annistan?

A No, sir. It's the plant that is located in Sauget, Illinois, which we referred to yesterday as the William G. Crumridge plant.

Q Now at the Sauget plant, could you tell me in general summary how the sampling program was carried out, how the measurements were made?

A In order to describe this sampling program, I will

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take a while to describe the physical situation and what we've done at that plant.

To give you the proper perspective, the plant dates from the early 1900's, prior to World War I, as best I can remember. It's an industrial complex in which we make over a hundred different chemical products. It has over a thousand employees. This gives you an idea of the size of the unit.

Within this complex we have a situation where sewer systems and water runoff and process runoff systems have been evolving through the years. They are of varying degrees of age, varying degrees of effectiveness, and some of course are in good repair and some are in constant need of attention.

Also, within this plant we have two facilities that are directly involved with polychlorinated biphenyls. One is the unit in which the polychlorinated biphenyls are produced. The other is the unit at which we destroy the scrap polychlorinated biphenyl when it can no longer be recovered and reused.

These two units since -- oh, for the past several years have been undergoing a program whereby we have installed facilities to contain the loss of PCB's into the environment, let's call it, or into the rest of that location.

To describe it -- and I found this expression

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useful in getting the proper understanding -- we use the concept the "bathtub" approach, which really involves paving, curbing, isolating the drains from these curved pavements into a separate sewer system, into a sump in which any accidental spills would be trapped before these drainage points enter the rest of the sewer system of the plant which, in turn, goes to the Sauget Village municipal treatment plant.

Now when we completed all of this work we of course monitored to see how effective our program of control was. You can see what we did; you can see that we could now analyze water samples that directly relate to the current PCB activities and also analyze water samples that are not related to the current PCB activities.

With the difference in that data we must conclude that PCB's are coming from sources other than the two I mentioned, the two active sources.

The question then is: Where could these be coming from?

The only conclusion we could reach is that these must be coming from locations throughout this large industrial complex which, at one time, involved either the use or the handling or the storage of polychlorinated biphenyls, and we find this presence of polychlorinated biphenyls to vary, for example, with sewer breaks, with heavy rainfalls and the like, so it's a changing number that we see.

eb10

Q Let me ask you this:

Are you able to isolate which measurements are taken of PCB's from current activities from ones that are not associated with current activities?

A Yes, we can. We can determine the PCB's resulting from the current activities. We can determine the PCB's resulting from total activities and by subtraction, we arrive at the PCB's whose source we cannot identify.

Q What I mean is this:

Are there discharges which are so physically isolated from the current activities that you can sample them, you can sample that stream and say that stream contains PCB's; however, none of the PCB's in that stream can be from the current operations, it must all be from the soil or residues?

A We have not done that program, and I'm not familiar with the sewer system to be able to respond to the sampling at all of these points.

Q Are all the Aroclors currently sold by Monsanto manufactured at this location?

A Yes, sir. There are only three types manufactured today.

Q Which three are those?

A Aroclor 1221-- I apologize, there are four: Aroclor 1016, Aroclor 1242, Aroclor 1254.

eb11

Q Have the discharges from the Crumridge plant been analyzed to determine if any of the Aroclors which are no longer being manufactured are present in the discharge?

A That is rather difficult to do. The PCB's identified in the discharge have been generally described as Aroclor 1254. Since we still make Aroclor 1254, it is rather difficult to determine whether that's current production, except for this very important feature in that these two sewer systems are separate and distinct and we can analyze the water coming from the current activities.

Q Well, let's take the sewer system which contains water not coming from current activities. Has that been analyzed to see which Aroclors are present?

A That water has been analyzed at the point where it enters the village treatment plant, the Sauget treatment plant, waste treatment plant.

Q But doesn't that stream include both current activity --

A Yes. To make it fairly simple, and I know I'm oversimplifying, imagine a Y. One leg of the Y represents the simplistic picture of the total plant sewer system, the other leg of the Y representing the composite from the incinerator area where we destroy PCB's, and the production area where we manufacture and handle PCB's.

These two streams come together. Eventually

eb12

they end up in the village treatment plant and that's the point where we analyze, at the village treatment plant.

Q So that at the point at which you take the samples the two streams are mixed together?

A That is correct. And also this system picks up not only process waters, if you wish to define them as-- In other words water related to chemical production, but they include the typical kinds of waters that exist in any insulation of this type: the sanitary waters, rainfall, runoff; every water source imaginable ends up in this system.

Q Now you stated here that PCB's can be found in soils and waters. Have you measured the soils at the Crumridge plant?

A Not to my knowledge.

Q Is this statement based on other measurements of soils?

A We have measured soil samples and I'll have to defer to Dr. Tucker as to what his laboratory has looked at.

Q On page 13, under "Economic Considerations," in the first paragraph you state:

"Yet, inspite of all our efforts, we cannot today meet the proposed effluent standard."

But in fact isn't it your testimony that you are not affected by the proposed effluent standard?

A . This presupposes there that if we were in a

eb13

position where our plant outfall had to enter a navigable water in spite of all the efforts in both the technical and the money and all the resources we put into controlling PCB's, -- then I might add here because I feel it is important, we believe that the best control for PCB's is preventing it from every coming in contact with the water, as much as is humanly possible.

In spite of all these efforts -- and we believe this is unique for an industrial chemical of this type -- we just don't see how the standard that is proposed can be achieved.

Q What levels of PCB's enter the Sauget treatment plant in terms of concentrations in pounds per day?

A This number will vary -- has varied and I think, as has been pointed out already in previous testimony, we do have the problems mentioned of sampling and what-have-you. But the number as best I recall varies from 10 to 15 pounds per day.

Q Now you discussed the sump in the PCB manufacturing facility-- I'm sorry, the sump is the terminal point before going into the treatment plant for wastes from the incinerator and the manufacturing facility; is that correct?

A Yes, sir.

MR. PARK: Mr. Eckert, one of the people here said the earlier answer sounded like-- I wonder if we could

eb14

ask the clerk, did he say 10 to 15 or 10 to 50, just for clarification?

MR. ECKERT: Well, what was the witness' answer?

THE WITNESS: Ten to 15 pounds per day.

BY MR. ECKERT:

Q Getting back to my original question, I have correctly described it?

A Yes, sir, that's it.

Q Is any treatment given to the material in the sump before it enters into the treatment water?

A The treatment is one of physical separation of the two phases. In the event that the PCB's are present, being heavier than water, they accumulate at the bottom of the sump. Periodically they are pumped out, put into proper containers, and removed to the incinerator for destruction.

Q The figure that you gave of 10 to 15 pounds per day, I assume that is based, as Dr. Simon's figures were based, on a concentration, average concentration times an average flow. Is that correct?

A Yes, sir.

Q And can you give me the figure for that average concentration and the average flow?

A I have figures for the average flow. I do not have handy the concentration but one could work back.

The total complex from which this water comes has

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a flow that runs from about 15 to 18 cubic feet per second, which is about eight to ten million gallons a day.

Q What do you consider to be the major sources of the 10 to 15 pounds per day?

A I believe the major sources of these are locations throughout the plant, --

Q What about the sump itself?

MR. PARK: He's not finished with his answer.

MR. ECKERT: I'm sorry.

BY MR. ECKERT:

Q Will you proceed, please?

A (Continuing) -- throughout the plant, in which at one time we used PCB's, whether as a heat transfer unit or as a hydraulic fluid or even -- may even have stored material in particular areas.

At the time the PCB's were treated as most other chemicals there were some leakages; some did get into the soils; some did get into the sewer systems. Through the years, through the 40 years or so it has been manufactured there there has been this accumulation -- manufactured and used.

I cannot specifically point to a source because it is not highly visible and not easily locatable. We have some suspicions that underneath our plant there are -- you might even call them caverns where erosion from broken sewer lines has resulted in a removal of the soil. It's conceivable

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that some PCB's are back in there.

The sewer lines themselves conceivably could have some PCB's adhering to the matter that adheres to the walls of the system.

The soil of course is probably the most important contributor and by "soil" I'm also referring to crushed rock surfaces and so on throughout the plant.

End 1C

ld brbl

Q Has any measurement been made of the effluent from the sump following the active PCB work?

A Yes.

This is where we get our -- where we get an idea of the PCB's that result from the current activity.

Q And how many pounds per day come from the sump?

A That, too, sir, varies with the sampling conditions. As best I recall it runs from, oh, a pound and a half, two pounds, sometimes it will reach five pounds as a peak per day.

These seem at times to be affected by rainfall, by activity throughout the unit.

Q Now, in the other parts of the plant, are PCB's stored or piped through or otherwise present? And when I say "other parts," I'm referring to other than the incinerator and the manufacturing area.

A No, sir, not knowingly.

And I'd like to comment: we've been talking PCB's, using the three letters to designate mixtures of chemicals, really, so when I'm referring to these numbers in pounds per day, what I'm saying is that this is the material the analytical chemist sees with his instruments, that contains a chlorinated biphenyl, irrespective of the amount of chlorine involved, all isomers.

Q Are PCB's discharged from any facilities operated

brb2

by Monsanto into receiving waters?

A No, sir. No that I'm aware of; they shouldn't be. They can't be.

Q Are they present or used in any facility other than the Krummrich plant?

A No, sir.

Mr. Eckert, I don't know if this is in order or not, but some thoughts come to me as I read some scratch notes that might give some perspective.

You've talked about the eight to ten million gallons per day water from the plant as a total. It might help to look at the amount of water coming out of those parts of the plant which today are actively involved with PCB's. This is the producing unit and the incinerating unit.

In those two areas, we have these kinds of quantitie involved: the production area averages about 250,000 gallons a day. The incinerator area, when running full out, about 190,000 gallons a day.

Now, the production area goes from a low of about 100 to a high of about 500; the incinerator area, a very low number of 14,000 gallons a day up to a quarter of a million, 250,000.

I mention that because it might be interesting when we look at this Mississippi River in which these streams eventually end up to note that the average flow represents

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0.0002 percent of the mass of water in that river compared to the average flow of that river.

Q Have you made any measurements of PCB's in the Mississippi River?

A Yes, sir.

We tried some measurements, and found them, frankly, to be information that we didn't know quite how to use. In fact, it was baffling.

This occurred, as best I recall, after we had some discussions with EPA representatives following the issuance of the Interdepartmental Task Force Report, in which, as I best recall, the recommendation was made that 0.01 parts per billion should be the tolerable amount of PCB's in the main bodies of water; I believe I'm correct there.

We went to the Mississippi River, took some samples above stream and down stream, and I'll agree with any professional scientist that will say that one sample doesnt' tell the whole story; but the results are baffling.

Upstream measured higher than downstream from our plant. This further emphasizes how complex it is to get a sample --

Q What were those measurements?

A As best I recall, it was about 0.2 part per billion upstream, 0.1 part per billion downstream. And this is based on an analysis of the total water sample, which contains a

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considerable amount of sediment.

So with that kind of information we decided we would be in a better position to make some better use of our resource -- laboratory, technical, manpower, and what have you -- in concentrating our efforts back at the plant, preventing the material from ever reaching the water, rather than try to monitor the large Mississippi River.

Q Who made those measurements?

A I don't know the individuals by name, but they were personnel at Monsanto's plant at which the material is manufactured.

Q Did they use gas liquid chromatography?

A Yes, sir.

Q Do you know what the variation of that technique is at these levels?

A I'm not qualified to answer that. Again, I would suggest that Dr. Tucker, who serves as our advisor, could best answer.

Q How far down the stream from Sauget is the confluenc with the Mississippi?

A I'm confused, sir: it is on the Mississippi.

Q It is on the Mississippi River?

A Yes, sir.

MR. PARK: Did you understand the question? What is.on the Mississippi River?

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THE WITNESS: I understood the question: how far down --

MR. ECKERT: I didn't understand. I didn't know that Sauget was on the Mississippi River.

That answers my question.

MR. PARK: Would you repeat your question? I'm not sure I understood it.

MR. ECKERT: Well, I understood he said that the waste eventually wound up in the Mississippi River, and I inferred, incorrectly, that that meant they were discharged into a tributary that went into the Mississippi River.

THE WITNESS: No, sir.

This discharge is to the sewage treatment plant, which in turn discharges into the Mississippi River.

BY MR. ECKERT:

Q Now, on page 13 you give some cost figures. You suggest a:

"Design using adsorption, settling and filtration of aqueous waste, followed by incineration of the adsorbent."

Have you estimated or made any attempts to determine what levels of PCB's would be present in the discharge from such a facility?

A No, sir.

And I'd like to emphasize the important word in that

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paragraph is "conceptual". This is just a figment of my imagination, if you will, that this approach might have some merit.

But I'd like to point out -- and I don't know quite how to express this, but let me attempt -- doing nothing about controlling PCB's, in my opinion, is irresponsible.

Spending scarce resources -- and no matter how big the organization, whether it be the U.S. government or Monsanto or what have you -- resources pursuing technology to reach some unwarranted level or objective can, again, be considered irresponsible.

At this point in time there has been no reason whatever for anyone working with PCB's to expend any kind of resources looking for the levels that your proposed standard now seeks.

The emphasis has been made in controlling PCB's to a level that, as best as I can determine, is unprecedented for industrial chemicals worldwide.

And I say this with all seriousness. I could be accused of being subjective, but I have to complement the people involved in our plant. I mentioned this bathtub approach, I mentioned the incinerator; I didn't mention, but I should have, perhaps, this activity devoted to the production of a PCB that our studies show is respectively less persistent in the environment than the old mixture.

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All of these took us twenty main years of effort, technical effort, and the expenditure of two to three million dollars, all aimed to getting to this point of a few pounds per day from a unit that produces -- I forget the number -- 50 million pounds per year, approximately.

Q Well, we'll get to that persistence in a minute.

MR. ECKERT: I don't have any further questions for Mr. Papageorge. Unless you have some redirect, I would like to get to Dr. Tucker.

MR. PARK: Okay. I do have some redirect.

JUDGE SWEENEY: Go ahead.

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REDIRECT EXAMINATION

BY MR. PARK:

Q I guess, starting with the most recent first, Mr. Papageorge:

You were asked a few minutes ago about PCB use in other Monsanto plants. I suspect you were thinking in terms of manufacture.

Is PCB used in electrical apparatus and so forth in those plants?

A That's a good point.

Our plants do not use PCB's for anything other than in the uses to which we now market, mainly in capacitors and electrical transformers. We do not use PCB's for any other purpose.

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Q All right.

Is the Krummrich plant the only plant discharging into the Sauget sewage treatment facility?

A Oh, no.

We are one of many industries located in that area that discharge into the treatment plant, and as I -- I have some notes:

I believe we represent about half of the gallonage. The total gallonage to this treatment plant runs 16 to 20 million gallons per day, which is double what we introduce.

Q So if the effluent from the Sauget waste treatment facilities were monitored where it enters the Mississippi River, there would be no way of telling where a specific substance or substances came from?

A That is correct, yes.

Q Yesterday, during your examination, there was a reference made to, and several questions asked about something referred to as "the Yusho disease."

This was in connection, I believe, with a reference in Monsanto's testimony relating to the fact that -- at the bottom of page 10 of the testimony, I believe, the sentence at the bottom of the page, which was summarizing the paragraph pointing out the considerable amount of production of PCB that has taken place worldwide for a number of years -- and the paragraph concludes with the statement:

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"With this amount of material discharged into the environment, it is of considerable importance to note that extensive harm predicted by some theories has not been found and documented."

As I recall, it was in this context that the Yusho disease was raised.

Is that an example, the Yusho disease, an example of PCB's in the environment causing harm?

A Not in my opinion.

Again, I perhaps assumed something. The Yusho incident,which we discussed yesterday, was a tragic industrial accident which resulted int he contamination of an edible oil at extremely high levels -- and I am told this by toxicologists within the Food and Drug Administration -- and to get some perspective, this would amount to going to an eating establishment and ordering a beverage or food containing high levels of PCB's: it's not surprising that the human beings that did est this oil or ingest this oil exhibited the symptoms we talked about yesterday.

But this in no way fits the environmental concept that we have been discussing here.

Q Do you recall the levels of PCB that were in the rice oil that the people actually consumed?

A I believe it was 2000 parts per million, of that order of magnitude.

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Q You're saying that that was in no way related to any environmental situation?

A No.

That rice oil was not contaminated as a result of PCB's entering the natural environment, and by some transport methods found themselves in this oil, no.

Q All right.

The paragraph to which I referred a moment ago is concluded at the top of page 11 of our testimony, and the first sentence at the top of page 11 reads:

"This lack of evidence --," that is, of harm caused to the environment by PCB,

"-- indicates that all of the PCB's do not persist in the environment as a result of factors such as the biodegradation that we discussed previously."

I think a question was raised in this context yesterday about drawing an inference of the lack of persistence from a lack of harm.

Would you want to clarify or elaborate on that point, sir?

A I'll try. I don't know if I understand that question, or understood it even yesterday, but let me try to describe the intent of the words that we've been talking about.

We are aware of the amount of polychlorinated biphenyls and the types of mixtures that were marketed, and we

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know from the applications into which half of these materials entered, at least half were the type that, in a very short period of time, the PCB's would end up in the environment as we all understand it.

Coupling that thought with another concept, or with another supposition which I didn't believe was appropriate to discuss in this particular paragraph -- but let's make an assumption at this point that PCB's, at some level -- and for our purposes it is not necessary to say how high, but at some level -- should create some effect which could be interpreted as a harm.

You'd expect then that with all of this million tons of material that is mentioned here introduced into commerce, you'd expect, if in truth it accumulates in the environment, does not persist, keeps building up, some day that clock is going to run out and an effect will be noted. I have not seen any evidence that documents this effect.

The question, then, is raised: what happened? Are we wrong in some manner, or is it because we really don't know enough about PCB's? Is there something that makes these PCB's inactive or unavailable or destroys them?

So the point I wanted to make there is that something has happened to PCB's introduced freely into the environment under the old ideas we had about PCB's, to such a degree that this harm which I know many of us have read -- what's

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going to happen to us and to all of the creatures in the world hasn't happened.

Now, in addition to that: in spite of all of this material introduced very freely into the environment and none of this harm or evidence of harm being recorded, surely it can't get any worse, because under today's conditions those applications have deen discontinued in this country and in most of the rest of the world, and I personally don't see how it can get any worse than it has been, and I can only see improvement.

Q Thank you, Mr. Papageorge. I have just a couple of others here.

I'd like to call your attention to Monsanto's Exhibit 33, I believe. Yes. Reference 33.

Again, a question was asked yesterday concerning the levels that show on a graph, a chart, on about --

A It should be numbered page 5, because between 4 and 6 there is this graph.

Q Page 5 of referance 33.

(Continuing) -- showing levels of production of PCB at the Crumridge plant for the last several years, and the chart, after showing a drop in production of 1254 from 69 to 70, then it does appear that tha amount of 1254 produced is relatively constant during the years after 1970.

Is it a fact that that's relatively constant?

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Would that have been a surprise in 1970, or what were the reasons for its remaining constant?

A The reasons could be many. I will mention, but only as a point of information, the amounts of these materials produced and marketed will, of course, vary with economic conditions. It's not a great factor here but it could lead to some increases in the future, even though the applications are limited.

Going back: when we withdrew the polychlorinated biphenyls from the general marketplace and restricted the applications to which they were put, one would have expected that the amount of 1254 produced would then have dropped. This was a natural consequence because 1254 was used in paints, inks, adhesive, hydraulic fluids, heat transfer fluids, just about all the uses that other PCB's have been put to.

However, working against that reduction was another factor. This is the one where, in order to remove from commerc the more persistent higher chlorinated isomers as much as possible, we made another decision, and this was, "Let's remove Aroclor 1260 from the marketplace and its use in transformers, and replace it with the 1254 which, relatively speaking, has mo of the biodegradable isomers in it."

So the reason we see 1254 quantities staying fairly constant is that one decrease was offset by another increase. But to get a true, total picture, one should look at the sum

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of 1260 plus 1254 if you're trying to get some impression of what effect, what types of products are now being introduced into the marketplace.

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Q Lastly, I would like to call your attention to our Reference No. 2; this is an article by Dr. Ricebraugh.

A Yes, sir.

Q And, specifically to page 353, the last paragraph.

I thought there was a little confusion concerning a question or two related to this paragraph, and I wasn't sure you understood the question that was asked.

Would you look at the last paragraph on page 353 where Dr. Ricebraugh points out that Aroclor 1242 production in 1970 was four times that of Aroclor 1254 production, and yet, in all of the zooplankton that was analyzed, he seemed to find 1254 and no 1242.

What conclusions or conclusion did Dr. Ricebraugh draw from this?

A Well, an obvious conclusion could be that Aroclor 1242 is being degraded such that the residual material that is being observed looks like Aroclor 1254.

Q If the environment immediately after manufacture and use contained some Aroclor 1254 and a greater amount of 1242, but if the 1242 biodegraded much more rapidly is it unreasonable to expect that zooplankton or any other organism that might retain in its system some PCB's would find only 1254?

A It's a reasonable conclusion, but, again, I would suggest Dr. Tucker would be a better source of information

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in that area.

MR. PARK: That's all I have.

MR. LORANT: I have one question of the witness in case you have something further, I will interject my one question, if you please.

MR. PARK: What is your name, sir?

MR. LORANT: Bernie Lorant.

MR. PARK: Are you with EPA?

MR. LORANT: No. I am one of the -- I represent one of the Objectors.

MR. PARK: Fair enough.

RECROSS-EXAMINATION

BY MR. LORANT:

Q I wanted clarification on one answer you gave, Mr. Papageorge. Yesterday you were asked, "Can you state metabolism has occurred if you don't identify a metabolite?" and your answer to that question was, No.

I am not sure exactly what you mean by that, but I take it you do not mean that one must structure structurally or chemically identify a metabolite before you know metabolism has occurred; is that correct?

A That's my understanding.

Q So that by identifying the metabolite you weren't thinking of chemical identification, necessarily?

A. I'm not really qualified to talk about the

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metabolitic processes, but in my, say, layman's understanding when they talk about metabolite, as I understand it, it's a chemical entity identifiable by the chemist, that could conceivably have resulted from some process involving another chemical in a creature, let's say, that has ingested or breathed, absorbed the material.

Q That may come close to the definition of what a metabolite is. The thrust of th question is when does metabolism occur, and my only point is: I wanted to make sure what you meant by your answer in that I inferred a chemical identify being required by your answer, and I think you fall short of that; do you not?

A Yes.

In my understanding of these matters it is possible for something to be metabolized resulting in chemical entities that cannot be directly traced back to the original material. For example, the resulting metabolite might be carbon dioxide and water, finding carbon dioxide and water I cannot jump to the conclusion that material was metabolized or that it wasn't metabolized. It doesn't tell me anything.

Q Well, you may see a potential metabolite as a spot on a paper chromatogram and not know what it is, but know that it is not your original product -- chemical; isn't that true?

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A Right.

Q Or as a peak on a gas chromatograph?

A Yes.

Q Or any other manifestation that tells you a change has occurred without necessarily being able to elucidate a change?

A That is correct.

Q Okay.

MR. LORANT: Thank you.

BY MR. ECKERT:

Q Just a few questions.

On the Sauget plant, does any other facility, to your knowledge, any facility other than the Crumbridge plant, contribute PCB's to the Sauget plant?

A I do not know.

Q Now, in response to questioning from Mr. Park with respect to your statement on the lack of evidence of harm in the environment, you stated that a lot of the PCB's have gone up, but, as I understood your testimony, you stated that something has happened to them, so that we don't find them.

Couldn't that something simply be dilution?

A It is possible.

I am trying to recall Dr. Serafin's analysis. I really don't remember the details.

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Q Now, on your response to Mr. Lorant's question with respect to metabolism I wasn't trying to force you yesterday to say that you had to be able to elucide the chain between the metabolism, between the material metabolized and the metabolite; but you would agree, wouldn't you, that in order to show metabolism you should be able to find something which you could call a metabolite, even though you may not be able to trace it back to the material metabolized?

A I agree.

MR. ECKERT: No further questions.

JUDGE SWEENEY: You are excused.

(Witness excused.)

MR. PARK: Could we have a short recess, sir?

MR. ECKERT: It's up to Judge Sweeney. I would just as soon move it to Dr. Tucker. We're short of time.

Whereupon,

tucker

E. SCOTT TUCKER

took the stand as a witness and, having been first duly sworn, was examined and testified as follows:

CROSS-EXAMINATION

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BY MR. ECKERT:

Q Dr. Tucker, as I understood your background, you are an analytical chemist, is that correct?

A Yes.

Q Which analytical technique is used for the

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measurement of PCB's, the quantitative measurement of PCB's?

A The dominant technique that is employed is electron capture gas chromatography. There are, however, other techniques.

Q Now, is that technique more sensitive in the measurement of higher chlorinated homologs?

A There is a dependence in the sensitivity on the degree of chlorination as well as the substitution or the position of the chlorine in the biphenyl molecule.

Q So that the more chlorines in the molecule, the lower the level at which you would expect you would be able to detect residues; is that correct?

A That's correct.

May I add something to that? With the sensitivity of the electron capture detector there's hardly any problem in detecting monochloro biphenyls through deccachloro. There's adequate sensitivity to detect, with this technique, to detect any isomers including the monochloro biphenyl.

Q Right. But wouldn't the limit of detection for each isomer change with respect to the number of chlorine atoms?

A Yes, I believe we've established that in your first question.

Q Do you have a rough idea for comparative purposes of what the limit of detection would be for a homolog with

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six chlorine atoms or five chlorine atoms as opposed to one with two?

A When you talk homolog, are you talking an isomer or a homolog? I think we should define it.

Q Well, let me ask you what's a homolog?

A A homolog, well, if you're talking about six chlorines you could have -- well, let's talk about three because I forget how many homologs there are in the six; but if you have, say, two chlorines in a molecule, I think you can have upwards of 12 isomers.

Now, all of those 12 isomers constitute a homolog or dichloro biphenyl. So, now, if you're talking about the sensitivity of a homolog, then you may talk about 1 to 12 isomers which would, of course, improve your sensitivity in a sense.

If you are talking about the detection of a specific isomer then you're into the area where we really don't have any information that indicates specific sensitivities of this sort. So, I think very honestly the question should be clarified if you're going to pursue this.

Q I am glad you did clarify that, and I was asking about homologs rather than isomers.

As I understand it, it's much more difficult to identify individual isomers than it is to identify homologs?

A Yes, but isomers are available and you can

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measure them and you can run them through an electron capture gas chromatograph.

Q Well, could you give me, just for comparative purposes the limit of detection for 5 chlorine atoms in the homolog as opposed to three?

A Okay.

I believe -- and with your permission, of course -- that it might be better to talk about detections in terms of, say, 54 chlorinated biphenyl, which people say is a pentachloro biphenyl, or, say, a 42 percent chlorinated.

If you take something like a 42 percent chlorinated biphenyl and assume unity at the detection limit, and you go to something like a 1248, which is 48 percent chlorinated biphenyl, you get, I think, a factor of about 1.542 increase in sensitivity.

If you go to a pentachloro biphenyl, or a 54 percent chlorinated biphenyl you may get upwards of a factor of 5, and so on. But it is one order of magnitude difference between monochloro in homolog sense, and a deccachloro or, in terms of sensitivity.

Q So let me pose you a hypothetical:

Assume that we have measured in the environment a level of very close to the detection limit of 1254; wouldn't it be quite possible that there might be 1242 there in a concentration of roughly one-fifth that which would not

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be picked up by the detection method?

A Since your question is hypothetical I would have to answer yes. However, under actual laboratory conditions when you're operating near your limit of detection there are ways of getting more of the material into the instrument, and I believe that you would sincerely have some indication that there was chlorinated -- lower chlorinated materials there.

So in the real sense, no; hypothetically, yes.

Q Well, what is this technique for getting more of the material into the instrument?

A Concentrated sample by evaporation, injecting a larger amount, increasing the sensitivity of the detector.

Q Well, when you speak of concentrating by evaporation, do the vapor pressures of the various homologs vary?

A You have two questions here.

Q Well, let's speak of the formulation of 1254, 1242, 1216, do the vapor pressures in the formulations vary?

A Yes, obviously.

Q And is it true, as a general rule, that the lower chlorinated formulations have a higher vapor pressure than the higher chlorinated formulations?

A Yes.

Q So that if you were to evaporate a sample concentrate you would expect, would you not, to lose more of

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the lower chlorinated formulations?

A If you were not an analytical chemist and did not perform these analyses, you might; that is not the case.

Q Well, I don't understand your answer.

A The answer is that, no, under the conditions of evaporation that are applied by most analytical chemists you do not lose the monochloro biphenyls.

Q How is it done?

A You generally blow a stream of nitrogen or air across a hexane containing solution. Now, hexanes' boiling point is so low relative to a monochloro biphenyl that you don't lose it, the monochloro biphenyl.

Q Now, in the process is salicic acid used as a clean up?

A There are some procedures, and I believe it was initiated by the EPA where salicic acid is used as a solid absorbant for clean up.

Q Is this a procedure that you use?

A No.

Q Is it a procedure that might widely be used?

A It is a procedure that has been used. There are some problems with it, if that's what you're alluding to.

Q Well, could you describe the problems?

A The problems are that if you are not quite careful in terms of the type of solvents and things of that sort

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that you use, you lose the PCB's from the solvent absorbant. The potential exists to lose some of the monochloro biphenyls or the lower chlorinated biphenyls.

However, as you go to more polar solvents, when you load a salicic acid column, you do get these materials, and most analysts who have been in the business for a while are aware of this fact, and are very careful to avoid the loss of the lower chlorinated materials in their work-up of samples.

Q Now, I would like to turn to your paper on bioaccumulation -- on bacterial degradation, rather.

A What number is that, please?

Q I'm just trying to find it myself.

It's number --

A No. 21, I believe.

Q Right. That's correct.

Now, a general question first: In conducting this test did you make a budget of precisely what happened to the PCB's that were used in the test?

A Yes. There is a budget here in a sense. In other words you're putting in so much, you're measuring what's left, and the other disappears; so, therefore, you can account for 100 percent. And that's a budget in a sense.

Q That is a budget in a sense; but do we know exactly what happens to that which disappears?

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A These particular experiments deal with primary biodegradation. I think that's fairly well spelled out in this particular article. In studying the biodegradation of materials this is probably one of the things that you look at initially, because, after all, if it does not undergo primary biodegradation, I mean, a minute change, then there isn't much sense in looking at it in any further extensive tests.

However, if I will be allowed, I will say that as time has become more available, and in our laboratory we have conducted other tests which do show that a number of polychlorinated biphenyls undergo ultimate biodegradation.

By "ultimate biodegradation," I mean complete mineralization to $CO_2$, water, and mineral salts; and they do so at a rate that is equivalent to glucose.

Q Which formulations?

A These primarily are the lower chlorinated ones. We've been dealing with monochloro biphenyl mixtures. We worked with Aroclor 1221, and we're working our way up the scale.

Now, I will tell you very honestly that as we get into the more higher chlorinated materials, I do not anticipate complete, ultimate degradation, nor would any microbiologist.

Q How have you -- well, you've stated that it undergoes complete degradation to $CO_2$; how have you identified

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the $CO_2$ as being resulting from the degradation?

A Well, there are two techniques that are generally employed to do this type of thing. One is, of course, the radio-label techniques; the other -- well, actually, there are there.

One is stable isotope techniques, Carbon-13; one is radio-label techniques, Carbon-14; and another is just sikmply to use a nutrient pour system which has a low endogenous respiration rate and produces little $CO_2$. And then you add your carbon source, so, therefore, most of the $CO_2$ comes from your carbon source. And you can do a budget analysis.

The particular test that was employed is the test Thompson and Gunthie. It is a test that is used by the Soap and Detergent Association; it's well-established, and it s been around for, I would say, perhaps, maybe 10, 15 years.

Q These recent tests thatshow the complete, the ultimate biodegradation, they are not included in the exhibits you have?

A I am sorry, they are not; but I felt they were worthy of mentioning and I did ask your permission.

Q Yes.

Well, unfortunately, we can't examine you on those because we haven't read them. Are they written up so they can be supplied?

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A I can provide you with handwritten or maybe even notebook pages. I will have to check to make sure that this information can be released; but at this point in time I see no reason why it cannot be provided to you.

Q Now, in the tests that you did here you vigorously aerated the sample for a period of 48 hours; isn't that correct?

A That's correct.

Q Now, isn't it possible during that aeration that some of the PCB's simply evaporated?

A This is a rather obvious possibility, yes.

Q Did you use glass containers?

A Excuse me. If you are not going to pursue that, I would like to make a comment with your permission?

Q You may clarify your answer.

A Each time this test is run we take the total effluent, gas effluent, from this unit and scrub them through scrubbers. The scrubbers are then analyzed to determine what the volatility losses are. And I believe if you look into the paper in detail the volatility losses are spelled out.

Q What did you use to scrub the gases?

A The scrubbers were three hexane scrubbers in series, and what was done was they were analyzed, each one was analyzed; in other words, No. 1 was analyzed, No. 2 was

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analyzed, No. 3 was analyzed. These scrubbers are put in series to insure that you are not blowing them through, completely through; and in all cases the last scrubber contains a very insificant amount, which means we were trapping any volatilized PCB's.

So volatility losses are not contributing to the primary biodegradation rates states.

Q Were glass vessels used for this experiment?

A Yes.

Q Do PCB's adsorb onto glass?

A Yes.

Q Was this accounted for in any way in your results?

A Yes.

There's a little trick in this kind of game, that when you're dealing with water and soluble materials you obviously run into this problem, and I'm glad you brought it out.

We operate these units until we achieve what is called a steady state, by which I mean that the surfaces in the system, for example, the glass and things of this sort, have actually -- there has been actually enough material introduced into the system that you read a steady state, i.e., your active adsorption sites on the glass are not -- are fully covered. And so your losses are not due to mechanical reasons.

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Q In this experiment, in this particular experiment, you di not identify the metabolite; did you?

A To answer your question, no; there is a reason that we didn't.

Q You can explain.

A Okay.

We manufacture well over -- you see, the scope of my group is a little bit broader than PCB's, although we do have direct responsibility for the analytical portion of PCB's and the biodegradation and things of this sort. The company itself manufactures in the thousands of products and we are attempting to develop tests which will tell us about the environmental compatibility of our products.

And so time is of essence. So the first thing to do is obviously establish that we do get primary biodegradation. The second thing was to see if we get ultimate degradation.

I currently have one new Ph.D. who is in the process of attempting to elucidate what some of the metabolites are, and what the mechanism is for the breakdown of PCB's.

Q Now, after this 48 hours continuous aeration, what percentage of the PCB's that were used in the experiment were degraded?

A Well, I would refer you to the paper. Unfortunately they are not numbered because the jounal to which it was

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submitted said "put it lightly in blue" and that does not Xerox.

But there is a graph in here, and it's about halfway through, and in it we plotted average degradation rate per 48 hour cycle versus the percent chlorine, which, of course, is on a weight-weight basis.

Did you find the graph?

Q Yes, I have the chart before me.

Could you describe each of these formulations in terms of the number of chlorine atoms?

A Yes, I can.

The initial one, biphenyl, obviously has zero chlorine atoms.

Aroclor 1221 I believe has approximately -- in between, say a mono and a dichloro biphenyl. I think it leans a little bit toward the dichloro biphenyl.

MCS 1043 is a research compound that was utilized becausse it fit in between and will give us a point so we can get a trend. It is sort of a di-tri compound.

Aroclor 1242 is a trichloro biphenyl. It's considered that on a percent chlorine weight basis

Aroclor 1016 is of course the version that has the higher molecular rate, more persistent PCB isomers removed, and it would correspond to, say, something less than a trichloro biphenyl, since you obviously remove some of the

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heavier chlorinated materials.

And Aroclor 1254 is a material that has, it's a pentachloro biphenyl, and which has for sometime now most closely represented what researchers are finding in the environment. However, I hesitate to say that with Aroclor 1254 even some of the earlier peaks which are tetrachloro biphenyls, and even maybe some pentas, are not found in the environmental samples.

Is that an adequate description of the compounds studied?

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Q Yes.

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JUDGE SWEENEY: We'll take a 15-minute recess at this time.

(Recess.)

JUDGE SWEENEY: Back on the record.

BY MR. ECKERT:

Q Dr. Tucker, I have a couple of questions on bio-accumulation but before we get into that, I have a couple more questions on your experimental data.

Have you made any attempt to sample environmental conditions to substantiate or correlate your findings in the laboratory?

A Yes, in a sense. I think because, again, of the lack of manpower and the scope of the problem we are dependent a great deal upon the government and the academic people to provide this kind of information.

And I think yesterday when you were referring to references 2 through 13 in our testimony, there is adequate information that supports the kind of biodegradation data and the tissue accumulation data that we've been able to generate with our resources.

Q I'd like to turn to Exhibit 12.

A What page of our testimony is that referred to, please?

Q Well, you've referred to Exhibits 2 through 13 at page 6.

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eb2

A Right, page 6.

I'd like to refer to it in context to our testimony, so I'd like to have it handy.

Exhibit 12?

Q That's right.

Now the statement in the text of the testimony is that:

"Environmental monitoring programs have clearly demonstrated that, with the exception of direct high-level controllable release near points of manufacture or use, the PCB's found in our environment are the more highly chlorinated ones, i.e., those containing predominantly five or more chlorine atoms per biphenyl molecule."

A Excuse me. I've been attempting to put these references back in order so that I can find them in a rapid fashion, so if you would be kind enough, can I have the question repeated, or the statement or whatever it was? I'm sorry, I wasn't listening.

Were you reading a statement out of the text here?

Q I was reading the third paragraph on page 6, the last sentence of the paragraph, beginning "Environmental monitoring programs."

A Okay.

Q Now with reference specifically to Exhibit 12,

eb3

to your knowledge are these eagles which were sampled eagles which were found near points of manufacture or use?

A I have no knowledge of that, no. I do not believe it is stated in the article. However, I could be wrong. I'd have to take time to read the article to answer that question. I do not have knowledge of there being near the point source discharge.

Q I'd like to have you look at page 254 of that article. Now this is a chart representing the mass spectrum of analysis of tissues of the eagle, is it not?

A Yes. This is I think a GC mass spectrum.

Q Now on Figure 2, can you identify what the peak is that is labelled M-256?

A That's the M/E I believe, as indicated in the figure for the empirical formula $C_{12}H_7Cl_3$, and by the isotopic abundance pattern, a fragmentation pattern, I would probably say it's a trichloro biphenyl.

Q So here's an instance where a biphenyl containing less than five chlorine atoms was found in the environment; isn't that correct?

A I would like to clarify-- Okay.

Yes, to your question. But can I digress for a second and sort of describe what Aroclors are, just very briefly?

Q If you think it will help explain.

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eb4

A I really do, and after all, we are all here to try and clear this up.

In each of any chlorinated biphenyl product which is produced by direct chlorination you'll find a little bit of Aroclor 1221, a little bit of Aroclor 1242, a little bit of Aroclor 1254, a little bit of Aroclor 1260. The point is that they are dominantly one or the other.

In other words, when you chlorinate a biphenyl directly you get a distribution so the potential exists to have any one of 210 isomers in any of the products.

I think that's an important point; at least it is to me.

Q That is an important point. Doesn't that seem to indicate that no matter which PCB you are discharging, it will be probably contain some of all the PCB's?

A I think this is an obvious point that has been established, yes.

Excuse me. Are you going to move on from this article?

Q If you have some additional explanation of this article, please go ahead.

A Okay.

I believe this article was included here in support of the statement and I think there is actually a better demonstration of the fact that this article does support the

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conclusion which has been our objection. It can be seen if you look at the graphs on page 253.

These are of course-- I believe these are electron-capture chromatograms of Arocore 1254 products or what I prefer to call 54 percent chlorinated biphenyl, and then that which was isolated from the eagle carcasses.

And I think you'll see that there is a definite difference in the pattern of peaks between the standard and those which were isolated from the eagle. So that if you would look at it going from left to right, in Chromatogram A you will see the early eluding peaks, which of course would be the lower chlorinated materials in that particular product, and if you go to the Chart B and starting from the left-hand side again, you'll see that they are highly attenuated, which indicates that they have been -- they may have been metabolized and/or excreted, which is a point which is being made in that particular paragraph.

Q Well, now, you stated that these are attenuated. Could the attenuation be accounted for by the lower rate at which the lower chlorinated biphenyls accumulate in tissue?

A I think-- I heard that mentioned yesterday and I think while there's a difference in, say, the hydrophobic character of these, I think they are close enough together that they pretty well accumulate to the point where you would see them; so, No.

eb6

Q Well, you are seeing them here, aren't you, even though they are attenuated?

A The authors of this paper did see a trichloro biphenyl; yes, sir, but the fact that the material was not the same as the standard indicates that something has occurred that has altered the pattern.

Q Now on Exhibit 37 I believe, the paper by Baxter et al., --

A I have the exhibit.

Q In general is it a fair summary to say that this paper shows that very little, if any, degradation of hexachloro biphenyls occurs?

A Yes, that is a fair statement; in the time frame that they used, I might add.

Q Now with respect to time frames, these experiments were all done under what might be described as ideal conditions for bacterial degradation. Isn't that correct?

A I think in these particular experiments -- and I would have to review it -- that they used a basal medium, and I'm not so sure that you consider it "ideal" conditions.

You might consider it a nutrient pour system, but I would have to review the paper again, however.

Q Well, I suppose I should ask the question differently.

Are you likely to encounter in the environment

eb7

circumstances as conducive to bacterial degradation as the circumstances induced in these experiments?

A I would say that you would find in the environment a spectrum of these types of things. In other words, for example, in river water you have a nutrient pour system. In activated sludge you have a nutrient -- a highly active system. So I'd say you can find these conditions in the environment.

Q Now you described the gas recapture or cleanup phase of your old experiments.

A You mean where we checked to make sure we did have volatility losses?

Q Yes.

A Okay.

Q Was the same procedure followed in this experiment?

A I would have to check.

As I recall, Jean Mainprize was the one, the microbiologist involved, and Ron Lidgett. They did check for volatility losses. I think they found they weren't significant. I don't know whether it is in this specific article, but through personal communication with these people, since they are part of our company, of course I have discussed their work extensively with them.

Q On page 7-- And hold the Baxter paper, if you will, to one side.

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A Page 7, not of--

Q Page 7 of your affidavit.

A All right.

Q A definition is proposed of polychlorinated biphenyls, and it identifies them as those having gas chromatographic retention times greater than 60, relative to -- and I don't know how to read that.

What does this define? Can you describe in lay terms what this means?

A Okay.

First of all it is defined in terms of what I would say is the recommended EPA methodology which I believe has come out of the Cincinnati Laboratory that Jim Lichtenberg has worked on and that they are in the process of validating.

So the "60" refers to a retention time relative to a standard compound para para prime DDE.

The cut point which is defined by 60 gets down into-- It starts-- There are some tetrachloro biphenyls and then of course the ones that are further up, the persistent ones, the ones that are long lived in the environment.

Is that adequate?

Q I think I understand.

In other words, this is generally those having four or more chlorine atoms, or is it more than four?

eb9

A What you said was correct. These are the polychlorinated biphenyls that have generally -- start with tetrachloro biphenyls and then go up.

However, just below 60 there might be a minor amount of a tetrachloro biphenyl or something of that sort, but it is sort of a point where you are cutting at the tetrachloro biphenyl and up.

Q Now it's not your contention, is it, that the lower chlorinated biphenyls are not toxic?

A You know, it is not my contention that anything is not toxic. You have to be real careful when you talk about toxicity. I'm not a toxicologist and I don't want to be trapped into acting like I am one.

Let me explain-- Do you want to know why we proposed this definition?

Q Yes.

A Okay. All right.

The definition is proposed because we sincerely believe that the predominant problem with polychlorinated biphenyls is the persistence of some of the higher chlorinated ones in the sense that if they persist for exceedingly long periods of time and can bioaccumulate, then there is the potential possibility that they could achieve, if they continue to be released, that they could achieve a level in higher organisms that could have a toxic impact. And this is

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true of anything that accumulates.

So we are focusing on this.

Now unfortunately in this testimony, it is not stated clearly that we are not recommending that we shovel the lower chlorinated biphenyls out into the environment. We are only saying "Let's restrict ourselves to the problem at hand," and we believe persistence to be the dominant problem.

And you have to look at this document in combination of all things that are suggested and not just isolated points. In other words, clean up, restrict and release, restricted use, and things of this sort.

Q Well, if we had to cut off somewhere, wouldn't we want to cut off at a point which included those which have been found in the environment? For example, the ecodata showed that some of the free chlorine--

A Well, first of all, let me back up.

You asked me if I could establish that those eagles were collected near a point source discharge. I said No. Can you establish that they were not?

Q Well, I think that the burden of proof here, if I can be so bold, ought to be on those who are putting this stuff out.

A All right. I may be overstepping my bounds. If I am, I apologize.

eb11

I don't know that those eagles -- how close those eagles were to a point source discharge so therefore, I can't have any idea whether or not they could have gotten the trichloro biphenyls because they were directly exposed to it or because it came up through the food chain.

Q Well, what about Jensen's papers?

A You've only cited one reference to me that shows one example of finding one trichloro biphenyl in an environmental sample.

Q Well, I'll cite another one. How about Jensen's paper? I believe that's Exhibit 4.

A Yes, Exhibit 4.

MR. LORANT: Are you referring to Reference 4?

MR. ECKERT: Reference 4 to his exhibit.

BY MR. ECKERT:

Q Now on page 248 of that paper it states:

"We found that the principal PCB components were PCB numbers 7 to 14 but the mussels also contained the lower numbers."

Do you know what lower numbers he's talking about?

A Well, as I understand it -- and I've have to go back and look, of course, but Gunther Widmark, who works with Soren Jensen -- He does not work with him now, but they were at the University of Stockholm. They developed a numbering system for the polychlorinated biphenyls so the numbers 7

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through 14 don't necessarily designate 7 -- a biphenyl that contains seven chlorines.

And I think if you really read this statement and think about it a little bit, I don't think the implication is necessarily there that they are finding the lower chlorinated materials, i.e., monochloros, dichloros, trichloros. It's just saying that they are finding the lower numbered peaks as witnesses by their numbering system.

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If you will go further, and if I may read this:

"The results suggest that the low PCB numbers are metabolized or excreted faster than the higher numbers, so there is an increase of the latter as it passes through a food chain."

This is also so in Jensen's statement.

Q Turning to page 9 of your affidavit, you describe a procedure that was done to evaluate the accuracy of these analytical techniques.

Do you know what the solubility of Aroclor 1242 is?

A Yes, I do.

In pristine distilled water, you know, solubility with these types of compounds is kind of a shaky thing, but in pristine distilled water, I believe, the solubility of Aroclor 1242 is on the order of 200 parts per billion.

Q How about 1254?

A 1254, I think, drops -- there is a linear relationship, incidentally, which is very nice and interesting -- I think 1254 is on the order of about 50, but I am coming from memory now.

Q And 1260?

A At 25.

Q In other words, the distilled water used in these experiments was spiked with between two times and twenty times

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the amount which it could solubilize.

Isn't that about right?

A That is correct.

Q Could the insolubility of the PCB's account in part for the differences between the results obtained by the labs?

A No, it could not, and I will explain why.

In the instructions, as I said, the actual whole experimental design which we set up -- the details are available -- in the instructions to the other laboratory that participated in the test, since they were instructed to extract the bottles with hexane each time and then combine the hexane extracts, then this would effectively take all the insoluble PCB's out of the bottle.

As you point out, the problem in preparing analytical standards of this sort with the water-insoluble materials is really a real difficult one. Even if you would put it in below the solubility limit of the Aroclor in question in the water, in distilled water, some of it would still go out on the glass, be preferentially adsorbed on the glass.

So to answer your question, no, that could not account for the variability that was seen.

Q Well, would the hexane extraction take the adsorbed PCB's off the glass?

A I am laboratory B, incidentally. I think we did

brb3

a pretty good job. We got 93.7 percent, and that's a fair amount in this kind of game.

Q Was the variability different for 1254 or 1260 or 1242 alone, as opposed to the mixtures of all three components, sir?

A Let me refresh my memory here.

(Pause.)

These limits which are stated, the 95 percent confidence limits and the repeatability limits that were obtained through analysis of variance refer to the whole works.

These data are all the data. In other words, they include the mixtures, too. We did do an additional experiment which is not mentioned here, in terms of could you or could you not identify whether you had a 1254, a 1242, and a 1260? There was some variability there.

However, the manner in which these were quantitated is the exact manner which the FDA recommends, and it's probably one of the better ways in terms of doing it when you're dealing with rough mixtures, so that when we had a sample that had all three of the Aroclors in it it was simply broken down into three regions, and three different standards were employed.

So I would not think it would contribute -- in other words, I do not think it would skew the variability.

Q Now, there is a report that was published by Holden

brb4

which involved a collaborative study of PCB's.

Did Monsanto participate in that study?

A Was this the ideal baseline study or the OECD work?

Q The OECD work, I believe.

A I do not know whether Monsanto participated in it. My laboratory did not. We may have in Europe, but I don't know.

Q Are you familiar with the findings of thes study, Doctor?

A I'm familiar with it in a cursory sense, but I am not familiar with the actual samples or how they were prepared or now they were distributed or the instructions that were given and how they should be handled, and things of this sort, so I'm not prepared to address myself to that at all.

Q Well, just addressing yourself to your own results, your recovery of 93.7 plus or minus 19.2 percent: would you say that that is a pretty reasonable degree of accuracy of analysis?

A It represents accuracy and precision, and I would say quite honestly in a laboratory like ours where we've been doing it for seven years and where the same person did the analysis on the same day on the same instrument, that yes, these are pretty good results, and these are the kind of results that a laboratory can achieve if they do it carefully

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enough in their own laboratory with well-trained analysts and good equipment, good, well-tuned equipment -- and also with pristine clear distilled water samples.

Q Now, are you familiar with any processes by which furans can be formed through oxidation of polychlorinated biphenyls?

A As an organic analytic chemist, yes, I am very familiar with organic chemistry and with the fact that you can make furans.

Q Now, Exhibit 8 to the Monsanto testimony is the paper by Crosby.

A I have it.

Q I will put to you the same question that I put to Mr. Papageorge.

On page 374 and 375, the statement is made that:

"Irradiation of chlorinated biphenyls dispersed in water, followed by GC/MS, revealed identifiable traces of 2-chlorodibenzofuran as a photolysis product --"

I won't read the rest of the sentence.

Do you have the sentance in front of you?

A Yes.

Q Does this indicate to you that under irradiation from the sun in the environment, furans could be formed from PCB's after discharge?

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A I will say yes, the possibility exists, if I am allowed to qualify that statement.

In the experiment that Crosby performed, he could have easily produced what they call phenyl phenols, ortho-phenyl-phenols; and when you put an ortho-phenyl phenol in a gas chromatograph in an injection port that's hot -- and I don't care whether it's glass or metal or what -- and you have another chlorine that is ortho to that, you stand a good chance of producing in the instrument a furan; and I've discussed this problem with many people.

I'd also like to go on in this particular article and read some more of his quotations, because I want to make sure that the relevance of this to an environmental situation is established.

First of all, on page 373, to indicate that you can form phenyl phenols through hydroxylation, and that all these things are subject to photodegradation -- even the furans if they are indeed produced in the environment, and there have been people who have looked for them and not found them -- it says:

"Previous work in this laboratory demonstrated that chlorinated aromatic compounds are reductively dechlorinated readily in organic solvents when irradiated with UV light at sunlight wavelengths. Under similar conditions, irradiation

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in aqueous media results in replacement of the chlorine by hydroxyl as well as by hydrogen."

This points out the fact that there is a possibility of forming phenyl phenols which, as I indicated, if you treat them -- if you heat them you can condense them and produce furans in the instrument. So you have to be damn careful on this type of thing.

I would like to also turn to page 375 -- and let me just review this very, very shortly.

(Pause.)

Okay. The bottom paragraph starting out, as I said, on page 375, it starts out, and I would like to read it:

"The photodecomposition of the lower chlorinated PCB isomers in both polar and nonpolar solvents reveals the oparation of environmental mechanisms which could effectively degrade these widespread decontaminants."

The point is, we can have other than biological degradation that accounts for peaks not appearing in residues and in water; and I would say, as he goes on he says:

"Indeed, the notable absence of the lower chlorinated biphenyls from most environmental samples --"

And he is referencing our reference 9 which is this

brb 8

huge, magnificent study that was carried out by some real competent people.

"-- is suggestive of an important role of decomposition in the environmental fate of PCB's, the interpretation of their source and movement, and prediction of toxic effects on aquatic life," i.e., he is again saying there is a mechanism other than biodegradation for degradation of these materials.

And, incidentally enough, the higher chlorinated biphenyls absorb the kind of light that passes through our atmosphere to a greater extent than the lower chlorinated ones, because you get a shift toward higher wavelengths, absorption wavelengths, as you increase the chlorination of the biphenyl molecule.

Q Doctor, your testimony has been very helpful, and I want to thank you.

MR. ECKERT: I have no further questions.

MR. PARK: Could I have one half minute?

JUDGE SWEENEY: Yes.

(Pause.)

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I do have one question.

REDIRECT EXAMINATION

BY MR. PARK:

Q Dr. Tucker, yesterday you may recall there were a few questions concerning sampling and the problems that might be created by improper sampling, or, perhaps, improper handling of samples.

Could you clarify this subject of sampling and analysis of samples, please?

A Yes. I think it is an important thing that we're all approaching, and something we ought to address ourselves to is, we ought to resolve sampling problems and, of course, analytical differences in our laboratories, if we're going to get into the enforcement area which -- we aren't there, obviously.

But it was touched on yesterday, and it was asked, you know, sort of, why was sampling such a problem? And we've done a lot of sampling in our plants. And we have found that -- and to make the statement in here, and I would like to just add to it a little bit.

We found that the type of sampling that one applies can affect drastically the results that you get in terms of what's coming out of the plant. So obviously, if it doesn't represent what's there, it can be the high or low, so you can have real problems. So you have to design the system for

dr-2

each plant; in other words, you have to go in and look at it and make sure you're doing it right.

Also, I note that there's a frequency designated in the Federal Register for sampling. And I think that this should be looked at very closely, as to wether or not it is the correct frequency for sampling.

We have also found that, in sampling our discharges, that the depth at which you sample -- I mean vertically, also horzontally -- can make the results vary by orders of magnitude. We've found that if we sample where turbulence versus where we have quiescenct conditions, you can get just total differences.

Also, the particulates are extremely important in terms of how you sample -- the size of the particulates in the stream, and things of this sort.

Also, I think that in industrial effluents, especially industrial effluents like Monsanto's, that the effluent is extremely more complex than you find out in Lake Michigan or in other areas. So that you have to be exceedingly careful in the identification and the quantification of what you see; because in the world there are a lot of other things that are electron-capture active.

I also think that we're really going to have to look at whether grab sampling, which is recommended, is really right and whether or not we shouldn't really get into isokine-

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tic continuous sampling, which is probably the ultimate in this kind of thing.

At the same time, in terms of frequency, we mentioned the rainwater problem that brings up backgrounds and things of this sort that can give erroneous results. All I can say is that as we go down the road, that we've got an awful lot of work to do, and I hope we can all cooperate.

MR. PARK: That would conclude our examination here, your Honor, but I would like to just make sure the record does contain my objection to the failure by the EPA to question Dr. Wright on toxicology, since he is here present, and ask him the questions he had asked of Mr. Papageorge. I object if they fail to do so now, since he is available.

JUDGE SWEENEY: You're excused, Dr. Tucker.

(Witness excused.)

MR. ECKERT: Do you recall specifically the questions?

I have my questions all laid out.

MR. PARK: There were a few related to page 11, Mr. Eckert. I think the bottom two thirds, perhaps.

MR. ECEKRT: Oh, yes. Right.

MR. PARK: I think if Dr. Wright could testify for just a few minutes, it would be appropriate.

MR. ECKERT: All right. I think a couple of questions for Dr. Wright would put this in place.

dr-4

MR PARK: We'd appreciate it.

Whereupon,

PAUL WRIGHT

was called as a witness by the Environmental Protection Agency and, having been first duly sworn, was examined and testified as follows:

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CROSS EXAMINATION

BY MR. ECKERT:

Q Dr. Wright, I would refer you to the second paragraph on page 11 where it is stated that "not enough is known about the fate and effects of PCB's in the natural and diverse aquatic and marine environments to properly design laboratory studies."

I would like to know what more you would need to know in order to properly design a laboratory study.

A Some of the prime considerations in designing laboratory studies is to imply parts of the design that are directed to the populations in the environment which you wish to simulate, and in this particular case this would include the species, their location, the period of time they would exist in a particular environment.

Q Well, is your point then that everything has got to be done on a case by case basis, depending upon the organisms in the receiving water?

A It is not necessary to do everything on a specific

dr-5

point by point basis, as long as the studies which are designed and conducted are done in such a manner to be applicable to each of the particular point sources.

Q Now, hasn't a great deal of work been done, in fact, on PCB's and a wide variety of organisms, and occurred in a wide variety of environments?

A That's precisely what has been done. Many grab samples have been taken under many different environmental conditions, in which many different organisms have been sampled.

Q I'm referring to bioassays. Now, haven't a number of bioassays been run on a number of different organisms?

A Yes.

Q And don't these organisms occur in all parts of the country?

A Not all organisms occur in all parts of the country.

Q No, but aren't there representative-- Haven't representatives been tested of organisms which occur in all parts of the country where you find PCB's manufactured?

A My opinion is they have not been conducted in a manner that can be used to matrix or blanket each of these situations.

Q Well, specifically, what's missing?

A An indication of the areas to which any specific assay applies, and the expected differences you might wish to look for in those specific areas.

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Q Well, now, we're talking about things that degrade

dr-6

extremely slowly, here.

Isn't it possible for PCB's discharged in the one location to migrate to some rather considerably different locations?

A Yes, it certainly is.

Q On the bottom of the page, you refer to a series of studies showing bioaccumulation.

What was the duration, in general terms, of the bioassays which showed magnification ranging between 1,000 and 75,000?

A I think these were in terms of the laboratory studies, in terms of four to six weeks, at which time the general consensus was a plateau had been reached.

Q Were studies done on the entire life cycles of any organisms?

A I believe not in these references. But I do not recall life cycle studies of bioaccumulations.

Reproduction studies have been done.

Q Have you reviewed the affidavit of Dr. Veith which we distributed?

A Not in detail. I only recieved it two days ago.

Q Now, I refer you to Exhibit 23.

On page 175 of Exhibit 23, and this is a paper, by the way, by Duke, Lowe, and Wilson, you see the paragraph beginning, Residues of Aroclor 1254?

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A Yes.

Q Now, starting seven lines from the bottom of that paragraph, the sentence beginning "Less than 0.1 ppb" --

A Yes.

Q Would you read that sentence, please?

A It indicates that less than a tenth ppb -- in other words, a tenth microgram per liter -- of Aroclor occurred in the water at Station 2, and it was not detected in the lower bay water.

Q All right.

Now, I'd like you to refer to Table I, which is on the facing page.

A Yes.

Q Now, if you will look down to the values for the residues in the organisms sampled, would you read the value for residues of Aroclor 1254 in croaker?

A It's a value of 12.

Q 12 parts per million, isn't it?

A Yes, it is.

Q And for Menhaden?

A Eleven.

Q And it's ten for pinfish, is it not?

A Yes, it is.

Q And then there's another value of eleven for menhaden -- I'm sorry, twelve for menhaden; correct?

dr-8

A Yes, twelve.

Q Now, taking the value of twelve, could you determine roughly what the apparent degree of accumulation is in this environmental situation, based on the ambient level of 0.1 micrograms per liter?

A I could make this calculation you suggest. I would not imply to you that that calculation would represent the apparent bioaccumulation in the environment any more than I would imply to you that the data presented by Crump and Weisner, where they have similar point source measurements in the water and similar assays of fish tissue in the same water, where you could make calculations with a wide range.

Q Well, let's just see what we do agree upon.

Our croaker, for example, the level of the croaker is 120,000 times the level that was detected as the maximum level in the ambient waters; is that correct?

A When the measurements were taken, that's correct.

Q When the measurements were taken.

And the statement is made that -- not that the level was 0.1 ppb but that it was less than 0.1 ppb; isn't that also correct? This is on page 175.

A Yes, it is.

Q So that it might well have been more than 120,000, mightn't it?

dr-9

MR. PARK: Could I ask, where does 120,000 come from?

MR. ECKERT: That's 12 parts per million, divided by 0.1 parts per billion.

I have no further questions. Thank you, Dr. Wright.

MR. PARK: May I have one, sir?

JUDGE SWEENEY: Go ahead.

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REDIRECT EXAMINATION

BY MR. PARK:

Q Dr. Wright, in your opinion as a toxicologist, is it appropriate, or would it be appropriate, to base standards for an entire country or any given very broad area, on the basis of an effect found on an organism or a species such as salmon eggs or pink shrimp, which are found in only a small or an isolated part of this country or area?

A It's my understanding that the purpose of the PCB effluent standard is to protect the aquatic organisms and to protect the organisms, the higher trophic levels, that may feed upon the aquatic organisms. And to base this total degree of potential toxicity to all these organisms on a specific piece of data, a specific species, would not be applicable.

Q In other words, if salmon eggs, as an example, are unusually sensitive to PCB; but if they are found only inside the northwestern part of the country in waters that drain into

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the Pacific, it would not be appropriate or, say, make good sense, to establish standards in the eastern part of the country for rivers that drain into the Atlantic or the Gulf of Mexico on the basis of sensitivity of salmon eggs?

A That is a correct interpretation of what I've said.

Q One last question, Dr. Wright.

Could you quickly turn to our reference number 28. This is the Woods Hole article.

MR. ECKERT: Which exhibit is this?

MR. PARK: Our reference 28.

I have a copy here for you, Mr. Eckert, if you need one.

MR. ECKERT: I have it here. I'm just turning to it.

BY MR. PARK:

Q On page nine there is a little table back of the page that I believe was referred to by someone, and frankly I can't remember whether it was Mr. Eckert or ourselves, in connection with the reference that we have on our page six of our testimony.

The third paragraph up from the bottom on page six of our testimony.

My question is, Dr. Wright, how does the article on the Woods Hole oceanography support the statement that's there on page six?

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A The paragraph on page six, in essence, says that during the period of time the polychlorinated biphenyls have been manufactured, that the primary amounts of material have been the lower chlorinated homologs; and if the lower chlorinated homologs were accumulated in the biological organisms to the same extent the higher chlorinated homologs were, we would expect to find them presently in approximately equal concentrations or approximately higher concentrations than the higher chlorinated homologs.

The data available from the environmental samples indicates that that is not so. And the data presented from Woods Hole, in studies in the laboratory where the accumulation from water directly into the organism, indicates that the bioaccumulation of the lower chlorinated homologs is much less than that of the higher chlorinated homologs, and would support the statement that has been made.

Q And that statement is?

A I will read: "It further demonstrates that even under conditions of unlimited use, and without special precautions to avoid release into the environment, which is not now the case, that the lower polychlorinated biphenyls degrade rapidly enough to prevent bioaccumulation."

MR PARK: That's all that we have.

MR. ECKERT: I have very little bit of recross on that same paper.

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RECROSS EXAMINATION

BY MR. ECKERT:

Q Would you turn to page nine?

A Yes.

Q Do you see the table of concentration factors for various isomers?

A Yes, they range from 1,000 to 48,000.

Q A 48 to 1 differential, in some cases.

Couldn't the difference in concentration factors account for the lack of finding of lower chlorinated homologs in the organisms, rather than bacterial degradation or environmental degradation?

A Either of those factors could account for the lack of accumulation, and in order to know which factor is responsible, you would have to have an integration of the total exposure period, and the isomers exposed.

Q You'd have to have more data than they have here, isn't that correct?

A We sufficient data of the experiment reported by Woods Hole to evaluate his experiment and to define what the accumulations were in that particular system.

Q That's right. But, as I understand it, we don't have the data to say whether these differences in accumulation result from merely the degree to which, shall I say, the partition coefficient or the degree to which these homologs degrade,

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we don't know which of those factors is responsible, isn't that correct?

A No, even in this instance we don't.

MR. ECKERT: No further questions.

JUDGE SWEENEY: You're excused.

(Witness excused.)

MR. ECKERT: Now, before we start with Dr. Lauer, perhaps we can break for lunch.

JUDGE SWEENEY: Yes. We'll recess to 1:00.

Before we leave, are we finished with Exhibit 83 now?

MR. ECKERT: Yes, I am.

JUDGE SWEENEY: Exhibit 83 and the referenced attachments thereto are recieved into evidence.

(The documents referred to as Exhibit 83 were received in evidence.)

MR. ROGERS: Your Honor, I guess there have been some more requests for documents, basically on PCB's.

Dr. Blanchard is here, and perhaps we could straiten it out with the parties right now.

JUDGE SWEENEY: All right. We'll recess for lunch.

(Whereupon, at 12:00 noon, the hearing in the above-related matter was recessed, to reconvene at 1:00 on Thursday, May 9, 1974.)

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AFTERNOON SESSION

(1:05 p.m.)

JUDGE SWEENEY: We'll be back on the record.

Who is the next witness, please?

MR. ECKERT: Dr. Gerald J. Lauer.

Whereupon,

GERALD J. LAUER

took the stand as a witness and, having been first duly sworn, was examined and testified as follows:

CROSS-EXAMINATION

XXXXX

BY MR. ECKERT:

Q Dr. Lauer, on the second page of your affidavit you state that "The acute toxicity of PCB's is too variable to justify across-the-board standards."

Can the same statement be made about the chronic toxicity of PCB's?

A There is lesser data and information on the chronic toxicity of PCB's available in the literature; but I think the same statement would be true for those, the chronic toxicities as well.

Q I would like to refer to your Table 1 where you do present some of the acute data. Are these concentrations nominal or measured concentrations?

A Well, that would vary from one piece of data to the other, and to identify specifically what that was, we

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would have to go back to the original reference and look. I suspect as far as the older data is concerned for a good part of the data most of those concentrations would be nominal rather than final, especially relative to the static tests.

Q Would you expect if those had been measured concentrations instead of nominal concentrations that the values would be lower?

A As a general proposition -- you mean the values for the LC-50 or the values for the concentration of PCB present?

Q Either one?

A Well, the values -- the effect on the values for the LC-50 probably would be to lower them if by using the nominal information compared to using the measured concentrations throughout the term of the experiment.

Q Let's take a look at the first data point given. It's Aroclor 1221 for cut-throat trout.

Now, Aroclor 1221 is a relatively low chlorinated mixture, is it not?

A Yes, it is.

Q And what is the LC-50 for Aroclor 1221?

A In that particular experiment it's listed as 1,170 parts per billion.

Q Now, Aroclor 1242 has somewhat more chlorine than

jrb 3

1221, isn't that correct?

A That's correct.

Q Do you see the figure for cut-throat trout on the bottom of that page, and Aroclor 1242?

A Yes, I do.

Q And what is that figure?

A That figure is 5,430 parts per billion.

Q Now, on page 3 of Table 1 a figure is given for cut-throat trout and Aroclor 1248. Now, there is more chlorine in 1248 than 1242; is there not?

A That's correct.

Q And what is the figure for cut-throat trout there?

A 5,750.

Q Moving on to page 4 we come to Aroclor 1254 which has still more chlorine than 1248, isn't that right?

A That's correct.

Q What is the figure for cut-throat trout and 1254?

A 42,500 parts per billion.

Q And finally on page 6 of Table 1 we have Aroclor 1260 which, as I understand, is no longer being made; isn't that correct?

A I could not verify as to that from my own knowledge.

Q Nevertheless it contains more chlorine than any

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of the other mixtures listed here, isn't that right?

A That's correct.

Q And the LC-50 is what value for cut-throat trout?

A 60,900.

Q Now, from these data points would you conclude that at least for cut-throat trout the acute toxicity is inversely proportional to the chlorination?

A That would appear to be the case for cut-throat trout under the particular bioassay conditions that were used to determine those data.

However, I would point out in looking at other species you can find, you know, mixed patterns and reverse sorts of patterns. It doesn't seem to be a clear-cut kind of generic pattern relative to -- or at least among species as compared to within a particular species.

Q Well, I'm wondering about some of these data points myself.

Now, let's take Aroclor 1242 on page 1 of Table 1.

Now, earlier testimony by Dr. Tucker was to the effect that the solubility of Aroclor 1242 is on the order of 200 parts per billion; is that correct?

A If that's what he said I presume it is correct. I don't know that of my own knowledge.

Q Well, in any event it is no higher than 200; I believe that was the highest number he used. And here we

jrb 5

have an LC-50 of 5,430 parts per billion.

How could you have LC-50 based on a figure well beyond the solubility of the compound under test?

A The usual way that that happens is that in bioassay operations or tests -- and I could not swear to that being the case in this instance, but I suspect it's the case -- the toxicant being tested is delivered into the test container and to the organisms being exposed by way of dilution apparatus, using solvents to deliver the toxicants into the system, in concentrations higher than would otherwise be able to exist in solution, in water alone.

Q Now, getting back to page 2 of your affidavit, you state "This complexity" -- and I'm reading from just below the middle of the page -- "This complexity of influences requires that effects of pollutants be evaluated on a case-by-case basis and not be the across-the-board approach used by EPA."

How would you go about evaluating the effects of pollutants on a case-by-case basis?

A Well, there's a great deal involved, and I don't think I could give a complete description for that here.

However, in some respects I think generic studies could be employed if they were done in such a way as to be applicable to the conditions that exist at each of the discharge sites; but, for the most part, these need to be

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complimented by studies that would take into account the unique conditions that would exist t each discharge point. And these unique conditions would apply both to the type and nature of the discharge as well as the nature of the receiving body of water and the biota in it.

So I would think there would be a two-pronged sort of approach to look at this with both being required, the first being hopeflly possible in order to save a lot of reinventing the wheel from site-to-site. The second to look at the specific discharge sites being used to take into account those conditions which are unique to each discharge point, and to the biota that exists there.

Having said that, then I think the evaluation would have to take into account the quantities of discharge, the patterns of the discharge that do exist at that site, the volumes of flow, the amount of suspended sediment, the composition of the species and their particular roles involved in the basic functioning of the ecosystem at those sites; the longevity or life expectancy of the organisms involved; the length of their residence time within the vicinity of the discharge as opposed to being -- as opposed to further distances from the point of discharge; whether or not they would choose to prefer or avoid the discharge plume; all of those kinds of factors would need to be looked at, I think carefully in a way that's relevant to the evaluation of the

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environmental effects of the discharge at each of those particular sites.

I could not prescribe the precise research agenda for that because I think it would be inappropriate to attempt to do so from the seat of one's pants, to do so in a way that would be applicable to all of the individual sites; that would require a close analysis of the characteristics of the individual sites in order to come up with an agenda of data collection that would be addressed to this kind of an effort.

Q Well, have you any idea how much it would cost to carry out the kinds of studies that you're talking about for each pollution source?

A No, that would very much depend upon the characteristics of each site. In general it would be a substantial amount, but it would depend upon the characteristics at each site, how complex they were, and how much of the conditions at each site might be treated on a generic basis as opposed to a unique basis.

Q When you refer to generic studies are you talking about bioassays, for example?

A That would be one form of generic studies. If properly done and interpreted it would be useful.

Q How long would it take for any given discharge to complete carrying out the kinds of studies that you believe would be required?

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A Again, I could not answer that as an across-the-board thing. It would depend upon the conditions at each of the discharges. However, I think that the approach could be structured in such a way that you would identify the prime criteria that you wanted to get information on first and use those as the first cut factors for analysis, and then go on to lesser -- the lesser important factors as would be determined both by a general understanding of what's in the literature and what information came out of the first-cut analysis at those individual sites.

And I would think this would properly be done in the format of cooperative kind of a review of the conditions that exist at the site, hopefully, by the people who have the responsibility to come up with regulatory mechanisms and limits as well as those people who have to meet those regulatory limits. And the agenda would be established on that kind of a basis, and then undertaken.

I could not, as I indicated, give a timeframe in which this could be accomplished that would be applicable at any given site; that would have to be determined upon, based upon, that kind of a process.

Q At the bottom of page 2, you refer to the difference between acute values for various PCB formulations.

Isn't this variation typical of chlorinated hydrocarbons? For example, wouldn't you expect to find

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this same variation for DDT?

A Yes, you very much would, and it's dependent upon so many factors that this is exactly the reason why I would propose that it's not really a realistic procedure to look at the thing as an across-the-board effort. You really have to take into consideration the factors that do affect the toxicant potential of these kind of discharges relative to the conditions that exist where they are being discharged.

Q What factors are you referring to there?

A Many of them I just referred when you asked about what kinds of data, what kinds of research would need to be undertaken at these individual sites in a case-by-case evaluation attempt. And I think that my answer would apply here that I gave to that question.

Q On page 3 you refer to the bioconcentration data, and you state toward the bottom of the page, that "Most of the existing bioconcentration data are based on exposures of confined organisms in laboratories to concentrations in water formulated by use of solvents."

Are you familar with any data which are based upon environmental exposures rather than exposures in the laboratories?

A Yes.

There are some data in the literature that I had reviewed by the time I wrote this, and since then I have

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read the testimony of Dr. Veith and Nebeker and Wilson, et cetera, and Duke; and they also have some additional information part of which was not in the available scientific literature but is about to be in some cases, and in other cases it involves internal reports.

So I am familiar with information that exists wherein concentration factors or concentration factors have been computed based upon the concentrations found in water and in organisms from the same body of water.

Those do present some kind of a problem, though, because the main problem with those -- there are problems with the laboratory concentration factor information that I alluded to; there are also problems with the concentration factor estimates from field data, a large part of which have to do with the inability to really know what past exposure was that caused that concentration to exist in the organism.

It's not necessarily true that the fish that you catch in the vicinity of where the water sample was taken live within that particular concentration during the relevant exposure time that caused it to accumulate the amount that it has. It could have lived closer to the discharge point in higher concentration for part or all the time or it could have lived in locations further away from the discharge point than are represented by the chemical sample in the water.

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So those concentration factors are subject to that kind of uncertainty.

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Q Well, just the same, would you say, based upon those values, that values in excess of 100,000 for bio-concentration might not at all be unusual?

A I would say, based upon that data, it is entirely possible that there are concentration factors that high.

I would also say that those concentration factors may not really truly represent the concentration factors that exist because of not knowing the past exposure history of the fish.

That's exactly why I propose that there's a need to evaluate not only the toxicity but the bioaccumulation on a site-by-site basis and that is because of the uncertainties and the variability that can exist.

The concentration factors could in fact be higher than 100,000; they could go either way. And that's exactly the reason why I propose that. It needs to be looked at in relation to the actual discharges that occur, and the types of biota and water bodies that are involved in those individual discharges.

Q Well, have you read Exhibit or Reference 23 to Monsanto's testimony, the study by Duke, Lowe and Wilson on Escambia Bay?

A Yes, I have. I don't know if that is their exhibit number but I have read the-- I read the testimony that was submitted by Dr. Duke.

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Q This particular one is a Monsanto exhibit but I think it might be instructive to have your opinion on it since it bears on your testimony.

Do you have a copy of it that you could refer to?

A As I say, I don't know if that's the same as you're talking about.

MR. RICHEL: Is it the same as the material that--

MR. ECKERT: I don't believe so.

THE WITNESS: If it is not the same, then I don't have a copy of it.

BY MR. ECKERT:

Q This is one of the exhibits to Dr. Duke's testimony.

Let me ask you, do you have a copy of an article entitled "A Polychlorinated Biphenyl (Aroclor 1254) in the Water, Sediment, and Biota of Escambia Bay, Florida," by Duke, Lowe and Wilson?

MR. RICHEL: Did you say this was a reference attached to Duke's testimony? Which reference or attachment is it?

MR. ECKERT: I don't know. I don't have it in front of me. It may have been one of those literature citations which were available openly and not distributed.

JUDGE SWEENEY: Did you want him to look at something in there?

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MR. ECKERT: Yes, I did.

JUDGE SWEENEY: Well, he can look at my copy if that will help.

THE WITNESS: I really don't think I have what you're talking about.

(Document handed to the witness.)

BY MR. ECKERT:

Q Now I'd like you to look at page 176. I gather you have read this article before, have you not?

MR. RICHEL: Do you need time to study the text?

(Pause.)

THE WITNESS: I don't believe I've read this particular article, but I do recognize some of the data in it, some of which is summarized in this testimony of Dr. Duke. So-- Well, let's see what the question is.

BY MR. ECKERT:

Q The question is simply this:

The figures on page 175 given directly in the middle of the page for concentrations measured in the river are less than 0.1 ppb at Station 2. Station 2, as you can see from Figure 1, is at the Escambia River.

Now that figure is 0.1 parts per billion; is that correct?

A Yes, that's what it says.

Q The end of that sentence says ". . .it was not

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detected in lower bay water," meaning presumably that if there was Aroclor there it was below the limit of detection, whatever that might have been, certainly lower than 0.1 ppb.

Do you think we can infer that from what it says right here?

A That would seem appropriate, yes.

Q Now I'll ask you to refer to Table 1 and the data given there for croaker, menhaden, pinfish and menhaden. These are the fourth, fifth, sixth and seventh data points listed. Do you see those data?

A Yes, I do.

Q Now are these fish salt water species?

A Predominantly.

They run up into estuarine type situations but as a general characterization, I would say you could characterize them as salt water.

Q So you would not expect to find them then in the-- They would not ordinarily venture into a fresh water river, would they?

A Probably not beyond some point in the salt gradient at least. They do exist up into brackish water situations but generally are not found in fresh water.

Q Now referring to the far right-hand column, the residues in those fish range between 10 and 12 parts per million, do they not?

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A Yes, they do.

Q Wouldn't this tend to indicate that a bioconcentration factor of at least 100,000 and possibly well above 120,000 was operating here?

A No, I wouldn't-- It could, but I would not say that it necessarily does.

Q Well, what would be the mitigating factors?

A Well, these fish are coastal water fishes, for the most part, and there is not anything really indicated about their size or age in here, but simply, the problem with making that direct association has to do with not knowing what their past history was.

It could well be that they existed in some other area or body of water where the concentrations of the Aroclor were much higher than they are here in some previous time, or it could also indicate-- Another possibility is that they were only recent occupants of this area and that they may not have reached a threshold concentration or a stabilized type of concentration in their tissues, so that in fact the estimates could be low.

I just don't think you can make a definitive conclusion about that. In any case I would also say that there's a problem with these bioconcentration factors anyway because it does indicate in the context of that paragraph that the presumption is that the source of the PCB in the water is from

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the sediment and there are many different routes of entry, potential routes of entry or PCB's into fish. And it could be from the water and it could be directly from the sediment and it could be from the organisms that the fish have eaten.

That being the case, it is-- That's an inherent problem with looking at bioconcentration when it is strictly referred to water concentrations because that's not the only source of access for organisms living in the environment, so that's a generic problem with bioconcentration factors.

So no, I would not say that these data represent a concentration factor that I would look at with confidence as really representing a true bioconcentration factor in fish relative to concentration in water. There are too many other variables, and it could be high or low.

Q Apart from the data which EPA has presented, have you developed any data of your own on bioconcentrations in the environment?

A No, I have not.

I just would make the observation, though, I have high regard for the researchers in EPA. There have been some statements made by Dr. Veith, for example, that the solubility is inversely proportional to the amount of chlorination and that the bioaccumulation is inversely proportional to the degree of chlorination, as a general kind of proposition, and I don't find any real argument with any given piece of data.

eb7

What I am saying in my testimony is there is so much variation amongst the data that exist that you really can't make good sense out of it in terms of coming up finally with a conclusion as is done in the proposed standards, that you will take one concentration value for one species of fish, not even from this continent, and maybe not from the same kind of conditions that exist relative to the discharges, and apply it to other biota and fish species, including fresh water species, and come up with an across-the-board, nationwide standard that is really realistic.

If we have to balance the matter of what is going to be permitted to be discharged into aquatic systems against the other societal values that are part of the over-all equation and that need to be taken into account by regulatory agencies and by society as a whole, that's the main thrust of my testimony.

I would not argue that any one of these pieces of data is the relevant piece of data that ought to have been used instead of what was used. My main point is that in fact there was some more relevant data I would have picked to have applied to fresh water situations that has been developed by the Duluth Laboratory that should have been used in the standards.

I don't know why EPA doesn't use their own laboratory's data-- It's the best that exists -- in coming up with

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these standards when it's there, instead of reaching out to some ambiguous salmon data that the authors of which even question the validity of at this stage of the game.

I know the people in the Duluty lab pretty well. They are all old peers of mine in the Public Health SErvice and they are constantly ignored on all of these questions, including thermal standards and I don't understand why.

Q Well, I'm glad to hear you say that. As you can see by the affidavits we've distributed, we're doing our best to get the lab data into the record of this hearing so we can use it.

Now on page 4 you refer to the wide range of bio-concentration values, and you state that that defies generalization.

But I think perhaps if we turn to Table 2 we might see a trend or two here.

For example, take a look if you would at the figure for Daphnia given under 1254 about two-thirds of the way down the page.

A On page 2?

Q No, on Table 2, page 1.

A Okay.

Q Do you see the data for Daphnia under 1254?

A Yes, I do.

Q . After one day of exposure the concentration factor

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was 24,700. Is that correct?

A That's correct.

Q And after four days it was 47,000?

A That's correct.

Q Now if you will take a look at bluegill-- I'm sorry, not bluegill but-- Well, yes, the bluegill figures given under 1248.

These are considerably higher figures, are they not, 26,000, 71,000?

A Well, the one is on the same order. The 71,000 I would say is quite a lot higher than the four days, 47,000 figure for Daphnia.

Q Then if you look at the data for channel catfish after 60 days, that's 72,030.

Based on these data, even though the points do seem disparate, would it be a fair summary to say that the longer the residence time of the species in the test, the greater the degree of accumulation?

A There is a tendency in that direction. Certainly accumulation is a time-related function and as a general proposition, the rate of accumulation tends to be much faster in the earlier exposure time than it does later on.

I think Dr. Veith pointed out it's a first-order type of reaction and the time at which the levelling off occurs varies from species to species and from condition to

eb10

condition. And as I think he appropriately pointed out, you have to evaluate the potential for accumulation based upon the conditions that exist for the ecosystems in question, so I concur totally with what he said in his testimony regarding that.

It's a matter that you have to look at according to the conditions that exist where the problem is that you are addressing yourself to.

Q Well, assuming that we're talking about a concentration that exists over long periods of time, wouldn't you want to predict bioconcentration by the use of rather long-term studies?

A Yes, I would think so.

Q In the second paragraph on that page you refer to available data summarized by Dr. Simons.

Which data indicates that homologs containing four or less chlorine atoms per biphenyl do not accumulate in tissues of fish and wildlife?

A In that respect I'm referring to the conclusions that he drew from the references which are indicated in his testimony on page 10 of his testimony.

Q I have before me page 10 of Dr. Simon's testimony and I don't see anything -- any statement to the effect that homologs containing four or less chlorine atoms do not accumulate. Perhaps you can help me out.

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A I'm referring in that instance-- My reference in that instance is made to Nos. 1, 2, and 3 in the middle of that page 10, and the references are cited for that.

The first reference refers to the bacterial degradation rate increasing as the chlorination decreases.

Item 2 refers to the residue storage levels in rats decreasing exponentially as the weight percent chlorine decreases.

And No. 3 refers to the PCB residues found in wildlife being dominantly penta, hexa-, hepta-, and octa chloro biphanyls.

It's those three references that I was referring to.

Q Would it be a fairer statement that homologs containing four or less chlorine atoms per biphenyl do not accumulate in tissues of fish and wildlife at as great a rate as those containing more chlorine atoms per biphenyl?

A Well, that certainly is an outcome of the situation, and I think that's a desirable outcome.

Q But you can't say, can you, that the homologs do not accumulate at all?

A Not based upon those papers. There is a remarkable lack of data in the literature that is available, both that I had available at the time of writing this testimony and in the more recent submissions by the agency itself on the lower homologs, as far as reporting residuals are concerned.

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That has to be for some reason. It could either be for the reason that they degrade quicker or that they are not taken up in the first place. There are some indications that degradation -- a greater rate of degradation for the lower chlorine homologs is a factor in this, and I think Dr. Veith referred to that in his study of the Milwaukee River situation as one of the possible explanations for seeing a greater rate of loss of the lower chlorine homologs with distance moving downstream compared with the higher chlorinated homologs.

So both mechanisms could enter into the equation and cause the same result, and I think there is some importance to finding out whether one or both of those mechanisms are involved.

But I think the most important end result is their apparent scarce -- if occurrence at all in the accumulation in the residues, in the organisms in question. Environmentally that's the most important thing as far as the consumers of those organisms are concerned.

I think there is still some more work that needs to be done to find out which role either of those two plays, individually or in combination, in effecting the fact of lower chlorine residuals of the lower chlorinated forms in biota.

Q Thank you very much, Dr. Lauer.

MR. ECKERT: No further questions.

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MR. RICHEL: I just have one or two questions if I may.

REDIRECT EXAMINATION

BY MR. RICHEL:

Q Prior to your appearance here today, Dr. Lauer, we had some discussion about this problem of localizing the standard, did we not?

A Yes, we did.

Q And for the moment, let's just call the act of localization an impact study.

Now a moment ago Mr. Eckert questioned you as to the potential cost of such a study. Do you recall that?

A Yes, I do.

Q And we can all imagine, I take it, that the cost could be great.

A Yes.

Q You indicated to me the other day, did you not, that there are problems with funding these studies from a public level, with public funds, in other words. Is that right?

A Well, I would think so. I cannot speak for the whole public sector of people responsible for the public sector, or the decision-makers responsible for providing money for research. But judging upon past recent history, for research funds available for addressing these

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environmental problems, it has been the history that the agency involved who are given these kinds of funds aren't given anywhere near the amount of funds that are required to do the full job, so it was based on that kind of experience that I made that remark to you.

Q Right.

And I take it if you did want to have such an impact study for a site and if public funds couldn't foot the entire bill, that the use of private funds by perhaps the industrial facility at that site could be used to supplement public funds? Would that be an acceptable solution?

A Well, this is being done right now in many respects and as I would view it in the over-all ecological context, regardless of where the moneys come from directly, eventually society and the consumers pay the bill ultimately.

So really it's a question of where the moneys are readily available and visible to fund this kind of research, but in fact, the burden of financing studies and research to come up with some of these answers is progressively falling more and more toward the private sector in trying to evaluate these environmental impacts.

MR. RICHEL: Given this, all I wanted to do was to assure the representatives of EPA that I have authority to say the following, and that is:

We would participate in the funding of studies that

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would carry out the concepts that have been indicated by Dr. Lauer as, of course, related to our sites.

MR. ECKERT: One quick question on recross if you are through, Mr. Richel.

MR. RICHEL: Yes. Sure.

RECROSS-EXAMINATION

BY MR. ECKERT:

Q Now these localization studies, as I understand you were referring to-- I believe it was Dr. Simons who testified with respect to a facility discharging into a river which was already rather badly polluted and in which only carp resided.

Do you recall that testimony?

A I was not here when Dr. Simons testified.

MR. WILLS: I believe it was Dr. Wright and Dr. Munson.

BY MR. ECKERT:

Q If you were confronted with such a situation--

MR. RICHEL: What situation?

BY MR. ECKERT:

Q A situation in which the discharge of PCB's was into a receiving water which was heavily polluted by other industrial sources, and in which only carp and some other more resistant forms were living, how would you do a localization study for such a stream?

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A Well, it could be done on two bases. As far as the decision on which bases it should be done on, it does not rest solely with the biologist. It could be done on the basis of the conditions which exist that you describe as one approach, because that's what exists right now.

And on the other hand it could be done on the basis of some other level of environmental quality that really involves a societal kind of decision.

For example if the kind of hypothetical stream you're talking about is one which is that way and because of all the circumstances which accrue is elected to stay that way because of economic, social, and other kinds of problems associated with making it better than it is, then the only realistic approach would be to analyze the situation as it exists and as it is perceived to continue to exist.

If on the other hand that body of water involves one which realistically -- I am not talking about politically, in terms of philosophy, but realistically is one that is going to be cleaned up to some other level and will contain other species of fish, then that poses the question of whether or not the localized analysis of this particular problem should not be done relative to the anticipated cleanup goals.

That makes it a bit more difficult under that kind of a hypothetical circumstance because you can't deal with the system as it is perceived or as it is desired to be but as it

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is, and that becomes much more of a hypothetical kind of study in the instance of trying to address to what the stream might look like, say ten years from now or 15 years from now, if all of the other water pollution abatement efforts are effective and implemented.

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MR. ECKERT: A point of clarification here:

The reference to carp was from Dr. Wright's testimony, from Westinghouse.

BY MR. ECKERT:

Q Moving on with this situation now, this hypothetical situation:

If you were interested in cleaning that water up and you were enforcing control measure against the other dischargers on the river, wouldn't it be reasonable to select the sensitive important species that would be likely to exist there if these other discharges were cleaned up, and to base your standard upon them?

A As a general philosophy I would say so. I really think these kinds of decisions need to be made with a lot of different inputs to them, one of thich is biological and aquatic effects.

And in that respect, if the practical accomplishment of the goal is in view, rather than what is being said to be the goal, if there is a goal that can be achieved and there is a schedule for achieving it, and all of the people put forth the money that's required to achieve it, and that's a goal that has been selected, and all of the forces in society say this is what we want for that body of water, then the individual and collective effects of all the pollutants which apply to that body of water have to be taken into

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account individually as well as collectively.

And in that sense the amount of regulatory effort which you would apply to each of the individual pollutants, and to them collectively, would depend upon what the effects of those pollutants were in causing that stream to be different now than is desired to be by the perceived goal.

That's one of the problems that I see in the proposed standards as the exist: there's really some fuzziness involved in the proposed standards. It's pretty clear-cut that part of the standards are addressed to acute toxicity but thereafter it gets pretty fuzzy.

The standards are by word and description defined, and the purpose of them is described as protecting aquatic life. I think there's fuzziness in the chronic portion of the standards wherein the output or the end result of the proposed standards is not really based on protecting the aquatic life per se, but it's all messed up, involved with the bioaccumulation and the potential effects on the consumers of the aquatic life.

I'm not saying it shouldn't be. What I'm saying is that the standards ought to very clearly be defined as to probably three levels rather than two. As to those three items explicitly: acute effects; chronic effects for the aquatic life themselves, flat-out straight, right there; and the the third step -- and have the numbers be relevant, the numbers

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in the regulations be relevant in each of those steps -- and then the third step would take into account what the potential health hazards are for consuming marine or aquatic foodstuffs by the consumers.

And right now, the chronic part of this is all messed up between those two things, and that causes a lot of difficulties and fuzziness involved.

The FDA standards are threaded in amongst this, the 5 part per million limitation gets mixed in with this. There ought to be a clear cut distinction as to what the purposes are for each of the standards proposed and not have this mixed-up treatment involving chronic toxicity with effect of accumulated residuals mixed together.

The end result may not be different, after analysis taking account relevant data to the situations of the individual discharges, but it ought to be clearly defined what each of those regulation objectives are and what the limits are that are being promulgated to meet those objectives.

I just find that an awkwardness in the standards as they are proposed. There's too much mixed up in the chronic, in the proposed chronic limits, aside from the fact that they aren't really -- they aren't really addressed to, nor do they take into account, the data that exists aht would be more relevant than the ones that were used, which is a separate kind of a problem.

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But is is not for a biologist to dictate these things, you see, in terms of what the stream standards are. The goal should be all -- I think our role is, and the role of any other technician involved in talking about any other subject, is to say, "You tell us what you want, and then we'll try to do the best we can to analyze the problem and tell you what's required to get there." So I don't think we can set ourselves up as dictators.

In other words, I don't think the standard-setting process should only take into account aquatic biology.

Q Well, I think that's a good point.

Have you gotten into human health -- getting into human health problems, have you measured or attempted to measure, or do you know of data in which any investigators have measured PCB residues in fish taken from the environment?

A Do I know of any data?

Q First, have you done it yourself?

A I have not done it myself.

Q Are you familiar with any data that relate the residues in fish to point source discharges of PCB's?

A I know of -- I'm not sure if I can say yes to the coupling in that question that you have.

I know of data that exist on residuals in fish that have been collected from water bodies. I'm not sure that I

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would agree or say that they have been coupled with point source discharges in a realistic sort of way, but there are data in the literature that exist for residuals in fish, and I am aware of those.

Q You've referred to the FDA guidelines.

Are you familiar with any data on fish taken from the environment which exceeded the levels specified by the FDA for human food?

A Yes, I am.

Q Where were those samples taken?

A In one instance, from Lake Michigan. In another instance, there was one fish -- a carp, as I recall -- in the Hudson River. There are other instances; I just can't recall the specific circumstances that were involved.

Q Do you recall the levels in the carp in the Hudson River?

A This is my recollection. I think it was on the order of 11 parts per billion. But that's subject to correction, because I am recalling information at this point.

Q And subject to correction, roughly where was the fish taken?

A It was taken in the vicinity of Poughkeepsie, as I recall.

Q Thank you very much.

MR. RICHEL: I have one or two additional questions

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raised here by the talk about carp.

FURTHER REDIRECT EXAMINATION

BY MR. RICHEL:

Q As I understand it, Dr. Lauer, the carp was taken from the Hudson.

Is that right?

A That's right.

Q At about Poughkeepsie?

A That's my recollection.

Q At any rate, it would be south of Albany?

A That's correct.

Q As the Hudson River flows from the Adirondacks to the Atlantic Ocean, is it one continuous flow? Are there any interruptions during its flow?

A Well, it's about 480 kilometers long, and along that length there are tributaries coming in, and beginning in Albany there are dams on the upper part of the river.

Q And no dams, no major dams, below Albany?

A No.

Q And would you, when studying the Hudson River, refer to the upper Hudson and the lower Hudson?

A That's commonly done, yes.

Q And would the upper Hudson be one river system and the lower Hudson be another?

A Well, they are a continuum, but the lower Hudson

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is the tidal portion. It's the portion connected with the coastal waters, and it's subject to tidal fluctuations and to salinity incursions into the river. So they are quite different kinds of bodies of water, but of course one is the upper and one is the lower.

Q And the salinity problem that you brought in and the tidal flows: they don't relate to the upper Hudson?

A No.

Well, the salinities don't relate to the upper Hudson, and the tidal flows don't relate to the upper Hudson directly. There is an indirect relationship of where the -- of the position of the salt front in the lower Hudson that is determined substantially by the amount of fresh water flows out of the upper Hudson and the other tributaries.

Q But you'd call them two distinct water bodies?

A Well, they have many distinct characteristics; but they are connected. They're all in the same watershed; the upper runs into the lower.

MR. RICHEL: I have nothing further.

MR. ECKERT: This brings up one or two more questions, and then I'll be through.

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FURTHER RECROSS-EXAMINATION

BY MR. ECKERT:

Q Is the Hudson Falls facility a G.E. facility: that's a G.E. facility?

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A That's my understanding.

Q Is it located on the upper Hudson or the lower Hudson?

A The upper Hudson.

Q Is Poughkeepsie on the upper Hudson?

A Poughkeepsie's on the lower Hudson.

Q The lower Hudson?

A That's correct.

Q Thank you.

MR. ECKERT: That's all.

JUDGE SWEENEY: You're excused, Doctor.

(Witness excused.)

JUDGE SWEENEY: Exhibit 82 is received into evidence.

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(Exhibit No. 82, marked for identification, was received into evidence.)

JUDGE SWEENEY: Who's next?

MR. ROGERS: Mr. Marks of the Velsicol Corporation.

MR. ECKERT: This concludes the cross-examination of the PCB witnesses, your Honor. We're going to move into Endrin now.

MR. RICHEL: Your Honor, before we leave PCB's, I'd like to clarify exactly when the EPA witnesses on PCB's

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will be available for cross-examination. That date fluctuates, as does the number of people who are testifying.

MR. ECKERT: I think we can be firm on both of them.

The number of people testifying, as I indicated on the record yesterday, is four, and I named them on the record yesterday. And the date on which they will be testifying is the 28th of this month. This is necessitated by Dr. Duke's scheduling problems.

JUDGE SWEENEY: Well, what's happened to the toxaphene, the industry toxaphene witnesses you had scheduled on the 28th?

MR. ECKERT: We will move them to the 29th. We just shift the 28th and the 29th.

MR. RICHEL: Do you anticipate that cross-examination will be on one day?

MR. ECKERT: That's our present anticipation.

MR. RICHEL: And if it weren't to go one day -- I am not indicating that it is, but if it weren't to go one day, what date would follow for cross-examination of PCB witnesses?

MR. ECKERT: Well, we would simply have do do it seriatum. If we went over to the 29th, we would have to go over to the 29th.

Now, I must point out at this point that I am

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discussing with Counsel for Hercules the possibility of an off-the-record meeting, technical meeting, similar to the one that was held on benzidine, but I don't have anything final to report on that.

MR. RICHEL: What impact would that have?

MR. ECKERT: That would mean that there would be no hearings on toxaphene.

MR. RICHEL: And what would that do to the proposed date for cross-examination of PCB witnesses?

MR. ECKERT: It would not change it al all.

JUDGE SWEENEY: IT would give you an extra day. It would give you the 29th, the 28th and the 29th.

I'm not saying I'm agreeing with any of this. If we have some free time in between we're not going to take time off, we're going to move somebody else in there.

We've had enough of this running out of witnesses; we've wasted at least two days, that I know of, by quitting in the middle of the day, running out of witnesses.

MR. RICHEL: I would hope we will get ample notice. I must note for the record that the decision on the cross-examination on industrial witnesses on PCB's took place in the absence of any representatives of PCB objectors, and indeed changed the order entirely from what we were led to expect.

I would simply hope at this point that if the date of

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cross-examination of EPA witnesses is to change, that we get ample notice at this time.

Whereupon,

DANIEL R. MARKS

took the stand as a witness and, having been first duly sworn, was examined and testified as follows:

JUDGE SWEENEY: The testimony, the written testimony of Daniel R. Marks will be identified as Exhibit No. 84.

(The document referred to was marked Exhibit No. 84 for identification.)

MR. LORANT: Your Honor, will that cover both affidavits?

JUDGE SWEENEY: No, just the one I said.

MR. LORANT: There are two affidavits of Mr. Marks.

JUDGE SWEENEY: Oh, there are two?

MR. LORANT: Yes. One is headed "Testimony of Daniel R. Marks Respecting Technology to Remove Endrin from Water," and the second is "Testimony of Daniel R. Marks Respecting Two Formulas of Endrin."

JUDGE SWEENEY: I only have the one.

MR. ROGERS: I only have the one, too.

JUDGE SWEENEY: Which one do you have?

MR. LORANT: "Technology to Remove Endrin from Water." Look at the last page.

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MR. ROGERS: Oh, I see.

JUDGE SWEENEY: Well, in answer to your question if that is what you were referring to, the two of them will both be identified with one number since they are attached.

MR. LORANT: That's perfectly satisfactory. What was the number again, 84?

JUDGE SWEENEY: 84, yes, sir.

MR. LORANT: Mr. Rogers, I take it you hadn't seen that before.

MR. ROGERS: Yes.

CROSS-EXAMINATION

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BY MR. ROGERS:

Q Mr. Marks, I am going to ask you several questions about the manufacturing facility in Memphis, details of the operation.

Before we get into that I want to ask you essentially what your duties are, and then I want to get into the formulators. I'm just trying to give you an idea of where I am going to go here.

A All right.

Q Would you give us very briefly what your duties are as Technical Superintendent at the Tennessee plant?

A My duties are supervision of the quality control laboratory, the chemists who do process development work, and environmental matters, both air and water.

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Q You are responsible, I take it, to some extent for keeping track of regulations both State and Federal, and seeing that the Velsicol operations are compatible with those standards?

A Yes.

Q You have always been with the Velsicol operation since graduation, is that correct?

A Not always.

I started -- after graduation, I started to work with E. I. du Pont, then went into the service. When I came back I started work with Hayden Chemical Corporation which was bought up by Velsicol in 1950. I worked there until 1952 and then I went to U.S. Industrial Chemical Company, Division of National Distillers in Huntsville, Alabama for three and a half years. And in 1955 I came back to Velsicol and have been there since.

Q All right.

Well, let's turn to the formulators and try to cover that rather quickly.

I had asked your counsel to provide us with a list of locations of endrin formulators, and he did give me a piece of paper this morning. I would like to read quickly those names into the record, and if there are any incorrect, will you stope me and make sure we have them correct?

There are 14 of them. The first one is

jrb 4

Arlington, Tennessee --

MR. LORANT: Those are the locations, Mr. Rogers.

MR. ROGERS: Yes.

Brownfield, Texas; West Monroe, Louisiana; Hanover, Pennsylvania; New Orleans, Louisiana; Landale, Arizona; Macon, Georgia; Memphis, Tennessee.

A I have one correction there. Memphis is their corporate headquarters. I believe their fomulating plant is in Helena, Arkansas.

Q Is that Helena Chemicals?

A Yes -- no; Riverside Chemical. That's at Marks, Mississippi.

There's another one here. Helena Chemical that I gave you is Memphis, which is actually in Helena, Arkansas. Riverside is -- the plant is in Marks, Mississippi.

Q So we don't have any formulators in Memphis, is that corect?

A Right.

Q Greeneville, Mississippi; Greely Colorado; Port Valley, Georgia; Syracuse, New York; and Lockport, New York; is that correct?

A That's correct.

Q And Marks, Mississippi?

A Yes.

Q Now, these are all formulators that take technical

jrb 5

endrin from your operation and make it into various consumer products, is that correct?

A Yes.

Q Is there more than one formulation for endrin?

A Yes.

Q Could you briefly list the formulations?

A I'm not real familiar with formulations since we deal at the Memphis plant only with the technical product; but I do know that endrin is formulated with methyl parathyon. I believe the endrin content I believe is 1.6 pounds per gallon. Endrin has been formulated, I don't know how much of it is presently used in this form -- as a straight 1.6 pound per gallon formulation.

And also there have been endrin dists formulated, although I don't know for sure that any of that is still being used.

Q Well, the reason I asked that, we've gone through several pesticide hearings, for example, aldrin and dieldrin is made into several types of products. But we are basically talking about a liquid formulation?

A Yes, I believe the majority of endrin is formulated as liquid.

Q And that it is sold by the formulators to farmers or custom applicators, is that correct?

A This I believe is correct.

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Q Does the Velsicol corporation sell the endrin to these formulators, or is it a custom contract operation?

A It has been both. We are now in the process of getting ready to do some formulations ourselves, but in the past it has been either contract or an outright sale to the formulator.

Q You mean at the Memphis plant you'll be doing some formulating?

A Yes, some.

Q Now, you've given us a list of these 14 sites, have the number of formulators remained relatively constant in the last ten years or has it gone down or increased?

A This I don't know.

Q When are these formulators in operation?

A I don't know for sure. I believe in the fall and winter months primarily, before the growing season.

Q And isn't it a batch formulation process or a constant flow process?

A All that I've heard of has been batch.

Q Let's clarify that for the record.

What do you mean by a "batch" process?

A A batch process is when a fixed quantity of formulation is made up in a single vessel where there is no continuous feed of raw materials and draw-off of product on a continuous basis, but everything is done in one vessel,

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and contained until the final finished product is drawn off and packaged.

Q How does the formulator get the technical endrin? Does it come in in a railway car?

A Usually by truck.

Q In a powder or liquid?

A It's a crystalline product.

Q Now, are these trucks designed specifically for endrin or do they carry other chemicals?

A They are common carriers.

Q How do they clean out their holds, if you will, following carriage of endrin?

A This I would not know, I bave not observed.

MR. LORANT: Possibly there is a misunderstanding on the part of the witness, Mr. Rogers; are you implying -- assuming that they are shipped in bulk containers like a tank car?

THE WITNESS: Endrin is packaged in drums.

BY MR. ROGERS:

Q Tbe reason I am asking these questions, as you know, we are not simply dealing with the Memphis plant; we're trying to locate all the point sources and try to determine what the particular problems might be and what the discharges might be.

A Right.

jrb 8

Q What concentration of endrin is the technical, is it completely pure endrin?

A The technical runs from 95 to 98 percent pure endrin.

Q Have you ever visited a formulation plant?

A No, I haven't.

Q Well, in your affidavit you say in II, "Having conducted a survey of the formulator customers of Velsicol Chemical Corporation" -- et cetera, what kind of survey was this?

A This was a telephone survey in which I contacted officials in each formulator, and inquired if they had an effluent, and if they did, where it went.

Q Well, are you generally familiar from your long dealings with these people with their general operations, how they formulate?

A Not having seen -- actually been in a formulating plant, I could not say.

Q Well, let's talk about this telephone survey.

Could you give us some details about the response to your question on discharge quantities or discharges into navigable waterways?

A Yes.

The majority of the formulators reported that they had no effluent, that any spills were absorbed on an

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absorbant, a clay or some other type absorbant. This was swept and cleaned up and buried in an approved landfill.

Therefore, they considered there was no effluent to a sewer. They avoided all possibility of -- in most cases they mentioned they put dikes in the floor and so forth, so that any spills would be contained and capabile of being absorbed.

Q Well, you said the "majority" were in this category? Is that correct?

A Yes.

Q What about those that were not?

A There were two who went to the city sewer treatment system.

Q Who were those?

A Cottonstates -- no, I take it back, there were three. Cottonstates, Miller Chemical and Fertilizer -- that would be West Monroe, Louisiana; Hanover, Pennsylvania; and New Orleans. I'm not sure, I believe that New Orleans has a treatment system. It may be like Memphis.

Q So we're basically talking about three plants that would discharge into a public system and eleven that have no discernible discharge?

A Yes.

Q Well, do the 11 that have no discharges have an evaporative system, or do they have --

jrb 10

A Some of them are, it depends on the location. Brownfield, Texas, has an evaporative system. They said it had not rained in 10 months.

Helena said that they go to a closed lagoon that evaporates. Those are the two evaporative systems.

Q Are you through?

A Yes.

Q Well, how do the others achieve a no-discharge?

A By absorption of spills and landfill disposal. of the absorbant.

Q Well, they must have a closed system for the water usage?

A Yes.

Q How much water is used in formulating endrin?

A I don't know.

Q Well, I take it that there has got to be quite a bit for you to have 1.6 pounds of endrin -- is it per gallon?

A Per gallon.

Q Of water?

A No. This is an organic solvent. It's non-aqueous system. The formulations are non-aqueous.

Q That's the question I'm asking.

A That I know, but how much water they may use incidentally in the plants, I don't know; but there is no water involved in formulation of these pesticides.

jrb 11

Q Well, maybe we should be talking about the organic solvent, then, where that goes. Do you know whether it's a completely closed system, and we are just talking about leaks?

A Yes, it's a closed system. The solvent is put in, the endrin is put in, and it's dissolved; and this is all drummed up as product.

There is no -- except for incidental leakage would be the only way that I can imagine that there would be any spills.

Q Has this type of formulation been the practice throughout the years?

A As far as I know it has.

Q The reason I asked that tomorrow we're going to ask Dr. Polen several questions about residues of endrin in the Lower Mississippi; and some of the studies I am going to refer to are 10 years old. And I was just wondering if indeed they had used closed systems then why these reporters concluded as they did that endrin formulation plants were the main source of contamination of the Lower Mississippi.

Do you have any thoughts on that?

A No, I don't.

Q What are the formulatin plants in Pennsylvania and New York making the product for? What types of crops?

A This I don't know. I believe the one in Pennsylvania makes rat poison or something of this sort.

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My only contact with these formulators is our laboratory does, since a lot of it is contract formulation for Velsicol, we do quality control checks before we allow anything under the Velsicol name to be shipped out. So we get it analyzed in our laboratory continuously, the samples from these formulators.

Now, I know that this is a dust formulation of endrin. I don't know in what quantities it's made, I have been told it was for rat poison or mice in orchards, I believe, is actually the usage; but I really don't know of my own knowledge that this is true.

Q Well, I take it that these formulators make other products? I think I asked you that?

A Yes, as far as I know they do.

There are no exclusive formulators of endrin products that I am aware of.

Q To your knowledge has there been any cross contamination?

A Not to my knowledge.

MR. LORANT: Pardon me, Mr. Rogers, just by way of incidental information one of the uses for endrin is in post-harvest to an orchard floor for mouse control; and that's shown in a table in Dr. Polen's affidavit.

BY MR. ROGERS:

Q The major use of endrin is for cotton, isn't that

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correct?

A Yes. I would say so.

Q What other major uses are there, and maybe we should be referring to some of Dr. Polen's charts.

MR. LORANT: I wonder, Mr. Rogers, this witness is a plant man and is not concerned officially with the utilization of endrin as such and consequently may not be able to give you the type of accurate information you would desire.

I have no objection to his conjecturing as to some of these things and to be as helpful as he can; but I wonder if it will be very productive.

MR. ROGERS: Well, I can save the questions. It's just that I don't believe Dr. Polen answers this question of what the major uses are, the percentage uses. He lists certain uses, but doesn't give us an idea of the relative magnitude.

Now, if this witness doesn't know, we'll go on.

THE WITNESS: No, I don't know for sure. I have no numbers on that.

BY MR. ROGERS:

Q Do you have any information on how the endrin is applied in the field?

A No, not definitively.

Q Is it applied by airplane?

A In some cases in the South, I think it is.

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Q Well, aren't some of your duties to keep an eye on the possible sources of contamination of endrin in the environment?

A As far as the Memphis plant is concerned, yes. As far as the environment, this gets a little bit out of my territory.

MR. LORANT: Again, Mr. Rogers, by way of clarification, when you ask him with regard to state regulations and so forth, I think the witness was talking with respect to the Memphis plant, but maybe you were thinking in the broad regulatory aspect of pesticides. And that would not be this witness responsibility.

BY MR. ROGERS:

Q You said you get some of the analyses from each of the formulators, is that correct?

A Yes.

Q Is this true of their discharge, if any?

A No, we have no information about their discharge, only the finished product they are making and only that that they make for Velsicol.

Q You are concerned with the efficacy and efficiency of the product, aren't you?

A This is correct.

Q Do you know if these formulators have laboratories?

A Some of them do, I don't know whether all of them

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do or not.

Q Well, how firm can you be that the formulators do not have a discharge; is this simply on the basis of your telephone calls?

A This is simply on the basis of the telephone inquiry and their own statements.

Q Well, I take it is your position -- meaning Velsicol's -- that the proposed toxic standards would not affect the formulators?

MR. LORANT: This witness would not have a position relative to that.

MR. ROGERS: Why not?

MR. LORANT: Because that would be, I would venture to say, a policy decision.

MR. ROGERS: Well, if they don't have any discharges and he says that in his affidavit, "It is believed that none operate facilities constituting a point source discharge into navigable waters."

MR. LORANT: That's correct. That's a factual statement, and that's the extent of his inquiry.

BY MR. ROGERS:

Q My next question, then, is, ergo, they would not be affected by whatever number, directly affected by whatever number we come up with in these toxic hearings; is that correct?

jrb16

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A This would be my impression, yes.

Q Except to the extent, perhaps, that the manufacture is affected by the numbers?

A Yes.

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Q With the three plants that you mentioned that have connections with a city sewage system, what liquid wastes are they discharging to the system?

A I didn't go into detail with them. I just asked them did they have a water discharge, and if so, where did it go? I didn't go into any detail with them about where their process had originated and so forth.

Q Well, can you state for a certainty that all the formulators use a non-aqueous formulation technique?

A To the best of my knowledge, yes.

Pesticide formulations -- Endrin is not, as far as formulation is concerned, not different from toxaphene or other pesticides.

I believe the object of a formulator is to make as concentrated a solution as possible. This, of course, involves the use of an organic solvent. To the formulation are added additives like emulsifiers so that the user can disperse these in water to some desired concentration and then apply that.

But the formulator, as far as he is concerned, would like to keep water out of the systems, because of the presence of emulsifiers and --

Q The formulator wants to make as concentrated a solution as he can?

A Yes.

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This is to his advantage, in selling the most in the least number of drums, for instance.

Q That's not true of all pesticides, though, is it?

A Well, I can't speak for others. I would think so, though.

Q Really?

What about the granulated insecticides for farm land, which are -- that's an example, isn't it, where it is not concentrated?

MR. LORANT: Mr. Rogers, I really didn't want to be in the position of objecting, because perhaps this information is interesting.

However, we are far afield of the expertise of this witness, and I would further state that all formulations of Endrin that are permitted in the United States are registered with the EPA, and I think the punch of a button will give you all the formulations that are so registered, and would give you that information far more accurately than this witness can.

MR. ROGERS: Well, that's one area; you hit upon, perhaps,one point.

But there are many aspects of Endrin sales and formulation where we do not know the actual day to day occurrences, and we really want to know those because, as we are going to talk about tomorrow, we have Endrin toxicities lower

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than any other chemical known to man in the parts per trillion range, and we want to know how this Endrin can get into the environment from point sources, for example.

Now, that's the reason I'm pursuing this with this witness who has been employed by Vesicol for 19 years.

MR. LORANT: We are talking now about point sources and not agricultural applications. If we are talking about agricultural applications, we would have had someone here to that point. But I can't see where it's relevant to this inquiry.

MR. ROGERS: Well, Shell has maintained in the other proceeding, as you well know --

MR. LORANT: That's the proceeding on tolerances and cancellation of agricultural labels.

Your Honor, again I think I would like to move to limit the inquiry of this witness to the more relevant aspects of his knowledge and, indeed, to the relevant aspects of this hearing.

MR. ROGERS: Well, I want to submit that fertilizer blenders and formulators are definitely point sources.

MR. LORANT: This witness has testified that he inquired of Vesicol's formulators and that they either had no effluent, water effluent, or else they went to a municipal sewer with secondary treatment.

He didn't do more than that, as he has already

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testified, so how can he say more about what they do? He has never visited a formulating plant.

MR. ROGERS: There is an inherent inconsistency in even what he said.

Do the formulators use a non-aqueous solution, all of them? Do some of them use water in their solution? Why are they going to sewage treatment plants at all, if they have completely closed systems?

I asked that question; he didn't know.

MR. LORANT: These are not Endrin formulators uniquely, as he has already testified.

A formulator deals with many things. When he's dealing with Endrin, he's dealing with Endrin. But when he's dealing with toxaphene or, indeed, I think you're correct in what was implicit in your previous question: some toxicants, pesticides, are formulated in the parts per million concentration, growth regulators and so forth. However, this witness aan't testify to the entire spectrum of pesticides when his whole experience has been at Velsicol, Memphis.

BY MR. ROGERS:

Q Let me ask this question.

When you asked these formulators whether they had a discharge at all, or where the discharge went, were you asking them specifically in terms of Endrin?

A No.

brb 5

Q Well, what difference does it make what they do with DDT or with methoxychlor? Really, what difference does that make? What's the value of your inquiry if you didn't ask them about Endrin?

MR. LORANT: Again, Mr. Rogers, if they have no effluent --

MR. ROGERS: Mr. Lorant, in the affidavit it says it's believed none operate facilities constituting a point source discharge into navigable waters.

MR. LORANT: Because he asked the question and it was answered to him, and he has now given it in his affidavit.

JUDGE SWEENEY: Well, let me answer the question, Mr. Lorant.

MR. LORANT: All right.

JUDGE SWEENEY: It's his affidavit, not yours.

BY MR. ROGERS:

Q Was that sentence in your affidavit in terms of just general pesticides or Endrin?

A It was in terms of effluent, aqueous effluent, period. This is what I asked them.

Q What about in terms of effluent, liquid effluent, from Endrin formulation? Do you know whether they discharge any of that?

A If they told me they had no effluent from their

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plant, I did not see pursuing it to whether it was Endrin or something else that they weren't putting in.

Q Well, what about the ones that did say they had effluent from their plants?

Was that Endrin?

A I only talked personally to one of these. Someone else talked to the other two, and the one I asked if there was any Endrin in his effluent, he said, "I don't know; I never analyzed it." But he did not think there was any Endrin in it.

Q But he has never analyzed it?

A Right. He couldn't give me a number, therefore.

Q You talked to one?

A Yes. Only one of the three who went to the sewer.

Q Who talked to the other two?

A Mr. Mitchell.

Q General Counsel?

A Yes.

Q Did they have Endrin going to the sewer?

A Well, this I don't know, since he just gave me a not saying that he had called them, those two, and gave me the list for the rest to call.

Q So, to sum up, you're not sure whether the Endrin formulators across the board have closed formulation systems or not, are you?

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A Well, I haven't seen them, so I just have their word.

Q Are the formulators under any type of guidance or control by Velsicol?

A In what way?

Q Do you warn them of the unbelievable toxicity of Endrin?

MR. LORANT: I object to that.

MR. ROGERS: I'll withdraw that.

THE WITNESS: I had no contact with them; I don't know.

BY MR. ROGERS:

Q Well, who does have contact with them? Do you have any environmental quality control people who keep in touch with the formulators and keep them informed of toxicity problems?

A I don't know.

MR. ROGERS: Would Dr. Polen know?

MR. LORANT: Surely.

BY MR. ROGERS:

Q Are there any fertilizer blenders for Endrin?

A I don't know this.

Q Or custom applicators?

A I couldn't say.

Q Well, is Endrin put on by the farmer, or do you have

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a license to do it? Surely you know that; you've worked for the company for 19 years, sir. Surely you know whether a farmer can go out and buy Endrin or whether it has to put on by a licensee?

JUDGE SWEENEY: He didn't say he didn't know, Mr. Rogers. Give him a chance to answer.

BY MR. ROGERS:

Q Go ahead.

A I don't know.

Q All right.

Well, let's turn to your manufacturing plant at Memphis.

Is this the only manufacturing site for Endrin?

A To my knowledge, it is.

Q In the United States and the world?

A In the United States. I don't know about the world.

Q Has it always been Velsicol's only manufacturing site?

A For Endrin, yes.

Q What other pesticides are manufactured at this Memphis plant by Velsicol?

A We make heptaclor and we make chlorohepton.

Q How long have you been making Endrin at the Memphis plant?

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A The commercial plant started production at the end of 1955.

JUDGE SWEENEY: Mr. Rogers, I think we'll take a recess now.

MR. ROGERS: All right.

JUDGE SWEENEY: We'll take a recess until three o'clock.

MR. ROGERS: Fine.

I imagine I have 45 minutes more.

JUDGE SWEENEY: All right.

We'll finish today, anyway?

MR. ROGERS: Certainly.

(Recess.)

end 3C

JUDGE SWEENEY: On the record.

BY MR. ROGERS:

Q Let's go back to the manufacturing site, Mr. Marks and we'll try to run through how the material is made and some of the details of your process.

Let me just quickly get back to the products that are made. You make heptachlor, chlorohepton, and endrin, at that plant; is that right?

A Yes.

Q Are all the pesticides being made at the same time or do they have to be made at separate times?

A Well, the heptachlor plant is separate from the endrin plant.

Q Separate in the sense that --

A They are completely separate units.

Q Different waste streams?

A Yes.

Q But the chlorohepton, where is --

A That's made at the heptachlor plant; it's just a mixture of solvent and heptachlor.

Q So we can talk simply in terms of endrin plant and what goes on at the endrin plant?

A Yes.

Q All right.

Is endrin being made year-around?

jrb2

A Yes.

Q Is it a batch process? Or is it a continuous flow?

A Batch process.

Q So you would have a batch discharge, also you would not have continuous flow of water from the pipe?

A Well, we have continuous flow of water from pipes in the plant, cooling water, heat exchanger, cooling water, things of this sort, that are continuous but are not in contact with endrin, with the exception of one small stream that is a vacuum jet tail water.

Q All right.

Well, let me just talk about the streams that have or which possibly could have endrin in them. Are those streams fairly constant or do they fluctuate a great deal.

A They are fairly constant.

Q At what flow?

A From the endrin plant there is about 450 gallons a minute total flow at the present time.

Q Now, how do you maintain a constant flow when you have a batch operation?

A Well, the batch operation goes on inside the vessel; as soon as one batch is finished and pumped out, another one is started.

They don't necessarily turn off the cooling water

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on the jacket on a heat exchanger, they just leave it running.

Q Okay.

Then I guess my question is: From the batches themselves, do you have any discharge of liquid?

A No; only through leakage and spillage. The endrin as produced in the reactor comes out in a slurry form, crystals, and in an organic solvent. It is centrifuged to separate the solvent, dried in a rotary vacuum dryer, and packaged.

Q All right.

Let me see if I have this correct, then? You have a vessel at the Memphis plant in which you put the various raw materials from which you derive endrin; is that correct?

A Yes, right.

Q And all those materials are in such precise quantities that they mix perfectly and you get a batch of endrin?

A Right.

Q And you don't have a runoff of X-chemical or Y-chemical?

A No, it's all contained in the reactor.

Q Have you ever attempted to measure the leakage from a vessel like that?

A To answer your quetion as you asked it, no. We

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made surveys of the water coming from the plant to try to determine losses, you know, adventitious or otherwise of endrin; but to say, to go up to a reactor and measure what's leaking, you know, there's nothing leaking as far as endrin is concerned.

Q All right.

A It would be awfully hard to measure.

Q You do have endrin in your discharge flow, correct?

A Yes, we have some.

Q Where does the endrin come from?

A Some of it comes from -- on our vacuum dryer blender we have a filter system, and air type filters system, to filter the vapors being dried off of the endrin. Sometimes there will be some very fine endrin dust carried through. This gets into the vacuum jet tail water and is one source, a small source, of endrin contamination.

We have a distillation system for recovering the organic solvent and this is endrin in an organic solution and sometimes there are leaks, flange leaks or something of this sort that can drain into the system. We are now engaged in a program to eliminate these sources insofar as humanly possible.

Q You gave a gallons per day or gallons per minute

Was that for --

otal endrin plant. Now, a lot of

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this is made up of un-endrin contaminated water; that's the total effluent from the plant.

Q What is the flow of the water that could possibly be contaminated by endrin?

A Well, the total flow from the entire plant is about 2,500 gallons a minute, goes to the city in an intercepto: sewer, and there's another 800 or so that goes to a city storm sewer.

Q Why don't we back up. I want to make sure we have these definitions exactly precise and the numbers right.

In your endrin plant you have certain types of water that don't really get involved with the endrin manufacture In other words, --

A Right.

Q -- you have laboratory wastes and things like that?

A Yes.

Q I take it you have several sets of pipes. Now, do all these pipes lead to one major outfall?

A yes, from the endrin plant, they do. In other words all of the watter, effluent from the endrin plant, regardless of whether it comes from contaminated sources or not at the present time goes into a single sewer system, which then combines with other sewer systems from other producing units to become the final plant effluent.

Q Now, that was the 2,500 gallons per minute?

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A Yes, that's the final effluent, that 2,500 gallons per minute.

Q Well, why did you give a figure of 800 gallons per minute? Where does that go?

A Well, we actually have three discrete flows. The 800 gallons a minute is made up of two surface streams, some cooling water, uncontaminated cooling water is just put out into a ditch to runoff from surface drainage to the city's storm sewer.

Q That would be in addition?

A Yes, that's in addition to the 2,500.

Q But we need only talk about the 2,500 in terms of possible endrin concentrations?

A There is a little bit of endrin in the other picked up from the soil, adventitious pick-up, not direct process.

Q Do you have any idea of how much?

A It runs on the order of a tenth of a pound per day or less.

Q In the 800 --

A In the 800 gallons.

Q Now, the 2,500 gallons per minute goes to the city sewage system?

A Yes, interceptor sewer.

Q And from there it goes into the --

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A Into the Mississippi.

Q After treatment?

A Memphis has no treatment plant at the moment. I have been invited to the ground-breaking of the new North Treatment Plant later this month.

Q So that the flow goes into a piping system which is the interceptor?

A Yes.

Q And from there it goes into the Mississippi?

A Yes.

Q What is Cypress Creek or Wolf Creek?

A This is the storm sewer that I am speaking of.

Q I see.

A Now, it flows into Wolf River, which is a tributary of the Mississippi.

Q The reason I asked that, Dr. Polen has referenced several studies which show Cypress Creek, I think is the name of it, to be at one time heavily contaiminated with endrin. Now, were the discharges at that time the same way they are now, or has there been a change?

A There has been a tremendous effort to try to clean up the Cypress Creek, in other words, eliminate any possibility of contamination; and in addition, the city has -- it used to be just a dirt ditch with pools and things laying on the bottom. The city has come along and with the

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exception of about three-quarters of a mile of it, of the tail end, it's now just a six-inch, sixty-foot wide concrete open trench.

Q But does your endrin -- strike that.

Does the 2,500 gallons per minute flow go into Cypress Creek now?

A No.

Q It goes directly to the Mississippi?

A It goes directly to the Mississippi.

Q Through underground piping?

A Through underground piping along with other industries' wastes.

Q Let's talk about the 800 gallon flow for a minute.

How does the endrin get into that flow when it's only cooling water?

A Mainly from contact with soil. We're in the process now of trying to pin down exactly where this is coming from. We have traced it back up into the actual plant pipe where the water comes out, and the endrin is not there; so it's picked up after it contacts the soil.

Q Well, how does it get in the soil?

A I don't really know for sure. It could have been spills over the years.

Q Volatilization?

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A Any kind of mechanism. I really don't know.

Q Well, could it be dust or volatilization from the plant?

A It might be possible, I couldn't say at the moment. I don't have enough data to pin it down.

It's something similar to the problem as described about PCB's, you know, in other nonproducing areas of the plant. Endrin has been produced for a good many years.

Q Well, all right.

You mentioned you had a vacuum dryer?

A Yes.

Q And that is vented or that has pumps?

A No, it has a steam jet vacuum source.

Q Well is it vented?

A Only through the steam jet when there's endrin in there, when it's in operation.

Q Is this one way endrin can get into the environment?

A Yes, this is one of the direct streams that I mentioned to you before. This is a very small amount, however.

Q Now, this goes to the 800 or the 2,500 gallons?

A This goes to the 2,500.

Q How has your manufacturing process changed over the years, if at all?

A Well, the basic process itself has not changed

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with one exception: we have made improvements in materials-handling equipment. The original plant used screw-type conveyers for conveying the wet endrin from the centrifuge, and to the dryer and to the blender from the dryer. We changed the process to eliminate a separate dryer. We now have a combination dryer-blender which eliminated one transfer of potentially dusty material.

We now use centrifuges instead of -- I mean slow speed basket centrifuge instead of high speed, constant speed centrigures. When the knife came up, the centrifuge discharge knife, hit the cake at high speed -- endrin is a rather brittle crystal and it converted it into dust. In the early days of endrin production we had a tremendous dust problem.

We have tremendously improved this by going to a centrifuge that doesn't break the crystal, so it remains crystalline and much less dusty.

We've improved our housekeeping considerably, recognizing endrin being the problem that it is. We have areas of the endrin plant diked off so that if water spills on the floor it goes to a sump and we have to pump the sump out and send it to the incinerator, things of this sort.

We're trying to contain the endrin if it gets out and try to contain it in the system; but if it gets out, try to isolae it from any effluent capability.

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Q How many pounds per day do you discharge?

A We are averaging on the order of 1 to 2 pounds a day. Some months we might discharge as much as 3, but this figure has continually been coming down to about the 1-1/2 to 2 pound level generally.

Q Well, for example, how many pounds were you discharging five years ago, if you have any idea?

A I don't recall the exact figure. I am sure it would be more.

Q Do you have any figure for the concentration of endrin in your waste stream?

A Yes, I do.

It runs on the order of, the general order of 10 parts per billion, or less sometimes.

Q Have you ever measured the point at which the sewer line hits the Mississippi for endrin concentration?

A We have not, but EPA has.

Q Do you remember the figure?

A I don't recall it offhand.

Q Where do you get the water which you use in your plant?

A If we want it essentially iron-free, and there are a couple of process uses that we don't want iron in, in the total plant, we buy it from the city. Of course all our drinking and sanitary water is city-supplied water. The main

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plant cooling water supply is from our own wells. We draw the water from the same stratum that the city does, but they aerate it and pick up iron; so, therefore, we do have some higner iron in our well water than we do in our city water, but it even comes from the city mains or from our wells. The ultimate source of it is the same.

Q How long is the sewer system from the point at which you enter it to the point where it hits the Mississippi?

3 D

A My best guess would be five to six miles.

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Q Are there other chemical products that are given off in the manufacture of endrin?

A Yes. We find some intermediates in some of the water.

Q Well, is it Aldrin and Dieldrin; aren't they given off?

A We don't find Aldrin and Dieldrin. They are not, apparently, as far as I know, made in the process that endrin is.

The front end of the process is different.

Q Well, Aldrin and Dieldrin are byproducts at your Memphis plant, aren't they, for heptachlor or one of the --

A No, not to my knowledge.

Q Well, if you know, what chemical byproducts are being discharged?

MR. LORANT: Byproducts of what?

MR. ROGERS: The endrin manufacture.

A Well, the three intermediates can be detected in the water. What we call hexavinylchloride, Diels-Alder, adduct of hexachlorocyclopentadiene and vinylchloride.

The second product is what we call Hex-PCH, which is hexachlorobicycloheptadiene.

And the third product is isodrin.

Q Q In several of the reports that Dr. Polen refers to in his testimony, residues of X and Y show up.

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A All right. That's the --

MR. LORANT: Which report are you referring to?

MR. ROGERS: I think in almost every one of his references from the Pesticide Monitoring Journal X and Y either appear or were looked for. And I wondered if those are compounds you have referred to.

A Two of them are, yes.

X and Y are the first two.

MR. ROGERS: I see. Okay.

BY MR. ROGERS:

Q Are these metabolites of endrin?

A No, they are intermediates in the process of making endrin. They are the steps.

Q Are they persistent? Or do they metabolize into other forms?

A I don't have any personal knowledge of their metabolic processes.

Q Where, in the process of endrin, do you lose these intermediates?

A Well, the hexavinylchloride is converted into hex-PCH, and hex-PCH is converted into isodrin, and the isodrin is converted into endrin.

Q You said these can convert, one to the other. Do they do so?

A Chemical reactions.

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Q They cannot do it in the environment, is that correct?

A I would not think so, under the conditions that it takes for a reaction. I cannot conceive of it in the environment.

Q Has anyone studied whether in fact these reactions have taken place in the environment?

A Not to my knowledge.

Q Well, if we find isodrin or the other two compounds you mentioned, which I'm not going to try to name, in the water, can we be confidant that they come in some way from endrin manufacture?

A This would be a conjecture on my part. I don't know of anyone else making these materials, so I might be brought to conjecture, you are right.

Q Do you have any idea of the quantities of these other compounds that are being discharged daily?

A In a general order of magnitude.

I don't know about isodrin. But the hex-PCH hex-vinyl in the order of magnitude of a half to one part per million.

Q A million?

A Yes.

Q And you're talking now the total of all of these?

A Individually.

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Q So we could be up to three parts per million, total?

A If you throw those two in, possibly yes; I don't know about the isodrin, however. I don't recall any numbers for it.

Q What about pounds per day?

A I think we're talking about something in the neighborhood of possibly 40 or 50.

Q Mr. Marks, have you ever done any toxicity studies, or are you aware of any toxicity studies on these other products?

A We have -- in our laboratory, we have exposed fish to Hex-PCH. They apparently live, at least on a 48 hour $TL_m$ type test.

Apparently saturated solutions have no effect on them as far as we can tell.

Q Well, can you site, or can you lead us, to any studies which would give us an idea of the toxicities of these other products?

I take it this was some unpublished work.

A Right. I know of no published work.

Q Let me ask you some questions about your laboratory.

Do you monitor and analyze right at the Memphis plant yourself?

A Yes.

MR. LORANT: Are you talking about the effluent

dr-5

stream?

BY MR. ROGERS:

Q The effluent stream?

A Yes.

Q How often do you monitor?

A Daily.

Q Once per day, or --

A Well, we take a composite sample, and make one analysis a day.

Q And I assume you monitor for endrin and these three other products?

A We don't monitor for isodrin. We analyzed the normal analysis as Hex-PCH, hexvinyl, endrin. As far as the endrin plant is concerned we analyze for some other things also.

Q What are those?

A Heptachlor and heptachlorepoxide.

Q I'm confused now, because I thought you said that these three things are the other chemical products that appear in the stream, and I asked you about some of them in the plants.

A Right. Well, the plants are separated, but we monitor the three streams as they leave our property. This is the sampling point.

Q I see.

A Therefore, in effect they are combined at that point. But they start out separate as far as the plant itself is

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Q Are the pipes combined, then, before they, as a unity, come into the sewage system?

A Yes.

Q And you monitor after the combination?

A Right. We monitor the final effluent. This is what the state has required.

Q Just out of curiosity, what are the heptachlor ranges, if you remember?

MR. LORANT: I object.

I can't see the relevance to that in a hearing on endrin.

MR. ROGERS: Let me give you the relevance.

We've had someone in the industry when this is talked about: lack of cynergistic effects; we've had much testimony about additive effects; we've had a lot of testimony about why the EPA should go out and look at every situation as a case by case situation and determine whether there are any other pollutants present, determine the types of water that it's going into, whether it's hard or soft -- all these specific situations which could affect the toxicity of the chemical.

And here, clearly we have a situation in which several toxic chemicals are together; and if EPA should, in fact, follow industry's advice and try to do it on a case by case basis, these are the types of things we would like to know: how many toxic chemicals are being put into the stream,

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and in what quantities.

MR. LORANT: Go ahead.

A It runs generally on the same order of magnitude as endrin.

BY MR. ROGERS:

Q Three points maximum, and three parts per billion?

A Three, maybe five, something of this sort. Sometimes a little more.

Q Are there any other -- is this heptachlor or heptachlorepoxide?

A Well, there's very little, if any, heptachlorepoxide. We only analyze for it because the state requested we tell them. It's usually a part per billion to undetectable, in that range.

Q Well, let me just quickly sum this up, then, and then we will go on.

You can have in your final effluent stream between 40 and 50 pounds per day of isodrin and the other two biproduct compounds?

A Well, as I said, I don't know what the isodrin is. We don't normally analyze for that.

Q So these are the other two?

A These are the other two.

Q Could I call them X and Y?

A If you like.

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Q All right.

MR. LORANT: Why don't you call them by their chemical names.

MR. ROGERS: Because I can't pronounce them.

MR. LORANT: Well, hexavinylchloride and hex-PCH is what you're talking about.

MR. ROGERS: All right.

BY MR. ROGERS:

Q With those two, we have 40 to 50 pounds per day?

A Yes, as best I can estimate.

Q And we have endrin up to three pounds per day, but you think it is more one to two pounds?

A The last few months it's been running more closely to two, or less.

Q And an undetermined amount of isodrin.

A Right.

Q But we do have between a half and one part per million isodrin?

A This I don't know. I would imagine the isodrin would be less, but I don't really know.

Q And then we have up to five pounds per day of heptachlor?

A Right. Those are average figures I'm giving you.

Q Why are you using so much water in your endrin plant?

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A Mostly, a wholloping part of it is to run the barometric condensers steam jets. We have some vacuum jets over in the endrin plant, other than in the endrin process, too. This is a big part of it.

Q Well, are these contaminated, this great quantity of water? Are these flows contaminated or susceptible to contamination?

A Many of them are not. As I say, we're engaged in the program at the moment to segregate uncontaminated streams, combine all the contaminated streams, and then do something with it.

Q That was my next question. Thank you.

What do you think your flow will be then, from your contaminated streams?

A Well, our plants are to combine the effluent from -- well, to reduce it by internal recycle where possible, or diversion, if not possible to recycle -- separate the contaminated streams.

We are hopeful that we will get down to a total from endrin and heptachlor plants both of 75 gallons a minute.

Q That's a tremendous reduction, isn't it?

A Yes.

Q Am I right: it's from 2,500 to 75?

A Oh, no, I'm talking about just that flow from the endrin and heptachlor plants combined. It's now around 1,030

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gallons a minute. And not all of this will be eliminated. Some will just be diverted into -- you know -- around -- it will still be in the sewer but be delivered around the possible point of contamination. And that balance, on the total outflow, is something like 1,900 gallons.

But the contaminated flow of the contaminated sewer will be, we hope, 75 gallons, which we can deal with.

Q I see.

Well, to return quickly to your statement, and particularly those portions of the statement where you say that there is no available technology that could bring the effluent concentrations down to within EPA's range.

Is that a fair summary of what you have stated?

A Yes. Based on our present knowledge, yes.

Q Do you know of an article published in 1965 by Roebeck et al, and it's in the Journal of the American Waterworks Association?

A I am not familiar with that one.

Q Well, I don't want to pursue this too long, but I did come upon it in a publication by EPA. Let me ask you the question, and I'll give you the article so you can take a look at it.

A All right.

Q In here, they talk about powdered activated carbon and they have a powder plant study in which they bring endrin

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concentrations down to EPA's -- to within EPA's designated range. That chart is on page 192, and if you would like, I'll show you that.

(Document handed to the witness.)

MR. LORANT: Was the article fully defined, the reference?

MR. ROGERS: I don't know if it was.

BY MR. ROGERS:

Q Perhaps you would like to read into the record the whole article title and the citation.

A Right.

It's title is Effectiveness of Water Treatment Processes in Pesticide Removal, by Gordon G. Roebeck, Kenneth A. Doestel, Jesse M. Cohen and James F. Kreissl.

It says, "a paper presented on June 4, 1964 at the Annual Conference, Toronto, Ontario," by these people who apparently were from the Division of Water Supply and Pollution Control, U.S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Q Would you give the journal it appears in?

A Journal of the American Waterworks Association, February, 1965.

Q My question simply is, did you have a chance to review that article before you made your statement, your verified statement?

dr-12

Q Do you agree that at least the chart that appears there shows that they are getting endrin concentrations down to quite a low level?

A The data would seem to indicate this. I have a question as to how practical this process would be in actual practice, where they are using batch carbon dosages apparently.

Q Why is that?

A Well, because of kinetics and so forth, the amount of carbon that would be required for the type of problem we have would be so great that I don't believe powdered carbon would be practical from an economic standpoint.

Q Even for 75 gallons per minute?

A Yes.

Now, remember, we're not talking about -- we're talking about reducing the flow. We're not talking about reducing the contamination in that flow from the equivalent of a thousand down to seventy five, because all of the contaminated streams will be in there, but they will just be more concentrated.

We're taking out the dilution water.

Q But doesn't that make the carbon system that much more efficient?

A Possibly. I have no data about treating it. The work that I'm familiar with in the literature, and the work that we have done in our own laboratory, would lead me to

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believe this would have to be experimentally verified in a pilot operation.

Q Have you or has Velsicol hired a consultant to look into the possibility of activated carbon treatment?

A Yes. We've had consultants look into -- not restricted to just activated carbon, but to find a functional system to do the job of reducing the endrin to a one pound per day maximum limit, which is what the EPA has requested.

Q Who has requested that?

A The EPA?

Q Where?

A Atlanta. Region Four.

Q In what form did this request take?

A Well, I think it evolved essentially, "If you don't agree to this limit, we'll sue you;" this type of thing. It's an enforcement type operation.

Q Well, I want to be very clear about this, because it's our understanding that headquarters of the regions are looking to this hearing for contamination, of what quantities of toxic pollutants will be allowed.

A Well, this agreement came up before the toxic pollutant subject came up, and this is the limit under which we are now operating and aiming to meet.

Q Well, I hope you're aware of -- maybe I should address this to Mr. Lorant, but even permits that are granted

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now have a specific proviso that they are subject to 307 regulations and that the more stringent regulations will apply.

MR. LORANT: I'm aware of that, Mr. Rogers. That such seems to be the case.

However, that doesn't negate what Mr. Marks just said, that there has been communication with EPA over an extended period of time, and that one pound per day is the goal that they have urged us to shoot for.

MR. ROGERS: Region Four.

MR. LORANT: That's correct.

THE WITNESS: In cooperation with the enforcement division in Denver.

This came about as a result of an EPA survey of our waste streams in connection with a survey of other big industries in Memphis.

BY MR. ROGERS:

Q Let me return quickly to this carbon adsorbtion, and then I want to get into the consulting contract you have let and the type of technology you're looking at.

Were you in Atlanta on April 19th for the technology transfer related to this toxic hearing?

A Yes.

Q There was a paper presented there by Hager and Rizzo of Calgon Corporation; do you recall that?

A Yes. I've talked to both gentlemen about it.

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Q And the reason I bring it up is that they, too, suggest that with granulated carbon the endrin limits can specifically be met. And they have a chart, Figure 5, in which they actually show the EPA limits being met with their system.

Did you have a chance to review this?

A Yes, I have. And this is really my objection to their conclusions. They used a static system, not time-dependent; an equilibrium system, so to speak, which in our experience in trying to translate activated carbon to using granular carbon, which is the only thing that is really best suited for a stream type application, does not bear our kinetically and otherwise the efficiencies that this theoretical type curve would indicate.

I have some other comments about their work, but that's the main thing.

End 3E

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4A ebl

Q Mr. Marks, let me quickly ask you some questions about other pesticide manufacturers.

EPA put out a publication some years ago in which they did a survey of the various manufacturing sites and they went to Montrose Chemical, which produces DDT, and Shell, which produces Aldrin-Dieldrin. And at least according to this publication, and also according to our information, those systems have no liquid wastes at all. They discharge to a concrete evaporative area.

Are you aware of that?

A Yes.

Is this the 1972 book?

Q Yes.

A I believe I have a copy of that.

I'm aware of this, but the humidity conditions in the Memphis area would not be conducive, and the rainfall would not be conducive to evaporative systems.

Q Wouldn't you merely make it bigger?

A Well, we have limited space to do it. I suspect Shell had half the Denver Arsenal to put their lagoon in.

Q They have a hundred acres.

A We don't have a hundred acres all told.

Q You have another facility in Illinois, do you not, Velsicol?

A Yes.

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Q That produces other chemicals?

A Yes.

Q And they use, as I understand it, a deep well injection system.

A Yes.

Q Have you ever examined that for your situation?

A Not seriously, because it is our belief that the Memphis Light Gas and Water Division wouldn't stand still for-- You see, the water supply in Memphis does not come from the river; it comes from artesian wells. At the 500-foot level where most of it is drawn-- They go all the way down as far as I know to 3,000 feet below, and it is not exactly the type of environmental situation one would want to dig a disposal well in.

Q No, I can see that.

Let me turn to page 5 of your statement where you refer to this promising technique. Would you give us some more details on this proposal and what you've been doing to look into it?

A Yes.

Last year in February in Environmental Science and Technology, Dr. Kennedy of Rohm & Haas,published an article, the first one I have seen published, on the Amberlite XAD-4 resins-- They have an XAD-2, but the XAD-4 is recommended in this case -- in which he mentioned the fact that it had a

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great affinity for chlorinated hydrocarbons, and it had been used in what apparently was a DDT operation, at least a by-product they were adsorbing, similar to that from a DDT operation.

This developed our interest. At the time, our project with Ryckman, Edgerly & Tomlinson to try to find a functional system to meet the one pound limit was coming to a conclusion with their recommendation that we use solvent extraction, but we rather objected to recycling 600 gallons a minute of something as formidable as heptane, so we were looking for an alternate source, and this came to our notice.

We obtained samples of the resin and tried it out on our actual effluent and found that it did indeed have a very good adsorptive capacity for Endrin as well as other -- the other materials, other chlorinated materials, contaminants in the waste stream.

It seemed to be relatively non-selective.

Somehow, I'm not sure just exactly how, Dr. Bob Swank with the Technology Division in Athens learned of it. I believe there was someone in our R&D Department talking about another matter -- It seemed to be casual -- asked us to come down and talk to him, which we did.

And he was familiar with the resin. He had talked to Kennedy at Rohm & Haas and he was looking for someone who would take on a program in this area to build a demonstration

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plant to show that -- to prove the technology.

And he asked us to request a grant from them, as much from EPA's standpoint so they would have the information and as much from our standpoint to cooperate and work together on the solution to the problem. And of course this was before the-- This was last year, before the toxic standard came out.

We began our work actually last October and during this interim when we were working, this toxic standard came out.

MR. LORANT: You're talking about the proposed standard?

THE WITNESS: The proposed standard, to try to meet this.

So we prepared the grant application which I understand from our last conversation with Dr. Swark is essentially approved and it is just waiting for the accountants in North Carolina to approve the allowable portion of it for his granting of the money.

So any minute we expect to have a proposal from EPA on this.

The work itself, the laboratory work itself is extremely promising with one exception, that we don't seem to be able to get it down below a half a part per billion. We ran activated carbon columns under the identical conditions,

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side by side. The carbon column broke through in two weeks, and by "breaking through" I mean reached the outlet, reached equilibrium with the inlet.

We ran the resin column until about the middle of January from the 12th of October. It had never shown any sign of breaking through.

The resin has an additional advantage from a commercial process standpoint, that it is easily regenerable by a solid. The carbon has to be thermally regenerated and of course this creates other problems, air pollution and so forth, as well as expense.

You mentioned the Hager and Rizzo paper. At Atlanta the costs which they quoted at the meeting were in the range of $5 to $20 a thousand gallons of waste treated.

My preliminary estimated cost for the resin system in the most inflationary conditions I can think of is on the order of $2 to $2.50 a thousand gallons.

BY MR. ROGERS:

Q Which would be 75 per thousand gallons?

A Yes.

Now you see, 75 gallons a minute is around 110,000 gallons a day.

Q So you'd be talking $300 a day?

A Right, as against their cost anywhere from $600 to

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2,000, roughly.

So this is why the resin, from a practical standpoint,looks good to us.

Its capacity-- We don't know what its capacity is. We haven't run static tests like Rizzo and Hager did because we don't feel they are directly applicable to a dynamic column type situation.

We are working with the actual stream samples.

Q Are you through?

A Yes.

Q You said you thought you could -- or that the studies that have been done, the tests that have been run -- get down to .5 parts per billion.

A Right. We have had results as low as that. One of the things we are wanting to work on now is to try to see why they were that low at times, and try to determine what the ultimate point is. But as of the moment our experiments with varying contact time, column height, flow rate and so forth, do not indicate that we can get down -- can expect to get down to .2 parts per billion.

Q Just doing some quick arithmetic, if you currently have about 10 parts per billion and want one to two pounds per day with a half a part per billion you'll have around .1 pound per day. Isn't that correct?

A Well, no, because we're not planning on treating

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that stream which has 10 parts per billion. The stream, after we reduce and combine and divert, the 75 gallons a minute is what we propose to treat. It will be much more highly concentrated. It will have the same total weight of material per day in a 75- instead of 1,000-gallon per minute flow rate.

Q You are not going to try to treat the stream with the 10 parts per billion?

A No, not as such.

Q Is that the cooling stream?

A Well, it depends on which one you're talking about.

We are planning on treating the contaminated pesticide sewer system that goes to the city interceptor sewer.

Q How many pounds per day are in that?

A That's the two to three pounds average.

Q So you have another stream with one to two pounds?

A We have another stream, two streams, which total roughly .1 pound a day, those going to Cyprus Creek, the 800 gallons a minute surface flow. It's usually .1 pound or less.

Q Well, what is the concentration when you get down to 75 gallons per minute?

A We don't know for sure what that will be. It is hard to predict. We can calculate it on the assumption that

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it would be a direct ratio. We're not sure this is actually in practice what will happen. The feed to the resin column we plan to filter which, in itself, takes out a portion of the pesticide.

Q Well, do you have any ballpark figures on your concentrations when it hits the resin?

A No, I have not back-calculated it to that point up to now.

Oh, when it hits the resin?

Q Yes.

A Yes. The effluent from the filter will be something in the neighborhood of -- oh, 30 to 100 parts per billion.

Q And you're going to get that down to .5 --

A We're going to get that down to .5, and that will be the 75 gallons which goes into the remaining roughly 1800 gallons of other plant effluent.

Q How many pounds per day is that then?

A Assuming that were the only thing, that we cleaned up the 75 gallons and we didn't pick up anything else out of the sewer system, that would be something on the order of a hundredth of a pound per day.

Q Then in addition to that you'd have a separate stream--

A In addition to that we have a separate stream

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which goes to Cyprus Creek which, say, is tens parts per billion. We get it down to a half, to one part per billion. It isn't itself going to meet the proposed limit, even with the resin technology.

Q But when you do use the resin technology you are going to get it down to an acceptable level; isn't that correct, theoretically?

A Well, we can meet the pound a day limit proposed. The concentration limit I'm not really-- Well, you see this is why we need the demonstration unit.

You know, we can sit here and theorize and throw numbers around but you go out in the plant and try to do something at this level-- You see, you have an analytical problem at this level, too. Can you detect it at that level? So this is not as simple as I maybe seem to imply.

Q We realize that.

We're having some problem because we keep talking about two different streams here, and you're saying that even when you apply the resin technology to the one major stream and get it down to 75 gallons per minute, you still can have a problem with the other--

A Right, our problem is going to be, as I see it, with the concentration limit rather than necessarily on the total poundage.

Q Let me go back and get this clear for the last

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time.

In that stream that goes directly to Cyprus Creek, what is your concentration, what is your flow per day, and what is your pound per day?

A All right.

We have two streams, one about 600 gallons a minute, one about 250.

Now the 250 gallon a minute stream flows through the caustic chlorine plant and really is not connected with the organic area at all, although, due to analytical problems, we do sometimes think we detect, some days, a little Endrin part per billion or less in this stream when actually, you know, it really should not be there.

There is no mechanism one could imagine that could be there, and it just shows up sporadically. We feel this is an analytical problem.

The other, 600 gallon a minute stream does flow alongside the organic area and it has the concentration of, say, five to ten parts per billion of Endrin.

Q And that goes into Cyprus Creek?

A That goes into Cyprus Creek.

Q So we can just calculate that ourselves, taking the flow times the concentration.

A Right. You can calculate that. That's relatively clean water you know.

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Q Well, ten parts per billion is what we would agree to be--

A Well, I'm not proposing that.

Q What is the proposed grant for, what amount of money?

A Well, the total grant is for $464,000, the total cost of which, of course, we will have to pay a portion. EPA will pay whatever portion they arrive at, and that's what we are waiting to hear now.

Now this really involves here again some cooperation with EPA, two distinct demonstration units.

Now there is another process which Dr. Swank is looking at and has invested some money in with a firm called Envirogenics in California, which claims to have a method by which they chemically degradate chlorina ed hydrocarbons.

Dr. Swank has asked us-- In fact, as one of the inducements between us, he has asked us to, on a contract basis, build a demonstration unit for the Envirogenics system alongside ours because they need a pesticide plant effluent to try their tests on.

They've done-- I have seen no reported work from Envirogenics on Endrin and therefore I did not include it in this because the thrust of my affidavit was that I knew of no demonstrated process that would meet these limits in actual practice reported, other than some static laboratory

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studies on powdered carbon.

Dr. Swank wants to totally fund, on a contract basis, the Envirogenics work. The problem with the Envirogenics system is that whereas we are removing -- we're not adding anything to the stream; we're removing something already there.

The Envirogenics system apparently does not totally dechlorinate these compound and nobody knows what the toxicity of the products are. The fact they say you can't determine the pesticide coming out doesn't mean that you can't determine other chlorinated materials.

So this is the point and the agreement as proposed is-- You see, what I'm saying is the $464,000 also includes the total cost of constructing Envirogenics' system, which is $129,000 plus our cost for operating it. So the cost of our unit is something like $300,000, to be partially funded by EPA if everything works out.

We're not talking about a little bit of money. This program, to get down to 75 gallons a minute, is costing over a half a million dollars.

Q But in conclusion I take it that you would not be doing this unless you saw a distinct possibility that this method would be practically feasible in your plant?

A Well, I think Dr. Swank and others I've talked to in EPA agree with me that the resin system looks like

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the best available technology, whatever it gets it down to; whether it meets the proposed limit is open to question.

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Q A while ago you said you were talking with a company called Rohm & Haas.

What is that?

A Rohm & Haas is a commercial manufacturer of, among other things, ion exchange resins; and this is a particular type of ion exchange resin. It's about eighty percent cross-linked, which takes out most of its ion exchange capacity, but makes a very hard, durable bead.

Q All right. Fine.

MR. ROGERS: I have no further questions.

Thank you.

JUDGE SWEENEY: Mr. Lorant?

MR. LORANT: Might I inquire, Judge: it's about four o'clock. I'm not sure I can finish with the witness today.

JUDGE SWEENEY: Well, do the best you can.

MR. ROGERS: Your Honor, I will have two to three hours tomorrow, and as you know we've been having a problem with witnesses.

If Mr. Lorant wants to do --

JUDGE SWEENEY: Well, you'd better stop having a problem with witnesses.

MR. ROGERS: The problem was simply, we weren't able to get --

JUDGE SWEENEY: You'll never get finished, and we

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won't get the EPA evidence in this month.

MR. ROGERS: The industry counsel were not prepared to go forward with cadmium tomorrow. We were willing to bring people in from Duluth tomorrow, and there were so many involved, and they just simply said they were not prepared logistically to go ahead with cadmium; but EPA was ready to bring the witness in tomorrow.

What I'm saying is --

JUDGE SWEENEY: You're saying that tomorrow we won't have anything to do in the afternoon again?

MR. ROGERS: It may be.

MR. LORANT: Well, we have this witness to finish and we have Dr. Polen, who will be here tomorrow.

MR. ROGERS: Well, your Honor --

JUDGE SWEENEY: Mr. Rogers, this is the third or fourth time I've said this.

You and Mr. Eckert are going to have to get together and get this hearing --

MR. ROGERS: We'll have a witness here tomorrow afternoon.

The problem is, industry counsel are telling us they couldn't be here for cadmium starting Friday afternoon.

JUDGE SWEENEY: We'll just tell them to be here if you're going to have a witness and if they want to cross-examine, for them to be here. Otherwise his evidence will go

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in without cross-examination.

You've done everything you could to work with the industry lawyers. They're dragging their feet. We gave them a full week already, and Mr. Quarles has gone way out of the way extending the hearing through the end of the month.

The industry witnesses are the ones who asked for this hearing, and they should be prepared to go ahead.

MR. ROGERS: Well, I'm through with this witness, your Honor.

MR. LORANT: Your Honor, again I would request -- there are certain points in the testimony that I thought were a little confused, and I would need a little time with the witness to discuss these points with him so that I could perhaps clarify them.

JUDGE SWEENEY: All right.

We'll take a five-minute recess, and you can talk to him.

MR. LORANT: Thank you.

(Recess.)

JUDGE SWEENEY: Back on the record.

Mr. Lorant, you go as far as you can until about 4:30.

MR. LORANT: Thank you.

JUDGE SWEENEY: Go ahead.

MR. LORANT: Okay.

brb 4

REDIRECT EXAMINATION

BY MR. LORANT:

Q Mr. Marks, to clarify the scene, as it were, is Endrin a solid?

A Yes.

Q And you ship it only in sealed containers?

A Yes.

Q So that there are no such things as bulk shipments of Endrin?

A Right.

Q And, as I understood you to say, this was a batch process operated in the plant at Memphis, Tennessee?

A Yes.

Q Now, you've been with Velsicol for 19 years?

A 19 years.

Q Have you ever functioned in the commercial area with respect to Velsicol -- marketing, utilization of the products and so forth, out in the field?

A No.

Q Have you ever -- in the commercial sense: I am not talking about your backyard gardening, but in the commercial sense -- applied agricultural chemicals in any area, sir?

A No.

Q And have you ever participated in commercial

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formulation of Endrin?

A No.

Q So that your experience, even though it is 19 years, is restricted to he commercial operation?

A Yes.

Q The commercial operation in the production area, I should say?

A Yes.

Q That's true, isn't it?

A That's true.

Q Now, with respect to the efforts at containing Endrin at the Memphis plant, which I understood is, at least, within the scope of some of your responsibilities, can you tell us what you have done to minimize loss of Endrin in the effluent from the plant?

A Well, as I testified before, we have changed the process to eliminate a unit that was producing dust, and reduced the potential for dust getting out of the system by process changes.

We have put dikes and sumps in all of the affected areas to catch and prevent the admission of Endrin to the sewer system.

We have largely eliminated the use of wash water on floors, things of this sort that would produce a possible problem.

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We have improved our housekeeping capability and qualifications requirements to prevent Endrin being exposed to the possibility of getting into the sewer systems.

Q Are you through?

A And we have diverted some streams of water to better utilization, let's say.

Q And have you done everything that you can think of along those lines to minimize the loss of Endrin in your effluent?

A Yes, I would say so.

Q When some spills on the ground, how do you get it up?

A We have to shovel it up and place it in drums, and this is then disposed of.

Q Now, you have three streams leaving the plant.

Isn't that correct?

A Yes.

Q Two of them go to Cypress Creek, which is what you have characterized as the open sewer, or the open storm sewer?

A Yes.

Q And one of them goes into the city interceptor and ultimately winds up in the Mississippi River?

A Yes.

Q And what is the total volume of effluent from the

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plant, all three streams?

A The total volume runs approximately 3300 gallons a minute.

Q And how much flows into each of the two streams going to Cypress Creek?

A The northwest stream averages approximately 250 gallons a minute. The southwest stream averages approximately 600 gallons a minute.

Q And, combined, you've characterized these two streams as containing about 10 parts per billion?

A Yes.

Q And totalling how much per day?

A Well, I take that back.

Combined, no. This would have to be a calculated figure. The southwest stream has about 10 parts per billion; the northwest stream usually has none, never more than one or maybe two, as a possible analytical artifact.

Q One or two --

A Parts per billion.

Q You say "an analytical artifact." What do you mean by that?

A Well, an inaccurate analysis, not definitely identified as Endrin.

Q Well, perhaps you mean something triggering your gas chromatograph that may not be Endrin?

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A That's right.

Q Can you explain the gas chromatographic analysis that you employ for Endrin?

A Yes.

We use an electron capture gas chromatograph, injecting extracts, solvent extracts of the aqueous sample, into the chromatograph to develop the chromatogram, in which the peaks are quantitated.

Q Well, could you be a little more specific, Mr. Marks? Would you go through it sequentially?

A All right.

The sample is taken in a glass bottle.

Q A sample of water?

A Of water from the effluent, either a grab sample or a composite, depending upon the purpose of the analysis. It's taken in a glass bottle to the laboratory.

A suitable portion, usually in the neighborhood of 800 milliliters of this sample, is shaken on a shaking maching for a specified period of time, like 15 minutes, with ten milliliters of a spectrally pure solvent, one which gives no response to the electron capture detector, either hexane or -- generally hexane, sometimes heptane.

This extract is then injected -- dried to remove any occluded water, and then injected in roughly one to two microliter quantities into the electron capture gas chromatograph,

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either preceded or followed by injections of standard solutions of the component to be analyzed, or a mixure of the components, and the peak heighth, and area of the desired peak from the sample of effluent is compared quantitatively with those of the reference materials of know concentration.

Q By peak height you are now talking about a chart on your instrument?

A Yes.

Q And a needle which is recording something?

A It is recording the output of the electron capture detector, the detector current flow.

Q And how do you know when it is Endrin, or how do you surmise when it's Endrin?

A By the retention time, the time from the injection of the sample to the appearance of the particular peak. It's a characteristic of gas chromatography that this is a constant value.

Q So if there is a peak at the right spot on your chart, it's presumptive that it is Endrin?

A Yes.

Q Why are you characterizing these as "possible artifacts"? What leads you to that conclusion?

A They occur on a stream which flows a short distance in a ditch in an area where, to my knowledge, there has never been any exposure to Endrin.

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I'm not analytically sure that is is Endrin, just because there's a peak there, and not something else that sometimes shows up, or possibly even use of contaminated glassware or something. At this low level of analysis it's extremely difficult to get an analytically pure set of glassware to work with.

Q What is the limit of sensitivity for this method of analysis?

A I would say in our experience it's between a half and one part per billion.

Q Where is your laboratory located?

A It's located inthe plant area.

Q The same plant area where you manufacture Endrin?

A Yes.

Q How many pounds of Endrin do you make per year?

A We make approximately 4.5 million pounds.

Q Don't you have a problem in your laboratory ensuring no contamination in dealing with levels this small?

A Yes, we do.

Q Would you attribute any of your feeling that this is an artifact to that situation?

A Yes, I would.

Q Now, the one that we've been talking about -- the stream we've been talking about, as I recall, is a 600-gallon permanent stream.

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Is that right?

A Yes.

Q Going to Cypress Creek?

A Yes.

Q And the 250-gallon per minute stream also going to Cypress Creek, that one would be about ten parts per billion, sir?

A No.

That's the one that occasionally shows -- most of the time shows nothing, and occasionally shows a peak. It's a stream that flows throught the caustic chlorine area.

Q I'm sorry; I'm confused.

Of the two streams, one being 250 gallons per minute, and the other being 600 gallons per minute, both going to Cypress Creek, is the 250 gallon per minute one the higher or the lower concentration?

A It is the lower.

Q The lower.

And the 600 gallon per minute is the higher?

A Yes.

Q And it is the one that has 10 parts per billion, then?

A Yes.

Q And the 250 has what may be artifacts; is that what you were saying?

brb 12

A Yes, right.

Q But in any event, based on your analyses, and assuming that everything you look for and peaks in the right spot in your chromatogram: this is counted as Endrin, and what is reflected in your statement as about a tenth of a pound per day?

A Yes.

Q So that some of that tenth of a pound per day could be artifacts?

A Yes.

Q The origin of those two streams: could you generally characterize them?

A Yes.

The smaller stream to Cypress Creek, 250 gallons a minute, consists of steam condensate from the Bryant heaters in the caustic plant, and seal water from the Nash hydrogen compressors in the caustic chlorine plant.

The streams on the southwest, about probably 300 to 400 gallons, this represents blowdown from the cooling towers and the water recirculation system. The rest of it is either uncontaminated heat exchanger water that is diverted to the ditch or air conditioner cooling water on the air conditioning system for the laboratory, and things of this sort.

Q So that none of the combined 850 gallons in the two

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streams is relevant to the Endrin operation per se.

Is that true?

A Yes, as far as I know.

Q I believe Mr. Rogers asked you what the source of the Endrin in these streams are, or what you think they are; and if he didn't, I would like to ask that.

A I think it is pickup from the soil content.

Q How long has Endrin been manufactured there?

A Since 1955 that I know of, commercially.

Q Now, in your affidavit, I take it -- I take it you made a literature review to accumulate those references that you could find relevent to the state of the art of removing material like Endrin from water?

A Yes.

Q And you concluded in reviewing this literature that there is no demonstrated method for attaining the standard as presently proposed for Endrin.

Is that correct?

A Yes.

Q You were shown a reference by Mr. Rogers --

MR. ROGERS: Actually, two references.

THE WITNESS: This is the only one I have.

MR. ROGERS: And I referred to the Calgon article.

THE WITNESS: Oh, yes. You referred to it, yes. That's right.

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BY MR. LORANT:

Q I'll take the first one you showed him first; I don't seem to have it written down what that reference was. Would you again allude to it so we can identify it?

A Yes.

It's titled "Effectiveness of Water Treatment Processes in Pesticide Removal" by Robeck, Dostall, Cohen and Kreissl, and it appears in the Journal of the Journal of American Waterworks Association, in February, 1965.

Q Have you had a sufficient opportunity to lookaat it to draw conclusions from it, or would it require more time?

A I haven't had a chance to read it.

Q Let's defer that for a moment, then, and go on to the so-called Calgon study.

MR. LORANT: Is that definitive, or must Mr. Rogers --

MR. ROGERS: Yes.

BY MR. LORANT:

Q Have you had a chance to review that?

A Yes.

Q And have you done so with sufficient detail to draw conclusions from it?

A Yes.

Q And does anything in that article alter your conclusio:

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as represented and drawn in your testimony submitted in this hearing?

A No.

JUDGE SWEENEY: Would this be a good point to break and give him overnight, then, to look at this other article?

MR. ROGERS: Is there any objection to making these two articles exhibits, to clarify the record? They were both -- there really are only two parties involved in this Endrin question, and we have referred to it several times.

MR. LORANT: I have no objection. Are they both in the public literature?

MR. ROGERS: I don't think the Calgon article is, because it was so recent, but they both have seen it --

THE WITNESS: Yes, I've seen it.

MR. ROGERS: And you were at the meeting when it was presented.

THE WITNESS: Yes.

MR. ROGERS: And the other one is a traditional classic article that has been referred to many times.

MR. LORANT: I would have no objection to that.

JUDGE SWEENEY: Do you have copies of those you could bring in tomorrow, Mr. Rogers? You should have at least one.

MR. ROGERS: On the Calgon we have copies, and I

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was just informed we'll get copies of the other one also, your Honor.

JUDGE SWEENEY: If you'll bring two copies or more --

MR. LORANT: I would like one of each.

MR. ROGERS: We'll give you a Calgon one right now.

(Handing document to Mr. Lorant)

MR. LORANT: Thank you.

MR. ROGERS: Why don't we do this, your Honor?

JUDGE SWEENEY: All right.

If you've got it there we can put it in right now.

The Calgon article, entitled "Removal of Toxic Organics from Waste Water by Adsorption with Granular Activated Carbon" will be identified as Exhibit 85, and received in evidence.

(The documents referred to was marked Exhibit No. 85, for identification, and was received in evidence.)

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JUDGE SWEENEY: We will recess until 9:00 o'clock tomorrow.

(Whereupon, at 4:30 p.m., the hearing in the above-entitled matter was recessed, to be reconvened at 9:00 a.m. the following morning, Friday, 10 May 1974.)