UNITED STATES DISTRICT COURT
DISTRICT OF MAINE

ORIGINAL

K. MURDOCK MURRAY, SR., et al,
Plaintiffs,
vs.
BATH IRON WORKS CORPORATION,
and
EUGENE O. DAUPHIN, JR.,
Defendants.

Civil Action
Docket No 93-188-P-DMC

D E P O S I T I O N

Pursuant to due notice, the deposition of RAYMOND D. HARBISON, Ph.D., was taken by the Plaintiffs before Pamela A. Chorlog, C.M., Registered Professional Reporter and Notary Public, State of Florida at Large, at the Progress Center, One Progress Boulevard, Alachua, Florida, commencing at 9:05 a.m., on Thursday, May 19, 1994.

APPEARANCES:

MARCIA CLEVELAND, ESQUIRE (VIA TELEPHONE), McTeague, Higbee, Libner, McAdam, Case & Watson, 4 Union Park, Topsham, Maine 04086, Counsel for Plaintiffs.

ARLYN H. WEEKS, ESQUIRE, Conley, Haley & O'Neil, Post Office Box 651, Bath, Maine 04530, Counsel for Defendant Bath Iron Works Corporation.

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WITNESS:

EXHIBITS

STIPULATION

It is stipulated and agreed by and between counsel for the respective parties as follows:

1. All objections, except as to form of the question, be reserved until hearing on the same or until trial.

(Whereupon, Plaintiff's Exhibit Number 164 was marked for identification.)

Thereupon, RAYMOND D. HARBISON, Ph.D., being first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MS. CLEVELAND:

Q. Okay, Dr. Harbison. I would like to begin by asking you some questions about your curriculum vitae. First of all, I understand that the copy which is being introduced into evidence -- or which has been marked for introduction into evidence as Exhibit 164 is your most current copy of your CV?

A. Yes, ma'am.

Q. I have a copy which is 36 pages long, which I understand from our prior conversation may not be up to date.

A. That's correct.

Q. Just to make sure I know what's been added, could you tell me what are the last items in each of the different categories beginning with your summary of experience? Has anything been added to that before the Academy of Toxicological Sciences, Board of Directors?

A. The last one I have is 1993 to present,

Academy of Toxicological Sciences, Board of Directors.

Q. So I can assume that my copy is reasonably complete with respect to that. Has there been anything added to Industrial Experience, which is on my Pages 6 and 7?

A. I don't know what you have. I don't think so, but I can't see what you have.

Q. Is there anything very recent, any very recent industrial experience? The first one I have is "Occidental Oil - Worker safety in oil shale production."

A. Correct.

Q. And the last one is "Diversitech/Gen Corporation - Evaluation of mortality among PCB-exposed tire and plastic fabricators."

A. Correct.

Q. Moving on to Grant Support, is there anything new after Toxicology Support, DER, 1991 to 1993?

A. I don't have anything after that.

Q. Anything after the Methamphetamine-Induced Toxicity for NIDA?

A. No.

Q. Turning to your Teaching Experience, is

there any addition to that? The first item I have is Medical Toxicology at Vanderbilt Medical Center and the last item I have is listed Health Implications/Aspects of Chemical Issues, Superfund University Training Institute, East Tennessee State University.

A. That's correct.

Q. Okay. And any additions to the Continuing Education? I have seven items on the copy I've got.

A. So do I.

Q. And have there been any additions to your list of publications? I have 113.

A. I have 132.

Q. Does that include the books and monographs and reports?

A. I don't think so.

Q. Okay. Then could you immediately after the deposition just provide me with an updated list of your publications?

MS. WEEKS: I can get it to you by tomorrow morning, Marcia.

MS. CLEVELAND: Okay, good. Thanks, Arlyn.

Q. Okay, Dr. Harbison. Let me ask you some

questions about your background. Obviously I'm not going to go through every item on your CV, but there are areas that I would like to question you about that are particularly relevant to this case. First of all, your background is in toxicology and pharmacology. Correct?

A. Correct.

Q. And what board certifications do you hold?

A. Board certification in toxicology.

Q. And what is the board that does that certification?

A. The Academy of Toxicological Sciences.

Q. Okay. And that is not a medical doctor's certifying board. Am I correct about that?

A. It certifies medical doctors as well as Ph.D.'s.

Q. But the certification is not one that is a medical specialty exclusively. Is that correct?

A. That is correct.

Q. So you don't have to be a medical doctor to qualify for that board certification?

A. You do not.

Q. And am I correct that you are not an M.D., doctor?

A. That is correct.

Q. And you are not licensed to practice medicine anywhere?

A. That is correct.

Q. Do you have any other board certifications?

A. I do not.

Q. Is there a board certification in epidemiology?

A. I don't know the answer to that.

Q. Could you please summarize for me the research that you have done during the last five years? And that would reach back to 1989.

A. I have evaluated the effects of chemicals and their mechanisms of action to elucidate both the harmful effects as well as the beneficial effects of chemicals on the living system, and have evaluated specifically the effects of various chlorinated hydrocarbons and other chemicals as to the way that they affect cells and the differences between the effects in various cells and in various species.

Q. Okay. Now, could you be more specific and tell me what chemicals you have studied? You've said chlorinated hydrocarbons. Why don't you begin by telling me specifically which substances in that

category you have done research on.

A. Okay. I'm not sure I'm going to be able to remember them all. You want the last five years?

Q. Yes.

A. You want me just to name them?

Q. Yes.

A. Piperonyl butoxide, halothane, bromobenzene, carbon tetrachloride, morphaline, PCBs, ethylene dibromide, phenylpropanolamine, polycyclic aromatic hydrocarbons, methanesulfonate. Those are the ones that I could easily identify.

Q. Okay. Have you published the results of the research in those substances which you've just referred to?

A. Some of it, yes.

Q. And have those been peer-reviewed publications?

A. They have.

Q. When you send me the copy of your updated CV, could you indicate which publications in the last five years you have just referred to in answering this question; in other words, which publications are peer-reviewed reports of your research on these substances?

A. Sure.

Q. Have you done research on other categories of chemicals in the last five years?

A. Yes.

Q. Could you tell us what those are?

A. Dioxin, dibenzofurans, metals, other chlorinated hydrocarbons, like trichloroethylene, perchloroethylene, methylene chloride. Those would be the ones I could recall.

Q. And again if you could indicate which publications on your list refer to that research, I would appreciate it.

A. Wait a minute. I'm sorry, I didn't understand that question then. I thought you were asking for studies that have been done but haven't been published as peer-reviewed --

Q. No, I'm sorry. I thought that originally we were talking about chlorinated hydrocarbons and then I wanted to ask you about other types of chemicals or minerals that you have studied.

A. Well, I didn't understand it that way. I thought you wanted to know all chemicals, so I didn't answer that first question with just chlorinated hydrocarbons.

Q. Well, have we now covered all the substances that you've done research on or is there

something I have missed?

A. Those are all the ones I can reasonably recall.

Q. And you mentioned metals. What metals?

A. Lead, cadmium, selenium (selenium). Those would be the ones I could recall.

Q. Okay. And just to clarify what I want with your CV, could you indicate on your CV which articles in the last five years are reports of that research that you have just referred to and also indicate which of those articles are peer reviewed? I'm trying to move on to the next phase of this fairly quickly.

A. Okay, but I don't think we're communicating. What you just asked me is metals that I have studied. They have not resulted in peer-reviewed publications.

Q. I understand that, and I'm just trying to ask you to indicate which ones have on your list of publications by indicating it on your list of publications. I understand that, that not all of these resulted in peer-reviewed reports and I just need to know which ones did.

A. Okay.

Q. Now, when you said you did research on

them, were you directing that research or were you spending time in the lab yourself?

A. It would have been both.

Q. How much of your time was spent actually in the laboratory directly involved in the research?

A. Well, it will vary from week to week, year to year, month to month. I would say it may vary from 10 percent to 20 percent to 25 percent.

Q. And that is the percentage of research time spent in the lab?

A. Yes, ma'am.

Q. And does that mean that the balance of research time is administrative?

A. No. It means it would be writing, reviewing results, summarizing results, statistically analyzing results, writing publications. It would be spent in those activities.

Q. Okay. Now, of that research what percentage was research in animal species?

A. I would estimate that probably about 80 percent.

Q. And what percentage was in human tissue in vitro?

A. I'm not sure I could give you a

percentage for that. I couldn't. It's a small percentage, but I couldn't identify what it is.

Q. Was any of that research clinical studies of humans?

A. Yes.

Q. What was the clinical study?

A. It was a study of metabolism of various amino acids and other protein materials in humans looking for the rate of excretion or the pattern of excretion of these materials from the human; also looking at blood levels of lead and other chemicals. That would be the general areas.

Q. Okay. And what was the purpose of this research, and in particular the amino acid study, the metabolism of amino acids?

A. To look at the efficacy of the administration of certain materials as to their bioavailability, that is, how much was taken up by the body, and how much of that material would be excreted, either unchanged or excreted as metabolites.

Q. Was this a pharmacological study or a toxicological study?

A. It would have been both.

Q. But was it a study designed to evaluate

the effectiveness of a drug or a would-be drug?

A. Yes.

Q. Have you done any epidemiology in the last five years?

A. Yes.

Q. And what was that?

A. An evaluation of the morbidity and mortality of workers at a facility using PCBs and also fabricating plastic materials.

Q. And were the results of that study published?

A. The study hasn't finished yet.

Q. Are there any drafts of the results?

A. There are not at the present time.

Q. Do you have a date by which you intend to publish an article on that study?

A. I would hope that by the end of the summer we would have a draft of that.

Q. And is that a draft that you would then be submitting for publication?

A. Yes, ma'am.

MS. CLEVELAND: Arlyn, could you make a note that when that draft becomes available I would like to see it, see a copy of it?

MS. WEEKS: So noted.

Q. Now, in reviewing the copy of your CV that I have, I notice that you serve on 13 different boards at the present time. Is that accurate?

A. I don't know. I would have to look.

Q. Why don't you take a minute.

A. I see five.

Q. Could you tell me what those five are?

A. The Board of Directors of the Academy of Toxicological Sciences; the Advisory Board of Earth 2020, University of Virginia; the Science Advisory Board Consultant for the Environmental Protection Agency; the Board of Advisors of the Environmental Institute; and the editorial board of Teratogenicity, Mutagenicity and Carcinogenicity.

Q. So in that list -- maybe I misunderstood the Summary of Experience. The other items in that list under Summary of Experience which you indicate are to the present include serving on the faculty of educational institutions?

A. Correct.

Q. Let me just ask you about the five boards you are on now. How much time per week do you devote to the work of those boards all together?

A. I don't serve or spend time on a weekly basis on those boards.

Q. How much do you spend a month or a year?
A. Probably a day a year.
Q. Do you attend all the meetings of those boards?
A. Not all of them.
Q. For example, the editorial board of the publication about mutagenicity, how often does that board meet?
A. It doesn't meet annually. What I do is I receive materials, provide peer review, and most of that is done through the mail.
Q. How much of your time is spent peer reviewing works for that publication or any other publications?
A. It would vary.
Q. Between what and what?
A. Well, it would depend on the month, it would depend on the year. Maybe as much as 10 percent of my time sometimes and it may be as little as a few percent.
Q. On the other four boards which are not editorial boards, do you spend any time other than meetings on the work associated with those boards?
A. Yes.
Q. How much of your time is devoted to

those?

A. Well, again it would depend on the year, it would depend on the month. It depends on what the board is doing. It may be a few percent or it may be no percent depending on what the board is doing at what time.

Q. Now, your teaching experience, how much time do you spend teaching and preparing courses for teaching?

A. I would estimate that -- again that varies. It depends on the semester. It's probably about 10 percent, 15 percent.

Q. So 10 to 15 percent when you are teaching, that is, during a semester when the course is being offered?

A. That's correct.

Q. What is your position at the University of Florida?

A. I am a professor of pathology, toxicology and pharmacology and Director of the Laboratory for Environmental and Human Toxicology.

Q. Now, when you take all those duties -- well, first of all, let's take the director of the center. How much of your time is spent doing administrative work related to the center?

A. It's a laboratory. The laboratory administration is minimal, a few percent. Most of it I spend in research, and that's the percentages we've talked about.

Q. So the administration, does that overlap with the figure you gave me for research?

A. Yes, it would.

Q. Now, I think when I was asking you about research, I was asking for a breakdown of how you spend your research time, but I don't believe I asked you the total percentage of your time you spend on research. What would that total be?

A. I would estimate that it's probably about 30 percent. It will vary, 30, 40 percent.

Q. Now, when you say research, do you include in that the work that you do for industry which you have designated as industrial experience on your CV?

A. I do not.

Q. So that's a separate category, right? Industrial experience is a separate category from research?

A. Well, it may be. Some research may occur as a result of industrial work and some of it may not be, so there may be some research in there.

Q. What percentage of your time is spent doing industrial work which doesn't come under the heading of research?

A. This is any kind of --

Q. Any kind of industrial contract that you haven't already accounted for.

A. But for research?

Q. No. Any industrial experience that is not research, that you did not include in that figure of your time spent on research.

A. Okay, I'm not sure I can do it that way. I can tell you how much time I spend in the practice of toxicology. That would include environmental, industrial, forensic, it would include all of those areas. I could give you a figure for that.

Q. Okay, do that. Then I can ask you some more questions.

A. Okay. That's probably 40 percent, maybe as much as 50 percent depending on the time.

Q. And of that 50 percent how much of that 50 percent is spent testifying either in administrative proceedings or in court proceedings?

A. It varies. I would estimate between 15, 30 percent.

Q. Is that 30 percent of 50 percent or 30

percent of the total?

A. No, that would be 30 percent of my time.

Q. And what is the nature of the other industrial work that you do that isn't testifying and isn't strictly research?

A. It would be the practice of toxicology, providing technical assistance to the United States Environmental Protection Agency for hazardous waste site investigation, for evaluating the impact of chemical releases, chemical spills, providing technical assistance to emergency rooms and on-scene coordinators and field investigation teams, managing medical surveillance programs. Those would be the general areas.

Q. Now I have one question about publications before I forget it. Isn't it true, Dr. Harbison, that in listing the authors of the publication, the author listed first is the one who spent the most time on the research and the second is the second-most and so on and so forth?

A. No.

Q. How would you describe the system for deciding who is listed first?

A. Well, I don't know that there is a system. I can certainly tell you how it's done in

my lab.

Q. Okay. How is it done in your lab?

A. It depends on who initiated the work, who is responsible for the work. It may or may not be relevant to the time spent. It depends on whether it's a student or a postdoctoral fellow or another faculty person. All of those factors would be considered in who ends up being the first name.

Q. And if it's a postdoctoral candidate or a student, would they tend to be further down the list?

A. No.

Q. So in other words, there are situations in which they would come first?

A. Yes.

Q. And what would those situations be?

A. If it's their dissertation research or if it is their postdoctoral training research project, they would probably most likely be first.

Q. In your list of publications I notice there are many where you are the second listed. There are many where you are not, but there are many, especially toward the latter part of your list of publications, where you are second. Does that mean that your role was a supervisory one?

A. No.

Q. What was your role? For example, let me give you the ones that I have. I've got Number 113, Roberts, S.M., R.D. Harbison and R.C. James, "Ethanol inhibition of cocaine esteratic metabolism," The Toxicologist, and that's the last one I've got on my list. What was the situation there?

A. What was the situation?

Q. Yes. Why is Roberts first, you second and James third?

A. Well, probably because Roberts did the work in the lab and I did some of the work, but not all of the work, and he may have written it and I may have ultimately reviewed it and approved it. I'm not really sure what the mechanism was for that particular paper.

Q. Okay. Now I would like to ask you some questions about the sources first for your personal income and then I will focus on the sources of your center's income. What percentage of your income comes from research?

A. It varies from year to year. It may range as high as 50 percent or sometimes greater and it may be lesser depending on what's going on in a

particular year or a particular month.

Q. And what's the low end? You said it may range up to 50 percent or more. What's the lower end of the range?

A. I would say probably 30 percent.

Q. What percentage comes from work for industry or government contracts that are not research?

A. I'm sorry, I don't understand that question.

Q. Well, I think before we discussed a few different categories of your work. One is research, one is industrial or environmental work which is not research, and the third one was testifying in proceedings. And I'm trying to get a breakdown of income from those three basic areas of your work. So what would be the contracts with industry that are not included in the research figure you just gave me?

A. No, but remember, I said it's not a contract with industry. It is a practice of toxicology.

Q. But I assume you get paid for that at some point.

A. Sure.

Q. And I'm just trying to get at what percentage of your income gets paid for, as you characterize it, the practice of toxicology?

A. The practice of toxicology would probably range between 30 percent and 40 percent.

Q. And what percentage of your income comes from testifying in administrative or court proceedings and providing support for such proceedings?

A. I would estimate that ranges from 15 to 20 to 30.

Q. Now let me turn to the center that you administer. What percentage of its income --

A. Excuse me, it's not a center, it's a laboratory.

Q. Okay, a laboratory. There's no entity larger than the laboratory?

A. No, ma'am.

Q. What percentage of the laboratory's income comes from research grants other than the State of Florida?

A. I would estimate that it's probably 80 percent.

Q. And does the State of Florida contribute some support to the laboratory?

A. It does.
Q. Is that the remaining 20 percent?
A. Yes, ma'am.
Q. And there's no other sources we haven't covered. Am I right about that?
A. I'm sorry, I'm not understanding the question. I only gave you one source.
Q. One source was research and you said that was about 80 percent, and I said is the balance from the State of Florida?
A. No, no. I thought your question was what support did the State of Florida provide.
Q. Right.
A. Okay. The answer to that is about 20 percent.
Q. And I'm just trying to establish, and this may seem obvious, but you said about 20 percent, and 20 plus 80 is 100 percent. Are there any sources of funding for your laboratory other than the two we have just discussed?
A. I'm sorry, I'm not understanding. I've only discussed one.
Q. You discussed research and the State of Florida. I first asked you what percentage of your income came from research other than from the State

of Florida and you said 80 percent.

A. Correct.

Q. Then I asked you how much came from the State of Florida and you said about 20 percent.

A. Correct.

Q. And I'm just asking you, is there another source of funding for your laboratory that we haven't covered?

A. Yes.

Q. What's that?

A. I mean you haven't asked me about the 80 percent.

Q. Well, I'll get into that. I'm happy to get into that.

A. I'm sorry.

Q. All right. What is in the 80 percent?

A. The National Institutes of Health.

Q. Is that exclusively the National Institutes of Health?

A. You mean the 80 percent?

Q. Yes.

A. It would be predominantly the National Institutes of Health. We do have some other support that comes along now and then from pharmaceutical industries, from other industries. It would be a

small percentage of the 80 percent.

Q. Okay. I would like to turn your attention to your list of grant support. It's Pages 8 and 9 of the copy of the CV that I have. And let's just deal with the ones that are relatively current, like starting with the Study of the Reproductive Toxicity of Selected Chemicals. From there to the end of the list which ones are sources of funding other than the National Institutes of Health or the Florida DER?

A. Okay. The one that you started with, the Study of Reproductive Toxicity of Selected Chemicals, that source is not either NIH or DER. It's from the National Foundation, March of Dimes.

The next one would be the Studies of Isomer Specific PCB-Induced Toxicity. That's a cooperative agreement with Rutgers College of Medicine. That is neither of those other two entities. Those would be the two.

Q. All right, thank you.

When were you first hired by Bath Iron Works in this case?

A. I wasn't hired by Bath Iron Works.

Q. Have you ever been hired by Bath Iron Works?

A. Not that I know of.
Q. Have you ever been retained by Bath Iron Works?
A. Not directly that I know of.
Q. So are you being paid by Bath Iron Works?
A. I don't know who is paying my bill. I assume that that is probably the case.
Q. And when did you first reach an agreement to do some work that would result in your being paid by Bath Iron Works?
A. Well, again I don't know that I'm being paid by Bath Iron Works. I suspect that's probably the case, but I don't have any dealings with Bath Iron Works.
Q. Okay. When did you first enter into some sort of arrangement which led us to this deposition today?
A. Probably it would have been in December, or January of 1994.
Q. And what is your understanding of who is going to be paying for this service?
A. I am to submit my bills to Arlyn Weeks or Constance O'Neil.
Q. So you are being paid through their law firm?

A. I don't know the arrangements for payment. I simply send a bill.

Q. How much time have you spent on this matter since being retained either by Constance O'Neil or Arlyn Weeks?

A. I would estimate that it has probably been about three days.

Q. And by that you mean three eight-hour days?

A. Correct.

Q. So about 24 hours?

A. That's probably about right.

Q. And how much of that time was preparation for this deposition?

A. I didn't spend any time specifically preparing for this deposition, but obviously all of that work I suspect would be in preparation ultimately for providing opinions.

Q. Are you compensated based on an hourly rate?

A. Yes, ma'am.

Q. And what is that hourly rate?

A. $175.

Q. And is that the same for testifying? Is it the same hourly rate when you testify?

A. It is.

Q. During the time that you spent on this matter, what did you review?

A. I have reviewed the complaint, the letter from Mr. Jack Krueger --

Q. What is the date on that letter?

A. That would be August 7, 1979.

Q. Okay.

A. The letter from Mr. Frances Drake, the test results from the Dauphin-Bath wells.

Q. And what is the date on that one?

A. 3/19/80. Additional test results dated 3/27/80, the State of Maine interdepartmental memorandum to Mr. Ed Pinkham from Mr. Jack Krueger.

Q. And the date of that? Why don't you just list them each with the date.

A. Okay. That would be 4/9/80. The trip report for Robert Herman, dated 11/13/86; the Citizens' Environmental Laboratory data report, dated 4/25/92; the letter from Richard Wardell, dated 6/15/92; the Citizens' Environmental Laboratory data, dated 6/17/92; the Citizens' Environmental Laboratory data, dated 6/22/92; the summary of the Bath Iron Works split sample results, dated 6/19/92; the summary of the report of sampling

results, Maine Department of Environmental Protection, dated 8/7/92; the letter from Corrine McCandless, dated 8/25/92; the letter from Mr. James Nichols, dated 8/31/92; the Citizens' Environmental Laboratory data report, dated 2/4/93; the Phase I Remedial Investigation Report, dated 10/13/93; the revised Phase I Remedial Investigation Report, dated 2/18/94; the medical records of Stephen Varney, Lydia Murray, Pam Varney and Denise Wilhelmi; the depositions of Dr. McLellan, Dr. Clapp and Dr. Winters.

That would be all.

Q. Okay. Have you ever been to Bath, Maine?

A. I don't believe so.

Q. Have you ever been to the Dauphin site?

A. No, ma'am, I have not.

Q. Did you review any material from the plaintiff's hydrogeological expert, Ken Stone, concerning the remedial investigation?

A. I don't believe so.

Q. Did you review the residential well results from 1986 and 1987? I didn't hear it offhand in the list that you gave me.

A. Yes. I don't think so.

Q. Do you know where the plaintiffs in this

case lived in relationship to the Dauphin site?

A. Their specific locations I do not.

Q. Do you know the relative distance from the plaintiffs' houses to the Dauphin site?

A. I don't recall the specific distance.

Q. Did I hear you unrolling a map to look at it?

A. You did.

Q. Okay. What map is that that you were looking at?

A. I am looking at the sediment sample map --

Q. If you can give me the number, we can track it down later when we read the transcript.

A. The number?

Q. Yes. It should have a figure number in the lower right-hand corner.

A. I'm sorry, it does. 41-B.

Q. Okay. So I think the question we had, which I'm not sure you've answered, was do you know how close the plaintiffs' houses are to the Dauphin site?

A. I don't specifically know, not for each of the plaintiffs.

Q. I think you've probably answered this,

but do you know what the plaintiffs were exposed to in their wells when their wells were still in use, what was in that well water?

A. I haven't seen any data for the individual plaintiffs that would indicate what was in their water at any specific time.

Q. Now, I'm going to ask you some questions about your views on carcinogenesis, which I know you have spent quite a bit of time on. And what I'm looking for here is, as I say, your views and your opinions on these general issues.

First of all, do you believe that chemicals are capable of inducing cancer in humans?

A. Some chemicals, yes.

Q. And when we use the term cancer, just so that we're sure we're talking about the same thing, what is your definition of cancer?

A. Cancer is by definition a metastatic process. It is a cell transformation that results in a cloning process whereby cells that are now able to invade surrounding tissues and metastasize throughout the body are created; and their growth is not suppressed or repressed, so it is a transformation to a new cell, and the subsequent cloning of those cells which results in a metastatic

for the demonstration that it is a human carcinogen is fairly weak, but it certainly is for regulatory purposes, and for those purposes I would certainly concur that it is a Class A regulated human carcinogen.

Q. Are there other substances which are regulated as Class A human carcinogens that you personally don't consider carcinogens?

A. I don't remember all the Class A, so I couldn't answer that question.

Q. I'm sorry.

A. I can't answer the question without knowing what they are.

Q. Now, I understand that you believe that there are different types of mechanisms by which chemicals cause cancer in humans. Is that correct?

A. That is correct.

Q. And some chemical carcinogens you would consider initiators. Is that correct?

A. That is correct.

Q. Would you tell me how you define an initiator?

A. An initiator is a chemical that is able to interact with the DNA of a cell. It is able to irreversibly bind or damage the DNA, resulting in a

DNA that now has an error that can ultimately be expressed and ultimately cloned.

Q. Now, in your view is a chemical carcinogen an initiator if it is metabolized in the body into another substance which then interacts with the DNA? Do you call that situation an initiator?

A. Well, it could be if it meets the definition of what I just described as an initiator.

Q. Okay. So the fact that a chemical is metabolized in the body into an intermediate which then interacts with the DNA does not necessarily disqualify it as an initiator?

A. It does not.

Q. Of the known human carcinogens that you have mentioned so far, are any of them considered to be -- do you consider any of them initiators?

A. Let's see. We talked about vinyl chloride, we talked about benzene and hexavalent chromium.

Q. And maybe arsenic.

A. And maybe arsenic. I would not consider benzene as an initiator, I would not consider chromium or arsenic as initiators. Vinyl chloride I probably would not consider to be an initiator,

either.

Q. Okay. Can you give me an example of a known human carcinogen that you consider an initiator?

A. Well, I can't think of one at the present time. It would have to be a substance again that can interact with the DNA. It would have to be an alkylating agent or some substance that would ultimately alkylate or interact irreversibly with DNA.

Q. Okay. When you say interact irreversibly with DNA, does that mean necessarily that the chemical alters the DNA in a way which is cloned? Is cloning a crucial part of your definition of an initiator?

A. I'm sorry, I did not hear that.

Q. In your definition of what constitutes an initiator, is it essential that after the interaction takes place with the DNA and the DNA is altered, that that alteration is then cloned? Is that a crucial part of your definition?

A. Well, an initiator may not initiate cancer. If the DNA damage is repaired and if the DNA damage is not cloned, it won't initiate cancer. So an initiator is a description of a substance that

is able to interact with DNA and potentially can cause a change in the DNA, but unless that DNA change occurs and is cloned, then there won't be the initiation of the transformation of the cell.

Q. Now, for carcinogens that you consider to be initiators, is there a safe threshold for a population? I'm not talking about whether an individual will or will not develop cancer, but when you look at the full exposed population, can you establish a safe threshold for initiators?

A. Yes, I believe so.

Q. And why is that? Why do you believe that a threshold can be established?

A. Well, a threshold can be established because we now know that there are many repair processes for repairing damaged DNA. And it was recently reported that every single DNA of every single cell of the body is damaged probably about 10,000 a day, and therefore, there are lots of damages that occur to DNA which are very efficiently repaired by a variety of enzyme systems, and an initiator would have to overwhelm that repair system in order to ultimately damage the DNA to result in an irreversible damage that could ultimately go on to be cloned.

So based upon the background damage that occurs to DNA and based upon the efficiency of that DNA repair, there are exposures to even initiators that are without risk based upon that knowledge of molecular biology and based upon the stoic geometry of those reactions and the damage that could occur to the DNA in those cells.

Q. What is that article that you just referred to about DNA repair?

A. There are many articles on DNA repair. I mean there are hundreds, thousands. Bruce Ames is the fellow who recently evaluated the daily bombardment of DNA and the frequency of DNA damage. He published those calculations probably, I don't know, I'll estimate five to eight years ago.

Q. Do you remember the journal it was published in?

A. I do not.

Q. Do you know of any studies which have established where a threshold is for any particular carcinogen that you consider is an initiator? In other words, by that I mean, you know, a study which actually shows here is a threshold below which we cannot observe an increased risk.

A. Sure.

Q. What are those for initiators?

A. For initiators?

Q. Right, a chemical that you consider an initiator.

A. Well, I couldn't give you an example of an initiator. I would have to look at that. I can't answer.

Q. If you can find a citation for an article like that, please provide it to Arlyn and she can give me the citation and I can get it up here.

A. Sure.

Q. But I would like to know what that citation would be.

By the way, do you know if Bruce Ames has done any further work on the issue of the amount of DNA damage and DNA repairs in that article you referred to?

A. Oh, he has, yes.

Q. So he would have further publications on that issue you believe?

A. Yes.

Q. Now let's move on to promoters. Could you give me an example of some chemical carcinogens that you -- maybe that's not the right word if they are promoters, but anyway, chemicals which you

believe can play the role of promoters in carcinogens?

A. There are different kinds of promoters.

Q. Okay. What are the different kinds?

A. There are chemicals that can produce chronic inflammation, chronic irritation; as a result of that chronic inflammation and irritation can produce ultimately a tumor, or cancer. That would certainly be one form of promotion.

There are other chemicals that can alter cell-cell communication. That would be another form of promotion. So there are different mechanisms of promotion.

For example, the carcinogenicity of benzene would be a promotion phenomenon whereby a chronic inflammation, chronic irritation could ultimately result in an acute myelogenous leukemia. That would certainly be one example.

Q. Okay. Well, is asbestos another example of chronic inflammation in your view?

A. It would be chronic injury, and chronic injury resulting in chronic inflammation, yes.

Q. Do you know of any studies establishing the threshold of asbestos exposure below which cancers are not induced?

A. Yes.

Q. What are those?

A. Well, there are regulatory standards that are the basis for safe levels of exposure. Those would be the permissible exposure limits.

Q. I wasn't really addressing regulatory standards.

A. Well, I know. You're asking me for the literature. I'm not going to be able to just remember the literature for you. I can certainly provide you with a list of the literature that would be my opinion with regard to the basis for the setting of those standards or that there is a threshold below which there is no increased risk for cancer.

Q. Okay. I would just like a citation to what you consider to be the most important literature supporting a threshold for asbestos. You don't have to give me a lot of citations, but whatever it is you would personally rely on for that proposition.

A. Okay, as long as you're not going to hold me to just the one I provide to you.

Q. No. But as long as you give me something that fairly represents what you rely on for your

opinion.

A. Sure.

Q. Okay? I just don't need 10 pounds of citations.

Now, with benzene, you described that process as a chronic inflammation. What cell is being clinically inflamed in benzene-induced cancers?

A. It's the metabolism of benzene in the marrow, which ultimately results in the chronic inflammation and chronic injury.

Q. But what cell is being chronically inflamed and injured in your view?

A. Well, it's the stem cell process. I am not prepared to give you the specific cell.

Q. So are you telling me that neither benzene nor any of its metabolites interacts with DNA or RNA?

A. I don't know of any specific metabolites that interact that would result in DNA damage.

Q. Let's move on to PCBs, because you mentioned that you have done some recent research on that. Do you believe that PCBs are a promoter in chemical carcinogenesis?

A. Under certain circumstances of exposure

PCBs can be promoters.

Q. And what are those circumstances?

A. There are studies that show that depending on when you administer PCBs you can enhance carcinogenicity of some chemicals, for example, liver carcinogens, and in other instances you can retard or inhibit or block the carcinogenicity of other chemicals.

Q. So if PCBs and vinyl chloride, for example, were present together, would PCBs in your view enhance the carcinogenicity of vinyl chloride if that's a liver carcinogen?

A. I don't know of any biologically plausible mechanism by which PCBs would enhance the carcinogenicity of vinyl chloride.

Q. What do you mean by biologically plausible?

A. Well, any biological data that would support the interaction between the polychlorinated biphenyl and the vinyl chloride.

Q. Could you tell me, give me an example of a liver carcinogen that you feel PCBs would enhance, that is, would increase the carcinogenic impact?

A. I don't recall the specific chemicals. I think there were various nitrosamines that were

studied.

Q. Let's get back to biological plausibility. How do PCBs work as promoters?

A. PCBs are enzyme inducers, and as enzyme inducers can enhance the conversion of chemicals from one form to a biologically active form and in that process may promote the carcinogenicity of those compounds whose metabolism is enhanced as a result of that interaction.

Q. And going back to vinyl chloride, does the vinyl chloride molecule itself in your view interact directly with DNA or is it metabolized with an intermediate which interacts with DNA or RNA?

A. It's metabolized to an intermediate.

Q. Where does that metabolism take place?

A. In the endothelial cells. I'm sorry, that's not correct.

Q. Okay. Where?

A. It occurs in the parenchymal cells. The endothelial cell is the cell that is ultimately affected as a result of those metabolites.

Q. When you say parenchymal cells, you mean the lining of the -- the inside of the lungs?

A. No, the liver. Parenchymal cells.

Q. But inside the liver?

A. Well, the liver parenchymal cells are the cells of the liver, the hepatic parenchyma.

Q. Okay, that's what I'm trying to clarify. We're talking about liver parenchyma?

A. Yes, ma'am.

Q. Do PCBs accumulate in the fatty tissue of humans?

A. They can.

Q. Okay. Let's talk about dioxin, because I know you've testified on dioxin issues on a number of occasions. What do you consider to be the known toxic effects of dioxin?

A. Dioxin can produce chloracne, and that is the only effect that has been demonstrated, adverse effect that has been demonstrated to be associated with exposure to dioxin.

Q. And at what levels of exposure can chloracne occur?

A. By levels you mean what would be in the environment?

Q. Well, in the environment and to which humans were exposed.

A. That's a difficult question to answer because exposure is only the opportunity for contact. So the fact that dioxin is in the

environment doesn't mean it gets into your body.

Q. That's true.

A. So talking about concentrations in the environment is really not very relevant without knowledge about how much gets into the body. Within the body the normal circulating level of dioxin is around seven, eight parts per trillion. It would be orders of magnitude greater than that that would be associated with chloracne.

Q. So it would be in the hundreds of parts per trillion?

A. Yes, ma'am.

Q. And does dioxin accumulate in the body, in any of the tissues of the human body?

A. It can.

Q. Where does it tend to accumulate?

A. In the body fat.

Q. Now, do you consider dioxin to be a chemical which is capable of intensifying the carcinogenic effect of other chemicals?

A. I would not consider that to be so.

Q. Let me go back and ask you a much more general question about your views on the value of research in animals and research in humans. Could you just summarize your view of the role of the

animal studies in toxicology?

A. Animal studies are useful for evaluating chemicals for which there is little or no information, useful for evaluating the potential toxicity of a chemical. For regulatory purposes that information can be used for public policy purposes for regulating a chemical.

For example, if something is determined to be an animal carcinogen for regulatory purposes, you don't have to wait until it's demonstrated to be a human carcinogen in order to be able to regulate that chemical. So as a matter of public policy, animal testing is used for identifying the potential harmful effects, including carcinogenicity of chemicals.

Some of that information may be reliable, some may not be reliable. It depends on the mechanism of action. And we certainly know that there are some chemicals that that information is not reliable based upon molecular biology information with regard to, for example, peroxisome proliferation based upon differences in metabolism. Many of the old fears with regard to some of those chemicals, such as some chlorinated hydrocarbons, are not consistent with present facts.

So animal testing has a role in evaluating the potential harmful effects of chemicals. It is used for public-policy purposes, however, it cannot be used to establish the cause of a human ailment or disease.

Q. Okay. And when animal studies are used to show that animal's metabolism of a suspect carcinogen, for example, is different than human metabolism, I assume that you have to have pretty good data about human metabolism of that substance to be able to show that the animal metabolism is different. Is that correct?

A. That would be correct, that you would need human metabolism data if the metabolism is the difference.

Q. Or whatever the difference was, you would need comparable data in humans to be able to tell that the animal was different.

A. Well, by comparable, you would need human information to be able to determine whether or not, for example, peroxisome proliferation or globulin accumulation in the kidney, you would need human information for that phenomenon or for the metabolism to be able to distinguish between the animal testing data and humans in order to be able

A. Well, I don't have an opinion about that. All I did is I looked at the data that existed, and based upon the data that existed I evaluated the exposure, and that exposure doesn't result in an increased risk.

Q. And if that data were for some reason not representative of the exposure, then I take it that your opinion might change?

A. It may. I would have to reevaluate whatever that data was or how it wasn't representative.

MS. CLEVELAND: Okay. That's all I have, Dr. Harbison. Thank you.

MS. WEEKS: I have no questions.

THE WITNESS: I would like to read if I could.

(Witness excused.)

(Whereupon, at 10:20 a.m. the taking of the deposition was concluded.)

CERTIFICATE OF OATH

STATE OF FLORIDA

COUNTY OF ALACHUA

I, Pamela A. Chorlog, a Notary Public of the State of Florida at Large, being duly authorized by Statute to administer oaths (Ch. 29, F.S., and Fla.R.Jud.Admin. 2.070), certify that the witness, RAYMOND D. HARBISON, Ph.D., was first duly sworn by me to testify the whole truth.

Witness my hand and seal at Gainesville, Florida, this 24th day of May, 1994.

Pamela C. Chorlog

C.M., R.P.R., AND NOTARY PUBLIC
STATE OF FLORIDA AT LARGE
MY COMMISSION EXPIRES 2/16/94

PAMELA A. CHORLOG
MY COMMISSION # CC 343382
EXPIRES: February 16, 1998
Bonded Thru Notary Public Underwriters

CERTIFICATE WITH ACKNOWLEDGEMENT

I, Pamela A. Chorlog, C.M., Registered Professional Reporter, certify that I was authorized to and did stenographically report the foregoing deposition; and that the transcript is a true record of the testimony given by the witness.

I further certify that I am neither attorney or counsel for any of the parties, nor a relative or employee of any attorney or counsel connected herewith, nor financially interested in the event of this case.

I further certify that the original of this deposition was delivered to Ms. Cleveland and was true and correct at the time of delivery.

Pamela A. Chorlog

PAMELA A. CHORLOG, CM, RPR

STATE OF FLORIDA
COUNTY OF ALACHUA

The foregoing certificate was acknowledged before me this 24th day of May, 1994, by Pamela A. Chorlog who is personally known to me.

Bernice Oosterhoudt

BERNICE OOSTERHOUDT, Notary Public, State of Florida
My Commission Expires 2/1/97