IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEVADA

NEVADA POWER COMPANY, Plaintiff,	)	
-vs-	)	CV-89-555-LDG (LRL)
MONSANTO COMPANY, GENERAL ELECTRIC CORPORATION, et al., Defendants.	)	

DEPOSITION OF WILLIAM B. PAPAGEORGE

On the part of the Plaintiff

July 19, 1993

Concannon & Jaeger
General Court Reporters
705 Olive Street, Suite 604
St. Louis, Missouri 63101
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FOR THE DISTRICT OF NEVADA

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Plaintiff,
-vs-
MONSANTO COMPANY, etc., et al.,
Defendants.

CV-S-89-555-LDG (LRL)

I N D E X

E X H I B I T S

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEVADA

NEVADA POWER COMPANY, etc.,)
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Plaintiffs,)
)
-vs-) # CV-S-89-555-LDG (LRL)
)
MONSANTO COMPANY, etc., et al.,)
)
Defendants.)

DISCOVERY DEPOSITION OF WITNESS, to be used in an action pending in the District Court of the United States, for the District of Nevada, entitled NEVADA POWER COMPANY, etc., is Plaintiff, and MONSANTO COMPANY, etc., et al. are Defendants, pursuant to Notice, under the provisions of Rule 26 of the Rules of Civil Procedure, taken on July 19, 1993, at the law offices of Messrs. Husch & Eppenberger, 100 North Broadway, St. Louis, Missouri, before John T. Concannon, a Notary Public within and for the State of Missouri.

A P P E A R A N C E S

The Plaintiff was represented by Mr. Ralph A. Bradley, of the law firm of Bradley & Merrell, c/o Jones, Jones, Close & Brown, Chartered, 700 Bank of America Plaza, Las Vegas, Nevada, 89101.

The Defendant, Monsanto Company, was represented by Mr. Scott Bauer, of the law firm of Kirkland & Ellis, 1999 Broadway, Denver, Colorado, 80202,

The Defendant, Westinghouse, was represented by Mr. Robert P. Morgan, Counsel, Westinghouse Electric Corporation, Gateway Center, Pittsburgh, Pennsylvania 15222.

WILLIAM B. PAPAGEORGE

a witness of lawful age, being first duly sworn to tell the truth, the whole truth, and nothing but the truth, deposes and says, on behalf of the Plaintiff, as follows:

DIRECT EXAMINATION

QUESTIONS BY MR. BRADLEY:

Q. Mr. Papageorge, my name is Ralph Bradley. You and I have sat through some depositions involving you where you were a 30(b)(6) designee for Monsanto on different topics in the case of Nevada Power Company versus Monsanto, Westinghouse and General Electric; that's correct, is it not?

A. It is.

Q. This is the time set for your personal deposition. Are you here, today, represented by an attorney?

A. Yes.

Q. Have you had a chance to discuss with your attorney the purposes of a deposition?

A. Yes.

Q. If at any time you don't understand one of my questions, will you tell me?

A. I will.

Q. And when you give an answer to one of my questions, I'm going to assume you understood the question.

Fair enough?

A. Keep in mind, I may have a misunderstanding and my answer may be based on that misunderstanding.

Q. Well, if you think you may have a misunderstanding, will you tell me?

A. Oh, certainly.

Q. All right. And if, at any time, you want to take a break, you just let me know, all right?

A. I will.

Q. Do you recall having your deposition taken February 23rd and 24th of 1993 in this lawsuit?

A. I do.

Q. And at that point in time, you were a 30(b)(6) deponent on the topics referred to in the deposition?

A. That was my understanding.

Q. All right. If I asked you the questions today that I asked you on February 23rd and 24th of 1993, would your answers be the same?

MR. BAUER: Object to the form. It's overbroad. There's hundreds of pages of the transcript. Without presenting Mr. Papageorge with an opportunity to look at them all and see which ones were based on his personal knowledge and which were not, I don't see any way he can answer that question.

Q. (By Mr. Bradley) Well, Mr. Papageorge, do you think that any of the answers you gave February 23rd and 24, 1993 were wrong?

MR. BAUER: Objection.

A. No, sir. They were as truthful as I knew how to make them.

Q. (By Mr. Bradley) All right. If I asked you the same questions today, would your answers be the same as you gave February 23rd and 24th of 1993?

MR. BAUER: Object to the form. Are you asking him in his personal capacity or a corporate representative who has been educated on certain topics?

MR. BRADLEY: We're here today on his personal deposition.

MR. BAUER: All right. Can you answer the question, Mr. Papageorge?

A. My answers today will be based on my personal involvement and understanding and experience, as I understand it. That's the way my answers will be put together.

Q. (By Mr. Bradley) I understand that. And if -- My question, though, is if I asked you the same questions today that I asked you back in February, would your answers be the same?

MR. BAUER: Object to the form, overbroad, without giving him an opportunity to look at the questions and answers to know whether there is something other than his personal knowledge in the answer.

A. I can anticipate or expect a question requiring an answer which I had no personal experience, other than what was given to me by attorneys. My answer would not be the direct answer you might expect. It will be couched in "I was told by Mr. so-and-so just last month that this is the answer." I personally have no experience with that particular activity. My answer would differ in that regard.

Q. (By Mr. Bradley) Do you recall when you had your deposition taken in February of this year?

A. Yes.

Q. When you indicated -- When you gave your answers, which answers were based upon information people told you as opposed to information based on your personal knowledge?

A. Sir, that particular deposition, I was personally confused in attempting to categorize the questions, as to whether they fell into the 30(b)(6) type or were based on my personal experience. So I just gave the best answer, as truthful as I could make it. I did not try to determine the legalities of the question, if you will.

Q. I appreciate that. My question is more narrow. My question is, when you gave your answers in February, did you indicate when your answers were based upon information given to you by others if, in fact, your answers were based upon information given to you by others?

A. I did not describe them as such, no.

Q. Okay. Did you review any documents in preparation for today's deposition?

A. Yes.

Q. What documents did you review?

A. I was shown the notice that --

THE WITNESS: This is now for my personal deposition?

MR. BRADLEY: Yes.

A. I saw a collection of documents. I did not read each and every word in them. Perused them.

Q. (By Mr. Bradley) What documents did you peruse?

A. Oh, there was a six or eight inch stack of paper. I don't recall all of the --

Q. I want you to describe for me the ones that you do recall.

MR. BAUER: Are you specifying -- Well, I think we clearly specified some documents that were for the 30(b)(6) that we think we're going to get to tomorrow. You want to exclude them for the present purposes?

MR. BRADLEY: Yes. He indicated -- I think his understanding was that my question was limited to just the documents you reviewed for your personal deposition.

A. Personal? I'm confused right now.

MR. BAUER: He may not have known in all cases.

A. The documents that I was able to review briefly in some cases did apply to my personal involvement and experience. In others, they occurred prior to my assignment within Monsanto as it related to PCBs, or occurred after I was relieved of that assignment, and some refer to situations in which I was personally not involved.

Q. (By Mr. Bradley) Tell me which documents you remember reviewing that included your personal involvement and experience.

A. I recall a document that referred to meetings that were held with representatives of Federal departments and agencies, and I was one of the participants in those meetings. I recall some copies of letters that I sent to representatives of customers with my signature on them; I recall a copy of the text that I used in making a presentation before Monsanto's corporate management committee in April of 1970. That's all that comes to mind at the moment.

Q. All right.

A. There were, of course, others.

Q. In an effort the make your personal deposition as brief as I'm able, I take it if I asked you the same questions today that I asked you back in February of 1993 regarding your educational background, your answers would be the same?

A. Yes.

Q. And I take it if I asked you the same questions regarding the work that you did at Monsanto and the titles that you had while at Monsanto, your answers would be the same?

A. Yes.

Q. If I asked you questions today that I asked you in February of 1993 regarding the meetings you personally attended, would your answers be the same?

MR. BAUER: Object to the form, overbroad without providing the witness with an opportunity of seeing hundreds of pages of deposition transcript.

THE WITNESS: Would these be meetings of a specific type or just all meetings?

MR. BRADLEY: Any question I asked you about any meetings you personally participated in.

MR. BAUER: Same objection.

A. I would certainly attempt to recall the meetings being questioned. I may forget a few and may even remember some this time around that I'd forgotten the previous time but the intent would be the same.

Q. (By Mr. Bradley) Let me ask it this way. If I asked you questions about meetings you attended, would your answers - your answers would be based upon personal knowledge, would they not?

MR. BAUER: Object to the form.

A Certainly. Meetings I personally attended, yes.

Q. (By Mr. Bradley) And if I asked you -- To the extent I asked you questions back in February, 1993 about meetings that you personally attended, would your answers then have been based upon your personal knowledge?

A. Yes.

MR. BAUER: Object to the form.

MR. BRADLEY: Let's go off the record for a moment

(Whereupon, a colloquy was held between Counsel, off the record.)

Q. (By Mr. Bradley) Did you receive any tutorial sessions on toxicology or epidemiology from a gentleman named William Hunt?

A. No.

Q. Pardon me?

A. No.

Q. Do you recall a William Hunt?

A. Yes.

Q. Did you have any discussions with Mr. Hunt where results of studies on toxicology or epidemiology would be described and the significance of any results would be discussed?

A. Yes.

Q. Okay. What was his position at Monsanto when you had those discussions?

A. He was a staff toxicologist with Monsanto's Corporate Medical Department.

Q. Do you recall what you discussed with Mr. Hunt?

MR. BAUER: Object to the form, overbroad.

MR. BRADLEY: Relative --

MR. BAUER: Compound.

Q. (By Mr. Bradley) Do you recall what you discussed with Mr. Hunt relative to PCBs?

MR. BAUER: Same objections.

A. He shared with me his latest information regarding the status of studies involving PCBs that were ongoing at the time.

Q. (By Mr. Bradley) Did you have any responsibility within Monsanto relative to the toxicology of PCBs?

A. The responsibility relative to toxicology that I was aware of, assigned to me, was one of communicating with anyone - whether it be a customer, researcher, government employee, private citizen - the information relating to results of studies that were couched in terms that hopefully a layman would understand.

Q. When did you have that job responsibility at Monsanto?

A. It started in January, 1970.

Q. Prior to that date, you had had no course work in toxicology; is that correct?

A. That is correct.

Q. Prior to January of 1970, you had no course work in epidemiology; is that correct?

A. That is correct.

Q. Prior to January of 1990, you had had no specific instruction from any other Monsanto employee regarding toxicology; is that correct?

A. As long as we both understand the use of the word "toxicology" here. I did have some information regarding the possible effect of PCBs when carelessly used by employees.

Q. When did you come by the information regarding the possible effects of PCBs when carelessly used by employees?

A. It started about 19 - the middle of the 1950s.

Q. And when you began learning about those possible effects, did you have a degree in toxicology?

A. No.

Q. Did you have a degree in epidemiology?

A. No.

Q. Did you have a medical degree?

A. No.

Q. Did you receive any training from any toxicologist regarding the possible effects of PCBs when carelessly used by employees?

A. By a toxicologist, no.

Q. Did you receive any training from any medical doctor regarding the possible effects of PCBs when carelessly used by employees?

A. Yes.

Q. Which doctor gave you that training?

A. The plant doctor at the John F. Queeny Plant in St. Louis, Dr. Bershe, B-e-r-s-h-e, I believe is the way he spelled it.

Q. How did Dr. Bershe relate information to you regarding the possible effects of PCBs when carelessly used by employees?

A. It was a face-to-face discussion originated by me after I had read some information that had been provided to the plant, and this had to do with many chemicals, PCBs being one of them.

Q. How long did you have the this face-to-face discussion with Dr. Bershe relating to PCBs?

A. Oh, must have been a half-an-hour at the most.

Q. Now, was it a half-an-hour for all of the products or half-an-hour for the PCBs?

A. About half-an-hour for the PCBs.

Q. Other than your discussion with Dr. Bershe, did you receive any training whatsoever from anyone regarding the possible effects of PCBs when carelessly used by employees?

A. Yes.

Q. From whom did you receive that training or information?

A. Dr. Emmet Kelly, who was the Corporate Medical Director.

Q. Anyone else?

A. Mr. Jack Garrett, who was the staff industrial hygienist reporting to - in Dr. Kelly's department. Those are the individuals that I recall.

Q. When did you receive training from Dr. Kelly on the topic of possible effects of PCBs when carelessly used by employees?

A. During the period 1965 to the end of 1969.

Q. When did you receive that training from Jack Garrett?

A. The same period.

Q. What type of training did you receive from Dr. Kelly between 1965 and 1969 regarding the effects of PCBs when used carelessly by workers?

THE WITNESS: I don't know what you mean by "type." You mean how was it conducted?

MR. BRADLEY: Yes.

A. Dr. Kelly, as Corporate Medical Director, made it a point to visit Monsanto's operating units at least once a year. He would come by the Anniston plant, where I was plant manager, review our medical practice with the plant physician, stop by my office and review with me his findings, his recommendations, and during those discussions, we would touch on the products manufactured at that plant and PCBs was, of course, among those products.

Q. So between 1965 and 1969, you were the plant manager at Anniston?

A. Yes.

Q. And at least - Or excuse me. Once per year during the time period 1965 to 1969, Dr. Kelly would come to your plant and he would review findings and recommendations relative, in part, to PCBs with you?

A. Yes.

Q. And when he met with you once per year, roughly how much time would he spend with you on that one visit per year relating to the possible effects of PCBs when carelessly used by employees?

A. Again, about half-an-hour on a specific subject.

Q. And how would Jack Garrett give you information regarding the possible effects of PCBs if carelessly used by employees between 1965 and 1969?

A. Very similar to the way Dr. Kelly did. Mr. Garrett would come by the plant, conduct his audit, I'm going to call it, his review, and share with me, again, his findings, his recommendations.

Q. Is it Mr. Garret or Dr. Garret?

A. Mr.

Q. Would Mr. Garret come by your plant more than once per year, between 1965 and 1969?

A. Occasionally, he was able to come by more than once, yes.

Q. Do you recall, between 1965-- Well, let me ask it this way. Between 1965 and 1969, did you meet with Mr. Garrett more than once per year where you discussed the possible effects of PCBs when carelessly used by employees?

A. Yes.

Q. And tell me how many times you met with Mr.

Garrett during that, the '65 to '69 period where that topic was raised.

A. I never kept score, sir. I know it was at least once a year and some years, he was able to come by at least a second time.

Q. So once or twice on year?

A. Yes.

Q. And when he visited your plant once or twice a year, how much time would he spend with you where he provided information regarding the possible effects of PCBs if carelessly used by employees?

A. Oh, I thought I said half-an-hour.

Q. So really, the same time as Dr. Kelly?

A. Yes.

Q. In the 1950s, did you have any responsibility for disseminating information regarding the possible health effects of PCBs if carelessly used by employees?

A. Yes.

Q. What were your job responsibilities in that regard?

A. At the time, I was a member of the plant maintenance department. In that department, there are individuals who are involved with PCBs, either as electricians, with electrical equipment, or pump mechanics when they're working with pumps; pipefitters with pipe lines and so on. Part of my responsibility was to make certain that the employees understood the chemicals they were working with and how to handle them and what the effects might be if they were mishandled, and PCBs was one of many that were discussed and reviewed at least - well, every month we would have sessions and once a year we would talk about a specific product, like PCBs.

Q. Over what period of time did you have that type of job responsibility?

A. As best as I recall, it was 1955 or thereabouts through about 1958. Those aren't exact but it's roughly the period of time.

Q. What job responsibility -- Excuse me. What was your job title between 1955 and 1958?

A. Well, I started out as a maintenance supervisor for about a year and then I was appointed maintenance superintendent for the remaining period.

Q. In 1958, did you become plant manager?

A. No.

Q. What job did you have in 1958?

A. About 1958 - I may have missed that year a little - I was appointed a superintendent in the plant engineering department.

Q. What work did you do as a superintendent in the plant engineering department?

A. Oh, I supervised the activities of engineers and technicians that were assigned to address some of the operating units at the plant, in terms of making the operations more efficient, safer, bigger. Whatever it took in an engineering sense to accomplish the need that was perceived.

MR. BRADLEY: It's now a little after 10:30. I'm going to take about a minute break.

(Whereupon, a five minute recess was taken.)

Q. (By Mr. Bradley) Did you ever have a discussion with Dr. Kelly regarding toxicology related to PCBs?

A. Yes.

Q. Did that start in the early 1970s?

A. No. It started earlier than that. Back in the late '60s.

Q. Did those discussions with Dr. Kelly ever cease?

A. No.

Q. What was the subject matter of the discussions you had with Dr. Kelly regarding toxicology of PCBs?

A. It varied with time. The initial discussion had to do with the testing that was conducted in the '30s, '40s and '50s to establish the safe levels in the working environment. The discussion that I had with Dr. Kelly beginning in 1970 and on had to do with the more recent testing that was being conducted at the time that included exposure to animals for long periods of time. I think that about covers it.

Q. You're retired from Monsanto?

A. I am.

Q. When did you retire?

A. My last working day was December 31st, 1986.

Q. Up until the time of your retirement, had you received - excuse me - had you attended any formal course work in toxicology?

A. No.

Q. Up to the time of your retirement, had you attended any formal course work in epidemiology?

A. No.

Q. Up until the time of your retirement in 1986, did you receive any training of the sort you'd received -- Let me rephrase the question. Did you receive any medical training on the subject of PCBs, formal medical training on the subject of PCBs prior to your retirement?

A. No.

Q. During the course of your employment at Monsanto, Monsanto did have employees with medical degrees working for it; is that true?

A. Yes.

Q. Between 1965 and 1975, how many medical - Excuse me. How many people were employees at Monsanto who were medical doctors?

MR. BAUER: Object to the form. Lack of foundation. Indefinite as to whether we're talking about United States or worldwide, but you can answer if you're able.

A. I just don't know the total number.

Q. (By Mr. Bradley) Let's limit this now to members of Monsanto's Medical Department. Between 1965 and 1975, did Monsanto have a medical department?

A. Yes.

Q. How many employees did it have during the 1965 to 1975 period?

MR. BAUER: Object to the form. Lacks foundation.

A. There again, I don't have numbers because it included the physicians, it included the nursing staff, it included the medical librarian, the secretarial help. I just don't have the number.

Q. (By Mr. Bradley) Do you have the number for the number of medical doctors that were employed by Monsanto within its Medical Department in the United States between 1965 and 1975?

THE WITNESS: This is the corporate medical department?

MR. BAUER: I think -- That was my confusion, because there are individual plant doctors too, whether you're talking about just the corporate function as opposed to the individual plant doctors.

MR. BRADLEY: Yes, I am talking about the Corporate Medical Department.

A. 1965. Certainly. Dr. Kelly and as best I recall, he had two medical doctors - doctors with medical degrees - in the St. Louis office.

Q. (By Mr. Bradley) And during that same ten year period between 1965--

A. Excuse me.

Q. I'm sorry.

A. I misled you. That was 1965. When you said ten years, I haven't covered '75 yet. By 1975, as best I remember, the medically degreed personnel in that department was close to half a dozen.

Q. Between 1965 and 1975, did Monsanto employ toxicologists?

A. Yes.

Q. Roughly how many did they have between 1965 and 1975 as part of their corporate department?

A. By 1975, I believe, as best I recall, the number had reached four. That's approximate.

Q. And what was the number in 1965 approximately?

A. '65, professionally trained toxicologists? I don't recall an individual with that type of degree.

Q. When did Monsanto, as best you recall, first employ a professionally trained toxicologist as part of its corporate department?

A. I believe Dr. Hunt was the first, and as best I recall, it was the late '60s.

Q. Did Monsanto conduct unpublished studies between 1935 and 1965 regarding the environmental or human health effects of PCBs?

MR. BAUER: Objection. Lacks foundation.

THE WITNESS: Can you help me with the word "conduct"?

MR. BRADLEY: Either performing in-house or contracted for outside of Monsanto.

MR. BAUER: Same objection.

A. The answer is yes.

Q. (By Mr. Bradley) Okay. And how did you become aware of those unpublished studies?

A. Well, I mentioned earlier, Dr. Kelly would review with me toxicology results that he had. That's when I first became aware of the types of studies that were placed with outside laboratories, and later in much more detail, when I had my tutorial with Mr. Wheeler in January,

1970. He covered the types of studies, the years they were conducted, the type of PCB that was tested, the type of animal that was used and so on. Much more detail.

Q. What were you told about those unpublished studies regarding PCBs? I'm interested in knowing when they occurred, what animals were involved, as best you recall, what it was that was being measured.

(Whereupon, a two minute recess was taken.)

Q. (By Mr. Bradley) I'm interested in knowing when the studies occurred, what animals were involved in the study, what effects were being examined, when the studies occurred, who the authors were. Basically everything you can remember about the studies, including their number.

A. Oh, I certainly don't remember everything. We're talking now about unpublished reports. I'm having difficulty in remembering the name of the laboratory. There was a St. Louis based laboratory that was involved. I remember the principle investigator - Oh. Dr. Younger, Younger Laboratories, was one of them and he was a member of another laboratory which went under another name. They conducted the then accepted testing for industrial chemicals. By "then," I'm talking about that period of time, the state of the science at the time. These were short-term tests at quite high levels of exposure in which the animals were either fed or they breathed fumes of chemicals; some of the feeding was out of their normal feeding pans, if you will, and some of it was by force-feeding, the Gavogue approach, where the material is injected into their stomachs. Some of the testing involved skin testing - shaving the bellies of rabbits and exposing that shaved area to the chemical. The most common animal tested was the white rat, and the details escape me at the moment as to exactly when these tests were done. I do know there were an initial series in the '30s/'40s period and they were redone in the '50s as a sort of a double check to see if the results were similar, and they were. From those studies, the staff at Monsanto's Medical Department was able to arrive at the precautionary information that was issued with the products, in terms of breathing excess fumes and getting it on the skin and ingesting, and the harmful effects that were noted would range irritated skin to the condition referred to as chloracne and, of course, with increasingly high doses, the effect of the liver, and if the bad practice continued and the exposure was quite great, the damage to the liver would be such that it would not recover and therefore, result in potential death. That's the type of information that was extracted from these studies.

Q. Did you ever have responsibility at Monsanto for the wording that was used as part of any labels that were affixed to PCB dielectric fluid manufactured by Monsanto?

A. I did, yes.

Q. When did you have responsibility for the wording of the labels?

A. Responsibility was assigned to me when I was appointed Manager, Environmental Control in January, 1970. I think it's appropriate to indicate that that responsibility was not a sole responsibility. It was a shared responsibility.

Q. With whom did you share the responsibility?

A. With the -- Primarily, with the Medical Department.

Q. Were they responsible for making certain the labels had the appropriate medical information on the labels?

A. They always were and continued, yes.

Q. And what responsibility did you have, then, regarding the labels in January of 1970?

A. It centered primarily on the reference to the finding of those materials in the environment, the possible effect on the environment; the need to keep the material from escaping into the environment and the proper methods for manufacturing it, shipping it, using it, disposing of it.

Q. In the period between 1965 and 1976, did Monsanto have Industrial Biotest Laboratories do some work on Monsanto's PCB products?

A. Yes.

Q. Part of those studies were chronic studies; is that correct?

A. Yes.

Q. During those chronic studies, Elmer Wheeler monitored the development of the studies?

A. Yes.

Q. Did Mr. Wheeler visit the IBT Laboratories between 1965 and 1976?

A. Yes.

Q. Did he visit those laboratories as part of his monitoring of the chronic studies that IBT was performing on Monsanto's PCB products?

A. Yes.

Q. Did Mr. Wheeler tell you about his personal visits to the IBT Laboratory regarding the chronic studies?

A. Yes.

Q. What did he tell you about those personal visits to IBT regarding the studies?

A. Primarily, a status report on how far along the studies were, what the findings to date were; some prediction of what the end result might be, as to what effects one might expect. That type of discussion he would have with me.

Q. Did Mr. Wheeler indicate to you whether he visited the area in which rats were housed which were used as part of Monsanto's PCB chronic studies?

A. Oh, yes.

Q. And what did he tell you? Did he tell you he visited those areas?

A. Yes. He visited the facilities, saw the activities. Nothing unusual about his report.

Q. Did he indicate to you, either by report or by any other means, anything unusual about the IBT facility where the rats were housed?

A. No.

Q. Did he ever discuss with you any concerns he had about the sanitary conditions at the IBT lab?

A. No.

Q. Did he ever express to you any concerns about the conditions under which the rats were being housed at the IBT Labs?

A. No.

Q. Did he ever express to you any concern about animals running loose at the IBT Labs in the areas where the rats were kept which were being used as part of the

Monsanto PCB product study?

A. Never.

Q. Did Dr. Hunt visit the IBT Laboratory during the time the chronic studies were being conducted there?

A. Yes.

Q. And did he, Dr. Hunt, indicate to you whether he had visited the area in which the rats were housed which were being used as part of those chronic studies?

A. He did.

Q. What, if anything, did Dr. Hunt tell you about the area where the rats were housed at IBT during the time they were conducting the chronic studies?

A. That everything was in order. Studies were going on well. No problems that he shared with me.

Q. In 1956, were there tradenames for Monsanto's dielectric fluid that contained PCBs?

A. There were tradenames, yes.

Q. What were they? Let me help you. Was Therminol one?

A. Therminol was a tradename of Monsanto's heat transfer fluids containing PCBs.

Q. Pydraul?

A. Pydraul was a Monsanto tradename for fluid used in hydraulic equipment.

Q. Inerteen?

A. Inerteen was a Westinghouse tradename, which was used with formulations made by Monsanto for Westinghouse.

Q. Pyranol?

A. Pyranol is a General Electric trademark for dielectric fluids bended for GE specifications.

Q. Santovac?

A. Santovac is a Monsanto trademark for fluid used in vacuum machinery.

Q. Was Santovac R ever used in Monsanto's PCB dielectric fluids?

MR. BAUER: Object to the form of the question.

A. I'm having difficulty remembering just which of the PCB mixtures Santovac was made from. It's very likely that that same type of PCB ended up in dielectric fluids.

Q. Did Monsanto ever import Therminol, Pydraul, Inerteen, Pyronal or Santovac?

MR. BAUER: Objection. Lacks foundation.

A. Not to my knowledge.

Q. (By Mr. Bradley) What job title did you have in January of 1970?

A. Manager, Environmental Control.

Q. And what responsibilities relative the PCBs did you have with regard to that job title?

A. I was responsible for keeping abreast of any development as it related to PCBs in the environment; advising management on actions that I felt were appropriate to respond to this information I was receiving. I was responsible for communicating extensively both within Monsanto and outside of Monsanto regarding this information as is related to PCBs in the environment.

Q. With the job title you had in January of 1970, would you expect to learn whether Inerteenn, Pyronal, Pydraul, Santovac and Therminol were imported to Monsanto if, in fact, they were imported?

MR. BAUER: Object to the form. Lacks foundation, indefinite as to time of the imports.

A. That was certainly one of the considerations, but I never, in my job, received any information to indicate that importation of those materials did take place. So as I said, to my knowledge, it did not happen.

Q. (By Mr. Bradley) Did you ever learn during your employment at Monsanto whether the Monsanto's Corporate Medical Department assembled a file on the products manufactured by Monsanto that contained PCBs?

A. Yes, there was a file in the Medical Department.

Q. And I take it, you reviewed that file at some point in the your career at Monsanto?

A. I reviewed -- I don't know that I saw the total file but I saw a high percentage of it, yes.

Q. Did the Medical Department at Monsanto begin its files in the '30s?

A. Yes.

MR. BAUER: Objection.

Q. (By Mr. Bradley) Did Monsanto have a policy of trying to maintain a corporate library, medical or otherwise, that contained all of the references to chemicals manufactured by it which contained PCBs?

MR. BAUER: Object to the form.

MR. BRADLEY: What's wrong with the form?

MR. BAUER: Vagueness with respect to the use of the word "policy" with respect to the particular question.

MR. BRADLEY: Go ahead and answer the question.

A. There was a practice within Monsanto to have libraries covering this subject of PCBs and its products. There were at least two that I'm aware of: one, of course, was in the Corporate Medical Department and its contents centered primarily on health effects; the other was over in Monsanto's Research Department, which included the scientific/technical kind of information, and also included all studies ever made by Monsanto's technical people regarding properties of these materials, the potential uses that they could be put to and so on.

Q. (By Mr. Bradley) Did Monsanto ever have a policy whereby it kept files of any medical information relating to chemicals Monsanto handled, produced or sold?

A. Yes.

MR. BRADLEY: Off the record for a moment.

(Whereupon, a conversation was held between Counsel, off the record.)

Q. (By Mr. Bradley) Between 1966 and 1975, were you told about any industrial incidences in the 1930s and 1940s where chlorinated chemicals were found to have caused liver damage in workers?

A. Yes.

Q. Did Dr. Kelly and Mr. Wheeler give you that information?

A. Yes.

Q. What did they tell you about those industrial incidences?

A. The situation had occurred, as I remember, at a plant that was coating wire with chlorinated hydrocarbon chemicals in which the employees of that plant suffered liver damage and, as I recall, there was some deaths involved. This was traced back to the material at that time called Halowax, which I understand is a chlorinated naphthalene, and in that bath, there were some PCBs. There was some discussion held, and I believe there was some investigators involved. I remember the name Dr. Drinker. I don't remember any of the others.

Q. Did Dr. Kelly -- Were you finished?

A. Not quite.

MR. BRADLEY: Sorry.

A. As I remember, Dr. Kelly was involved very intimately with these discussions. The conclusion that he had reached was that we ought to treat chlorinated hydrocarbons as being, as having the potential of causing this kind of damage without waiting for a specific study being conducted for each and every one of them.

Q. And did Dr. Kelly and Mr. Wheeler give you that information in roughly January of 1970?

A. Yes.

Q. Do you know whether any of the PCBs manufactured by Monsanto were ever determined to contain chlorinated naphthalene?

A. I never heard of that, no.

Q. You're familiar with the term "synergism?"

A. Yes, I believe I'm somewhat familiar with it.

Q. Did Monsanto, in 1966 or any other time, do any studies to determine whether tetrachlorobenzene acted synergistically with PCBs?

MR. BAUER: Objection. Lacks foundation.

A. No. Not to my knowledge.

Q. (By Mr. Bradley) Did Monsanto ever add tetrachlorobenzene to its PCBs as part of its dielectric fluid blends?

A. Yes.

Q. As part of your work at Monsanto, were you familiar with chemicals that were blended together to form the dielectric fluid that Monsanto's manufactured and sold?

A. Yes.

Q. Did you learn in January of 1970, or at any other time, whether Monsanto had performed any studies to determine whether any of the chemicals added to PCBs to create those blends acted synergistically?

A. No.

Q. Did you ever learn, as part of your job responsibilities at Monsanto between - excuse me, following 1956, that workers exposed to PCBs reported skin lesions along with systemic effects, such as digestive disturbances?

MR. BAUER: Can I hear that read back, please?

(Whereupon, the reporter propounded the previous question.)

MR. BAUER: Objection. Vague as to whose workers are being involved, but you can answer if you're able.

A. I'm aware of a reference to skin effects of PCBs. I don't recall any reference to digestive difficulty.

Q. (By Mr. Bradley) Do you know whether Dr. Kelly was involved with a report involving workers exposed to PCBs that reported skin lesions along with systemic effects such as digestive disturbances in the 1960s and then pursued a study of it?

A. I just don't recall that, no. 1960?

MR. BRADLEY: In the 1960s.

A. In the '60s? I don't remember.

Q. (By Mr. Bradley) All right. The situation involving Halowax that you testified to was presented, at least in part, in a 1937 report by Cecil Drinker; is that true?

A. Yes.

Q. Did Monsanto undertake -- Excuse me. Did Monsanto conduct, either in-house or by outside contract, any studies to determine whether any adverse health effects reported by Dr. Drinker were caused by the PCBs or the chlorinated naphthalene?

A. No.

Q. When you met with Dr. Kelly in early 1970 as part of your tutorial, did he indicate to you that he learned in 1937 that if there is a sufficient amount of exposure to PCBs to cause a skin rash, or Chloracne, there may be sufficient amounts to cause systemic poisoning in those persons who are hypersensitive to PCBs?

A. Yes.

Q. In your work at Monsanto, did you ever learn that workers exposed to PCBs had reported skin lesions along with systemic effects, such as impotence?

A. What was that last word?

MR. BRADLEY: Impotence.

A. No, I don't recall that. Skin lesions, yes.

Q. (By Mr. Bradley) In 1966, were you aware of any study or studies that relate exposure to PCBs with Chloracne?

A. Can you help me with the definition of "study?"

MR. BRADLEY: That would include a report, written report. Any effort to determine whether there was reported to be chloracne as a result of exposure to PCBs.

A. Yes.

Q. (By Mr. Bradley) What study or studies or reports were you familiar with in 1966 that related exposure to PCBs with chloracne?

A. There was an incident at the Anniston, Alabama plant, Monsanto, where the PCBs were manufactured, where a special production run of a very highly chlorinated PCB was made, and this was in the '50s. Some of the employees developed the condition referred to as chloracne. This was eventually traced to impurity of the benzene used as a raw material at that time. That's the only report that I'm aware of that related chloracne to PCBs.

Q. Did the Drinker 1937 report relate chloracne with PCBs?

MR. BAUER: Object to the form of the question. There's more than one Drinker report, I believe, and without looking at the report or reports, the question is over broad, but you --

MR. BRADLEY: Let me rephrase it.

Q. (By Mr. Bradley) Do you know whether Dr. Drinker ever published a report or study that related exposure to PCBs with chloracne?

A. I recall Dr. Drinker reporting the presence of chloracne with the mixture of chloronaphthalene and chloro - PCBs. I also recall a report in which he referred specifically to PCBs, but I also recall that he retracted that because he was mistaken about the identity of the material initially. So there were several reports that Dr. Drinker is associated with here.

MR. BRADLEY: Would you read back the answer here?

(Whereupon, the reporter propounded the previous answer.)

Q. (By Mr. Bradley) In 1966, were you aware whether anyone within Monsanto had concluded that inhalation of fumes from PCBs could result in chest irritation that would resemble a serious chest cold among Monsanto workers?

A. Yes.

Q. Was that ever published in a journal or some professional paper?

A. I don't recall seeing that, no.

Q. During the course of your employment at Monsanto, did you ever learn that PCBs were present in cow milk?

A. Yes.

Q. Do you associate the presence of PCBs in milk as a hazard?

A. That's dependent on the concentration of PCBs in the milk and the amount of milk that's consumed. So I need more information.

Q. Was there ever an agency of the United States that addressed the presence of PCBs in paints, use of a formulation that contained Aroclor 1254?

A. Yes.

Q. What was the agency?

A. It was primarily the Food and Drug

Administration.

Q. Was there a point in time between 1966 and 1975 when you learned that Aroclor 1254 was being used in certain paints?

A. Yes.

Q. When did you learn that?

A. Sometime in 19 -- Let me think. In the late '60s, middle to late '60s.

Q. Did Monsanto ever terminate the sale of Aroclor 1254 and similar PCB mixtures for use in applications such as paint?

A. Yes.

Q. Was that done in August of 1970?

A. Yes.

Q. And why did Monsanto terminate the sales of Aroclor 1254 and similar PCB mixtures for use in applications such as paint?

A. Those applications were perceived to be the type that led to almost - I say almost - instant release to the environment without any possibility for controlling that release. So in the interest of keeping it out of the environment, that particular use was terminated.

Q. Are you familiar with the term biomagnification?

A. Yes.

Q. What is it?

A. This is a term that is used to identify the situation that occurs in nature where the different life species form a food chain and the presence of a material at low concentrations at the bottom of the food chain is reflected in increased amounts up the food chain, with the largest amount being consumed by the creature at the top of that chain.

Q. Have any investigators determined a formula for the biomagnification of PCBs in the human food chain?

MR. BAUER: Objection. Lack of foundation.

A. As I remember, there were some individuals that came up with suggested approaches. At the moment, I don't recall their names nor the numbers. The numbers did vary quite a bit from investigator to investigator.

Q. (By Mr. Bradley) How did you learn of the numbers arrived at by the different investigators? Let me ask it this way. Did you learn it as part of your regular job responsibilities at Monsanto?

A. Yes. Uh-huh.

Q. And did those numbers range from a thousand to two hundred thousand?

A. That sounds like the range, yes, sir. Uh-huh.

Q. Was the concept of biomagnification relative to PCBs in the human food chain made known to you in 1970?

A. Yes.

MR. BRADLEY: It's roughly noon. Why don't we adjourn until 1:00?

MR. BAUER: Okay.

(Whereupon, a luncheon recess was taken until 1:00 p.m.)

Q. (By Mr. Bradley) At some point, did you learn of any environmental contamination from plasticizers containing PCBs? "Plasticizer" being defined as however Monsanto defines it.

A. All right. Yes.

Q. When did you first learn of that?

A. The PCBs used in the coatings for silos, which led to the presence of PCBs in milk.

Q. And when was that?

A. That was 1970.

Q. And how did you define plasticizer in answering my question?

A. As it relates to PCBs, these are the uses to which PCBs were sold, other than for use as fluids in machinery such as heat transfer units, electrical equipment, hydraulic systems.

Q. During the '60s and '70s, were PCBs added to ink?

A. Yes.

Q. To sealants?

A. Yes.
Q. Paper?
A. Carbonless copy paper, yes.
Q. Were they used in some, for some dental purposes?
THE WITNESS: Dental?
MR. BRADLEY: Yes.
A. Yes.
Q. (By Mr. Bradley) And would all of those be considered plasticizers, as Monsanto uses the term?
A. Yes.
Q. Did Monsanto ever know that PCBs were being used to extend the life of pesticide?
A. Yes.
Q. When did Monsanto learn that?
A. There was a scientific article published by personnel with the Department of Agriculture Research Center which described the use of PCBs as an extender of pesticide for crawling insects. I, at the moment, don't recall the date of that publication. On or about the date of publication is when Monsanto was aware of this suggested use.
Q. And was this publication published, to your best estimate during the 1960s?
A. It sounds reasonable. It might have been the

late '50s, '60s.

Q. Did Monsanto ever develop products that were to be used to solicit users of its PCBs?

MR. BAUER: Object to the form.

A. I have a little confusion regarding "develop products."

Q. (By Mr. Bradley) Let me ask it again then. Did Monsanto, during the 1950s, develop brochures that were distributed to the public advertising the potential uses of PCBs?

A. Yes.

Q. And in any of those brochures, did Monsanto claim that PCBs could be used as insecticide extenders?

A. I believe so, yes.

Q. And did Monsanto make that -- Excuse me. Did Monsanto include that information in its brochure before or after the report of the Department of Agriculture that you referred to?

A. After.

Q. In the 1960's, did you ever learn that Monsanto's PCB manufacturing facilities were directly causing a water contamination problem?

THE WITNESS: Can you help me with "water contamination"? Water where?

MR. BRADLEY: Water near any of Monsanto's manufacturing facilities.

MR. BAUER: Objection. Vague as to whether the question relates to the presence of PCB's in the water or any other substance from, at or involved in the manufacturing plant, which makes many other products.

MR. BRADLEY: Let me rephrase it then.

Q. (By Mr. Bradley) During the '60s, did Monsanto learn that the PCB manufacturing facilities were causing a water contamination problem by the discharge of PCBs into the water, or water treatment plants, near those manufacturing facilities?

A. Monsanto was aware of the presence of PCBs in the waste waters which were transferred to the local municipal treatment plants. There was no evidence that the water that left those plants contained PCBs.

Q. Did Monsanto learn in the 1960's that PCBs were in fish anywhere?

A. Yes.

Q. When did it learn that?

MR. BAUER: Objection. Lacks foundation as to when anybody in Monsanto worldwide knew that, but Mr. Papageorge, you can give him your recollection.

A. Monsanto was aware of the presence of PCBs in fish in the late '60s as reported by - if I'm not mistaken, the original work out of Swedan, amongst its samples had some fish. That would be the earliest report.

Q. (By Mr. Bradley) And did Monsanto become aware in the 1960s of the presence of PCBs in shrimp?

A. Yes.

Q. When did it learn that?

MR. BAUER: Same objection.

A. Again, that would be about 1969. Late '60s.

Q. Is that when you learned about it?

A. I learned about it in early 1970.

Q. From Dr. Kelly?

A. Elmer Wheeler.

Q. As part of one of your tutorials?

A. Correct.

Q. Did Monsanto develop analytical procedures to determine the presence of PCBs in water at any point in time?

A. Yes.

Q. When did they do that?

A. It started in 1967 and was considered to be accurate and trustworthy by 1969.

Q. Do you recall during your deposition of February 23rd and 24th, 1993 being asked the question at page 132, my question is: "QUESTION: When did Monsanto develop analytical procedures for the determination of PCBs in water?" Objection was made by Mr. Featherstone to the scope and the answer was: "ANSWER: By 1968, the methodology had been developed to the point where it was considered acceptable." Do you recall giving that testimony during your deposition?

MR. BAUER: Well, can we see a copy of the transcript, please?

A. I probably said that. I missed it by a year. My memory is not that accurate.

Q. (By Mr. Bradley) You also indicate in your answer given in February that the methodology was refined by 1969; is that correct?

A. That is correct.

Q. Are you familiar with the acronym ANSI?

A. Oh, yes. Yes, sir.

Q. And what does ANSI stand for?

A. American National Standards Institute.

Q. What is that institute?

A. It is an institute that is available to industry to establish standards for products and procedures throughout any industry that has an interest in establishing such standards.

Q. Were you ever a member of a committee known as C-107 of the ANSI?

A. I was. This was a committee that was appointed to address the use of PCBs in electrical equipment, the proper handling of the PCB type material, the proper use, the proper disposal, the proper testing.

Q. Did Monsanto suggest the creation of C-107 with ANSI?

A. No.

Q. Was Monsanto one of two sponsors of the C-107 committee?

A. I didn't associate Monsanto's being a sponsor. There was a member of Monsanto on a steering committee working within the organization known as NEMA, National Electrical Manufacturers Association, that made a recommendation that a committee be formed under the auspices of ANSI.

Q. And the person within NEMA who made that recommendation was a Monsanto employee; is that true?

MR. BAUER: Object to the form of the question. Lacks foundation, that Monsanto or any employee of Monsanto, was a member of NEMA.

MR. BRADLEY: Guess we're about to find out.

A. There was a Monsanto individual who was part of the group that came up with this decision. This person was not a member of NEMA, nor was Monsanto a member of NEMA.

Q. (By Mr. Bradley) The suggestion to start C-107 was made, in part, by Monsanto and in part by NEMA;

is that correct?

A. That is correct, yes.

Q. The purpose of the C-107 committee was to develop standards regarding the use, handling, testing and disposal of PCBs; is that correct?

MR. BAUER: Objection. Asked and answered.

A. Yes.

Q. (By Mr. Bradley) During the time that -- Well, over what period of time was the C-107 committee in existence?

A. The best I can recall, it was '71 through -- It was still in existence in 1976, when I had a job assignment change. I do not know when it finally disbanded.

Q. Between '71 and '76, who headed the C-107 committee?

A. I did.

Q. Did Paul Benignus ever head that committee?

A. No.

Q. Who took over the chairmanship of the committee once you left in '76?

A. I don't know that I ever heard the name. I don't know.

Q. Was there a transformer and a capacitor subcommittee of C-107?

A. Yes.

Q. And who headed the transformer subcommittee of C-107 between '71 and '76?

A. He had Raab, R-a-a-b.

Q. And at that time, where was Mr. Raab employed?

A. General Electric.

Q. And what work did he did at General Electric?

A. He was involved with transformers, located in Pittsfield, Massachusetts.

Q. And during the period 1971 to 1976, who at the C-107 committee was the head of the capacitor subcommittee?

A. Dr. Posefsky, P-o-s-e-f-s-k-y.

Q. Where did Dr. Posefsky work between 1971 and 1976?

A. He worked with General Electric, and I believe it was a Hudson Falls.

Q. Do you know what position Dr. Posefsky had with GE at Hudson Falls?

A. I don't know the official designation. I do know that he was involved with technology associated with capacitor manufacturing.

Q. Do you know whether Nevada Power Company was a member of either subcommittee?

A. They were not.

Q. Did the transformer subcommittee have roughly seven or eight members between 1971 and 1976?

A. At least that. It seems to me there were more. There was a roomfull of people.

Q. And were the members of the transformer subcommittee predominantly employees of transformer manufacturing companies?

A. Yes.

Q. Was there anyone who was a member of the transformer subcommittee of C-107 between 1971 and 1976 who was not employed by a transformer manufacturing company?

A. Yes.

Q. Who?

A. Well, I recall an individual that represented the utility companies.

Q. Do you recall that person's name?

A. Starts with an L.

Q. And do you recall what organization that person was employed by?

A. He was employed by Union Electric Company in the St. Louis area. He represented some industry group and I have forgotten the name of that group.

Q. Anyone else beside the employee of Union Electric Company?

A. A representative of Doble, D-o-b-l-e, Engineering Company.

Q. What was Doble Engineering Company between 1971 and 1976?

A. They provided a service to owners, operators of transformers.

Q. Was anyone else a member of this transformer subcommittee during the 1971 to '76 period who was not an employee of a transformer manufacturing company?

A. Yes. As I remember, there were some Government representatives involved on and off. Such entities as the TVA Authority, UPA. I'd have to see the documents to refresh my memory. That's all that comes to mind at present.

Q. And how about the capacitor subcommittee of C-107 between 1971 and 1976? Did it have any members that were not employees of capacitor manufacturing companies?

A. Yes.

Q. Who were they?

A. Some of the same individuals we referred to under the transformer committee would also serve on the capacitor committee.

Q. And were Union Electric Company employees part of the capacitor subcommittee?

A. He would sit in on some of their deliberations, yes.

Q. Was he a member of their subcommittee?

A. I would say yes. This membership was not a formal kind of appointment. It was -- The membership was open to anybody interested.

Q. Was Doble Engineering a member of the capacitor subcommittee?

A. No.

Q. Were there any representatives from government who were members of the capacitor subcommittee?

A. As best as I recall, yes.

Q. Were there any other members who were not employees of manufacturing, capacitor manufacturing companies?

A. I don't recall any.

Q. Did Monsanto employees participate in these subcommittees?

A. Yes. I did, for example.

Q. Did Paul Benignus participate?

A. On occasion, yes.

Q. Anyone else within Monsanto participate with the meetings and work with either of those two subcommittees?

A. No.

Q. Was someone from Westinghouse on the capacitor subcommittee?

A. Yes.

Q. Was someone from Westinghouse on the transformer subcommittee?

A. Yes.

Q. Who was that person who was on the transformer subcommittee from Westinghouse?

A. Transformers? T.K. Slote.

Q. And who from Westinghouse was on the capacitor subcommittee?

A. Don McClain. I think his first name was Robert. R.D. McClain.

Q. In 1971, didn't you become aware of reports of fish kills that were attributed to PCBs?

A. I don't associate fish kills with PCBs. I just don't remember any.

Q. All right. Do you remember hearing reports of fish kills generally from a Monsanto plant where some regulatory agent would contact the plant and they'd relay it to St. Louis? I don't mean to trick you either. You've given testimony on that in your prior deposition. Would you like to review that?

A. Right now, I have trouble recalling fish kills. It doesn't come to me right now.

Q. Do you recall whether Monsanto ever obtained samples of fish that had been killed reportedly because of exposure to PCBs?

A. I recall Monsanto receiving samples of fish. I do not recall any particular incident that I can associate with those samples.

Q. Was testing ever performed on those fish samples to determine the presence or absence of PCBs?

A. There were analyses made, yes, sir.

Q. What were the results of the analyses?

A. There were PCBs in the tissue.

Q. Okay. Did the analytical research laboratory in St. Louis perform those analyses?

A. They performed some of these analyses, yes.

Q. Who performed the analyses that were not performed by the analytical research laboratory in St. Louis?

A. Well, I'd have to have the specific instances. There are other laboratories, governmental labs, private labs and universities.

Q. Do you recall whether the amounts of PCBs found in the fish exceeded any guidelines or regulations established by the Food and Drug Administration?

A. I recall some of the findings exceeded that, yes.

Q. Did you learn in 1960 that crab exposed to PCBs contained PCBs in their tissues?

THE WITNESS: In 1960?

MR. BRADLEY: 1960s

THE WITNESS: Crab?

A. I don't remember.

Q. (By Mr. Bradley) Do you remember learning of the results of any tests performed by the fish laboratory in Gulf Breeze, Florida?

A. Yes.

Q. When did you about those?

A. In January, 1970.

Q. And do you know whether it was reported by Gulf Breeze, Florida that they had conducted tests on certain species of fish regarding the presence of PCBs?

A. I recall tests being conducted at the laboratory to determine the effect of PCBs on marine creatures. I don't recall any test that was designed to just determine the presence of PCBs in the fish.

MR. BRADLEY: Would you read the answer back for me, please?

(Whereupon, the reporter propounded the previous question.)

Q. (By Mr. Bradley) Do you recall when the -- Well, let me ask it this way. Did Gulf Breeze, Florida's lab produce a report that described their study of the effects of PCBs on certain species of fish?

A. I recall a report that included information on the sensitivity of young shrimp to the presence of low levels of PCBs. I vaguely recall reports of the studies that were made to determine what effect PCBs had on other marine life - fish, in particular. I do not recall that any dramatic effects were reported regarding reproduction, illnesses and so on.

Q. What do you--

A. I don't remember that.

Q. What do you recall, if anything, about the results of the exposure of shrimp to low levels of PCBs?

A. I recall that the newly hatched shrimp could not tolerate concentrations of something like five parts per billion in the water.

Q. Is the Gulf Breeze, Florida Commercial Fisheries Laboratory, a laboratory that tested crab and analyzed the tissues and found PCBs?

A. I just don't associate crab with PCBs. It does not ring a bell at all with me.

Q. Do you remember during your deposition of February 23 and February 24, 1993 being read the question on page four of Plaintiff's Exhibit 415 at the top - actually, it begins on page three at the end. It says, "We have talked with scientists at the Gulf Breeze, Florida Commercial Fisheries Laboratory. They have conducted studies with crab and shrimp. This is the laboratory that did detect a buildup in crab and also the lethal effect on juvenile shrimp." Did I read that correctly?

A. Yes, sir.

Q. "QUESTION: What did you mean when you said, "This is the laboratory that detected a buildup in the crab?" ANSWER: This is the laboratory that tested crab and analyzed the tissue and found PCBs."

A. I don't doubt that.

MR. BAUER: Take a look at it. Is Plaintiff's Exhibit 415 a document authored by Mr. Papageorge, do you know? It's quoted here and you don't have it here, today.

MR. BRADLEY: I don't have it. I don't have it with me this very moment. I'll represent that my records indicate that 415 is a letter from W.B. Papageorge to Mr. Jenkins, dated July 8th, 1970.

MR. BAUER: Thank you.

THE WITNESS: Jenkins?

MR. BAUER: The question pending, did you read the questions and answers correctly?

MR. BRADLEY: That is correct.

A. Yes, you did.

Q. (By Mr. Bradley) All right. Do you recall, does that refresh your recollection on whether this is the laboratory that tested crab and analyzed the tissue found?

A. It doesn't. I still do not recall it.

Q. Have you ever written that certain uses of

PCBs were grossly contaminating the environment?

A. I believe I did, yes.

Q. When you wrote that, what uses of PCBs were you indicating were grossly contaminating the environment?

A. I don't have a good measure for quantifying "grossly," but I had in mind the uses we described earlier, such as the carbonless copy paper; the inks; the sealants; the calking materials; the inks, the adhesives. Those uses that permitted almost immediate entry into the environment. They were not in sealed equipment.

Q. And did you write that some uses of PCBs were grossly contaminating the environment in 1970?

A. I believe I did, yes, sir.

Q. Are you familiar with a gentleman known as Congressman Ryan?

A. Yes, I'm familiar with him. Yes.

Q. Was he a congressman in 1970?

A. Yes.

Q. And he was a member of the United States Congress?

A. Yes.

Q. In 1972, did Congressman Ryan introduce any legislation dealing with PCBs?

A. Yes.

Q. What was that legislation?

A. I don't recall the exact year but as best I recall, Congressman Ryan made two attempts to introduce legislation relating to PCBs. As I recall, his first attempt was to restrict the use of PCBs under certain conditions. His second attempt was to totally ban PCBs from any use.

Q. Do you recall when Congressman Ryan first introduced legislation addressing or dealing with PCBs?

A. As best I can recall, about 1971.

Q. Do you know whether he introduced a bill to ban PCBs in 1970?

A. That could be the bill, in '70, which he tried to limit the use. It was a later bill, either '71 or '72 period. I may be off by a year, '70, '71, '72 period. The second bill was the one that called for a total ban.

Q. Did you ever write that many PCBs are man made and were introduced to the environment because of our lack of understanding of what these materials can do to the environment?

A. I did.

Q. Was that written in 1970?

A. That sounds about right, yes.

Q. What did you mean when you wrote that PCBs were introduced to the environment because of our lack of understanding of what these materials can do to the environment?

A. There was no information that would indicate that PCBs, for example, would harm juvenile shrimp. There was no information that would lead to many of the allegations that were occurring then, in 1970, regarding the effect on reproduction of birds. It's this kind of information that just was not available.

Q. In your work at Monsanto, did you ever discuss with employees of General Electric anything having to do with the alleged toxicity of PCBs?

A. Yes.

Q. Did you have more than one discussion on that topic with GE employees?

A. Oh, yes.

Q. When did those discussions begin?

A. As best I recall, very early in 1970. A group of General Electric representatives came to St. Louis and we had a session on PCBs in the environment.

Q. Do you know whether you had a discussion with any G.E. employees prior to 1970 regarding the toxicity of PCBs?

A. I did not personally, no.

Q. Do you know whether, prior to 1970, anyone within Monsanto had discussions with GE regarding the toxicity of PCBs?

A. Yes.

Q. On who had those discussions with G.E.?

A. Monsanto's medical department personnel. Primarily, Dr. Emmet Kelly.

Q. And to whom was Dr. Emmet Kelly speaking with at G.E., if you know?

A. I don't know.

Q. Did Monsanto have any discussions with employees of Westinghouse regarding the toxicity of PCBs?

A. Yes.

Q. When did those begin?

MR. BAUER: Object to the form of the question. Lacks foundation. I don't think this witness would know when they began.

A. I have an understanding.

Q. (By Mr. Bradley) What is your understanding?

A. These discussions occurred in the early '30s, '40s.

Q. How do you come by that understanding?

A. From my discussions with Dr. Kelly.

Q. And does it also come from your discussions with Elmer Wheeler?

A. Yes. He just confirmed what Dr. Kelly had told me.

Q. And did you personally have discussions with employees of Westinghouse regarding the toxicity of PCBs?

A. Yes.

Q. When did those begin?

A. Again, a group of Westinghouse employees met with Monsanto, must have been 1970. Right after I got the assignment as manager of environmental control.

Q. After you got that assignment, would you send studies that may have come into Monsanto regarding the toxicity of PCBs to General Electric?

MR. BAUER: Object to the form.

MR. BRADLEY: All right.

Q. (By Mr. Bradley) Let me ask it this way. After January of 1970, did you ever review any current studies regarding the toxicity of PCBs?

A. Yes.

Q. Did you send copies of those studies to anyone at General Electric?

A. I sent copies of status reports - about a two page document - which described the results known to date, as of the date of that status report.

Q. Would you also send those to Westinghouse?

A. Yes.

Q. To whom at Westinghouse did you address the status reports?

A. Oh, I don't recall. There wasn't one person.

Q. Do you recall to whom at General Electric you addressed the status reports?

A. Again, it would not be one person. It would have been a --

Q. Was it typically addressed to one particular department?

A. No. It was generally addressed to the individual that I was led to believe served as the PCB spokesman for either General Electric or Westinghouse, and that assignment seemed to change through the years.

Q. Do you recall the names of any G.E. or Westinghouse people to whom you sent those reports?

A. I recall a few of them. I'm trying to remember. The Westinghouse was John -- I can't remember his last name. There was Ed Simon from General Electric; Mr. Raab at one point in time, at General Electric, Mr. Leseski at one point in time. It was kind of a fluid type of assignment.

Q. How about Dr. Sloth?

A. Dr. Sloth, and so was Don McClain, and there were others at Westinghouse. Dr. -- Starts with a D.

Q. Daykin?

A. Daykin. It's been awhile. I just can't remember all the names.

Q. I'm going so show you Plaintiff's Exhibit 1217 after I show it to the attorney for Westinghouse, and then I'll ask you if you ever reviewed that document before.

A. I have not seen this document before.

Q. Did Monsanto -- Excuse me. Did Monsanto blend a product called Pydraul 312-C in October of 1973?

A. Yes, sir.

Q. Was that a blend intended for use in dielectric fluid?

A. No.

Q. What Aroclor comprised Pydraul 312-C?

MR. BAUER: Object to the foundation. Assumes a fact not in evidence, that there was any Aroclor in Pydraul in 1973.

A. None.

Q. (By Mr. Bradley) Were there any PCBs in Pydraul 312-C in October of '73?

A. There were none.

Q. None. I'm now showing you Plaintiff's Exhibit 1507 and ask if you have ever seen that document before?

A. I have seen this before.

Q. Is that an April 28, 1972 letter from Elmer Wheeler to Dr. Otis Fancher at IBT?

A. It's Dr. Otis Fancher, who used to be with IBT and retired at this point in time.

Q. All right. And is that a true and accurate copy of the letter in April of 1972 from Elmer Wheeler to Dr. Fancher?

A. The only thing missing is the Monsanto logo that is normally on letters of this type.

Q. All right.

A. And it's missing the man's signature, the author's signature.

Q. When you saw it, did it have the letterhead on it?

A. As best I recall, yes.

Q. And did it have the signature on it?

A. Yes, sir.

Q. And other than those two omissions, is it a true and accurate copy of what you saw before?

A. I believe so.

Q. And was this a letter Mr. Wheeler wrote on or about the time he gained the information that's contained in the letter?

A. Yes.

Q. And did Mr. Wheeler write this as part of the regular business activities at Monsanto?

A. Yes, sir.

Q. And was a copy maintained in Monsanto's files as part of its regularly conducted business?

A. Yes.

Q. I'm now going so show you Plaintiff's Exhibit 1237, which is a February 3, 1971 letter from R. Emmet Kelly to Griffith Quinby.

MR. MORGAN: What's the number?

MR. BRADLEY: 1237.

A. I have reviewed the document.

Q. (By Mr. Bradley) Is that a document you've seen before today?

A. Yes, I have.

Q. And except for the yellow highlighting, is that a true and accurate - and the Bates numbers at the bottom - is that a true and accurate copy of the letter that you saw that was written on or about February 3, 1971 from Dr. Kelly to Dr. Quinby?

A. Other than the missing Monsanto logo on the letterhead and the missing signature, it is.

Q. And was that letter written at or about the time that Dr. Kelly gained the information that's referred to in the letter?

A. Much of this information Dr. Kelly obtained through decades of experience.

Q. Apparently, Dr. Kelly was responding to a letter from Dr. Quinby; is that correct?

A. Yes.

Q. Apparently the letter was authored on or about the time that Dr. Kelly put together the information in the letter; is that correct?

A. That is correct.

Q. And is that a document that was authored as part of the regular business activities conducted by Dr. Kelly at Monsanto?

A. Yes.

Q. And was a copy maintained in the files of Monsanto as part of its regularly conducted business?

A. Yes.

Q. I'm going to show you Plaintiff's Exhibit 419, which is apparently authored by you and it's dated October 26th, 1970 and ask if you you've seen that document before today?

A. I have seen this document before, yes.

Q. And is that a true and accurate copy of a document you authored on or about October 26th, 1970?

A. It appears to be.

Q. And did you author that document at about the time that you gained the information that's contained in the exhibit?

A. Yes.

Q. And did you author that document as part of your regular business activity at Monsanto?

A. Yes.

Q. And was a copy maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 416, which is a letter dated May 25, 1970, from Elmer Wheeler to Otis Fancher at Industrial Biotest Laboratory and ask if you have seen that document before today?

A. I recall this document.

Q. Is that a true and accurate copy of the letter written by Elmer Wheeler on or about May 25, 1970 to Otis Fancher?

A. Again, except for the absence of the letterhead and signature, it appears to be.

Q. And was that letter authored at or about the time that Mr. Wheeler gained the information that's contained in the exhibit?

A. Yes, sir.

Q. Was that document authored as part of the regular business activity of Mr. Wheeler while a Monsanto employee?

A. Yes.

Q. Was a copy maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1494, which is a letter from Dr. Kelly to Herbert Blumenthal with the U.S. Food and Drug Administration dated April 8th, 1970 and ask if you've seen that document before?

A. I have seen this document before.

Q. Is this a true and accurate copy of an April 8th, 1970 letter from Dr. Kelly to Herbert Blumenthal?

A. Yes. Again, except for the letterhead an signature.

Q. Is this a letter written by Dr. Kelly at or about the time he gained the information that's contained in the exhibit?

A. It is.

Q. Is this a document that was authored by Dr. Kelly as part of his regular business activities at Monsanto?

A. It is.

Q. Was a copy of this exhibit maintained within Monsanto's files as part of its regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1193, which is an April 8th, 1970 letter from Dr. Kelly to Dr. Blumenthal, and again and ask if you've seen that document before today?

A. I recall this document.

Q. Is this a true and accurate copy of a letter, dated April 8th, 1970, from Dr. Kelly to Dr. Blumenthal?

A. Yes.

Q. Absent the letterhead and signature?

A. Yes.

Q. And was this document authored at or about the time that Dr. Kelly gained the information that's contained in the exhibit?

A. Yes.

Q. And was this letter authored by Dr. Kelly as part of his regular business activities while a Monsanto employee?

A. Yes.

Q. Did Monsanto maintain a copy of this as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 420, which is a March 30th, 1970 transmittal from Dr. Kelly to you, and ask if you have ever seen that document before?

A. I have seen this document before.

Q. What do you call that document? Is that a memorandum?

A. Memorandum. It's a Monsanto in-house form of correspondence.

Q. All right. Is that a true and accurate copy of a memorandum you authored in March, 1970?

A. I didn't author --

Q. Excuse me. Is it a true and accurate copy of a memorandum Dr. Kelly authored to you in March of 1970?

A. Yes.

Q. Was that memorandum authored at or about the time Dr. Kelly gained the information that's contained in the exhibit?

A. Yes.

Q. Did Dr. Kelly author that memorandum as part of his regular business activities while in a Monsanto employee.

A. Yes.

Q. Was a copy maintained in Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you a document entitled "Summary -- Interim Status, Chronic Toxicity Aroclors." It has in highlight the date 3-18-70 in the top right hand corner, which does not appear to be part of the original document.

MR. BAUER: Does this have an Exhibit Number on it?

MR. BRADLEY: I'm sorry. Yes.

MR. BAUER: 709. Okay.

MR. BRADLEY: 709.

A. I have reviewed the document.

Q. (By Mr. Bradley) Have you seen that document before today's date?

A. I have seen -- Yes. The reason I'm hesitating, it doesn't appear to me to be one piece of communication. It looks to me, from the information I read that there's a considerable time period that it covers.

MR. BAUER: Can we go off the record for a second?

MR. BRADLEY: Yes.

(Whereupon, a short colloquy was held between Counsel, off the record.)

MR. BRADLEY: Let's go back on the record. Mr. Court Reporter, if you would attach a sticker indicating Plaintiff's Exhibit 709-A to the portions of Plaintiff's Exhibit 709 that have the Bates numbers ADM005988 through ADM005992.

(Whereupon, the reporter marked Plaintiff's Deposition Exhibit Number 709-A, for identification).

MR. BRADLEY: I'm going to separate Exhibit 709 from 709-A and I now reshow you Plaintiff's Exhibit 709.

A. I have looked at the document.

Q. Is it a document that you've seen before?

A. Yes, but not as a composite.

Q. When you saw the summary, which is page one of Plaintiff's Exhibit 709, did it have any attachments to it?

A. No. This is the interim report that I had mentioned earlier, that I got out of Mr. Wheeler's office on a periodic basis describing the status of the long-term studies undergone at IBT.

Q. Well then, what I'm going to ask is that you hand me back the other sheets of paper and ask the court reporter to mark as Plaintiff Exhibit 709-B pages with the Bates Number 007569 - excuse me, 005985, 005987.

(Whereupon, the reporter marked Plaintiff's Depositions Number 709-B, for identification.)

Q. (By Mr. Bradley) Is Plaintiff's Exhibit 709 a true and accurate copy of a summary, "Interim Status -- Chronic Toxicity With Aroclors?"

A. Yes.

Q. Was that a document -- Well, do you know who authored that document?

A. I believe I do.

Q. Who authored it?

A. Elmer Wheeler, Monsanto.

Q. Do you know he authored it on or about March

18th, 1970?

A. I find that date does not match the wording in the text below.

Q. All right. When would you estimate that that exhibit was authored?

A. Let me see. It refers to eleven months after the start in May and June of '69, which would make it April and May of '70. So the date of this document would more likely about May or June, '70, giving enough time for the information to be transferred to Monsanto and the document to be composed.

Q. Is that a true and accurate copy of a Summary -- Interim Status that you reviewed in 1970?

A. Yes, sir.

Q. Okay. Was it authored at or about the time that the author obtained the information that's contained in the exhibit?

A. Yes, sir.

Q. Was it authored as part of the regular business activities at Monsanto?

A. Yes, sir.

Q. Was a copy maintained within Monsanto as part of Monsanto's regularly conducted business?

A. Yes.

Q. And it's understood that when you said it's a true and accurate copy, that you meant absent the orange highlighting?

A. That is correct.

Q. I'm now going to show you Plaintiff's Exhibit 1495, which is a letter from Elmer Wheeler to Dr. Joseph Calandra at Industrial Biotest Laboratory, dated March 4th, 1970, and it shows a cc was sent to you, and ask you if you've seen that document before today?

A. I recall this document.

Q. Is that a true and accurate copy of a letter authored March 4th, 1970 from Mr. Wheeler to Mr. Calandra?

A. Yes. Again, it's missing the letterhead and signature.

Q. Was that exhibit authored at or about the time that Mr. Wheeler gained the information that's contained in the exhibit?

A. Yes.

Q. Was the exhibit authored by Mr. Wheeler as part of his regular business activities while a Monsanto employee?

A. Yes.

Q. Was it, a copy of it, maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1403 and ask if you've seen that document before.

MR. BRADLEY: Actually, let me know when you're finished reviewing it, then I want to show it to other counsel before I ask any questions about it.

Q. (By Mr. Bradley) Is this a true and accurate copy of a letter sent by Elmer Wheeler to Mr. Speicher at Westinghouse on July 25th, 1956?

A. Yes.

Q. Is this a document that was written by Mr. Wheeler at or about the time he obtained the information contained in the exhibit?

A. Yes, sir.

Q. Was this exhibit prepared as part of the regular activities of Mr. Wheeler while he was a Monsanto employee?

A. Yes.

Q. And was a copy of it maintained in Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

MR. BAUER: Were you including the handwritten notes in your answer with respect to that one, Mr. Papageorge?

THE WITNESS: Can you help me with your question?

MR. BRADLEY: He wants to know whether, when you reviewed it, it had the handwriting on it.

A. Yes. Yes. I was shown this document, including the handwriting, by Mr. Wheeler in January, '70.

Q. (By Mr. Bradley) All right. I'm now going the show you Plaintiff's Exhibit 89, which an October 23, 1959 letter from Elmer Wheeler to Mr. Speicher?

A. Speicher.

Q. At Westinghouse, and ask if you've seen that document before?

A. I have seen this memorandum before.

Q. Is that a true and accurate copy of the October 23, 1959 letter from Mr. Wheeler to Mr. Speicher?

A. Yes. Again, the letterhead, signature are missing. Other than that, it appears to be so.

Q. And was that letter authored by Mr. Wheeler at or about the time he obtained the information that's contained in the exhibit?

A. Yes, sir.

Q. Was that exhibit authored by Mr. Wheeler as part of his regular activities and the regular business of Monsanto?

A. Yes, sir.

Q. Was a copy maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 352. Is that a document you've seen before?

A. I have seen it before, yes, sir.

Q. This is a letter, dated July 18, 1975 from George Levinskas to Dr. Calandra with an attachment?

A. Yes.

Q. Is that true and accurate copy of the July 18th, 1975 letter Dr. Levinskas sent to Dr. Calandra with the attachment?

A. Yes.

Q. Is this a document that was authored at or about the time that Dr. Levinskas gained the information that's contained in the Exhibit?

A. Yes.

Q. Is it a document that was authored as part of the regular activities of Monsanto and its employee, Dr. Levinskas?

A. Yes.

Q. Was a copy maintained in Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm going so show you Plaintiff's Exhibit 435.

A. I have seen this document before.

Q. Is that a December 1, 1966 letter from D. Wood to G. Buchanon, with an attachment?

A. It is.

Q. Is that a true and accurate copy of the letter from D. Wood to G. Buchanon, dated 12-1-66 with the attachment?

A. Yes.

Q. Is that a document that was authored at or about the time that the author gained the information contained in the exhibit?

A. Yes, sir.

Q. Was the exhibit prepared as part of the regular business activities of the author when it was written?

A. Yes.

Q. Was D. Wood a Monsanto employee in December of 1966?

MR. BAUER: Object to the form. Indefinite as to which Monsanto entity.

Q. Was D. Wood an employee of Monsanto in December of 1966?

A. Monsanto Chemicals, Limited.

Q. And where was that headquartered?

A. In London, England.

Q. All right. And was a copy of this exhibit maintained in Monsanto's files as part of its regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1446, which may, to your viewing, be two documents. It may only be one. It has three pages, written by Dr. Von Ottenger, dated February 28th, 1938 on the toxicity and potential dangers of Inerteen. It also has a med research project number MR-46 submitted by Dr. Von Ottenger, entitled "The Toxicity and Potential Dangers of Inerteen."

MR. MORGAN: What's the number on that again?

MR. BRADLEY: Pardon me. The number? It's 1446.

MR. BAUER: Mr. Bradley, would you state for the record whether this was a document that was produced by Monsanto?

MR. BRADLEY: I don't know. Do you know?

MR. BAUER: It bears the numbers that have been used in the case by Westinghouse, for their production, the NPC numbers. That's why I asked the question. These copies bear the NPC numbers.

A. I've glanced through the document. I do not recognize it at all. I have not seen it before.

Q. (By Mr. Bradley) All right. Prior to today, have you ever heard of the name Dr. Von Ottenger?

A. I don't recall it.

Q. Did you learn during your tutorials with Elmer Wheeler or Dr. Kelly, or with any of the discussions you had with any of the toxicologists at Monsanto during any time you were an employee of Monsanto, that a medical doctor with Westinghouse in 1938 concluded that the contact of Inerteen which contains PCBs with the skin causes dryness of the skin, thickening and scaling and it appears that sufficient quantities may be absorbed in this way to cause damage of the liver?

MR. MORGAN: Object to the form of the question.

MR. BRADLEY: What's wrong with the form?

MR. MORGAN: Assumes facts not in evidence. I don't think it's ever been established that Dr. Von Ottenger was with Westinghouse.

A. No such discussion ever took place.

Q. (By Mr. Bradley) Well, let me ask one further question then. Did you ever learn during your tutorials with Dr. Kelly or Mr. Wheeler, or with any of the other toxicologists, that it was concluded by Dr. Von Ottenger, M.D., in 1938 that contact of Inerteen with the skin causes dryness of the skin, thickening and scaling and it appears that sufficient quantities may be absorbed in this way to cause damage of the liver?

A. No.

Q. Were you ever informed by Dr. Kelly, Mr. Wheeler or any of the other toxicologists working at Monsanto that in 1938, a medical doctor whose last name Von Ottenger determined that, in view of the possibility of a toxic action of Inerteen on the liver, persons suffering from injuries of the liver, including jaundice, syphilis and heart diseases, should be excluded from operations in which Inerteen is handled?

A. No.

Q. Were you ever informed while a Monsanto employee that in 1938, Dr. Von Ottenger concluded that workers handling Inerteen, or with frequent exposure to its vapors, should undergo periodic examinations?

A. No.

Q. Were you ever informed while a Monsanto employee by anyone that workers handling Inerteen, or with frequent exposure to its vapors, should have special attention paid to their nutritional condition?

A. No.

Q. Were you ever informed that, in 1938, a Dr. Von Ottenger concluded that the condition of the liver should be checked by determining the Peteric index in the blood and the excretions of urobilin and urobilinogen in the urine for workers handling Inerteen or with frequent exposure to its vapors?

A. No.

MR. BAUER: Mr. Bradley, did we could take a break when you're finished with this document?

MR. BRADLEY: All right.

MR. BAUER: I would appreciate it.

Q. (By Mr. Bradley) Were you ever informed while a Monsanto employee that in March of 1938, Dr. Von Ottenger, M.D., Ph.D., reported on experiments carried out in part by Haskel Laboratory on the subject of the toxicity and potential dangers of Inerteen and related substances, including a method of analysis for halogenated hydrocarbons in air?

A. No.

Q. Were you ever informed of a study that had been performed in 1938 on rats by Dr. Von Ottenger and others which concluded that continued application of Inerteen to the skin of rats and humans causes dryness of the skin, thickening and scaling and the observations made in rats indicate that sufficient quantities may be absorbed through the skin to produce injurious effects on the liver?

A. No.

Q. One or two questions relating to the document and then we'll take a break. Did Monsanto ever inform its customers that contact with Inerteen to the skin of humans causes dryness of the skin, thickening and scaling, and that observations made in rats indicate that sufficient quantities may be absorbed through the skin to produce injurious effects on the liver?

MR. BAUER: Object to the form of the question. Lacks foundation. It's also compound, in the sense that there's more than one fact in the statement you just quoted. You can answer, if you're able.

A. I don't know of any advice of that nature being submitted by Monsanto as it relates to Inerteen.

Q. (By Mr. Bradley) Did Monsanto submit that information in regards to any of the products it blended that contained PCBs as dielectric fluid?

MR. BAUER: Same objection.

A. There were product bulletins describing the use of PCBs in dielectric fluids that contained sections entitled "Safe Handling," or "Toxicity" and the like, in which information of this type would appear, and this happened through the years in different bulletins.

Q. (By Mr. Bradley) In the 1950s, did Monsanto produce any product bulletins that indicated that sufficient quantities of PCBs when exposed to the human skin may be absorbed through the skin to produce injurious effects on the liver?

MR. BAUER: Objection. Lacks foundation.

A. I recall a bulletin that reported possible, potential effects on the liver, damage to the liver. I do not recall which bulletin and what year.

Q. (By Mr. Bradley) What is a product bulletin? Well, let me rephrase the question. What was the product bulletin that contained that information? By that, I don't mean what was the title of it, I mean what was the purpose of it?

A. There were several types of bulletins that described fire resistant dielectric fluids. Some of them were worded in such a way to inform the uninitiated as to the availability of these materials and the benefits thereof and the proper way to handle them and use them. Some of them were designed with the intent, or worded with the intent to help the reader who already is using the materials on the proper treatment of these materials and the recycling and reuse, and when is the right time to dispose of them when they no longer can be with recycled. Those are the two general topics that were covered in two distinct types of publications. Now, through the years, these publications would be revised, sort of updated, with a different format perhaps and different pictures and the like, but the basic messages were those two.

Q. Well, is it fair to say that the product bulletin, among other things, was a type of sales brochure?

A. Yes. It was one of the purposes.

Q. And you probably don't have any information whether the particular product brochure that you've testified to was submitted to anyone, other than a prospective purchaser of the Aroclors that were part of that product brochure or sales brochure; is that fair to say? You just don't know whether it was or was not?

A. That is true. I do not.

MR. BRADLEY: Let's take a break.

(Whereupon, a fifteen minute recess was taken.)

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's Exhibit 1536 and ask you to review that for me, please?

A. I have glanced through the document.

Q. Is this a document from Elmer Wheeler to W.R. Richard, dated October 21, 1968 with an attachment?

A. It is.

Q. And is this a true and accurate copy of that letter and attachment?

A. It appears too be, yes, sir.

Q. Does the letter and attachment appear to contain information that was acquired at or about the time the exhibit was prepared?

MR. BAUER: Object to the form.

MR. BRADLEY: Okay.

MR. BAUER: Lacks foundation, specifically.

MR. BRADLEY: Would you read back the question? Never mind. I'll ask a new one.

Q. (By Mr. Bradley) Was the exhibit authored at or about the time that the author gained the information that's in the exhibit?

MR. BAUER: Same objection.

A. It appears to be.

Q. (By Mr. Bradley) Was that document generated as part of the regular business activities of Mr. Wheeler when he was a Monsanto employee?

MR. BAUER: Object to the form. Compound, since it's a memo with attachments.

Q. (By Mr. Bradley) Was the memo with its attachments authored by -- Excuse me. Was the memo with the attachments to it authored by Mr. Wheeler as part of Mr. Wheeler's regular business activities while he was a Monsanto employee?

A. The memorandum, yes.

Q. And was the memorandum with its attachment maintained, a copy of it maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going so show you Plaintiff's Exhibit 424, which is a memorandum from W.R. Richard to E. Wheeler, dated September, 1969. Is this a document you've seen before today?

A. Yes, I have.

Q. Is that a true and accurate copy of a memo written by W.R. Richard to Elmer Wheeler, dated September, 1969?

A. Yes, with some notes and so on.

Q. So the copy you had, or the copy you reviewed, didn't have the handwritten notes?

A. That is right.

Q. Absent the notes, it's a true and accurate copy?

A. Correct.

Q. And is this a document that was written by W.R. Richard at or about the time he gained the information that's conveyed in the exhibit?

A. It is.

Q. Is this a document that was authored by Mr. Richard as part of his regular business activities as an employee of Monsanto?

A. It is.

Q. Is this a document that was, a copy of which was maintained by Monsanto as part of its regularly conducted business?

A. Yes.

MR. BRADLEY: I'm going to ask the court

reporter to mark this Plaintiff's Exhibit 3000.

(Whereupon, the reporter marked Plaintiff's Deposition Exhibit Number 3000, for identification.)

Q. (By Mr. Bradley) Is this a document you've seen before?

A. I have seen this before, yes, sir.

Q. What is this document?

A. This document is a copy of portions of minutes of a meeting of the Monsanto Board of Directors held on May 22, 1969.

Q. And is this a true and accurate copy of the portion of the minutes of the Board of Directors meeting on 5-2-69?

A. Yes.

Q. And was this document generated at or about the time of the information that's contained in it?

A. Yes.

Q. Was it authored as part of the regular business activities of Monsanto?

A. It was.

Q. Was a copy maintained in Monsanto's files as part of its regularly conducted business?

A. Yes.

Q. Was one million, one hundred thousand dollars spent for the expansion of the solid Aroclor facilities at the Anniston, Alabama plant following April 15th, 1969?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1575 and ask you to review that.

A. I have reviewed the document.

Q. What is it?

A. It's a memorandum authored by Dr. Richard, Monsanto, addressed to many individuals listed in the upper right-hand corner within Monsanto.

Q. What is the date of it?

A. The date is May 13th, 1969.

Q. Is this a true and accurate copy of the memo sent May 13th, 1969 from W.R. Richard to the people listed on the exhibit?

A. It appears to be, yes, sir.

Q. Was that exhibit -- Excuse me. Is the information contained in that exhibit -- Start all over again. Was that exhibit authored by W.R. Richard at or about the time that he obtained the information contained in the Exhibit?

A. Yes.

Q. Is the exhibit -- Excuse me. Was the Exhibit prepared as part of the regular business activities of W.R. Richard while he was a Monsanto employee?

A. Yes.

Q. Was a copy maintained within Monsanto as part of its regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 421. Is that a copy of the minutes of the Corporate Development Commission, dated 11-17-69?

A. It's a copy of a portion of their minutes.

Q. Is it a true and accurate copy of a portion of their minutes?

A. It is.

Q. And does that exhibit -- Let me ask it this way. Was that exhibit authored at or about the time the information was obtained that's related in the exhibit?

A. Yes.

Q. Was that document authored as part of the regular business activity of Monsanto?

A. Yes.

Q. Was a copy of it maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

MR. BAUER: Mr. Bradley, let me state for the record that I've just noticed that this document, which is from the Stroh case, I believe, from the production numbers, has a section including legal aspects that was redacted for the purposes of this case. I'm going to tell you now that it's come to my attention that it was produced in two different versions in this case and the other case. I'm going to make an inquiry about whether there was an inadvertent waiver in the previous case because I know in this case, that section was redacted. If we're going to make an assertion of inadvertent waiver, I will promptly let you know.

MR. BRADLEY: Fine.

Q. (By Mr. Bradley) The figures at the bottom. What I'd like you to do is read for the record the first sentence, beginning, "Monsanto's worldwide..."

A. "Monsanto's worldwide Aroclor business amounts to a hundred and four million pounds per year. Seventy million used in functional fluids and thirty-four million in plasticizers."

MR. BRADLEY: Let's go off the record for a moment.

(Whereupon, a discussion was held between Counsel and the witness, off the record.)

MR. BRADLEY: Off the record, we were discussing the numbers followed by "M" versus numbers followed by "M" with a line over it.

Q. (By Mr. Bradley) Would you describe for me how Monsanto used, or what it meant when it had a number followed by "M" and what it meant when it had a number followed by "M" with a line over it?

A. The "M" designated thousands, the "M" with a line over it - the M Bar, as Monsanto people used to call it - represents millions.

Q. I'm now going to show you Plaintiff's Exhibit 428 and ask you to review that for me.

A. I have reviewed it.

Q. Is that a document you've seen before?

A. Yes, I have.

Q. Is that a memorandum of March 6th, 1969 from Mr. Richard to Mr. Wheeler?

A. Yes.

Q. Is it a true and accurate copy of the memorandum of that date from Mr. Richard to Mr. Wheeler?

A. Yes. It lacks Dr. Richard's signature.

Q. All right.

A. But it's accurate otherwise.

Q. Does that exhibit contain information that was gathered by the author on or about the date it was authored?

A. It does.

Q. And was that exhibit written by Mr. Richard as part of his regular activities as a Monsanto employee?

A. Yes.

Q. Was a copy of the exhibit maintained within

Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1196.

A. I have reviewed the document.

Q. Is that an October 21, 1968 letter from Elmer Wheeler to Dr. Richard with an attachment authored by Risebrough?

A. Yes.

Q. Is that a true and accurate copy of the letter from Mr. Wheeler and a true and accurate copy of the attachment?

A. It appears to be.

Q. Was the letter from Wheeler to Dr. Richard of 10-21-68 -- Let me ask it all over again. Does that letter from Mr. Wheeler to Dr. Richard contain information that was gathered by Mr. Wheeler at about the time he wrote the exhibit?

A. Yes.

Q. Did Mr. Wheeler generate that exhibit as part of his regular business activities as a Monsanto employee?

MR. BAUER: Object to the form, to the extent the question relates to the attachment as opposed to the cover memo. You can answer, Mr. Papageorge.

MR. BRADLEY: I was just referring to the cover memo.

A. Yes.

Q. (By Mr. Bradley) All right. And was the cover memo with the attachment maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 439?

A. I have reviewed the document.

Q. Is that a true and accurate copy of a September 20th, 1955 letter from Dr. Kelly to Mr. Barrett.

MR. BAUER: Object. Lacks foundation.

A. It appears to be.

Q. (By Mr. Bradley) Except for the yellow highlightings?

A. Correct.

Q. Was this exhibit authored by Dr. Kelly at or about the time he gathered the information that's contained in the exhibit?

MR. BAUER: Same objection.

A. Yes.

Q. Did Dr. Kelly author this document as part of his regular business activities while a Monsanto employee?

MR. BAUER: Same objection.

A. Yes.

Q. (By Mr. Bradley) And was a copy of this exhibit maintained in Monsanto's files as part of its regularly conducted business?

A. Yes.

MR. BRADLEY: Mr. Bauer, one of the things you and I need to discuss is what is to be done with documents authored by Dr. Kelly if you're not going to produce him as a witness. You requested that I raise issues with you in advance, so I'm doing that now.

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's Exhibit 1496 and ask you to review that, please.

A. I have reviewed the document.

Q. Is that an October 23, 1970 letter from Elmer Wheeler to Professor Lee?

A. It is.

Q. Is that a document you've seen before today's date?

A. I have seen it.

Q. Is that a true and accurate copy of the letter sent from Elmer Wheeler to Professor Lee on October 23, 1970?

A. Except for the missing letterhead and signature, it is.

Q. And was this document authored by Elmer Wheeler as part of his regular business activities while a Monsanto employee?

A. Yes, sir.

Q. And was a copy of this maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. It was.

Q. And did Elmer Wheeler author this document at or about the time he obtained the information that's contained in the exhibit?

A. Yes.

Q. Going back for a moment to 439. Had you seen this document before today's date?

A. Yes.

Q. And is it a true and accurate copy of the document you saw before today's date?

A. I thought we answered. Yes, except for the highlighting.

Q. Okay. I'm now going to show you Plaintiff's Exhibit 1257 and ask you to review that.

A. I have reviewed the document. I have never seen it before.

Q. Okay. I'm now going to show you Plaintiff's Exhibit 4442, which is a February 6th, 1950 - unless you correct me on the date - letter from Louis Spolyar S-p-o-l-y-a-r, M.D., Director of the Division of Industrial Hygiene, United States Board of Health, directed to the Toxicology Department of Monsanto Chemical Company in St. Louis, Missouri.

A. I have read the document. I do not recognize having seen it before.

Q. All right. I'm now going to show you what's been marked for identification as Plaintiff's Exhibit 441 and ask you whether you've seen that document before?

A. I have not seen this document before.

Q. I'm now going to show you Plaintiff's Exhibit 293, and ask you if you've seen that document before.

A. I have not seen the first page. The remaining two pages are the previous document Dr. Kelly wrote to Dr. Barrett in London.

MR. BAUER: He didn't mean the immediately preceding document. I think that's it there

THE WITNESS: That's the one.

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's Exhibit 292 and ask you to review that for me, please. For your assistance, I'll represent to you that that's not the entire document, that it is intended to show the chapter relating to toxicity of that document, or hazard.

MR. BAUER: It has a couple of chapters, including the one you mentioned.

A. I have reviewed the document.

Q. (By Mr. Bradley) Is that a document you've reviewed before today?

A. I have seen it before, yes, sir.

Q. All right. And when you saw it before, you probably saw the entire document?

A. Oh, yes.

Q. All right. Is this a true and accurate copy of the portions of the April, 1955 report of E. Mather, entitled "Process for the Production of Aroclors and other Chemicals," relative to the chapters that are represented in the exhibit?

MR. BAUER: Well, object to the extent that some of the pages are cut off. I think he can make out all the words but there is some cut off because of the xeroxing. I don't think that effects the contents, but go ahead and answer if you're able.

A. It appears to be, yet it's difficult to be certain because the pages are not numbered and it's difficult to determine whether there are any missing or not. That doesn't mean they are missing, but it's difficult to establish that.

Q. (By Mr. Bradley) Does it appear to you, though, right now, that there are pages missing? It doesn't appear to you that there are pages missing. Let me ask you this. Does it appear to be a true and accurate copy of those portions of that exhibit authored by Mr. Mather?

A. Yes, it appears to be. Yes.

Q. All right. And was this document prepared by E. Mather on or about the date that he gathered the information that's gathered in the exhibit?

A. Yes.

Q. Did E. Mather author that document as part of his regular responsibilities as a Monsanto employee?

A. He did.

Q. Was a copy of that maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. Yes.

Q. This document was written for whom? Who was its intended audience?

A. It's intended for the technically trained individuals at the producing plants, Anniston and the Krummich plant in Illinois.

Q. It was not intended for any of Monsanto's customers?

A. That is correct.

Q. I'm now going to show you Plaintiff's Exhibit 438 and ask you to review that document.

A. I have reviewed it.

Q. Is that a document you have seen before today?

A. I have.

Q. Is that a true and accurate copy of a letter from Mr. Garret to Mr. Patrick, dated November 14, 1955?

A. It appears that the top has been eliminated. Otherwise, it appears to be true and accurate.

Q. And at the top, you would expect to see something that said Monsanto, to/from, or something of that nature?

A. Reference to Monsanto Company, yes.

Q. All right. Does that exhibit contain information obtained by the author at or about the time the exhibit was authored?

A. Yes.

Q. And was that exhibit prepared by Mr. Garrett as part of his regular responsibilities and activities as a Monsanto employee?

A. Yes.

Q. Was a copy maintained within Monsanto's files as part of Monsanto's regularly conducted business?

A. It was.

Q. I'm now going to show you Plaintiff's Exhibit

301, which is a document prepared by J.W. Malloy entitled "Standard Operating Instructions for Aroclors," revised July, 1964.

A. I have reviewed the document.

Q. Is this a document you've seen before?

A. I have seen portions of it. There are portions I do not recognize in here.

Q. Are you able to say whether this a true and accurate copy of the standard operating instructions for Aroclors written by J.W. Malloy in July of 1964?

MR. BAUER: Object to the form.

A. I see portions of the standard operating instructions in this document. I also see some information that I cannot relate to the standard operating instruction document.

Q. (By Mr. Bradley) All right. If you would, please indicate for me which of the pages you recognize as being part of the standard operating instructions for Aroclors written by J.W. Malloy in July of '64.

THE WITNESS: Shall I use the large number designation here to describe them?

MR. BRADLEY: Yes, please.

A. Starting with -- Well, the title page E, followed by four zeroes; 93; 94 is a blank page; 95; 96; 97; 98 appears to be; 99; 100; 101; 102; 103; 104; 105; and

106. I do not recognize or relate the remaining pages, which goes from 107 through 115.

MR. BRADLEY: All right. May I see this for a moment?

THE WITNESS: As being part of the original document.

MR. BRADLEY: Off the record.

(Whereupon, a discussion was held between Counsel and the witness, off the record.)

Q. (By Mr. Bradley) I'm now going on show you Plaintiff's Exhibit 1729 and ask you to review that document.

A. I have reviewed the document.

Q. Is that a true and accurate copy of a letter written November 30th, 1961 from Elmer Wheeler to Mr. Smith at G.E.?

MR. BAUER: Objection. Lacks foundation.

A. It lacks the Monsanto letterhead and the author's signature. Otherwise, it appears to be accurate.

Q. (By Mr. Bradley) Is this a document that was generated by Mr. Wheeler at or about the time he obtained the information that's contained in the exhibit?

A. Yes.

Q. Is this a document that Mr. Wheeler authored as part of his regular business activities as a Monsanto employee?

A. It is.

Q. Did Monsanto maintain a copy of this as part of its regularly conducted business?

A. It did.

Q. I'm now going to show you Plaintiff's Exhibit 395.

A. I have reviewed the Exhibit.

Q. Is that a document you've seen before today?

A. Yes, I have.

Q. Is that a true and accurate copy of the proper handling of Aroclors as authored by Paul Benignus in 1960?

MR. BAUER: Object to the form, in that the document is incomplete, but you can answer.

A. It appears to be a true and accurate copy of portions of the full document.

Q. (By Mr. Bradley) All right. May I see it for a moment? Is this a true and accurate copy of the cover page, the index and chapter 12 of the proper handling of Aroclors and their mixtures in the electrical industry authored by Paul Benignus in 1960?

A. It is.

Q. Did Mr. Benignus author that document at or about the time he obtained the information that's obtained in the exhibit?

A. Yes.

Q. Was the exhibit prepared by Mr. Benignus as part of his regular business activity as a Monsanto employee?

A. Yes.

Q. Did Monsanto maintain a copy of that document as part of its regularly conducted business?

A. Yes.

(Whereupon, a discussion was held between Counsel, off the record.)

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's Exhibit 1210. Ask you to review that for me.

A. I have reviewed the exhibit.

Q. (By Mr. Bradley) Is that a document you've seen before today?

A. I have seen it, or this particular exhibit consists of portions of a full document I had seen before.

Q. May I see it please? Does this document contain two pages, then a table of contents, then a third page, then a section entitled "Toxicity?"

A. Yes.

Q. Okay. And is a true and accurate copy of the portions of that document that you reviewed, or excuse me, that was prepared in May of '57?

A. Yes.

Q. Was is that document?

A. This is another example of a product brochure, publication. It's entitled "Aroclor, Resins and Plasticizers for Chlorinated Rubber."

Q. Who is the intended audience of that document?

A. Rubber manufacturers.

Q. Are you able to discern who the author of the document is?

A. I cannot.

Q. Does the information contained in the exhibit contain current information regarding the topics discussed in the exhibit? By "current," I mean current as of May, 1957, the date of the --

A. Yes.

Q. Was it Monsanto's regular business practice to generate that document?

A. Yes.

Q. And was a copy of that document maintained in Monsanto's files as part of its regularly conducted business?

A. It was.

Q. I'm now going to show you Plaintiff's Exhibit 1177, which is a document that you apparently authored, dated February 2, 1972 to Dr. Posefsky and Mr. Raab. It had attachments to it.

A. I reviewed the exhibit.

Q. What is the exhibit?

A. The exhibit consists of a letter that I authored addressed to Dr. Posefsky and Mr. Raab, the Chairman of the Committees under ANSI.

Q. The subcommittees on transformers and capacitors?

A. That is correct. Attached to that letter are three pages of questions and answers that I rough drafted for their use.

Q. What was your purpose in developing the questions and answers?

A. At a meeting held by the ANSI Committee, these questions were raised and I was asked to attempt to answer them, and this is my first pass attempt to answer those questions.

Q. Were the questions and answers intended to be answers to potential questions from the public for users of PCB dielectric fluid?

A. It wasn't just -- Anybody, irrespective of whether public or professional or governmental or regulatory, who would raise questions of this type, and the intent was to try to help whoever was being questioned to give a correct answer.

Q. And is this a true and accurate copy of the letter with its attachment that you authored February 2, 1972?

A. Except for the missing letterhead and signature, it appears to be.

Q. Did you generate this letter with its attachment as part of the regular practice of Monsanto to make memorandums of that sort and letters of that sort?

A. Yes.

Q. And did Monsanto maintain a copy of that letter with the attachment as part of its regularly conducted business?

A. Yes.

MR. BAUER: Is this a good time for our break?

MR. BRADLEY: Yes.

(Whereupon, a ten minute recess was taken.)

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's Exhibit 625 and ask you to review that.

A. I have reviewed the exhibit.

Q. Is that a document you've seen before today?

A. I have never seen this.

Q. I'm now going show you plaintiff's Exhibit 516 and ask you to review that.

A. I have glanced through this document.

Q. Is that a document you've seen before today?

A. I have seen it in the past several weeks.

Q. Is that a true and accurate copy of a submission to the Subcommittee on Oversight Investigation of the Committee on interstate and Foreign Commerce, U.S. House of Representatives by Monsanto Company, dated November 16, 1979.

MR. BAUER: Objection. Lacks foundation.

A. It appears to be.

Q. (By Mr. Bradley) Do you know who authored that document?

A. No, I don't.

Q. Do you know why it was authored?

A. No, I don't.

Q. Do you know whether that document contains information that was current to whoever authored it on or about November of '79?

MR. BAUER: Object to the form.

A. Do I personally? No. No, I don't. Since I only saw this a few weeks ago, I have no background to help me with it.

Q. (By Mr. Bradley) All right. I'm now going to show you Plaintiff's Exhibit 1103, which is a February 10, 1971 document that appears that you authored to Mr. Lowell Miller of the EPA.

A. I remember this letter, or a copy of this letter.

Q. Absence the yellow highlighting, is this a true and accurate copy of a letter you wrote February 10th, 1971 to Lowell Miller with the EPA?

A. Other than missing letterhead and signature, it is.

Q. Did you write that letter based upon information contained in the letter that you had -- Oh. Let me start all over again. Does the exhibit contain information that you obtained at or about the time you authored the letter?

A. Yes.

Q. Did you write that letter as part of the regular, your regular practice as a Monsanto employee?

A. I did.

Q. And did Monsanto maintain a copy of that as part of its regularly conducted business?

A. Yes.

Q. You refer in here -- Well, I'm reading the first sentence. "I recently noted in the United States Department of Agriculture PR Notice 70-25, dated October 29, 1970, that polychlorinated bipheynals must be eliminated from economic poisons." What do you mean by "economic poisons?"

A. Such things as pesticides.

Q. Why did you refer to pesticides as an economic poison?

A. That's the terminology they used in that notice.

Q. I'm now going so show you Plaintiff's Exhibit 1556 and ask you to review that.

A. I have reviewed the exhibit.

Q. Is that a document you've seen before today?

A. I have. Uh-huh.

Q. Is this a true and accurate copy of a letter, dated March 3rd, 1972 from W.R. Cory, Director, Functional Product Groups for Monsanto to Mr. Paul Defalco, Jr., with the United States Environmental Protection Agency, along with an attachment?

A. It is, again, missing the letterhead and signature. Otherwise, it appears to be a true copy.

Q. And does the attachment appear to be a true copy of the attachment that was attached to the March 3rd, 1972 letter that you received?

A. Yes.

Q. And does the exhibit contain information that's authored by Mr. Cory at or about the time -- Let me rephrase the question. Does the exhibit contain information that came to Mr. Cory on or about the date of the exhibit?

A. Yes.

Q. And was that document and the exhibit attached to it authored as part of the routine, regular business responsibilities of Mr. Cory as a Monsanto employee?

A. Yes.

Q. And did Monsanto maintain a copy of that entire exhibit, including the attachment, in its file as part of its regularly conducted business?

A. Yes.

Q. May I see it again, please?

A. Sure.

Q. I'm looking now at page numbered NEV 012601, and also numbered 711853, and it has the years 1960 to 1971 and shows the real amounts of production of PCBs by Monsanto for years 1960 to 1970 and the estimated number for 1971; is that correct?

A. It does.

Q. And are you familiar with those numbers?

A. Yes.

Q. And do those appear to be accurate representations of the total amount of PCBs produced in the United States by Monsanto during the years represented?

A. Yes.

Q. Okay. I'm now going on show you Plaintiff's Exhibit 1120, which is a three page document entitled "Historical Summary of PCB Environmental Issue," by W.B.

Papageorge. Is that a true and accurate copy of a document you authored with that title?

A. It is.

Q. When did you author that document?

A. 1970.

Q. Did you author that document based upon information that was available to you on or about the time you authored the document?

A. It was.

Q. Did you author that document as part of the regular practice of Monsanto's business, as a Monsanto employee?

A. Yes.

Q. And did Monsanto maintain a copy of that exhibit as part of its regularly conducted business?

A. It did.

Q. I'm now going to show you Plaintiff's Exhibit 310 and represent to you that it is a March 30th, 1970 letter to you from Dr. Kelly that has both the letter, itself, which is difficult to read, and a retyped version with some yellow highlighting.

A. Yes. This is similar to a previous exhibit.

MR. BAUER: 420

THE WITNESS: 420. That's another copy of it.

MR. BRADLEY: Let me see that.

MR. BAUER: My notes indicate that we did 420 already.

MR. BRADLEY: They do appear to be the same.

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's 1664 and ask you to review that document for me.

A. I have reviewed the document.

Q. Is that a document you've seen before today?

A. Yes, I have.

Q. Is that a true and accurate copy of a May 14th, 1970 report on a meeting with Bayer, Caffaro and Prodelec, in Brussels?

A. Yes.

Q. Did the author of that exhibit write the Exhibit based upon information that was available on or about May 14th, 1970?

A. Yes.

Q. Was that exhibit generated as part of, as part of the regular business activity of Monsanto?

A. Yes.

Q. And was a copy maintained within Monsanto's files as part of its regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1335, which is a letter from you to Mr. Carlington Wilburn in Westinghouse, July 6th, 1970 and, I'll show it to Westinghouse's attorney before I hand it over to you.

A. I have reviewed the document.

Q. Is this a true and accurate copy of a letter you wrote July 6th, 1970 to Mr. Carlington Wilburn at Westinghouse?

A. Yes. Again, it's missing the letterhead and the signature.

Q. And also this has highlighter and the original didn't have highligher on it?

A. That is true.

Q. And did you write this exhibit based upon information that came to you on or about the date of the Exhibit?

A. Yes. Uh-huh.

Q. And did you generate and author this document as part of your regular responsibilities as a Monsanto employee?

A. I did.

Q. And did Monsanto maintain a copy of this as part of its regularly conducted business?

A. Yes.

Q. I'm now going so show you a document which is PLaintiff's Exhibit 415, which is a July 8th, 1970 letter from you to Mr. Jenkins in Massachusetts.

A. I have reviewed the exhibit.

Q. Is this a true and accurate copy of a letter you authored July 8th, 1970 to Mr. Jenkins?

A. Yes. Except that it's lacking, again, the letterhead and signature and there are some items that are highlighted in yellow.

Q. All right. And does this exhibit contain information that you gathered on or about the date of the exhibit?

A. It does.

Q. Did you author the exhibit as part of your routine business responsibilities at Monsanto, as a Monsanto employee?

A. Yes.

Q. And did Monsanto maintain a copy of this exhibit as part of its regularly conducted business?

A. Yes.

Q. I'm now going to shoe Plaintiff's Exhibit 1566, which is a letter to you dated May 18th, 1971 from S. Uneno with the Mitsubishi Monsanto Chemical Company?

A. I have reviewed the exhibit.

Q. Is this a true and accurate copy of the letter written to you by that individual on May 18th, 1971?

A. It is, except for the highlighting.

Q. And was this exhibit -- Excuse me. Does this exhibit contain information that became available to the author on or about the date of the exhibit?

A. It does.

Q. And was this exhibit prepared as part of S. Uneno's regular employment responsibilities as a Mitsubishi Monsanto Chemical Company employee?

A. Yes.

Q. And did Monsanto maintain a copy of this as part of its regularly conduct of business?

A. It did.

Q. I'm now going show you Plaintiff's Exhibit 1542, which is a letter to you from J.R. Durland, dated July 8, 1971 and J.R. Durland appears to be with Mitsubishi Monsanto Chemical Company.

A. I have reviewed the exhibit.

Q. Is this a true and accurate copy of a letter with an attachment, dated July 8th, 1971 to you from Mr. Durland with Mitsubishi Monsanto Chemical Company?

A. The memorandum, addressed to me, appears to be a true and accurate copy except for the highlighting. The attachments I find puzzling. I cannot relate the attachments to the letter.

MR. BRADLEY: I'm going to ask the court reporter, then, to, -- Excuse me. I'm separating this exhibit and I'm asking the court reporter the mark the

attachment as Plaintiff's Exhibit 1542A.
(Whereupon, the reporter marked Plaintiff's Deposition Exhibit Number 1542A, for identification.)

Q. (By Mr. Bradley) Was the letter from Mr. Durland to you based upon information that came to Mr. Durland on or about the date of the letter?

A. Yes.

Q. Did Mr. Durland write this letter as part of his regular, routine responsibilities as an employee of Mitsubishi Monsanto Chemical Company?

Q. He did.

A. Did Monsanto maintain a copy of this as part of its regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 1593, which is a September 13, 1971 inquiry from you to W.R. Richard.

A. I reviewed the document.

Q. Is that -- Absent the highlighting, is it a true and accurate copy of an inquiry you sent to W.R. Richard on or about September 13th, 1971?

A. It's lacking a signature, again, and it's lacking a reference to being a Monsanto memorandum.

Q. With that exception, though, it appears to be a true and accurate copy?

A. Yes.

Q. And did you -- Excuse me. Does this exhibit contain information that came to you on or about the date of the exhibit?

A. It does.

Q. Did you author this document as part of your regular responsibilities as a Monsanto employee?

A. Yes.

Q. Did Monsanto maintain a copy of this as part of its regular conduct of business?

A. It did.

Q. I'm now going to show you Plaintiff's Exhibit 872, which is a letter that apparently was authored January 19, 1973 to Paul Benignus, who was then Chairman of the Steering Committee of the C-107 Committee.

A. I reviewed the document.

Q. Is that a true and accurate copy of the letter you sent to Mr. Benignus on that date?

A. Other than the highlighting, yes.

Q. And does that exhibit contain information that became available to you on or about the date of the exhibit?

A. Yes.

Q. Did you author that document as part of your regular, routine business responsibilities as a Monsanto employee?

A. Yes.

Q. Did Monsanto maintain a copy of that document as part of its regular conduct of business?

A. Yes.

Q. Was there a difference between the steering committee of the C-107 and the C-107 committee?

A. Yes, there was. It consisted of different membership.

Q. What was the purpose of the steering committee of C-107?

A. To establish policy, the direction the committee was expected to take, its objectives. I guess to use the word, to steer us in the right direction.

Q. Who else was a member of the steering committee of the C-107 during the period 1971 to 1976?

MR. BAUER: By who, you mean in addition to Mr. Benignus?

MR. BRADLEY: Yes.

A. It's been so long, I don't remember them all. I remember an individual from Maloney Electric Company as being on that steering committee. I forgot his name. I just don't remember the members any longer.

Q. (By Mr. Bradley) Do you recall whether there were any members of the steering committee who were not employees of manufacturing companies that manufactured transformers or capacitors that contained PCBs?

MR. BAUER: Object to the form of the question because at various times Mr. Benignus was on the committee, but you can answer if you're able.

A. Other than Mr. Benignus, they were all employees of companies that were members of, who manufactured electrical equipment.

MR. BRADLEY: All right.

Q. (By Mr. Bradley) What is the CEE that's referred to -- Let me rephrase the question. What was the CEE that's referred to in paragraph numbered three?

A. I really don't remember.

Q. Do you remember what any of the acronyms in that paragraph refer to?

A. I remember SEGRA, that's listed in Paragraph Three, S-E-G-R-A, as being the equivalent in Europe of NEMA in the United States. I do not recall at the moment what these other acronyms refer to.

Q. I'm now going show you Plaintiff's Exhibit 1505 and ask you to review that.

A. I have reviewed the exhibit.

Q. Is that a document you've seen before today?

A. Yes, I have.

Q. Is it a true and accurate copy of minutes of a

meeting with EPA on April 13th, 1972?
A. Yes, except for the highlighting.
Q. All right. And do the minutes contain the information that was generated at the meeting?
A. Yes.
Q. And was it Monsanto's regular practice to develop minutes of meetings it held with regulatory agencies?
A. Not in every case but most instances, yes.
Q. Was this particular document developed as part of the regular business activities of Monsanto?
A. Yes.
Q. And it was -- Was a copy of it maintained within Monsanto's files as part of its regularly conducted business?
A. Yes.
Q. I'm going to show you Plaintiff's Exhibit 1166 and ask you to review that document.
A. I have glanced through the document.
Q. What is the document?
A. It's a document I prepared back in September of 1971, entitled "Monsanto's PCB program," and it was presented to a meeting of the ANCI Committee C-107 on September 14, 1971.
Q. I don't recall if I asked this. Is this a

true and accurate copy of the document you prepared on that date?

A. It is.

Q. And did you -- Excuse me. Does that exhibit contain information that was made known to you on or about the date of the exhibit?

A. Yes.

Q. Did you prepare that exhibit as part of the routine business responsibilities you had at Monsanto as a Monsanto employee?

A. Yes.

Q. Did Monsanto maintain a copy of that exhibit as part of its regularly conducted business?

A. Yes.

Q. I'm now going to show you Plaintiff's Exhibit 150, and ask you to read that document which a letter from Elmer Wheeler to Otis Fancher dated April 8, 1972.

A. I think we saw this already.

MR. BRADLEY: Did we?

MR. BAUER: Been there and done that.

MR. BRADLEY: Good.

MR. BAUER: This is one we've done before.

Q. (By Mr. Bradley) I'm now going to show you Plaintiff's Exhibit 524 and ask you to review that. While you're reviewing that. Another Versar document is 1184.

MR. BAUER: Can I get a copy?

MR. BRADLEY: You want to borrow it and give it to me tomorrow?

MR. BAUER: I can get a copy made right now.

(Whereupon, a ten minute recess was taken.)

Q. I have glanced through the exhibit.

Q. (By Mr. Bradley) Is this an exhibit you've seen before?

A. I have.

Q. What is it?

A. It's a copy of a product pamphlet or brochure addressing - it's entitled, "Care and Grooming of Askarel Transformer Fluid."

Q. Can you tell from the exhibit what date it was authored?

A. It's rather difficult to read but I see back on the last page, 003816, very fine print, a "54," which leads me to believe it was about a 1954 edition.

Q. All right. And is this a true and accurate copy of the document that was written in 1954 on that topic?

A. It appears to be, yes, sir.

Q. And was that document prepared based upon information that was then available to the author?

A. Yes.

Q. And was that document prepared as part of the regular practice of Monsanto's business activity?

A. Yes.

Q. And did Monsanto maintain a copy of that as part of its regularly conducted business?

A. Yes.

Q. I'm now going show you Plaintiff's Exhibit 522 and because of the time, this is the last set of questions I have for you. If you'd review that for me, please.

A. I have reviewed the exhibit.

Q. What is it?

A. It's a copy of a product brochure entitled "When you want Fire Safety, Reliability, Minimum Maintenance, Specify Askarel Type Transformers."

Q. Are you able to identify the date that document was authored?

A. The best I can do is it appears about 1962.

Q. Is that document authored based upon information that was available in 1962?

A. Yes.

Q. And was the document generated as part of the regular business activity of Monsanto?

A. Yes.

Q. And was a copy maintained in Monsanto's file as part of Monsanto's regularly conducted business?

A. It was.

MR. BRADLEY: It's 5:00 and we're set to start again tomorrow. So I will adjourn this until tomorrow morning.

THE WITNESS: Thank you.

MR. BAUER: Very good.

THE WITNESS: Same time tomorrow, 9:00.

MR. BRADLEY: 9:00, yes.

(Whereupon, the deposition was continued until 9:00 on July 20, 1993.)

WILLIAM B. PAPAGEORGE

Subscribed and sworn to before me this _____ day of

__________________________, A.D., 19____.

Notary Public

MY COMMISSION EXPIRES:

STATE OF MISSOURI)
) SS
COUNTY OF ST. LOUIS)

I, John T. Concannon, a Notary Public within and for the State of Missouri, duly commissioned, qualified and authorized to administer oaths and to take and certify to depositions, do hereby certify that pursuant to Notice in the civil cause now pending and undetermined in the District Court of the United States, within and for the District of Nevada, entitled NEVADA POWER COMPANY, etc., et al., Plaintiffs, -vs- MONSANTO COMPANY, etc., et al., Defendants, to be used in the trial of said cause in said Court, I was attended at the law offices of Messrs. Husch & Eppenberger, 100 North Broadway, in the City of St. Louis, State of Missouri, by Ralph A. Bradley, Esq., attorney for the Plaintiff; by Scott Bauer, attorney for the Defendant, Monsanto Company; by Robert P. Morgan, attorney for the Defendant, Westinghouse Electric Corporation, and by WILLIAM B. PAPAGEORGE, the witness, in said office on July 19, 1993.

The said witness, WILLIAM B. PAPAGEORGE, being of sound mind and being by me first carefully examined and duly cautioned and sworn to testify the truth, the whole truth and nothing but the truth in the case aforesaid, thereupon testified as is shown in the foregoing transcript, said testimony being by me reported in shorthand and caused to be transcribed into typewriting, and that the foregoing pages correctly set out the testimony of the aforementioned witness, WILLIAM B. PAPAGEORGE, together with the questions propounded by counsel and the remarks and objections of counsel thereto, and is in all respects a full, true and complete transcript of the questions propounded to and the answers given by said witness; and that said testimony, so transcribed, was subscribed to by the witness on the ______ day of ____________________, A. D., 1993.

I FURTHER CERTIFY that I am not of counsel nor attorney for any of the parties to said suit, nor related, nor interested in any of the parties or their attorneys.

I FURTHER CERTIFY that Deposition Exhibits that are marked and referred to for identification and attached to and made a part of this deposition are the identical exhibits referred to and identified by the witness in the foregoing deposition.

WITNESS MY HAND and Notarial Seal, given this ______ day of _______________, A. D., 1993, at St. Louis, Missouri.

MY COMMISSION EXPIRES SEPTEMBER 12, 1994

____
JOHN T. CONCANNON,
Notary Public, within and
for the State of Missouri

August 18, 1993

Mr. William B. Papageorge
c/o Scott Bauer
Kirkland & Ellis
1999 Broadway
Denver, Colorado, 80202

Re: Nevada Power -v- Monsanto

Dear Mr. Papageorge:

This letter, incorporated as the last page of your deposition, taken on July 19, 1993, will serve as notice to you that your testimony is now ready for your reading and signing of same. You will recall your attorney, Mr. Bauer, indicated a preference for you reading your deposition, rather than waiving signature.

I am sure Mr. Bauer, or someone in his office, will be in contact with you in the near future concerning the reading and signing of the transcript. I assume the same procedure will be followed as in the past.

Thank you for your cooperation in this regard.

Sincerely,

JOHN T. CONCANNON
Shorthand Reporter

Concannon & Jaeger
General Court Reporters
705 Olive Street - Ste. 604
St. Louis, Missouri 63101

JTC:md

BCC: F. G. BENIGNUS
D. A. OLSON

July 8, 1970

Mr. F. G. Jenkins
Vice President, Materials
Sprague Electric Company
North Adams, Massachusetts 01247

Dear Mr. Jenkins:

I was fortunately able to visit your Brown St. Plant on June 17 with Randall Graham. I personally found the discussion informative and interesting and I was most favorably impressed with the concern and interest expressed by your management personnel. We discussed briefly some of the points raised in your letter dated June 11. I will try in this letter to be more specific.

Biodegradability - Biodegradation studies conducted in our research laboratories in St. Louis, Missouri and in Ruabon, Wales using media consisting of local river waters or activated sludges acclimated to biphenyl give direct evidence that the lower chlorinated biphenyls are affected. There is some evidence that chlorine position on the biphenyl configuration does influence the degree of distruction by the microorganisms. I have enclosed a tabulation from our Ruabon laboratory which attempts to show this difference. We do not have formal information regarding the effect of sunlight or other natural influences on Aroclors. Experience gained over many years indicates Aroclors are highly stable under all known conditions present in the environment.

Toxicity - There is ample evidence from many laboratories that certain species of birds which are at the top of the marine food chain cannot reproduce properly when PCB's are present in their diets. The U. S. Fisheries laboratory at Gulfbreeze, Florida conducted a study which indicated that juvenile brown shrimp did not survive in water containing 5 parts per billion of PCB. Attached are copies of reports on these studies.

PLAINTIFF'S EXHIBIT 415

STR CC4

EX.

Monsanto has sponsored some studies on laboratory rats and dogs. A summary of the results to date is attached.

Disposal - The preferred method for disposal is high temperature incineration. I suspect there are several commercial burners on the market which will perform well. I personally witnessed burning tests at the John Zink Company's unit in Tulsa, Oklahoma. Temperatures must exceed 1600°F to assure that complete destruction is achieved. Lower temperatures would only vaporize the Aroclors and create atmospheric pollution or, worse yet, would form, by partial oxidation, materials which could be highly toxic (e.g. furans and dioxins). With incineration HCl is formed which must be scrubbed from the stack gas and neutralized before disposal. We are planning for an initial installation in one of our plants later this year. As a service to our customers who may not have access to other incinerators, we have offered to accept scrap Aroclor for immediate storage and eventual incineration. Tentatively, Monsanto will charge 3¢ per pound of returned material. This charge does not include freight or container costs and will be reviewed when final incineration costs are established. Material which is returned for disposal should be addressed to Monsanto Company, W. G. Krummrich Plant, Sauget, Illinois, Attention: Supervisor Department 246.

Solids contaminated with Aroclors present a bigger challenge. As yet, we have not tested an incinerator with these materials. Until we get more information the best we can advise is safe burial in an authorized, properly operated land fill located away from any water systems.

We have laboratory work underway on other forms of destruction. As yet no economically feasible approach has been found.

Analytical Methodology - I have attached copies of Monsanto's analytical procedures for the determination of PCB's in water, soil, air and biological samples. We are interested in comparing our methods with those devised by other laboratories. Any comments your laboratory may have would be welcome and appreciated.

STR 004C3

I hope that the above information is useful to you. If I can be of further service, please let me know.

Sincerely,

V. D. Papageorge
Manager
Environmental Control

[illegible]

cc: Mr. H. Davis
Sprague Electric

G. R. Graham

OCT 1 1973

bcc: Cumming Paton St. Louis
Geo. F. Fague St. Louis
Geo. Roush, Jr. St. Louis
Elmer P. Wheeler St. Louis
D. L. Mellon Akron

October 9, 1973

Mr. Harold Wolf, Plant Engineer
WESTINGHOUSE ELECTRIC CORPORATION
1202 South Carlisle Street
Bellefontaine, Ohio 43311

Dear Mr. Wolf:

I am writing to you at Dave Mellon's request to confirm the results of your conversation on October 8, 1973, relative to the skin irritation problems you have experienced recently with our Pydraul 312-C.

Pydraul 312-C is classed as practically non-toxic. Our normal experience and testing indicates it is non-irritating when exposed to the skin; however, as in handling any chemical, good hygienic procedures should be followed. In the case of skin contact, washing with soap and water is recommended. In case of eye contact, flushing with copious amounts of water is recommended.

Given the acute problems you have experienced, further precautions should be taken. The use of gloves or a silicone-based organic solvent in soluble hand cream should be considered to protect hands and other exposed areas. Hand creams of this type are available from:

1. Mine Safety Appliances
   Pittsburgh, Pa.

2. Calgon Commercial Division
   Calgon, Inc.
   7501 Page
   St. Louis, Mo. 63166

3. Sugar Beets Products Co
   P. O. Box 1387
   Saginaw, Michigan 48605.

In the event of exposure, again, the exposed areas should be washed thoroughly with soap and water.

NEV 006480

PLAINTIFF'S EXHIBIT 1217

705716

If, despite these actions and precautions, skin irritation problems persist, a cortisone ointment prescription should be applied to the affected area.

I would encourage you to solicit your Industrial Hygienist, Mr. H. W. Speicher, for any additional thoughts on this matter. Additionally, our medical department is prepared to consult with you further. If you feel further discussions are warranted, please call Mr. Elmer P. Wheeler at (314) 694-2196, our Manager of Environmental Health, or George Roush, Jr. M. D. at (314) 694-2188, our Associate Medical Director.

I hope this enables you to preclude future skin irritation problems. We stand ready to assist you in any manner appropriate. I have attached the OSHA Material Safety Data Sheet on Pydraul 312-C for your files.

Very truly yours,

dlm:hm
encl:

C. F. Seger
Sales Representative
Specialty Products Group

PCP

April 28, 1972

Dr. Otis Fancher
624 N. Abrego Drive
Green Valley, Arizona 85614

Dear Otis:

I am ashamed that I have been so slow in reviewing the manuscripts and sending you our comments. I guess Kep's sending me the chronic rat and dominant lethal and chicken study on the 18th of April finally stirred me to move.

First of all, I agree we should hold up the publication of the chicken work until the current study is completed.

The only other comment I have of substance is that I wish we could work in several paragraphs reviewing the Treon work on vapors published in 1956 (see enclosed xerox copy of reprint). A logical place for a review of those data would be at the top of the 3rd page of your review paper, before your paragraph at the top which begins with "During succeeding years little information was reported concerning the toxicology of the PCB until McLaughlin etal, 1963, etc."

Most of the review articles on the PCB's have failed to indicate awareness of the Treon work. I believe this is because the Risebroughs, Peakalls, etc., etc. -- the environmentalists -- have not encountered the American Industrial Hygiene Association Quarterly in the review of the literature nor is it likely that they ever heard of the AIHA.

In any case, I think the work is worthy of review even though it was inhalation data particularly since Drinker's earlier work in '37 is frequently mentioned and this again concerned inhalation.

In the last paragraph of this same review paper you

PLAINTIFF'S EXHIBIT 1507

NEV 008563

707815

refer to the "permissable ambient concentrations of PCB's" as suggested by Drinker in 1939. Actually the ACGIH established the Threshold Limit Values based on Treon's work rather than the earlier Drinker work. I believe we may have arrived at our high dietary level of 100 ppm in the studies done at Bio-Test based on the Treon work rather than Drinker's.

George Levinskaas is reviewing each of the papers to see if you, Kep and I have missed typo's and he may well suggest some grammatical changes which we will enter on our copy and send xerox's to you and Kep.

I hope to get copies of all of the studies in the hands of Bill Papageorge, Scott Tucker and the lawyers next week. I do not anticipate a lot of changes from them and hope that the attorneys agree that we can go ahead with publication.

Best personal regards,

Sincerely,

Elmer P. Wheeler
Mgr., Environmental Health
Medical Department

EPW/bks

cc: M. L. Keplinger

TX - ~~J. Mason~~
H. Bergen
from WBP
2/4/71

February 3, 1971

Griffith E. Quinby, M. D.
Consulting Toxicologist
Preventive Medicine
Post Office Box 1313
Wenatchee, Washington 98801

Dear Dr. Quinby:

Thank you for your letter of January 20, which arrived on the 27th, at which time I was out of town and just returned.

I appreciate very much your interest in the polychlorinated biphenyls and am happy to reply serially to the questions raised in your letter concerning the "Monsanto Statement on PCB" printed in Environment, Vol. 12, No. 1.

May I preface my answers with the comment that we take no responsibility for Dr. Risebrough's statements in the publication and I am assuming that your questions relate to the Monsanto statement published therewith.

Now, as to your questions:

1. The Monsanto statement supplied Environment Magazine was prepared with my collaboration and approval.

   My interest in the toxicity of and occupational hazards involved with the polychlorinated biphenyls and terphenyls dates back to 1936. I recall vividly the first meeting held at Harvard under the sponsorship of Dr. Cecil Drinker to discuss the early results of research carried on under his direction on the chlorinated biphenyls

PLAINTIFF'S EXHIBIT 1237

NEV 021184

729239

and chlorinated napthalenes [Ref. J. Ind. Hyg. Toxicol. 19, 300 (1937)]. You may be sure that the Medical Department at Monsanto has been aware of all subsequent publications relating to the toxicity of chlorinated biphenyls and terphenyls.

The literature indicates that there was a number of incidents of industrial effects in the late 1930's from the use of a waxy material composed of chlorinated napthalenes, chlorinated biphenyls and chlorinated diphenyl ether. I submit, however, that there have been few instances reported since 1940 concerning ill effects in workers exposed to the chlorinated biphenyls or chlorinated terphenyls when used alone. In the rare cases that have been reported, the recommended procedures for safe handling and usage have been ignored.

2. Monsanto has been aware that in the early and mid-1950's there was some use of PCB's as extenders for pesticides where the formulations were applied to field crops, or, in the case of research sponsored in New York State not participated in by Monsanto, on forests for attempted control of elm tree disease. These experiments were based on research efforts of the USDA. As far as our records indicate these were abortive attempts in using the PCB's in "broadcast applications" on perhaps all kinds of crops. The facts as we know them are that uses never did develop where the PCB's were incorporated in formulations for "broadcast applications" to agricultural crops such as vegetables, animal feed, cotton, citrus, etc. I don't have exact figures but I would estimate that something less than 100,000 pounds of PCB's were ever used in experimental or semi-commercial applications. To me and to our company this does not represent "broadcast application" as the term is generally used now and as it relates to the application of most common agricultural insecticides.

3. Most of the possible uses of PCB's recommended as possibilities in our Technical Bulletin O/PL-306 remained as possibilities. It is true that PCB's were used in specialty (industrial, corrosive resistant) paints; in specialty rubber for sealants (not automobile tires as has been alleged); in specialty adhesives for many purposes. They were not widely used in lubricants or cutting oils. I don't know what is meant by "carburator fluids".

NEV 021185

W. B. PAPAGEORGE

October 26, 1970

H. S. Bergen
W. R. Richard
R. E. Keller
E. P. Wheeler

J. R. Savage

Recent data from Dr. J. P. Mieure's ~~work~~ indicates the presence of naphthalene in biphenyl and anthracene or phenanthrene and dibenzofuran in Santowax R used in the manufacture of Aroclors.

The naphthalene, anthracene or phenanthrene could be present in the benzene used in the diphenyl unit or could be co-produced with the biphenyl, terphenyl and quaterphenyl.

The dibenzofuran could result from oxygen containing contaminants in the benzene or, more likely, be formed because of the presence of the promoter, acetone.

The Anniston Plant should design and execute a program for determining the source or sources of these contaminants.

W. B. PAPAGEORGE

ms

84136

PLAINTIFF'S EXHIBIT
419

EX 202

May 25, 1970

Otis E. Fancher, Ph.D.
Director
Industrial Bio-Test Laboratories, Inc.
1810 Frontage Road
Northbrook, Illinois 60062

Dear Otis:

This letter will authorize you to proceed with a study with the leghorn chickens with the Aroclor 1242, lot number AL-55. This should duplicate the study you did previously with Aroclor 1242, lot number AK-255, except in this instance you have suggested using dietary levels of 2, 4, and 8 ppm.

This sample of Aroclor represents our current regular production which involves some clean-up instituted since the previous sample was made available to you. We would hope that we might find a higher "no effect" level with this sample as compared to the previous work.

As soon as suitable reference standards are available, the research laboratory in St. Louis will more carefully characterize the two samples in terms of possible minute amounts of contaminants.

Best personal regards.

Sincerely,

Elmer P. Wheeler
Manager, Environmental Health 84090

EPW:ju

PLAINTIFF'S EXHIBIT 416

15 STR 022806

EX 965

April 8, 1970

Herbert Blumenthal, Ph.D.
Chief, Petitions Review Branch
Bureau of Foods, Pesticides and
Product Safety
U. S. Food and Drug Administration
200 C Street, Southwest
Washington, D. C. 20204

Dear Herb:

Confirming our telephone conversation I have enclosed Xerox copies of the status reports for the chronic toxicity studies for our Aroclors at Industrial Bio-Test, Inc.

Specifically, three of our polychlorinated biphenyls are under investigation. These are Aroclors 1242 (biphenyl chlorinated to the extent of 42%), 1254 (biphenyl chlorinated to the extent of 54%), and 1260 (biphenyl chlorinated to the extent of 60%). Studies include two year oral administration to rats, two year oral feeding to dogs and a three generation rat reproduction study.

As indicated in the enclosures, the levels of administration are 1, 10 and 100 ppm for each of the compounds. Further, the status reports for the chronic dog studies represent data at the end of nine months.

The enclosed copies on the rat studies show data at the end of six months administration. As we mentioned on the telephone, we added 300 rats to the chronic studies after the original two year project had gotten underway to allow a sufficient number of animals for sacrifices at three, six and twelve months. Histopathology has been completed on the sacrificed animals and Dr. Calandra has reported verbally that there are no positive pathological findings.

NEV 014230

PLAINTIFF'S EXHIBIT 1494

713482

WATER_PCB-SD0000072434

The rat reproduction studies are into the second generation. At this point Dr. Calandra has indicated that there definitely has been no effect with any of the compounds at the 10 ppm dietary level. There is some equivocal possible effect in the animals at the 100 ppm level with Aroclor 1254.

If you have any specific questions after reviewing the enclosed status summaries, please feel free to call Dr. Calandra or Dr. Fancher directly.

Best personal regards.

Sincerely,

R. Emmet Kelly, M. D.
Medical Director

REK:ju

c.c. Dr. Joseph C. Calandra
Dr. Otis E. Fancher
b.c. W. B. Papageorge, G. W. Ingle
Enclosures

NEV 014231

713483

April 8, 1970

Dr. Herbert Blumenthal
Chief, Petitions Review Branch
Bureau of Foods, Pesticides and
Product Safety
U. S. Food and Drug Administration
200 C Street, Southwest
Washington, D. C. 20204

Dear Herb:

I thought you would be interested in knowing that Monsanto is committed to a program which will allow the future use of our Aroclors only in those applications where escape to the environment can be prevented.

Secondly, we have essentially a crash program under way to find non-persistent, non-chlorinated substitute products. Already, we have two large users switching to substitutes of this type. Obviously, Herb, you can recognize the competitive aspects of developing and phasing into sales such type of substitutes so, at present, we are not making any widespread announcement. On the other hand, if the publicity gets as red hot as it did in the case of DDT, we may be forced to make such an announcement at any time.

Cordially,

R. Emmet Kelly, M. D.
Medical Director

REK/ln

PLAINTIFF'S
EXHIBIT
1193

NEV 014232

713484

Monsanto

FROM (LOCATION): St. Louis

DATE: March 30, 1970

SUBJECT:

REFERENCE:

CC: H. S. Bergen - HBERG
H. L. Minckler - HMINC
P. S. Park - PPARK
J. E. Springgate - JSPRI

PLAINTIFF'S EXHIBIT 31

TO: W. B. Papageorge
WPAPA

We have been in communication with a Dr. Hill of the Ohio State Board of Health. He has found PCB, particularly Aroclor 1254, in samples of milk from at least three herds in Ohio. He has traced this contamination back to silage from three different silos. Dr. Hill reported concentrations of 0.2 ppm of PCB in the silage in the center of the silo and up to 20 ppm in the material next to the walls. He also stated that concentrations in the milk were between 0.1 ppm and 0.6 ppm and that some of the milk had been destroyed.

The silos are concrete silos whose interior surfaces were painted in 1967 using a formulation that contained 1254. I don't know if there was any other Aroclor in the formulation nor do we know the coating manufacturer; although, this could be found out if important. The presence of PCB in the silage came from flaking off of the material and possibly from leaching out during the silage storage. At present they will have to destroy about 150 tons of silage which is valued at about $30 per ton. As a rough guess, they consider there may be 50 other silos involved in Ohio that were painted with the same formulation. They are also looking into the fat contamination of the cows themselves.

All in all, this could be quite a serious problem, having legal and publicity overtones.

This brings us to a very serious point. When are we going to tell our customers not to use any Aroclor in any paint formulation that contacts food, feed, or water for animals or humans? I think it is very important that this be done. It may be that some of the customers will assure themselves on the basis of non-extractability that a particular formulation might be safe but I think we should make a blanket recommendation against these uses.

R. E. Kelly

R. Emmet Kelly, M. D.

REK/ln

PLAINTIFF'S EXHIBIT 420

STR 029900

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

SUMMARY--INTERIM STATUS

CHRONIC TOXICITY WITH AROCLORS

In May and June of 1969, two year feeding studies were initiated with Aroclors 1242, 1254 and 1260. The materials are being fed to rats and dogs at levels of 1, 10 and 100 parts per million in the diet.

After 11 months there have been no clinical effects observed in the rats in the Aroclor 1242 study. Animals sacrificed at six months showed negative micropathology. There have been no clinical effects in the dogs and blood and urine chemistry studies at the one, three and six month intervals were negative.

In the case of Aroclor 1254, rats have shown a slightly depressed weight gain at 100 ppm. In the animals sacrificed at six months, there was slight increased liver weights in males of the animals on the 100 ppm diet. Micropathology was negative at all levels. In the dogs there have been depressed weight gains in the females at all levels fed and at the 100 ppm level in the males. Blood and urine chemistry has been negative.

With Aroclor 1260 there has been no effect on weight gain but has been increased liver weights in males at 10 and 100 ppm in the animals sacrificed at six months. Micropathology is negative. In the dogs there has been depressed weight gains in the females at 10 and 100 ppm and in the males at 100 ppm. Blood and urine chemistry has been negative.

The above data indicate that these materials are about the same order of toxicity as DDT in rats and dogs. This is reassuring in that DDT is probably the least toxic insecticide to mammalian species. Further, there is general agreement that DDT has not presented a hazard in animals or man in spite of its presence in the environment.

Interim or progress reports such as above have been provided periodically to the U. S. Food and Drug Administration, the U. S. Department of Agriculture and other governmental agencies. In addition, the data and the progress of the studies have been discussed candidly with Dr. Edward J. Burger, Jr., in the Office of Science and Technology, Executive Office of the President.

PLAINTIFF'S EXHIBIT 709

ADM 005984
93517

ADM 005765

SUMMARY--INTERIM STATUS

OF

CHRONIC TOXICITY STUDIES

	Aroclor 1242	Aroclor 1254	Aroclor 1260
2 year chronic--rats at 1, 10, 100 ppm in diet			
Status--9 months	No effect clinically	Lowered weight gain at 100 ppm	No effect (see below)
Status--6 months sacrifice including micropathology	No effect clinically	Increased liver wt. in males at 100 ppm Negative pathology--all levels	Increased liver wt. in males at 10 & 100 ppm Negative pathology--all levels
2 year chronic--dogs at 1, 10, 100 ppm in diet			
Status--10 months	No effect clinically	Lowered wt. gains* all females at 1, 10 & 100 ppm Lowered wt. gains males at 100 ppm	Lowered wt. gains** females at 10 and 100 ppm Lowered wt. gains at 100 ppm
Status--6 months including blood & urine chem.	Negative	Negative	Negative**

* See report for details relative to "Mortality"
** See report for details relative to "Mortality" and "Blood Chemistry"

WATER_PCB-SD0000072439

ANIMAL LONG TERM STUDIES

INTERIM STATUS

	1242	1254	1260
2-year rat chronic			
At 1, 10, 100 ppm Status-9 months	100 ppm Poss. liver enlargement Males 10 ppm O.K.	100 ppm Poss. Liver enlargement Males 10 ppm O.K.	100 ppm Poss. liver enlargement M & F 10 ppm O.K.
2-year dog chronic			
Status--9 months	100 ppm O.K.	100 ppm Body wt. dec. 10 ppm O.K. 1M-1F died-- cause unrelated to exp't	100 ppm 1M-1F died refused food-- no other gross abn. 10 ppm possible body wt. effect

Presented to Meeting with FWPC Scientists At Duluth Minn on 17 Mar 70

ADM 005986

3/18/70 Given to people at Dilutta

ANIMAL LONG TERM STUDIES

INTERIM STATUS

	1242	1254	1260
2-year rat chronic			
At 1, 10, 100 ppm Status-9 months	100 ppm Poss. liver enlargement Males 10 ppm O.K.	100 ppm Poss. Liver enlargement Males 10 ppm O.K.	100 ppm Poss. liver enlargement M & F 10 ppm O.K.
2-year dog chronic			
Status--9 months	100 ppm O.K.	100 ppm Body wt. dec. 10 ppm O.K. 1M-1F died-- cause unrelated to exp't	100 ppm 1M-1F died refused food-- no other gross abn. 10 ppm possible body wt. effect

ADM 005987

AROCLOR TOXICITY DATA

Toxicity Data	Cost	AROCLOR 1221 Have	Need	Date Begin	End	MCS 1016 Have	Need	Date Begin	End	AROCLOR 5432 Have	Need	Date Begin	End	AROCLOR 5442 Have	Need	Date Begin	End
Acute Rat-LD50	$ 200	X	$ (200)*	11/15 1970	12/31 1970		$ 200	11/15 1970	12/31 '70	X	$	11/18 1970	12/31 '70	X	$ (200)*	11/15 1970	12/31 '70
Rabbits-MLD (dermal)	250	X	(250)*	"	"		250	"	"	X		"	"	X	(250)*	"	"
Skin Irr. (rabbit)	100		100	"	"		100	"	"	X		"	"		100	"	"
Eye Irr. (rabbit)	125		125	"	"		125	"	"	X		"	"		125	"	"
Vapor Inhalation (Rats)	200		200	"	"		200	"	"			"	"			"	"
Fish (2 species)	600		600	"	"		600	"	"		600	"	"		600	"	"
Sub-acute 90-day rat **	6,000		6,000	1/2/71	6/1 '71		6,000	1/2/71	6/1 '71		6,000	1/2/71	6/1 '71		6,000	1/2 '71	6/1 '71
90-day dog	10,000		10,000	"	"		10,000	"	"		10,000	"	"		10,000	"	"
Fish (30-90 day)	3,000 (est.)		3,000				3,000				3,000				3,000		
Reproduction Rats	17,000		Defer				Defer				Defer				Defer		
Chickens	8,000		Defer				Defer				Defer				Defer		
Teratology Rabbits	4,500		Defer				Defer				Defer				Defer		
TOTAL:	$49,975																
NEED NOW:			$20,475				$20,475				$19,600				$20,275		
DEFERRED:			$29,500				$29,500				$29,500				$29,500		

* (Repeat)
** Control group cost $2,100

ADM 005988

AROCLOR TOXICITY DATA

Toxicity Data	Cost	AROCLOR 1254 Have	AROCLOR 1254 Need	AROCLOR 1254 Date Begin	AROCLOR 1254 Date End	AROCLOR 5460 Have	AROCLOR 5460 Need	AROCLOR 5460 Date Begin	AROCLOR 5460 Date End	HB-40 Have	HB-40 Need	HB-40 Date Begin	HB-40 Date End	MIPB Have	MIPB Need	MIPB Date Begin	MIPB Date End
Acute																	
Rat-LD_{50}	$ 200	X				X				X				X			
Rabbits-MLD (dermal)	250	X				X				X				X			
Skin Irr. (rabbit)	100	X				X				X				X			
Eye Irr. (rabbit)	125	X				X				X				X			
Vapor Inhalation (Rats)	200	X				X											
Fish (2 species)	600	X					$ 600	12/15 1970	1/31 '71		$ 600#	12/15 1970	1/31 '71		$ 600#	12/15 1970	1/31 '71
Sub-acute																	
90-day rat **	6,000										6,000#	11/2/70	2/15 '71		6,000#	11/2 '70	2/15 '71
90-day dog	10,000																
Fish (30-90 day)	3,000 (est.)		$ 3,000														
Reproduction																	
Rats	17,000	X					Defer										
Chickens	8,000	X				X											
Teratology																	
Rabbits	4,500		4,500	11/15 1970	2/15 '71		Defer										
TOTAL: NEED NOW: DEFERRED:	$49,975		$ 7,500				$ 600 21,500				$ 6,600#				$ 6,600#		

* (Repeat)
** Control group cost $2,100
\# Already paid

ADM 005989

AROCLOR TOXICITY DATA

Toxicity Data	Cost	MCS 1043				Mono-Chloro Mono-Bromo Biphenyl				Mono-Bromo Dichloro Diphenyl				AROCLOR 6062			
		Have	Need	Date Begin	Date End	Have	Need	Date Begin	Date End	Have	Need	Date Begin	Date End	Have	Need	Date Begin	Date End
Acute																	
Rat-LD50	$ 200		$ 200	3rd qtr. '71	1st qtr. '72		$ 200	3rd qtr. '71	1st qtr '72		$ 200	3rd qtr. '71	1st qtr. '72	X			
Rabbits-MLD (dermal)	250		250	"	"		250	"	"		250	"	"	X			
Skin Irr. (rabbit)	100		100	"	"		100	"	"		100	"	"	X			
Eye Irr. (rabbit)	125		125	"	"		125	"	"		125	"	"	X			
Vapor Inhalation (Rats)	200		200	"	"		200	"	"		200	"	"				
Fish (2 species)	600		600	"	"		600	"	"		600	"	"				
Sub-acute																	
90-day rat **	6,000		6,000	"	"		6,000	"	"		6,000	"	"				
90-day dog	10,000		10,000	"	"		10,000	"	"		10,000	"	"				
Fish (30-90 day)	3,000 (est.)		3,000	"	"		3,000	"	"		3,000	"	"				
Reproduction																	
Rats	17,000		Defer				Defer				Defer						
Chickens	8,000		Defer				Defer				Defer						
Teratology																	
Rabbits	4,500		Defer				Defer				Defer						
TOTAL:	$49,975																
NEED NOW:			$20,475				$20,475				$20,475						
DEFERRED:			$29,500				$29,500				$29,500						

* (Repeat)
** Control group cost $2,100

ADM 005990

AROCLOR TOXICITY DATA

Toxicity Data	Cost	Bromo-Chlorobenzene Have	Need	Date Begin	End	2,2 Prime Dichloro Diphenyl Ether Have	Need	Date Begin	End	Have	Need	Date Begin	End	Have	Need	Date Begin	End
Acute																	
Rat-LD_{50}	$ 200		$ 200	3rd qtr. '71	1st qtr. '72		$ 200	3rd qtr. '71	1st qtr. '72								
Rabbits-MLD (dermal)	250		250	"	"		250	"	"								
Skin Irr. (rabbit)	100		100	"	"		100	"	"								
Eye Irr. (rabbit)	125		125	"	"		125	"	"								
Vapor Inhalation (Rats)	200		200	"	"		200	"	"								
Fish (2 species)	600		600	"	"		600	"	"								
Sub-acute																	
90-day rat **	6,000		6,000	"	"		6,000	"	"								
90-day dog	10,000		10,000	"	"		10,000	"	"								
Fish (30-90 day)	3,000 (est.)		3,000	"	"		3,000	"	"								
Reproduction																	
Rats	17,000		Defer				Defer										
Chickens	8,000		Defer				Defer										
Teratology																	
Rabbits	4,500		Defer				Defer										
TOTAL:	$49,975																
NEED NOW:			$20,475				$20,475										
DEFERRED:			$29,500				$29,500										

* (Repeat)
** Control group cost $2,100

ADM 005991

AROCLOR TOXICITY STUDIES--INDUSTRIAL BIO-TEST LABORATORIES

Toxicity Data	Cost	AROCLOR 1221 BTL Number	AROCLOR 1221 Date Begin	AROCLOR 1221 Date End	MCS 1016 BTL Number	MCS 1016 Date Begin	MCS 1016 Date End	AROCLOR 5432 BTL Number	AROCLOR 5432 Date Begin	AROCLOR 5432 Date End	AROCLOR 5442 BTL Number	AROCLOR 5442 Date Begin	AROCLOR 5442 Date End
Acute													
Rat-LD_{50}	$ 200												
Rabbits-MLD (dermal)	250												
Skin Irr. (rabbit)	100												
Eye Irr. (rabbit)	125												
Vapor Inhalation (Rats)	200												
Fish (2 species)	600												
Sub-acute													
90-day rat*	6,000												
90-day dog	10,000												
Fish (30-90 day)	?												
Reproduction													
Rats	17,000	Defer			Defer			Defer			Defer		
Chickens	8,000	Defer			Defer			Defer			Defer		
Teratology													
Rabbits	1,800	Defer			Defer			Defer			Defer		
TOTAL:	$44,275												
DEFERRED:	$26,800												

Control group cost $2,100

ADM 005992

WATER_PCB-SD0000072446

November 9, 1970

Mr. Keith Kelly
Manager of Purchasing
Power Systems
Westinghouse Electric Corporation
~~Box 341~~
Bloomington, Indiana 47401

Dear Keith:

At our meeting in St. Louis on 30 October you asked that Monsanto clarify several items relative to the Aroclor 1242 sales contract between our respective companies.

First, I want to confirm that our existing contract, by this letter, is expanded to include Aroclor 1232*. We request that Westinghouse use the same precautions that you now do with Aroclor 1242 to prevent the product from entering into the environment through spills, leakage, disposal, vaporization or otherwise. Only those applications where the product can be totally contained should be considered. At your convenience I would like Westinghouse's estimated requirements through June 1973.

The second item is the contract termination clause. Originally the clause was added to the contract to protect against the unknown. At the time, Monsanto did not know if the industry, in their use of the Aroclors, could and would be willing to "close the system" and prevent the products from entering into the environment. We did not know whether Monsanto could "close the system" within our own production facilities. Both the electrical industry and Monsanto have made considerable progress in the last six months.

Monsanto management is committed to continuing the supply of this product to the electrical industry as long as all customers continue to take the action necessary to prevent the Aroclors from entering into the environment and until a suitable alternate product is available.

This is now the intent of the termination clause. Monsanto will terminate an agreement with a given customer if the

*changed - original letter stated 1254. 11/30/70

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PLAINTIFF'S EXHIBIT 1195

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WATER_PCB-SD0000072447

Mr. Keith Kelly
Westinghouse Electric Corporation

November 9, 1970

~~industry-in-general-or~~ that specific customer does not adequately prevent the product from entering the environment. Monsanto may terminate the agreement if a suitable substitute product becomes available.

I hope this adequately covers your company's concern of Monsanto's Aroclor plans for the future. As I said in the St. Louis meeting, it is very important that we open up the communications between our companies respective managements. We should proceed with arrangements for a meeting in St. Louis in the near future.

Very truly yours,

T. L. Gossage
Director of Sales
Functional Fluids

/lse

bc: H. S. Bergen
W. B. Papageorge
P. G. Benignus
G. R. Graham

MONSANTO CHEMICAL COMPANY

ST. LOUIS 4, MISSOURI

July 25, 1956

Sievetson

Mr. H. W. Speicher, Administrator
Industrial Hygiene
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

Dear Mr. Speicher:

Thank you for your letter of July 19 requesting toxicity information on several of our Aroclors and atmospheric sampling methods.

I am sending under separate cover two detailed reports published by personnel at the Kettering Laboratories entitled, "The Toxicity of the Vapors of Aroclors 1242 and 1254." The data contained herein were condensed and presented by Dr. Treon at the AIHA meeting in Philadelphia this year. It was published in the form presented in the June, 1956 issue of the "AIHA Quarterly," a copy of which I am sure you must have. I am asking Dr. Treon, by a copy of this letter, to send you a reprint of his publication if such is available at the present time.

You will note that Dr. Treon has proposed that the hygienic standard for Aroclor 1242 be tentatively established at 2 milligrams per cubic meter and that the standard for 1254 be established at 1 milligram per cubic meter. I am sorry that we do not have similar data on Aroclor 1250. However, we have no particular reason to expect that a 60 per cent chlorinated biphenyl offers any greater hazard than a 54 per cent chlorinated biphenyl.

You will note further that Dr. Treon's work discusses a modified Willson hydrocarbon apparatus used in the sampling of his test atmospheres. In a limited amount of sampling in our own plants we have used the Willson equipment as shipped to us. I have enclosed a description of the operating procedure prepared by one of our research groups which is somewhat more detailed than that provided with the instrument.

You have previously seen our complete reports on the decomposition of Pydraul when allowed to drip or flow onto a heated metal Inconel surface. The data in those reports have convinced us that there is no greater acute hazard should Pydraul accidentally contact metals at the temperatures investigated than there would be with other industrial hydraulic fluids. I do not have any data to support any conclusions as to what might occur if the Pydraul were to be used

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as a hydraulic fluid in making magnesium die castings. We do have a report that one plant handling large quantities of molten magnesium purposely sprayed Pydraul into the molten material primarily to see if there would be a great deal of spattering of the magnesium. The company reported to us that their tests convinced them that Pydraul could be used. Whether or not they are using Pydraul, I cannot say.

Chlorinated diphenyl

I note in rereading your letter that I have not answered your question relative to skin effects following Aroclor contact. * We recommend that repeated and prolonged skin contact with any of the Aroclors be avoided. We have patch tested several of them with negative results. In addition, reported cases of skin irritation have been surprisingly few in view of the heavy tonnage quantities of Aroclor manufactured and handled in the last twenty years. We believe, however, that care in handling and good personal hygiene is necessary to avoid irritation.

As with many chlorinated hydrocarbons, exposure to sufficient quantities over a long enough period of time could conceivably result in chloracne. In this respect, however, the Aroclors are not the potent chloracenegens, such as chlorinated naphthalenes. To our knowledge, there have never been any cases of chloracne in the electrical industry's use of these products.

If I can be of any further assistance, please let me know.

Very truly yours,

Elmer P. Wheeler
Assistant Director
Medical Department

EPW:SMB

Enclosure

cc Dr. Joseph F. Treon
The Kettering Laboratory

Mr. Paul G. Benignus
Monsanto

CC: Paul Benignus-SC

October 23, 1959

AIR MAIL

Mr. H. Wilbur Speicher
Administrator, Industrial Hygiene
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

Dear Wilbur:

Thank you for your letter of October 21 inquiring about the safe use of trichlorodiphenyl and a mixture of 40% trichlorobenzene and 60% hexachlorodiphenyl.

We market trichlorodiphenyl as "Aroclor 1242". The combination of hexachlorodiphenyl and 40% trichlorobenzene is known as "Inerteen PPO". The diphenyl in this combination is our "Aroclor 1260".

The physical and chemical properties of the Aroclors mentioned are shown on the table on pages 4 and 5 of the enclosed Aroclor bulletin. Enclosed also is a reprint indicating the results of chronic toxicity studies with Aroclors 1242 and 1254. The following comments answering your questions serially are based on information contained in these bulletins.

I believe prolonged and repeated skin contact with any of the Aroclors should be avoided for two reasons. In the first place, the less chlorinated products are liquids and are excellent solvents for oils and fats in the skin as well as other organic materials. Secondly, it is possible that prolonged or repeated skin contact could lead to chloracne. I know of only two cases where such experience has developed during the long history of production and use of the Aroclors. In one case, an Aroclor was being used as a heat transfer medium in a system that allowed vapors to escape when the material was heated to 600°F. Several workmen developed "blackheads" which were found by an industrial physician but which in his words were so insignificant that the men were not aware of them nor would a general practitioner notice them. This indicates to me, however,

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PLAINTIFF'S EXHIBIT 89

that sufficient exposure, whether by inhalation of vapors or skin contact, can result in chloracne which I think we must assume could be an indication of more serious systemic injury if the exposure was allowed to continue.

A second case of mild chloracne about which we have any knowledge resulted from workmen dipping their hands in the liquid Aroclor as if it were mineral oil or vegetable oil. In addition, their clothing sooner or later became impregnated with the material and thus exposure was magnified.

You asked at what temperature local exhaust ventilation should be provided. Although the distillation range for Aroclor 1242 is 325-360°C. and 385-420°C. for Aroclor 1260, I feel that good practice dictates that local exhaust ventilation be provided when any of the Aroclors are heated above 150°F. in open tanks or in any systems where the material is not in a completely enclosed system (vapor-proof tanks, kettles, pumps, piping, etc.). This may be ultra conservative because as the distillation ranges and vapor pressure curves (page 12 of the Aroclor bulletin) indicate, the loss of vapors at 150°F. should not be significant except in any work area where general ventilation or air changes do not exist.

Your next question related again to possible skin and systemic effects and I believe it is answered above.

In connection with the 40% trichlorobenzene-60% Aroclor 1260 combination, I believe the thoughts expressed above also apply. I understand that the trichlorobenzene which is used is a mixture of the 1,2,3-, 1,2,4-, and 1,3,5-isomers which will begin to distill at 205°C. Again, I believe this indicates a low vapor pressure for the solvent at room temperatures. The only reference we have to trichlorobenzene toxicity is contained in the Public Health Service Publication No. 414 entitled "The Halogenated Hydrocarbons Toxicity and Potential Dangers" by Dr. W. F. von Oettingen, U.S. Government Printing Office, 1955 (pages 297-298). Dr. von Oettingen refers to some work done in 1937 which indicated that the trichlorobenzene was less toxic than mono or dichlorobenzene. In my opinion, a reasonable MAC for this material would be 100 parts per million.

The enclosed publication on the toxicity of Aroclor 1242 and 1254 suggests an MAC for 1242 of 2 milligrams per cubic meter which is twice that recommended by the ACGIH for a chlorinated diphenyl of unstated chlorine content. In the case of 1254, the publication suggests that the MAC of 1 milligram per cubic meter "recommended tentatively for safe industrial practice by the American Conference of Governmental Industrial Hygienists" is reasonable. On the other hand, reference to Henry Smyth's Cummings Memorial Lecture of 1956 in which he discussed the basis for the then existing "hygienic standards" indicates that

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Henry agrees that MACs of 1 mg/cu.m. for Aroclor 1242 and 0.5 mg/cu.m. for Aroclor 1254 are more realistic. In the absence of any chronic toxicity data on Aroclor 1260, we suggest an MAC of 0.5 mg/cu.m., the same as in the case of 1254.

I have been in one plant where these materials were used for capacitors and transformers. The care and handling and the provisions of exhaust ventilation were not in accordance with the thoughts expressed above. The only reported difficulty was some mild eye irritation when impregnation cabinets where the items were heated to 110-120°C. released vapors of trichlorobenzene and the Aroclor into the workroom when the cabinet doors were opened. In my mind, such cabinets should be ventilated to remove the vapors rather than allow them to be released into the working atmosphere.

I have been told that your company has had some 20-25 years' experience with the products discussed above. It was suggested that Mr. James B. Ford, manager of transformer manufacturing engineering at your Sharon Plant would be a source of information regarding experience with Inerteen FPO. Similarly, Mr. R. E. Marbury of your Bloomington, Indiana Plant has been associated with the use of Aroclor 1242. Perhaps you have already discussed potential exposures with these gentlemen. If so, I would be interested in learning of their practical experience with these products.

I look forward to seeing you in Pittsburgh next week.

Sincerely,

Elmer P. Wheeler
Assistant Director
Medical Department

EPW:dn
Enclosures 2

2

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

July 18, 1975

Dr. J.C. Calandra
Industrial BIO-TEST Laboratories
1810 Frontage Rd.
Northbrook, Ill. 60062

re: AROCLOR 2-year Rat Feeding Studies

Dear Joe:

The attached table summarizes a comparison of the 3 revised AROCLOR reports (1242, 1254, 1260).

In 2 instances, the previous conclusion of "slightly tumorigenic" was changed to "does not appear to be carcinogenic". The latter phrase is preferable. May we request that the AROCLOR 1254 report be amended to say "does not appear to be carcinogenic".

The number of hepatomas reported for AROCLORS 1260 and 1242 have been interchanged. This appears to have arisen from confusion regarding the numbering of the animals. The original reports show tumors in animals with numbers in the 100-300 range for AROCLOR 1260 and in the 500 to 800 range for AROCLOR 1242. This leads me to conclude that the numbering scheme shown in the second set of reports is correct. With AROCLOR 1254 confusion is compounded. The original report showed tumors in animals with numbers in the units to teens, but the revised report shows animal numbers ranging from 40 to 1000. Can this be straightened out?

I was unable to reconcile the differences in the animal numbers between the first supplemental report and the original reports, I had inquired as to the changes in the numbers. As I recall, I was told that the sections had been renumbered when the new slides were made and that a key relating to the sets of numbers

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BIO-TEST

would be supplied. This has not been done. It may not be necessary for AROCLORS 1260 and 1242, but AROCLOR 1254 remains unresolved.

Insofar as I can see, the remainder of the reports appear acceptable.

Kindest personal regards,

Sincerely,

George J. Levinskas, PhD
Mgr., Environmental Assessment
and Toxicology

/bkp

att.

cc: Dr. George Roush, Jr., M.D.

E001272

100738

Product	Supplemental Report #1 (mailed)	Supplemental Report #2 (JCC delivered)
AROCLOR 1260		
conclusion	slightly tumorigenic	does not appear carcinogenic
hepatomas	3	7
range of test animal nos:		
p. 9	600 to 800	100 to 300
p. 10	1000 series	800 to 900
p. 11	70 to 100	10 to 40
p. 12	500 to 600	80 to 200
p. 13	600 to 700	200 to 300
p. 14	700 series	200 to 300
AROCLOR 1254		
conclusion	slightly tumorigenic	slightly tumorigenic
hepatomas	6	6
AROCLOR 1242		
conclusion	slightly tumorigenic	does not appear carcinogenic
hepatomas	7	3
range of test animal nos.	as in report #2 for AROCLOR 1260	as in report #1 AROCLOR 1260

Brussels, Belgium

1st December, 1966

Aroclor Sweden

DW:gh

G. R. Buchanan - St. Louis

THIS COPY FOR

A. Arpino - Brussels
Dr. Emmet Kelly - St. Louis
D.V.N. Hardy - London
R.A. Steenrod - St. Louis

Dear George,

I attach a copy of a letter received from Ola Palm in Stockholm. I have sent copies of this letter also to the appropriate departments within our own organisation. In consideration of the importance we are placing on development of the Swedish market for Aroclor over the next five years, we would be grateful if you could arrange for this information to be considered by the appropriate departments in St. Louis and their comments transmitted to us as soon as possible.

Based on the recommendations made by our medical departments we shall have to decide whether to arrange for publication of data in Sweden or not.

In relation to the specific problem mentioned of disposal of used materials, we would be interested to learn how this problem is handled in America. In the U.K. many companies have been burying material in drums, material in the drums having been absorbed into vermiculite or some similar porous material. Has any entirely safe method been developed for the disposal of waste Aroclor ?

Best wishes.

GB.

pp D. Wood.

P.S. Thinking of the total quantities of Aroclor used in Sweden compared with the much larger volumes of Pentachlorophenol and Sodium Pentachlorophenate, for water treatment in the paper industry and sapstain control in the timber industry. Is it likely that the chlorinated phenols show similar chromatographic traces to the chlorinated bi-phenols?

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Ex 10

WATER_PCB-SD0000072457

cc: Mr. D.S. Cameron - ME

RISING & STRAND

AKTIEBOLAG

OP/BO

TELEFON: 34 01 33 TELEGRAM: HENNA TELEX: 1434
POSTGIRO: 3 44 43 BANKGIRO: 73-0448

STOCKHOLM VA
SVEAVÄGEN 47 November 28, 196

Monsanto Europe
BRUSSELS 3
Belgium

For the attention of Mr. D. WOOD

Dear David,

re: AROCLORS

As mentioned, there has been some publicity in Sweden concerning investigations made at the Institution of Analytical Chemistry at the Stockholm University. These have revealed that a group of products called Polychlorinated Bi-Phenols - PCB for short - accumulated in certain organs of animals. They are said to be related to DDT and equally poisonous.

Biphenyls not biphenols

The findings were discussed at a meeting of scientists at the Wenner-Gren Centre in Stockholm on November 22. Below please find a translation of an article in the Swedish daily paper "Dagens Nyheter":-

"It is found in salmon and in pike. It is found in sea eagle living on fish. It is found on the surface of the needles of the fir trees, that is in the air. It is found in the hair of ~~a~~ five months baby...

The scientists working with biocides have for a long time seen this something as unknown "peeks" on their gas chromatographs and at a meeting at the Wenner-Gren Center, Research Assistant Sören Jensen of the Institution for Analytical Chemistry at the Stockholm University could reveal the identity of these peeks. It has been found that they consist of a group of poisons, Polychlorinated Biphenols (for short PCB) which are closely related to, and equally poisonous as, DDT.

PCB is broken down considerably slower than DDT and gives rise to damage of liver and skin. PCB is not

STR 017391

used as a herbicide. It is not manufactured in Sweden but is supposed to used by the industry to quite some extent. No special industry can so far be accused of being the source of contamination.

Research Asst. S. Jensen has tested 200 fishes and a number of birds. He has taken several samples of air and has reached the conclusion that PCB is equally common in Nature as chlorinated hydrocarbons of the type of DDT, DDE, and Lindane. Even fish in Laddjojaure in Lapland contain PCB. Mr. Jensen has also found that PCB does not appear in animals living on a vegetarian diet, such as the elk.

In the course of his work, Mr. Jensen has not found anything indicating that the source of contamination comes from agricultural additives. It is, however, obvious already now that PCB is most frequently found in organisms living in water or feeding from water animals. In all examined pikes PCB was found. In a sea eagle found dead outside Stockholm it was found that the liver contained 30 mg of mercury per kilo, 76 mg DDT and considerably more PCB. The exact figure has not yet been determined.

PCB is found in water and in air, and not only in the Swedish air, but also in e.g. London air. Mr. Jensen has not yet been in London for sampling but could identify the poison by studying a gas chromatogram of air published in a British technical journal.

Mr. Jensen has also examined the hair of his family and himself and has found PCB on all samples. Most PCB was found in the hair of his wife but most sensational was that the girl aged 5 months had more PCB in her hair than her brothers and sisters of 3 and 6 years. Probably the girl had got the poison via the mother's milk.

In the State Museum Mr. Jensen has examined the whole collection of sea eagles dating back to 1880. By testing it could be established that PCB was present only in birds from 1944 and thereafter while birds collected before 1944 were quite free from PCB.

The use of PCB in Sweden is not established in detail. According to American sources these types of products are used in the manufacture of a variety of heat-resistant materials. They are used for electrical insulation, for fire-proof heat transport in hydraulic oils, in lubricating oils used at high temperature and pressure, in paints and as pigments in various plastics. PCB is not imported only as such. It is also part of several finished products. Nothing is known as to the way in which it reaches the water and the air. According to Mr. Jensen, products containing PCB should have this openly declared.

PCB is equally harmful whether absorbed via the skin, through the food, or by inhalation. In contact with the skin it can cause oedema. For DDT the highest permissible concentration in the air has been set at 0.5 - 1 mg/cu.metre. For PCB it has been mentioned to be 0.5 mg/cu.metre. Mr. Jensen will now try to get more complete analytical material. He hopes eventually to be able to disclose the source of the contamination and will also increase his cooperation with toxocologists and geneologists."

Another daily paper, Svenska Dagbladet, has a similar article. Here it is mentioned that Mr. Jensen, working under Laborator (Professor) Gunnar Widmark, has disclosed facts which will have far-reaching importance since the findings have proved a new source of pollution of the nature.

One of the participants at the meeting was Dr. A.V. Holden of Scotland, scientific contact man between the twelve O.E.C.D. countries, who has established coordinated analysis of chemicals used and found in nature.

I suppose there is no doubt that what has been termed Polychlorinated Biphenyls is equal to Aroclor. There is also no doubt that the published facts will cause considerable unrest in several quarters. We probably will have to have Aroclor registered with the Swedish Board of Poisonous Substances and the industry will have to be particularly careful in handling the material. The problem in some cases of course may be the disposal of used material. I understand that there hardly exists a convenient method of destroying Aroclor and that possibly burying unuseable material may be the only answer.

We shall be glad to hear from you soon.

Yours sincerely,

RISING & STRAND ......AG
HENRY STRAND

STR 017393

Toxicity and Potential Dangers of Inerteen.

Animal experiments indicate that Inerteen is less toxic than trichlorobenzene; that the intake of fatal doses (fairly large quantities, perhaps 3 to 5 tablespoonfuls) will cause hyperemia of all internal organs, extensive degeneration of the liver, and damage of the mucous membranes of the stomach. With smaller doses these effects are less severe and there is evidently some tendency toward healing if further absorption of the toxic material is prevented.

The contact of Inerteen with the skin causes dryness of the skin, thickening and scaling, and it appears that sufficient quantities may be absorbed in this way to cause damage of the liver.

It appears that for short exposure concentrations of 0.5 mg. per liter of air represent the maximal allowable concentration, and for continued exposure, concentrations below 0.05 mg. per liter of air.

Dangerous concentrations, or at least potentially dangerous concentrations, may be recognized by drawing 10 liters of air at a rate of about 1 liter per 2 minutes through a test tube containing 1 cc. of ethyl alcohol, cooled in dry ice or in an ice salt mixture, and then pouring the alcohol carefully on the surface of a few cubic centimeters of water in a test tube. If the concentration of Inerteen is over 0.03 mg. per liter, a white ring is produced between the two layers.

For the safe handling of Inerteen it appears necessary that concentrations of its vapors in air are kept below 0.05 mg. per liter of air by adequate forced ventilation at the site of the production of such vapors.

Greatest personal hygiene is of paramount importance. Contamination of the skin should be avoided by proper protective garments such as gloves, caps and coveralls. In case of accidents or with short exposure to higher concentrations, of and above 0.2 mg. per liter of air, respirators or open air masks should be worn. The skin should be kept immaculately clean and ointments such as lanolin or Aquafor should be applied to the skin after the washing of the hands.

In view of the possibility of a toxic action of this material on the liver, persons suffering from injuries of the liver (jaundice) syphilis, and heart diseases should be excluded from operations in which Inerteen is handled.

Workers handling Inerteen or with frequent exposure to its vapors, should undergo periodic examinations; special attention should be paid to their nutritional condition, and the condition of the liver should be checked by determining the icteric index in the blood and the excretion of urobilin and urobilinogen in the urine.

Regards the treatment of toxic effects of Inerteen, the local irritation of the skin should be treated with bland ointments after the toxic material has been removed by intensive washing and scrubbing. In case there is evidence of injury of the liver, a diet rich in carbohydrates, administration of glucose and insulin, and duodenal lavage with magnesium sulfate may be beneficial. If Inert-

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has been swallowed, emetics such as soap water or mustard water should be given immediately. This should be followed by gastric lavage with a suspension of activated charcoal in water, and saline cathartics such as Epsom salts should be given to remove any toxic material from the intestinal tract.

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Medical Research Project No. MR-46.

THE TOXICITY AND POTENTIAL DANGERS OF INERTEEN

Submitted by

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Director

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The Toxicity and Potential Dangers of Inerteen and Related Substances, Including a Method of Analysis for Halogenated Hydrocarbons in Air.

W. F. von Oettingen, M.D., Ph.D.

The toxicological experiments on this problem were carried out by Dr. J. H. Foulger and Dr. A. J. Fleming of the Department of Toxicology and the pathological studies were made by Dr. W. T. Read, Jr. of the Department of Pathology of the Haskell Laboratory

The material was investigated with oral administration to rats, application to the skin of rats, and in inhalation experiments. The latter were planned in such a way as to approach as closely as possible the actual conditions encountered in the use of this material in transformers, in order to evaluate the maximal hazard which may be encountered in its use for this purpose. For comparison, additional tests were made regards the toxic effects from inhalation of vapors from Pyranol and Transformer Oil (Westinghouse). In addition, a method was worked out for the determination of Inerteen in air.

Effect of Oral Administration.

In order to determine the minimal fatal concentration of Inerteen for rats, 100 animals were given by stomach tube <u>single doses</u> of Inerteen, as indicated in the table.

Dose cc./kgm.	No. of animals treated	No. of dead	Time of death	Per cent mortality
1.0-1.49	26	5	4 † within 8 days	19.2
1.5-1.99	24	9	6 † " 3 "	37.5
2.0-2.49	10	3	3 † " 3 "	30.0
2.5-2.99	20	10	9 † " 3 "	50.0
3.0-3.49	20	15	15 † " 3 "	75.0

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In these, as in subsequent experiments, all rats showed signs of discomfort immediately following the administration, later they became depressed and refused, frequently, water and food; within a few hours they became weak and stuperous, so that they were finally unable to rise. When this stage was reached they invariably died. One of these rats was found to suffer from albuminuria, one developed tremors of the head and fore-limbs, and one showed severe hemorrhages from the intestinal tract. The table indicates that with oral administration the minimal fatal dose of Inerteen for rats, which kills 75 per cent of the animals within 3 days, is 3.0 to 3.49 cc. per kilogram body weight.

Upon pathological examination of 20 of these animals, those that had died spontaneously showed congestion of the lungs, which was combined with edema and hemorrhage in several instances. Ten of the animals had mottled gray or yellow livers and in three instances there was a diffuse pallor with moderate yellowness. In 5 out of 6 animals studied microscopically the liver showed marked and rather extensive hyaline necrosis in the central part of the lobules; the liver cells in this area revealed fatty degeneration of the cytoplasm; and in 2 animals that died 52 and 54 hours after the treatment these cells contained increased numbers of mitotic figures. In the majority of the animals the mucosa of the intestine was congested and the fecal material in the intestines contained old blood; and in one instance fresh blood was found in the lower third of the ileum, lower colon, and sigmoid. Microscopically the stomach of two animals presented typical hemorrhagic erosions of the mucosa; another showed hemorrhagic areas in the mucosa; and in the remaining animals postmortem changes did not allow an exact investigation.

In order to follow up the toxic effect of Inerteen on the liver, a group of 30 white rats was treated in the same way with single oral doses of 1.15 to 1.20 cc. per kilogram body weight. Six of these were killed 3, 8, and 11 days, respectively, after the administration.

Upon pathological examination it was found that two of the 6 animals killed after 3 days had bloody materials in their stomachs and in 50 per cent of these animals the liver was slightly yellow in color and the liver cells were large and contained numerous mitoses and occasionally there was necrosis of cells immediately about the central veins. Animals killed after 8 days presented a slight enlargement of the liver with a questionable yellowish color, the liver cells were large, those arour the central veins were dark, and occasionally there was some fatty degeneration of these cells. Rats killed after 11 days showed no important gross pathology. Microscopically, all sections showed a slight swelling of the liver cells with occasiona vacuolization of the cytoplasm. No other organs showed patholog changes referable to the exposure.

In order to study the effect of repeated oral administratic of Inerteen, 3 groups of 10 rats each were treated in the follow ing way:

The first group received from 0.38 to 0.66 cc. per kilo for 3 consecutive days. None of them died and 5 were killed after the 3rd treatment for pathological examination. The second group was fed doses from 0.63 to 0.88 cc. per kilo. Two died following the 2nd dose and 5 were killed for autopsy after the 3rd administration. In the third group the doses ranged from 1.23 to 1.78 cc. per kilo. One rat died after the 1st, three after the 2nd, and four after the 3rd treatment, and the remaining animals were killed four days after the 3rd treatment.

Upon pathological examination the livers of the rats of the first group appeared somewhat lighter than usual and one showed large yellow areas; there was a diffuse mild swelling of the liver cells with some polychromasia; occasionally the cells showe some vacuolar changes of the cytoplasm, but in general these changes were not very severe. In 4 rats of the third group which died after 3 treatments the stomachs were dilated with food and in two of these there was also some old blood present. Microscopically, one rat had small inflammatory ulcers in the fore stomach and another showed hemorrhagic erosions of the pylorus. All showed some hyperemia of the liver and in one rat this was of mottled appearance. Microscopically two rats showed swelling of the liver cells with fatty degeneration of those in the centr parts of the liver lobules. Two others presented central necros of the liver cells with hyperplasia of the endothelial cells in these areas, one showing in addition, numerous mitotic figures i the liver cells. Of 2 rats which were killed 4 days following the 3rd administration, one had a small amount of blood in the gastric content. The livers of both animals appeared moderately enlarged and microscopically there was a generalized swelling of the liver cells with some polychromasia. One rat suffered from a fairly general vacuolar degeneration of the liver cells and another presented vacuolar changes in the central part of the lobules.

In order to compare the toxic effects of Inerteen with trichlorobenzene and ethyl-tetra-penta-chlorobenzene, a group of 10 rats was given daily doses of trichlorobenzene ranging from 0.36 to 0.58 cc. per kilo body weight. One died after the 1st, four after the 2nd and four after the 3rd administration, the remaining rat was killed 4 days following the 3rd and last treatment.

It appears, therefore, that daily doses of 0.36 to 0.58 cc. per kilo of trichlorobenzene killed 90 per cent of the animals with 3 doses, whereas it was found that doses of 0.62 to 1.04 cc. per kilo of ethyl-tetra-penta-chlorobenzene, given in the same way, killed only 10 per cent, and Inerteen in doses of 1.25 to 1.78 cc. per kilo, given in the same way, killed 80 per cent of the rats.

Upon pathological examination, animals which were treated with trichlorobenzene and which died spontaneously showed a passive congestion of the lungs and the liver; the stomachs were distended with food; in four some blood was present in the

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gastric contents and in one instance there was a hemorrhagic erosion of the mucosa. In two rats the liver showed irregular mottling. Liver sections of all animals showed necrosis of the liver cells around the central veins and those in the outer parts showed vacuolar degeneration. In rats which died 3 to 4 days after the first treatment there was some endothelial hyperplasia in the areas of necrotic liver cells. One animal presented an increase in the number of mitotic figures in the liver cells.

Of the 7 rats treated with ethyl-tetra-penta chlorobenzene, the one which died spontaneously after the 3rd dose showed congestion and hemorrhages of the lungs, generalized passive congestion of the spleen, bone marrow and other viscera, distended stomach, and moderate yellow mottling of the liver, the liver cells being mildly swollen and showing fine vacuolar degeneration. The animals which were killed showed only a questionable enlargement of the liver and kidney and a slight swelling of the liver cells with occasional vacuolar degeneration, which changes were extremely mild.

It appears, therefore, that Inerteen is considerably less toxic than trichlorobenzene, the minimal fatal dose with oral administration, killing 70 per cent of the animals, being around 3.0 cc. per kilo rat; whereas ethyl-tetra-penta-chlorobenzene does not appear to be nearly as toxic with oral administration. The pathological changes observed after oral administration of Inerteen appear to be fairly consistent and obvious. Large doses which are fatal in one or two days, cause terminal passive congestion of the viscera, extensive degeneration of the liver with necrosis around the veins, and locally, ulceration of the gastric mucosa. Whereas sublethal doses cause within three days gastric irritation and hepatic degeneration with signs of regeneration, the latter is decidedly more marked after eight days, and after eleven days no definite liver pathology may be present. It should also be pointed out that single large doses appear to be more injurious than such doses given in fractions.

Effect of Application to the Skin.

Ten white rats were treated daily with an application of about 0.5 cc. of Inerteen to the shaved skin of the back, precautions being taken to prevent absorption through the gastro-intestinal tract by licking and by inhalation. All rats lost weight during the experiment but they showed no toxic signs aside from a slight restlessness at the beginning of the experiment. At the site of the administration the skin became dry, thickened and scaled without any fissures being formed. Similar reactions were observed on the human skin especially on the hands, cheeks and forehead. One of the rats died after 11, and three after 13 treatments, the remaining being killed 24 hours after the 15th application.

Upon pathological examination the liver of all animals was found to be dark gray brown in color with mottling on the surface. In those rats which died spontaneously there was fatty degeneration of the liver cells with necrosis of those around the central veins and in animals killed at the end of the experiment there was a mild swelling of the liver cells with occasional vacuolar degeneration in some. Microscopically the skin at the site of application of 4 rats showed hyperkeratinization with occasional blister formation, one animal showed perifolliculitis, one hyperplasia of the epithelium rather than hyperkeratinization, and in 3 rats there was a mild fibroblastic proliferation with some round cell infiltration in the underlying connective tissue.

It appears, therefore, that the contact of Inerteen with the skin does not only cause local reactions such as dryness, thickening and scaling of the skin, but also systemic effects as indicated by the injurious effect on the liver.

Effect of Inhalation of Vapors.

In evaluating the toxic effects of inhalation of vapors liberated from Inerteen at elevated temperatures, attempts were made to reproduce conditions more severe than would be met in the overheating of a transformer. In these experiments rats were exposed in a limited space of about 1 cubic foot capacity to the vapors of the boiling material which entered directly into the chamber through a hole in the bottom. In each experiment 8 rats were exposed on 28 to 66 occasions for 20 minutes, twice daily, to vapors from Inerteen, Pyranol, or

Transformer Oil (Westinghouse). During this time they showed irritation of the skin, which appeared to be most marked on those parts of the body not protected by hair, and which persisted for some time after the exposure. Pyranol appeared to produce the most effect in this respect, followed by Inerteen and Transformer Oil, in the order given. In opposition to the 4 rats exposed to Pyranol and Transformer Oil, 3 out of 6 rats exposed to Inerteen lost weight, but no other toxic signs were observed. It is quite possible that rats exposed in this way absorbed some toxic material through the gastro-intestinal tract by licking the fur during or after the exposure since the material had a tendency to condense on the walls of the chamber and on the surface of the animals. The maximum concentration of Inerteen to which these rats were exposed was determined as about 0.5 mg. per liter of air.

Upon pathological examination of rats exposed in this way on 14, 35 and 66 occasions to Inerteen, no definite pathological signs could be observed in the liver or other organs which could be referred to the exposure.

Two rats treated with 41 exposures to the vapors of Pyranol showed no definite cellular changes in the liver although in one animal there was an increased number of mitotic figures in the liver cells.

Two rats exposed on 44 occasions to the vapors of Transformer Oil (Westinghouse) showed no definite pathological changes of the internal organs.

In order to study the effects of continued exposure, 10 rats were exposed 8 hours daily on 5 days a week for 20 days to concentrations of 0.05 mg. to 0.09 mg. of Inerteen per liter of air. They showed no toxic nor pathological signs referable to the exposure; there were no definite changes of the red blood corpuscles or the hemoglobin. The animals were killed 2 days after 20 exposures.

It appears, therefore, that neither frequently repeated short exposures for 20 minutes each to concentrations of 0.5 mg. of Inerteen per liter air, nor continued exposure to concentrations of 0.05 to 0.09 mg. per liter air cause a definite toxic effect on the liver.

Determination of Concentrations of Inerteen in the Air.

In order to determine the concentration of Inerteen vapors in the air, the following nephelometric method was worked out, after several other procedures had been considered.

A definite volume of air to be tested is drawn at a rate of about 1 liter every 4 minutes through a test tube containing 5 cc. of ethyl alcohol, immersed in dry ice-acetone mixture in order to prevent the evaporation of the alcohol. At the end of the sampling 1 cc. of the alcohol was mixed with 10 cc. of distilled water and the resulting turbidity was measured with a photo electric cell, using a sodium vapor lamp as the source of light.

The turbidity of unknown samples was compared to the turbidity produced by known standards made up of trichlorobenzene and ethyl alcohol. This method gave satisfactory readings over a range from 0.30 to 3.0 mg. per liter of air and when the original dilutions were taken into account, it was sufficiently sensitive to detect quantities as low as 0.03 mg. of Inerteen per liter of air. The method is not specific for the various members of the halogenated hydrocarbons but since the vapors liberated from Inerteen consist mainly of trichlorobenzene, as will be shown below, it may be used for the determination of Inerteen vapors in air.

In order to obtain information regards changes of the concentration of vapors in air with the distance from the source of production, samples of air were taken in a closed space at varying distances from boiling Inerteen and the following concentrations were determined:

Distance (inches)	Concentration mg. per liter
14	4.50
20	1.38
29	1.14
36	1.14

When samples were taken at various distances over an open beaker of boiling Inerteen the results were as follows:

Distance (inches)	Concentration mg. per liter
5	0.36
10	0.45
15	0.24
20	0.24

These experiments show that the concentrations of Inerteen in air decrease rapidly with the distance from the source of their production.

In order to study variations of the concentrations over a period of time and with different temperatures, a current of 10 liters per minute of air was passed over the surface of Inerteen of about 10 square inches, contained in a flask and thence into a bell jar. Samples were taken from the jar at various intervals after the flow was started and with various temperatures. The following concentrations were determined:

Time of sampling in hours	Concentration of trichlorobenzene in mg. per liter	Temperature of trichlorobenzene in flask °C.
	Trichlorobenzene	
½	0.29	25
2	0.51	25
6	0.60	25
1	1.68	50
4	1.70	50
1	1.90	90
	Inerteen	
6	0.58	25

This tabulation shows that the determinations made at 25°C. and with the 6 hour sample were almost the same for trichlorobenzene (0.60 mg. per liter) and Inerteen (0.58 mg. per liter). This suggests the possibility that the bulk of the vapors liberated from Inerteen at this temperature may be trichlorobenzene; so that the hazards from inhalation of Inerteen vapors are identical with those from the inhalation of trichlorobenzene. In order to confirm this, 325 cc. of Inerteen were submitted to fractional distillation and the following results were obtained:

Fraction	Temperature of distillation °C.	Volume collected cc.	Specific Gravity of fraction	Boiling Point °C.
1	240	35	1.459	208-219
2	240-254	45	1.478	228
3	254-280	45	1.493	240
4	280-300	30	1.577	289
Residue	above 300	180	1.592	-

Since the specific gravity of trichlorobenzene is 1.466 and the boiling point 208°C.-219°C., it is evident that up to 240°C. the vapors consist exclusively of trichlorobenzene and that for this reason the above statement is justified, namely, that for most conditions the hazards from vapors of Inerteen are identical with those from trichlorobenzene.

Résumé.

The experiments discussed in this report show that with oral administration Inerteen is considerably less toxic than trichlorobenzene, the minimal fatal dose killing from 70 to 75 per cent of the rats being around 3.0 cc. per kilogram body weight and 1.4 to 1.8 per kilogram body weight, respectively. Fatal doses will cause passive congestion of all viscera, extensive degeneration of the liver, and ulceration of the gastric mucosa. With sublethal doses these effects are less severe and there is evidence that they will heal when no further exposure occurs.

Continued application of Inerteen to the skin of rats and humans causes dryness of the skin, thickening and scaling; and the observations made in rats indicate that sufficient quantities may be absorbed through the skin to produce injurious effects on the liver.

Repeated inhalation for short periods of concentrations of 0.5 mg. of Inerteen vapors per liter of air, or repeated inhalation for 8 hours of concentrations of 0.05 to 0.09 mg. per liter of air causes no definite injurious effects in rats. Vapors liberated from boiling Pyranol, Inerteen, and Transformer Oil (Westinghouse) are irritant and the irritant action decreases from Pyranol to Transformer Oil (Westinghouse), Inerteen being intermediate in this respect.

It has been shown that vapors liberated from Inerteen under conditions approaching those as might be encountered in transformers consist mainly of trichlorobenzene.

A simple method for the determination of Inerteen (trichlorobenzene) vapors in air is given. If 10 liters of air are drawn at a rate of about 1 liter every 2 minutes through a test tube containing 1 cc. of ethyl alcohol, cooled in dry ice or in an ice salt mixture, and the alcohol is then poured carefully on the surface of a few cubic centimeters of water in a test tube, a ring of turbidity is produced if the concentration of Inerteen (trichlorobenzene) is over 0.03 mg. per liter of air. If under these conditions a white ring is produced, the air tested should be regarded with suspicion and should be improved by more effective ventilation.

It was found that the concentration of Inerteen (trichlorobenzene) in a closed space 14 inches above the surface of boiling Inerteen is 4.5 mg. per liter and in an open space 5 inches above the surface of boiling Inerteen is 0.56 mg. per liter, and when the temperature in a transformer, standing in a closed room (vault), rises to 90°C. the air may contain 1.9 mg. per liter of air.

From the animal experiments reported, it appears that concentrations below 0.05 mg. per liter of air will cause no toxic signs or symptoms even with continued exposure.

Regards preventive measures, the following may be suggested:

It appears to be of paramount importance that the contamination of the air be reduced to concentrations below 0.05 mg. per liter of air by adequate forced ventilation at the site of the production of such vapors.

Greatest personal hygiene is not less important. Contamination of the skin should be avoided by wearing proper protective garments such as gloves, caps, and coveralls. In case of acciden or with exposure to higher concentrations of and above 0.2 mg. pe liter, respirators or open air masks should be worn. The skin should be kept immaculately clean and ointments such as lanolin or Aquafor should be applied to the skin after washing the hands.

In view of the hepatotoxic action of this compound, individuals suffering from injuries of the liver, syphilis, and heart diseases should be excluded from operations in which Inerteen is handled.

Workers handling Inerteen or with frequent exposure to its vapors should have periodic examinations, special attention should be paid to their nutritional condition, and the condition of the liver may be checked by determining the icteric index in the blood, and the urobilin and urobilinogen excretion in the urine.

Regards the treatment of toxic effects produced by exposure to Inerteen, it appears advisable to increase the resistance of the liver by carbohydrate diet; administration of glucose and insulin may be advisable, and duodenal lavage with magnesium sulfate may be tried. Local irritation of the skin produced by Inerteen should be treated with bland ointments after the toxic material has been removed by intensive washing and scrubbing. In case Inerteen has been taken by mouth, the toxic material should be removed from the stomach by emetics such as soap water or mustard water, and this should be followed by gastric lavage with a suspension of activated charcoal in water and saline cathartics such as Epsom salts.

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E. P. Wheeler - St. Louis

October 21, 1968

Polychlorinated Biphenyls in the Environment

R. E. Kelly, M. D./ W. H. Hunt
Scott Tucker - Queenv Plant
R. A. Keller - KKELL
~~C. Payton - CPAYT~~
H. Bergen - HBERG
W. K. Johnson - WJOHN

W. H. Richard
WRICH

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Attached is a Xerox copy of a technical paper which Scott Tucker and I picked up in Washington recently. This was provided us by Donald A. Spencer of the National Agricultural Chemicals Association. Mr. Spencer requested that the paper be held "confidential" until such time as it may be published. Spencer indicated that if this paper were distributed one of his principal "sources" would refuse to give him prepublication information in the future.

Risebrough's presentation (the attached) was made at a meeting of 20 to 30 toxicologists held at the University of Rochester in June. The meeting was billed as "The First Annual Conference on Toxicology" and was underwritten presumably by the AEC which has had contracts at Rochester for many years. Attendance was by invitation only.

The meeting dealt "exclusively" with pesticides with about one-third of the papers relating to mercury. As far as Spencer knows the papers, including the attached, will undoubtedly be printed as proceedings of the conference although I suspect individual authors were given permission to publish elsewhere.

In a few words, Risebrough has found PCBs along with chlorinated pesticides in a number of species of fish and birds along the California coast as well as in waters off Baja California and Central America. He further reports PCB in fish from the Channel Islands and Puget Sound. No PCB was detected in the liver of tuna taken in the Galapagos Archipelago. Scott Tucker is going to scrutinize the analytical aspects and particularly the validity of some of the assumptions made by the author.

Elmer P. Wheeler

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Attachment

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POLYCHLORINATED BIPHENYLS IN THE GLOBAL ECOSYSTEM

PERSONAL COMMUNICATION

NOT A PUBLICATION

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POLYCHLORINATED BIPHENYLS IN THE GLOBAL ECOSYSTEM

ABSTRACT

Compounds identified as polychlorinated biphenyls, pollutants of industrial and agricultural origin, are now widely dispersed in the global ecosystem. Tissues of peregrine falcons have contained the highest concentrations so far measured. Significant amounts are also present in several species of pelagic sea birds. The geographical distribution patterns indicate that the polychlorinated biphenyls, DDT, and the other chlorinated hydrocarbon biocides, are dispersed predominately by air transport. The polychlorinated biphenyls are powerful inducers of hepatic enzymes which degrade oestradiol. Their enzyme inducing activity in pigeons is approximately four times as great as that of technical DDT and six times that of p,p'-DDE. Both the polychlorinated biphenyls and p,p'-DDE could account for a significant portion of the environmental deterioration which has caused the aberrant calcium metabolism observed in raptors and other species of birds since the Second World War.

Deterioration of the environment has proceeded at a rapid pace and it is universally accepted that it has caused the extinction of some species and has profoundly influenced the relative abundance of others. Whether chemical changes in the global ecosystem have been sufficient to cause widespread harmful effects is still a matter of controversy, yet the interpretation of Ratcliffe's findings that the calcium metabolism of British peregrine falcons (*Falco peregrinus*) changed adversely just after the Second World War is unambiguous (1). A widespread change in the chemical environment has occurred which has affected not only the calcium metabolism of the peregrine falcon but also of other raptors and terminal avian carnivores in both Britain and North America. In every case thin eggshells have been associated with populations which were declining and which were also contaminated with the synthetic chlorinated hydrocarbons which have come into general use since the war. Moreover, geographic variations in eggshell thicknesses have been correlated with the amounts of chlorinated hydrocarbon residues in populations of peregrine falcons, bald eagles *Haliaeetus leucocephalus*, ospreys *Pandion haliaetus*, double-crested cormorants *Phalacrocorax auritus*, and herring gulls *Larus argentatus* (1,2). No other environmental change, such as radioactive fallout, has shown comparable variation over a wide geographical area.

Calcium physiology is intimately related to reproductive physiology and is to a large extent regulated by steroids such as estrogen and vitamin D (3). All or most of the synthetic chlorinated hydrocarbon biocides so far tested induce hepatic enzymes which degrade steroids by hydroxylating them, thereby increasing the rate at which they are excreted (4, 5, 6, 7, 8, 9). The relatively small amounts required to produce this effect (6,10,11,12,13) and the discovery that small amounts of DDT appear to have estrogenic effects (4) have made irrelevant much of the parts per million approach to pollutant ecology based only upon toxicity data.

In both Great Britain and North America it was the decline of the peregrine falcon which has initiated concern about the possible harmful effects of environmental contamination. In the distinguished tradition of British field ornithology, the population collapse in Great Britain was well documented (14,15,16,17) but in the United States the eastern population was extinct before competent observers were aware of a general, widespread decline (18). Breeding peregrines persist in apparently normal numbers in the Pacific northwest (19) and in the Arctic (20,21). A small remnant population remains in southwestern North America.

In 1967 we collected an unhatched, abandoned egg in Baja California, Mexico. Analysis of this egg (Table I) showed that it contained almost 5 milligrams of p,p'-DDE, indicating a high level of contamination in both the adult female and the local peregrine population. Considerable effort was made to identify the unknown peaks present in the chromatograms but these attempts were unsuccessful until the reports appeared from Sweden (22,23) and Great Britain (24) identifying polychlorinated biphenyls in European wildlife. The published chromatograms of the commercial mixture of polychlorinated biphenyls (PCB) and of an extract of a European kestrel (_Falco tinnunculus_) (24) were very similar to those

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times of the unknown peaks in these extracts proved to be identical with those of several PCB compounds on DC-200 and QF-1 columns (25) and on a mixed SE-30:QF-1 column. The chlorine content of several extracts and standards was determined with a Dohrman microcoulometric detector and a method of quantification of the PCB peaks was devised based upon peak heights produced in the electron capture detector related to standard p,p'-DDE (25). Toxaphene, a mixture of polychlorinated camphors, has been reported to be resistant to nitration, whereas DDT is destroyed (26). PCB is also not destroyed by this procedure.

In Table I are presented the results of analyses of peregrine falcons, all of which were originally trapped for the purpose of falconry, which died shortly afterwards in captivity from a variety of causes and were then donated to us for analysis. Significant amounts of PCB were present in Arctic peregrines only a few months old (Nos. 5 and 6), but higher residues were present in a second year Arctic bird (No. 2) and exceptionally high residues were present in an adult trapped in California (no. 4). In birds 2 and 4 the total lipid reserves were very low, and in both the brain levels of DDE and PCB were high, perhaps at toxic levels. Fat mobilization during reproduction or in times of starvation or stress could be expected to cause significant changes in the internal distribution of chlorinated hydrocarbons. Steroid hydroxylase activity in the liver might increase at this time. Dieldrin concentrations were lower than in the peregrines analyzed in Britain, but DDE concentrations were approximately comparable (28).

In Table II are presented the results of analyses of peregrine prey species, remains of which were collected at eyries in Baja California, Mexico. With the exception of the remains of one mourning dove (Zenaidura macroura) and of three fish bats (Pizonyx vivesi), prey material found at four eyries consisted of sea birds. Of these, the eared grebe (Podiceps caspicus) and the black petrel (Loomelania melania) constituted 32% and 25%, respectively, of the remains. Black petrels, like other petrels and shearwaters (29,30, Table III) contained especially high concentrations of both DDT and PCB, a fact which appears to result from their feeding upon organisms at the sea surface, which would receive the components of aerial fallout. Reproductive success in this population of peregrines appears to be subnormal. In 1968, each of two pairs hatched only one young, both of which were fledged. Two other pairs apparently fledged only one young per eyrie and none was observed to hatch or to fledge more than a single young. In the past, two to four young, the number normally produced by healthy peregrines (20), were raised by each pair (31). The region is wilderness, with little or no human interference, and is remote from sources of pollutant application.

In California, numbers of breeding peregrines have been reduced by at least 80% in recent years. Despite minimal human interference, peregrines have disappeared from the nearby Islas Coronados in Mexico, where it can be inferred that they preyed upon seabirds. The remaining few pairs in California, however, appear to be reproducing normally and rear, when undisturbed, 2 to 4 young each year. They are found, like most of the surviving peregrines in Great Britain (17), in a relatively low levels of chlorinated hydrocarbons. Twenty seven remains of 16 prey species collected at a coastal eyrie which produced three young birds in 1968 included 8 mourning doves, one rock dove (Columba livia), 2 woodpeckers, 8 passerine species, one grebe and 6 shorebirds (Scolopacidae). No analyses of the prey species from that region have yet been made, but mourning doves from San Diego (Table III) contained very low residues. On the basis of the residue data available on land and water birds in California (29,32), it is a reasonable hypothesis that the food species of this pair and of other successful pairs at inland eyries are less contaminated than water birds preyed upon by peregrines elsewhere. A clutch of eggs collected in this region contained the normal, prewar, amount of calcium, whereas other peregrine eggs from California collected since the Second World War have contained significantly smaller amounts (2). Despite official protection, the surviving birds are still subjected to shooting by sportsmen and to harrassment of the eyries. If these could be effectively reduced, the population might yet survive.

In Table III are presented the results of analyses of marine and terrestrial birds and of three species of fresh water fishes for PCB and DDT content and concentration. From the ratio of total DDT to PCB, it is apparent that regional fallout patterns for the two compounds exist. In almost all of the fishes (25) and the birds from San Francisco Bay which have been analyzed, this ratio is between one and two. Among the birds this was true for the peregrine falcons (Table I), the western gull eggs, the Caspian tern eggs and one of two black-crowned night heron eggs (Table II). The other black-crowned night heron egg had a typically "ocean" profile, suggesting that the adult female had spent the winter

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along the coast. In most of the birds from the Farallon Islands, which are 27 miles west of the Golden Gate Bridge, this ratio is between 2 and 5. In Panama, where PCB contamination might come from the Canal Zone and industrial areas in Panama City, the ratio is between 1 and 2 (Table III).

In the Gulf of California, a region relatively remote from the sources of either DDT or PCB contamination, this ratio is in most cases approximately 9 or 10. This was true in the egg of the peregrine falcon (Table I) in all of the black petrels and least petrels analyzed, in the Craveri's Murrelets (Table II), in five of six osprey eggs, and in six of seven western gull eggs (Table III). Among the exceptions, the fish bat, with relatively more DDT, but with low concentrations of both DDT and PCB, was the most divergent, with a ratio of 43 (Table II). It is not clear whether this reflects differences between avian and mammalian physiology or a fundamental difference in feeding habits. The exceptions among the osprey and western gull eggs had relatively more PCB; the profiles of the chromatograms resembled those of the Caspian tern from San Diego. The adult females might, therefore, have come from the other side of the peninsula of Baja California. In the eggs of both the elegant terns and the Heermann's gulls, this ratio is lower, reflecting higher amounts of PCB relative to DDT. Both species migrate out of the region following the nesting season and most likely acquire their PCB residues elsewhere.

In sea birds from the Pacific, whether in the fulmars, red phalarope, ancient murrelet and rhinoceros auklet, species nesting in the Arctic and the North Pacific, or in the shearwaters which breed in Australia, New Zealand and Chile, this ratio was usually between 5 and 10. PCB was not found in eggs of the Adélie Penguin, brought from Cape Crozier, Antarctica and kindly made available for analysis by Dr. R. E. Feeney. In these, however, the amount of DDT on a lipid weight basis was very low and the ratio of DDT to the lowest amount of PCB which could have been detected was only 18. A larger amount of fat material from Antarctic organisms, which would yield a sufficient amount of DDT would, therefore, have to be analyzed before concluding that PCB has not yet reached the Antarctic.

The presence of PCB in the few land birds analyzed shows that it is also distributed among terrestrial ecosystems in North America. The PCB concentrations in the three species of fresh water fish from Clear Lake, Lake County, California, were very low, lower than those in marine fish from San Francisco Bay and Puget Sound, and in several cases, lower than those in fish from the Pacific Ocean (25).

Individuals of species resident in industrial areas have, as expected, higher PCB levels than individuals of the same species from more remote regions. Analysis of 10 eggs from 10 clutches of the western gull from the Farallon Islands showed an average DDT concent of 412 micrograms with a standard error at the 95% confidence level of 102 and a PCB content of 136 ± 55. DDT and PCB content of 4 eggs from 3 clutches from an island in San Francisco Bay was significantly higher (Table III). Seven eggs from 7 clutches in the Gulf of California contained 385 ± 230 micrograms of DDT and 45 ± 30 micrograms of PCB. The DDT content is, therefore, not significantly different from that of the Farallon eggs, but the PCB content is much lower.

Birds from the Gulf of California also contain dieldrin and endrin (Tables II and III) but the number of analyses is as yet insufficient to compare their relative abundance to that of DDT and PCB. Despite the inability of the Shell Chemical Company to find any chlorinated hydrocarbons at the mouth of the Colorado River which drains into the Gulf (34) it is likely that some do enter from that source. A significant fraction, however, must come from the atmosphere (35), and air transport best explains the presence of PCB in remote areas. They are poorly soluble in water and have very low but finite vapour pressures (36). Incineration of PCB-containing materials would greatly increase the rate of entry into the atmosphere. Since PCB is used in the manufacture of many industrial products, the high amounts found in San Francisco Bay, Puget Sound (25) and San Diego Bay presumably result from direct discharge of industrial wastes into these waters.

The PCB compound with retention time 1.25 on DC-200 columns and 1.33 on QF-1 columns, relative to p,p'-DDE, is one of the more prominent peaks in San Francisco Bay extracts and in the commercial mixtures, yet it is not present or is present in relatively lower amounts in extracts from Baja California and Panama. To test the possibility that PCB might be subject to degradation by ultraviolet light, standard PCB solutions in hexane were evaporated to dryness in petri dishes, or over layers of water and 3% NaCl solution, and irradiated at a distance of 4 inches with a 15-watt germicidal lamp emitting at 2537 A. In each case, the major change in the chromatograms of the irradiated PCB was a reduction in the relative height of this peak. The effect was more pronounced when PCB was irradiated on the aqueous surfaces.

Peregrines could, therefore, acquire PCB as well as the other chlorinated hydrocarbons, over all of their global range. No PCB

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residue data are available for prey species from the Atlantic, but compounds which appear to be PCB have been isolated from seals (33). A second year male peregrine spent the winter of 1967-68 on Isla Pacheca, Panama, where the pelican, booby, and frigate bird eggs of Table III were collected. The high concentrations in all of the petrels analyzed suggest that the fork-tailed petrels (Oceanodroma furcata), a major prey species of the Peale's race of the peregrine falcon in British Columbia (19, might be similarly contaminated.

The white-tailed kite is becoming abundant in areas of California where insecticide use is intense, yet because it preys primarily upon the short-lived and herbivorous vole Microtus, the species accumulates very low residues of either DDT or PCB. The American kestrels and the barn owl eggs analyzed also contained very low residues. Both species are very common in California. In contrast, the single Cooper's Hawk, a species which elsewhere has shown thinning of eggshells (2) and which preys upon birds, contained high amounts of both DDT and PCB (Table III).

The percentage of p,p'-DDE in the total DDT residue has been given in the tables below. In almost all cases it is above 80 percent. It is most likely, therefore, the most ecologically relevant of the DDT compounds although the differences in estrogenic activity among the various DDT compounds (4) suggest that biological effect does not necessarily reflect parts per million concentrations.

Previous work (13) has shown that both DDT and dieldrin induce hepatic enzymes in the pigeon which, in an in vitro preparation, increase the metabolism of progesterone and testosterone. This work has now been extended to study the metabolism of oestradiol by enzymes induced by p,p'-DDE, technical DDT (Dupont) and PCB (Aroclor 1262). The experimental procedure previously described (13) was followed except that the chlorinated hydrocarbons were injected intramuscularly rather than given orally and in the separation of oestradiol and its metabolites, the solvent system used was the upper layer of a mixture of benzene:heptane:methanol:water 7:3:8:2. The strips were monitored with an autographic strip scanner. The profiles obtained for the various inducing agents are shown in figure 1. It will be noted that the profile of the metabolites obtained following enzyme induction using DDE and DDT are identical, but that a different metabolite is produced by the enzyme induced by PCB. The amount of metabolites formed was calculated from the radioactivity of the peaks. The results obtained are given in Table IV.

p,p'-DDE at body concentrations of 40 ppm in the pigeon significantly increases the rate of oestradiol degradation by the induced hepatic enzymes under the experimental conditions. It may be concluded, therefore, that DDE in nature increases the rate of metabolism of estrogen and other steroids as they pass through the liver. The metabolites produced are more polar and their biological activity is most likely altered. On a weight basis, the PCB preparation had an oestradiol degrading potential approximately 5.6 times that of p,p'-DDE and 4.1 times that of technical DDT. PCB and p,p'-DDE may, therefore, be the most ecologically significant pollutants now accumulated by organisms.

Studies on the activity of induced enzymes in the rat at various times after a single injection of DDT or dieldrin have been made by Ghazal (37). He found that it took 70 days for the activity to fall to half its maximum value in the case of DDT and 15 days in the case of dieldrin. Experiments with dieldrin on pigeons show that only a quarter of maximum activity remains after a month. Thus, there is evidence that the effects of these induced enzymes can persist over a long period of time although more studies are needed to determine the steroid degrading potentials of livers of those species contaminated with chlorinated hydrocarbons. The profile of the metabolites should be some indication of the history of exposure to chlorinated hydrocarbons.

Decreases in eggshell thickness and eggshell weight have amounted to as much as 19% in both Britain and America (1,2). Chances of eggshell breakage are thereby greatly increased (1,14). Humidity may significantly affect the hatching success of duck eggs (38,39) and decreased eggshell thickness in poultry has been shown to cause decreased hatching success through increased water loss from eggs (40,41). The environment in which birds now exist is no longer the same as that in which they evolved; it is unlikely that any species has the genetic capacity to meet the selection pressures resulting from the abrupt environmental change which has produced the thin eggshells.

Several mechanisms may account for the aberrant calcium metabolism observed in peregrines and other birds. Vitamin D, a steroid, is essential for the absorption of calcium from the alimentary tract and increases the level of calcium available from bone resorption (42,43). Hens deficient in Vitamin D lay eggs with lower eggshell weights, less yolk calcium, and presumably, with lower Vitamin D contents. The developing embryos of such eggs utilize less calcium from the eggshell (44). Reduced levels of estrogen and androgen could be expected to reduce the deposition of medullary bone, a major source of calcium during egg and eggshell formation

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(3,45,46,47). Lowered estrogen levels could also affect both the amount of calcium normally excreted (48) and the concentration of serum calcium which normally increases under estrogen stimulation as a result of liver synthesis of yolk proteins which are bound to calcium (45). Induction of steroid metabolizing enzymes by chlorinated hydrocarbons could affect any of these processes.

Vitamin A mobilization is also influenced by estrogen (49,50) indicating that eggs of contaminated birds might be deficient in vitamin A. Bumblefoot is a foot ailment that has showed an increased incidence in captive peregrine falcons in recent years. Both prophylaxis and treatment involve the administration of vitamin A.

Fortunately, all of these hypotheses are subject to experimental test; alienated molecular biologists are now in a position to perform an enormous and invaluable service to the world's wildlife and to those concerned with its preservation. The peregrine falcon is a species long highly revered and respected. G.H.Thayer (51) has described it as "the embodiment of noble rapacity and lonely freedom". A subtle irony therefore exists in the fact that the peregrine may be the first species to be extirpated by global contamination.

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Table 1: Chlorinat.. hydrocarbons in North American . eregrine Falcons. Concentrations in parts per million, wet weight, dry weight, or lipid weight.

Sample	Dieldrin	Total DDT[(a)]	%DDE	PCB	DDD/PCB
1. Unhatched egg [(b)] Baja California (wet)	0.11	102	97	10.2	10
2. Second year [(c)] migrant from Arctic					
breast muscle (wet)	NM	99	94	28	3.5
breast muscle (dry)		296		84	
brain (wet)	NM	85	98	21	4.7
carcass (wet)	0.87	70	93	19.7	3.5
carcass (lipid)	62.5	5000		1420	
3. Immature, California [(d)]					
breast muscle (wet)	NM	14.4	90	9.4	1.5
liver (wet)	NM	7.7	92	4.5	1.7
brain (wet)	0.04	2.8	89	1.5	1.9
brain (lipid)	0.50	36		19.3	
carcass (wet)	0.11	20.2	92	10.8	1.9
carcass (lipid)	1.6	300		160	
4. Adult, California [(e)]					
breast muscle (wet)	NM	127	87	98	1.3
liver (wet)	NM	77	80	57	1.4
brain (wet)	0.31	49.5	86	34.6	1.4
brain (lipid)	3.7	595		415	
carcass (wet)	1.7	85	87	65	1.3
carcass (lipid)	50	2600		1980	
5. Immature [(f)] migrant from Arctic					
breast muscle (wet)	NM	2.3	81	0.16	14
breast muscle (dry)		7.8		0.54	
liver (wet)	NM	1.0	92	0.10	10

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Table 1, continued

brain (wet)	NM	0.43	83	0.037	12
body fat (wet)	NM	50.3	82	3.2	16
carcass (wet)	0.07	9.3	82	0.80	12
carcass (lipid)	0.44	63.7		5.5	
6. Immature Arctic migrant [g]					
breast muscle (wet)	NM	1.9	69	0.6	3.4
breast muscle (dry)		6.0		1.9	

[a] DDT residues include: p,p'-DDT, p,p'-DDE, p,p'-DDD (p,p'-TDE), p,p'-DDMU, o,p'-DDT and o,p'-DDE. NM: not measured.

[b] Chlorinated hydrocarbon contents of the egg were: 4,700 micrograms p,p'DDE; 40 micrograms o,p'-DDE; 29 micrograms p,p'-DDT; 7.4 micrograms p,p'-DDD; 37 micrograms p,p'-DDMU; 5 micrograms dieldrin; 12 micrograms heptachlor epoxide. Concentrations were calculated by assuming a volume of 47.3 ml., the average value obtained by measuring 11 clutches of peregrine eggs from California in the Museum of Vertebrate Zoology, University of California, Berkeley, and by assuming a density of 1.0.

[c] Second year female, captured in October on the Texas coast during migration. Died in captivity shortly afterwards, no apparent cause of death. No body fat. Total body content of chlorinated hydrocarbons: 35 mg. DDT, 10 mg. PCB, 0.44 mg. dieldrin, 0.18 mg. heptachlor epoxide. Total body lipid, 7 gm.

[d] Plumage characteristics of both 3 and 4 were intermediate between those of typically resident California birds and the arctic race F.p. tundrius, as described by White (27). No. 3 was immature female of the year trapped in the southern San Francisco Bay area in the winter of 1966. Observed feeding in the area for a week prior to capture. Died suddenly after eating a dead gull. Moderate body fat. Total body chlorinated hydrocarbon content: 13 mg DDT,

6.8 mg. PCB, 0.07 mg. dieldrin, 0.09 mg. heptachlor epoxide. Total body lipid, 43 gm.

[e] Adult female. Trapped in the southern San Francisco Bay area in the winter of 1966. Observed feeding in the area for a month prior to capture. Died shortly afterwards with no apparent cause of death and no body fat. Total body chlorinated hydrocarbon content: 52 mg. DDT, 40 mg. PCB, 1.0 mg. dieldrin, 1.0 mg. heptachlor epoxide. Total body lipid, 20 gm.

[f] First year female trapped on the Texas coast in October. Lost at Pt. Mugu, California, the following January and was shot by a sportsman 3 weeks later. Abundant body fat. Total body content: 7 mg. DDT, 0.6 mg. PCB, 0.05 mg. dieldrin, 0.17 mg. heptachlor epoxide. Total body lipid, 110 gm.

[g] First year female trapped on the Texas coast in October. Died shortly afterwards of heat prostration.

Table II. PCB and DDT in prey species of Peregrine Falcons in the Gulf of California. Content in micrograms of whole bodies and eggs; concentrations in parts per million wet weight (W) or lipid weight (L).

Species [(a)]	N	DDT µg	DDT ppm	%DDE	PCB µg	PCB ppm	DDT/PCB
Eared Grebe (13) Whole body	3	...	0.28, 0.26, 12.1	97	NM[(b)]		...
Black Petrel (10) Whole body	8	810 (685-1344)	9.2(W)	81	...	1.0(W) (0.90-1.14)	9.2
Least Petrel (6) Whole body	3	99	3.2(W)	83	...	0.35(W)	9.3
Eggs	2	30 (23-37)	...	84	3.1 (1.2-5.0)	...	10
Fish Bat (3) Whole body	7	25 (15-31)	0.71(W)	62	0.58 (0.45-1.06)	0.02(W)	43
Craveri's Murrelet (2) eggs (one clutch)	2	230 [(c)] (223-238)	39(L)	80	...	4.5(L)	8.7
Whole body, adult	1	37.1	0.31(W)	85	...	0.039(W)	7.9
Whole body, adult	1	295	2.4(W)	85	...	0.26(W)	9.2
Elegant Tern (1) Eggs	8	15.5 (9.6-24.3)	5.0(L)	90	...	1.5(L) (0.8-3.6)	3.9
Heermann's Gull (1) Eggs	3	195 (94-278)	48(L)	95		8.1(L) (3.5-11.3)	5.9

(a) All specimens were collected in the vicinity of four peregrine eyries in Baja California. Numbers in parentheses are the number of remains of each prey species which were found at the eyries. Also found were remains of one cormorant. (*Phalacrocorax sp.*), one Red Phalarope (*Phalaropus fulicarius*), one Northern Phalarope (*Lobipes lobatus*), and one Mourning Dove (*Zenaidura macroura*), but local specimens of these species were not analyzed. Eggs of least petrels, elegant terns and Heermann's gulls were from different clutches. Eared grebe: *Podiceps caspicus*; black petrel *Loomelania melania*: least petrel: *Halocyptena microsoma*; fish bat: *Pizonyx vivesi*; Craveri's Murrelet: *Endomychura craveri*; elegant tern: *Thalasseus elegans*; Heermann's gull: *Larus heermanni*.

(b) not measured. Interfering peaks on chromatograms.

(c) both eggs also contained 0.08 ppm dieldrin (lipid weight) and 0.17 ppm endrin (lipid weight).

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Table III. PCB and DDT in the global ecosystem. Content in micrograms and concentrations in parts per million wet weight (W) or lipid weight (L).

Species		N	Total DDT µg	Total DDT ppm	%DDE	PCB µg	PCB ppm	DDT/PCB
White crappie (1)		1	--	1.83 (W)	6	--	0.004 (W)	475
Black crappie (2)		1	--	2.10 (W)	6	--	0.003	660
Bluegill (3)		1	--	5.5 (W)	6	--	0.005	1200
Adélie penguin, (4) eggs		5	0.78 (0.59-1.04)	0.128 (L)	74	<0.044 µg/egg		>18
Western grebe, (5) breast muscle		1	--	26.4 (W)	5	--	0.098 (W)	270
Fulmar (6)								
	A	1	--	0.41 (W)	76	--	0.08 (W)	5
	B	1	--	3.4 (W)	89	--	0.34 (W)	10
	C	1	10,475	17.5 (W)	96	3900	6.5(W)	2.7
Pink-footed (7) shearwater		1	2,000	3.0 (W)	93	277	0.42(W)	7.2
Sooty shearwater (8)								
	A	1	--	12.3 (W)	94	--	1.2(W)	10
	B	1	--	10.3 (W)	86	--	0.9(W)	12
	C	1	1,265	2.3 (W)	85	NM		
Slender-billed (9) shearwater		1	--	32.0 (W)	92	--	2.1(W)	15
Ashy Petrel (10)		3	2,158 (1644-2826)	59.3 (W)	95	389 (298-482)	9.8(W)	5.5
Brown Pelican, (11) eggs, Panama		6	59 (18-183)	11.5 (L)	61 (47-78)	23.1 (18-30)	--	1.55 (0.97-3.2)
eggs, Baja Calif.		2	53 (47-59)	10.0 (L)	81	10.4 (9.0-11.7)	--	6.5, 4.0

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Table III, continued

Frigatebird[12] eggs, Panama	3	9.6,8.7,30.0	...	88	8.4,5.7,84.0	...	1.1,1.5, 0.4
Brown Booby[13] eggs, Panama	4	20.8 (16.4-24.5)	8.2 (L)	89	12.2 (6.5-18.9)	4.8(L)	1.7
Brandt's Cormorant[14] eggs	17	326	—	91	113	--	2.9
Pelagic Cormorant[15] eggs	2	128 (125-130)	—	90	62 (48-75)	—	2.1
Cinnamon Teal[16]	1	4340	10.9 (W)	70	--	0.91	12
White-tailed Kite[17]							
eggs, clutch A	4	11.4 (9.8-12.9)	0.76 (W)	77	6.4 (5.5-7.8)	—	1.8
Unhatched egg B	1	5.1	0.34 (W)	82	0.84	--	6.0
Unhatched egg C	1	5.3	0.35 (W)	73	3.6	--	1.5
Clutch D	2	8.3/egg	...	82	4.3/egg	...	2.0
Clutch E	3	10.2/egg	9.0 (L)	57	4.0/egg	...	2.6
Clutch F	4	31.9/egg	...	80	3.8/egg	...	8.5
Cooper's Hawk[18]	1	8,500	25.2 (W)	90	--	6.3	4.0
Golden Eagle[19] egg	1	150	2.0 (W)	98	17.5	0.23(W)	8.5
Osprey, Baja Calif.[20]	6	127 (30-264)	55 (L)	85	(7.3,3.0, 103)(24, 7.0,19)	--	8.5,10.1 1.3,11.2 9.7,11.1
Merlin[21]	1	435	2.9 (W)	94	55.4	0.39 (W)	12.7
American Kestrel[22]							
Whole body, adult	1	5.1	0.044	39	3.7	0.031	1.4
eggs, 2 clutches	6	2.4/egg	0.20 (W)	93	1.0/egg	0.09(W)	2.3
Black-crowned night heron (23)							
egg	1	541	—	89	330	—	1.6
egg	1	869	—	99	23	--	36

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Table III, continued

Western Gull[24]							
eggs, San Francisco Bay, 3 clutches	4	803 (632-1123)	--	85	805 (580-1310)	--	1.0
eggs, Farallon Is. 10 clutches	10	412±102	--	89	136±55		3.0
eggs, Baja Calif. 7 clutches	7	385±230	--	97	45±30	...	9.1,10.5, 5.0,12.3, 10.6,10.7, 10.5
Forster's Tern[25]							
eggs	2	665 (598-732)	--	89	114 (91-137)	--	5.8
Caspian Tern[26]							
eggs, San Francisco Bay	2	1269 (1216-1322)	--	89	805 (660-950)	--	1.7
eggs, San Diego Bay	5	1430 (991-2430)	--	88	1010 (550-1600)	--	1.4
Red Phalerope[27]	1	--	0.78 (W)	79	--	0.10	8
Common Murre[28]							
eggs	6	1945 (932-3621)	151 (L)	90	558 (364-1010)	45 (L)	3.5
Cassin's Auklet[29]	1	--	5.8 (W)	98	--	0.16	36
Ancient Murrelet[30]	1	--	0.75	90	--	0.15	5
Rhinoceros Auklet[31]	1	--	2.7	97	--	0.36	8
Mourning Dove[32]	2	12.0,33.1	0.19(W)	77, 93	Not detected	...	...
Barn Owl[33]							
eggs, one clutch	3	27.7/egg	1.25(W)	95	10.4/ egg	0.47(W)	2.7
eggs, one clutch	2	143/egg	6.6 (W)	96	14.4/ egg	0.66(W)	10
Meadowlark[34]	2	21.2,448	0.18, 3.3 (W)	77, 93	2.5,28.1	...	8.4, 15.9

Unless otherwise specified, analyses were of whole bodies. Endrin and dieldrin were identified on the basis of retention times on both QF-1 and DC-200 columns.

1. *Pomoxis annularis*, 284 gm., Clear Lake, Lake Co., Calif. May 1968
2. *Pomoxis nigromaculatus*, 212 gm., Clear Lake, Lake Co., Calif., May 1968.
3. *Lepomis macrochirus*, 229 gm., Clear Lake, Lake Co., Calif., May 1968.

Table III, continued

4. Pygoscelis adéliae, Cape Crozier, Antarctica, October, 1967.
5. Aechmophorus occidentalis, Clear Lake, Lake Co., Calif., May, 1968.
6. Fulmarus glacialis. A and B: Monterey Bay, Calif., Nov. 1, 1966. C: Point Reyes, Calif., December, 1967. Fulmars breed in Alaska.
7. Puffinus creatopus. Breeds in Chile. Collected in May, 1968, in the Gulf of California.
8. Puffinus griseus. Breeds in New Zealand and Chile. A and B: Monterey Bay, November 1, 1966. C: Gulf of California, May, 1968. NM: not measured, interfering peaks.
9. Puffinus tenuirostris. Breeds in Australia. Monterey Bay, Dec., 1966.
10. Oceanodroma homochroa. Farallon Islands, Calif. May, 1968.
11. Pelecanus occidentalis. Panama eggs were collected on Isla Pacheca and Isla Pachequilla, Gulf of Panama, Feb. 1968. One egg contained 0.06 ppm dieldrin and 0.06 ppm endrin, another contained 0.16 ppm dieldrin and 0.07 ppm endrin (lipid weight). Baja California eggs were collected at Bahia de los Angeles, March, 1968. One egg contained 0.24 ppm dieldrin and 1.13 ppm endrin (lipid weight).
12. Fregata magnificens. Isla Pacheca, Panama, February, 1968.
13. Sula leucogaster. Isla Pacheca and Isla Pachequilla, Panama, February, 1968. Two eggs were analyzed for dieldrin and endrin. Dieldrin: 0.08, 0.18; endrin: 0.06 and 0.011 ppm (lipid weight).
14. Phalacrocorax penicillatus. Farallon Islands, May, 1967
15. Phalacrocorax pelagicus. San Mateo Co., Calif.
16. Anas cyanoptera. San Diego, April, 1968. Adult male.
17. Elanus leucurus. A: Contra Costa Co., Calif. April, 1968. B and C: Contra Costa Co., May, 1968, 2 and 3 young raised, respectively. D: abandoned, Contra Costa Co., May, 1967. E and F: destroyed nests, Contra Costa Co., March, 1968.
18. Accipiter cooperii. Balboa Park, San Diego, Feb., 1968. First year female, died of trichomonaisis.
19. Aquila chrysaetos. San Luis Obispo Co., Calif. April, 1968. Unhatched egg in nest where one young was raised. Egg also contained 4.7 micrograms of dieldrin, 1.9 micrograms of heptachlor epoxide, but no endrin.
20. Pandion haliaetus. Gulf of California, March, 1968. One egg also contained 0.10 ppm dieldrin and 0.25 ppm endrin (L).
21. Falco columbarius. Immature, Utah. December, 1967.
22. Falco sparverius. Adult was road kill, Mendocino Co., Calif., December, 1967. Eggs from Davis, California, 1968.
23. Nycticorax nycticorax. Eggs from different clutches, San Francisco Bay, May, 1967.
24. Larus occidentalis. Standard errors, 95% confidence limits.
25. Sterna forsteri. San Diego Bay, May, 1967.
26. Hydroprogne caspia. 1967.
27. Phalaropus fulicarius. Monterey Bay, November 1, 1966.

Table III, continued

28. *Uria aalge*. Farallon Islands, May, 1967.
29. *Ptychoramphus aleutica*. Farallon Islands, April, 1966.
30. *Synthliboramphus antiquum*. Monterey Bay, Nov. 1, 1966.
31. *Cerorhinca monocerata*. Monterey Bay, Nov. 1, 1966.
32. *Zenaidura macroura*. San Diego, July, 1968.
33. *Tyto alba*. Clutch A from Contra Costa Co., Calif. March, 1968. Clutch B from Yolo Co., Calif., April, 1968.
34. *Sturnella neglecta*. Davis, Calif., December, 1967.

Table IV

Increase of oestradiol metabolism by pigeon liver homogenates from birds treated with various chlorinated hydrocarbons

	Amount of polar metabolities formed in mμmoles
Control	29.3 ± 6.5
DDE (40 mg/kg)	76.2 ± 13.1
DDT (40 mg/kg)	93.1 ± 11.2
PCB (20 mg/kg)	160.0 ± 10.5

Each figure is the average with standard deviation of a group of four birds. In all cases 500 mμmoles of oestradiol-6,7-T (500 mc/mM) was present in the incubation mixture. Incubation time 30 mins, weight of microsomal fraction used was 300 mg. All chlorinated hydrocarbons were injected i.m. into the pectoral muscle 7 days before sacrifice.

NEV 018656

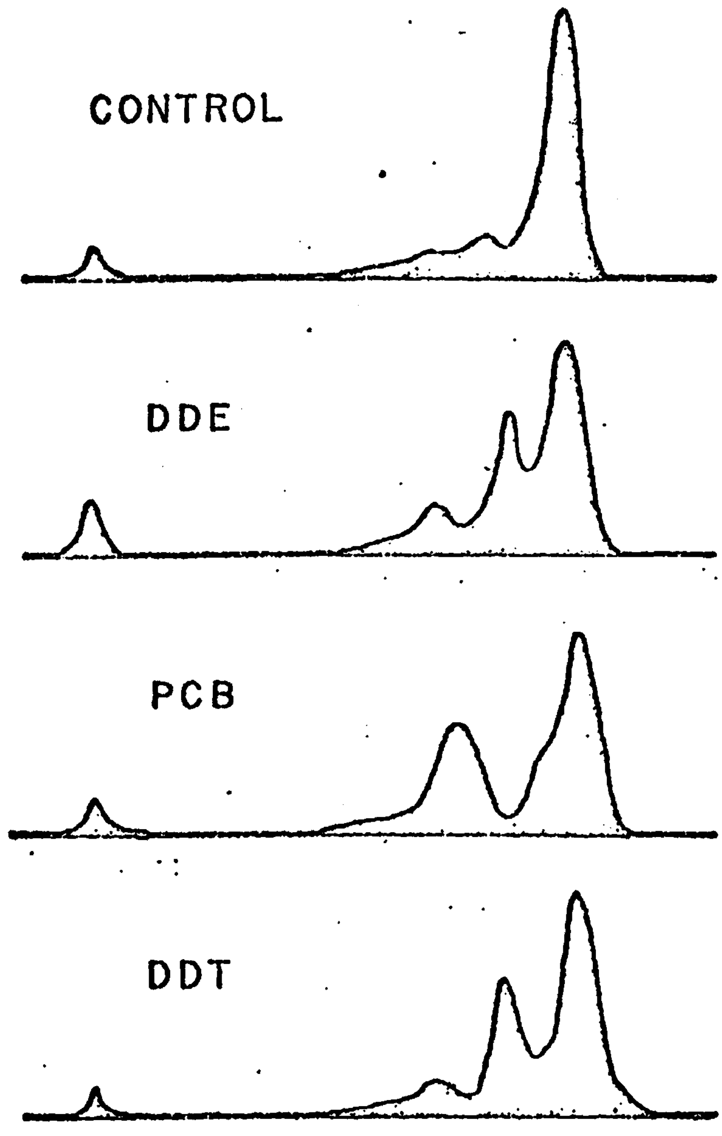

Figure 1. Chromatographic separation of oestradiol and its metabolites. The large peak is unaltered oestradiol.

NEV 018657

726708

WATER_PCB-SD0000072506

References

1. Ratcliffe, D. A., Nature 215, 208 (1967).
2. Hickey, J. J. and Anderson, D. W., in preparation. Anderson, D. W., personal communication.
3. Simkiss, K., Calcium in Reproductive Physiology (Reinhold, New York, 1967).
4. Welch, R. M., Levin W., and Conney, A. H., Chemical Fallout, First Rochester Conference on Toxicity, in press (1968)
5. Hart, L. G., Schultice, R. W., Fouts, J. R., Toxicol. Appl. Pharmacol. 5, 371 (1963).
6. Hart, L. G., Fouts, J. R., Naunyn-Schmiedebergs Arch. Exp. Path. Pharmakol. 249, 486 (1965).
7. Conney, A. H., Welch, R. M., Kuntzman, R., Burns, J. J., Clin. Pharmacol. Therap. 8, 2 (1966).
8. Conney, A. H., Pharmacol. Rev. 19, 317 (1967).
9. Kupfer, D., Residue Rev. 19, 11 (1967).
10. Gerboth, G., Schwabe, U., Arch. Exp. Pathol. Pharmakol. 246, 469 (1964).
11. Gillett, J. W., J. Agr. Food Chem. 16, 295 (1968).
12. Schwabe, U., Arzneimittel-Forsch. 14, 1265 (1964).
13. Peakall, D. B., Nature 216, 505 (1967).
14. Ratcliffe, D. A., British Birds 51, 23 (1958).
15. Ratcliffe, D. A., Bird Study 10, 56 (1963).
16. Ratcliffe, D. A., Bird Study 12, 66 (1965).
17. Ratcliffe, D. A., Bird Study 14, 238 (1967)
18. Hickey, J. J., ed. The Population Biology of the Peregrine Falcon (University of Wisconsin Press, in the press).
19. Beebe, F. L., Condor 62, 145 (1960).

20. Cade, T. J., White, C. M., and Haugh, J. R., Condor 70, 170 (1968).

21. Enderson, J. H., and Berger, D. D., Condor 70, 149 (1968).

22. Jensen, S., New Scientist 32, 612 (1966).

5 23. Widmark, G., J. Ass. Off. Anal. Chem. 50, 1069 (1967).

24. Holmes, D. C., and Simmons, J. H., and Tatton, J. O'G., Nature 216, 227 (1967).

1 25. Risebrough, R. W., Chemical Fallout, First Rochester Conference on Toxicity, in the press (1968).

26. Erro, F., Bevenue, A. and Beckman, H., Bull. Environ. Cont. Toxicol. 2, 372 (1967).

27. White, C. M., Auk 85, 179 (1968).

28. Jefferies, D. J. and Prestt, I., British Birds 59, 49 (1966).

29. Risebrough, R. W., Menzel, D. B., Martin, D. J., and Olcott, H. S., Nature 216, 589 (1967).

30. Wurster, C. F. and Wingate, D. B., Science 159, 979 (1968).

31. Walker, L. W., personal communication.

32. Keith, J. O. and Hunt, E. G., Transactions of the Thirty-First North American Wildlife and Natural Resources Conference (Wildlife Management Institute, 1966).

3a 33. Holden, A. V. and Marsden, K., Nature 216, 1274 (1967).

34. Aldrin, Dieldrin, Endrin (A Status Report), The Shell Chemical Company, 1967.

35. Risebrough, R. W., Hugget, R. J., Griffin, J. J. and Goldberg, E. D., Science, 159, 1233 (1968).

36. Technical Bulletin/PL-306, Monsanto Chemical Company.

37. Chazal, A., Koransky, W., Portig. J., Vohland, H. W. and Klempau, I., Arch. Exptl. Pathol. Pharmakol. 249, 1 (1964).

38. Jones, R. E. and Leopold, A. S., J. Wildlife Management 37, 221 (1967).

39. Mayhew, W. W., J. Wildlife Management 19, 36 (1955).

40. Buckner, G. D., Martin, J. H. and Peter, A. M., Amer. Journ. Physiol. 71, 543 (1925).

41. Buckner, G. D., Martin, J. H. and Peter, A. M., Ky. Agr. Expt. Sta. Bull. 291 (1929)

42. Nicolaysen, R. and Eeg-Harsen, N., Vitamins and Hormones, 11, 29 (1953).

43. Coates, M. E. and Holdsworth, E. S., Brit. J. Nutrit. 15, 131 (1961).

44. Hart, E. B., Steenbock, H., Lepkovsky, S., Kletzien, S. W. F., Halpin, J. G., and Johnson, O. N., Jour. Biol. Chem. 65, 579 (1925).

45. Simkiss, K., Biol. Rev. 36, 321 (1961).

46. Clavert, J. and Benoit, J., C. R. Soc. Biol., Paris, 136, 509 (1942).

47. Kyes, P. and Potter, T. S., Anat. Rec. 60, 377 (1934).

48. Common, R. H., J. Agric. Sci. 23, 555 (1933).

49. Gardener, U. E., Phillips, W. E., Mow, W. A. and Common, R. H., Nature 170, 80 (1952).

50. Plack, P. A., Miller, W. S. and Ward, C. M., Proc. Biochem. Soc. 90, 33 (1964).

51. Thayer, G. H., Bird Lore 6, 47 (1904).

52. The major support was provided by the National Science Foundation Grant GP 6362. Work in Baja California was supported in part by the National Science Foundation Grant GB 7600 to the San Diego Society of Natural History. The oestradiol degradation studies were supported by the United States Public Health Service Grant E.S. 00306. Pure p,p'-DDE was kindly supplied by the Federal Drug Administration. Aroclor samples were kindly supplied by the Monsanto Chemical Company. We thank P. L. Ames, M. S. Coulter, H. L. Davis, Mama Diaz, R. E. Feeney, Dr. Luis Howell R., J. Jehl, W. Kerr, F. MacIntyre, Ing. E. Mayo, Sr. R. Marmolejo L. and other

authorities of the United States of Mexico, E. McMillan, D. Mendola, the Morro Bay Audubon Society, H. S. Olcott, H. J. Peeters, A. C. Risser, R. L. Rudd, Janos Szabo, Lic. Dario Tovar, L. W. Walker and R. Winslow for their assistance.

Monsanto

FROM (NAME & LOCATION): W. R. Richard - Research Center

DATE: September 9, 1969

SUBJECT: DEFENSE OF AROCLOR - F. FLUIDS

REFERENCE:

TO: E. Wheeler - EWHEE

cc: P. Hodges PHODG
M. Farrar Res. 1
~~[illegible]~~ H. Bergen HBERG

General Policy

Make the Govt., States and Universities prove their case, but avoid as much confrontation as possible. Comply and work with public officials to meet or exceed requirements ahead of time. Adverse publicity and competition are the real weapons.

Analytical for Aroclor
- In Air - Which Aroclors are present? Where?
- In Water - Which compounds
- In Animals interfere?

G Ag

Keep track of how much contamination - which sources.

Prove Bioharmful - Let Govt. prove its case, on case by case

Monsanto Visit-Govt. Biolabs - in search of toxicologi experiments and evidence vs. Aroclors to keep up progress.

Monsanto Prove Bioharmless - Limited work at Ind. Bio-test -

"Safe" toxic level for {man, mammals, fish} via Rats, Chickens, Fish

Seek evidence of Bio da

Question evidence ag us

Question shrimp toxic especially other to chemicals.
If Aroclor bad, oth must be worse.

Probable Outcome

We can prove some things are OK at low concentration. Give Monsanto some defense.

We can't defend vs. everything. Some animals or fish or insects will be harmed.

Aroclor degradation rate will be slow. Tough to defend against. Higher chlorination compounds will be worse ... lower chlorine compounds.

84174

Therefore we will have to restrict uses and clean-up as much as we can, starting immediately.

to what level? Which ones?

PLAINTIFF'S EXHIBIT 424

PLAINTIFF'S EXHIBIT 4575A

EV 071 MON 0209

WATER_PCB-SD0000072511

Therefore we will have to work for alternate products in end use applications; for Aroclor production facilities.

Clean Up Aroclors and substitute products where necessary and when required, before threats of publicity and competitive activity overwhelm us.

Water Pollution seems to be first issue

Aroclor product is refractive, will settle out on solids - sewerage sludge - river bottoms, and apparently has a long life.

Florida or Gulf Coast - Aroclor 1254 - Aroclor 1260 pres[ent] issue.

40-200 ppb - causing problem at Pensacola (Monsanto) in plant effluent-causing " with shrimp.
- can't risk shut-down of plant.

Federal and State can extrapolate to other plants in Gulf area.

San Francisco - Aroclor 1254 and 1260

Reported Aroclor to be present in San Francisco Bay.

Reported to be thin egg shells in birds -

Lot of screaming -

Great Lakes Warf studies on DDT

Aroclor 1254 will be found!

Aroclor 1242 will be found?

Air Pollution - Possible spread - but less of an issue right now.
Analytical work more difficult.

Direct Contact with Product

Doesn't seem to be an issue - except for food heat transfer

We don't believe Aroclor is being used as carrier for insecticide - sprayed around -

We are not positive but most uses are "closed" systems or products used in solid plastics, or adhesives, or sealants.

F. Fluids	Possible Pollution by Customers Plant Operation	Possible P by Custome
Product		
Hydraulic Fluids	Yes, leakage external	Possible - Johnson Mot Castings.
Air Compressor Fluids	Yes, leakage external	Leakage int
Heat Transfer	Yes, leakage external	Leakage int
Capacitor Fluids	Yes, leakage from plant - Scrap materials.	In product closed for e
Transformer Fluids	No, Should be clean. Yes, Reworked transformers	In product closed for e

* Capacitors can go to land fill dumps. Probably not burned, in Al containers.

** Need to take care of Aroclor in discarded transformers. Product could be drained and reworked.

Probable Conclusions

Hydraulic Leakage - Product could be caught at machines but will take a lot of clean-up work with customers. - Will have to have replacement product - with less-sensitive components. Work from this base on clean-up to prevent more pollution problems.

Air Compressor Fluids "

Hydraulic Fluids Must expect "shrimp" experiments, West Florida State, to be "aired" sometime soon; next few months.

This will lead to bad publicity and competitive action vs. all Pydrauls.

We will have to try to confine to Aroclor 1254 and Aroclor 1260.

We will have to take action before that time.

Gulf Coast -

Action W. Richard	Be able to replace Aroclor 1254 and Aroclor 1260 in Pydraul AC and 625 in 2 month's time before Nov. 15, 1969.
Fallon/ Richard	Have trial product in hands of Gulf Coast accounts and distributor before Dec. 15.
Fallon	Suggest possible buy of "all phosphate" ester from Food Machinery. Use this as one trial fluid MCS___ for insurance.
Richard/	Suggest possible substitution of Aroclor 5442 for Aroclor 1254 in hydraulic and compressor blends. E. Wheeler judges lower order of toxicity and solubility for 5442 series. Have to test product in pump test for deposits.
Fallon/ Richard	Suggest field trials of our own all-phosphate ester.
Fallon/ Kuhn/ Kountz	Work with large customers to clean-up streams. Bring in Findett as mfg. partner in the recycle business. Get money out of recycle operations.

Inland-Waterways-

Wheeler/ Richard	Be close enough to Great Lakes studies to judge situation. Are there animals which are being affected by the concentrations found?
Richard	Be prepared to replace Aroclor 1254 and Aroclor 1260 in 4 months in hydraulic fluids and in air compressor fluids.
Richard	Be prepared to replace all Aroclor 1242 or 1248 in 6 months in hydraulic fluids. This means replacement of Pydraul 312 series, and control of sale of Aroclor 1248 to other hydraulic accounts such as Cities Service and Mobil.

Heat Transfer

4 0081

Fallon/ Roush/ Kountz	Systems will have some leakage depending strongly on engineering and maintenance. Need to work with customers on clean-up.
Fallon/ Roush	Need to replace FR especially in food or sensitive product areas where the product is getting into water. See dish washer compounds. See letter E. Wheeler to J. Fallon.

We have possible rep[la]cement products in Therminol 55.
Therminol 66.

Action

Kuhn

Try to assure adequate production of Therminol 66 in face of decreased Aroclor production. H_2 and terphenyl supply may become short.

Switch customers to Therminol 55
or Therminol 66
ahead of pollution problems in customers plant.

Work with customers on plant and dumping practices.

Kuhn/ Fallon

Findett already set up to rework. Need to make them a manufacturing arm. We get sale of recycle-rework fluid.

Capacitor Fluids

Capacitor plants have repurification and recycle systems but up to 5% of product can be lost by poor plant producers and off-quality material.

Mkt. Benignus/ Bryant

Eng.-Kountz/ Mfg-Hodges

5% of production could be 1M lbs/year. This is a big loss for the type of pollution we are trying now to guard against.

Action

Eng.,TSD-Plant Pollution Control

Hodges/ Kountz

Monsanto must start to work with capacitor people to clean up plant practices. We have set-up to accept material for rework into hydraulic fluid but this relocation is not a satisfactory solution. Material must be reworked to electrical grade or destroyed, whichever is more economical. Must start now to get control of off-grade material.

Capacitor products

Enclosed in Al or stainless steel for 5 to 25 year period.

Will ultimately have to dispose of capacitor products.

Recommend we try to save this product fo: a time.

Recommend replacement future Aroclor busine with other products. Have 2 years.

Action

Monsanto must help plant clean-up of customer plants decantation, coalescing, adsorption, disposal of adsorbent or recycle of adsorbents.
Monsanto badly needs "know-how" for clean-up.

Monsanto should seek Govt. contract money for clean-up research, (See MRC R. Binning, D. Nelson)

<u>Transformers</u>	Transformer Plant can operate in a clean, efficient manner with recycle of off-grade Aroclor.	Product transfor[illegible] can remain close[illegible] no exposure for 2
<u>Action</u> Benignus/ Bryant	Should advise disposal of filter element materials so as to minimize chance of water pollution. Incinerate or dispose.	
	Reworked transformers pose a threat if the Aroclor is dumped into a water stream.	Should try to ret[illegible] business by clea[illegible] by education of c[illegible] tomers.
<u>Action</u> Benignus/ Bryant	Should try to minimize chance of dumping "old" fluid by re-working and by educating co. shops and collecting product for rework or disposal.	
	Dalton is set up in England to rework electrical grade fluid.	
Kuhn/Kountz Findett?	Need rework facility here + disposal scheme.	

<u>Monsanto Plants</u>

The Dept. of Interior and/or State authorities could monitor plant outfall and find ppm of chlorinated biphenyls at Krummrich or Anniston anytime they choose to do so. This would shut us down depending on what plants or animals they choose to find harmed.

<u>Action</u> - Take steps to see that every precaution is taken to prevent Aroclor entering water streams. Try to reduce to ppb level.

P.Hodges-Seek a Govt. contract on adsorption and incineration
TSD cycles - MRC.

Engrg.-
Kountz Take samples of streams and river water and mud evidence for before and after clean-up. Samples can be stored for further analysis if we can't keep up current with analytical determinations.

Apply Monsanto clean-up methods to customer plant clean up equipment and procedures.

Action -

Engrg. & Mfg.

Kountz and Kuhn

Evaluate liquid incinerators vs. solids handling incinerators for disposing of Aroclor and pentachlorophenol wastes. I estimate Aroclor disposal at 1-4M lbs/year, exclusive of cleaning up river bottoms or outfall bottoms.

Hydraulics	20% of 4M lbs	800,000 lbs
Heat Transfer	10% of 2M lbs	200,000 lbs
Capacitors	5% of 20M	1,000,000 lbs
Transformers	5% of 15M	750,000 lbs
		2,750,000 lbs

Central Eng. & Mfg TSD

Kountz & Kuhn

Possible help from MRC

Set up an incinerator to handle Aroclor disposal - preferably one which will handle solids such as muds - slurries as well as liquids. Have in operation within 12 months. Ideally have incinerators available different sections for disposal.

<u>Chronic Toxicity Studies - Ind. Bio-Test</u>

Wheeler Keller Ind.Bio-Test

Continue studies to establish FDA type limits of toxicity on Aroclor 1242, Aroclor 1254 and Aroclor 1260.

Rework with R. Keller-S. Tucker the number of samples which are to be analyzed for Aroclor in tissue. Try to see if Aroclors are changed metabolically. Does concentration level off, decline if feeding is stopped?

Institute studies against the most limiting biological parameters. If shrimp are the most limiting species for Aroclor levels of toxicity, then we will have to have biological studies on these species to confirm or deny adverse findings.

Biodegradation Studies

Set up rate of biodegradation studies with Inorganic Div. on Aroclor 1242 vs. Aroclor 1254
Aroclor 5442 vs. Aroclor 5460
Swisher Chlorinated diphenyl ether
Chlorinated paraffin vs. chlorinated naphthalene
Chlorobromo Aroclors 1242 and 1248

Baxter Lidgett MCL Contact Baxter and Lidgett at MCL regularly for results on Aroclor degradation. They are reported to be moving on laboratory experiments.

Establish contact with chlorophenol degradation studies of Cellu-Chem Group.

WRR

W. R. Richard

WRR:ms

MINUTES OF MEETING OF THE CORPORATE DEVELOPMENT COMMITTEE

November 17, 1969

Present: Messrs.
E. J. Bock, Chairman
H. H. Sible
J. R. Eck
J. L. Gillis
E. J. Putzell
C. H. Sommer
J. N. Ehlers, Secretary

DEFENDANT'S EXHIBIT 1082 TRIAL

ORGANIC DIVISION, LAW AND MEDICAL DEPARTMENTS -- REPORT ON POLYCHLORINATED BIPHENYLS

Present: Messrs. C. J. Smith, J. Mason, T. K. Smith, H. S. Bergen, J. E. Springgate, R. E. Kelly, E. P. Wheeler, Rodney Harris, Jr., D. W. Miller, W. C. Robinson

Monsanto's worldwide Aroclor business amounts to 104 $\overline{M}$ lbs./yr., 70$\overline{M}$ used in functional fluids and 34 $\overline{M}$ in plasticizers. This represents \$22 $\overline{M}$ in sales. Products range from monochlorobiphenyl

PLAINTIFF'S EXHIBIT 421

STR C0154C

to decachlorobiphenyl, terphenyls, and chlorinated terphenyls. Production locations are at Anniston, Alabama, Sauget, Illinois, Newport, U.K. and Yokkaichi, Japan.

<u>Environmental Aspects</u> - E. P. Wheeler

The 5 and 6 chlorinated biphenyls (Aroclor 1254 and 1260) have been found at limited locations in water, in birds and some forms of aquatic life. Recent indications are that such biphenyls may affect reproduction of fowl life and may be toxic to shrimp. These products are not toxic from the acute standpoint to man or fish but there is some evidence of ecological buildup in certain water deposits, in fish and ultimately in bird life.

- Aroclors 1248 and lower in number are believed to be biodegradable but this has not been conclusively established as yet.

<u>Legal Aspects</u> - D. W. Miller

The law in the field of manufacturer's liability is changing rapidly. Although the law is unsettled, the present general rule is that if a manufacturer knows or should know that a product of its manufacture may cause damage if not properly used, he has a duty to give adequate warning to customers and users.

Recommendations from the legal standpoint consist of -

1. Take steps to insure that PCB's are contained and not discharged in plant effluent.

2. Provide adequate warnings to customers and users, including advice as to disposal methods.

3. Establish testing program to determine precise effects of PCB's on birds, aquatic life and animals and to determine the possible escape of PCB's from plasticizers.

<u>Plan of Action</u> - H. S. Bergen and J. E. Springgate

The availability of alternate products to satisfy customer requirements was reviewed. Main problems are that no replacement product is available for capacitors and replacement products for other uses pose a pollution problem.

In plasticizer uses, evidence is not available as to whether Aroclors escape from end products, either through leaching or by dispersal in burning.

The recommended plan of action is to establish a tailored program for each business group and each customer market situation to assure that the loss of PCB's in the environment, if any, is minimal.

1. Appoint a Project Manager - responsible for the overall management of the Aroclor pollution problem. He would be assisted by a Task Force from members of each business group plus Medical, Law, Engineering and Manufacturing.

2. Notify all Aroclor customers of PCB problem.

3. Reduce and effectively control PCB effluents from Monsanto plants.

4. Educate customers on need to reduce and effectively control PCB effluents at their plants.

5. Develop and implement new packaging systems for Aroclor 1254/1260.

6. Introduce to market, replacement products for Aroclor 1254/1260.

7. Continue and expand biodegradation test program with Aroclor series, particularly 1242, 1248 and 1254.

8. Continue toxicological test program.

9. Accelerate present analytical test program.

10. Determine feasibility and cost of eliminating 5/6 Cl_2 in Aroclors 1242 and 1248.

11. Study incineration products.

12. Develop business plan to offer:

    - Monsanto Fluid Reclamation and Recovery with Enviro Chem. (Reclamation already under-way at Findett.)

Cost of this program is estimated at approximately $400M SARE and $700M capital to change equipment.

Conclusions: In light of the recent and developing evidence of a possible threat to certain species of bird and aquatic life, we should plan to discontinue the manufacture of Aroclors 1254 and 1260. The Division is instructed to develop a program to discontinue these products and report this to the Committee.

The status of Aroclor 1242 should continue to be tested to determine whether it contributes to this problem. Other products which might be involved should also be examined.
(Excerpt to Messrs. H. L. Minckler, Rodney Harris, Jr., R. E. Kelly, T. K. Smith.)

STR 001542

W. R. Richard - Research Center

DATE March 6, 1969

SUBJECT AROCLOR WILDLIFE ACCUSATIONS

REFERENCE

TO : E. Wheeler - EWHEE

cc H. Bergen HBERG
J. Springate JSPRI
W. Schalk WSCHA
D. Olson DOLSO
R. Kelly RKELL
J. Garrett JGARR
P. Hodges PHODG
P. Park PPARK
R. Keller JFQ
E. Tucker JFQ

2.

Risebrough in a recent paper "Nature", Vol. 220, Dec. 14, 1968, has attacked chlorinated biphenyls in three ways:

(1) a pollutant - widely spread by air-water; therefore an uncontrollable pollutant.

(2) a toxic substance - with no permissible allowable levels causing extinction of peregrine falcon by induced hepatic enzymes which degrade steroids upsetting Ca metabolism leading to reproductive weakness, presumably through thinner egg shells.

(3) a toxic substance endangering man himself; implying that the peregrine falcon is a leading indicator of things to come.

As outlined in Science, Vol. 163, Pg. 548, Environmental Defense Fund (EDF) is attempting to write new legal precedents in conservation law by hearings and court action. In the Wisconsin case, water quality standards are at issue. "A substance shall be regarded as a pollutant if its use results in public health problems or in acute or chronic (injury) to animal, plant or aquatic life". Wisconsin is one of 7 states which now have federally approved water quality standards. According to Bern Wright, acting chief of the Federal Water Pollution Control Administration's Water Quality Standards Branch, DDT would fit the definition of a pollutant upon a showing that it is harmful to aquatic life.

These people in EDF are saying we must not put stress on any living thing through a change in air or water environment. Eagles, plant life, anything which lives or breathes. This group is pushing hard on the extension of the word harmful. They claim "enzyme inducer" activity is the real threat of DDT and PCB's and are using these arguments to prove that very small amounts of chlorinated hydrocarbons are "harmful".

? ?

Monsanto is preparing to challenge certain aspects of this problem but we are not prepared to defend against all of the accusations.

(a) Monsanto is preparing itself to identify trace ppb quantities of chlorinated biphenyls in water samples, in concentrated collected air samples, and in animal tissues. We will know whether we have been falsely identified and accused or not. We will eventually know where any pollution is taking place and the extent of the pollution.

PLAINTIFF'S EXHIBIT 428

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PLAINTIFF'S EXHIBIT 3

PLAINTIFF'S EXHIBIT 4135

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(b) We are not prepared to defend ourselves against the accusations made of enzyme and hormone activity, the isolation of enzymes or metabolic products, the indirect accusation of cancer, or the splitting of genes, when this accusation is made. Whether we can defend this route or not needs further discussion.

(c) Through the Industrial Bio-Test program we are to establish the long term allowable limits of chlorinated biphenyls for certain birds-fish-animals by feeding experiments, pathological examination, and tissue analysis for chlorinated biphenyls. We may be able to answer reproductive ability in some animals.

DDT has been under attack for some years because of its chlorine content, its persistent ability to be identified, and the wildlife problems attributed to it. We will still be under the same attack by the mechanisms listed in (b) even though we might establish safe operating limits for humans and certain animals.

Where does this leave us?

Under identification and control of exposure - we will be able to identify and analyze residues as well or better than anyone in the world. We will probably find residues other than DDT and PCB's. We will probably wind up sharing the blame in the ppm to ppb concentration level.

We can take steps to minimize pollution from our own chlorinated biphenyl plants, we can work with our larger customers to minimize pollution, we can continue to set up disposal and reclaim operations. We can work for minimum exposure in manufacture and disposal of capacitors, transformers and heat transfer systems, and minimize losses for large hydraulic users.

But, we can't easily control hydraulic fluid losses in small plants. It will be still more difficult to control other end uses such as cutting oils, adhesives, plastics and NCR paper. In these applications exposure to consumers is greater and the disposal problem becomes complex. If chlorinated biphenyl is shown to have some long term enzyme or hormone activity in the ppm range, the applications with consumer exposure would cause difficulty.

Risebrough has taken known Aroclor samples and claims to have evidence of enzyme and hormone change. Here there is no question of identification. Either his position is attacked and discounted or we will eventually have to withdraw product from end uses which have exposure problems. Since Risebrough's paper in "Nature", Dec. 1968 has just been published, it is timely, perhaps imperative, that this paper and its implications be discussed with certain customers. This is a rough one because it could mean loss of business on empty and false claims by Risebrough.

Well prepared discussions with Ind. Bio-Test, Monsanto biochemists, the medical and legal departments must take place now. The position of DDT manufacturers should be determined as a guide. We are being accused of the same things attributed to DDT.

I have written this memo to clarify some of the issues. May I please have comments.

Thanks,

W. R. Richard

ms

Att.

E. P. Wheeler - St. Louis

October 21, 1968

Polychlorinated Biphenyls in the Environment

R. E. Kelly, M. D./ W. H. Hunt
~~Scott Tucker - Queeny [illegible]~~
R. A. Keller - RKELL
C. Payton - CPAYT
H. Bergen - HBERG
W. K. Johnson - WJOHN

W. R. Richard
WRICH

Extra

Attached is a Xerox copy of a technical paper which Scott Tucker and I picked up in Washington recently. This was provided us by Donald A. Spencer of the National Agricultural Chemicals Association. Mr. Spencer requested that the paper be held "confidential" until such time as it may be published. Spencer indicated that if this paper were distributed one of his principal "sources" would refuse to give him prepublication information in the future.

Risebrough's presentation (the attached) was made at a meeting of 20 to 30 toxicologists held at the University of Rochester in June. The meeting was billed as "The First Annual Conference on Toxicology" and was underwritten presumably by the AEC which has had contracts at Rochester for many years. Attendance was by invitation only.

The meeting dealt "exclusively" with pesticides with about one-third of the papers relating to mercury. As far as Spencer knows the papers, including the attached, will undoubtedly be printed as proceedings of the conference although I suspect individual authors were given permission to publish elsewhere.

In a few words, Risebrough has found PCBs along with chlorinated pesticides in a number of species of fish and birds along the California coast as well as in waters off Baja California and Central America. He further reports PCB in fish from the Channel Islands and Puget Sound. No PCB was detected in the liver of tuna taken in the Galapagos Archipelago. Scott Tucker is going to scrutinize the analytical aspects and particularly the validity of some of the assumptions made by the author.

Elmer P. Wheeler

cs

Attachment

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PLAINTIFF'S EXHIBIT 1196

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Confidential — Not to be released until published! 10/7/68 EAV

CHLORINATED HYDROCARBONS IN MARINE ECOSYSTEMS

R. W. Risebrough
Institute of Marine Resources
Department of Nutritional Sciences
University of California, Berkeley

ABSTRACT

Polychlorinated biphenyls, which are widely used as plasticizers and in the manufacture of many industrial products, and the DDT compounds have been found to be widely distributed in marine ecosystems of the Pacific Ocean. Marine birds contain higher concentrations than fish; tissues of the Peregrine Falcon have contained the highest concentrations which have been so far recorded. The polychlorinated biphenyls have not yet been detected in samples of airborne particulates but their observed distribution in the sea indicates that they are dispersed by wind currents. Their effects upon natural populations, including man, are as yet unknown. The DDT compounds are also accumulating in the sea and are present in highest concentrations in marine birds. Their distribution indicates that coastal areas are not the primary sources of contamination of the pelagic species. A quantitative approach to the problem of aerial transport of pesticides to the sea has been made by analysing the pesticide content of airborne particulates. The results indicate that wind transport can account for the observed distribution of DDT compounds in the California waters and that the amount of pesticides entering the tropical Atlantic as fallout from the Northeast Trades is comparable to that entering the sea from a major river system.

REPORT

The accumulating evidence that no part of the world is now free of pesticide residues, the products of atomic explosions, or of a variety of industrial pollutants has produced subtle but profound changes in our concepts of remoteness, isolation, and of our own position in the world-wide ecosystem. There has never been any question that local ecosystems may be irreversibly changed by the introduction of synthetic chemicals, whether these introductions be purposeful or incidental. The sea is the dominant feature of the world-wide ecosystem. The accumulation of significant amounts of several pollutants in marine organisms, pollutants which are non-polar and therefore water-insoluble but lipid-soluble, not only elicits an uncertainty about the long-term utilization of the sea as a source of human food, but has suddently raised the question of the ultimate survival of a number of species of sea birds. These comprise a very large fraction of the world's wildlife and doubts about their future would have been considered preposterous and untenable only 3 or 4 years ago.

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Silver Spring, Md. 20904

10/9/68

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Perhaps because fish kills have provided the most dramatic evidence of pesticide contamination, pesticide distribution studies in the United States and elsewhere have frequently consisted of monitoring the levels in major river systems [2,7]. In spite of the low solubility of chlorinated hydrocarbons in water [4], their tendency to pass into the vapour phase [16,1,5,6,12], their persistence in soils [3,10,18], and their presence in very low concentrations in some streams draining areas of intensive application [17], rivers do transport large amounts of stable, persistent pesticides to the sea. A large proportion of these pesticides are adsorbed to silt particles which are part of the runoff from areas of application. Thus, the Sacramento and San Joaquin rivers, which drain the Central Valley of California, one of the most heavily pesticided areas of the world, annually bring about 1,900 kg of chlorinated hydrocarbons into San Francisco Bay [2,21], and the Mississippi contributes about 10,000 kg of the Gulf of Mexico [7,21].

When the Institute of Marine Resources began a study of the distribution of chlorinated hydrocarbons in marine fish, we expected to find, therefore, much higher levels in the fish from San Francisco Bay ~~than in the fish~~ from the Pacific Ocean [24]. The data of Table I, however, show that collections of the Northern Anchovy and of the English Sole from the coastal waters contained as much as or significantly more total DDT residue than did the collections from San Francisco Bay. Total DDT concentrations were highest in the collection from waters off Los Angeles, but anchovies from the Channel Islands area off Port Hueneme also contained significantly more residue than the anchovies of San Francisco Bay. Since no major river system enters the Pacific Ocean from Southern California, the source of these pesticides could not be agricultural drainage waters. Similarly, the data of Table II, which set forth the distribution of total DDT residues and of polychlorinated biphenyls in several collections of marine fish, including Shiner Perch from San Francisco Bay, Hake, Jack Mackerel and English Sole from the coastal waters of California, Bluefin and Yellowfin Tunas from waters off Baja California and Central America, and Skipjack Tuna from South America and the Central Pacific, show that almost all total DDT residue levels fall within the range of 0.2 and 2.0 parts per million, wet weight, including those in the Bluefin and Yellowfin Tunas, which are more pelagic. Only the Yellowfin Tuna from the Galapagos region and the Skipjack Tuna contained lower total pesticide residues. The majority of fresh-water fish from Wisconsin analysed by the Wisconsin Conservation Department in 1965 contained less than 0.2 ppm of total DDT residue [27]. Moreover, fish from a stream in Wisconsin which drained an orchard where chlorinated hydrocarbons had been intensively applied over the years contained lower pesticide residue than did the marine fish from the Pacific Ocean [17]. These combined observations indicate that it is very unlikely that pesticides in marine fish have originated only in coastal waters contaminated by local agricultural runoff.

The polychlorinated biphenyls (PCB) occurring in fish and other marine organisms are assumed to be industrial pollutants. They are used extensively in industry as plasticizers and in the manufacture of paints, resins, electrical insulators and other products, and are available in railway car amounts. Since they are very stable, resist degradation, have significant vapour pressures, are poorly soluble in water and highly soluble in lipid, it is inevitable that they should be concentrated in biological systems. Their chemical structure is

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in some respects similar to that of several chlorinated hydrocarbon pesticides, including DDT and the benzene hexachlorides, so that it is to be expected that they would behave similarly in their movements through ecosystems. They are highly toxic to man when inhaled as vapours [9,25] and the more heavily chlorinated components have greater toxicity. Their presence in concentrations as high as one part per million on a wet weight basis, and several times higher on a lipid weight basis, in species which are used as human food, should be a matter of considerable concern. At the present time it is not entirely clear how the PCB enter marine food chains, but they could easily be introduced into the atmosphere as vapours during manufacturing processes, when high temperatures increase vapour pressure, or by gradual volatilization over a period of time or even when materials containing them are incinerated.

The PCB peaks had been evident in chromatograms of our extracts of marine fish and birds but remained unidentified until late in 1967. Extracts of tissues and of an unhatched egg of a Peregrine Falcon, a species whose decline and local extinction has frequently been attributed to pesticides, contained exceptionally high amounts of the unknown compounds [22]. Attempts to identify them were unsuccessful until reports appeared from Sweden [30] and from Great Britain [14] that PCB had been identified in wildlife with the use of mass spectrography and gas-liquid chromatography, respectively. The published chromatogram [14] was virtually identical with those we had obtained from the Peregrine Falcons extracts.

The commercial PCB preparations are mixtures of several compounds. Of these, those having the following retention times relative to p,p'-DDE on DC-200 and QF-1 columns have been detected in marine fish and birds:

DC-200: <u>1.25</u>, <u>1.48</u>, <u>1.75</u>, 2.05, 2.41, 2.50, 2.90, 3.41, 3.88, 5.53

dieldrin: 1.00; p,p'-DDD: 1.27; p,p'-DDT: 1.68

QF-1: 1.10, <u>1.33</u>, <u>1.40</u>, 1.65, <u>1.72</u>, 2.14, 2.59, 3.23, 3.88, 4.84

dieldrin: 1.49; p,p'-DDD: 1.75; p,p'-DDT: 1.91.

The retention times of the three principal peaks are underlined. Similar values for the DC-200 column have been reported from extracts of seals from the North Atlantic [13]. Because of the similarity of retention times, it is evident that large amounts of PCB will interfere with the determination of p,p'-DDD and p,p'-DDT on DC-200 columns and with p,p'-DDD on QF-1 columns. Conversely, in many extracts, the PCB content can be determined only after DDD and DDT have been removed by saponification with alcoholic KOH. The quantitative measurements of the PCB compounds were made as follows: it was assumed that each produces the same peak height in the electron capture detector as the same amount, by weight, of p,p'-DDE. After summing the contributions of the individual peaks, the total was multiplied by 4.2. Measurements of standard solutions by this method yielded results close to the predicted values and to those obtained by measuring the total halogen content with the microcoulometric detector.

Measurements of the PCB in the fish extracts were made from pooled extracts. Unlike the DDT compounds, the PCBs appear to be relatively more abundant in San

Francisco Bay, but their presence in Yellowfin Tuna taken off Central America indicates a wide geographical distribution.

Concentrations of the chlorinated hydrocarbons, both pesticide and PCB, tend to be an order of magnitude higher in marine birds than in fish. In Table III are listed the total DDT and PCB concentrations in tissues and in entire birds of several species. Table IV lists the DDT and PCB content of those eggs so far analysed. The latter values will eventually be also expressed as parts per million, lipid weight.

From the data in Tables III and IV it is evident that both DDT and the polychlorinated biphenyls are widely distributed among marine birds, which are the terminal carnivores of a complex variety of food chains in the sea. Sooty and slender-billed shearwaters are pelagic species which breed in New Zealand and Australia, respectively and which spend the southern winter in the northern Pacific. Rhinoceros Auklets and Ancient Murrelets breed on the coasts of British Columbia and Alaska, whereas Kittiwakes, Fulmars and Red Pharalopes breed in Alaska and the Canadian Arctic. All of these specimens were collected in California, so that it is not clear how much DDT and PCB the birds had ingested on their breeding grounds. In the pelagic bird species, in most of the fish from the ocean and in the other specimens from areas remote from sites of application, such as Baja California, the ratios of DDT to PCB are of the same order of magnitude and most values are between 5 and 15. If both PCB and DDT were dispersed around the world by the same transport system, their relative concentrations in "remote" areas would very likely be similar. Additional data are needed to support this hypothesis; eggs from tropical regions and from Antarctica have been obtained and will eventually be analysed.

In many of the specimens from San Francisco Bay and San Diego Bay this ratio is close to one. Absolute concentrations of PCB also tend to be higher, suggesting that the most important sources of contamination are local.

The sample sizes of Tables III and IV are very small; many samples, however, remain to be analysed. Only tentative suggestions can be made from the data, but a consistent pattern is evident. Thus, the Western Gull egg from San Francisco Bay and the Pigeon Guillemot egg from the coast near San Francisco contained more PCB than the egg of each species from the Farallons. Of the two night heron eggs analysed, one had an "ocean" profile: high DDE, low p, p'-DDT and DDD, high DDT/PCB ratio; the other had a "bay" profile. The Caspian and Forster's Terns nest side by side on the dikes in San Diego Bay, yet the DDT/PCB ratio is much lower in the Caspian Terns, which feed primarily along the coast, than in the Forster's Terns, which feed along the brackish and fresh-water dikes and canals. The two California Peregrine Falcons had both been feeding in San Francisco Bay prior to capture; in both the ratios of DDT to PCB are near unity.

The high DDT concentrations recorded in the Bermuda Petrel /32/ and in the Skua from Antarctica /26/, which are species of the high seas, also indicate that coastal regions were not the primary source of contamination.

A quantitative approach to the problem of aerial transport of pesticides over the sea has been made by measuring pesticide concentrations in airborne particulates [21]. Over the past year, Goldberg, Griffin and others at the Scripps Institution of Oceanography have collected airborne particulate matter on nylon mesh screens coated with glycerin which had been mounted on the Scripps pier in La Jolla. Dust collected on such screens in several areas of the world had previously been shown to contain the mineral talc in concentrations much higher than expected on the basis of its natural distribution [31]. Talc has been extensively used as a diluent for pesticides, in addition to other industrial applications. Moreover, the rate at which talc has been deposited on glaciers shows a significant increase after 1940 [31]. Analysis of the airborne dust collected on the Scripps Pier showed that pesticides, predominately p,p'-DDT were present in concentrations ranging from one to eighty-one parts per million, corresponding to a mean value of 7×10^{-11} grams per cubic meter of air. The method fractionates against those materials carried on particles less than several micra or present as vapours. This value is therefore a lower limit of the amount of chlorinated hydrocarbons in the air. No PCB peaks were observed in the chromatograms of the dust extracts. These were then pooled, concentrated, and saponified in order to degrade DDT and DDD. PCB was not present in the saponified extracts and a maximum concentration of 5 ppb was calculated for the dust samples, 10,000 times lower than that of the total pesticides. Since the ratios of PCB to DDT observed in fish and birds is much higher, it would appear that the PCBs remain as vapours in the air and do not adsorb to particulate matter. In the near future we hope to obtain air samples which have been passed through a cold chamber in which PCBs, pesticides and other compounds present as vapours would condense.

The winds at the Scripps pier in La Jolla are predominantly landward with an unknown fraction of air from nearby agricultural areas. Although the lack of knowledge about air circulation patterns and fallout rates makes difficult at the present time a calculation of the amounts of pesticides brought to the coastal waters of California by winds, such a transport system could account for the unexpected geographical distribution of the DDT compounds in fish.

The Science Research Council of the United Kingdom had earlier mounted a similar screen on the eastern tip of the island of Barbados in an attempt to collect extraterrestrial dust of meteorite origin. The Northeast Trades at Barbados have blown over 5000 kilometers of the tropical Atlantic and it was therefore considered highly unlikely that any dust accumulating on the screen could be of continental origin. This assumption was, however, in error, since significant quantities of airborne particulate material were collected on the screen which upon mineralogical and biological examination proved to be most likely from Africa and Europe. Fallout rates of the dust over the tropical Atlantic and its contribution to the bottom sediments were calculated [8]. Gram samples were subsequently made available to us for analysis. The concentrations of pesticides in the dust ranged from less than one part per billion to 164 ppb, with an average value of 41. Knowledge of the fallout rate over the ocean made possible an estimate of the quantity of pesticides entering the tropical Atlantic between the Equator and 30° N. This figure, a minimum value since the recovery of very small particulate materials was low, was 600 kilograms a year, which compares with the value of 1,900 kilograms entering San Francisco Bay in the San Joaquin and Sacramento Rivers [21]. It cannot be concluded that these pesticides had originated only in Africa; the DDT residues accumulating

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in the rare and declining Bermuda Petrel [32] might have come from any part of the world.

Most of the chlorinated hydrocarbon content of the particulate material of marine air consists of p,p'-DDT, p,p'-DDE, however, comprises the large proportion of the total DDT in marine fish and birds. The percentage of DDE is lower in fish from San Francisco Bay and Puget Sound; DDT and DDD are comparatively more abundant. DDE, however, comprises only 22% of the total DDT residue entering San Francisco Bay in the San Joaquin River [2] and in bottom mud, where anaerobic conditions might prevail, DDT can be expected to be converted to DDD rather than to DDE [15,29]. From mammalian and insect toxicity studies it has been concluded that DDE is relatively harmless. Recent research at the Patuxent Wildlife Research Center, however, have indicated that the toxicity of DDE to birds is much higher than expected and may be about one half that of p,p'-DDT [28]. Like p,p'-DDT, p,p'-DDE is capable of inducing liver epoxidase enzymes [11]. Such enzymes degrade sex hormones by hydroxylating them [19] and thereby may affect calcium metabolism. No evidence of abnormal calcium metabolism has yet been observed in sea birds, but a significant decrease in eggshell weight of several birds of prey in Britain after the Second World War is evidence of a fundamental change in the environment [20].

The effects of the PCB compounds upon natural populations remain unknown. The highest concentrations so far recorded were in an adult female Peregrine Falcon from California, where the species has recently undergone a sharp decline [22].

Application of the persistent biocides and the release of nondegradable waste products into the environment have frequently been justified by arguments that point out that local populations of organisms remain relatively uncontaminated and that, especially in the case of the chlorinated hydrocarbon insecticides, even the persistent compounds disappear with time. It is abundantly clear that these arguments have become misleading, irrelevant, and wrong. Pollutants do go everywhere. Those which are non-polar, water-insoluble and which have finite vapour pressures will eventually appear in marine food chains. The DDT compounds and the polychlorinated biphenyls have already done so to an alarming degree.

TABLE I

.esidues[a] in collections of Northern Anchovy (Engraulis mordax) and .ish Sole (Parophrys vetulus) from San Francisco Bay and California stal waters.

Species locality, date	N	Mean Wt (g)	p,p'-DDE[b]	Total DDT[b]
Northern Anchovy				
San Francisco Bay July 29, 1965	17	12.4 (6-22)	0.21 ±0.05	0.59 ±0.11
San Francisco Bay November 4, 1965	29	4.0 (2-5)	0.11 ±0.05	0.33 ±0.04
Monterey November 30, 1965	30	26.5 (21-35)	0.68 ±0.19	0.90 ±0.22
Morro Bay June 16, 1965	29	25.9 (19-33)	0.45 ±0.12	0.74 ±0.22
Port Hueneme February 24, 1966	15	11.6 (2.8-21.5)	2.44 ±0.77	3.04 ±1.00
Terminal Island Los Angeles, June 25, 1965	44	11.7 (6.5-20)	10.2 ±2.1	14.0 ±1.9
English Sole				
San Francisco Bay July 29, 1965	18	14.3 (5-35)	0.14 ±0.02	0.55 ±0.07
San Francisco Bay November 4, 1965	33	17.3 (7.5-53)	0.13 ±0.03	0.55 ±0.12
San Francisco lightship December 1, 1965	15	253)175-306)	0.12 ±0.03	0.19 ±0.04
Monterey February 15, 1966	15	195 (89-262)	0.53 ±0.13	0.76 ±0.16

[a] from R. W. Risebrough, D.B. Menzel, D. J. Martin, Jr., and H. S. Olcott, in preparation. DDT residues include the two isomers of DDT,p,p'-DDT

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TABLE I, continued

and o,p'-DDT and their metabolic derivatives: p,p'-DDE, o,p'-DDE p,p'-DDD and p,p'-DDMU.

b wet weight parts per million, means, standard errors, 95% confidence limits

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TABLE II

DDT [a] and polychlorinated biphenyl (PCB) residues in marine fish. [b]

Species, locality, date	N	Mean Wt. (g)	Total DDT	% p,p'-DDE	PCB	DDT/PCB
Northern Anchovy						
Terminal Island June 25, 1965	44	11.7 (6.5-20)	14.0 ±1.9	83	1.0	14
Shiner Perch						
San Francisco Bay October 20, 1965	14	5.5 (4-8)	1.0 ±0.1	28	1.2	0.8
San Francisco Bay October 20, 1965	10	26.7 (10-48)	1.4 ±0.3	35	0.4	3.5
San Francisco Bay November 4, 1965	15	15.3 (8-49)	1.1 ±0.1	33	1.2	0.9
English Sole						
San Francisco Bay July 29, 1965	18	14.3 (5-35)	0.55 ±0.07	25	0.11	5
San Francisco Bay November 4, 1965	33	17.3 (7.5-53)	0.55 ±0.12	24	0.11	5
San Francisco lightship, Dec. 1, 1965	15	253 (175-306)	0.19 ±0.04	63	0.05	4
Monterey February 15, 1966	15	195 (89-262)	0.76 ±0.16	70	0.04	19
Jack Mackerel						
Channel Islands November 22, 1965	31	81.8 (45-141)	0.56 ±0.10	57	0.02	28
Hake						
Puget Sound January 29, 1966	22	281 (185-350)	0.18 ±0.05	23	0.16	1.1

TABLE II, continued

Hake						
Channel Islands February 24, 1966	6	384 (61-872)	1.8 $\pm$1.1	68	0.12	15
Bluefin Tuna[c]						
Body muscle	7	--	0.56 $\pm$0.24	45	0.04	14
Liver	9	--	0.22 $\pm$0.13	45	0.04	6
Yellowfin Tuna						
Liver[d]	13	--	0.07 $\pm$0.02	13	ND[e]	>7
Liver[f]	13	--	0.62 $\pm$0.19	30	0.04	15
Skipjack Tuna						
Liver[g]	3	--	0.057	23	0.1	0.6
Body Muscle[g]	13	--	0.051 $\pm$0.014	18	ND	>30
Liver[h]	25	--	0.056 $\pm$0.023	11	ND	>30
Liver[i]	12	--	0.029 $\pm$0.008	21	ND	>20

[a] from Risebrough et al. [24] Concentrations in wet weight, parts per million. Means, standard errors, 95% confidence limits

[b] Northern Anchovy (Engraulis mordax), Shiner Perch (Cymatogaster aggregata), English Sole (Parophrys vetulus), Pacific Jack Mackerel (Trachurus symmetricus), Hake (Merluccius productus), Bluefin Tuna (Thunnus thynnus), Yellowfin Tuna (Thunnus albacares), Skipjack Tuna (Euthynnus pelamis).

[c] Isla Geronimo, Baja California, Aug. 29, 1965

[d] Tower Island, Galapagos Archipelago, Nov. 6, 1965

[e] N.D. not detected, less than 0.01

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TABLE II, continued

[f] Central America (90° W, 8° N) Aug. 23, 1965

[g] Hawaii, November, 1965

[h] Galapagos Islands, November and December, 1965

[i] Cape Pasado, Ecuador, September 1, 1965

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TABLE III

DDT[a] and PCB residues in marine birds[b] and in the Peregrine Falcon[k]

Species, locality, date	Total DDT[c]	% DDE	PCB	DDT/PCB
Cassin's Auklet[d]	5.8	98	0.16	36
Ancient Murrelet[e]	0.75	90	0.15	5
Fulmar[f]	0.41	76	0.08	5
Fulmar[f]	3.4	89	0.34	10
Red Phalarope[g]	0.78	79	0.10	8
Rhinoceros Auklet[h]	2.7	97	0.36	8
Slender-billed shearwater[i]	32.0	92	2.1	15
Sooty shearwater[j]	12.3	94	1.2	10
Sooty shearwater[j]	10.3	86	0.9	12
Peregrine Falcon[k]				
breast muscle, second year female, migrant from Arctic	104	99	22	4.5
breast muscle, immature California	13	99	10.5	1.2
breast muscle, adult female, California	112	98	109	1.0

a: from Risebrough et al. [23] and Risebrough, Kirven and Herman [22]; b: entire bird analysed, except Peregrine Falcons; c: includes p,p'-DDT, p,p'-DDD, p,p'-DDE, p,p'-DDMU, p,p'-DDE; parts per million, wet weight; d: Ptychoramphus aleuticus, adult female, Farallon Islands, April, 1966; e: Synthliboramphus antiquus, Monterey Bay, Nov. 1, 1966; f: Fulmarus glacialis, Monterey Bay, Nov. 1, 1966; g: Phalaropus fulicarius, Monterey Bay, Nov. 1, 1966; h: Cerorhinca monocerata, Monterey Bay, Nov. 1, 1966; i: Puffinus tenuirostris, Monterey Bay, Dec. 12, 1966; j: Puffinus griseus, Monterey Bay, Nov. 1, 1966; k: from Risebrough, Kirven and Herman [22].

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TABLE IV

DDT and PCB content in eggs of several bird species.

Species, locality	N	Total DDT[a]	% p,p'-DDE	PCB[a]	DDT/PCB
Brandt's Cormorant[b] (*Phalacrocorax penicillatus*)					
Farallon Islands	17	326	91	113	2.9
Pelagic Cormorant (*Phalacrocorax pelagicus*)					
San Mateo Co. Calif.	2	128 (125-130)	90	62 (48-75)	2.1
Murre *Uria aalge*					
Farallon Islands	6	1945 (932-3621)	96	558 (364-1010)	3.5
Pigeon Guillemot *Cepphus grylle*					
Farallon Islands	1	110	95	20	5.5
San Mateo Co.	1	103	91	62	1.7
Cassin's Auklet *Ptychoramphus aleuticus*					
Farallon Islands	2	147 (127-167)	97	15 (12-18)	10
Western Gull *Larus occidentalis*					
Farallon Islands	1	423	95	118	3.6
San Mateo Co.	1	235	94	112	2.1
San Francisco Bay	1	458	87	480	0.95

TABLE IV, continued

Black-crowned Night Heron *Nycticorax nycticorax*					
San Francisco Bay	1	541	89	330	1.6
	1	869	99	24	36
Caspian Tern *Hydroprogne caspia*					
San Francisco Bay	2	1269 (1216-1322)	89	805 (660-950)	1.7 (1.3-2.0)
San Diego Bay	5	1430 (991-2430)	88	1010 (550-1600)	1.4
Forsters Tern *Sterna forsteri*					
San Diego Bay	2	665 (598-732)	89	114 (91-137)	5.8
Least Petrel *Halocyptena microsoma*					
Baja California	2	30 (23-37)	84	3.1 (1.2-5.0)	10
Peregrine Falcon[c] *Falco peregrinus*					
Baja California	1	4830	97	471	10

a: total micrograms; b: samples pooled for PCB analysis, p,p'-DDE content ranged from 63 to 1240 micrograms; c: from Risebrough, Kirven, Herman [22].

NEV 022131

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REFERENCES

[1] ACREE, F., JR., BEROZA, M., BOWMAN, M.C. J. Agr. Food Chem. 11 (1959) 278.

[2] BAILEY, T.E., HANNUM, J.R., J. Sanit. Eng. Div. Amer. Soc. Civil Engrs. 93 (1967) 27.

[3] BARTHA, R., LANZILOTTA, R.P., PRAMER, D., Appl. Microb. 15 (1967) 67.

[4] BOWMAN, M.C., ACREE, F., JR., CORBETT, M.K., J. Agr. Food Chem. 8 (1960) 406.

[5] BOWMAN, M.C., ACREE, F., JR., LOFGREN, C.S., BEROZA, M., Science 146 (1964) 1480.

[6] BOWMAN, M.C., ACREE, F., JR., SCHMIDT, C. H., BEROZA, M., J. Econ. Entomol. 52 (1959) 1038.

[7] BREIDENBACH, A.W., GUNNERSON, C.G., KAWAHARA, F.K., LICHTENBERG, J.J., GREEN, R.S., Public Health Rept. 82 (1967) 139.

[8] DELANEY, A.C., DELANEY, A.C., PARKIN, D.W., GRIFFIN, J.J., GOLDBERG, E.D., REIMANN, B.E.F., Geochim. Cosmochim. Acta 31 (1967) 885.

[9] Documentation of Threshold Limit Values, 41 (Committee on Threshold Limit Values, American Conference of Governmental Industrial Hygenists) 1966.

[10] FAHEY, J.E., BUTCHER, J.W., TURNER, M.E., Pesticides Monit. J., 1 4 (1968) 30.

[11] GILLETT, J.W., CHAN, T.M., TERRIERE, L.C., Agr. Food Chem. 14 6 (1966) 540.

[12] HARRIS, C.R., LICHTENSTEIN, E.P., J. Econ. Entomol. 54 (1961) 1038.

[13] HOLDEN, A.V., MARSDEN, K., Nature 216 (1967) 1274.

[14] HOLMES, D.C., SIMMONS, J.H., TATTON, J.O'G., Nature 216 (1967) 227.

[15] JOHNSON, B.T., GOODMAN, R.N., GOLDBERG, H.S., Science 157 (1967) 560.

[16] LICHTENSTEIN, E.P., ANDERSON, J.P., FUHREMANN, T.W., SCHULZ, K.R., Science 159 (1968) 1110.

[17] MOUBRY, R.J., HELM, J.M., MYRDAL, G.R., Pesticides Monit. J. 1 4 (1968) 27.

[18] NASH, R.G., WOOLSON, E.A., Science 157 (1967) 924.

[19] PEAKALL, D.B., Nature 216 (1967) 505.

[20] RADCLIFFE, D.A., Nature 215 (1967) 208.

[21] RISEBROUGH, R.W., HUGGET, R.J., GRIFFIN, J.J., GOLDBERG, E.D., Science 159 (1968) 1233.

[22] RISEBROUGH, R.W., KIRVEN, M.N., HERMAN, S.G., in preparation

[23] RISEBROUGH, R.W., MENZEL, D.B., MARTIN, D.J., JR., OLCOTT, H.S., Nature 216 (1967) 589.

[24] RISEBROUGH, R.W., MENZEL, E.B., MARTIN, D.J., JR., OLCOTT, H.S., in preparation.

[25] SAX, N.I., Dangerous Properties of Industrial Chemicals, Reinhold, New York, (1963).

NEV 022132

REFERENCES, continued

[26] TATTON, J.O'G., RUZICKA, J.H.A., Nature 215 (1967) 346.
[27] THOMPSON, D.R., Wisconsin Conservation Department Survey Report, February 14, 1966.
[28] United States Department of the Interior, Fish and Wildlife Service; Wildlife Research Problems Programs Progress 1966 Resource Publication 43, Washington, D.C.
[29] WEDEMEYER, G., Science 152 (1966) 547.
[30] WIDMARK, G., J. Ass. Off. Anal. Chem. 50 (1967) 1069.
[31] WINDOM, H., GRIFFIN, J.J., GOLDBERG, E.D., Environ. Sci. Technol. 1 (1967) 923.
[32] WURSTER, C.F., JR., WINGATE, D.B., Science 159 (1968) 979.
[33] The National Science Foundation, (grant GP 6362) provided financial support. I thank P. L. Ames, E. D. Goldberg, S. G. Herman, M. N. Kirven, H. S. Olcott, P. Reiche and R. L. Rudd for their assistance. The Monsanto Chemical Company generously provided samples of Aroclor 1254 and 1262.

COPY

Dr. D.V.N. Hardy
Dr. E.R. Newman.

Monsanto Chemical Company

St. Louis, Missouri

September 20, 1955

Dr. J.W. Barrett

London

Your memo September 8 to Mr. Nason

AROCLOR TOXICITY

Howard Nason has given me your memo of September 8. I will be happy to discuss this with Dr. Newman during his visit here. I think, however, there are several points that I can answer you now.

You comment upon the difference in toxicity between Aroclor 1254 and 1242. This is not particularly surprising because in the earlier work it was found that toxicity increased with chlorination. Of course, from the standpoint of volatility in the case of inhalation or absorption from the gut from the point of view of ingestion are important. Frankly, there was not too great a difference between the two compounds, however. As you know, the maximum allowable concentrate is 0.1 ml/cubic meter in the case of 1254, and as high as 10.0 mgm in the case of 1268. I think the former is too low and the latter is too high. In this country they don't use the MACs very routinely, but certainly in England I think it would be alright to consider 0.2 mgm/cubic meter as perfectly safe.

I don't know how you would get any particular advantage in doing more work. What is it that you want to prove? I believe your work should be directed towards finding out what the concentrations are of Aroclor during different operations whether it is industrial or painting. The reports you have seen from Kettering Laboratory are the result of approximately $15,000 to $20,000 expenditure by MCC.

MCC's position can be summarized in this fashion. We know Aroclors are toxic but the actual limit has not been precisely defined. It does not make too much difference, it seems to me, because our main worry is what will happen if an individual developes any type of liver disease and gives a history of Aroclor exposure. I am sure the juries would not pay a great deal of attention to MACs.

PLAINTIFF'S EXHIBIT
439

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COPY

Page 2 September 20, 1955 AROCLOR TOXICITY

We, therefore, review every new Aroclor use from this point of view. If it is an industrial application where we can get air concentrations and have some reasonable expectation that the air concentrations will stay the same, we are much more liberal in the use of Aroclor. If, however, it is distributed to householders where it can be used in almost any shape and form and we are never able to know how much of the concentration they are exposed to, we are much more strict. No amount of toxicity testing will obviate this last dilemma and therefore I do not believe any more testing would be justified.

Let's see what our discussions with Dr. Newman and yourself bring out.

R. Emmet Kelly, M.D.

REK:k

124

October 23, 1970

Prof. G. Fred Lee
Water Chemistry Laboratory
The University of Wisconsin
Madison, Wisconsin 53706

Dear Dr. Lee:

I never have received my copy of your letter to Herb Stokinger dated August 14 which you referred to in your letter of September 23. Jack Garrett has received your letter of October 13 and I now do have a copy of your earlier letter and the position statement.

As you indicated in your letter to Jack, there is no reason why you should not discuss the results of our on-going toxicity studies with Dr. Calandra and his associates. I have enclosed a copy of my letter to Herb Stokinger with copies to you, Dr. Calandra and Dr. Mount concerning the status of our studies and the detailed results available at this time.

In connection with the position paper, I have the following comments:

1. In the second paragraph on the first page, there is a reference to pesticide formulations and the possible direct contamination of natural waters. I think you know that the polychlorinated biphenyls were never promoted as components in pesticide formulations for wide-spread dispersion on crops, orchards, etc. The fact is that the U. S. Department of Agriculture developed recommendations for the possible use of the waxy type Aroclors in pesticide formulations for painting interior surfaces. The USDA data indicated that hard surfaces (painted or metallic) sprayed with lindane or benzene hexachloride containing Aroclor 5460--a 60% chlorinated terphenyl, not PCB--remained toxic to flies, ants, roaches and silver fish for as long as three months compared to one

PLAINTIFF'S EXHIBIT 1496

NEV 008635

week's effectiveness for formulations of the pesticide without Aroclor 5460. The waxy Aroclors, 1254 and 1260, may also have ended up in some similar formulations. In any case the amounts used were insignificant, we think, in terms of any threat to contamination of natural waters.

2. In the second paragraph on page two, Wister Meig's publication in the JAMA is mentioned. Correspondence with the author following publication confirmed the fact that the chloracne was of such a mild nature that even trained dermatologists would probably have missed the evidence of the chloracne. To our knowledge, there have been no published reports of any chloracne episode since 1952. The question can be raised then as to whether the chloracne problem is of any real significance.

3. The third paragraph on page two refers to the chronic studies currently in progress. The first sentence implies that the two-year studies are complete. Secondly, there maybe a trend to convert completely to the metric system which would warrant units such as "micrograms per gram". I believe, however, that the practice in reporting doses fed to animals in chronic studies generally is to use a "parts per million" reference. Perhaps this is due to the fact that acute doses are usually expressed in terms of "milligram per kilogram of body weight" of the test animal.

This latter point I would leave to the judgement of Drs. Stokinger and Calandra. Similarly, a comparison of toxicity of that of DDT should rest with them. I would add that as recently as last month at a meeting with Garth Fitzhugh, he expressed the opinion that the Aroclors are "much less toxic than DDT". There is no question that the comparison varies depending on what species of mammals, birds, fish or possibly insects one is using to make a comparison. Obviously, whether one is talking about acute or chronic toxicity is relevant. Our own opinion at Monsanto is that the general statement that PCB's are no more and probably less toxic than DDT can be supported.

NEV 008636

At the present time, we do not think that a drinking water standard for the PCB's showing up in the environment should be lower than that for DDT.

I apologize for the delays involved in answering your request for information and comments.

Sincerely,

Elmer P. Wheeler
Manager, Environmental Health

EPW:ju

c.c. Dr. Joseph C. Calandra
Dr. Donald I. Mount
Mr. William B. Papageorge
Dr. Herbert E. Stokinger

October 11, 1937.

"Experimental work in animals shows that prolonged exposure to Aroclor vapors evolved at high temperatures or by repeated oral ingestion will lead to systemic toxic effects.

Repeated bodily contact with the liquid Aroclors may lead to an acne-form skin eruption.

Suitable draft ventilation to control the vapors evolved at elevated temperatures, as well as protection by suitable garments from extensive bodily contact with the liquid Aroclors, should prevent any untoward effect."

In talking with Dr. Kelly before these three paragraphs were written, we agreed that they might as well be phrased so that they could be used not only in the Aroclor booklet, but quoted in correspondence as that may be necessary.

L.A. Watt

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DEFENDANT'S TRIAL EXHIBIT D 1

PLAINTIFF'S EXHIBIT 1257

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EXHIBIT K-8

ADDRESS REPLY TO:
L. E. BURNEY, M. D.
SECRETARY AND COMMISSIONER
INDIANA STATE BOARD OF HEALTH
1330 WEST MICHIGAN STREET
INDIANAPOLIS 7, INDIANA

STATE OF INDIANA

Dr. E. Kelly

STATE BOARD OF HEALTH

February 6, 1950

Toxicology Department
Monsanto Chemical Company
St. Louis, Missouri

Dear Sirs:

One of our Indiana industries is using your ARCLOR 1248 (tetrachlorodiphenyl) as a heat transfer media (up to 400° F) in the extrusion of Tenite 2 plastic. Considerable vapor of arclor is present in the workroom due to leaks in the "closed" system. Several workers have reportedly become ill due to the inhalation of these vapors.

This plant called us as to any knowledge relative to the toxicity of this product. We did not have any data that could be transmitted to them. The so called illness was vague in that we could not learn from the plant what the exact complaints were.

We would appreciate any information which you have on the toxicology of this material.

Yours very truly,

Louis W. Spolyar, M. D.

Louis W. Spolyar, M. D., Director
Division of Industrial Hygiene
Indiana State Board of Health

LWS:pm

84238

PLAINTIFF'S EXHIBIT
442

STATE OF INDIANA

ADDRESS REPLY TO:
L. E. BURNEY, M. D.
SECRETARY AND COMMISSIONER
INDIANA STATE BOARD OF HEALTH
[illegible] WEST MICHIGAN STREET
INDIANAPOLIS 7, INDIANA

STATE BOARD OF HEALTH

February 28, 1950

Dr. R. Emmet Kelly
Medical Director
Monsanto Chemical Company
St. Louis 4, Missouri

Dear Doctor Kelly:

Thank you very much for your ~~very~~ informative letter of February 14, relative to the use of Aroclors in industry. The plant under question is the Brazil plant mentioned in your letter.

The chief complaints were irritation of the upper respiratory tract plus possible liver damage. At the time of our study Aroclor was circulated in galvanized pipes and most pipes were leaking. It was suggested that new pipes be installed and local exhaust employed.

Plant repiped with copper tubing and installed a local exhaust system over extruder rolls. With this improvement very little Aroclor vapors were escaping. This probably will solve their problem. Further the plant is considering building an enclosure around the extruder and rolls so that this equipment will be both enclosed and exhausted.

Thanks again for your help.

Very truly yours,

Louis W. Spolyar

L. W. Spolyar, M. D., Director
Division of Industrial Hygiene
Indiana State Board of Health

LWS:pm

84236

PLAINTIFF'S
EXHIBIT
8

PUBLIC HEALTH IS "THE ART AND SCIENCE OF PREVENTING DISEASE, PROLONGING LIFE AND PROMOTING PHYSICAL AND MENTAL EFFICIENCY THROUGH ORGANIZED COMMUNITY EFFORT." C.-E. A.

PLAINTIFF'S
EXHIBIT
441

Sect 10

Mather Report

"Aroclors"

Issued May 1946

updated 1955

9/8 - copy mailed to HCC

[redacted]

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56 ADM 002539

COPY

Dr. D.V.N. Hardy
Dr. H.R. Newman.

Monsanto Chemical Company

St. Louis, Missouri

September 20, 1955

Dr. J.W. Barrett

London

Your memo September 8 to Mr. Nason

AROCLOR TOXICITY

Howard Nason has given me your memo of September 8. I will be happy to discuss this with Dr. Newman during his visit here. I think, however, there are several points that I can answer you now.

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MCC's position can be summarized in this fashion. We know Aroclors are toxic but the actual limit has not been precisely defined. It does not make too much difference, it seems to me, because our main worry is what will happen if an individual developes any type of liver disease and gives a history of Aroclor exposure. I am sure the juries would not pay a great deal of attention to MACs.

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We, therefore, review every new Aroclor use from this point of view. If it is an industrial application where we can get air concentrations and have some reasonable expectation that the air concentrations will stay the same, we are much more liberal in the use of Aroclor. If, however, it is distributed to householders where it can be used in almost any shape and form and we are never able to know how much of the concentration they are exposed to, we are much more strict. No amount of toxicity testing will obviate this last dilemma and therefore I do not believe any more testing would be justified.

Let's see what our discussions with Dr. Newman and yourself bring out.

R. Emmet Kelly, M.D.

REK:k

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PROCESS FOR THE PRODUCTION OF
AROCLORS, PYRANOLS, ETC.
AT THE ANNISTON AND AT THE WM. G. KRUMMRICH PLANT

April 1955 -------------- E. Mather

Distribution List (amended July 19, 1956)

1. Mr. J. S. Brough, London
2. Dr. N. B. Dyson, Newport → Newport T.I.E. file
3. Mr. G. V. Taylor, Newport
4. Mr. G. V. Taylor, Newport → Newport Process Superintendent
5. Mr. W. E. Hamer, Ruabon
6. Mr. J. F. Stickley, St. Louis → Krummrich Plant
7. Mr. J. F. Stickley, St. Louis → St. Louis Library
8. MCL file at St. Louis
9. Mr. D. B. Hosmer, Anniston
10. Spare held in M.C.L. file at St. Louis
11. Dr. W. A. Hayward's file Ruabon

also Section IX, Specifications and Test Methods, to Newport Analytical Department.

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VI. PROCESS IN DETAIL, contd.

Packing

The finished Aroclors are run off into drums, a piece of diaper cloth being tied on the pipe outlet for the lighter Aroclors, and a piece of fine gauze for the heavier Aroclors, which have to be handled hot.

This, of course, is to arrest stray bits of pipe scale etc., but the precaution is now omitted at the Krummrich plant when material are being filled directly from the delivery of the filter. Newpor arrangements for filling and weighing drums are discussed in Londc Engineering Final Report, September 1951, page 1D8 and 1 F3-10, also in the start-up reports, July 24, and September 27, 1951.

The drums must be clean and dry, especial care being needed with electrical grades. Newport complaint NP/61, November 1951, of turbidity in 1248 was traced to the presence of water in the drums Apparently, in presence of water, the Aroclor reacted on the galvanizing of the drum. Newport plant report, December 1951, mentions the installation of equipment for drying the drums.

Care is taken not to do any packing if there is HCl fume in the ai:

The gaskets for the bungs of the drums have to be correctly chosen. A sample of the gaskets supplied by the Melrath Supply & Gasket Co. to the Krummrich plant was sent to MCL, April 1947. See also the ~~discussion of gaskets on page 2, Section XII, below.~~

Mr. Pemberton, December 1950, collected samples of the labels used at the Krummrich plant; one a patent list label, and the other a warning label on toxicity.

The effect of exposure of Aroclors to metal contact is discussed in Section VII, comments, page 17 below. Generally speaking, the distilled Aroclors are packed in galvanized drums, the undistilled ones in black steel drums. Flaked or milled solids were packed in barrels or Leverpac containers, bulk solid or resinous Aroclors go out in friction type lid drums, (galvanized for the distilled grades). Storage and blending of the distilled Aroclors is done in steel vessels sprayed with tin or zinc, or aluminum lined.

VI. PROCESS IN DETAIL, contd.

Packing, contd.

Since the Aroclors are such effective solvents , they damage, an are damaged by, ordinary paints, lacquers, insulating varnishes, This feature is important in connection with hydraulic fluids containing Aroclors. See, for example, MCL Research Progress rep 1151, DF 54/26/7 and DF 54/277/6 and 1152 DF 4/16/7 and 8 July 19 etc., also the Section III, Physical & Chemical data, above. Dru for electrical grades of Aroclors are not painted.

Newport Plant Technical Committee meeting, April 14, 1953, page 2 reported some promising tests with lacquered drums for electrical grades. It was decided not to use lacquered drums for resinous Aroclors on a returnable basis, because the lacquer suffered at the high temperatures likely to be used in melting the material f the drums.

Aroclors also are dispatched in rail cars. At the Krummrich plant the manhole of the car is protected by a tarpaulin tent during fil Newport plant report for July 1954 mentions the installation of tank-filling facilities. The Krummrich plant operating instructio August 10, 1954 mention that rail cars for Pyranols and Aroclors are insulated and have either a steam coil or a steam jacket. The are lined with Aluminium or else sprayed with tin and zinc. Only dry air is used for unloading. MCC have a "Christmas Tree" fitting a one piece fitting carrying air valve, dip pipe, release valve and pressure gauge, for use on rail tanks. It is important to dra the coil or jacket of the rail tank in cold weather. Galvanized or lacquered drums are used for Pyranols.

XI. HAZARDS.

Toxicity

There are many literature references*to harmful effects of the ty of "chlor acne" resulting from exposure to chlorinated diphenyls, especially in cases where people working with small electrical co ponents have been exposed to the fumes of hot, highly chlorinated Aroclors. Chlor acne is sometimes accompanied by gastric troubles, and there are literature references to liver troubles.

There was some trouble of this kind among the production workers a Anniston in the early days of the development of the Aroclors. A' that time highly chlorinated Aroclors were being made from dipheny which had come from low grade benzene. Since good benzene has bee used, the same Aroclors have been made without trouble. In March it was reported that the Anniston diphenyl and Aroclor plants had 12 years without lost time accident.

From the start of Aroclor manufacture at the Krummrich plant the operators have been supplied a clean change of clothes every day, and time has been allowed at the end of the shift for bathing. Operators are advised to wash hands and face before eating. The Anniston operators do not have the same issue of clean clothes.

* Percy May, "Chemistry of Synthetic Drugs" , 3rd edition, page 1
The "Chemist Analyst", September 1947, Volume 36, No.2 page 33 ~~and a report by Dr. M. G. Lester, Anniston plant, 1937, give da~~ on the toxicity of diphenyl.

MCC Bulletin P-115/(new edition) mentions 0.5 to 1.0 mg. per cbm in air as the highest safe concentration of higher Aroclors, and 10 mg. for more highly chlorinated Aroclors.

H. B. Edkins "Chemistry of Industrial Toxicology", page 1-9 give 0.5 to 1.0 mg. as the allowable limit in working rooms.

The MCC Bulletin "Physical Properties of Aroclors" mentions systemic effects arising from the oral injection of Aroclors.

See the letters, E. Mather to P.J.C.Haywood, December 17, 1951, Mather to Newman, January 8, 1952, reviewing the literature on t toxicity of Aroclors.

See also correspondence relating to the article in Chem. & Eng. May 17, 1954, pages 2038 -, and the warning labels mentioned on page VI-34 above.

XI. HAZARDS, contd.

St. Louis, Main Office

cc: Mr. W. E. Hamer, Ruabo
Mr. W. H. Ritchie, Rua
Dr. H. R. Newman, Ruab
Mr. S. M. Kulifay, Kru
Dr. D. S. Weddell, St.
Mr. F. T. Marshall, St

December 11, 1951

Mr. P. J. C. Haywood

Newport (Airmail)

AROCLORS::TOXICITY

Since writing to you on December 3rd I have come across a letter of mine to Mr. W. M. Cooper, London, June 24, 1948, (copies to W.D.S., W.H.G., and others), calling attention to an article in the J. T. Baker Company's "Chemist Analyst", Volume 26, No. 2, page 33, September 1947.

I attach a copy of this article, and I think you will agree that the warning relates only to really bad exposure, not such as should occur in ordinary analytical work.

On October 27, 1947 Mr. Barbre of the Krummrich plant sent a copy of the Journal to Dr. Jenkins at Anniston for comment. Dr. Jenkins did not make any comments at the time, but the following extract from Mr. Barbre's letter is interesting:

> "During the 11 years of production here only one man evidenced dermatitis. He had also shown similar symptoms in several other departments. When making Aroclor #1270 which is flaked, a noticeable amount of fine fume solidifies in the air. If men are exposed to it during hot humid weather, the skin is irritated, but we have not had any difficulty in curing cases of dermatitis from it".

F000040 ACM C

E. Mather

XI - HAZARDS, contd.

The Chemist Analyst, Vol. 36, No. 2, page 33,
J. T. Baker Chemical Co., Phillipsburg, N. J.
September 1947

ON THE TOXICITY OF THE "AROCHLORS" (sic)

Robert M. Brown, Chief
Industrial Hygiene Section, Division of Health
Dept. of Public Welfare, City of St.Louis, Mo.

A recently published article (Maglio, M. Martin, Chemist Analyst, 35 94 (1946)), has recommended the substitution of one of the "Arochlors" as the melting-point bath liquid in preference to the customary sulphuric acid. As stated in that article "Arochlors" are a group of chlorinated diphenyls produced by the Monsanto Chemical Company.

There is need therefore to give warning. For the toxicity of these compounds has been repeatedly demonstrated, both from the standpoints of their absorption from the inspired air, as well as from their effects in producing a serious and disfiguring dermatitis when allowed to remain in contact with the skin. Since these effects have been repeatedly observed, industrial hygienists have taken care to see that the proper controls have been established wherever these products are used. For example, the maximum allowable concentration of chlorinated diphenyl for an 8-hour working day is 1 milligram per cubic meter of air.

It is probable that nothing like an uncontrolled industrial exposure will occur in the laboratory. However, whether an individual is subjected to a possible acute exposure to chlorinated diphenyl, and its serious consequences, will depend upon the size of the melting-point bath, the caution with which it is used, and the temperature to which it may be heated. Likewise, with careless handling of the material and the resulting contamination of the skin, clothing, laboratory towels, work table surfaces, etc. the way is left open for the producing of dermatitis. Scrupulous cleanliness must be insisted upon wherever this material is handled

The foregoing remarks have been prompted by the belief that in recommending the use of a material with which is associated a potential hazard from the health standpoint, it is very important that the possible consequences be presented together with recommendations for correct handling.

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ACM CC2

XI. HAZARDS, contd.

Mr. A. C. W. Pennington of Newport, reporting on his American tour, December 29, 1950, page 5, writes:

"HEALTH AND SAFETY":

"At Anniston, no special protective clothing is provided the Diphenyl and Aroclors operators. A daily change of clothin was provided in the past but this practice ceased before the wa Gauntlet leather gloves and face shields are, of course, availa as required on the plant.

" Tins of cold cream ointment, theatrical quality, are to in the building, but the application of the cream is left to th operator's decision of the job in question. The men are expecte take a bath, in their own time, at the end of the shift. A goo quality soap, and alcohol for rubbing down purposes, are provide The operators are sufficiently trained in the need for personal cleanliness that a record of bath taking is not warranted.

"Emergency showers are provided on each floor of the Diphe building and safety notices are widely used.

"At St. Louis, Plant B, the Aroclors building is rated a toxic department. Each operator is provided with a complete set of clothing comprising hat, coat, trousers, combination underclothes, socks and rubber shoes. A clean change of clothing, except shoes, is placed in the operator's locker in time for the following shift. Men working extra shifts are given a clean set of clothing. Canvas gloves and goggles are provided and 'Ply' hand barrier cream is available for use when necessary.

"Twenty minutes' paid time is allotted for bathing at the end of the shift but, again, no record is kept that baths are actually taken. Theoretically, food is not allowed to be eaten within the Aroclors building. Instructions are issued that hands and face should be washed well before eating.

"Employees in toxic departments are given an annual medical examination and a lung X-ray every three years.".

XI. HAZARDS, contd.

Toxicity, contd.

A good deal of work has been done on determination of the vapour pressure of the Aroclors, and on the determination of concentrat of Aroclors in air. See pages 9-, Section III, above, for a sum of this work.

In 1950 (letter April 20, N. F. Rapps to E. Mather) the Admiralt expressed interest in the determination of micro-quantities of Aroclors. MCC have a method for the determination of traces in air by means of the "Halidometer".

Mr. Ellenburg, March 15, 1954, mentions work done by H. B. Richar Jr., of MCC, June 17, 1953, on the determination of the concentra of Aroclors in air. Mr. Ellenburg also states:

> "------- work on the safe limits of Aroclor vapour concentration in air is being carried on by the Medical Department at the Kettering Laboratories in Cincinnati. This work on animals is well under way, and will help us to know a little better just what is the safe limit of Aroclor Vapours that one might work in."

A question has been asked about the possible harm to plants if Arc containing paints are used in greenhouses. The reply is that most paints are somewhat harmful, and there is no evidence that Aroclor make them worse. Aroclors have been used as rabbit repellants, wi out doing any harm to vegetation.

Care is needed in laboratories etc. where Aroclors are used in heating baths; there should be very positive ventilation.

The vapours of hot Aroclors are distinctly irritating to eyes and nose above a concentration of about 3 mg per cbm in air. Newport plant report for December 1951 records burns by hot Aroclor -- a case of a splash into a man's eye -- without serious damage.

Packages of Aroclors leaving the Krummrich plant bear a label calli attention to possible toxic effects.

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XI. HAZARDS, contd.

Fire Hazards

Diphenyl, of course, will burn, and reasonable care is needed in handling it. Precautions with toluene are mentioned also on page VI-29, and under "Special Risks", below.

The Aroclors are handled as if non-inflammable. Drums of materia are melted in the middle of the operating building, by open gas flames, and open gas flames are freely used to heat pipe lines.

An instruction, dated April 28, 1948, calls for a daily inspectio of safety showers, fire extinguishers and gas masks, a check list being provided.

Flanged joints on Aroclor heating system can be a source of fume. See the notes on gaskets, page 2, Section XII, below.

Phosgene may be generated in electrical flashes and fires in trans formers containing Aroclors, but this is not thought to be a major risk.

Safety Equipment

Each operator in the Krummrich Aroclor plant is supplied with goggl rubber covered gloves, canvas gloves, rubber shoes and fume respira See also page XI-1. A spare suit of clothes is kept in a case in t department. The department has the usual first aid cabinet, gas ma (chlorine), fire extinguisher, (toluene, diphenyl), stretcher, safe showers, drinking fountain, eye bath.

Special Risks

The usual care is necessary in dealing with chlorine, in lighting the gas furnaces, and in handling hot materials, steam lines etc. Diphenyl might start to burn in chlorine gas if conditions in the chlorinator were badly out of line.

A Davis "Vapotester", model M-1, Type A, (Division of Davis Emergenc Equipment Co., Inc., Newark, N.J.) is held in the department for use in testing the air of the working building after toluene has been used, and for testing vessels before men are permitted to enter, and before "flame certificates" are given. The instrument contains a

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XI. HAZARDS, contd.

Special Risks, contd.

catalytic cell electrically heated to a fixed temperature, and the air to be tested is aspirated through it by means of a "squeeze ball". If combustible vapours are present, the temperature of the cell rises, and the indicating thermocouple registers on a calibrated scale.

The instrument has a zero adjustment, and it is checked twice a month by the instrument department. Flame certificates must give the number of the Vapotester used, also the data of its last calibration by the instrument department. The instrument has been useful in detecting gas escapes, and in tracing spills of gasoline, etc., from a neighbouring oil refinery into a public sewer which runs under Monsanto territory.

Mr. Benignus, of St. Louis, September 1953, discussed the dangers of using Aroclors in indoor paints. He discounted the possible dangers from phosgene formed by flash discharges in transformers charged with Aroclors.

See the references to safe handling of glycidyl phenyl ether on pages IX-161 etc.

At St. Louis — Mr. R. M. Webber

CONFIDENTIAL — Date: November 14, 1955

To: Mr. H. B. Patrick — Reference

At: Krummrich Plant — Subject: DEPARTMENT 246 (AROCLORS)

It is the opinion of the Medical Department that the eating of lunches should not be allowed in this department for a number of reasons.

(1) Aroclor vapors and other process vapors could contaminate the lunches unless they were properly protected.

(2) When working with this material, the chance of contaminating hands and subsequently contaminating the food is a definite possiblity.

(3) It has long been the opinion of the Medical Department that eating in process departments is a potentially hazardous procedure that could lead to serious difficulties. While the Aroclors are not particularly hazardous from our own experience, this is a difficult problem to define because early literature work claimed that chlorinated biphenyls were quite toxic materials by ingestion or inhalation. In any case where a workman claimed physical harm from any contaminated food, it would be extremely difficult on the basis of past literature reports to counter such claims.

Jack T. Garrett

Jack T. Garrett

JTG:SMB

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PLAINTIFF'S EXHIBIT 979

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MONSANTO COMPANY

ANNISTON, ALABAMA

STANDARD OPERATING INSTRUCTIONS

FOR

AROCLORS

Revised: July 1964

Copy No. 15

Prepared by: J. W. Molloy
Production Supervisor

R. G. Moody
Production Superintende

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OPERATING INSTRUCTIONS
AROCLORS

B. SAFETY AND HOUSEKEEPING

Safety of operations in the Aroclor Plant depends on the individual operator. Materials being handled and operations must be observed closely to guard against the following:

	Cause & Action to Prevent
1. Chlorine Gas	Chlorine gas is a very toxic corrosive gas. Leaks or high pressure can occur to liberate it. Action to Prevent: a. Report Chlorine gas exposure immediately for treatment with <u>Antidote</u>. Milk may be used in mild cases to relieve throat irritation. Oxygen from the resuscitator in the Dispensary is available. b. Keep gas mask in good condition. Keep a good canister in the mask. Use these type masks only in Chlorine concentrations to 2-3% Chlori in air. c. Use a Scott Air Pak in concentrations of Chlori gas above 3% in air. Three units are available in the Aroclor-Biphenyl Department. d. If caught in Chlorine gas without a mask, hold your breath and go cross wind until you are out of range of the gas. Place a handkerchief over your nose in small quantities of Chlorine. e. Report all Chlorine leaks for repair immediatel; Make temporary repairs with tape if possible. f. In case of a major Chlorine leak the source of Chlorine gas must be stopped. Notify the Chlorine Plant immediately if the pressure on the Chlorine manifold exceeds 30 psig. Cut off liquid Chlorine from the car.
2. Thermal Burns	Contact with hot uninsulated product lines at the chlorinators and still areas. Contact with uninsulated steam lines and open steam. Contact with hot Aroclors from broken lines or leaks. Contact with open flames at stills or from heating lines in the department.

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B. SAFETY AND HOUSEKEEPING

Action to Prevent:

2. Thermal Burns (Cont'd.)

a. Know that contact with equipment and product will cause a thermal burn due to the high temperatures. Make changes in operations with this hazard in mind.

b. Know the first aid treatment for burns. Cold Water Treatment (See Appendix A - Emergency Section).

c. Wear gloves and long sleeve shirts with the sleeves rolled down when operating. Gloves and clothing can make the differ between first and second degree burns.

d. Report uninsulated lines for repair of insulation.

e. Use only steam lines with hose and hose clamps in good condition.

f. The following operations are hazardous and should be done with care:

(1) Catching samples at the Aroclor chlorinator circulating pumps.

(2) Sampling the Solid Aroclor still receiver.

(3) Drawing bottoms on the Aroclor stil

3. Explosion

An explosion could occur in the chlorin by slugging liquid chlorine to the distributor or shutting off the water discharge valve on the chlorinator cooling coil. Slugs of Liquid Chlorine could react fast enough to cause excessive pressure in the vessel. A rupture of th chlorinator could occur. Closing the water discharge valve on the chlorinator cooling coil isolates water in the coil. As the reaction occurs releasing heat, the water will vaporize and could split coil and tank.

Action to Prevent:

a. Observe operation of the Chlorine vapor and do not let liquid Chlorine get into the rotameters. Pipe lines will be frosted.

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B. SAFETY AND HOUSEKEEPING

3. Explosion (Cont'd.)

b. In case Chlorine feed lines are frost. close liquid Chlorine feed valve to th vaporizer. Check steam addition to th vaporizer. Inspect operation of the vaporizer. Do not start up until sour of trouble has been located.

c. Do not close valve in water discharge line from the chlorinator coil.

d. Observe temperature of the chlorinator periodically and be sure it is not too hot (180°C maximum).

4. Falls

Slipping on cement floors, stairs, Aro on floor, ice conditions; tripping ove objects (hose, pipe, valve handles, et or losing footing on ladders, etc., ca cause falls.

Action to Prevent:

a. The majority of minor, serious, and ne miss injuries in the Aroclor Dept. are the result of falls. Prevention is alw within the ability of the operator by u of expert operating practices.

b. The following items should be done:

(1) Return hose to rack after using.

(2) Keep operating areas clean of all foreign objects.

(3) Return ladders to racks when not in use.

(4) Keep gloves on and hands out of poc especially going up stairs.

(5) Place guards around any area that presents a hazard that should be guarded.

c. Poor lighting due to burned out bulbs should be corrected at once. Poor ligh ing due to inadequate facilities should be reported.

d. Spills must be cleaned up immediately following their occurrence. Report any spill that can not be cleaned up within the shift to the Chief Operator. Spil' are to be reported in the log book.

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B. SAFETY AND HOUSEKEEPING

5. Fires

Fires can occur by:
- Biphenyl, Santowax R, or Santowa ignition.
- Chlorine problems in the vaporiz allowing reaction with steam to release Hydrogen.
- Furnace burner backfire.
- Wood, rags, or paper on hot lines
- Sparks from welding apparatus or open flames.

Action to Prevent:

a. Area must be clear of trash or flamma materials. Use trash skips and cans.

b. Smoke only in areas so designated.

c. Use spark producing equipment only wi a fire permit and proper inspection.

d. Use care in lighting gas torchs or the still furnaces.

e. Fire fighting equipment includes:

(1) Two wheeled dry powder units.

(2) Hose house with 200 ft. of hose.

(3) Two dry powder hand extinguishers, One CO_2 hand extinguisher.

(4) Two 3/4" water hoses.

(5) Hose connection north of Santowax.

(6) Scott Air Paks.

(7) Fire truck in fire house.

f. Observe visitors in the plant and be su they observe safety rules.

6. The following is a list of the chemicals handled in the Aroclor Plant operations and the precautions to be taken during their handling:

a. Chlorine Gas

Chlorine is a very toxic corrosive gas. Le or back pressure can occur and liberate chl rine gas in the area. Operators should hav their cartridge type respirators handy at a times while in the area. Use of gas masks explained in Section B-1.

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B. SAFETY AND HOUSEKEEPING

6. a. **Chlorine Gas (Cont'd.)**

If you are caught without a gas mask and large amounts of chlorine gas are libera hold your breath and go cross wind until you are out of range of the gas. Once o of the area, obtain an emergency gas mas and return to the area and correct the t:

A victim of chlorine gas fumes must be r as quickly as possible from the gaseous a Place patient on his back with head and b elevated. Milk may be used in mild cases a relief from throat irritation. If the patient has stopped breathing, start arti ficial respiration immediately.

b. **Biphenyl**

Biphenyl is a flammable material which wi burn. Burning should not be done in the presence of Biphenyl or Biphenyl vapors. melting point is 68.7°C., flash point 106 the fire point 124°C., and the auto ignit temperature is 258°C. Inhalation of Biph fumes is not recommended since it can cau a drugged effect on the person.

c. **Santowax R**

Santowax R is a flammable material which w burn. It is relatively non-toxic to huma beings. However, the vapors of Santowax R are irritating to the mucous membranes and bronichial tract. Prolonged breathing of the vapors should be avoided. The melting point is 140°C.

d. **Santowax C**

Same as Santowax R, since it is the crude material prior to distillation.

e. **Ferric Chloride**

Ferric Chloride is a black-brown solid. I causes only slightly irritating effects on the skin or mucous membranes. When heated it will decompose and release toxic fumes of HCl (hydrochloric acid). It will react with water to produce toxic and corrosive HCl fumes.

f. **Attapulgus Earth**

This material is a dried earth. No danger in handling. Wash off with water to clean.

g. **Hydrated Lime**

No particular hazard in handling this mater The dust is irritating to the eyes and ski and should be washed off with water.

h. **Crude Aroclors**

Crude Aroclors are hot since all are handl in steam traced or jacketed lines. They ca easily cause thermal burns in contact with

B. SAFETY AND HOUSEKEEPING

6. h. Crude Aroclors (Cont'd.)	the skin. Prior to air blowing, the material has HCl fumes entrained in it which are irritating to the skin or mucous membranes.
i. Hydrogen Chlorine Gas	This a corrosive gas which is toxic. I is irritating to the mucous membranes, the eyes, and to the respiratory tract. It will react with water to form Hydrochloric Acid.
j. Still Bottoms or Residue	Fumes from still bottoms are toxic. Th are extremely irritating to the mucous membranes, to the eyes, and respiratory tract.

HOUSEKEEPING

The Aroclor chlorinator and still operators are responsible for housekeeping during their shift. Good housekeeping is the mark of good operations, safety practices, quality, and costs.

Housekeeping duties are equal in importance with all other operating dutie

Poor Practices	Action to Prevent
1. Hoses, valve handles, dip sticks, rags, and other material on ground or floor.	a. Replace after use.
	b. Have place to store all necessary operating aids.
	c. Report needs to supervision.
2. Product leaks	a. Tighten valve packing glands and flange bolts.
	b. Report leaks to Chief Operator for maintenance alteration.
3. Trash and crude drums	a. Contact chief to have drums moved fr area.
	b. Use trash skip in area
4. Product spills or clean out messes	a. Prevent necessity of clean-out by keeping tracing, insulation, or jacke in good repair by getting items turne in for maintenance work.
	b. Spills must be cleaned up when they a made. Clean up will continue through the following shifts to finish the jo

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DETAILED INSTRUCTIONS

III. Loading Refined Aroclors

Aroclors are shipped in five gallon cans; 55 gallon drums; 4,000, 7,000, and 8,000 gallon tank cars; and 3,000 or 4,000 gallon tank trucks to customers.

a. Spotting Tank Cars

Normally the railroad switch crew will spot cars at the Aroclor loading dock. Occasionally it will be necessary to move a car. When it is necessary use the half track and pull the car into position.

(1) Obtain help to move the car.

(2) Attach hook on cable at front of the half track to a strong part of the car. Do not hook onto the ladder or other weak parts.

(3) Release the winch and let out 15 to 20 feet of cable to connect to the car.

(4) Release the brakes on the car.

(5) Use the half track to pull the car into position. Put the half track in four wheel drive. Do not use the winch to pull the car.

(6) Stop pulling the car when it is in position.

(7) Set the brake on the car.

(8) Remove the cable hook from the car and wind up on the winch drum.

b. Filling Tank Cars or Trucks

Aroclors are shipped in lined vessels to protect the electrical properties from contamination. Most vessels are lined with aluminum or a zinc-tin lining.

(1) Inspection of car or truck for loading:

(a) Enter each car or truck for inspection prior to loading. If necessary clean out the vessel. All material in the tank should be removed. Damaged lining areas should be cleaned of rust particles. Report damaged areas.

(b) Use a tank entering permit and a fire permit when entering a car. Observe safety rules for each permit.

(c) A fellow worker must be on top of the car holding the rope harness. Wear the safety belt harness, an air mask, gas test the car, and use a light when entering a tank car or truck.

C. DETAILED INSTRUCTIONS

III. b. (1) (d) Fill out tank inspection sheet.

(2) Put steam on the car after it is clean.

(3) Check to be sure there is enough material in a storage tank to load a car or truck as required. (An 8,000 gallon car requires about 63" of material in #2, #3, and #4 storage tanks.

(4) Circulate the material in the storage tank for two (2) hours, sample the tank, and have the sample checked for loading by the laboratory. If material is in specification proceed with loading of the tank.

(5) Install diaper cloth sock in the filter in the loading line and place a sock over the end of the loading line extension.

(6) Attach extension to the loading line at the dock and place sock end into the dome of the car.

(7) Connect ground wire to the car.

(8) Set valves in the loading line from the storage tank to the loading dock. Do not open valve in line at the car.

NOTE: Care should be taken to see that the correct valves are opened so only the desired Aroclor enters the loading line.

(9) Start pump at the storage tank.

(10) Open valve in drain line at the loading dock and allow one drum of Aroclor to flow through the line to flush out the loading line.

(11) Close valve in drain line and open valve in line to the car. Approximately 2½ hours is required to load a car.

(12) When the car is loaded, stop the pump, and close valve to the loading line. Fill car up one to two feet into the dome of the car.

(13) Remove loading line from car.

(14) Take samples from car and send to laboratory for final analysis. (See Schedule)

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C. DETAILED INSTRUCTIONS

III. b. (14)

SAMPLES TO BE TAKEN FOR LIQUID AROCLOR LOTS

MATERIAL	TANK CARS - TRUCKS or DRUMS
1221	2 x 1/2 Gallon
1232	2 x 1/2 Gallon
1242	3 x 1/2 Gallon & 1 x 5 Pint
1248	2 x 1/2 Gallon
1254	3 x 1/2 Gallon & 1 x 5 Pint
1260	3 x 1/2 Gallon
1262	2 x 1/2 Gallon

(15) Close and tighten lid on car.

(16) Seal car and record seal number and car number in Aroclor log book.

c. Filling Drums

Liquid Aroclor can be drummed from the storage tanks or the filtrate receiver. Solid Aroclors that are drummed are normally filled from the still receiver. Solid Aroclors 1268 and 5460 are normally flaked and bagged. Aroclor 2565 is a non-distilled product which is drummed from the blowing tanks.

The following steps should be followed when material is to be drummed:

(1) Send a representative sample (1/2 Gal. for Liquid Aroclors) of the material to the laboratory for inspection. If the material is via storage tank it should be circulated for two (2) hours. Material in a filtrate receiver or blowing tank should be agitated for 20 to 30 minutes. If material is in specification proceed with drumming.

(2) Check the scales to be used. Set the scales for the weight specified for each drum (See Table IV).

(3) Start the pump.

TABLE IV
AROCLOR FINISHED GOODS
DRUM WEIGHTS

Material	Drum Weights Lbs. - 5 Gals. & 55 Gals.
1221	50 or 520
1232	50 or 550
1242	55 or 600
1248	55 or 600
1254	60 or 600
1260	60 or 600
1262	60 or 600
1262 - 10% Toluene	60 or 600
1262 - 10% Xylene	60 or 600
1260 - 10% Toluene	60 or 600
A13B3B	65 or 675
5442	50 or 450
2565	500
4465	50 or 500
Inerteen PPO	65, 360, or 674

C. DETAILED INSTRUCTIONS

IV. Flaking Aroclors

Aroclors 1268, 5460, and 5060 are flaked on a drum flaker and bagged in 100 lb. bags.

a. Preparation for Flaking

(1) Place hot Aroclor heat on the pipe lines, valves, and flaker hold tank. Heat the Aroclor system up to 250°C. Observe temperature on the multi-point recorder in the chlorinator control room.

(2) Pump Aroclor to be flaked into the flaker hold tank.

(3) Check temperature of material in the hold tank. It should be 220°C. min. Temperature recorded on #3 still multi-point recorder.

b. Start-Up of Flaker System

(1) Turn electrical heat in the flaker pan on about 20 to 30 minutes before start-up.

(2) Open valve in water line feed to the flaker drum.

(3) Start the flaker drum. Start breaker at discharge of flaker.

(4) Open valve at bottom of the flaker hold tank.

(5) Open valve at sight glass to start Aroclor feed into the flaker pan. Observe flow in sight glass. Adjust valve to maintain the level in the flaker drum about one inch from the top of the drum.

(6) Observe operation to be sure the drum is picking up the material.

(7) After the flaker has run 15 to 20 minutes notify the Chief Operator material is in the hopper to be bagged.

(8) Continue to flake until the flaker hold tank is empty.

c. Shutdown of Flaker

(1) Normally the flaker will be run until the hold tank is empty.

(2) Allow the drum to pick up material from the pan until it will no longer contact the hot liquid product.

(3) Stop the flaker drum and the breakers.

DETAILED INSTRUCTIONS

VI. Milling Aroclors

Aroclor 1268 is the only Aroclor which is sold as a milled product. The material must first be flaked.

a. Select the drums of material to be milled.

b. Check the scales to be used. Place a new drum under the milling machine to collect the 1268.

c. Crushed dry ice is used during milling to keep the machine cool. This keeps the Aroclor 1268 from clogging up the machine.

d. Start the mill and auger.

e. Fill the bucket with crushed 1268.

f. Blend dry ice with the 1268 and feed it into the hopper over the mill. Use approximately five pounds of dry ice to each 100 pounds of Aroclor 1268 that is milled.

g. Fill the drums to the specified weight (normally 200 lbs.). Stencil the drums with the name of the product, lot number, net weight of each drum, and the initials of the person doing the work.

h. Continue this operation until the required number of drums are filled. Then stop the milling machine and clean up the scales, the milling machine, and the milling room.

i. All drums filled are palletized and moved to the loading platform for transfer to the warehouse.

MILLING

BCC D. F. Smith - St. Louis

November 30, 1961

Mr. Bruce Smith
General Electric Company
Evendale - Building 700
Cincinnati, Ohio

Dear Mr. Smith:

Mr. G. W. McKinney of our Cincinnati office has asked me to forward data and comments concerning the toxicity of our industrial fluids Pydraul F-9 and Pydraul A-200.

Enclosed are two sheets summarizing the animal toxicity data and known human experience with these fluids.

Mr. McKinney mentioned that you were interested specifically in the toxicity of the vapors of these fluids and secondly, in the possible hazards resulting from skin contact.

As indicated in the enclosures, exposures to high concentrations of vapors for a short period do not constitute a serious hazard. At normal temperatures, the vapor pressures of the fluids are such that little vapor is present in the atmosphere. When the fluids are in a system under pressure and at elevated temperatures, economical and efficient use of the fluids dictates minimum leakage be allowed during normal operations. In the event of a system failure such that the fluid is sprayed as a mist, either into the atmosphere or against molten metal or hot surfaces, the toxicity hazard is not serious since the concentrations of the mist, vapors and/or decomposition products would be discomforting to the degree that workmen would not voluntarily expose themselves for sufficiently long periods to experience a serious toxic effect.

In regard to skin contact, the possible reaction following prolonged and repeated skin exposure is more apt to be one where the fluids have acted as a good solvent, much like a common paint thinner or remover. Like many organic liquids, these

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fluids can dissolve the natural oils and fats on the surface of the skin, leading to drying and cracking. For this reason, we recommend that prolonged skin contact be avoided.

Although we have not made a complete chemical analysis of the decomposition products when either fluid is thermally decomposed, the survival of animals in suitable exposure chambers to massive concentrations of vapors, smoke and decomposition products indicates that phosgene is not a major component of such decomposition products. Depending on the conditions of pyrolysis or decomposition, the products include carbon monoxide, carbon dioxide, water vapor and aldehydes, such as one would expect with the decomposition of any complex organic compound. The only significant additional product would be hydrochloric acid. This may add to the acrid and irritating properties of the decomposition products and may be accountable for its discomforting or unpleasant effect on the nose and throat. For practical purposes, this could be considered an advantage in that the irritation limits the amount of exposure that any person would experience.

If I can be of any further assistance, please let me know.

Very truly yours,

Elmer P. Wheeler
Assistant Director
Medical Department

EPW:dh
Enclosures 2

cc Mr. Gordon W. McKinney
Monsanto Chemical Company
2330 Victory Parkway
Cincinnati 6, Ohio

E. L. Hammer

THE PROPER HANDLING OF AROCLORS AND THEIR MIXTURES IN THE ELECTRICAL INDUSTRY

3/32 " dia.

64 holes in 10 inches

Monsanto Chemical Co.
Organic Div. Sales Dept.
800 N. Lindbergh Blvd.
St. Louis 66, Mo.

P. G. BENIGNUS
Revised
January 1960

INDEX

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Attachments: Drawing No. 31-20847, The Tank Car
Drawing No. 31-20848, Dome Detail
Drawing No. 9C-8170-5, The Horizontal Storage Tank
Drawing No. D-13362, The Vertical Storage Tank
Drawing No. 9C-8248, The Breather
Drawing No. 9C-8278, The Varec Gauge
Drawing No. 9C-8178, The Unloading Platform

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CHAPTER 12

DERMATOLOGY AND TOXICOLOGY

Skin Exposure

Aroclors, or askarels, accidentally spilled on the skin do not cause an acute toxicity hazard, nor will they cause serious irritation. The materials should be washed from the skin with soap and water. Prolonged skin contact should be avoided. If work clothes become impregnated with these fluids, they should be removed and washed.

When sampling tank cars, canvas gloves and safety glasses, or goggles, should be worn. No special clothing is required, but the workers' garments should be laundered at least weekly and changed, if Aroclors or askarels are spilled on the clothes.

If accidental burns occur from contact with hot askarels, the burn should be treated the same as any ordinary burn. Aroclor, or askarel, adhering to the burned area need not be removed immediately unless treatment of the burn demands it in which case, soap and water, or repeated washings with a vegetable oil should be used. Accidental contact with the eyes results in painful irritation, but not permanent damage to the tissues or the sight. In event of such contact, the eyes should be flushed with a large amount of water for at least 15 minutes. The patient should then be referred to a physician who will treat with an ointment to soothe the eye.

Exposure to Vapors

Vapors from hot Aroclor, or askarel, have a degree of toxicity and should not be inhaled over a prolonged period of time. Experimental work on animals indicates that the maximum safe concentrations of vapors in work rooms is in the range of 0.5 to 1.0 mg. per cubic meter of air. Harmful amounts of the materials are readily detectable by odor and irritation to the eyes. Usually, people can detect concentrations of askarels in the amount of 1.0 mg. per cubic meter of air, which is the level regarded as the safe work room limit for an 8 hour day exposure.

Capacitor impregnations may be done at temperatures as high as 266°F. (130°C.). Following impregnation and draining the chamber, exhaust ventilation should be applied to the chamber to prevent askarel vapors entering the work room. Also, when opening a heated capacitor impregnating chamber, the workmen should wear a respirator during this short interval of exposure.

If transformer askarels are used at temperatures above 125° to 150°F. to fill an open transformer, exhaust ventilation should be provided in the immediate area.

The many years of satisfactory and safe use of Aroclors, or askarels, by the electrical industry for impregnating capacitors and filling transformers has demonstrated the industry's ability to handle these fluids without hazard to the workmen.

It is both simple and in line with "good housekeeping" and personal cleanliness to exercise the suggested precautions in all cases.

Vapors from a Severely Arced Askarel Transformer

Experimental data indicate that when askarel is decomposed by an electric arc, insignificant amounts of chlorine and phosgene gas are liberated. The gas is almost entirely hydrogen chloride, which is readily detectable by its odor and its irritating characteristics in even small amounts. Thereby, adequate warning of its presence is provided and significant amounts of fumes would be likely to cause a hazard only in a closed area. Individuals would not voluntarily expose themselves to serious toxic levels of the hydrogen chloride gas fumes.

156
MJR

MONSANTO

AROCLOR

Resins and Plasticizers for Chlorinated Rubber

Technical Bulletin O-124 May, 1957
Monsanto Chemical Company, Organic Chemicals Division, St. Louis 1, Mo.

Introduction

Monsanto produces a series of chlorinated biphenyls and polyphenyls identified by the trademark *Aroclor** for use as plasticizers and resins for chlorinated rubber base lacquers, varnishes and paints. These protective coatings are fire resistant, corrosion resistant, chemical resistant (to acids, alkalies and water), and have good electrical insulating properties.

When properly pigmented, these coatings have good weatherability. Chlorinated rubber films plasticized with an *Aroclor* grip common structural materials in strong adhesive bonds. Addition of an *Aroclor* improves the flexibility and life of chlorinated rubber and plastic coatings.

The formulations suggested in this bulletin are common in commercial practice. They are given as a starting point or guide in developing formulations that expand the outstanding qualities of these compounds.

905992

*Aroclor: Monsanto Trademark. Reg. U.S. Pat. Off.

PLAINTIFF'S EXHIBIT
8

PLAINTIFF'S EXHIBIT
1210

100084

The information contained in this bulletin is, to our best knowledge, true and accurate, but all recommendations or suggestions are made without guarantee, since the conditions of use are beyond our control. The Monsanto Chemical Company disclaims any liability incurred in connection with the use of these data or suggestions.

Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents

Some important applications for protective and decorative coatings plasticized with Aroclor compounds--

Wood and metal used in yachts, barges and other marine craft.

Structural steel for bridges, buildings, roofs and power-lines.

Structural materials at chemical plants, pulp and paper mills, textile mills, petroleum refineries and gas works for protection against acid fumes, alkalies and gas.

Tank cars and other rolling stock and construction machinery for protection against corrosive materials and weathering.

Equipment and stop-off lacquers used in electroplating.

Masonry floors and walls. Concrete swimming pools. Highway markings.

Cable coatings requiring fire resistance, chemical resistance, and excellent electrical properties.

Textile coatings resistant to chemicals, fire and water.

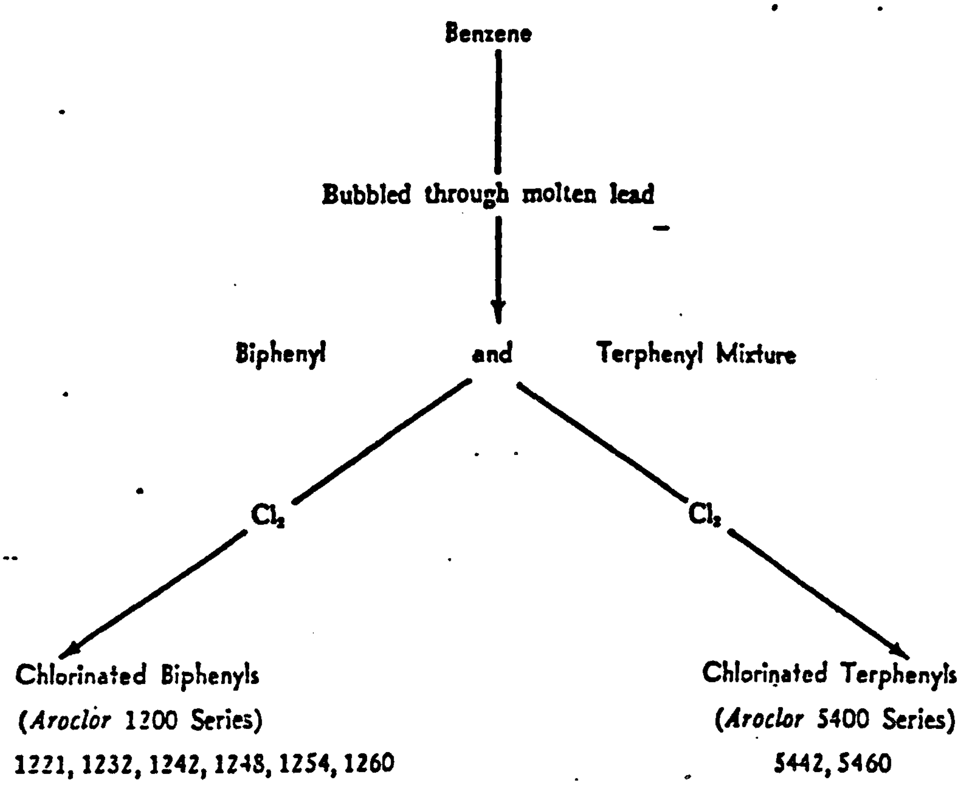
TABLE OF CONTENTS

This bulletin replaces technical bulletin P-124.

100086

905994

Naming and Preparation of Aroclor Compounds



Note: The last two digits in a numbered series refer to the degree of chlorination. *Aroclor* 1248 is a biphenyl with 48 per cent chlorination. *Aroclor* 5460 is a terphenyl with 60 per cent chlorination. Two special mixtures are:

Aroclor 4465—a 60:40 mixture (biphenyl to terphenyl) with 65 per cent chlorination.

Aroclor 2565—a 75:25 mixture (biphenyl to terphenyl) with 65 per cent chlorination.

The physical properties of the *Aroclor* plasticizers vary gradually with the degree of chlorination. At low percentages of chlorine, such as *Aroclor* 1221 and 1232, the compounds are clear and very fluid. At 42 per cent they resemble vegetable oil; at 48 per cent they thicken slightly and look more like a medium-grade mineral oil. At 54 per cent chlorine, the compounds are quite viscous; if a bottle containing them is turned upside down, the bubble rises slowly to the top. At higher percentages, the biphenyls become gumlike, and a fingerprint on the surface lasts several days. Then at 68 per cent chlorine, the range is complete; *Aroclor* 1268 is a white powder. The terphenyls (*Aroclor* 5442 and 5460) are both yellowish solids.

The gradual change in physical properties often allows a processor to select a plasticizer particularly suited for his operation. For example, if he wants to dry mix the plasticizer, *Aroclor* 1268 could be used. It melts at higher processing temperature and can act as a solvent-plasticizer.

Toxicity

Animal toxicity studies and 20 years of manufacturing and use experience indicate that *Aroclor* compounds are not serious industrial health hazards. If the materials are heated to volatilization, ventilation should be provided to prevent inhalation of vapors. This is true of other major components of the formulation as well as the *Aroclor* compounds.

Repeated or prolonged skin contact should be avoided although there are few instances of skin irritation. Human patch tests with finished products containing *Aroclor* compounds have shown no irritation. Monsanto will furnish information on specific *Aroclor* compounds upon request.

Shipping Information

Regulations	—None
Standard Containers	—Steel and Fiber (*Aroclor* 1268, 5460) drums.
Rail Classification	
Chlorinated diphenyl (synthetic resin, liquid, NOIBN)	—*Aroclor* 1142, 1148, 1154, 1160, 1162, 1168, 1221, 1232, 1242, 1248, 1254, 1260, 1268
Synthetic resin, liquid, NOIBN	—*Aroclor* 1260 mix, 1262 mix
Snythetic resin, other than liquid, NOIBN	—*Aroclor* 2565, 4065, 4465, 5042, 5060, 5442, 5460
Truck Classification	
Synthetic resin powder, NOI	—*Aroclor* 2565
Synthetic resin, lumps or solid mass, NOI	—*Aroclor* 4065, 4465, 5042, 5060, 5442, 5460

905996

100006

February 2, 1972

518-747-3341 Ext 217
518-792-4583 Home

Dr. A. Posefsky
Industrial and Power Capacitor
Products Department
General Electric Company
John Street
Hudson Falls, New York 12839

Mr. E. L. Raab
Distribution Transformer Department
General Electric Company
100 Woodlawn Avenue
Pittsfield, Massachusetts 01201

Gentlemen:

Attached is a Question and Answer list for responding to PCB inquiries which I offered to mail to you at our December 10th ANSI C-107 meeting.

I recognize that the list is not complete but I hope it will serve as a good start with further additions made by your respective committees. Should any help be required from Monsanto in responding to additional questions, please let me know.

Sincerely,

W. B. Papageorge
Manager, Environmental
Protection

/hg

attachment

cc: Messrs: A. M. Salazar - NEMA
P. G. Benignus - BOSC

NEV 024596

PLAINTIFF'S EXHIBIT 1177

734651

WATER_PCB-SD0000072593

Questions and Answers For ANSI PCB

1. Question

What is PCB?

Answer

PCB are initials which stand for polychlorinated biphenyl. PCB is a family of chlorinated hydrocarbons which have long been used as a fire-resistant safety fluid in electrical components.

2. Question

Is PCB in Askarel?

Answer

Askarel is a generic name for the PCB-containing fluids used in electrical transformers and capacitors. Individual electrical equipment manufacturers have different trade names which describe their specific fluid.

3. Question

Explain the current environmental flap over PCB.

Answer

In the mid-60's, scientific instruments became sophisticated to the point where parts-per-million or even parts-per-billion of a substance could be detected in the environment.

Swedish scientists, looking for DDT, encountered "interferring substances" in their laboratory analyses. These substances they identified as PCB.

Subsequently other scientists in other parts of the world looked for and found PCB in a variety of samples; thus leading to the conclusion that PCB exists in the worldwide environment.

NEV 024597

734652

4. Question

How does PCB get into the environment?

Answer

Probably through improper handling, use and disposal. A frequently cited accident occurred in Japan in 1968 when PCB leaked into rice oil which the Japanese use for cooking. Levels in the oil reached 2,000 to 3,000 parts-per-million.

However, it should be emphasized that when properly handled, used and disposed of, PCB can be as safe to use as any other chemical -- many of which are much more dangerous than PCB.

5. Question

Is PCB toxic?

Answer

Toxicity is a relative term. Some studies have shown it is toxic to certain species of birds and fish. More important, PCB is a persistent chemical which builds up in the environment. It, therefore, should not be allowed to escape to the environment.

6. Question

Does PCB cause birth defects?

Answer

Again, some studies have shown it can be detremental to the reproductive cycles of certain species of wildlife.

7. Question

Is the public in any immediate danger?

Answer

The Federal Government at a press conference in September, 1971, stated emphatically that the public was in no danger from present levels of PCB now in the environment. They said proper steps were being taken to reduce further escape of PCB which would ultimately reduce even the low levels currently being found in the environment.

8. Question

How can PCB be disposed of?

Answer

Under high temperature, controlled incineration, PCB breaks down into hydrochloric acid, carbon dioxide and water. There are three commercial incinerators in the United States which can handle disposal of used fluids. Contact your supplier for information about returning used fluids for proper disposal.

NEV 024599

WBP 2/2/72

734654

May 25, 1934

REPORT OF DR. FREDERICK B. FLINN OF PATCH TESTS
MADE ON MATERIAL RECEIVED FROM SWANN RESEARCH, INC.

The object of this investigation was to determine whether or not the various chlorinated diphenyl compounds submitted or some impurities contained therein might be the causative agent producing the dermatitis which had developed among some of the workmen in the plant.

Large white rabbits were used in making the patch tests to determine the action of the various materials submitted on the skin. The procedure was to shave the animal 36 hours before the patch was applied so that there would be no broken skin to interfere with or to aggravate the test. The material being tested was mixed with ethyl alcohol, either getting a solution or a suspension for the purpose of diluting the material. The patch was left on for various periods during the tests – some for 24 hours, others for 48 hours. The patch was then removed and the exposed area watched for two weeks to be sure that the test was negative. This was done to avoid the chance of not observing any latent or delayed action such as do sometimes take place in making patch tests. For our own information the materials which were negative were applied in a concentrated form in duplicate tests to see if a dermatitis might not develop under these circumstances.

Eight independent tests were made with each material and were made on different days with freshly prepared solutions to be sure that no error had crept in. Controlled tests were made each time with the alcohol and gauzes used to determine whether they might not be the causative agent causing the observed lesions.

Given below is Dr. Flinn's report, showing designations given the various materials by Swann Research followed by Dr. Flinn's designation and report of each specific material:

Aroclor 1262 (Lot 3, made before 3/1/33).

Aroclor 1262, Lot 3:– All eight tests were negative. The two tests with concentrated material were also negative. An intradermal test was negative.

Aroclor 1262 Lot Notebook No. 176, page 121; prepared by Harris of 94.5% diphenyl and 4.5% styrene and styrene high boiler:

Aroclor 1262, Lot Notebook 176, page 121, was negative to all tests including the concentrated and intradermal.

PLAINTIFF'S EXHIBIT 625

ADM 003165

90632

WATER_PCB-SD0000072597

Aroclor Special (Lot Notebook No. 192, page 9; prepared by Hubbard, of 75% diphenyl and 25% styrene and styrene high boiler). (Liquid Aroclor, specific gravity = 1.53).

Aroclor Special Notebook No. 192, page 9:- This chemical gave a positive test with each of the eight applications. It also gave a positive reaction with the intradermal test. The type of dermatitis was mild.

Aroclor 1248 (Lot 9, made 3/30/34):

Aroclor 1248, Lot 9: All eight tests gave a positive reaction. The intradermal test was also positive. The reaction was mild.

Aroclor 1248 (Lot 5, made 5/2/33):

Aroclor 1248, Lot 5 All eight tests gave a positive reaction with this compound. The intradermal test was also positive. I feel that the dermatitis produced by this material was milder than the two previous compounds which were also found to be positive. In several tests it did not make its appearance for 24 hours after the patch had been removed.

Aroclor 1269 (Lot 3, Dry Ground; made 6/22/32):

Aroclor 1269, Lot 3, ground dry: All eight tests were negative. The same is true of the two tests made with the concentrated material. The intradermal test gave negative reaction.

Aroclor 1269 (Lot Notebook No. 176, page 121; prepared by Harris, of 95.5% diphenyl and 4.5% styrene and styrene high boiler - dry ground):

Aroclor 1269. Lot Notebook 176, page 121, dry ground: All eight tests were negative. The concentrated tests were also negative. The intradermal test gave negative reaction.

Aroclor 1269 (Lots Notebook No. 176, page 121; same as immediately above but wet ground)

Aroclor 1269, Lot Notebook 176, page 121, wet ground: All eight tests were negative. The two tests made with concentrated material were also negative. The intradermal test gave a negative reaction.

Aroclor 1269, Lot 3, Notebook No. 192, page 10 (dry ground in pebble mill):

Aroclor 1269, Lot 3, Notebook No. 192, page 10: The eight patch tests were negative. The tests made with concentrated material were also negative. The intradermal tests gave a negative reaction.

ADM 003166

Halowax #1000:

Halowax 1000: This compound gave a positive test in all of the eight tests in which it was applied. The reaction was different from that of the three Aroclors giving a positive reaction. They were mild, but this material gave an ulcerative area.

Halowax #1001:

Halowax 1001: All tests with this compound, both concentrated and dilute, were negative.

Halowax #1004:

Halowax 1004: All tests with this material, both concentrated and dilute, were negative.

Styrene Dichloride (Notebook No. 192, page 16):

Styrene Dichloride: Notebook 192, page 16: Every test made with this material was positive. It was noticed that the rabbit pulled away when this chemical was applied even in the dilute form. This also gave an ulcerative lesion.

Aroclor 1248 Special (Batch 8, Sample 04 - made 10/4/30):

Aroclor 1248 Special Batch 8-0-4. Made 10/4/30: This Aroclor gave a very slight reaction with the skin but one must say that it is positive.

Aroclor 1260 (Lot 32, made 6/23/31):

Aroclor 1260. Lot 32. Made 6/23/31): All eight tests were negative. No intradermal or concentrated tests were made.

Aroclor 1262 (Batch 8A, Sample J.L-6, Made 7/8/30):

Aroclor 1262. Batch 8A. Made 7/8/30: All tests were negative.

Chlor Ethyl Benzene (Notebook No. 192, page 21):

Chlor ethyl benzene. Notebook 192, page 21: Every test made with this material gave a positive test. The lesion was of an ulcerative type.

Chlorinated Styrene (Notebook No. 192, page 19 - 5/16/34):

Chlorinated Styrene. Notebook 192, page 19. 5/16/34: Every test made with this compound gave an ulcerative lesion.

ACM 0C3167

Dr. Flinn's comments are copied verbatim, as follows:

"Comments:

One is impressed with the fact that each of the Aroclors giving a positive reaction were of a fluid nature. Attempts were made to expose the animals to vapors but observations made us conclude that the only difference was that the animal would be exposed to the hot material and it was well known that the reaction where such an exposure is given is more severe.

One cannot but feel that any styrene compound which may be found to be present as an impurity is the cause of your trouble. I was rather surprised that more of the compounds submitted did not show or give reactions with the skin. It has been shown in some investigations that chlorine did not produce a dermatitis when metallic electrodes were used but did if the metallic electrodes were replaced by carbon electrodes. The theory was advanced that some organic chlorine compounds were produced in the latter case.

I would suggest that you study your ventilation system in places where fumes are given off. That means be provided for the men to take a bath with soap and water if they come in contact with the type of material found to be positive. By this I mean if a leak or spillage occurs. The immediate bathing under these circumstances should be insisted on. I found that where I had gotten the material on my hands if I washed them thoroughly no trouble arose.

(Signed) Frederick B. Flinn

SUBMISSION TO

THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

OF

THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

U. S. HOUSE OF REPRESENTATIVES

By

Monsanto Company
800 N. Lindbergh Blvd.
St. Louis, MO 63166

November 16, 1979

1. HISTORY OF MONSANTO PRODUCTION AND SALES OF CHLORINATED BIPHEN

Monsanto entered the chlorinated biphenyls business in 1935, when it purchased the Swann Chemical Company. Production and distribution increased until the early 1970s, when, in response to reports of its presence in the environment, Monsanto restricted sales of chlorinated biphenyls. In 1977, the company ceased production and distribution of chlorinated biphenyls in cooperation with the electrical industry. Chlorinated biphenyls were banned (except for certain applications) in the U.S. in 1979.

Sales and Distribution

The chemical structure of the polychlorinated biphenyls has been known for nearly 100 years. Commercial production of these materials was initiated in 1929 by the Swann Chemical Company in response to the electrical industry's need for improved dielectric insulating fluids which would also provide increased fire resistance when used in transformers and capacitors. (See para. 2, page 2 of the Interdepartmental Task Force on PCBs report, "Polychlorinated Biphenyls and the Environment," May 1972 - Attachment 1-1.)

As the unique functional characteristics of these materials became more fully understood, additional uses were found. Their fire resistance made them an excellent choice in high pressure hydraulic applications associated with high risk of fire such as die casting and steel production. Their thermal stability and fire resistance were valuable in heat transfer systems.

Their stability, low water solubility, low vapor pressure and solvency power made them attractive in carbonless paper systems. Their fire resistance, thermal stability and viscosity characteristics made their use desirable in hot melt adhesives and other plasticizer applications.

Chlorinated biphenyls, therefore, evolved as a unique class of chemicals which met important needs for both industry and society. In some instances, fire and building codes required the protection of life and property offered by chlorinated biphenyls. It was within this framework that Monsanto and other producers developed a growing worldwide business for these versatile products. For a retrospective discussion of the benefits of chlorinated biphenyls, see Attachment 1-2.

The following charts show the data for chlorinated biphenyls through Monsanto's voluntary phaseout program to termination of production and sales in 1977. Significant points in these charts are:

a. Heat Transfer -- Between 1970 and 1972, a task force of Monsanto engineers worked closely with customers to replace chlorinated biphenyl fluids with materials of equivalent thermal stability but with unavoidable lower fire resistance. Phaseout was completed in 1972.

b. Hydraulic Fluid -- Development of replacement fluids began in 1970, and sales of chlorinated biphenyl-based fluids were discontinued in 1971.

MONSANTO INDUSTRIAL CHEMICALS COMPANY
1957 thru 1978
(Thousands of Pounds)

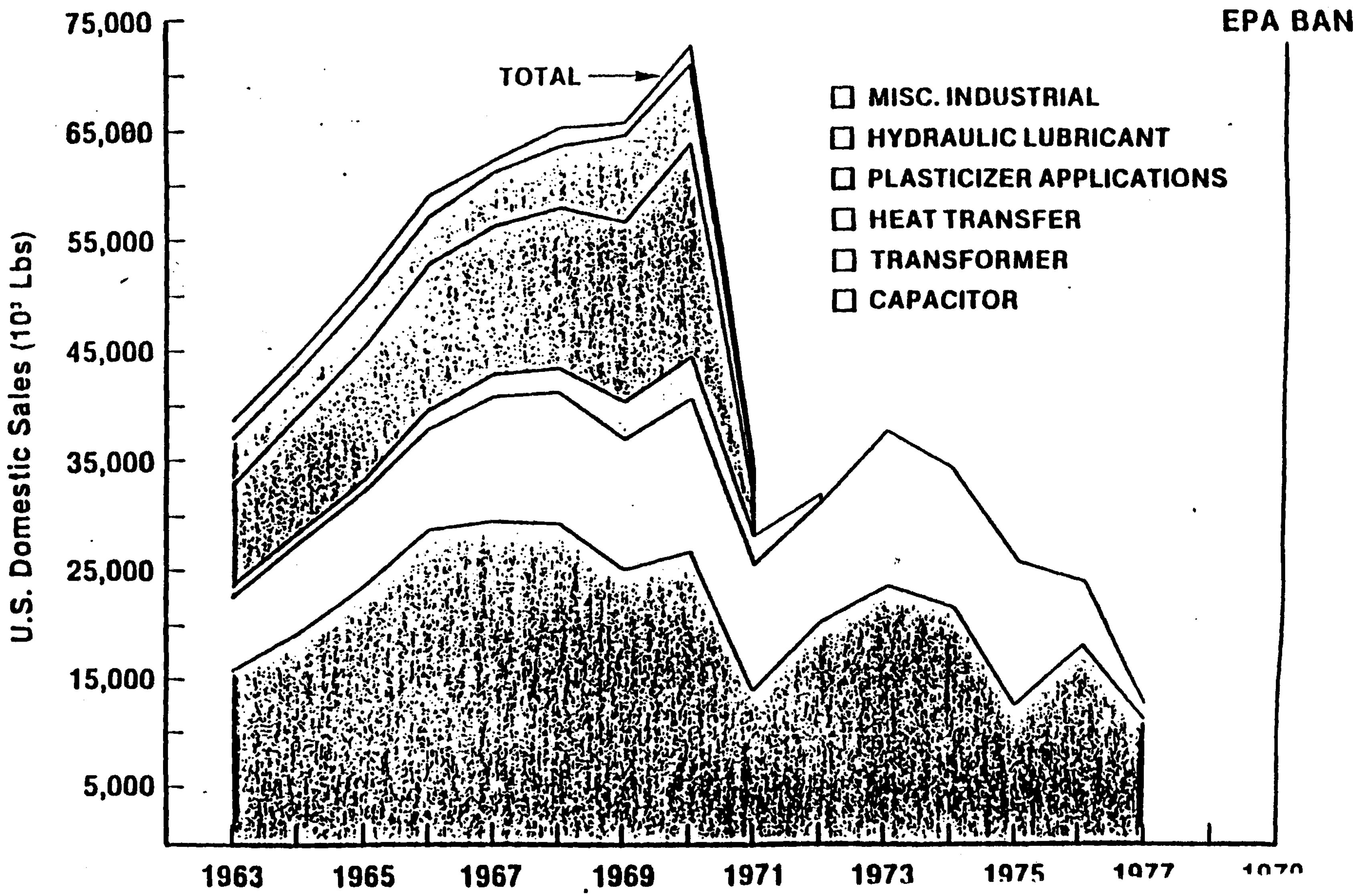
ADM 000765

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1978
U S PRODUCTION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DOMESTIC SALES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
U S EXPORT SALES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DOMESTIC SALES BY CATEGORY																						
Heat Transfer	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Hydraulics/Lubricants	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other Industrial	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Transformer	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capacitor	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Plasticizer Applications	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Petroleum Additives	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DOMESTIC SALES BY PCB GRADE																						
Aroclor 1221	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1232	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1242	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1248	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1254	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1260	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1262	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1268	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aroclor 1016	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]
[illegible]

U.S. DOMESTIC SALES OF PCBs BY CATEGORY

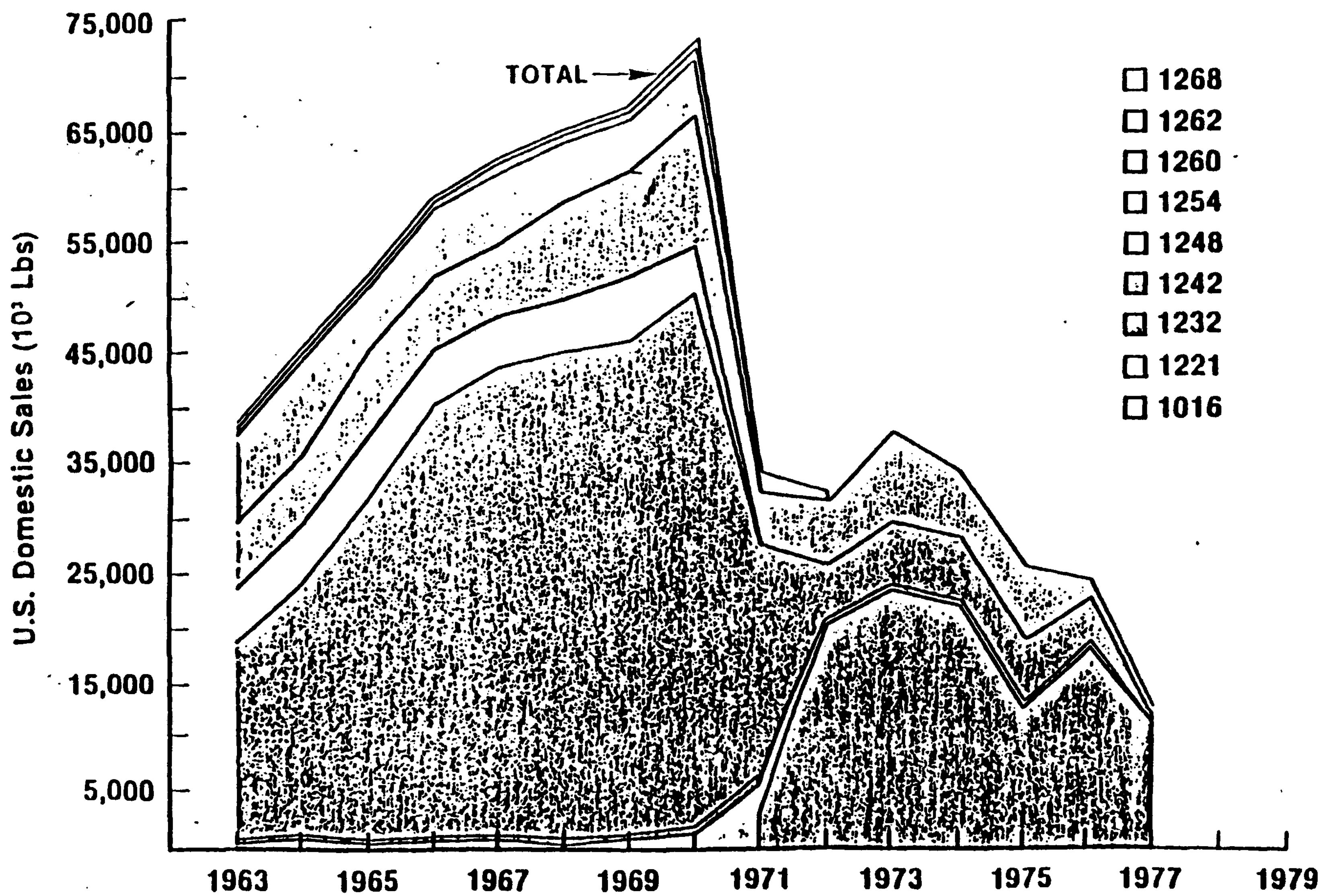
(The Uppermost Curve Represents The Total Sales.)



ACM 000766

U.S. DOMESTIC SALES OF PCBs BY GRADE

(The Uppermost Curve Represents The Total Sale)



ACM 000767

c. Plasticizer Applications -- Sales of most chlorinated biphenyl plasticizers were terminated in 1970, with phaseout completed in 1971.

d. Miscellaneous Industrial Uses (such as vacuum pump fluids) -- Sales ended by 1971.

These voluntary restrictions resulted in a 64 percent reduction in Monsanto sales of chlorinated biphenyls from 1970 to 1972.

However, termination of sales for dielectric uses would have resulted in severe economic and social dislocation. This was recognized by the federal Interdepartmental Task Force on PCBs which concluded in 1972 that "Their continued use for transformers and capacitors in the near future is considered necessary because of the significantly increased risk of fire and explosion and the disruption of electrical service which would result from a ban on PCB use." (See para. 6, page 4, of Attachment 1-1).

Therefore, Monsanto agreed to continue supplying the products to manufacturers of electrical power distribution equipment who use chlorinated biphenyls only in sealed systems such as capacitors and transformers. In continuing to sell to such customers, however, Monsanto required assurances that the materials would be safely handled and properly disposed of.

In making this decision Monsanto believed 1) that entry of chlorinated biphenyls to the environment could be effectively limited and controlled by users (see Attachment 1-3, Westinghouse report presented at the January 3, 1972, meeting of the National Industrial Pollution Control Council), 2) proper maintenance and decommissioning practices could limit fluid escape from transformer operations, and 3) withdrawal from production for these applications would have stopped production of equipment essential to the safe and efficient distribution and use of electrical energy. In addition, a more biodegradable lower chlorinated product (AROCLOR® 1016) had been developed by Monsanto for use by the capacitor industry (see Attachment 1-4).

Steps Taken in Labeling and Transport Practices for Ongoing Dielectric Sales, 1972-1977

Monsanto shipped PCB fluids in both bulk carriers and in drums. Bulk shipments were made in Monsanto-owned railroad tank cars, which were used exclusively for that service, or in customer-owned tank trucks. Drum shipments were made in special reinforced drums. A multilingual warning label was affixed to each package giving a brief description of the nature of the contents and appropriate actions to be taken in the event of a spill or leak. We also supplied a label to be used on return shipments for incineration, which gave similar information.

Industry Guidelines

In June, 1970, the Board of Directors of the Power Equipment Division of the National Electrical Manufacturers Association appointed a committee to review the chlorinated

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AROCLOR® is a trademark of Monsanto Company biphenyl situation as it affected electrical usage. As a result, in April, 1971, American National Standards Committee C107 was established to develop guidelines for the safe use, maintenance and disposal of askarel* and askarel-soaked materials used in electrical equipment. Monsanto participated in this committee. A final draft was completed by November, 1972, and the Standard Guideline was published in 1974 as ANSI C107.1-1974 (Attachment 1-5).

Monsanto's Withdrawal from the Chlorinated Biphenyl Business

When Monsanto decided in 1970 to restrict sales of chlorinated biphenyls, there were no satisfactory alternate materials for closed-system dielectric uses. This view was later affirmed by the EPA. At least as late as a 1975 press conference, the EPA reiterated it would not ask Monsanto to stop production because that would shut down the electrical power industry and the railroads in short order. The EPA objective was to find a way to proceed without shutting down the country. That was precisely the objective to which Monsanto had been committed since 1970.

The problems encountered in replacing chlorinated biphenyls were rooted in their unique fire resistant and dielectric characteristics and in their role in electrical and industrial applications for 45 years. The challenge facing the electrical industry was to replace chlorinated

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* "Askarel" is a generic name for fire resistant dielectric fluids, including those which contained polychlorinated biphenyls, made to meet specifications set by transformers and capacitor manufacturers.

biphenyls in an orderly manner, without creating other hazards of equal or potentially greater magnitude, and at the same time avoiding serious power and transportation disruptions.

Monsanto expended considerable effort and money in major research programs aimed at developing environmentally compatible replacement fluids for the electrical industry. The level of this research was greatly reduced in 1976 when the electrical industry developed the technology to adapt other compounds to its needs. It now appears the ongoing demand for liquid-cooled transformers will be satisfied by using silicone compounds. In the capacitor industry, the trend has been toward materials such as phthalate esters.

In adopting these substitutes, the electrical industry has been forced to accept lower fire resistance. New safety devices have been required to ensure that replacement equipment will not lead to increased risk to society from fire hazards.

In our press statement of October 5, 1976, Monsanto said we would complete distribution of all inventories and withdraw from the chlorinated biphenyl dielectric business by October 31, 1977. In making the announcement, Monsanto said the company would have targeted an even earlier shutdown date had transformer and capacitor manufacturers' conversion timetables permitted. All chlorinated biphenyl production was halted by Monsanto in July, 1977, and all customer shipments were completed by September, 1977.

At the time we stopped PCB production, Monsanto established policies which precluded licensing of chlorinated biphenyl technology and restricted sales of biphenyl to uses which would not involve halogenation.

PCBs continue to be manufactured by other firms in Germany, France, Spain, Italy and certain eastern European countries. They continue to be widely used throughout the world.

Reasons for Monsanto Phaseout

Scientific knowledge about the presence of PCBs in the environment, and about its possible significance, began to evolve during the late 1960s (see, e.g., Attachment 1-6). That evolutionary process, which is still incomplete, began with two events--one in Japan and the other in Sweden.

In 1968, about 1,000 people in Japan became ill from eating rice oil heavily contaminated with Japanese-produced PCBs as a result of an industrial accident which has come to be known as the Yusho incident. The level of PCB contamination in the rice oil was 2000 to 3000 parts per million, extremely high concentrations. Conclusions about that incident have been clouded by the unknown impact of impurities in the Japanese PCB concerned (see pages 160-167, Attachment 1-7). However, the incident sounded a cautionary signal.

In Sweden, Soren Jensen, using new analytical technology to investigate DDT residues in the environment, reported the possible presence of PCBs in fish tissue. Monsanto and others began immediately to study the Swedish work, following preliminary news media reports in late 1966.

Before the findings could be confirmed or duplicated in the U.S., analytical methods had to be refined in order to definitively separate PCBs from other chlorinated hydrocarbons that were known to be present in the environment. New techniques were required to enable researchers to detect these chemicals in the low parts per billion ranges being reported.

The presence of PCBs in the environment in the U.S. was confirmed by 1970, but little was known about their potential impact. Because PCBs were reported in the environment and tests indicated they could accumulate in the food chain, Monsanto voluntarily decided to terminate sales of chlorinated biphenyls to open applications -- those which could result in losses to the environment. Plasticizer and carbonless paper applications fell into this category.

Because of the contamination of rice oil in Japan, food processors using Monsanto's chlorinated biphenyl heat transfer fluids were advised to change to alternative heating methods and Monsanto reemphasized the need for improved monitoring of finished food products to preclude contamination by any heat transfer fluid. The decision was made in 1971 to terminate all heat transfer fluid sales of chlorinated biphenyls, substituting other products with equivalent thermal stability.

High operating pressures cause hydraulic systems to leak. Monsanto therefore alerted users to manage wastes to eliminate PCB discharge to the environment. As new hydraulic fluids were developed in 1971, we terminated sales of those containing PCBs.

As described earlier, Monsanto agreed with the electrical industry and government that the benefits to society of continued chlorinated biphenyl dielectric use outweighed the low risk of uncontrolled release from these sealed applications. The key to managing the risk was sound maintenance practice and disposal control.

With particular reference to the use of PCBs in human food and animal feed processing facilities, the FDA proposed usage regulations in 1972, which were adopted in 1973, and continue in force today (21 CFR §§109.15; 110.40(b); 500.45).

Although a variety of effects of PCBs has been postulated from research of widely varying quality, there is no evidence of environmental levels of PCBs being a major human health hazard. However, it became apparent that the public perceived risks associated with continued PCB dielectric use and preferred to forego its undoubted functional benefits. Therefore, in October of 1976, we advised dielectric customers that it was our intent, consistent with their progress with substitute products, to terminate chlorinated biphenyl production and sale by October, 1977. Each of them forecast how much product would be required to effect an orderly technical transition. In 1977, we made sufficient dielectric chlorinated biphenyl to satisfy the forecast transition demand and made final shipments in September. The small residual inventory was incinerated in our pyrolysis unit, bringing to a close our chlorinated biphenyl business.

In summary, Monsanto's decision to withdraw from the PCB business was based on concerns about environmental presence rather than health effects.

2. INFORMATION ON HEALTH EFFECTS

Chlorinated biphenyls range from liquid to solid, depending upon the degree of chlorination. On the basis of single dose animal tests commonly used to identify and label hazardous materials, they would be considered to be relatively harmless substances. Monsanto has conducted such acute toxicity and irritation tests on several chlorinated biphenyls over the years (1).

Questions have been raised in four areas of possible health effects of chlorinated biphenyls. These have been related to 1) skin (reddening, chloracne), 2) systemic effects (liver damage, respiratory effects), 3) environmental exposure, and 4) potential carcinogenicity.

A review of the literature from the 1930s and 1940s on the health effects of chlorinated biphenyls contains statements such as "Much of the literature that refers to chlorinated diphenyls is referring to the mixture of chlorinated diphenyl with chlorinated naphthalene." and "A number of the references recorded under chlorinated naphthalenes also discussed chlorinated diphenyl. It is difficult to determine the role played by the chlorinated diphenyls, as, in most instances, they were mixed with chlorinated naphthalene" (2). A parallel situation occurred during the late 1960s when reports of the detection of polychlorinated biphenyls in the environment began to appear. There was confusion and disagreement as to whether polychlorinated biphenyls or other halogenated hydrocarbons such as DDT were being measured, since the latter had already been identified as environmental contaminants.

<u>Skin</u>

Sometime before 1934, Swann Chemical Co. observed dermatological symptoms in workers exposed to chlorinated biphenyls. In May, 1934, Swann Research, Inc., requested Dr. F. B. Flinn of Columbia University's College of Physicians and Surgeons to conduct an investigation "to determine whether or not the various chlorinated diphenyl compounds submitted or some impurities contained therein might be the causative agent producing the dermatitis which had developed among some of the workmen in the plant." He commented on these studies as follows:

> "One is impressed with the fact that each of the Aroclors giving a positive reaction were of a fluid nature. Attempts were made to expose the animals to vapors but observations made us conclude that the only difference was that the animal would be exposed to the hot material and it was well-known that the reaction where such an exposure is given is more severe.
>
> "One cannot but feel that any styrene compound which may be found to be present as an impurity is the cause of your trouble. I was rather surprised that more of the compounds submitted did not show or give reactions with the skin. It has been shown in some investigations that chlorine did not produce a dermatitis when metallic electrodes were used but did if the metallic electrodes were replaced by carbon electrodes. The theory was advanced that some organic chlorine compounds were produced in the latter case.

> "I would suggest that you study your ventilation system in places where fumes are given off. That means be provided for the men to take a bath with soap and water if they come in contact with the type of material found to be positive. By this I mean if a leak or spillage occurs. The immediate bathing under these circumstances should be insisted on. I found that where I had gotten the material on my hands if I washed them thoroughly no trouble arose."

In his transmittal letter to Dr. J. N. Carothers of Swann Research, Inc., Anniston, Alabama, Dr. Flinn stated:

> "It may interest you to know that the dermatitis which was produced by your materials in the case of rabbits cleared up in a couple of weeks, indicating that unless there are repeated exposures the effects are only of a temporary nature. As I said before, I believe that if washing facilities are present and the men are instructed to use them it will do much to supplement the increased ventilation which you have installed." (3)

In the published literature, "the first observations on the development of acnelike lesions among workers in the United States coming in contact with chloronaphthalenes and chlorodiphenyls as well as acute yellow atrophy of the liver occurring among such workers were reported in 1935" (4). Results of Swann studies were published in 1936 (5).

There is a letter report dated December 22, 1949, to Dr. R. E. Kelly (Monsanto) from Dr. L. K. Halpern of the Barnard Free Skin and Cancer Hospital (St. Louis) describing a human patch study. This consisted of applying film treated with 11.5 percent AROCLOR and gauze moistened with 100 percent AROCLOR to skin of the upper arm of 218 volunteers using the technique developed by Dr. Louis Schwartz, Medical Director of the United States Public Health Service. Dr. Halpern reported "If the procedure recommended by the United States Public Health Service is sufficient to distinguish between chemical compounds that are innocuous when applied to the skin and other compounds that are primary irritants or sensitizers, then it would seem that Aroclor has no primary irritant effect nor is it a sensitizer of high potency." (6) Monsanto records show that this study was conducted with AROCLOR 1254.

In 1963, Monsanto received reports of subacute rabbit dermal studies it had sponsored on several chlorinated diphenyls. Salient features of these studies, conducted according to then-currently acceptable procedures, are summarized below (1).

AROCLOR	1221	1242	1248	1254	1268
No effect level*	150	50	10	10	500
LD_{50}**	250	75	50	75	1250
Local skin effects	none	none	none	yes	yes
Systemic injury	none	none	liver injury	liver injury	liver injury

* All dosages in mg/kg/day
** Based on 20-day dosing and 14-day observation periods

These studies showed that repeated and prolonged skin contact with the higher chlorinated biphenyls could produce skin irritation and that harmful amounts could be absorbed under such conditions. They also demonstrated that there was a safe level of exposure for each material, and that they could be handled safely if the earlier precautions to avoid excessive skin contact were observed.

Systemic Effects

On June 30, 1937, a symposium on systemic effects resulting from inhalation of chlorinated hydrocarbons was held at the Harvard School of Public Health. Dr. R. E. Kelly of Monsanto participated in the sessions at which results of investigations requested by manufacturers of chlorinated hydrocarbons were presented. Subsequently, three papers summarizing the results of those studies appeared in the scientific literature (7,8,9). With respect to chlorodiphenyls, the Harvard group concluded that "...it appears safe and it is certainly easily attained, to ventilate so that the air breathed does not contain more than 0.5 mgm. per cu.m. of any of these compounds...". In a separate unpublished report to Monsanto Company (10) Dr. C. E. Drinker of Harvard described the results of inhalation studies conducted with compound #1268, having a chlorine content of 68 percent. He concluded, "#1268, if handled with ordinary precautions as to ventilation, should be entirely harmless to workmen."

Monsanto sponsored a study at the University of Cincinnati Kettering Laboratory on "The Toxicity of the Vapors of AROCLOR 1242 R and AROCLOR 1254R." A report of those studies (11), presented at the 1956 meeting of the American Industrial Hygiene Association, stated that the investigation "...was undertaken because in the earlier literature dealing with the toxic effects of Aroclors, no distinction has been drawn between the toxic effects of chlorinated biphenyls and those of chlorinated napthalenes..."

No injury was observed after prolonged intermittent exposure of several species of animals to AROCLOR 1242 at air concentrations of 1.90 to 8.63 micrograms per liter. Animals subjected to comparable exposures of AROCLOR 1254 showed signs of apparently reversible liver cell injury. The authors concluded their observations by saying "It should be noted that it was necessary to heat these Aroclors in order to increase the rate of volatilization sufficiently to attain the concentrations maintained in these experiments. To the extent that their industrial usage is carried out at ordinary temperatures, the hazard of their inhalation may well be slight or entirely absent."

These studies confirmed earlier work which indicated that no harmful effects were to be expected if these materials were used with adequate ventilation since it was necessary to heat the substances to generate sufficiently high air concentrations to injure the test animals.

Prior to 1956, the American Conference of Governmental Industrial Hygienists (ACGIH) had established a Threshold Limit Value (TLV) of 1 mg/m^3 for chlorodiphenyl. In 1956, the listing was changed to read chlorodiphenyl (42% chlorine) as 1 mg/m^3. The 1957 list showed chlorodiphenyl (42% chlorine) as 1 mg/m^3 and an added TLV of 0.5 mg/m^3 for chlorodiphenyl (54% chlorine). The latter two values have been unchanged since then (12). Results of the Monsanto-sponsored study (11) contributed to the decision of the ACGIH to lower the TLV for the more highly chlorinated biphenyls (13).

Environmental Exposure

In response to reports of the presence of some PCBs in the environment, Monsanto, in 1969, initiated preliminary toxicity studies which led to a series of long-term tests. These tests, on the three predominant commercial polychlorinated biphenyls (AROCLOR 1242, AROCLOR 1254, AROCLOR 1260), consisted of 2-year (lifetime) feeding to rats, 2-year feeding to dogs, 3-generation rat reproduction studies with 2 litters cast per generation, rat teratology studies and dominant lethal mutagenic studies in mice. Toxicity and reproduction studies in chickens were performed to evaluate possible untoward effects in birds such as decreases in eggshell thickness. This series of studies (1) represented the most comprehensive safety tests of the time, and was similar to the tests required for food additives, although Monsanto certainly had no intention of applying for a food additive permit.

The highest dietary level (100 ppm) in the lifetime rat feeding studies produced a weight depression at 24 months in females fed AROCLOR 1254 and liver weight increases in all groups except males fed AROCLOR 1242. As with other halogenated hydrocarbons, the important histopathologic changes were present in the livers of animals sacrificed at the end of the study. These consisted of hepatocellular (liver) alterations such focal hypertrophy (localized enlargement), cytoplasmic lipid changes and in some animals from the 100 ppm groups, hepatomas or cholangiohepatomas (benign tumors). There was no evidence of hepatocellular carcinogenicity with any of the AROCLOR products.

In the dog 2-year studies, some slight decreases in body weight gain were noted. At the highest feeding level (100 ppm) of AROCLOR 1260, there was evidence of gastrointestinal inflammatory lesions and ulcerations.

In the rat reproduction studies, none of the AROCLOR products produced adverse effects in the 2 litters of the first generation. In the second and third generations, there was a reduction in the mating index and a decrease in the incidence of pregnancy at the 2 highest feeding levels (10 ppm and 100 ppm). The ability of females to carry pups to delivery, once conception had occurred, and to successfully nourish the young was not affected by the three AROCLOR products. No changes were produced in the reproductive tracts of either male or female rats by any of the 3 AROCLOR products.

There was no evidence of teratogenic or mutagenic changes with any of the chlorinated biphenyls at maximally tolerated dose levels in rats and mice.

In the chicken toxicity/reproduction study, AROCLOR 1260 was without effect at all test levels. AROCLOR 1242 and AROCLOR 1254 at 100 ppm in the diet decreased egg hatchability. Poor hatchabilit of eggs was found from hens fed 8 ppm of AROCLOR 1242. AROCLOR 1242 at 10 and 100 ppm and AROCLOR 1254 at 100 ppm were associated with reduced eggshell thickness. Chick viability was affected by both substances at a dietary level of 10 ppm.

Data developed by Monsanto and information gained from the Yusho incident in Japan were cited by the Food and Drug Administration (FDA) as a basis for establishing tolerances for chlorinated biphenyls in various foods in 1973 (14). Subsequently, the FDA proposed a reduction in those tolerances (15).

In 1976 it was reported that AROCLOR 1248 in the diet of monkeys, at or below FDA tolerance levels for chlorinated biphenyls, adversely affected reproduction (16). FDA limits on PCBs in the human diet are related to a safe level of 1 µg/kg body weight/day (14). The studies carried out by Allen and coworkers (16) were at dosage levels of approximately 89 and 183 µg/kg/day. Their work suggested that there could be a previously unknown effect on reproduction in primates and they failed to define a no-effect level. Monsanto, therefore, undertook a detailed monkey reproduction study with carefully administered dosages at and below those previously studied.

In the Monsanto study, 32 female and 16 male rhesus monkeys, divided into 4 groups each consisting of 8 females and 4 males, were given daily dosages of 0, 5 µg/kg, 25 µg/kg or 100 µg/kg of AROCLOR 1254. The in-life portion of that study, which lasted about 14 months, has been completed.

At Monsanto's highest dosage (100 µg/kg/day), which corresponded to the low level in the Allen study, we find that AROCLOR 1254 has similar effects to those reported earlier for AROCLOR 1248. The results at the lower levels are not completely evaluated.

Potential Carcinogenicity - Animal Studies

In 1975, Dr. Renate Kimbrough reported the induction of liver carcinomas in female rats fed AROCLOR 1260 for two years (17). The same lot of AROCLOR 1260 was used in her study as in Monsanto's earlier test. Monsanto's study showed that AROCLOR 1260 as well as AROCLOR 1242 and AROCLOR 1254, produced liver injury, but no cancers. Therefore, an extensive reevaluation was made of the original liver slides from the Monsanto studies as well as additional liver sections from all rats in the Monsanto two-year feeding studies. These slides were examined independently by Dr. D. Gordon of Industrial BIO-TEST Laboratories, by Professor W. Richter of the University of Chicago and by Professor Parvis Pour of the Eppley Institute for Research in Cancer. In addition, Dr. Pour evaluated sections of liver from rats in Dr. Kimbrough's study.

No carcinomas were seen in the livers of rats from the Monsanto studies, and Dr. Pour did not concur with Dr. Kimbrough' diagnosis of liver cancer in rats from her study (18) (see Attachment 2-2). The different criteria by which pathologists diagnose cancer, and the reported findings of cancer induced by polychlorinated biphenyls in various animal species, have been discussed by Dr. J. C. Calandra (19) (Attachment 2-3).

In 1977, the National Cancer Institute reported results of a bioassay for possible carcinogenicity of AROCLOR 1254. That report stated that AROCLOR 1254 was not carcinogenic under the test conditions (20).

Human Epidemiology Studies

The toxicity testing described above has provided a foundation for understanding the potential effects of chlorinated biphenyls. However, firm conclusions cannot be drawn without human epidemiological data drawn from exposed populations.

"The view that human health risks resulting from exposure to chemicals may be determined experimentally by testing laboratory animals is one that is widely accepted in the scientific community and has been adopted by EPA. Because experimentation on human beings raises ethical questions and because epidemiological studies often provide incomplete information, toxicology studies on laboratory animals are often necessary. However, because the extrapolation from animals to man is subject to some uncertainty, corroboration of laboratory test data with sound epidemiological information is desirable." (U.S. EPA, Support Document/Draft Voluntary Environmental Impact Statement for Polychlorinated Biphenyls, 1978). Such epidemiological data on PCBs is now becoming available.

Monsanto is aware of seven epidemiological studies done in the U.S. of persons exposed to PCBs. They include persons with occupational as well as community exposure, and the effects studied range from deviations in biological parameters, through reported symptoms and illnesses, to the occurrence of death from various causes.

Selikoff and colleagues studied 326 volunteers who were occupationally exposed to PCBs. They report the percentage of those workers with various dermatological, gastrointestinal, neurological and other symptoms, as well as the percentage with abnormal values of clinical chemistry parameters and of pulmonary function. They concluded that reported symptoms and abnormal findings in physical examinations were not related to duration of employment or level of PCBs in the blood, except for abnormal dermatological findings and abnormal levels of some indicators of liver function. Although the authors claim to have found an unusual impairment of pulmonary function in their study population, no effort was apparently made to detrmine whether this impairment was related to the other findings (see Attachments 2-4 and 2-5).

In spite of a correlation of some liver function parameters with PCB exposure, the prevalence of abnormal liver function was low. The authors state, "The paucity of other abnormalities on physical examination was striking; this included a very low prevalence of abnormal liver findings." (emphasis in original).

The Center for Disease Control examined liver function and blood levels of chlorinated biphenyls in a sample of PCB workers, their families, and exposed persons in the community, in Bloomington, Indiana. This study found very mild liver dysfunction (increased levels of the enzyme GGTP) and increased blood levels of a cholesterol-like substance in persons with higher blood levels of PCBs. It is not clear if these findings have any relationship to actual illness (see Attachment 2-6).

The Michigan Department of Public Health conducted a study of 182 persons who regularly consumed sports fish, a source of PCB, and classified as "exposed", "intermediate" and "controls" according to the amount of fish consumed. A direct relationship was found between the amount of fish consumed and blood level of PCB. However, no significant difference was found between the controls and the exposed in the incidence of 18 health conditions, many of which described the symptoms reported for Yusho disease. Furthermore, in 12 of the 18 conditions, people with the condition had lower blood

PCB levels than those without the condition. The authors conclude, "As a group, the exposed participants had no health problems or medical conditions that could be correlated with PCB levels, exposure to Lake Michigan fish, or known symptoms of PCB poisoning" (see Attachment 2-7).

NIOSH has completed a study of mortality rates in workers in a transformer plant where there was exposure to PCBs, but Monsanto is unable to comment because a report of the study is not yet available.

The South Carolina State Department of Health and Environmental Control recently completed a study of 32 workers in a capacitor plant, 10 of whom were regularly exposed to PCBs. Details of the study available to Monsanto are limited to those contained in newspaper reports, but the study apparently involved a medical examination and a determination of blood PCB level. The authors state that the study "clearly shows that at present there is no evidence of physical harm resulting from working with PCBs." (See Attachment 2-8)

These four recent studies appear to constitute the most extensive epidemiological work yet done on chlorinated biphenyls. They each indicate an absence of morbidity (ill health) associated with significant exposure to PCBs.

The Mobil Corporation carried out a study of the occurrence of cases of cancer in a population exposed for varying lengths of time between 1949 and 1957. Plant medical records were used to determine the occurrence of cancer in this group between 1958 and 1975. However, records were not available for about 20 percent of the eligible study group. The 41 men who were actually studied differed from the populations described above in that they were employed in a chemical plant which manufactured a number of different materials to which they might have been exposed during their working careers. The study found an excess of skin cancer (melanoma) based on three cases. After a preliminary report of these findings was made, the Mobil Corporation informed NIOSH that there had been "a substantial change" in the definition of the cohort, and that an analysis of the changed cohort might show quite different results. As far as Monsanto is aware, that analysis has not yet been completed.

In 1975, independent of the Mobil effort, Monsanto began to gather information for a mortality study of employees exposed to PCBs at its W. G. Krummrich plant in Sauget, Illinois. Because the plant had manufactured a number of chemicals those persons exposed to PCBs typically had a mixed exposure to other substances as they moved from job to job. Because the work histories of past employees were not computerized, it would have been necessary to identify those who had worked with PCBs by a manual search through 6,000 records. A preliminary identification was made of 50 deaths from various causes among past workers with PCB exposure, and a review of these suggested a possible excess of lung cancer, but not of skin or pancreatic cancer. This preliminary finding was announced in 1976.

A further attempt to identify a cohort yielded 89 men who had been exposed for at least six months in the period 1945-1965, who were then followed to determine their vital status as of the end of 1977. There were no excess deaths from pancreatic cancer, but 4 lung cancer deaths were found where about 1.5 would be expected. Smoking histories were not available. The accuracy of the determination of this cohort was limited by the necessity of conducting a manual search of the records.

At the present time, computerization of the Krummrich work histories is underway, and should be completed early in 1980. At that time it will be possible to better define the exposed population, and to better determine the other substances to which the population was exposed. However, because of the mixed nature of exposures in a chemical plant, it is unlikely that the Monsanto study can ever be as specifically related to PCBs as those conducted by Dr. Selikoff, CDC, the Michigan DOH, and the South Carolina DOH.

Section 2 Bibliography

1. Unpublished reports of studies conducted for Monsanto Company.

2. Irish, D. D. "Chlorinated Diphenyls, pp. 1340-1343 in Industrial Hygiene and Toxicology, Patty, F.A., ed., Interscience Publishers, New York, 2nd rev. ed., 1963.

3. Flinn, F.B. "Report of Frederick B. Flinn of Patch Tests Made on Material Received from Swann Research, Inc." May 25, 1934.

4. Schwartz L. "On Outbreaks of Halowax Acne ("Cable Rash") Among Electricians." J. Am. Med. Assoc. (1943) 122: 158-61.

5. Jones, J. W. and Alden, H. S. "An Acneform Dermatergosis". "Arch. Derm. & Syphilol. (1936): 33, 1022-1034.

6. Halpern, L. K. "Project W-31 Aroclor (Report on Patch Testing)." December 22, 1949.

7. Drinker, C. K., Warren, M. F. and Bennett, G. A. "The Problem of Possible Systemic Effects From Certain Chlorinated Hydrocarbons." J. Ind. Hyg. & Toxicol. (1937) 19:(7), 283-311.

8. Bennett, G.A., Drinker, C.K. and Warren, M.F. "Morphological Changes in the Livers of Rats Resulting from Exposure to Certain Chlorinated Hydrocarbons." J. Ind. Hyg. & Toxicol. 20:(2), 97-123.

9. Drinker, C.K. "Further Observations on the Possible Systemic Toxicity of Certain of the Chlorinated Hydrocarbons With Suggestions For Permissible Concentrations in the Air of Workrooms." J. Ind. Hyg. & Toxicol. (1939) 21:(5), 155-159.

10. Drinker, C.K. "Report to the Monsanto Company." September 15, 1938.

11. Treon, J.F., Cleveland, F.P., Cappel, J.W. and Atchley, R.W. "The Toxicity of the Vapors of Aroclor 1242® and Aroclor 1254®." Am. Indust. Hyg. Assoc. Quart. (1956) 17:(2), 204-213.

12. American Conference of Governmental Industrial Hygienists. "Threshold Limit Values for 1955." AMA Arch. Indust. Health (1955) 11: 521-524.
"Threshold Limit Values for 1956." AMA Arch. Indust. Health (1956) 14: 186-189.
"Threshold Limit Values for 1957." AMA Arch. Indust. Health (1957) 16: 261-265.
"TLVs® Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1979."

13. American Conference of Govermental Industrial Hygienists. " Documentation of Threshold Limit Values For Substances in Workroom Air." (1977) 4th printing, Cincinnati. pp. 51-52.

14. "Polychlorinated Biphenyls (PCB's)." Fed. Regis. 38: (129), July 6, 1973, pp. 18096-18104.

15. "Polychlorinated Biphenyls (PCB's)." Fed. Regis. 42:(63), April 1, 1977, pp. 17487-17494.

16. Barsotti, D.A., Marlar, R.J. and Allen, J.R. "Reproductive Dysfunction in Rhesus Monkeys Exposed to Low Levels of Polychlorinated Biphenyls (Aroclor 1248)." Fd. Cosmet. Toxicol. (1976) 14: 99-103.

17. Kimbrough, R.D., Squire, R.A., Linden, R.E., Strandberg, J.D., Montali, R.J. and Burse, V.W. "Induction of Liver Tumors in Sherman Strain Female Rats by Polychlorinated Biphenyl Aroclor 1260." J. Nat. Canc. Inst. (1975) 55: 1453-1459.

18. "Histopathological Re-evaluation of Livers from Rats Treated with AROCLOR." (Industrial Bio-Test Laboratories, Inc. Reports and Eppley Institute Reports.)

19. Calandra, J.C. "Review of the Technical and Regulatory Aspects of Aroclors" June 27, 1975.

20. "Bioassay of Aroclor® 1254 for Possible Carcinogenicity". National Cancer Institute.Technical Report Series. No. 38. (1978).

3. MONSANTO ACTIONS RESULTING FROM HEALTH DATA

Monsanto has been responsive to health questions about chlorinated biphenyls over the years. Those responses have been consistent with "state of the art" procedures available at the time the questions were raised. It should be noted that Monsanto's decision to leave the PCB business was based on concerns over environmental presence, not health effects.

Skin and Systemic Effects

When first reported in 1935 (1,2), the occurrence of skin and systemic effects from chloronaphthalenes and chlorodiphenyls constituted a new occupational health problem. It rapidly became of concern to federal and state occupational health personnel and to their industrial counterparts. Monsanto was among the sponsors of and a participant in the studies and the subsequent symposium held on this subject at Harvard University (3). In addition, Monsanto conducted its own studies on various polychlorinated biphenyls (4,5,6,7). Earlier, Swann Research, Inc. had conducted human patch tests on these materials (8). Results of these efforts suggested that controlling skin contact and vapor inhalation would permit safe industrial use of these substances.

In 1936, Monsanto began developing a corporate medical program. From the start, Monsanto's Medical Director ensured that chlorinated biphenyl workers at Anniston were included in this program. This consisted of periodic physical examinations, good work practices to ensure personal cleanliness of employees, adequate ventilation of the work areas, and overall good industrial hygiene practices. The buildings at the Anniston plant were relatively open and most of the processing was done in closed equipment. Therefore, employee exposure was relatively low. However, since some customers were using chlorinated biphenyls at elevated temperatures, with a greater potential for exposure, precautionary statements for handling them were prepared for customer use as early as 1937 (9) (see Attachment 3-1, 3-2, 3-3). As additional information developed, it was incorporated into Monsanto work practices and distributed to customers by way of correspondence, technical bulletins, and other corporate publications (see Attachment 3-4). In addition, upon request, Monsanto technical and medical personnel visited customer plants to advise them on safe handling of polychlorinated biphenyls. Finally, the Monsanto-sponsored studies on AROCLOR 1242 and AROCLOR 1254 led the American Conference of Governmental Industrial Hygienists (ACGIH) to lower the Threshold Limit Value (TLV) for the higher chlorinated biphenyls in 1957 (10).

Environmental Presence

In late 1966, Soren Jensen of the Karolinska Institute in Sweden reported the detection of polychlorinated biphenyls in the environment. This was confirmed by 1970. In the interim, Monsanto's European office had entered into discussions with the Karolinska Institute in an attempt to obtain details of the findings. In early 1969, representatives of Monsanto went from St. Louis to Sweden to meet with Jensen. He was not available, and discussions were held with his professor, Dr. Widmark. At about the same time, Monsanto decided to develop data on the chronic oral toxicity of chlorinated biphenyls. Although there was no intention of petitioning for such use, the extent of these tests was typical of those designed for the evaluation and establishment of the safety of direct and indirect food additives. This series of tests was undertaken because it represented the most comprehensive requirement of safety at that time (11). FDA was informed of the voluntary testing program in October, 1969 (12). Subsequently, as evidence of environmental presence increased, those studies were expanded in scope. Chicken studies to determine the effects of chlorinated biphenyls on avian species were completed in 1970 and 1971. Results of all these studies have been distributed to the FDA and other regulatory agencies. During this time period, Monsanto expanded the warnings on its product labels to include cautions against allowing escape to the environment (Attachment 3-5).

When, in 1976, reproductive disorders were reported in monkeys fed chlorinated biphenyls (13), Monsanto undertook a study to determine the validity of those findings. The Monsanto study is being conducted with AROCLOR 1254, a large volume material, instead of the relatively low volume AROCLOR 1248 used by the earlier investigators.

Potential Carcinogenicity

In 1975, after Dr. Kimbrough reported that AROCLOR 1260 produced liver cancer in rats (14), Monsanto undertook a review of liver sections from its earlier studies on AROCLOR 1242, AROCLOR 1254, and AROCLOR 1260. In addition, it retained Dr. Pour of the Eppley Institute for Research in Cancer to review all liver sections from all of the AROCLOR studies, i.e., Monsanto's and Dr. Kimbrough's (15). That review showed no occurrence of liver cancers. Finally, Dr. Calandra was retained to review and comment on available literature dealing with carcinogenicity of polychlorinated biphenyls (16). Results of those evaluations have been made available to regulatory agencies.

Section 3 Bibliography

1. Schwartz, L. "An Outbreak of Halowax Acne ("Cable Rash") Among Electricians." J. Am. Med. Assoc.(1943) 122: 158-161.

2. Jones, J.W. and Alden, H.S. "An Acneform Dermatergosis." Arch. Derm. & Syphilol.(1936) 33:1022-1034.

3. Bennett, G.A.,Drinker, C.K. and Warren, M.F. "Morphological Changes in the Livers of Rats Resulting From Exposure to Certain Chlorinated Hydrocarbons." J. Ind. Hyg. & Toxicol. 20: (2), 97-123.

4. Drinker, C.K. "Report to the Monsanto Company." September 15, 1938.

5. Halpern, L.K. "Project W-31 Aroclor (Report on Patch Testing)" December 22, 1949.

6. Treon, J.F., Cleveland, F.P., Cappel, J.W., and Atchley, R.W. "The Toxicity of the Vapors of Aroclor 1242 ® and Aroclor 1254 Am. Indust. Hyg. Assoc. Quart. (1956) 17:(2), 204-213.

7. Unpublished reports of studies conducted for Monsanto Company.

8. Flinn, F.B. "Report of Frederick B. Flinn of Patch Tests Made on Material Received from Swann Research, Inc." May 25, 1934.

9. Watt, L.A. Monsanto internal memorandum. October 11, 1937.

10. American Conference of Governmental Industrial Hygienists "Threshold Limit Values for 1955." AMA Arch. Indust. Health (1955) 11: 521-524.
"Threshold Limit Values for 1956." AMA Arch. Indust. Health (1956) 14: 186-187.
"Threshold Limit Values for 1957." AMA Arch. Indust. Health (1957) 16: 261-265.

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11. Unpublished reports of studies conducted for Monsanto Company.

12. Wheeler, E.P. Letter to A.R. Glasgow, October 3, 1969.

13. Barsotti, D.A., Marlar, R.J. and Allen, J.R. "Reproductive Dysfunction in Rhesus Monkeys Exposed to Low Levels of Polychlorinated Biphenyls (Aroclor 1248)." Fd. Cosmet. Toxicol. (1976) 14: 99-103.

14. Kimbrough, R.D. Squire, R.A., Linder, R.E., Strandberg, J.D., Montali, R.J. and Burse, V.W. "Induction of Liver Tumors in Sherman Strain Female Rats by Polychlorinated Biphenyl Aroclor 1260." J. Nat. Canc. Inst. (1975) 55: 1453-1459.

15. "Histopathological Re-evaluation of Livers from Rats Treated with AROCLOR." /Industrial BIO-TEST Laboratories, Inc. Reports and Eppley Institute Reports./

16. Calandra, J.C. "Review of the Technical and Regulatory Aspects of Aroclors." June 27, 1975.

4. <u>CUSTOMER RECORDS</u>

Over the years, Monsanto developed the normal commercial records on its sales of chlorinated biphenyls. They were useful for sales and service calls, accounting, production forecasting, and, when decisions were reached to limit chlorinated biphenyls, customer lists served as the basis for our notification visits, telephone calls, letters, and publication mailings in the period 1970-1972, as we phased out all but dielectric chlorinated biphenyl sales.

5. COMMUNICATING WITH CUSTOMERS

Notification Procedures

Beginning in February, 1970, Monsanto notified its customers of the early reports that PCBs had been detected in the environment. Additional information was transmitted to customers as it became available, along with details of Monsanto's phaseout. The notification letters included as Attachment 5-1 indicate the priority given to terminating applications that seemed relatively likely to lead to environmental release, were food related, or used the more highly chlorinated products. We cooperated with users of hydraulic fluids and heat transfer fluids to discontinue PCB use.

Simultaneously we introduced AROCLOR 1016, a lower chlorinated product for capacitor use, and restricted transformer fluid sales to equipment manufacturers only. In the case of both capacitor and transformer producers, we emphasized the need for control of PCBs. In 1974, Monsanto revised its dielectric literature to conform to the ANSI guideline (Attachments 5-2, 5-3, 5-4) which resulted from the industry work with ANSI referred to earlier. In 1976 the ANSI committee was reconvened to consider the need for revision of the guidelines. Completion of this task has been deferred pending issuance of EPA regulations on PCBs.

Monsanto Provided PCB Disposal Assistance to Customers

In 1969 Monsanto started testing the efficiency of PCB destruction by high temperature pyrolysis and constructed a 6 million pounds/year unit which was completed in May, 1971. This incinerator was designed, and was demonstrated, to destroy PCB wastes at 99.9998 percent efficiency (Attachment 5-5).

By September, 1971, this unit was in continuous operation and was destroying both waste from our production and PCBs returned by customers as they converted to non-PCB replacements. When phaseout from nonelectrical applications was complete, the incinerator was used to destroy waste PCB which collected from ongoing dielectric use.

A system was developed to properly handle customer return of wastes (Attachment 5-6). When some customers did not follow our suggested procedures, Monsanto reemphasized the need for proper packaging (Attachment 5-7). To assist in proper handling, posters were prepared and distributed to further educate those responsible for collection and handling of PCB wastes (Attachment 5-8).

In the period 1975-1976, large (approximately 80 million pounds/year) commercial facilities became available which could handle controlled PCB incineration more efficiently and economically than Monsanto's small prototype unit. These units incinerated PCBs until their operations were curtailed by the need for a specific permit under the EPA disposal regulations for PCBs, which became effective on April 18, 1978. The first permit has yet to be issued. The potential risks of accidental PCB contamination have undoubtedly increased because of the delay in EPA implementation of its incineration policy.

Label Warnings

In 1970 Monsanto modified the labeling of PCB packages to emphasize the need to keep it from the environment (Attachment 5-9). Subsequently, labels on drums were written in seven languages (Attachment 5-10).

Assistance with Identification of PCBs

Because of the changes in composition of PCB dielectric fluids since their introduction, Monsanto worked with the IEC to document such changes. This led to ASTM standard D2283, which lists the composition of all transformer askarels used at various times since 1932 (Attachment 5-11).

Monsanto researchers worked within ASTM to develop refined technology for determination of PCBs in the environment. This resulted in approval of ASTM D3304 (Attachment 5-12) which has become standard methodology for PCB quantification. While many laboratories have the necessary equipment, proficiency in the methodology varies widely. Monsanto's Applied Sciences group regularly consults with laboratories as they gain experience in testing for PCBs. Regulations require many such tests to be performed. The testing load has been greatly increased by the policy EPA adopted in controlling PCB-contaminated oils at the 50-500 ppm level. This is causing serious delays in reporting of test results.

We recognized that after Monsanto terminated production of chlorinated biphenyls small samples of products which had previous commercial significance would be required for research and standardization of detection equipment.

Arrangements were concluded with a laboratory supply house to take custody of a limited drum quantity and to supply such samples.

Continuing Research

Monsanto is funding studies at two major universities which are directed at finding innovative approaches to reducing PCB levels in the environment.

6. PCB DISPOSAL

During the years Monsanto made chlorinated biphenyls, the quantity of waste produced was relatively low and consisted chiefly of distillation residues, after separation of the useful product mix. Until 1971 these residues were landfilled. From 1971 to 1977 production waste was incinerated.

BCC: J. MASON - JMASO
H. S. BERGEN
E. P. WHEELER - EWHEE
J. D. EARLY - WASHINGTON
W. S. CLARK - WCLAR

February 10, 1971

Mr. Lowell E. Miller, Director
Pesticide Regulation Division
Environmental Protection Agency
South Agricultural Building
Washington, D.C. 20250

Dear Mr. Miller:

I recently noted in United States Department of Agriculture PR Notice 70-25 dated October 29, 1970 that polychlorinated biphenyls must be eliminated from economic poisons. We at Monsanto understand and are in complete agreement with this action as indicated in correspondence Dr. R. E. Kelly, Monsanto's Medical Director, had with Dr. Harry W. Hayes and Dr. C. Cueto, Jr. when the Pesticide Regulation Division was part of the U.S. Department of Agriculture.

I am deeply concerned, however, to note that this elimination has been extended to include the polychlorinated terphenyls. We have thoroughly searched all available literature and communicated with many laboratories, industrial, academic and regulatory, and been unable to find evidence that would indicate the polychlorinated terphenyls are contaminating the environment or that they are responsible for adverse effects on fish or wildlife.

We realize the importance of preventing the contamination of the environment but seriously question whether the polychlorinated terphenyls can be properly classified as contaminants. Does your division have available any information or data which would justify the elimination of these materials from economic poisons?

Sincerely,

W. B. Papageorge
Manager
Environmental Control

/lee

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PLAINTIFF'S EXHIBIT 1103

711772

Hearing Clerk
Environmental Protection Agency
Room 1019 - East Tower
401 M Street, S.W.
Washington, D.C. 20460

Re: Environmental Protection Agency
(40 CFR Part 129)
Water Program
Proposed Toxic Pollutant Effluent Standards
Federal Register, Vol. 38, No. 247,
Pages 35388-35395
Thursday, December 27, 1973

Gentlemen:

On January 18, 1974, in accordance with Section 104.6, Part 104, Chapter I of Title 40, Code of Federal Regulations, we filed objections relating to the polychlorinated biphenyl effluent standards proposed in new Part 129, Subpart I, Chapter I of Title 40, Code of Federal Regulations.

As provided in "Order and Notice in the Matter of Proposed Toxic Pollutant Effluent Standards for Aldrin-Dieldrin et al. - FWPCA (307) Docket No. 1" dated February 8, 1974 by William J. Sweeney, Administrative Law Judge, we offer the following comments describing our objections in greater detail.

INTRODUCTION

Monsanto Company has been a major manufacturer of chemical products since 1901. These products are used in numerous American industries, and in fact,

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through our research department, we have played a role in developing new products to meet the needs of industry and the consumer.

On some occasions a chemical compound with specific properties is developed to meet a need in a certain application. In other cases a chemical compound with unique properties is developed first -- possibly through innovative research, or even by happenstance -- and then an end-use is found.

The chemical structure of PCB has been known for nearly 100 years. It was not until the late 1920s that a use for PCB was found -- as a dielectric fluid in transformers and capacitors. The properties of PCB -- inertness, fire resistance and a non-conductor of electricity -- seemed to be perfectly suited to those electrical applications where high-voltage arcing could occur; possibly resulting in serious fires or damage to the equipment.

~~Monsanto began~~ Commercial production of PCB in 1929. As the unique properties of the material became known, new uses were found. For example, their fire-resistant nature made them excellent choices for use in heat-transfer fluids. Their inertness gave long-lasting qualities to lubricants. Their use in surface coatings improved waterproofing characteristics.

Handling of the product at the manufacturing level has not presented problems as long as ~~the proper~~ normal industrial hygiene practices were followed and PCB has always been considered less hazardous than many other chemicals in everyday use.

Therefore, ~~it appeared that~~ PCBs were a ~~very suitable~~ unique product which met ~~the~~ important needs of industry.

~~Late in the 1960s, sophisticated analytical procedures were developed which could detect very minute quantities of PCB in nature. Following this analytical break-through, researchers discovered that PCB could possibly be affecting certain forms of aquatic, marine, terrestrial and avian wildlife.~~

~~The persistent nature and stability of PCB, while so desirable from the standpoint of many industrial applications, appeared to be undesirable in terms of our environment.~~

CURRENT USES

When questions about the effect of PCB on the environment first surfaced, Monsanto Company reviewed its product line and the applications for these products. As more data were developed concerning the effect of PCB on ~~and~~ the environment~~al~~ ~~controversy grew~~, Monsanto took steps ~~intended~~ to reduce the entry of PCB into the environment. The

Company ~~stopped~~ restricted the sale of PCB, only to ~~for use in various~~ applications, ~~except~~ where no acceptable alternatives were available. (2500 point sources reduced to 40. — Production volume reduced by 60%)

Today, PCB manufactured by Monsanto Company is sold only to the electrical industry where it is used in closed systems as a dielectric fluid in transformers and capacitors -- applications for which ~~we understand~~ there exists ~~continues to be~~ no acceptable substitutes. ~~Currently there are about forty electrical equipment manufacturers approved by Monsanto for PCB sales~~.

Our manufacturing and sales reduction program was a unilateral action taken by Monsanto and was based on our evaluation of developing environmental data.

Insert A INS II

The Interdepartmental Task Force on PCBs in its report (1), concurs that the safety benefits derived justify the continued use in this application. Recommendation 6 under Findings, Conclusions and Recommendations reads as follows:

> "6. <u>The use of PCBs should not be banned entirely</u>. Their continued use for transformers and capacitors in the near future is considered necessary because of the significantly increased risk of fire and explosion and the disruption of electrical

service which would result from a ban on PCB use. Also, continued use of PCBs in transformers and capacitors presents a minimal risk of environmental contamination. The Monsanto Company, the sole domestic producer, has reported voluntarily eliminating its distribution of PCBs to all except manufacturers of electrical transformers and capacitors."

insert OECD here

DEFINITION OF POLYCHLORINATED BIPHENYLS

Commercial chlorinated biphenyl products, of which Aroclors® are examples, are produced by direct chlorination of biphenyl; the degree of chlorination being chosen to provide desired properties. ~~These~~ materials ~~are relatively inert, chemically~~ resistant, readily ~~soluble in most common~~ organic solvents, and have water solubilities on the order of 25-200 ppb. These products are in all cases multi-component mixtures and not single entities as implied by the commonly employed acronym "PCB." ~~In fact, the commercial mixtures can theoretically have as many as 211 different components containing 0-10 chlorine atoms per biphenyl molecule.~~

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While it is well understood and accepted that ~~each~~ poly chlorinated biphenyl isomers have a unique set of physical and chemical properties, it is apparently not understood that ~~each~~ i~~somer also~~ bioaccumulates, dissipates, and biodegrades at a different rate.

This lack of understanding is ~~amply~~ reflected in the definition proposed in the EPA Toxic Pollutant Effluent Standards (Federal Register, Vol. 38, No. 247, page 35393, Section 129.09a) and we quote:

> "As used in this Subpart, the term: Polychlorinated biphenyls (PCB's) means materials containing the biphenyl group which have been chlorinated to varying degrees. There are 210 possible different PCB compounds."

We object to this definition because it implies that all poly chlorinated biphenyl isomers are of equal environmental concern, i.e., that they all persist and bioaccumulate in the same manner in our environment. It has been well established by academic, government, and industrial researchers that this is simply not true. Environmental monitoring programs have clearly demonstrated that, with the exception of direct high-level controllable release near points of manufacture or use, the PCBs found in our environment are the more highly chlorinated ones, i.e., those containing predominantly five or more chlorine atoms per biphenyl molecule (2-13).

This is true even though the lower poly chlorinated biphenyls have constituted more than 65% of all the PCBs manufactured over the years. This is strong evidence that the ~~less~~ lower poly chlorinated ~~isomers~~ biphenyls degrade rapidly. It further ~~suggests~~ demonstrates that even under conditions of ~~unrestricted~~ unlimited use, and without special precautions to prevent release into our environment (which is ~~truly~~ not the case now), that the ~~less~~ lower poly chlorinated ~~materials~~ biphenyls degrade rapidly enough to ~~prevent~~ limit bioaccumulation. (2 - 13)

More recently, it has also been demonstrated in laboratory experiments that chlorinated biphenyl isomers, readily undergo bacterial degradation at rates dependent upon the number of chlorines per biphenyl-molecule (17, 18, 19, 20 and 21). There are also good indications that ambient environmental PCB levels are decreasing at rates more rapidly than predicted (14, 15, 16).

The rapid metabolism of these chlorinated isomers and their lack of importance as contributors to the chlorinated biphenyl tissue burdens is evidence in the results of numerous studies. Risebrough (2) reported that the chlorine composition of the PCB detected in Atlantic Ocean zooplankton was approximately

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54%. He concluded "It might be expected therefore that biphenyls with fewer chlorine atoms would predominate in planktonic samples unless these compounds were selectively degraded." Similar findings in fresh water and marine fishes were reported by Zitko (3) and Jensen, et al., (26). The disappearance of the lower chlorinated homologs in extracts of tissues from birds (5) and mammals (6) would also indicate rapid metabolism or excretion from birds and ~~metabolic breakdown of~~ the lower chlorinated homologs. ~~The formation of 4-chloro-4'-hydroxybiphenyl from 4-chlorobiphenyl in rabbits has been reported (7).~~ delete reference ~~It has also been suggested that hydroxylation~~ of the lower chlorine homologs ~~is~~ a general metabolic pathway, resulting in complete degradation, in birds and mammals (7). As a result of the ~~relatively rapid~~ metabolism and or excretion ~~and complete degradation~~ of the chlorinated biphenyls containing less than five chlorine atoms per molecule, their contribution to the effluent should not be used in measuring polychlorinated biphenyl effluent from a facility.

~~On the basis of these data we believe~~ conclude It ~~to~~ is ~~be~~ unrealistic to consider all poly chlorinated biphenyls equivalent in terms of persistence and bioaccumulation as does the proposed regulation. ~~We,~~ therefore, ~~suggest that~~, for environmental purposes, the definition of

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PCBs should focus upon those which are ~~truly~~ of concern and we recommend that ~~a more suitable~~ the following definition ~~would~~ be: substituted for that proposed in 40CFR-38-237.

"Polychlorinated biphenyls (PCBs) means materials containing the biphenyl group which is chlorinated and which have been shown to persist and rapidly bioaccumulate in the aquatic environment. These chlorinated biphenyls are identified as those components having gas chromatographic retention times greater than 60, relative to p,p-DDE = 100, under the standard conditions recommended in the EPA PCB test method."

In ~~suggesting~~ recommending this definition, we want it understood that we are not proposing the unrestricted release of the lower chlorinated biphenyls. We only suggest that the data indicates that our environment has shown the capability of handling these materials when large amounts were unknowingly released and that this, coupled with the industrial restriction of sales to critical non-dispersive uses, with emphasis on recycle and proper disposal, has already brought this aspect under control.

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ANALYTICAL METHODOLOGY

We have no reason to doubt that the recommended EPA PCB test method is capable of <u>detecting</u> ppt (parts per trillion) levels of PCBs in waste waters. However, our experience with analyzing industrial waste waters for PCBs at the ppb (parts per billion) level prompts us to be concerned about the following areas, some of which are not covered adequately in the test procedure.

1. Sampling Procedures
2. Correction for Laboratory and Reagent Background
3. Correction for Non-PCB Sample Interferences
4. Absolute Verification
5. Quantitation
6. Precision and Accuracy

Our concern lies in the fact that any method, ~~especiall~~y ~~one~~ as complex as a PCB analytical method, which is to be used for enforcement purposes must be <u>thoroughly</u> evaluated [and proved out by an extensive interchange of control samples between laboratories]. If this is not done, the enforcement, and hence effectiveness of any effluent limit, no matter what the level, will prove to be difficult, if not impossible.

For example, we have found that ~~if~~ [accurate sampling of] waste water streams [are critical & difficult to] ~~are not sampled properly,~~ the PCB levels found depend

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on the sampling procedure employed and bear no relationship to the amount of PCBs discharged. For this reason, sampling procedures used must be designed for the discharge in question and clearly stated. To our knowledge, this has not been done.

We also note that no provisions are recommended for correcting the apparent PCB level found in a sample for laboratory and reagent background. It is our experience that as one approaches the ppt level, this background can significantly affect the observed PCB level.

With regard to correction for non-PCB sample interferences, we feel that, while the procedure notes many of the possible interferences, it does not really address itself to those which are more likely to be in industrial waste water streams. For this reason, if the electron capture chromatogram does not match the PCB being manufactured or used, complete ~~absolute identifi-cation~~ of all components counted as PCB must be validated via an alternative technique such as Gas Chromatography/Mass Spectroscopy ~~GC/mass~~.

While the scheme proposed for estimation (quantitation) of PCBs is logical, it suffers from the same shortcoming as do the multitude of other procedures which have been proposed. It is an empirical estimate and only a reflection of the real PCB level. Therefore, it should be determined via an alternate, more-elaborate procedure how closely the calculated PCB levels (for each of the cases) are to the real PCB levels so that they may be corrected.

Last, but not least, the precision and accuracy of any procedure proposed as a standard method should undergo a thorough inter-laboratory evaluation. If this has not already been done, it must be carried out prior to the use of the procedure for enforcement purposes. The accuracy and precision of the Monsanto PCB procedure has been subjected to a preliminary evaluation. Prior to this evaluation, we probably would have overestimated the precision and accuracy of our procedure. The exact details of the evaluation are available.

¶ Briefly, samples were prepared by spiking <u>distilled water</u> with <u>500</u> <u>ppb</u> PCBs. Individual preparations include blanks (no PCBs), Aroclor® 1242 only, Aroclor® 1254 only, Aroclor® 1260 only, all 50-50 two-component mixtures, and a 1/3, 1/3, 1/3 preparation containing all three components. Six samples of each mixture were prepared and analyzed by two experienced analytical laboratories. Each result, expressed in ppb of the individual Aroclor®, was converted to percent of the total added. Analysis of variance was run on all data taken together and on each laboratory independently.

- The 95% confidence limits observed for individual results were:

Either Lab	87.5 ± 55.2%
Lab A	81.3 ± 46.4%
Lab B	93.7 ± 19.2%

- The repeatability for the individual labs, based on repeat tests of samples having identical prepared compositions was:

Lab A	± 42.0%
Lab B	± 11.6%

We feel that these results demonstrate the importance of evaluating the precision of any PCB procedure. Note that the test did not include sampling problems, used distilled water free of interferences, and was carried out at a relatively high PCB level (500,000 ppt) by two experienced laboratories. It is expected that, if sampling problems were involved, and the level of PCB present was extremely low, the accuracy and precision of any PCB method would degrade considerably.

Background for PROPOSED EPA EFFLUENT STANDARD

In the establishment of the proposed effluent standard the primary basis for toxicological consideration came from the Water Quality Criteria, October, 1973, (Federal Register, Vol. 38, pages 29646 et seq., Friday, October 26, 1973). These criteria were, in turn, based on Water

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Quality Criteria, 1972 by the National Academy of Sciences and the National Academy of Engineering.

The Water Quality Criteria, October 1973 have not undergone the normal review, criticism, comment and revision before final adoption. We object to the use of challengeable portions of a proposed publication in the development of critical effluent standards.

We note in Water Quality Criteria, 1972 in those sections pertaining to polychlorinated biphenyls, the frequent use of unpublished data and the disturbing use of qualifying phrases such as "...may adversely affect...", "...apparently related...", or "...the work...suggest..." In our opinion, none of the discussions present adequate data to support establishment of responsible effluent standards for PCBs.

On page 5 of Water Quality Criteria, 1972, the Committee emphasized the importance in understanding that there is a distinction between criteria and standards and that the words were not interchangeable nor or they synonyms for words such as objectives or goals. The report further states that it is necessary to establish scientifically-based recommendations for each assignable water use, implying availability of practical methods of detecting and measuring which can be applied to monitoring. Once these fundamentals are available; political, social and economical factors enter into the decision-making process to establish standards. In our opinion, these procedural steps were not followed in arriving at the proposed effluent standards for PCBs.

The maximum acceptable concentration in fresh water that would be permitted by the proposed standard is $0.002\mu g/l$. The rationale described in the Statement of Basis and Purpose, Toxic Pollutant Effluent Standards is based on results of a preliminary study which have suggested (not yet proven) a threshold PCB level for salmon egg mortaility. We cannot accept the selection of salmon as representing organisms which are usual or may potentially be present in water systems near the facilities described in Section 129.09, Subpart I, Title 40 CFR.

Although many reports have been published on the subject of polychlorinated biphenyls and living organisms, the majority of these describe the presence of PCBs in the environment. Presence should not be assumed to imply adverse effect. To our knowledge, no published report exists which conclusively relates the mortality of any wildlife species, aquatic, marine, mammalian or avian, to the presence of PCBs. The only reported mortalities are those achieved in laboratory studies. 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. Results from such studies are not extrapolatable to the natural situations and any conclusions derived from such studies must still be considered speculative. ~~In our considered opinion,~~ fundamental scientifically-based data is lacking and the establishment of effluent standards for polychlorinated biphenyls cannot be made intelligently and responsibly.

In the establishment of the PCB effluent standard for freshwater systems a bioaccumulation factor of 200,000 was selected. This factor has no extrapolatable relationship to either the residues of PCB in salmon eggs or to PCB residues of fresh water forage fish. The only published report of an accumulation factor of the magnitude selected was that for the hepatopancreas of the pink shrimp, Penaeus durarum, (27). Even though an accumulation of 204,000 in the hepatopancreas has occurred, a neaily complete elimination of PCB from that tissue was achieved when the shrimp were placed in water free of added PCB. The equilibrium whole body accumulation plateau indicated an approximate accumulation factor of 22,000. These results are in agreement with those reported by Stallings and Mayer (30), and with the studies of Ryther (28), Greichus et al (24) and Crump-Weisner, et al (22) showing equilibrium biomagnification factors between water and fish ranging between 1000 and 75,000 and would support the selection of a factor considerably lower than the 200,000 which was applied. We suggest, from a review of the available literature, that a factor of 20,000-30,000 could be supported. — Suggested [illegible] supported [illegible]

Abritrary safety factors were applied to the tolerable chronic limit to establish the so-called "critical chronic limit" which was then used to compute the maximum allowable effluent. These safety factors were proposed to account for a multitude of variables, including non-point sources, multiple discharges and industrial growth. The safety factors proposed were identical for 7 of the 9 materials for which effluent standards were prepared. These safety factors, resulting in approximately two-fold reductions, are so small as to be of no beneficial toxicological consequence.

In establishing the effluent standards, an attempt was made to distinguish between types of receiving waters by classifying them as streams, lakes and impoundments, estuaries and coastal waters. We do not believe this attempt to distinguish water bodies

NEV 025252

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is by any measure adequate. Water bodies are universally known to be complex systems with no two systems alike. With a complex material such as polychlorinated biphenyls, the determination of possible adverse effects in each water body becomes exceedingly difficult. The uniqueness of each water system must be considered.

A key parameter used to further describe the water body is the flow rate which was limited to the probable low rate of stream flow occurring during a seven-consecutive-day period once in ten years. We do not agree that is realistic or appropriate. In our opinion, ~~adequate~~ appropriate control can be achieved using average stream flow rates.

Further, the maximum flow rate that can be used in calculating the daily discharge permitted has been arbitrarily set at 10,000 cubic feet per second. This limit is based on a nondegradation philosophy which tolerates limited diffusion and on a desire to discourage industry from locating facilities on large main inland waters and coastlines. This limitation deprives our society ~~from~~ of the judicious use of an important great natural resource. Discharge limitations should be based on the ~~adverse~~ effects a material will have on a water system, ~~not on~~ given consideration to its size and ~~or~~ flow rate. For PCBs, proper control will not occur by imposing maximum flow rate conditions, but by applying results from scientific studies which properly define how each water system responds to the presence of PCBs.

RESIDUAL POLYCHLORINATED BIPHENYLS

Because of their chemical and physical properties, PCBs can be found in soils and waters long after a discharge has occurred. This source of PCBs to the environment will diminish with time. To maintain control of losses, emphasis should be directed toward discharges resulting from current and future uses of PCBs.

Since this problem of background levels occurs with all materials in varying degrees, we propose the following revisions:

From Section 129.01c(b), Subpart A, Part 129, 40 CFR, delete the words "in intake waters for a discharger".

Add an additional definition in Section 129.01a:

> "Background" means amounts of toxic pollutant (1) presently found in the waterways of the United States (including the intake waters of

a discharger, or (2) arising out of operations subject to this Part that occurred before the effective date of this Part, but were not discharged to the waterways of the United States before the effective date of this Part.

PCB DISCHARGE CONTROL - MANUFACTURING FACILITY

During the late 1960's, as more data were developed indicating PCBs could possibly be affecting certain forms of wildlife, Monsanto voluntarily undertook a two-phased program to keep the product out of the environment. One phase involved the limitation of sales of PCBs which was described above. The second phase involved the control of discharges at our manufacturing location.

Since 1969, we have invested more than 22 man-years of work and millions of dollars in this program.

In our manufacturing area, we have taken a number of significant steps to contain PCBs. In essence, we have made the department a "concrete bathtub". Drainage is directed to trenches and piping, and then to one of two 3,000-gallon settling basins. This insures PCB containment in case of accidental spill or equipment failure.

We have also installed an incinerator to safely dispose of PCBs. This is accomplished through incineration at or above 2000°F.

When small quantities of PCBs are collected into the settling basins in the manufacturing area, they are later pumped into drums, and eventually incinerated. In the incinerator area itself, drainage is directed to trenches and piping which flows to a 10,000-gallon basin. Recovered PCBs are periodically pumped to storage, or incinerated.

In the manufacturing area, we have also rerouted rupture disc lines and atmospheric vents through catch tanks, or redirected them to settling basins. This insures that, if a rupture does occur, PCBs will not get into the environment, but will be contained in a controlled area.

We also provide nitrogen blanketing on storage tanks to eliminate any "breathing" of the tanks and resultant PCB escape.

We have installed mist eliminators in vapor lines -- once again to eliminate the possibility of PCBs leaving the manufacturing area through these lines.

Finally, we have replaced underground sewers with above-ground sewers, and repaired or combined others, so that we can monitor the effluent from the department. In addition, this will prevent any unknown buildup of PCBs in our sewer systems or any contamination of PCBs into other sewers.

Much of the success of our efforts also depends on maintaining a high housekeeping level in the department itself. Among the housekeeping responsibilities our operators have assumed, are these:

> <u>All</u> pumps are checked for leakage on every shift. Drip pans that collect leaks are emptied into scrap PCB drums.
>
> All leaks are reported and documented so that corrections can be made and settling basins observed.
>
> "FloorDry" is used to absorb any liquid PCBs that have spilled or leaked. If it becomes necessary to flush PCBs to the settling basin, a minimum amount of water is used.
>
> Sampling drums and scrap PCB drums are quickly palletized, labeled, and transferred to the incineration area. 738512

Through these kinds of programs, we feel we have literally built a "concrete bathtub" to catch and safely dispose of PCBs at our manufacturing location.

We have also developed sophisticated systems to monitor our effluent. Monitoring effluent streams for PCBs is not an easy effort. Measurement can be changed dramatically by taking the sample at different places along the sewer main, by changing the level at which the sample is taken, by changing the speed at which the sample is taken, or by varying the velocity of the effluent. But we have purchased the best available laboratory equipment, which enables us to determine PCB content in the parts-per-billion range. Here again, however, many factors affect our findings. The minimum detection level of PCBs on a routine basis contained in distilled water is one part per billion (± 25%). If "dirty" water - i.e., that containing other materials which interfere with the determination of PCB -- is analyzed, the minimum detection level is 100 ppb ± 25%. Monitoring is difficult. But we feel with our experience and acquired "know'how", we're doing the <u>best</u> possible job. And we do this job 24 hours a day, 365 days a year.

We have also established loading and shipping safeguards to minimize accidental PCB loss during transportation. Specific written instructions are on every container we ship.

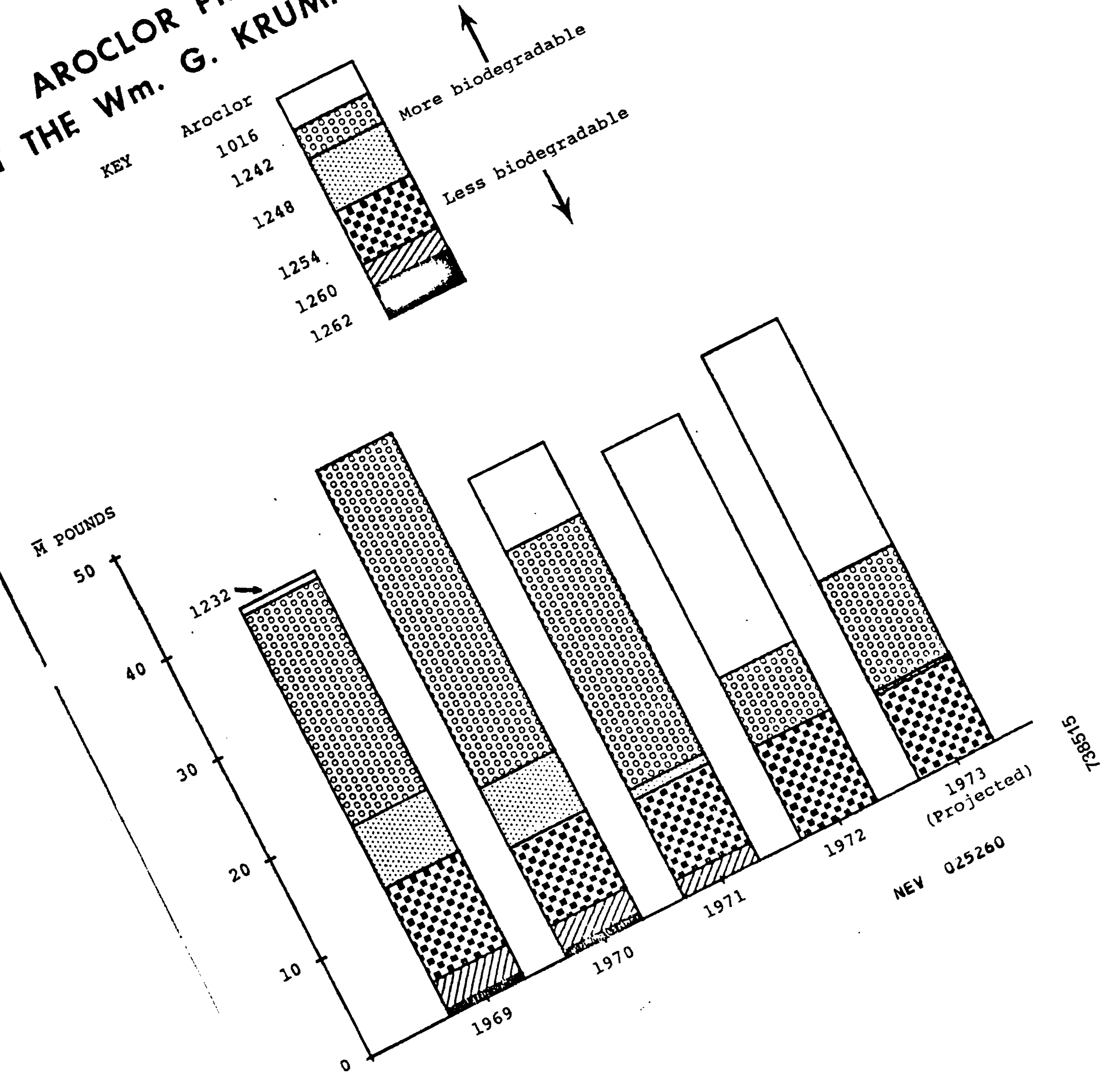
We have provided facilities for safely disposing of used PCBs returned from customers. As mentioned above, we installed a specially designed PCB incinerator, at a cost of $790,000. We have received an operating permit from the Illinois EPA for this incinerator, which meets all EPA requirements. This incinerator completely destroys PCBs received either from our manufacturing area or from customers.

Finally, we have moved toward the manufacture of a more biodegradable polychlorinated biphenyl. In 1971, we installed a new distillation column in our manufacturing department at a cost of $970,000. This allowed us to separate the higher chlorinated, less biodegradable compounds from the lower chlorinated, more biodegradable ones. Our PCBs are known by the trade name Aroclor®. We manufacture different grades of Aroclor® (1016, 1242, 1254, for example). The lower the grade number, the less chlorinated and more biodegradable is the product.

The attached table reflects how our production mix has changed to more biodegradable products while the production of higher chlorinated less biodegradable products has declined.

We believe we can confidently assert that we have taken strong measures to contain PCBs and keep then out of the environment.

AROCLOR PRODUCTION AT THE Wm. G. KRUMMRICH PLANT



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SUMMARY

1. Actions by Monsanto and its customers, which have resulted in limiting the use of PCBs only to electrical applications in hermatically sealed units, have dramatically reduced the quantities of the more persistent PCBs introduced directly into the environment.

2. There are over 200 chemical entities collectively known as PCBs. The chemical and physical characteristics of each of the isomers are not all alike. There is ample evidence that the higher chlorinated isomers are the type found in wildlife organisms and are, therefore, of environmental concern. We have proposed a definition describing the more persistent PCBs.

3. ~~We are concerned with~~ the accuracy and reproducibility of results attainable between laboratories using currently-available sampling and analytical techniques and further studies are recommended ~~proposed~~.

4. The proposed ~~We are concerned with a~~ PCB effluent standard is based on inadequate toxicity information on a non-typical fish species and on an unusually high artificial ~~and unique~~ bioaccumulation factor. ~~We~~ sincerely believe good ~~scientific~~ information is lacking ~~and~~ no ~~responsible~~ standard can be developed at ~~this time.~~

5. We object to a limitation of 10,000 cubic feet per second being arbitrarily assigned as a maximum stream flow ~~without a sound technical basis demonstrating adverse effects.~~

6. ~~We believe~~ the presence of background levels of PCBs should be considered ~~and propose a definition which would be helpful~~. when determining effluent [illegible]. The [illegible] definition of background [illegible] added [illegible] proposed [illegible]

7. ~~Control practices followed at our manufacturing unit have effectively contained PCBs.~~

Our purpose in commenting on the proposed standards is to aid the Agency in the development of realistic effluent standards which will achieve the intended objectives without serious technical, social and economic disruptions. We recognize the seriousness of this endeavor and find a statement made by Mr. John R. Quarles, Jr., Deputy Administrator, Environmental Protection Agency, of considerable interest. At a recent conference, Mr. Quarles (31) stated:

> "We have found it virtually impossible to devise intelligent standards which specify an appropriate degree of control over toxic pollutants irrespective of the sources of those pollutants and factors affecting the feasibility and timing of their abatement."

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We can appreciate Mr. Quarles' concern, particularily as it applies to PCBs. Lacking good scientific information on the fate and effects of PCBs in complex water systems each having unique characteristics, we urge extreme care be taken to avoid the promulgation of effluent standards which are unattainable and unwarranted.

Respectfully submitted,

HISTORICAL SUMMARY OF PCB ENVIRONMENTAL ISSUE

By

W. B. Papageorge

Polychlorinated biphenyls have been commercially available for over 40 years, and, as many of you are aware, are produced world-wide in many of the industrially developed nations.

As with many industrial chemicals, early studies to determine the toxicity properties of these materials were designed to provide the appropriate information to guide the manufacturers and users in its proper handling, storage and shipping. This understanding of the polychlorinated biphenyls resulted, through the years, in a remarkable record of very few incidences of human exposures resulting in observable effects. In each reported instance the existing evidence indicated that improper industrial hygiene practices were being followed.

During the late 1950's and 1960's increased interest in the presence and effects in the environment of chlorinated hydrocarbon pesticides resulted in the development of sophisticated analytical methodologies with capabilities of detecting these substances at extremely low levels of concentration.

In the use of gas-liquid chromatography for the determination of DDT and its metabolites, investigators were puzzled by the presence of response peaks which could not be identified. Generally, these peaks were ignored, and, in some laboratories, they were considered as possible metabolites of DDT.

In late 1966, Drs. Jensen and Widmark, Analytical Chemistry Laboratories, University of Stockholm, identified these peaks as polychlorinated biphenyls and claimed to have found these materials in many foods, human milk, infant hair, pine needles and in feathers from a mounted eagle in a museum. The results of this study were published in 1967.

During 1967 other investigators, using Jensen's method, established the presence of polychlorinated biphenyls in samples from the environment. By late 1967 and early 1968, presence in the environment was fairly well established, but in many instances could not be explained. All of the early reports indicated that the polychlorinated biphenyls being identified represented mixtures of the higher chlorinated isomers.

At this point, Monsanto launched a multi-point program aimed at obtaining more information about polychlorinated biphenyls and their presence and impact on the environment. This program included the following:

1. Develop analytical methodology

2. Conduct biodegradation studies

PLAINTIFF'S EXHIBIT 1120

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3. Conduct animal toxicity studies

4. Develop alternative materials for PCB applications

5. Develop a program for the recycle or proper disposal of scrap polychlorinated biphenyls

6. Develop a continuing program of informing our customers of significant developments

7. Cooperate fully with industrial, governmental and academic laboratories

Studies performed throughout the world have resulted in the following findings:

1. The presence of polychlorinated biphenyls in the environment has been confirmed.

2. Some isomers of polychlorinated biphenyls are more resistant to degradation than others.

3. The early claims indicating that PCBs result in widespread thinning of eggshells in wild birds have not been confirmed.

4. Massive fish kills attributed to PCBs have not been confirmed.

5. Biological magnification in the food chain does occur.

6. Some species of marine and wildlife are very sensitive to low levels of PCBs, e.g. brown shrimp, some species of fish, invertebrates, mink.

7. PCBs identified in samples obtained in remote areas represent the higher chlorinated isomers. Samples obtained near a source of the commercial material contain the lower chlorinated isomers.

8. High doses of polychlorinated biphenyls present in rice bran oil resulted in the presence of toxic effects in over 1,000 Japanese.

9. The effects of chronic long-term, low-level exposure to humans has not been established.

10. High levels found in human food and animal feeds are traceable to known sources.

Because of its presence in the environment and indicated effect on some species of wildlife, coupled with the concern regarding the effect on humans of low-level, long-term exposure, Monsanto voluntarily instituted a worldwide program for terminating the sale of polychlorinated biphenyls to those uses in which control of escape to the environment was impractical.

St Louis

March 30, 1970

H. S. Bergen - HBERG
H. L. Minckler - HMINC
P. S. Park - PPARK
J. E. Springgate - JSPR

RETYPED FOR LEGIBILITY

W. B. Papageorge
WPAPA

We have been in communication with a Dr. Hill of the Ohio State Board of Health. He has found PCB, particularly Aroclor 1254, in samples of milk from at least three herds in Ohio. He has traced this contamination back to silage from three different silos. Dr. Hill reported concentrations of 0.2 ppm of PCB in the silage in the center of the silo and up to 20 ppm in the material next to the walls. He also stated that concentrations in the milk were between 0.1 ppm and 0.6 ppm and that some of the milk had been destroyed.

The silos are concrete silos whose interior surfaces were painted in 1967 using a formulation that contained 1254. I don't know if there was any other Aroclor in the formulation nor do we know the coating manufacturer; although, this could be found out if important. The presence of PCB in the silage came from flaking off of the material and possibly from leaching out during the silage storage. At present they will have to destroy about 150 tons of silage which is valued at about $30 per ton. As a rough guess, they consider there may be 50 other silos involved in Ohio that were painted with the same formulation. They are also looking into the fat contamination of the cows themselves.

All in all, this could be quite a serious problem, having legal and publicity overtones.

This brings us to a very serious point. When are we going to tell our customers not to use any Aroclor in any paint formulation that contacts food, feed, or water for animals or humans? I think it is very important that this be done. It may be that some of the customers will assure themselves on the basis of non-extractability that a particular formulation might be safe but I think we should make a blanket recommendation against these uses.

R. Emmet Kelly, M. D. 81915

REK/ln

PLAINTIFF'S EXHIBIT

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St. L

March 30, 1970

E. S. Bergen - EBER
H. L. Minckler - HM
P. S. Park - PPARK
J. B. Springgate -

W. B. Papageorge
WPAPA

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R. Emmet Kelly, M. D.

REK/ln

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100337 91

WATER_PCB-SD0000072679

BCC: P. G. BENIGNUS
D. A. OLSON

July 6, 1970

Mr. Garlington Wilburn
Manager, Engineering
Westinghouse Electric Corporation
South Boston, Virginia

Dear Gary:

I have read your Process Specification 891400A "Disposition of Scrap Inerteen and Inerteen Contaminated Materials" and I found it an excellent document which reflects Westinghouse's concern about the PCB problem and is a major step forward toward improved control.

I do have one concern that I would like to pass on to you. The suggestion to burn solvent or oil contaminated with Inerteen does not refer to any minimum combustion temperature. As we discussed previously, total destruction of PCB's can only occur above 800°C. Any temperature below this minimum will result in vaporization with release to the atmosphere or worse yet, it is possible to partially oxidize PCB's into materials which can be highly toxic (e.g. dioxins or furans). Your incineration should be thoroughly reviewed.

I found our discussion and plant tour last week very interesting and informative. Your plant has excellent housekeeping and with continued emphasis on controlling loss of PCB's to the air and sewer, I am confident you can succeed in achieving a "bone dry" plant in which the leakage, spills, etc. are a rarity.

I am working with our P.R. Department on a suggested press release which I will send you soon.

Sincerely,

W. B. Papageorge, Manager
Environmental Control

cc: G. R. Graham

PLAINTIFF'S EXHIBIT 1335

PLAINTIFF'S EXHIBIT

GBRN003404

906102

WATER_PCB-SD0000072680

BCC: F. G. BENIGNUS
D. A. OLSON

July 8, 1970

Mr. F. G. Jenkins
Vice President, Materials
Sprague Electric Company
North Adams, Massachusetts 01247

Dear Mr. Jenkins:

I was fortunately able to visit your Brown St. Plant on June 17 with Randall Graham. I personally found the discussion informative and interesting and I was most favorably impressed with the concern and interest expressed by your management personnel. We discussed briefly some of the points raised in your letter dated June 11. I will try in this letter to be more specific.

Biodegradability - Biodegradation studies conducted in our research laboratories in St. Louis, Missouri and in Ruabon, Wales using media consisting of local river waters or activated sludges acclimated to biphenyl give direct evidence that the lower chlorinated biphenyls are affected. There is some evidence that chlorine position on the biphenyl configuration does influence the degree of distruction by the microorganisms. I have enclosed a tabulation from our Ruabon laboratory which attempts to show this difference. We do not have formal information regarding the effect of sunlight or other natural influences on Aroclors. Experience gained over many years indicates Aroclors are highly stable under all known conditions present in the environment.

Toxicity - There is ample evidence from many laboratories that certain species of birds which are at the top of the marine food chain cannot reproduce properly when PCB's are present in their diets. The U. S. Fisheries laboratory at Gulfbreeze, Florida conducted a study which indicated that juvenile brown shrimp did not survive in water containing 5 parts per billion of PCB. Attached are copies of reports on these studies.

PLAINTIFF'S EXHIBIT
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Monsanto has sponsored some studies on laboratory rats and dogs. A summary of the results to date is attached.

Disposal - The preferred method for disposal is high temperature incineration. I suspect there are several commercial burners on the market which will perform well. I personally witnessed burning tests at the John Zink Company's unit in Tulsa, Oklahoma. Temperatures must exceed 1500°F to assure that complete destruction is achieved. Lower temperatures would only vaporize the Aroclors and create atmospheric pollution or, worse yet, would form, by partial oxidation, materials which could be highly toxic (e.g. furans and dioxins). With incineration HCl is formed which must be scrubbed from the stack gas and neutralized before disposal. We are planning for an initial installation in one of our plants later this year. As a service to our customers who may not have access to other incinerators, we have offered to accept scrap Aroclor for immediate storage and eventual incineration. Tentatively, Monsanto will charge 3¢ per pound of returned material. This charge does not include freight or container costs and will be reviewed when final incineration costs are established. Material which is returned for disposal should be addressed to Monsanto Company, W. G. Krummrich Plant, Sauget, Illinois, Attention: Supervisor Department 246.

Solids contaminated with Aroclors present a bigger challenge. As yet, we have not tested an incinerator with these materials. Until we get more information the best we can advise is safe burial in an authorized, properly operated land fill located away from any water systems.

We have laboratory work underway on other forms of destruction. As yet no economically feasible approach has been found.

Analytical Methodology - I have attached copies of Monsanto's analytical procedures for the determination of PCB's in water, soil, air and biological samples. We are interested in comparing our methods with those devised by other laboratories. Any comments your laboratory may have would be welcome and appreciated.

I hope that the above information is useful to you. If I can be of further service, please let me know.

Sincerely,

V. B. Papageorge
Manager
Environmental Control

mm

cc: Mr. H. Davis
Sprague Electric

G. R. Graham

MITSUBISHI MONSANTO CHEMICAL COMPANY

FROM LOCATION : Tokyo

DATE : May 18, 1971

SUBJECT : PCB Environmental Problems

REFERENCE :

cc: Messrs.
D. Danna-St. Louis
J. R. Durland-Tokyo

TO : Mr. W. B. Papageorge
St. Louis

Dear Mr. Papageorge:

Thank you very much for your prompt action of sending us information and data about the environmental problems of PCB's, PCT's and other related products at my request of March 19, 1971. They are very interesting and useful to us.

After a careful review of the data received and analysis of the situation facing us here, we have come to conclude that it would be difficult to promote the sale of PCB related products in Japan without establishing a systematic strategy including not only presentation to customers of data explaining that products are free from pollution but also supply of such information as to degradation and disposal.

In this connection, we have decided that we would ask MC to provide us with basic data on MCS-1016, MCS-1043 and other promising substitutes for PCB referring to such points as mentioned above.

We shall be very happy, if you are good enough to arrange for us to get information and data listed below:

1. On MCS-1016

   An Environmentally Compatible Aroclor (Analytical Chemistry Special Study 71-2 Job No.13480 written by E. S. Tucker)

PLAINTIFF'S EXHIBIT 1566

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1) At the middle of page 2, it reads "the fact that PCB's containing 5-8 chlorine atoms are the most refractory toward degradation as witnessed by what has and is being found in 'weathered' biological materials". We would like to have a report proving said fact and comparative data on degradation with other PCB's.

2) Degradation data by RDA exposure described on pages 4 and 5 are needed.

   Have further tests been done by MC on MCS-1016 itself?

   We would like to have such graphic data on MCS-1016 and other items as shown on A-1221(Fig. IV, V) at the end of said report.

3) Detailed data are needed on "determination of PCB Residues in Rats Fed A-1242, A-1254, A-1260" described on page 6.

4) What are biphenyl active cultures C_2 and C_3 referred to on pages 3 and 4 dealing with "aceumulated bacterial degradation" and shown in PCB Environmental Problem March Status Report? Please send us detailed data on each item of PCB degradation by said materials.

   Are those active cultures usable on a commercial scale?

5) We know that MC's studies have been continued on bacterial degradation, rat metabolism, etc. of MCS-1016 for the purpose of proving safety of the product. How do they progress?

2. MCS-1043

1) What is MCS-1043?

2) According to PCB Environmental Problem March Status Report, degradation rate of MCS-1043 by SCAS is twice as fast as those of A-1242 and MCS-1016. Would you inform us of degradation data such as rat metabolism?

3) What are the performance of, and fields of application for MCS-1043?

4) One gallon sample is needed.

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3. On Semi-Continuons Activated Sludge Tests

   Is the SCAS method commercially usable as a degradation process for MCS-1043, MCS-1016, A-1242, HB-40, MIPB etc.?

4. As to HB-40 and MIPB, we would also like to have such data on degradation in human bodies that prove safety of the products. We also want to have data on 90-day studies explained about on page 5 of PCB Environmental Problem February Status Report.

Your assistance would be highly appreciated.

Best regards.

S. Uneno

S. Uneno
Product Director
Division C

MM:ri

MITSUBISHI MONSANTO CHEMICAL COMPANY

FROM LOCATION : Tokyo

DATE : July 8, 1971

SUBJECT : AROCLOR REFINING

REFERENCE : Your Memo July 1, 1971

TO : Mr. W. B. Papageorge
St. Louis, Mo.

cc: Messrs.
P. G. Benignus
H. S. Bergen
D. Danna
T. L. Gossage
T. Katayama
R. E. Keller/E.S. Tu
R. H. Munch
W. R. Richard
S. Un eno
E. P. Wheeler

This will acknowledge receipt of your memo and the attached 15 reports, all relating to the biodegradability and toxicity of Aroclors.

At MMK, we are under substantial critical pressure from both national and prefectural ministries, because the available data have been insufficient to satisfy them on the improved biodegradation of Aroclor 1016. Even though it is obvious that the data show comparatively rapid removal of chlorinated isomers in the lower range, the presence of Cl_4 and higher chlorinated compounds is criticized -- even if these may be only one-tenth of the concentration in Aroclor 1242. I suppose this is a natural fear of persistence. Since the effluent from the Yokkaichi plant, where our Aroclor unit is located, discharges into a large bay which is extensively used for fishing and oyster cultivation, reduction of higher chlorinated biphenyls to an economic level in 1016 is still considered a potential threat. We shall need any additional degradation data on Aroclor 1016 before we can introduce Aroclor 1016 as an improved product over Aroclor 1242.

My congratulations also on your expanding responsibility. I am sorry we were not able to get together while I was in St. Louis.

Best regards,

John
J. R. Durland

JRD:fu

PLAINTIFF'S EXHIBIT 1542

NEV 025473

738728

WATER_PCB-SD0000072687

BIODEGRADATION TEST PROGRAM

Provide Degradation Rates of Material Submitted for Testing

Business Group	Product (In order of Priority)	Testing Procedure	Location	Method of Analysis	Start Up Date	Estimated Completion Date
Functional Fluids	MCS 1043 MCS 1016 Aroclor 1242 Aroclor 1254	1. Activated Sludge 2. River Die-Away 3. Shake Flask	St. Louis St. Louis Ruabon	EC/GC EC/GC EC/GC	8-10-70 11-3-70 Underway	2-71 1-4-71 ?
	Aroclor 5432 Aroclor 5442 Arobrom 5465	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis St. Louis	? ? ?	Holding until further analytical method development work is completed	
	Trichloro-benzene	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	EC/GC EC/GC	10-27-70 11-3-70	4-71 1-4-71
	Gulf 200 Bright Stock Neville Uniclor 40	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	FID/GC FID/GC	12-1-70 12-1-70	6-71 2-2-71
	MCS 717 MCS 762 penta-Biphenyl Isomers hexa Biphenyl Isomers	Shake Flask	Ruabon	EC/GC	Underway	?
	NC Phosphate Cresyl Diphenyl Phosphate Tributyl Phosphate Tricresyl Phosphate Diphenyl Sulfone Tolyl Xylyl Sulfone Trichloro Diphenyl Ether Monobromodichlorobenzene (Cont'd)	Materials to be incorporated into program as equipment and manpower become available.				

BIODEGRADATION . ST PROGRAM

Provide Degradation Rates of Material Submitted for Testing

siness Group	Product (In order of Priority)	Testing Procedure	Location	Method of Analysis	Start Up Date	Estimated Completion Date
'unctional Fluids Cont'd)	2,2'-dichlorodiphenyl ether Cumylphenol Isopropylphenyl Phosphate Orthoxenyldiphenyl Phosphate Xylyl Phosphate Ester (Fyrquel 220)					
lasticizers	MIPB HB-40	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	UV and FID/GC	5-27-70 8-31-70	Initial work completed; report to be issued
	Aroclor 5460	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	?	Holding until further analytical method development work is completed	
	Aroclor 1221	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	EC/GC EC/GC	10-27-70 11-18-70	4-71 1-19-71
	Santicizer 711M	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	?	Holding until analytical method development complete	
	IN-425 IN-420	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	Hold -	Potential economic and acute toxicity problems	

(Cont'd)

738730

NEV 025475

BIODEGRADATION TEST PROGRAM

Provide Degradation Rates of Material Submitted for Testing

Business Group	Product (In order of Priority)	Testing Procedure	Location	Method of Analysis	Start Up Date	Estimated Completion Date
Food and Fine Chemicals	3,4,4'-Trichloro-carbanilide	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	UV UV	7-27-70 8-28-70	Initial work completed; report to be issued
	3,3',4-Tri-chlorocarbanil-ide 3,3',4,4'-Tetra-chlorocarbanil-ide Santophen I	River Die-Away	St. Louis	UV	8-28-70	Initial work completed; report to be issued
General Chemicals	p-Nitrochloro-benzene o-Nitrochloro-benzene p-Chloroaniline nitrated orthene	1. Activated Sludge 2. River Die-Away	St. Louis St. Louis	?	Analytical method development work to be initiated 11-23-70	

NEV 025476

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WATER_PCB-SD0000072690

W. B. Papageorge - General Offices - E2NK

September 13, 1971

P. D. Benignus - F2SH
H. S. Bergen - D2SA
T. L. Gossage - D2SL
R. E. Keller - 1760
E. H. Munch - 1760
C. Paton - C3SP

W. R. Richard - T3A

Dr. Lyon Mandelcorn, Westinghouse Research, Pittsburgh, Pennsylvania called to inquire about a formal report describing the relative data on the biodegradability of Aroclor 1016 and Aroclor 1242.

He indicated he had seen such a report and that someone in Monsanto had offered to send him a copy.

Is there a report we can freely share with customers or can the data available be presented in a manner that permits us to do so?

W. B. Papageorge

WBP/er

PLAINTIFF'S EXHIBIT 1593

NEV 025139

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WATER_PCB-SD0000072691

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
(314) OXford 4-1000

January 19, 1973

Mr. Paul G. Benignus
Chairman, Steering Committee
American National Standards
Institute Committee C-107
c/o Monsanto Company
800 North Lindbergh Boulevard
St. Louis, Missouri 63166

Dear Paul:

With the completion of the final draft of the guidelines for the proper use, handling and disposal of Askarels, it appears to me that ANSI Committee C-107 can now direct its attention to the remaining objectives, which you will recall are as follows:

1. Serve as a source for technical information and advice for Federal, State and local authorities and for the information of all others concerned.

2. Encourage the development of suitable disposal facilities and maintain a list of their capabilities and locations, for the information of all concerned.

3. Serve as the advisory group for U.S. participation in CEE, IEC, COPANT, SEGRA and other international organizations.

I would very much appreciate the recommendations of your Steering Committee relating to the makeup of working committees assigned to the effective achievement of these objectives.

Sincerely,

WB Papageorge

W. B. Papageorge
Chairman
ANSI Committee C-107

PLAINTIFF'S EXHIBIT 872

95525

WBP/bt

cc: A. M. Salazar

ADM 007709

PCB's - ALLOWABLE DISCHARGE FROM PRODUCING/USING PLANTS

MINUTES OF MEETING - 4/13/72 IN EPA OFFICES, WASHINGTON, D. C.

A. Present

For Monsanto

K. Warren Easley - Washington Office
W. B. Papageorge - G.O.
A. E. Leisy - WGK
R. M. Blowers - WGK
W. C. Engman - WGK
E. Scott Tucker - MIC - Research S. 2nd.
P. B. Hodges - G.O.

For EPA

John L. Buckley - Deputy Director - Ofc. of Research
Alphonse F. Forziati-Chief, Measurements & Instrumentation Branch
Paul E. Des Rosiers-Staff Engineer, Industrial Pollution Control
Elizabeth Anderson-Staff Chemist - Ofc. of Tech. Analysis
Gordon Everett - Director - Ofc. of Tech. Analysis
Marilee Miller - No title
Glenn Pratt - Chicago Region Enforcement
Kathleen Schirmer- Staff Ass't. (New Toxic Div. not established)

B. Background of Meeting

The Task Force for PCB's, with representatives from various Federal agencies including FDA, EPA, USDA and coordinated through the Office of Science and Technology, will soon release its voluminous report on the PCB's problem. Monsanto has cooperated with the involved agencies and had some insight into what would appear in the report. We agreed generally with nearly all of the report recommendations, but could not concur with two recommendations (as we understood them):

PLAINTIFF'S EXHIBIT 1505

NEV 000715

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(1) Water quality standard for PCB's to be set at 0.01 ppb for rivers and lakes.

(2) Zero detectable level in discharges from plants producing or using PCB's. An inconsistency existed in that we understood that the 0.01 ppb water quality standard was derived from a calculation involving 10-year low flows in the Mississippi River and a 3 lbs/day discharge from our WGK Plant (their understanding of what we were discharging to the river - the 3 lbs/day is equivalent to about 0.01 ppb in the river with no allowance for background).

A meeting was requested to discuss these recommendations with Dr. Buckley, with intent to prepare a formal presentation for them. However, due to time pressures in EPA, the meeting was set up on 1 day's notice. Our information and comments had, therefore, to be presented informally, with little time for preparation. The Monsanto group met to plan for the meeting on Wednesday afternoon, the various assignments/presentations were prepared that night and were reviewed on the plane to Washington, followed by another quick review in Warren Easley's office.

Our objectives for the meeting were:

(1) To induce EPA to recommend a more realistic water quality standard than the 0.01 ppb - say, 0.1 ppb. The higher level would be more in the range of reasonable precision by the average laboratory and would recognize a small PCB background.

(2) To induce EPA to drop the "zero discharge" concept and to allow a reasonable discharge (5 lbs/day) in terms of lbs per day - not concentration. 5 lbs/day is consistent with requests of the electrical industry using PCB's.

(3) To induce EPA to allow a reasonable time to attain the discharge limit.

C. Minutes of Meeting

(1) Following "round-robin" introductions, W. Papageorge stated our appreciation of this first opportunity to discuss with them the problems involved with plant discharges. He stated our desired format, which was to have various plant people discuss what we had done and were doing to control PCB discharges and to explain the problems involved. Buckley concurred.

(2) Art Leisy spoke briefly of the complex nature of the WGK Plant, the relationship to Sauget Village and the concern within manufacturing of the environmental impact of wastes from the manufacturing processes.

(3) Dick Blowers discussed physical growth of the plant, complexity of the sewer system, size and extent of our current program for in-plant waste reduction and control. He pointed out that PCB's were a major one of numerous concerns where we were actively planning recycling or otherwise reducing wastes. He did not discuss the type of waste treatment Sauget Village is contemplating. Some remarks from Glenn Pratt and others about secondary biological treatment were ignored.

(4) Bill Engman described the PCB containment and in-plant reduction program (full text is attached). At the close of his talk, he stated the present level of discharge as follows:

(a) From PCB manufacturing facilities - 2 to 4 lbs/day.

(b) From the Village waste treatment plant, 5-10 lbs/day.

(5) Dr. Buckley went through his rationale for the proposed limits:

(a) PCB in water is toxic to fish at very low levels - under 1 ppb for some species.

(b) They know from experience that PCB levels magnify greatly from water to fish - he said 75000X. With that factor and a FDA allowable limit of 5 ppm, allowable PCB concentration in water would be:

$$\frac{5 \text{ ppm}}{75000} = 0.07 \text{ ppb (approx.)}$$

With using a safety factor (7), this brought the allowable water level to 0.01 ppb. Buckley stated his intent that the 0.01 ppb level not be imposed as a legal standard but be used as a working limit.

(c) As a check on the reasonableness of that level, he had calculated the effects of our discharge of 3#/day (their figure) on the Mississippi River at 10 year low flow of 50,000 cu ft/sec.

That also equals 0.01 ppb at the low flow (or about 1/3 of that at average flow of 175,000 cu ft/sec which would allow an additional safety factor).

(d) They (EPA) have no actual measurements of PCB levels in the Mississippi south of LaCrosse, Wis. and don't plan to do any water measurement work. Buckley appeared disappointed that we have no actual background level measurements in the Mississippi River. They will plan to do monitoring by fish concentration studies - if fish PCB concentrations are under 0.75 ppm, the ambient water is likely to be under 0.01 ppb.

(6) As to allowable discharge, Buckley said they were considering a policy of zero "knowing discharge" (a term new to us and meaning any discharge above the absolute background level). This would appear to allow continuation of our background discharge plus a minimum amount from production facilities. He said that, where we were presently down to 2-4 lbs/day from our production unit, we could probably do more work and get to 1-2 lbs/day and that (plus our background) would be our "zero knowing discharge". (Note, in a later telephone conversation with Bill Papageorge, Buckley confirmed the above and said he planned to circulate a private memo within EPA explaining what "knowing" and "non-knowing" discharges meant and that our present discharge from production facilities of 2-4 lbs/day appeared reasonable

(7) Scott Tucker questioned ability to measure at the 0.01 ppb level. Dr. Forziati stated that their Athens, Ga. and Cincinnati, Ohio Analytical Labs are capable of easily detecting 0.01 ppb of PCB's in environmental samples, but they would not feel confident enough in their numbers to attempt enforcement at this low of a level. He went on to state that, "they would be confident enough at the 0.1 ppb level to go to court." When presented with the results of our internal round robin study (PCB method accuracy and precision) at a level approximately 50 thousand times higher than the proposed 0.01 ppb number, he again stated their labs were achieving better results. He also indicated that they were making quantitative PCB measurements via mass spectography at the nanogram level.

(Notes from Scott Tucker - "Based upon our lab experience, I would say that Dr. Forziati is a little overly optimistic with regard to the accuracy and precision of current PCB methodology. Dr. Forziati extended an invitation to Monsanto to visit their facilities and it is currently planned to contact him and arrange a visit. The objective of the visit will be to get a better feeling for their PCB analytical capabilities and to establish direct contacts with their analytical people").

(8) Paul Hodges raised the question of mixing zones. Dr. Buckley had stated that full flow in the river was used in calculating dilutions in the river because there was no acute toxicity problem with fish around the outfall.

Hodges pointed out that, when the Federal report is released, the states will move to enact PCB water quality standards and discharge regulations. Some of them, specifically Illinois, use limited mixing zones to determine compliance with water quality standards (in Illinois the sample is taken 600 feet downstream from the outfall). Hodges requested that the Federal report spell out the principle of using full dilution in the river. Buckley agreed.

(9) As an aside after the meeting, Glenn Pratt (Surveillance, Chicago Regional EPA office) said that they were concerned about the levels of mercury being reported to Illinois since they were over 0.25#/day. He said he had written a letter saying they wanted to come to see us about mercury and about PCB's but had not sent the letter when the subject meeting was arranged. He would be contacting us in 2-3 weeks. Art Leisy had, earlier in the meeting, invited Pratt to inspect our PCB production unit and control facilities.

D. Summary and Conclusions

(1) We feel that Dr. Buckley is taking a reasonably realistic approach to control with his "knowing" and "non-knowing" discharge concept. However, we are dubious that:

(a) It will hold up as the document is reviewed within higher levels and other branches of EPA.

(b) The Illinois Pollution Control Board will be as understanding as is Buckley when they move to formulate water quality standards and discharge regulations for PCB's. We would expect the Board to move shortly after publication of the Federal Task Force document and announcement of standards and regulations by the Federal EPA.

(2) The 0.01 ppb water quality limitation is likely to hold up even though measurements at this level are not accurate and the Federal people have very limited data on PCB concentrations in rivers and lakes. It is also likely to become or to be used as a legal standard.

(3) Apparently, Buckley moved quickly in his calculations establishing the 0.01 ppb limitation from the FDA level of 5 ppm <u>in edible portions of fish</u> to magnification of 75000X from water to <u>lipid portions</u> of fish (see C-5 above). This provides an additional safety factor to the 7X in his calculations. This was not really challenged at the meeting.

(4) We don't know whether or not 0.01 ppb is exceeded either above or below our outfall in the Mississippi River. We have analyzed two large adult Mississippi River carp for PCB's. They contained apparent PCB concentrations of 1.4 ppm and 5.1 calculated on the whole fish basis. Using Dr. Buckley's concentration factor of 75,000 indicates that the river could contain 0.02 - 0.07 ppb at the point where these fish were collected (this assumes that the 75,000 factor could apply to whole fish - we are uncertain about this). Further fish/water monitoring is needed.

716683

Paul B. Hodges

Paul B. Hodges

/ms

MONSANTO'S PCB PROGRAM

W. B. PAPAGEORGE

Presented at ANSI Committee C-107
Meeting - September 14, 1971

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

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

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

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

PLAINTIFF'S EXHIBIT 1166

NEV 024473

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

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

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

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

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

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

We have talked with scientists at the Gulf-Breeze, Florida Commercial Fisheries Laboratory. They have conducted studies with crab and shrimp. This is the laboratory that did detect a build-up in crab and also the lethal effect on juvenile shrimp. Very, very low concentrations - 5 ppb in the water - do destroy juvenile shrimp.

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

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

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

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

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

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

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

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

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

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

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

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

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

We decided that we could and must continue to supply the transformer manufacturer, the capacitor manufacturer, and at that time closed heat transfer systems based primarily on our concept that fire resistance was important in heat transfer.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

In the St. Louis area, we have two types of tests going. One is the use of river water with its normal biota in it, in which we introduced ~~these~~ polychlorinated biphenyls and look for the disappearance rate. It is a very quick and rather unsophisticated type of study. The other type of test is the one that simulates those conditions which are apt to be found in a normal municipal sewage treatment plant. It's an aerobic test using an activated sludge from a St. Louis waste treatment plant. As a standard, we use a soft detergent because it is well known to other laboratories. What we are doing, really is using our expertize that we established back in the days when the hard versus soft detergent controversy was quite common. And we are using these soft detergents that do degrade as our controls and comparing the PCB's to these controls. The studies so far show that there are isomers within each of these mixtures that do degrade. The lower the chlorine level, the faster they disappear, the higher the chlorine level the more resistant they are. Which only confirms what many of us had suspected. We were not too surprised by this data.

I will attempt to summarize ... I think we can conclude that PCB's are in the environment. There is no question about it. Many of these PCB's are manmade and were introduced to the environment because of our lack of understanding of what these materials can dó to the environment. In this country Monsanto, as sole producer, has attempted to improve the situation by limiting the applications to which these materials are used. Studies today would indicate that these PCB's are not and cannot be classified as highly toxic. There is still a lot of information that is needed to help us determine the long term effect on human beings. We feel that the properties of these materials make them, at least as of today, the most suitable material for use in transformers, capacitors and heat transfer systems. We also believe that under proper conditions we can control the amount of these that do enter the environment to the point where the adverse effects are not great and that the benefits we derive far outweigh the minor adverse effects that we might notice. Now there are many of us in the transformer and capacitor application that have made tremendous strides in controling these materials. I suspect our objective is to further improve our ability to control this material. In my personal opinion the emotion that is now prevailing regarding PCB's is something that we must contend with. Whether we believe in it or not, there are many people that sincerely believe PCB's should be totally banned.

PCB YEARLY SALES TOTALS

WESTINGHOUSE - ALL LOCATIONS

ALL PCB PRODUCTS

1954 - 1977

<u>1954</u>

4,681,644 lbs

<u>1955</u>

4,346,780 lbs

<u>1956</u>

7,083,144 lbs

<u>1957</u>

8,367,139 lbs

<u>1958</u>

4,562,464 lbs

<u>1959</u>

5,648,271 lbs

<u>1960</u>

8,294,977 lbs

<u>1961</u>

6,591,368 lbs

<u>1962</u>

5,843,134 lbs

<u>1963</u>

7,517,688 lbs

C000429

ADM CC6972

PLAINTIFF'S EXHIBIT 150

256 81313

1964

7,492,896 lbs

1965

9,271,259 lbs

1966

8,027,542 lbs

1967

10,856,219 lbs

1968

10,316,063 lbs

1969

8,038,072 lbs

1970

9,071,230 lbs

1971

6,851,689 lbs

1972

6,740,904 lbs

1973

7,951,141 lbs

1974

9,080,243 lbs

1975

7,754,663 lbs

1976

5,456,521 lbs

1977

693,993 lbs

Total All Years: 170,539,344 lbs

ADM CG8974

258 C000431

IN THE CIRCUIT COURT OF THE CITY OF ST. LOUIS
STATE OF MISSOURI

GLENN BROWN, et al, Plaintiffs,	)	
vs.	)	Cause No. 862-00694
MONSANTO COMPANY, Defendant.	)	

AFFIDAVIT IN SUPPORT OF MOTION TO SEVER

THOMAS M. BISTLINE, being first duly sworn, on his oath states:

1. I am Litigation Counsel for Monsanto Company. I make this Affidavit in support of Monsanto Company's Motion to Sever.

2. The information set forth in this Affidavit was compiled at my direction from historical sales summaries of Monsanto Company which were prepared annually in the ordinary course of Monsanto Company's business. The matters set forth herein are true to the best of my knowledge, information, and belief.

3. Monsanto Company sold the following products containing polychlorinated biphenyls to Westinghouse Electric Corporation at its plant in Bloomington, Indiana:

1957-1967

Aroclor 1242
Aroclor 1286 (Less than 6,000 lb./yr.)
Aroclor 1254 (Less than 100 lb./yr.)

C000432

81316

1968-1970

Aroclor 1242
Aroclor 1232 (Less than 1,500 lb./yr.)
Aroclor 1254 (Less than 200 lb./yr.)
Transformer Inerteen PPO (Less than 1,000 lb./yr.)

1971-1977

Aroclor 1242
Aroclor 1016
Inerteen 54201 CF
Inerteen 54201 A9
Inerteen 54201 KJ
Capacitor 21
Capacitor Aroclor 1489 (Less than 100 lb.)

4. Monsanto Company sold the following products containing polychlorinated biphenyls to Westinghouse Electric Corporation at its plant in Muncie, Indiana:

1964-1970

Therminol FR-2

1971

Therminol FR-1

1972-1977

No sales

5. Monsanto Company sold the following products containing polychlorinated biphenyls to Westinghouse Electric Corporation at its plant in Cincinnati, Ohio:

1959-1968

Transformer Inerteen PPO

1969-1972

Transformer Inerteen PPO
Transformer Inerteen 100-42 (Less than 1,000 lb./yr.)

C000433

1973-1976

Inerteen 70-30

THOMAS M. BISTLINE

COUNTY OF ST. LOUIS)
) SS.
STATE OF MISSOURI)

26th Subscribed and sworn to before me, a Notary Public, this day of March, 1987.

Shirley J. Schomburg
Notary Public

SHIRLEY J. SCHOMBURG
NOTARY PUBLIC, STATE OF MISSOURI
MY COMMISSION EXPIRES 7/24/87
ST. LOUIS COUNTY

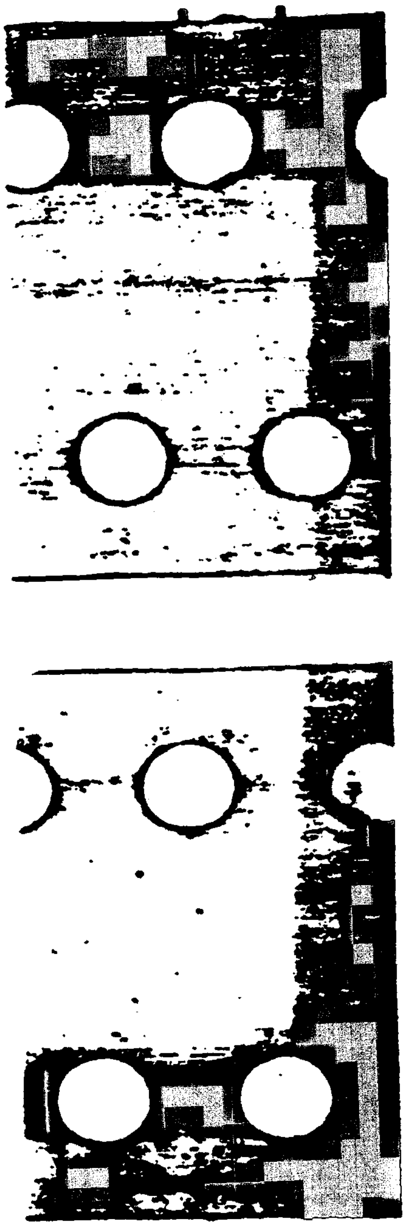
/38

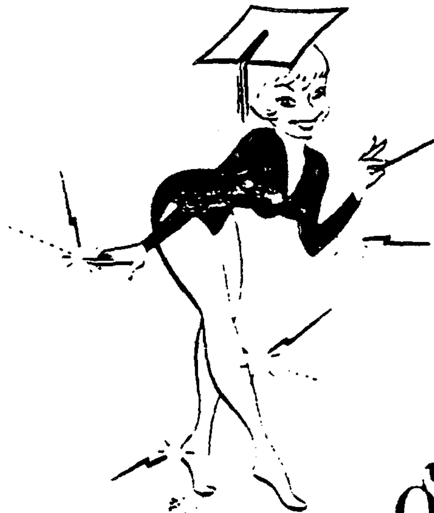
HUSCH, EPPENBERGER, DONOHUE,
CORNFELD & JENKINS

Charles E. Merrill - #27238
100 North Broadway-14th Floor
St. Louis, MO 63102
(314) 421-4800

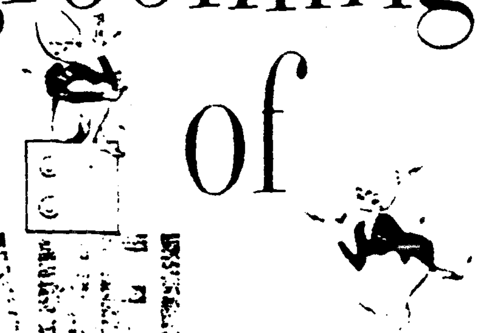
Attorneys for Defendant
Monsanto Company

C000434





care and grooming of ASKAREL TRANSFORMER fluid



Monsanto

. . . to help you be sure your Askarel liquid insulation is tip-top and to keep it in the best of operating health

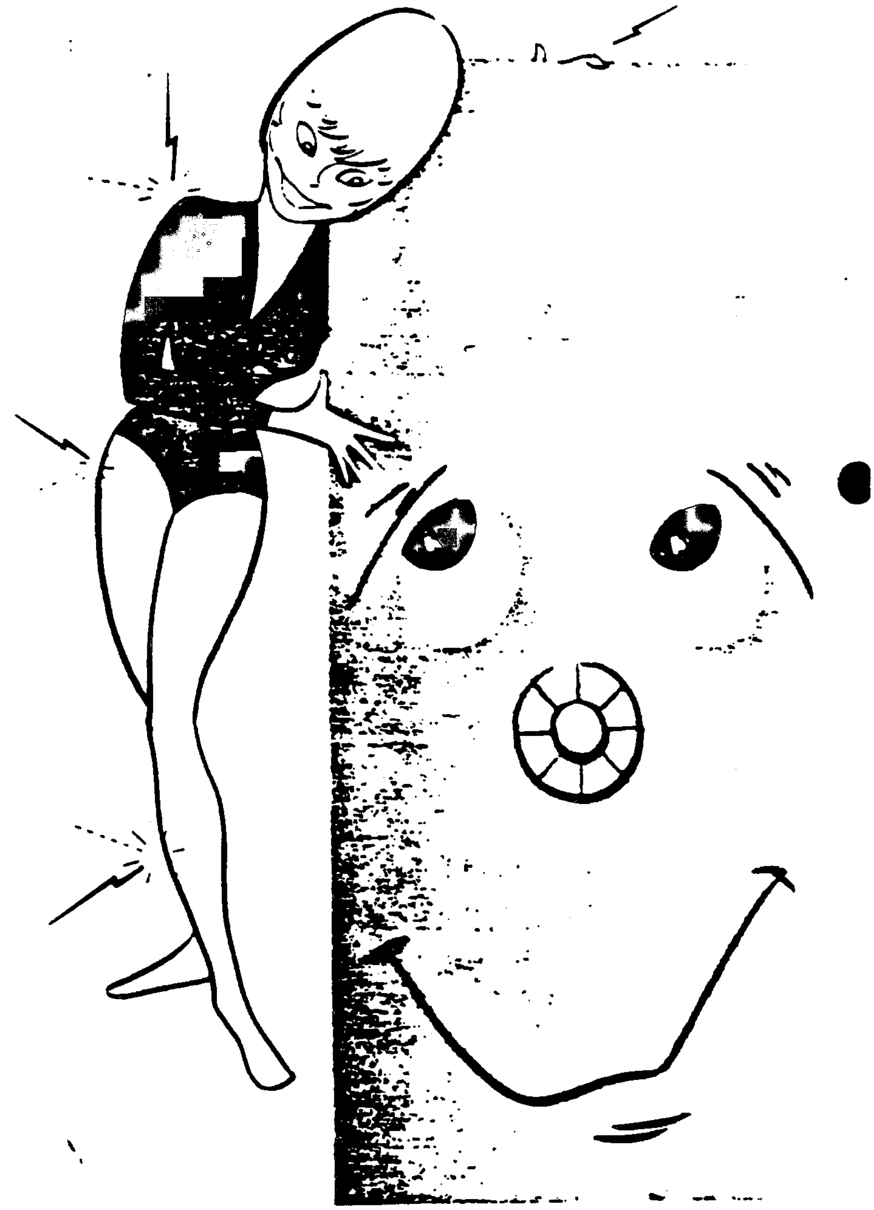
88392

ACM CCC940

PLAINTIFF'S EXHIBIT 524

YOUR "ASKAREL" TRANSFORMER SHOULD BE

your



ADM COC941

LET'S TALK ABOUT THE "liquid insulation" IN TRANSFORMERS

OILS—*that can burn*

There are quite a number of these. They are sold by oil companies: and these mineral oils are used in transformers where, if they catch fire, no great harm (besides the transformer itself) comes from the burning oil. If water gets into an oil-filled transformer, it tends to settle through the oil to the bottom. There are certain ways to check on the health of mineral oil insulation, too, but the "Check-points" are somewhat different than for askarel.

ASKARELS—*that cannot burn*

Although there are TWO *types* of askarel fluids (supplied under a number of brand names), actually they all have just one and the same basic ingredient: Monsanto's Aroclor® 1260. (If you want to know, Aroclor 1260 is hexachlorobiphenyl). And THIS is one of the world's best liquid insulations!

ADM 000942

WATER_PCB-SD0000072725

don't worry about "different kinds"

So, what are the two types? What's the difference? Simply this: they have different pour points — and — the tiny amount of "scavenger" chemical added to each is different. The Pyranol 1470 (General Electric) type has the lower pour point; it will still pour at 47° below (F.) zero. The Inerteen PPO (Westinghouse) type will pour down to 26° below (F.) zero. These two types each contain a tiny amount of a different additive; both additives are good and do their job. However, the additive in Pyranol type askarel can crystallize out a bit at 14° above (F.) zero. It does no harm; the crystals disappear after a while when the transformer warms up.

Other brand names, like Chlorextol (Allis Chalmers); Nonamol (Wagner Electric); Asbestol (Amertran Corp.); Saf-T-Kuhl (Kuhlman Electric) — are either one type or the other. Some manufacturers simply call their fluid by the common descriptive name: askarel. But, transformer manufacturers who supply askarel fluids have sound reasons for favoring their own type. So, it's best to stay with your particular brand.

However, since basically askarel is askarel, there will be no difference in the operation of your transformer if IN EMERGENCY you would interchange or even mix the two types!

But askarel is NOT oil — cannot, should not, must not be mixed with ordinary transformer oil. For one reason: the inside core materials used with mineral oil filled units get gooey with askarel. For another reason — over 2% of mineral oil mixed into askarel "clobbers" its fire resistance. For another reason — never mind! Don't *mix* or *interchange askarel* and *oil.*

"Askarel" liquid insulation is a very carefully-manufactured, highly pure, chemically made fluid. It does not vary in composition like the range of oils. AND . . . askarel is *heavier* than water. If water gets into askarel insulation, only a smidgeon (125 ppm) dissolves — the rest *floats on top.*

Askarel is one of the most fire-resistant, chemically-inert, heat-stable liquids ever developed! You can be sure of this: askarel does not deteriorate when exposed to air, heat, hot metal; it does not break down over long use to form conducting or corrosive chemicals; it does not sludge or oxidize. Askarel will remain perfectly stable year after year unless broken down by exposure to severe arcing — the kind that could set an oil transformer afire. The only real "enemy" of askarel is: contamination by water.

ACM CCC943

NOW LET'S TALK

year to year operation!

One of the most brain-y electrical engineers in the business once said: "The best 'maintenance' for askarel transformers is KEEP 'EM DRY, and leave them alone!"

This business of "keep 'em dry," however, whether your transformer is EITHER an oil-type or an askarel type, is the watchword! It takes some care. In fact, anything MECHANICALLY you can do to stop moist air breathing and condensation will be the best health insurance for your liquid filled transformer. Here are some of the questions that come up when you want to "keep 'em dry."

Is your transformer a **welded shell** or a gasket top?
(even the tightest gaskets can "breathe!")

Does your transformer run, stop; run, stop; run, stop?
(This hot-to-cold temperature cycling makes the breathing faster and harder!)

Is air around it mostly cold and dry or hot and moist?
(Wouldn't it be great for automobiles and transformers if there wasn't any such thing as condensation!)

When you have "breathing" and high humidity — you can cut back on check-ups if you fit the transformer with a drying device (all transformer makers offer these) or you can bleed dry nitrogen into the shell. Any mechanical steps you take to stop inside condensation will be double insurance on trouble-free operation.

Of course, if you are ordering a brand new transformer — either oil or askarel type — you can "design out" most of the moisture-entry points. Basically, you call for all-welded construction, including fins, pipes, and instrument connections AND a recessed gasket for the hand holes.

(If you or your electrical equipment supplier would like more complete details on tips to keep innards dry, we can send you a copy of: "Design Details For Moisture Protection of Liquid Insulation Transformers.")

So — you'll be happy to learn that preventing moisture contamination is the only major health insurance you need provide for your askarel insulation.

ACM 000944

CHECKING THE CHECKPOINTS

Now you are well on your way to being an "expert." Since you know that keeping tabs on MOISTURE is the *major* checkpoint on your askarel transformer, let's ask:

How do you keep tabs on moisture?

You do this by a periodic test of the askarel's dielectric strength.

Do not bother to check — or if you do — do not be misled or disturbed by relatively high power factor . . . or even a drop in volume resistivity.

(If you want to know why, you can read the fine print on the following page.)

The DIELECTRIC STRENGTH of the askarel is your major clue to the "health" (i.e. dryness) of your askarel transformer. Besides taking a good look at a sample of your askarel — dielectric strength is the only "test" you need actually run!

Here's why: the dielectric strength of askarel is sensitive to moisture; *not sensitive* to other ordinary contaminants (like metal dust, salts, dirt, etc.). The dielectric strength is also hurt by severe arcing, but you'll know that arcing is the culprit if the askarel has gotten noticeably black or has particles of sooty carbon floating in it. Unless you've had severe arcing (lightning, accidental overload, back surge, etc.), the dielectric strength is your "moisture indicator."

New askarel has a minimum dielectric strength of 35 KV at 25°C.; a maximum moisture content of 30 ppm. If you check the dielectric strength periodically, find that it is rapidly decreasing — this is your "clue" to moisture pick-up, arcing, or both. When the moisture content rises to 100-120 ppm (or over) — the dielectric strength will drop to 20 KV or less. That's your clue!

INSPECT FOR WATER CONDENSATION IN THE SHELL, AND "REFINE" THE ASKAREL.

As the operator, *you* will have to judge *how often* you want to check up on your askarel insulation. Steadily running, well-sealed askarel transformers have run as long as 25 years on the initial charge of askarel — and the dielectric strength still checked out at above 30 KV. HOWEVER, if the dielectric strength drifts downward to 25-20 KV at 25°C. — then it is time to "clean-up" the liquid insulation and to get rid of any water accumulation in the shell, too.

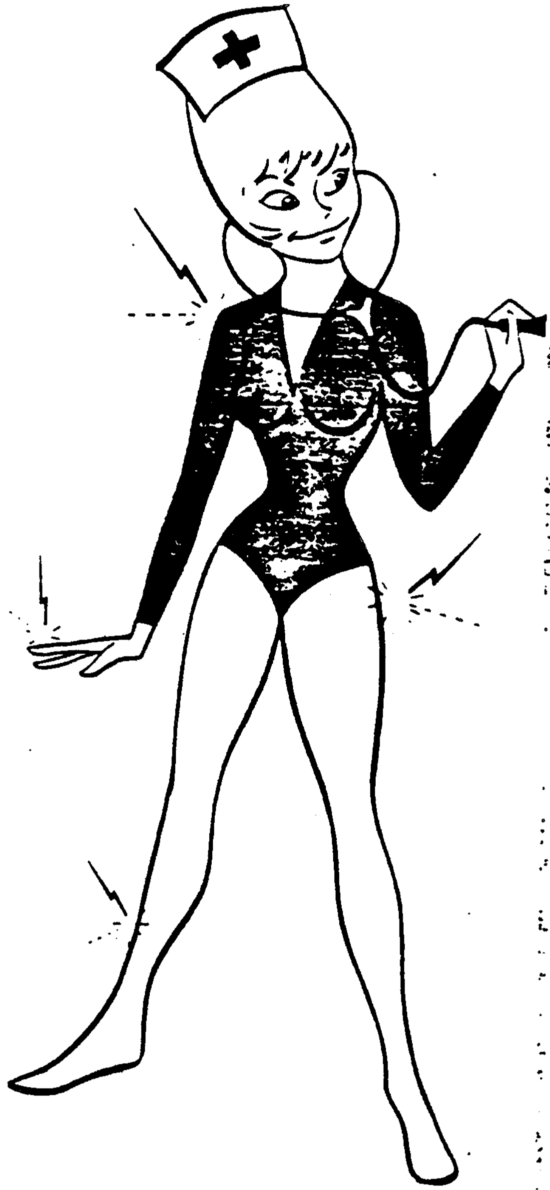
This askarel clean up is relatively simple; the askarel need NOT be discarded. BUT MOST IMPORTANT . . . if the dielectric strength drops *rapidly* over a *short period* of time, this shows rapid pick-up of water (or arcing).

When you take your sample for check-up — *be sure* to take it carefully (so it represents the *surface*) and handle the sample properly (so it doesn't *pick up* moisture in the sampling).

ACM CCC945

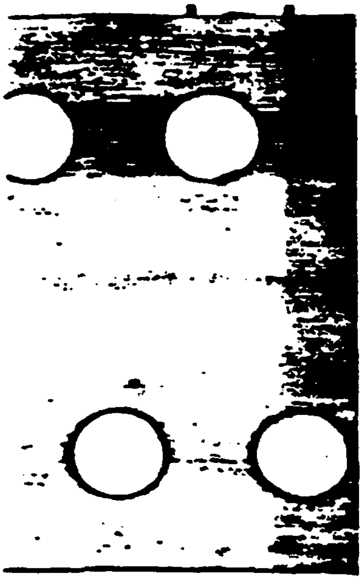
WATER_PCB-SD0000072728

How



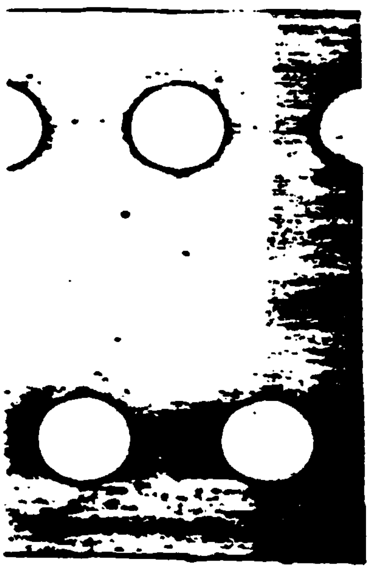
ADM 000940

to check test* your as



You'll be able to "take the pulse" of your askarel insulation with the following five simple rapid tests. Three are simply "inspection-by-eye!" You can do these check-ups yourself or have the tests run by a local transformer service shop.

1 **COLOR** by inspection — New askarel is a clear, faint-yellow liquid. After long-term use, the color will gradually intensify to brown. Any color change, such as taking on a green, red or blue cast, indicates extraction. If you find a distinct *change in color*, the complete range of electrical characteristics should be checked to learn if the extracted color is the tell-tale for contamination.

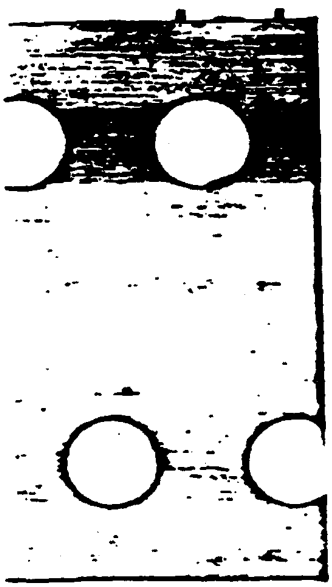


2 **CLARITY** by inspection — New askarel is clear and should remain clear in service. Development of turbidity or cloudiness indicates contamination from water, insulation particles, metallic dust or dirt. Cloudiness or turbidity calls for a complete analysis. The exception to this would be cloudiness in a cold sample of *PYRANOL 1470*. This type askarel contains a scavenger additive which will "come out" of solution when cold around 15°F. and cause white turbidity and perhaps show salt-like deposits on the transformer shell. If this is noticed, heat the askarel sample to 150-200°F. for several hours and agitate. Upon heating, the Pyranol's additive will redissolve, as it will in a warm transformer.

3 **BLACK COLOR AND SMALL CARBON PARTICLES** by inspection — If the color of the sample is black, and especially if suspended carbon particles can be seen, this shows that the askarel has arced and should be discarded. You can also detect exposure to strong arcing *chemically*, with indicator paper. Simply dip a piece of moist blue litmus paper into the askarel. If the blue litmus turns red, there is excess acidity from arcing beyond the limit absorbed by the "scavenger" additive.

ACM 000947

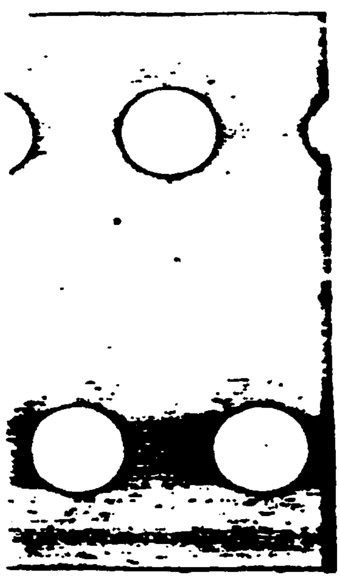
skarel insulation!



4 **DIELECTRIC STRENGTH** by ASTM D901, D877. The dielectric strength is the most important; and it is a simple test to make. The dielectric strength of new askarel is 35 KV at 25°C. minimum. This value should not be allowed to fall below 25-20 KV. Contaminants which may have pronounced effect on the power factor and volume resistivity *usually do not lower askarel's dielectric strength*. Reduced dielectric strength almost always shows exposure to strong arcing or moisture contamination.

5 **MOISTURE** – The moisture content of new askarel is 30 parts per million maximum. The moisture *saturation* level is about 125 ppm at ordinary temperatures. When the moisture content approaches 125 ppm saturation level, the dielectric strength goes down. The moisture content of askarel should not be allowed to rise over 70 ppm; it should be held as near as possible to 30 ppm.

NOTE: If your sample shows 30-35 KV dielectric strength, you need not check for moisture. However, if you do check moisture, use the Karl Fisher Method, ASTM D-1533.



IF ANY OF THESE FIVE CHECK-UPS APPEAR ABNORMAL, CONTACT YOUR TRANSFORMER MANUFACTURER FOR COMPLETE ANALYSIS.

These simple tests will show you the condition of your askarel insulation, but only *indirectly* the condition of your transformer. They can be relied upon when the sample is carefully taken so as not to "miss" water globules floating on the surface or adhering to the shell in the air space over the insulation. So, if you have taken mechanical precautions against moisture entry into your askarel transformers and can "Keep 'em dry!" these tests will be your assurance that, between checks, you can "Forget 'em."

*The American Institute of Electrical Engineers has published a comprehensive and informative guide titled "Proposed Guide for Maintenance of Transformer Askarel," AIEE No. 76 December 1958. This guide describes properties to be inspected and the ASTM method to be used.

Monsanto completely analyzes each production lot of transformer askarel by these methods prior to shipment. However, these official tests are **NOT ESSENTIAL** to the user of askarel transformers. When a complete analysis is required in a special case, the user should request it from the transformer maker who in turn can call on Monsanto if needed.

ACM CCC948

GROOMING ASKAREL FOR RE-USE

If strong arcing has blackened askarel, throw it away; it costs less to replace arced insulation than to reclaim it. If there's been no arcing, but a low dielectric test shows moisture contamination, you'll find it is quite easy to refine the askarel back to good operating dielectric strength. Simply run the insulation through a dry, absorbent filter.

Most operators prefer a portable refining apparatus, such as a plate press, fitted with a dolly, (available from Sparkler, Mundelein, Ill.); or the earthen cartridge filter type, (available from Industrial Filter Corp., Lebanon, Ind.). Filter paper liners for the plate press are available from Carl Schleicher & Schuell Co., Keane, N.H.

Any flexible hoses and gaskets on the refining equipment should be lined with or made of materials that will not be softened by contact with askarel fluid. (Silicone or Teflon materials are suitable).

If you use a filter press, before refining it is advisable to oven dry the filter paper at 100°C. for a half hour to remove all moisture. If the askarel to be refined contains excessive moisture, circulate it hot (55-60°C.) through the filter fitted with the paper liners only first. Then, refit press with dry paper and load it with the absorbent earth.

The earth refining process is simple:

1. SPREAD DRY EARTH EVENLY OVER THE FILTER SURFACE.

Fine-mesh Attapulgus clay or Fullers earth, dried and activated by heating for 12 hours at 250°C. immediately prior to use, is highly efficient. The amount of earth used should be 0.1 to 0.2 per cent by weight of the askarel (askarel weighs about 13 pounds per gallon).

To deposit the earth evenly, stir one-third of the earth with a small portion of askarel in a clean container. Pump the mixture through the filter and follow with two more one-third portions.

2. PUMP THE HEATED ASKAREL FROM TRANSFORMER THROUGH FILTER.

Circulate askarel taken from near the top of the transformer, pass it hot (55-60°C.) through the filter and feed back through the bottom transformer outlet.

3. CONTINUE CIRCULATING THROUGH THE FILTER UNTIL ASKAREL IS CLEAR.

When the askarel is clear use the simple tests described earlier to check for restored dielectric strength.

4. CHECK THE TRANSFORMER AFTER REFINING.

After refining the askarel, the overall power factor and insulation resistance should closely approximate the values it would show with new askarel fluid.

If the overall power factor is more than 30-35 per cent (at 20°C. and 60 cycles) it is considered POOR and it is advisable to run a complete analysis of the entire insulation system.

ADM 000949

POWER FACTOR & VOLUME RESISTIVITY

High power factor and low volume resistivity in transformer mineral oils are commonly regarded as "danger signals" that the oil has deteriorated and broken down chemically.

This is NOT true of askarel liquid insulation.

New, unused askarel shows these electrical values:

Power Factor:	0.05-0.2%	@ 60 cycles 20°C.
	about 1-2.0%	@ 60 cycles 100°C.

Volume Resistivity: 100-1000 x 10^9 ohm-cm @ 100°C., 500V., DC., 0.1" gap

Used askarel from SATISFACTORILY OPERATING TRANSFORMERS normally and frequently shows

Power Factor: 20 to 80% @ 60 cycles 100°C.

Volume Resistivity: about 25 x 10^9 ohm-cm @ 100°C., 500 V., DC., 0.1" gap

This relatively *high* power factor and relatively low volume resistivity of used askarel ARE TO BE EXPECTED. Even at these levels, the askarel's dielectric strength is STILL in the 30-35 KV range.

The reason is simple: askarel, unlike "oil," is a relatively polar liquid. The volume resistivity is sensitive to traces of conductive contaminants. However, even in the presence of large amounts of contaminants, the volume resistivity does not seem to fall below 10 x 10^9 (ohm-cm). Yet the dielectric strength remains high, because intrinsically askarel remains a non-conductor.

> To quote from Insulation Magazine, December 1961
>
> DIELECTRIC LOSS YARDSTICKS
>
> by John C. Botts, Manager Insulation Development Section, and Graham Lee Moses, Manager Services Engineering, Westinghouse Electric Corp., East Pittsburgh, Pa.
>
> "Dielectric loss is a good comparative evaluation for some characteristics of insulation. It may be used for comparing similar samples of the same materials. It may not be used as an overall evaluation for comparing different materials." i.e. "oils" and askarels

Power factor is not an important criteria of askarel insulation efficiency IN A PROPERLY CONSTRUCTED TRANSFORMER.

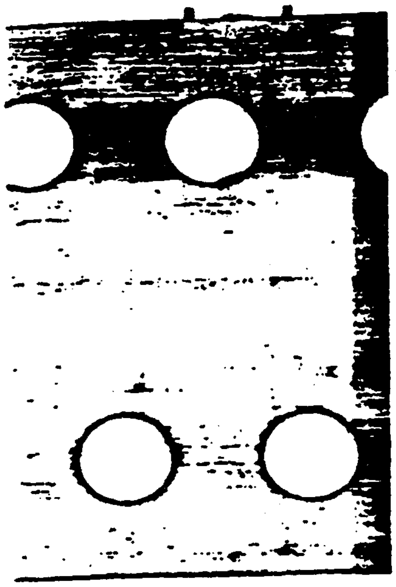
However — if improper construction materials or unpredictable foreign contaminants enter the system — high power factor in the absence of moisture in the shell can indicate improper construction.

ACM 000950

WATER_PCB-SD0000072733

sampling your as

NOW . . . since you know that the DIELECTRIC STRENGTH is the most important checkpoint, and that (except for arcing) MOISTURE is the villain that saps dielectric strength . . . you want to make sure that your SAMPLE truly represents your askarel insulation.



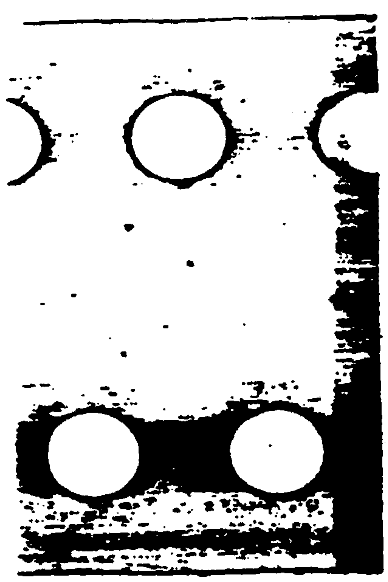
TAKE YOUR SAMPLE AS CLOSE TO THE TOP OF THE LIQUID SURFACE AS POSSIBLE!

(Many large askarel transformers have a built-in sampling tube near the surface for convenient sampling. If additional sampling tube connections are contrived on to valves for easier sampling, make the tubes of clean glass, stainless steel, aluminum or tin for rigid types; and silicone or Teflon tubing for flexible types.)

Water *floats* on askarel. If there is any water in your transformer, it may collect in little puddles ON TOP of the askarel. AND, therefore, more water will probably be dissolved in the askarel near the top, where it contacts any collected condensation.

If you find low dielectric strength and high moisture in the askarel, you will probably want to thoroughly dry out the shell and take some mechanical steps to keep it dry.

When you take your askarel sample for testing, take the same precautions (but no more) that you take when sampling mineral oil:



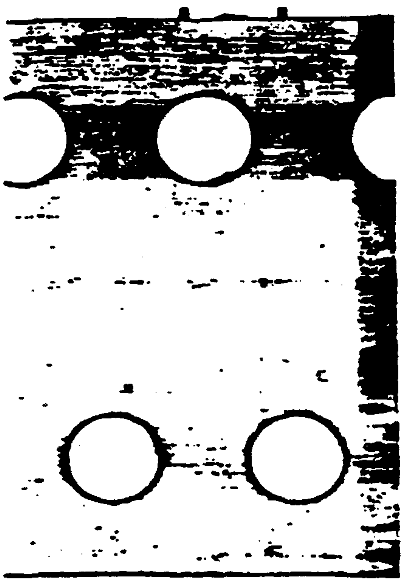
1. Select a dry day. Do not sample insulation on a warm, moist day when humidity exceeds 75%, and
2. Make sure that the askarel is at least as warm as the surrounding air. (Cold liquids can condense moisture from humid air.)
3. NEW containers for fluid sample
   Your sample container should be a new and previously **unused** small mouth pint glass bottle fitted with a Bakelite screw cap fitted with an aluminum or tin bottle cap liner. Make sure that the new bottle does not stand around open to collect dust or moisture. Rinse the sample bottle and cap lining two or three times with askarel from the transformer; then fill it. When sample will be tested promptly, a clear glass bottle can be used. If sample is to be stored indefinitely, use an amber glass bottle or wrap clear glass with aluminum foil.

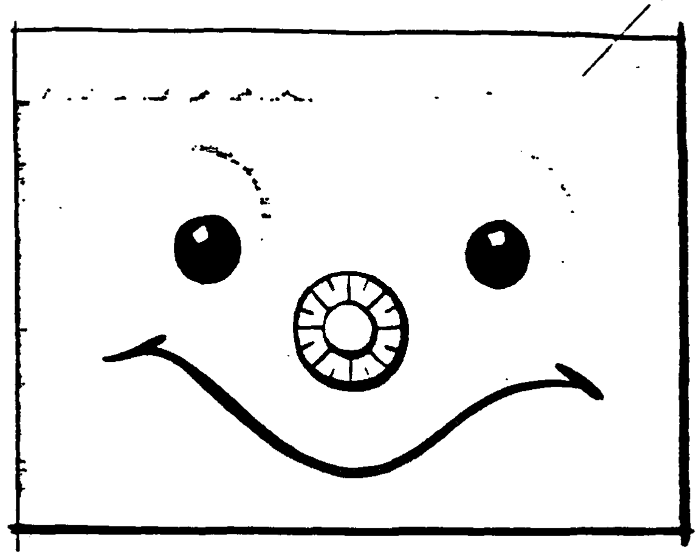
   Whenever a sample is to be shipped to the transformer manufacturer (or to Monsanto) for complete analysis, the container must be a 5-pint amber glass bottle. For your convenience, various transformer manufacturers and Monsanto will send you the sample bottle filled with new askarel; you simply empty out the new askarel and re-fill bottle with your sample.

ADM 000951

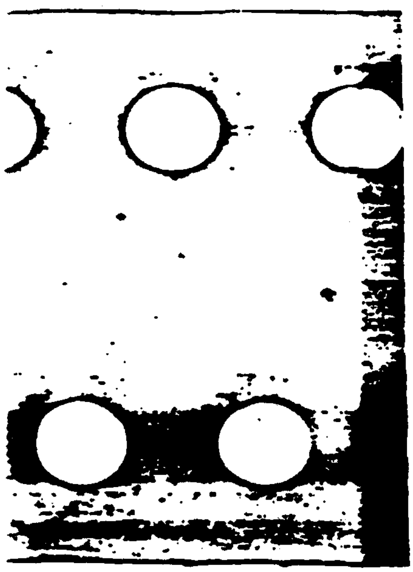
WATER_PCB-SD0000072734

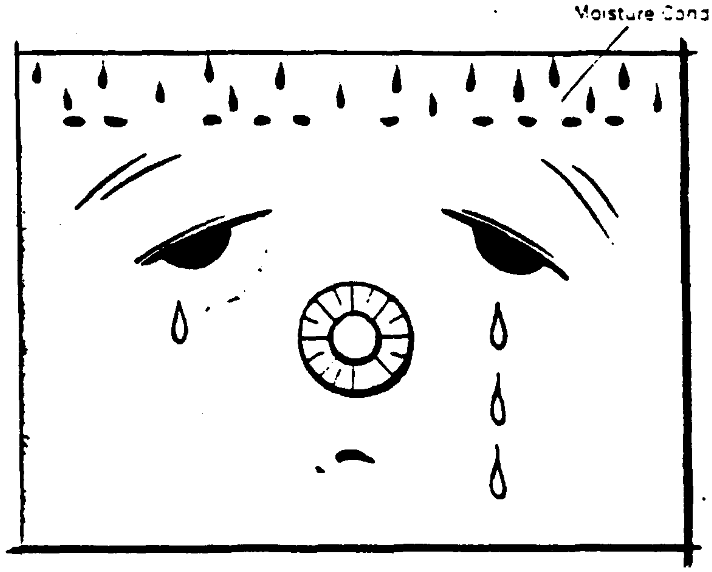
karel.....





Dielectric Strength: 30-35 KV
Moisture Content: 30-50 ppm





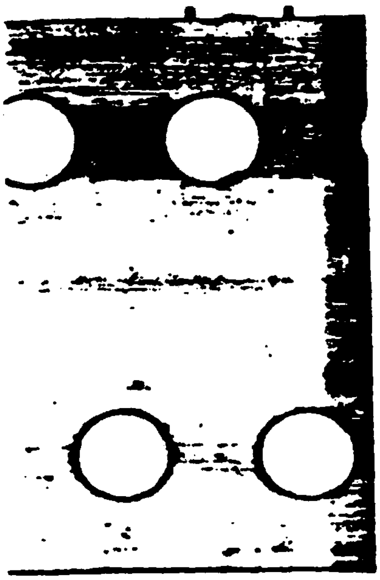
Dielectric Strength: 25-20 KV or less
Moisture Content: 125 ppm

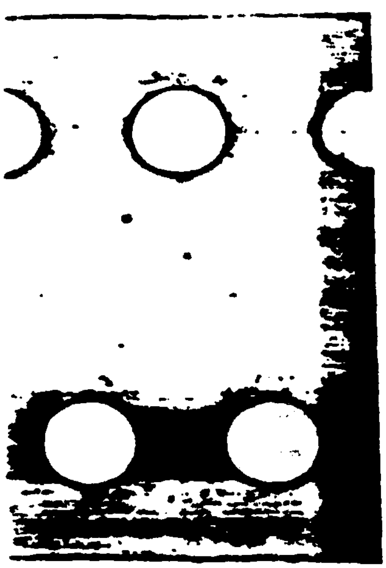
ADM COC952

THAT'S THE STORY:

keep 'em dry... let 'em alone!

But you might want these storage and handling "tips" to make you a complete transformer askarel expert.





STORE NEW ASKAREL IN A CLEAN DRY PLACE

Keep the 5, 30, or 55 gallon drums dry; turn them over on their sides to keep water off the drum head. (It can be sucked in by the drum "breathing.")

CLEAN UP SPILLAGE

Askarel can, if left standing, attack paint, rubber, or plastics. Absorb it from floors with sawdust, sweep, and then wipe dry. Use a rag wet with mineral spirits if you want to make sure it's all cleaned away.

TAKE ORDINARY PERSONAL CARE

Transformer askarel has been made, handled and used for over 30 years without causing toxic or other ill effects. Askarel can be handled in the same manner as insulating mineral oil. As with mineral oil, there may be some people allergic to askarel, so prolonged skin contact should be avoided where possible.

When accidentally spilled or splashed on the skin, askarel does not present an acute hazard nor will it cause serious skin irritation. Simply wash it off with soap and water. If work clothes become impregnated with askarel, they should be removed and washed.

Eye contact may cause temporarily painful irritation but NO PERMANENT DAMAGE to the tissues or sight. Flush the eye with large amounts of water. A drop of castor oil may be put in the eye. As with all eye first-aid, refer to a physician who will treat the eye with an ointment.

Ordinary, infrequent exposure to askarel vapors will not cause any ill effects. However, prolonged exposure to strong vapors should be avoided. If hot fluid is to be handled in a closed or confined area, provide ordinary exhaust ventilation. Harmful concentrations of askarel vapors are easily detectable by the smarting of the nose or eyes.

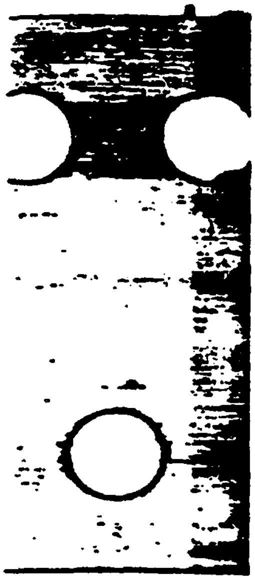
Should hot askarel (above 100°C.) have to be handled in the open in a confined\unventilated area — it is advisable to wear organic canister-type masks as supplied by Mine Safety Pittsburgh, Pa.

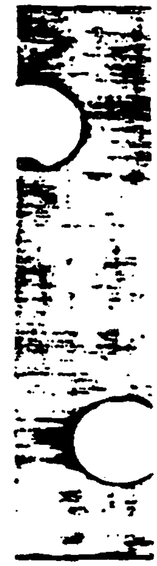
ADM 000953

WATER_PCB-SD0000072736

(AS FAR AS EQUIPMENT CAN BE!)

best friend!

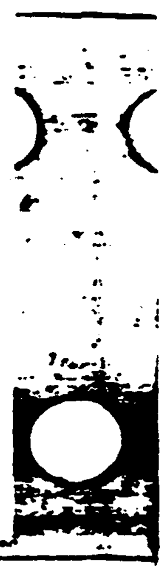




Since "askarel" type transformers were first made in 1930, few pieces of electrical equipment have equalled these "juice controllers" in trouble-free service. The name "askarel" applies to the liquid insulation that fills askarel type transformers. And "askarel" is a general name for a unique kind of chemical classified as a halogenated hydrocarbon. But, don't let this chemical jargon bother you one bit. After you read this little pamphlet, you'll be an EXPERT on operating askarel transformers; you'll know all about this wonderful liquid — askarel insulation — because it's all very simple.

however!

Since many engineers and maintenance operators work with BOTH askarel and transformer "oils," you will want to remember that askarel is *different* from mineral oil . . . and you'll want to know the simple ways to "check up" on the health of your askarel transformer.



That's the reason for this pamphlet. First, to tell you that your askarel transformer, in addition to being FIRESAFE, can be the most trouble-free piece of equipment you operate. Second, to give you the few simple facts that will make you an expert on the "whys" and "wherefores" of the easy maintenance. Knowing the facts given on the following pages, you will keep your askarel (and transformer) operating at trouble-free, top performance, year, after year, after year.*

We own one that has been operating as faithfully as a heart beat for 28 years!

Monsanto also supplies:

Pydraul AC	All synthetic fire-resistant compressor lubricant.
Pydraul	All synthetic fire-resistant hydraulic fluids.
Thermal Fluid	Fire resistant, non-vaporizing heat transfer fluid.
Coolanol	Dielectric coolants for high power electronic circuits.
Fluid OS-59	Dielectric for high frequency power transformers.

Monsanto

MONSANTO CHEMICAL COMPANY
Aviation and Special Fluids Department
Organic Chemicals Division
St. Louis 66, Missouri

Askarel transformer fluids can be ordered directly from any one of these Monsanto sales service centers

Atlanta
Boston
Chicago
Cincinnati
Cleveland
Detroit
Houston
Los Angeles
Minneapolis
New York
Pittsburgh
St. Louis
San Francisco
Seattle
Syracuse
Wilmington

ACM 000955

when you want **FIRE SAFETY**

RELIABILITY

MINIMUM MAINTENANCE

specify

ASKAREL-TYPE

transformers

Monsanto

BB376

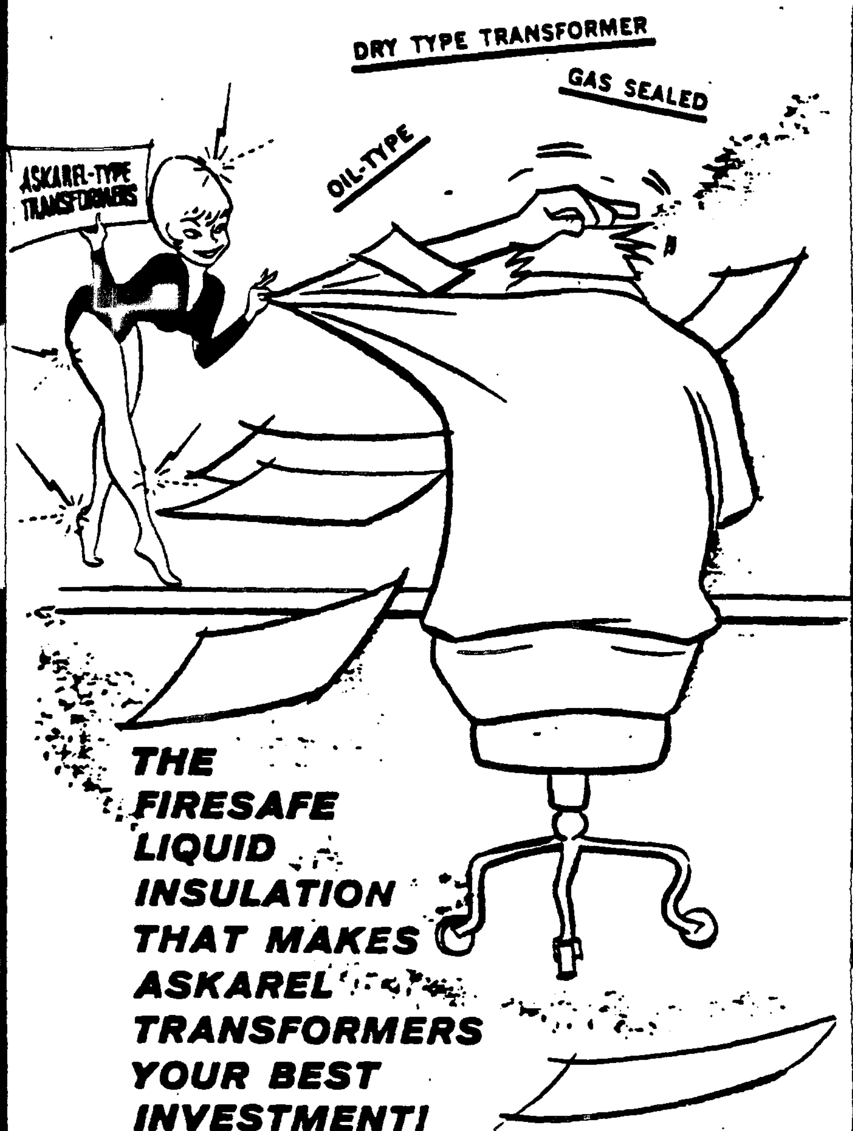
ADM 000926

Sometimes a "must" ...but often preferred by electrical engineers who know!

Askarel-type transformers have served industry, institutions, commercial housing, the military, electric utility companies and electric railroads safely, reliably, economically . . . for over 30 years.* They are supplied — built to exact specification — by all major electrical manufacturers. But only a relatively few engineers and electrical architects have dug into chemistry to learn WHY the askarel transformer is so fire safe, so reliable in operation, requires so little maintenance. Not too many electro-technologists know that askarel transformers (even when they cost a little more compared KV for KV with mineral oil transformers) can actually save money on the installation as a whole, and save money over years of use!

Askarel transformers are quite unique. And the "trade-secret" is *the fluid*. If you would like to join the "inner circle" of astute electrical architects and engineers who for the past 30 years have known just how, where, and why an askarel transformer should be installed . . . just check the facts (and factors) in the following few pages.

*Monsanto has manufactured and supplied askarel fluids since the askarel-type transformer was first introduced. Askarel-type transformers were first made by General Electric in 1930. The askarel fluid insulation was supplied under the trade mark Pyranol. Other electrical manufacturers soon developed askarel units using various trade marks for the askarel fluid, such as Inerteen (Westinghouse); Chlorextol (Allis-Chalmers); Noflamol (Wagner Electric); Asbestol (Amertran Corp.); Saf-T-Kuhl (Kuhlman Electric). Many manufacturers, however, simply use the generic name, askarel.



THE FIRESAFE LIQUID INSULATION THAT MAKES ASKAREL TRANSFORMERS YOUR BEST INVESTMENT!

Mineral-oil transformers can catch fire. Dry, open-type transformers can start a fire. Gas sealed transformers require pressure and their cost is high! But askarel transformers quietly handle their load, under surge and drop, delivering a steady power flow year after year.

The secret of this quiet, fire safe service is the askarel fluid . . . the finest liquid insulation that chemistry has developed.

Askarel fluid cannot be ignited by a blow torch! In addition, this dielectric liquid will not oxidize or sludge; will not attack or corrode metals; remains chemically stable when subjected indefinitely to temperatures at least as high as 150° C.

The unique values of the askarel-type transformers all stem from the chemical, electrical, and physical properties of the askarel fluids.

ADM C00928

5 CHECKPOINTS FOR CHOOSING ASKAREL-TYPE TRANSFORMERS

- fire safety
- economy
- dependability
- easy maintenance
- low noise level

FIRE SAFETY

Askarel fluids, unlike mineral oil, cannot be ignited . . . even by the heaviest arc, such as might accidentally be caused by lightning. Equally important, askarel transformers cannot carry or add burning oil hazards to fires that may start from other causes. The fluid does not deteriorate when exposed to heat, hot metal, nor does it decompose over long use to accumulate electrically unstable contaminants. Since askarel fluid won't burn, and gases formed by arcing do not support combustion, the use of askarel transformers eliminates the possibility of fire and secondary explosion.

Fire safe askarel transformers are the choice of far-sighted engineers for hospitals, hotels, schools, institutions, underground networks, military bases, mines, shopping centers, electrical railroad systems, rocket sites.

ECONOMY

Askarel type transformers cost about the same or very slightly more than open dry types, cost much less than sealed dry (gas) transformers. While askarel units cost up to 15% more than equal-capacity mineral oil units, this initial cost is only *part* of the economic picture: askarel transformers can usually be installed without the costly vaults, fire walls, or sprinkler systems required by safety codes for mineral oil units. Further savings accrue in the design of the power transmission system. Since askarel units can be placed in congested, closed areas without danger to workers, askarel units can be *close to the point of power* usage. (See Performance Comparison Table) In addition, fire insurance rates are usually lower when askarel units are used.

DEPENDABILITY

A properly designed and installed askarel transformer will give trouble-free service for a minimum of 30 years. Since their introduction in 1930, the manufacturers report finding the overall failure rate to be less than 0.5% for all units *under test and service conditions*. The Edison Electric Institute's last report (1956-1958) on their member utilities publishes the failure rate for askarel transformers as *0.13 per hundred banks per year!* Even these rare reported failures are found to be due to improper sealing that allowed moisture to enter. Modern design requirements for askarel transformer seals eliminates possible failure.

EASY MAINTENANCE

Askarel transformers are easiest to maintain! Most of the askarel transformers in service today have received little or no maintenance in decades of operation. Even the accumulation of relatively large amounts of non-ionic contaminants has little effect upon askarel's excellent dielectric strength. The only contamination that seriously affects the askarel's dielectric strength is water. Proper sealing banishes this source of contamination. Five simple periodic tests (three of them, visual) will check out the askarel insulation. Monsanto and the transformer manufacturers furnish guidance literature on this easy-to-follow maintenance. Unlike oil type transformers, with askarel units there is no chance of fluid oxidation or sludge formation, and therefore, less need for replacing the fluid.

LOW NOISE LEVEL

Askarel transformers operate quietly! Where open dry type transformers in office buildings, hospitals, schools and institutions require a sound suppressing room or locating far from point of use, askarel units are so quiet that no sound problem arises. Wherever a fire safe transformer is warranted, the askarel type unit operates at a significantly lower noise level than dry types and offers a significantly superior impulse rating over the dry type.

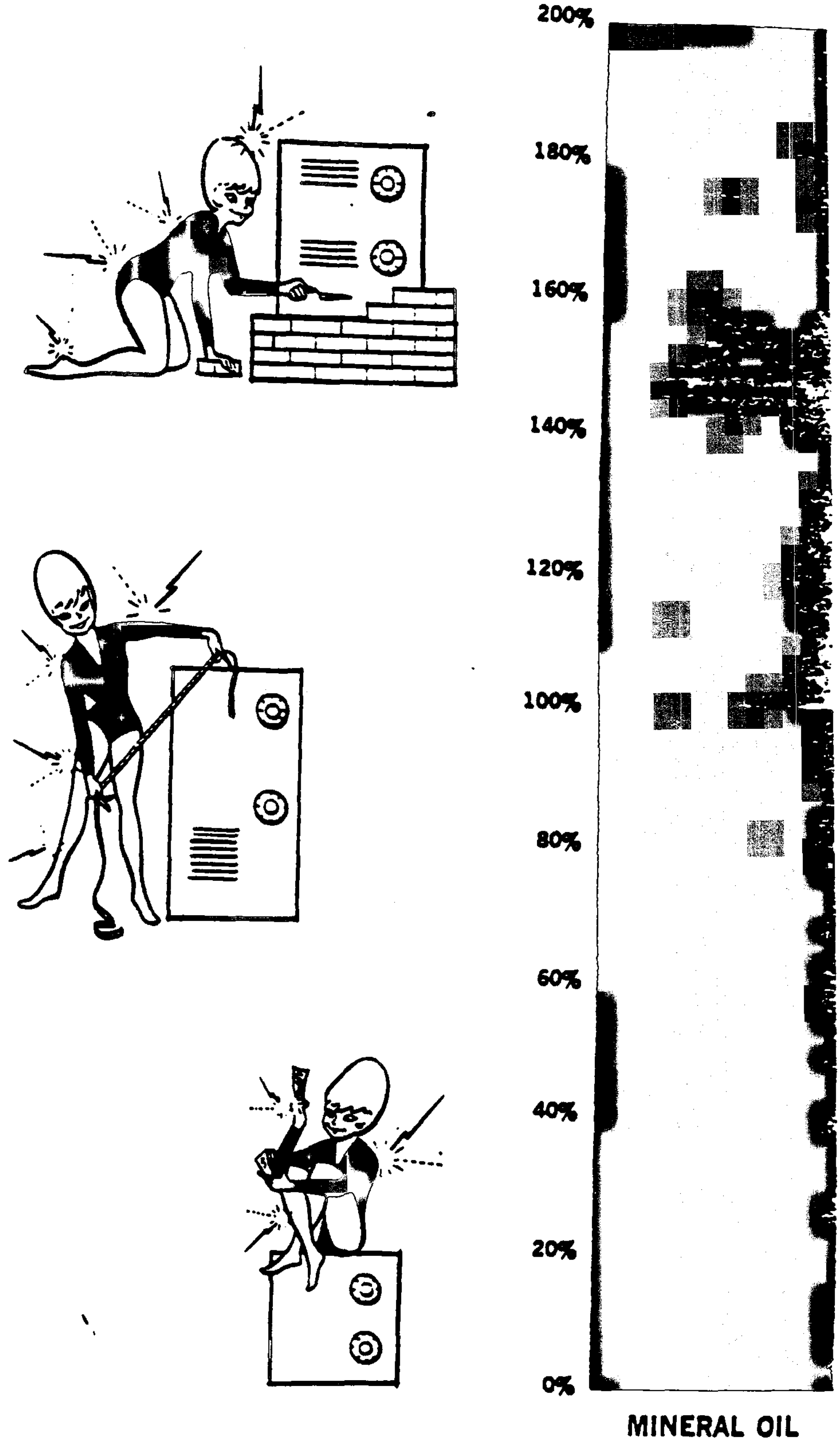
Askarel-Type Transformers Offer Five Important Advantages Over Other Type Transformers

Eliminate Fire Hazard	Proven Dependability
More Economical to Install and Operate	Less Maintenance, Easier Upkeep
	More Quiet Operation

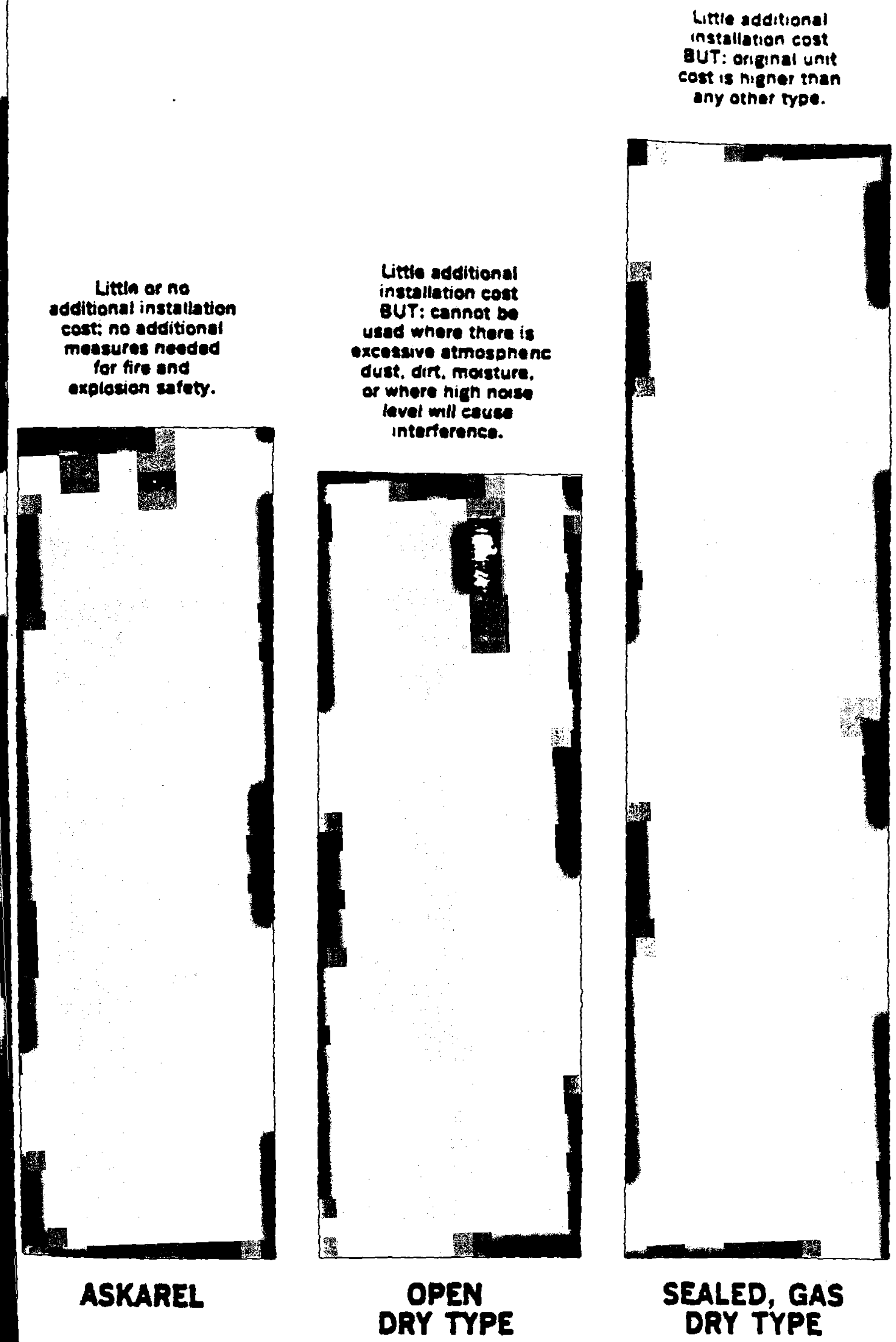
CHECK DEPENDABILITY

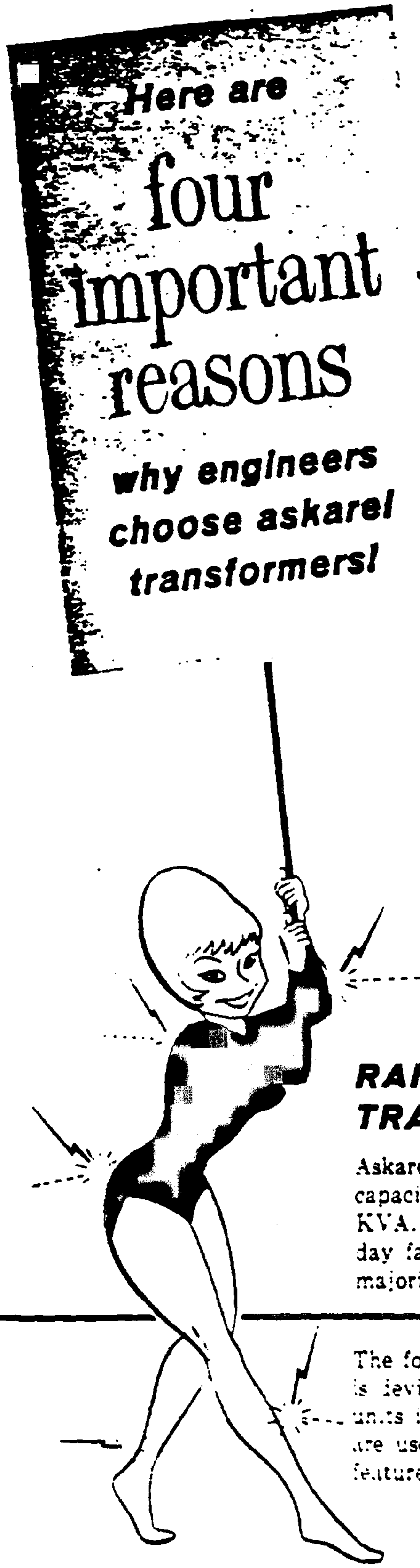
ADM 000930

BASE UNIT



ST & ADDITIONAL EXPENSE COMPARISON





SAFETY!

Freedom from fire and secondary explosion.

USE FLEXIBILITY!

Tightly sealed askarel transformers can be used in atmospheres contaminated with dust, lint, corrosive vapors and moisture.

DEPENDABILITY!

Askarel fluid does not oxidize or sludge.

LOW NOISE LEVEL!

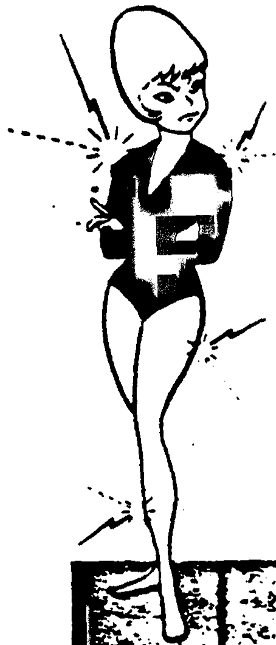
Askarel transformers can be installed close to power supply outlets without causing objectionable noise.

FOUR IMPORTANT ADVANTAGES FOR INDOOR USE, AND FOR OUTDOOR INSTALLATIONS, TOO!

RANGE OF ASKAREL TRANSFORMERS

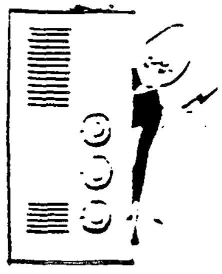
Askarel transformers are available in all capacities, in size ratings exceeding 15,000 KVA. Most askarel transformers in use today fall in the 25 to 2,000 KVA range, the majority ranging between 100 and 1,000 KVA.

The following transformer comparison chart is devised to show the economics of askarel units in the 25 to 2,000 KVA range, which are used primarily for their superior safety features.



compare the performance advantages...

	ASKAREL	OPEN DRY TYPE	MINERAL OIL TYPE	CLOSED GAS SEALED
Transmission & Service Costs	NORMAL RANGE	HIGH	HIGH	HIGH
Supplemental Installation Costs	NEGLIGIBLE	HIGH [illegible] damping [illegible] shielding from [illegible]tmosphere, contamination & [illegible] is needed)	HIGH (when used indoors, requires vaults, fire walls, sprinklers and noise damping)	NEGLI-GIBLE
Operational Dependability	EXCELLENT	Affected by corrosive atmosphere, moisture, water flooding, dirt and dust.	GOOD	EXCEL-LENT
[illegible]	[illegible] OR NONE	CONSIDERABLE	FAIR — due to oil's tendency to degrade in service.	NONE
[illegible]	VERY LOW	HIGH	MEDIUM	HIGH
[illegible]	[illegible]	[illegible]	[illegible]	LIMITED
Safety from Fire	EXCELLENT AND COMPLETE	FAIR — can cause ignition	POOR — can cause ignition and propagate fire	FAIR



HERE'S WHERE AN ASKAREL TRANSFORMER IS YOUR BEST CHOICE

INDUSTRIAL LOAD CENTERS

In factory areas where maximum safety from fire is required and atmosphere contamination may prevail.

UTILITY NETWORKS

Where location underground or above the surface requires protection from water and other elements, and where maximum safety against fire is needed.

INSTITUTIONS AND OFFICE BUILDINGS

In schools, hospitals, government buildings, hotels, airports, shopping centers, sport stadiums, etc., where maximum safety and lowest noise levels are required.

WATER FRONTS AND BOAT DOCKS

Where fire and weather resistance are the prime requirements.

ELECTRIC RAILROAD SYSTEMS

Transformers on electric trains and throughout the system require maximum safety features and assurance against faulty operation due to weather exposure.

MISSILE SITES

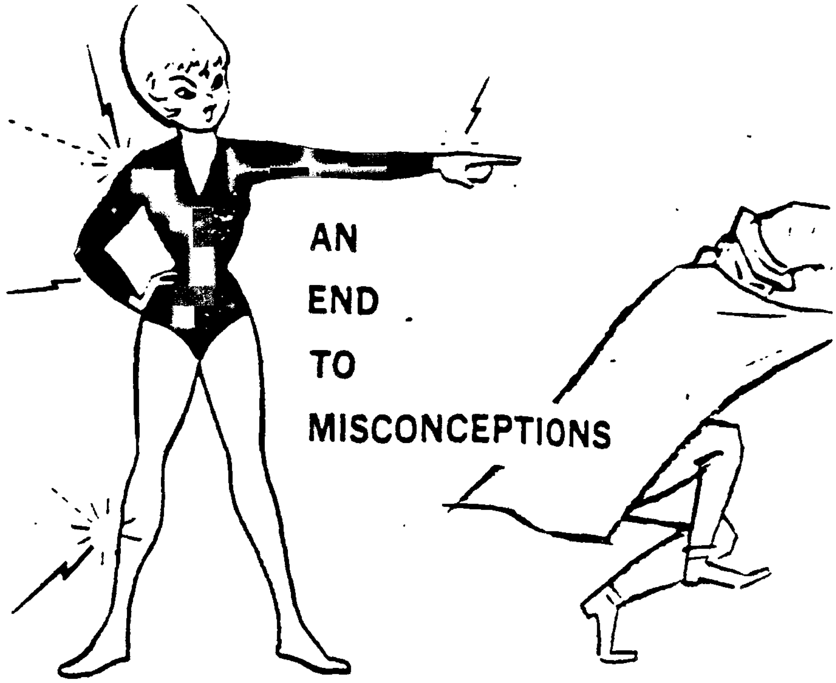
Where surface and underground structures demand reliable performance and complete protection from weather, fire and explosion.

CONGESTED OUTDOOR INSTALLATIONS

Where safety from fire and explosion are required for crews working close to transformer units.

ACM CCC935

WATER_PCB-SD0000072748



AN END TO MISCONCEPTIONS

Some engineers who have had no opportunity to acquire actual operating experience with askarel transformers and who have received little information about them sometimes harbor mistaken opinions that are contrary to the facts. Here are the three misconceptions that, however infrequent, have been occasionally encountered:

"Askarel fluids are 'poisonous.'" The facts: askarel fluids have been manufactured, handled, and used for over 30 years without encountering toxic or ill-effects. It is well accepted by transformer ma[illegible] and utilities that askarel fluids are not hazardous when [illegible]ndled under standards of normal good housekeeping and t[illegible] ordinary personal precautions used with other inert indu[illegible]ial materials.

"Askarel transformers can explode." The facts: there is no instance, in the whole use history of askarel units, of secondary explosion because gases formed by arcing are non-explosive and non-combustible ! Even under strong arcing, the possibility of primary explosion in a properly designed and escape-vented askarel transformer is very remote. Modern design features, such as cable connection seals, completely protect askarel transformers from possible explosion.

"Askarel fluids run a high power factor." The facts: Engineers experienced with askarel transformers know that it is *normal* for an askarel transformer to show a higher power factor than a mineral oil unit.

It is technically unsound to compare the insulating efficiency of oil and askarel by simply measuring power factor.
A high power factor in mineral oil is cause for alarm: BUT it is normal for askarel to show a power factor as high as 20 to 80 per cent at 100°C, 60 cycles (2-8% at 20°C) with absolutely no danger of efficiency loss or impairing normal operation.

NOTE: The most significant and reliable measurement of transformer askarel is its DIELECTRIC STRENGTH. Askarel will maintain its high dielectric strength unless there is significant moisture contamination or breakdown of the fluid from an unusually severe exposure to arc.

ACM CCC93c

Askarel fluids (both Inerteen and Pyranol type) are manufactured by Monsanto and shipped promptly to users anywhere in the world. Askarel transformer fluids, unlike naturally formed oils, are manufactured and quality-checked for consistency and shipped with an extreme care that is given to few industrial materials. This means askarel fluids can be depended upon to be uniform and provide the optimum service of any liquid insulation.

Operating with askarel units is the safest, easiest, often lowest cost way to distribute electrical power. Monsanto will be happy to send you a copy of the pamphlet "Care and Grooming of Askarel Transformer Fluid" or request a copy from the transformer manufacturer of your choice. And if you do . . . ASK HIM to check the facts on askarel transformers described on the preceding pages.

Monsanto

MONSANTO CHEMICAL COMPANY
A... ...n and Special Fluids Department
Organic Chemicals Division
St. Louis 66, Missouri

Askarel transformer fluids can be ordered directly from any one of these Monsanto sales service centers

Atlanta
Boston
Chicago
Cincinnati
Cleveland
Detroit
Houston
Los Angeles
Minneapolis
New York
Pittsburgh
St. Louis
San Francisco
Seattle
Syracuse
Wilmington

ACM CCC937

... LITHO IN U.S.A.