IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR THE COUNTY OF KING

CREIGHTON E. MILLER, Administrator of the Estate of
THEODORE MURRAY, SR.,
Plaintiffs,
vs. NO. 96-2-26232-3 SEA
KEYSTONE TANKSHIP CORPORATION; TEXACO, INC.; and
CHARLES KURZ & CO., INC.,
Defendants.

TESTIMONY OF DR. OTTO WONG

Heard Before: THE HONORABLE STEVEN SCOTT **August 6, 1998**
1:00 P.M. W813, KING COUNTY COURTHOUSE
SEATTLE, WASHINGTON
APPEARANCES: DIANE PENNEY-WAGSTER, MICHAEL J. CONNOR, DONALD A. KRISPIN and KELLY CARLEY,
representing the Plaintiffs;
MICHAEL H. RUNYAN, ERIC WIECHMANN, and GWENDOLYN PAYTON KLEIN,, representing
Defendant Texaco, Inc.;
GAIL LUHN PYLE and STEPHEN H. DANIELS, representing Defendants Keystone Tankship
Corporation and Charles Kurz & Co., Inc
REPORTED BY: TaraLynn A. Bates CSR # TA422BC
WHEREUPON, the following proceedings were had,
to wit:

AFTERNOON SESSION
August 6, 1998
1:00 P.M.
THE COURT: Please bring in the jury.
(WHEREUPON, the following proceedings were had in the presence of the jury.)
THE COURT: Members of the jury, because of a scheduling conflict, and particularly the next witness' schedule, I'm allowing the defendants to call a witness out of order at this time. So we're interrupting Dr. Gardner's testimony and we're not going to get back to him until Monday morning. We're going to be with the next witness the whole afternoon, I believe.
The defendant may call their witness at this time.
MR. RUNYAN: Thank you, Your Honor. The defense calls Dr. Otto Wong.
OTTO WONG, called as a witness on behalf of the Defense; being duly sworn by the Court, testified as follows:
DIRECT EXAMINATION
BY MR. RUNYAN:
Q. Dr. Wong, can you state your name, for the record, and also tell the court reporter your address?
A. Otto Wong. And my address is Applied Health

Sciences, 181 Second Avenue, San Mateo, California, 94401.
Q. And what is your occupation, Doctor?
A. I'm an epidemiologist.
Q. How are you currently employed?
A. I'm employed at Applied Health Sciences.
Q. And what is Applied Health Sciences?
A. It's my company, doing contract research, mainly in occupational and environmental epidemiology.
Q. And can you give the ladies and gentlemen of the jury an example of the type of things or the type of people that you have contracts with in Applied Health Sciences?
A. Because my interest is in-occupational and environmental epidemiology, so most of my work would be working with the industry to study the health patterns of workers exposed to different chemicals and so on.
Q. And can you tell the ladies and gentlemen of the jury, basically outline your educational background to become an epidemiologist?
A. Many, many years ago, I went to the University of Arizona for my undergraduate. I graduated with a degree in mathematics and physics, in 1970. And then I went on to Carnegie Melon University, in Pittsburgh, to study physics. I obtained a master's degree in physics in 1972. Then I decided to switch to epidemiology, public health, and I obtained a master's degree in 1973 and then a doctor of

science in 1975.
Q. And the last two degrees were both in epidemiology?
A. Epidemiology and biostatistics.
Q. Can you briefly sketch your employment history after you graduated with your doctorate in epidemiology?
A. After I graduated, I worked at Georgetown Medical School for about three, four years and then I started doing contract research for many years. And right now I'm in San Mateo. I also have two appointments at two different universities.
Q. Tell the ladies and gentlemen of the jury about those academic appointments?
A. I am an adjunct professor in biostatistics at Tulane Medical School in New Orleans. I think I picked Tulane because of the location. I also am a visiting professor of epidemiology and occupational health at a university, at a medical school in Taiwan. And I go there every summer to teach summer school and in the spring I teach at Tulane.
Q. Can you tell the ladies and gentlemen of the jury, basically, who are you teaching?
A. It would be both medical students as well as graduate students.
Q. Are you board certified in any specialties?

A. I'm certified in epidemiology by the American College of Epidemiology.
Q. What does it take to become board certified in - that specialty?
A. There are two levels of membership. One is the regular member, you have to have a doctor degree in epidemiology or related discipline and then you have to have so many years of experience and so on. That would be the regular member. And then there is the next level, what we call fellows. To be a fellow, you have to have -- make some kind of contribution to the science of epidemiology. And I'm a fellow of the college.
Q. With regard to your professional activities, are you a reviewer for any professional journals?
A. I've been asked by journals to review manuscripts submitted to journals on regular bases.
Q. Is that known as peer review?
A. Yes.
Q. I think Dr. Gardner talked about this, but basically, you review the article to see whether or not the methodology and the conclusions are sound?
MR. KRISPIN: Objection.
THE COURT: Hold on. Is there an objection?
MR. CONNOR: No.
A. At that stage we don't call that an article, we

call that a manuscript. Basically, if I want to have a paper published, I write it up as a manuscript, submit it to the journal and the journal will send it out to reviewers who know the subject matter well and look at the manuscript and make a recommendation to the editor as to whether the article should be published or not or should be published after some revisions and so on.
Q. (By Mr. Runyan) How many different professional journals, just in number, have you been asked to be a reviewer for?
A. I don't know.
Q. Can you tell the ladies and gentlemen some of the, don't go through them all, but some of the important ones that you've been asked to be a reviewer for?
A. Well, the ones related to our field would be American Journal of Internal Medicine, General Occupational and Environmental Medicine, in this country. Journals in Europe would be Occupational and Environmental Medicine, Cancer, Journal of the National Cancer Institute and so on.
Q. Have you given speeches and presentations with regard to your special interest?
A. Yes, I have.
Q. And, again, I don't want to go through every one, but can you give the ladies and gentlemen of the jury an idea of the number or some of the more important ones?

A. I remember the places that I like to go to but I don't remember the topics. Most of them would be studies of chemical -
MR. CONNOR: Your Honor, I am going to object to the generalities unless he can specify something.
THE COURT: Overruled.
Go ahead, you can answer.
A. Basically, my presentation would be on the work that I have done. And as I said before, my work focuses on occupational epidemiology.
Q. (By Mr. Runyan) Have you been awarded any awards or honors?
A. You mean in school and -
Q. Or by any professional organizations.
A. Well, I consider being a fellow of the college is an honor.
Q. Have you held any fellowships?
A. At that American College of Epidemiology. Also at the American Association of Human Biology.
Q. Have you authored any publications in your field?
A. Yes, I have.
Q. Okay. Again, without the risk of being objected to, do you have any estimate of the number of publications?
A. Probably about 120 or so.
Q. And with regard to benzene, have you authored any

scientific papers?
A. Yes, I have.
Q. Can you tell the ladies and gentlemen generally about those?
A. Probably about ten to fifteen published articles.
Q. And can you give them a flavor as to -- we will talk about some of them, but can you give them a flavor as to what the articles were about?
MR. CONNOR: I am going to object, Your Honor. It seems to me this is rather specific and the generalities is not helpful.
MR. RUNYAN: I don't know how it can be specific and general at the same time, Your Honor.
MR. CONNOR: I'm objecting to the general.
THE COURT: Overruled.
You may answer.
A. Basically, those would be studies of workers occupationally exposed to benzene. Or workers in the petroleum industry exposed to benzene and other petrochemicals.
Q. (By Mr. Runyan) Have you had any papers that have been funded by something called the American Petroleum Institute?
A. Yes.
Q. What is the American Petroleum Institute?

A. I guess the best way to characterize that is it's a trade association for companies in the petroleum industry.
Q. And how do you go about getting funding from the American Petroleum Institute?
A. What they do is they send out what we call requests for proposals, to do a study, to people that they think are qualified to do that kind of study. That would include consultants such as myself as well as universities. And most of the time we compete with universities for funding.
Q. Does the fact that a study is funded by somebody like the API have anything to do with the conclusions that you arrive at in the study?
A. Of course not.
Q. Can you explain to the ladies and gentlemen what safeguards there are to make sure that the source of funding doesn't affect your outcome?
A. Well, number one, we document all the data. So that if somebody wants to go back and look at the data, they can do so. And I always maintain the right to publish regardless, whatever the results are, positive, meaning. that we find something, or negative, meaning that we do not find something. So that is the safeguard that I have in terms of independence.

Q. Have you published articles that were not favorable to whoever was funding them?
A. Yes, I have.
Q. Can you give the ladies and gentlemen any kind of examples of that?
A. Well, for example, when we looked at benzene-exposed workers, we do know that benzene can cause a certain form of leukemia. And I have reported that.
Q. Now, I want to ask you some questions generally about epidemiology, okay?
A. Okay.
Q. Have I covered everything that's important with regard to your background?
A. I think so.
Q. Have you prepared some, I can't call them slides, but discussion papers that discuss various topics with regard to epidemiology?
A. Yes, I have. I think that would be helpful to speed up the process.
Q. Would it be helpful to show those to the jury as you discuss the general principles of epidemiology?
A. I believe so.
. MR. RUNYAN: We've already showed these to the other side, Your Honor.
Q. (By Mr. Runyan) Dr. Wong, is the determination

of causation in chronic diseases, such as cancer, in humans, are there complicating factors with regard to that?
MR. CONNOR: I'll object, Your Honor. There's no foundation.
THE COURT: What's your response, briefly?
MR. RUNYAN: He's an epidemiologist, which we've already established.
Q. (By Mr. Runyan) What is the science of epidemiology?
A. Well, I can give you a formal definition. I don't know how helpful that would be. A formal definition of epidemiology is the study of the determinants and distribution of diseases in human populations. So in that definition, we have two components. One is the distribution. In other words, we want to find out how the disease is distributed in the human population, which group, which subgroup in the human population has a higher rate of that disease than other groups. In other word,, we want to identify the high risk groups. Once we have identified the high risk groups, then we want to find out something about why, why do we see that group has a higher rate of disease than the rest of the population. And, hopefully, we can do something about the determinants, stop that exposure. That is really what we mean by epidemiology. And

the reason we need epidemiology is when you talk about chronic diseases, you cannot look at just one or two cases and make a decision on the causation, you really have to look at human populations. Large enough groups allow you to make a definitive conclusion. You cannot just look at a few people and say, "This causes that."
Q. And do you have examples that you can share with the ladies and gentlemen of the jury to talk about complicating factors with regard to the determination of causation and disease in human beings?
A. I can sure give you some very famous examples that you all know about. For example, in the late -
Q. Slow down, Doctor, because I've got to get the slides up here.
Generally, are there specific problems with regard to chronic disease in humans that complicates the determination of causation?
A. Yes, there are.
Q. And can you share those with the ladies and gentlemen of the jury?
A. And by chronic disease, we mean if we are exposed to a certain toxinogen, eventually we will get cancer. -But when you think about it, the time between exposure and the appearance of disease is very, very long.
An example would be if I start smoking today,

which I don't, I may get -
MR. CONNOR: Your Honor, I'm going to object to this. I don't think it's responsive and I also don't think there's any foundation in the record for this.
THE COURT: Overruled.
You may continue your answer.
A. If I start smoking today, I increase my risk of lung cancer tremendously. But I'm not going to get lung cancer tomorrow nor will I get lung cancer next year. I will get lung cancer, most likely, twenty, thirty years down the road. That's what we call latency.
And it's very important, because with that long latency, many things can happen. Therefore, you cannot look at just one or two cases, you really need to look at a group of people and follow them for a long time. That-is what we call epidemiology.
And on top of that, most cancers have multiple causes. For example, lung cancer. Lung cancer can be caused by many things, ionizing radiation, as well as smoking. So you really need to look at the group in the exposure.
Q. (By Mr. Runyan) Are there any other factors which complicate the determination of diseases in humans?
A. Well, when we look at one or two people, you cannot make a -- for example, even tobacco-related lung

cancer is not well understood. So the best thing we have at this point is epidemiology; by studying smokers, comparing their rates of lung cancer to nonsmokers. That is how we find out that smoking caused lung cancer.
Q. Is there a scientific way that we go about trying to establish causation with regard to any particular disease?
A. I think I'm a couple steps ahead of you now. I just said that. If we want to look at a causation of smoking and lung cancer, we need to study a group of smokers, find out how many lung cancers they have and compare that to the number of lung cancers in a similar group of people who do not smoke. That is how we determine causation.
Q. How about with regard to coffee drinkers, since we're in Seattle, can you discuss coffee drinkers as a possible example?
A. Well, one example is if we want to look at whether coffee drinking causes stomach cancer or not, we do the same thing as smokers.
MR. CONNOR: Your Honor, I'm going to object. I think he should at least give the testimony before he puts up the information, or establish some basis for the information.
MR. RUNYAN: I think he's giving an example, Your

Honor, of the coffee drinkers and how you go about scientifically determining whether or not coffee drinkers have any incidence of disease.
THE COURT: The objection is overruled.
A. If you want to find out whether coffee drinking causes stomach cancer, the obvious thing is to study a group in the population of coffee drinkers and compare it to a group of non-coffee drinkers. And that group will be comparable in every other aspect except for coffee drinking. And if, indeed, we see more cases of stomach cancer in coffee drinkers compared to non-coffee drinkers, then we know there may be something going on there.
Now, you do remember, even if coffee drinking does cause stomach cancer and we don't drink coffee, we still carry some risk of stomach cancer. Because it can be caused by different things. And so it's really observed, the number of observed cases. to the number of expected cases.
Q. (By Mr. Runyan) Are there examples that you can give to the ladies and gentlemen of the jury in the epidemiology literature where there was and now is accepted an established causation between a particular exposure or agent arid a particular disease?
A. I can think of one example. And that is many, years ago there were some reports of women with fibrocystic

disease who -
Q. Now, that's refuting it, correct?
A. Right.
Q. Let's talk about ones that, first of all, might confirm a diagnosis or a causation.
A. Well -
Q. Can you think of any of those?
A. Well, smoking and lung cancer would be another example.
Q. All right. What can we tell the ladies and gentlemen of the jury about how that was established?
A. We -- there were reports of lung cancer in smokers in the early 1900s. But those would be what we call case reports, they are not studies. So case reports by themselves would not be sufficient to demonstrate causation. So subsequently, the epidemiologists did a lot of studies on smokers, including the very first one done by Sir Richard Dahl at the Oxford University. And basically, he looked at 40,000 doctors who smoked, compared their lung cancer rate to a group of doctors who did not smoke. And, indeed, he found out that if someone smokes two packs or more per day, the risk of lung cancer is twenty times as high.
So based on that study, and subsequent studies, as well, we know that smoking can cause lung cancer.

Q. One of the things that we've talked about in this case is leukemia. Are there recognized causes of leukemia that have been established as a result of epidemiological studies?
A. Ionizing radiation is a known what we call leukemogen.
Q. And how is that established with regard to the relationship between leukemia and ionizing radiation?
A. Again, in the early 1900s there were reports of leukemia in radiologists who were exposed to, of course, radiation. And the natural question to ask at this point was does ionizing radiation cause leukemia.
Q. Let me interrupt you a second. You said there were reports about radiologists with leukemia. What are those called?
A. Those are called case reports.
Q. Are case reports accepted in the epidemiology world as a basis for establishing causation?
A. No, because we don't know how many -- how big the underlying population is. Without a denominator, we cannot determine what the risk is.
Q. I'm sorry, I interrupted you. Do you remember where you were? .
A. Based on those case reports, the interest was to find out whether, indeed, ionizing radiation can cause

leukemia or not. And subsequently, we have studied radiologists and compared the leukemia rates in the radiologists to other physicians who were not exposed to ionizing radiation. And, indeed, we found that radiologists who were exposed to ionizing radiation have a rate about ten times as high in terms of leukemia.
Q. Now, in terms of refuting a causation, you started to talk about a particular example, correct?
A. Yes.
Q. And what example was that?
A. That was on women with fibrocystic breast disease. And there were case reports that women who drink coffee may have an increased risk of that disease. But subsequently, when we do some formal epidemiologic studies, it turns out that's not true at all; women who drink coffee and women who do not drink coffee have the same risk.
Q. Can you summarize, then, what we've learned or what you just discussed in terms of the relevance to epidemiology and establishing causation?
MR. CONNOR: Your Honor, could I have a foundation, at least, as to whether or not he had anything to do with any of these studies?
' THE COURT: If that's an objection, it's overruled.
Do you want to repeat your question?

MR. RUNYAN: Sure.
Q. (By Mr. Runyan) Is there a way you can summarize, just in principles, what we've just discussed with regard to these examples?
A. The lesson we learn here is case reports, meaning that report about a single case or two or three cases, they are not studies and we cannot use them to determine causation. In order to determine causation, we really need to do epidemiologic studies, which would consist of a group of people exposed to the chemical or with that lifestyle or whatever, what we call exposure, and compare the number of cases of disease that we observe in that group to maybe the general population or to another group that's not exposed.
Q. Can you take an unexposed group of any type and compare it to an exposed group of another type?
A. There are lots of considerations going into how we choose the comparison group, the group that's not exposed. The most important thing is we really need to have a very large group so that the rate of disease is stable that we can compare to. If you have a small comparison group, the rate of disease is not stable in that group, it would not be a very good comparison group.
Q.' Is there a concept in epidemiology called relative risk?
A. Yes.

Q. Can you explain that to the ladies and gentlemen of the jury?
A. If we study a group of people exposed to a certain chemical, we know how many people there are, how old they are and so on, and we know how many cases of, example, of cancer we see in that group. With the number of cancers as well as the number of people in that group, we can calculate the risk of that cancer in that group. So that would be the risk in that group, in the exposed group. And if we have a nonexposed group or the general population, we can do the same thing, we can calculate the rates of disease, the rates of cancer in the nonexposed group.
And when we put them together, we form a ratio, the risk in the exposed group over the risk in the nonexposed group. Then we call that relative risk, the risk of the exposed people relative to the risk of nonexposed people.
Q. And how is relative risk used to establish causation?
A. We use that all the time. Because when you look at the risk, the relative risk, if it's rated N-1, that means we-have an increased risk, because the numerator would be greater than the denominator. When the relative risk is close to one or less than one, then we say there is

no increased risk.
Q. Is there another term that's used called cohort study?
A. Well, you're really getting into different study designs that we use in epidemiology. One study design is what we call cohort study. A cohort study is just that, we study a cohort of persons who have certain exposure in common and observe them over time, find out how many develop certain disease and rate of disease and compare that to the general population.
Q. Is there something also called a case control study?
A. A case control study is kind of -- thinks in reverse. We start with people with the disease and try to find out what kind of things they were exposed to. One example is if I go to a hospital and look at 100 cases of lung cancer, the medical history of 100 cases of lung cancer, and I notice that 80 percent of them, 80 out of 100 smoke, then I ask myself, "Is there anything between smoking and lung cancer?"
I don't really know how to interpret that 80 percent, I don't know whether that's high or low, so what I do is I get 100 controls, what we call controls, people who do not have lung cancer. And I look at the history, as well, to find out what percentage of them smoke. And if I

do that and I find out that only thirty percent of them smoke or forty percent of them smoke, then I know, "Hey, there is something going on between smoking and lung cancer." Because the percentage of smoking among lung cancer patients is much higher than the percentage of smoking in people without lung cancer. That is what we call a case control study.
Q. Now, you've already talked about relative risk. Well, with regard to cohort studies, how do you measure the relative risk or the measure of risk?
A. In cohort studies, we have something called standardized mortality ratio. It's the number of observed deaths in the exposed group compared to the number you would expect based on the number of people you have, how old they are and soon. You always have to have those two numbers in order to do a study, the observed number that you actually see in the group, compare that to what you would expect based on the general population even without exposure.
Q. And in a case control study, is there a different term?
A. In a case control study, that's what we call relative risk. It would be the percentage of cases exposed compared to percentage of controlled exposed. And that would be the 80 percent of lung cancer patients who smoke

compared to 40 percent of non-lung cancer people who also smoke.
Q. Is there something called a confidence interval?
MR. CONNOR: Your Honor, I am going to object to this. He's leading the witness. He's suggesting his answers.
THE COURT: Overruled.
MR. RUNYAN: I'm suggesting the topic, I confess.
Q. (By Mr. Runyan) Can you explain to the ladies and gentlemen of the jury what a confidence interval is?
A. Can I get a drink of water?
Q. Yes.
A. I think this is from the previous witness. So fair we have talked about relative risk. And that would be a single number. But in reality when we do a study, we are talking about statistics and so on, we would never be a hundred percent sure that number is exactly what we'll want. It depends on how large the study is. Now, let me give one very, very simple example. If I tell you I went out this afternoon and did a survey and 66 percent of the people that I talked to believe that Clinton should tell the truth, 66 percent, okay? Now, you'd be very impressed with the 66 percent until I tell you I only talked to three people and two of them say yes. So two out of three would be 66 percent. Okay? That

doesn't say much, only three. But on the other hand, if I tell you that 66 percent of people say yes and I talked to 3,000 people, 2,000 say yes, can you see the difference?
MR. CONNOR: Your Honor, I'm going to object to this. There is no foundation in the record, this is just a speech off the top of his head. There's no study he's relating it to. And it's not proceeding at a question and answer basis.
MR. RUNYAN: It's an epidemiology principle I'm trying to have illustrated to the jury.
THE COURT: He's giving an example to illustrate a principle. The objection is overruled.
A. So depending on how large the study is, we have something called a 95 percent confidence interval. When I say 66 percent, I'm not a hundred percent sure if, indeed, if I do a huge study, if I ask everybody in this 2,000, I would still end up with 66 percent. Okay? It depends on -- how large the study is would determine how confident I am in my answer.
If my example size, the group that I talk to, consists of only three people, I'm going to have a huge 95 percent confidence interval. In other words, my answer can be anywhere between ten percent or 99 percent. It doesn't tell you a whole lot. But if I have a large study, if I have a large group, I talked to a huge group, then I can be

sure that, indeed, it may not be exactly 66 percent but you would be somewhere between 60 and 70 percent, a very narrow 95 percent confidence interval.
So when we do a study, we determine the relative risk, at the same time we also want to tell the audience how large the study is, how confident we are. The larger the study, the smaller the 95 percent confidence interval. That is a very important concept to remember.
Q. Do you have a -
A. I'm not done yet.
Q. Sorry.
A. Unless the lower limit is above one, we cannot say there is a significant risk. Because, one, if one is included in the 95 percent confidence interval, what you're saying is my study cannot distinguish the result from one, there's no difference. Okay? So when the lower limit is above one, then we say there is a significant increase. When the 95 percent confidence interval includes one, then there is no significant increase.
Q. Do you have an example from one of the studies that you've done with regard to petroleum workers showing an illustration from the study of the confidence level?
A. I have -- every study would have a 95 percent confidence interval. When we talk about studies -
Q. Is this an example from your petroleum study of

the confidence level?
A. Well, what I have done there is I have several studies there. The first one is a little bit difficult to see; I have difficulty seeing it from here. But what we have is a crossbar. Okay. The end of the bar to the left would be the lower limit and the other extreme would be the -- can I go down and point?
Q. Sure.
A. That's the easier thing.
We have a study of all the refineries in this country, "Refining, U.S." And based on the data, I summarized them and calculate the SMR. The SMR is about, just a little below one. This is one, this vertical line is one.
MR. CONNOR: Could I interrupt for just a moment, Your Honor? I don't believe I have this.
MR. RUNYAN: I think it was in the material we provided you.
THE COURT: You want to make sure? They're saying they don't have it, Mr. Runyan.
(Discussion off the record.)
MR. RUNYAN: I couldn't find it.
THE COURT: For now, Mr. Connor, if you come around, can you see what he's referring to? Why don't you get to wherever you need to get.

Q. (By Mr. Runyan) Continue, Doctor.
A. So if this line is one, anything below there is less than one, anything above that is higher than one. And for all the refinery studies, we have a risk of about point nine something, I don't remember the exact number but it's slightly less than one. And the 95 percent confidence interval is somewhere between -- okay, this is point nine, this is point eight. So it's about point eight to about - this is one point one, so it's about one point zero something.
So that's the 95 percent confidence interval.
And what you see is for workers at refineries in this country, the risk is really at about point nine something and the 95 percent confidence interval is from point eight to about one point zero something.
Q. I think you can resume your seat.
We've talked about this a little bit this morning with Dr. Gardner. Are there generally accepted in the epidemiology circles criterion for establishing causation with regard to disease?
A. Yes, that's what we call the Hill criteria. It was first formulated by Professor Hill at the University of London many years ago. And subsequently, the same set of criteria have been used by the Surgeon General to determine the relationship between smoking and cancer, as well as by

the international agency for research on cancer, the WHO, to evaluate the carcinogenicity of different chemicals.
Q. Can you share with the ladies and gentlemen of the jury the criterion that are accepted that were set forth in -
A. Yeah, we basically have four, five or six criteria. And the very first one is what we call the strength and significance of association.
Q. And what's meant by that?
A. I was going to explain that.
Q. I'm supposed to ask you questions.
A. Basically, what we're saying is when you look at the risk ratio, the relative risk that we talk about, how high is the risk. The higher, the more likely that the relationship is causal. Okay? And whether that risk is significant or not. If it's not significant, then we're not talking about any increased risk at all. So there is no strength, per se.
So the first criteria really addressed the relative risk, how high that is and whether it is significant or not.
And the second one is consistency of association. When you look at all the studies, are they consistent. Once in a while you may see one or two studies that report an increased risk, but that's really what we call outliers,

they are not consistent with the rest. So the weight of evidence is we have to believe the majority of the studies and try to find out why that study, one or two studies, report differently.
Specificity of association is number three. And by that we mean if we want to look at the relationship between a disease and exposure, we need to be very specific. Multiple myeloma, we need to look at multiple myeloma. Are we talking about benzene, are we talking about petroleum products? We have to be specific, the same occupation or the same chemicals.
Number four is dose response. Dose response is very important. Because if chemical X can cause disease Y, then what we are saying is, if you think about it, is the more we have in terms of exposure to chemical X, the higher the risk of developing disease Y. And that has been proven in terms of smoking and lung cancer. If you smoke just a few cigarettes a day, you've increased your risk a little bit but if you smoke a few packs a day, then you really increase your risk.
So in other words, to demonstrate a causal relationship, you need to look at the level of exposure and the level of risk. If there is a nice upward trend as the exposure goes up, the risk also goes up, then you really know there is a causal relationship.

On the other hand, if you don't see a dose response relationship, in other words, the higher the exposure, that does not give you a higher risk, that may tell you that somehow your study is screwed up. It really does not give you a whole lot of information on the causal relationship.
Q. Okay. And there's also something called temporality or latency?
A. Yes. Like I said, if I'm exposed to certain carcinogens today, such as smoking, I'm not going to have lung cancer tomorrow. So in other words, to do a study, you really have to allow yourself a long enough time for the disease to appear.
Q. Now, Doctor, are you familiar, as a result of your training and experience and, indeed, your own research, with the epidemiology literature with regard to exposure to benzene and multiple myeloma?
A. Yes, I am.
Q. Have you, in fact, authored some of those articles?
A. Yes, I have.
Q. How many articles have you authored on that subject?
A. I don't know. Ten, fifteen.
Q. Okay. Based on your training and experience,

your education and your review of the epidemiology literature, including the ones that you've authored, do you have an opinion, Doctor, on a more probable than not basis, whether benzene can cause multiple myeloma?
A. I have an opinion. And my opinion -
Q. What is that opinion?
A. And my opinion is that exposure to benzene or other petroleum products does not increase the risk of multiple myeloma.
Q. Is it important for your opinion the amount or the dose of benzene with regard to its causal relationship to multiple myeloma?
MR. CONNOR: Your Honor, I'm going to object to the leading.
THE COURT: Overruled.
You may answer that.
Q. (By Mr. Runyan) Do you recall the question?
A. Yes. And when I look at all the studies, basically, I don't see any increase in any study at all. So to that extent, the risk of multiple myeloma is not dependent on exposure level, no.
Q. Now, I'd like to go through with you, are you prepared to discuss at least what you consider to be the important studies that are the basis for your opinion?:
A. Yes, I am.

Q. Okay. And, again, have you prepared pieces of paper that have the relevant information that you think is important with regard to analyzing these epidemiology studies?
A. Yes.
Q. I've put a -- I'm going to call it a slide because I don't know what else to call it -- a slide up with regard to cohort studies of multiple myeloma and exposure to benzene. Could you discuss with the ladies and gentlemen of the jury those studies and why you think they support your opinion?
MR. RRISPIN: Objection.
MR. RUNYAN: I heard that.
Q. (By Mr. Runyan) Go ahead.
THE COURT: Well, I'm waiting to hear from Mr. Connor.
MR. RRISPIN: That's correct.
THE COURT: I assume you're communicating with your co-counsel, not to the Court?
MR. CONNOR: Yes, he was communicating that to me, Your Honor, and I am not objecting at this time. I don't know where he's going with this answer.
THE COURT: That's fine. He-may answer the question.
Q. (By Mr. Runyan) Do you recall the question now?

A. Yes. These are what we call cohort studies of workers exposed to benzene. And there are about four or five of them.
MR. CONNOR: The problem with this is it's open-ended, it's compound. He's put a great deal of material on the screen and he's going to give a lecture. And, certainly, it seems to me at this stage that we should be proceeding on a question and answer basis. .
Q. (By Mr. Runyan) What cohort studies related to multiple myeloma and benzene do you think are important, Doctor?
A. The studies that I listed over there.
Q. And is it important to know the size, the cohort size, with regard to those studies?
A. Yes.
Q. Is it important to know the observed deaths or what occurred with regard to multiple myeloma?
A. Absolutely. We need to find out how many cases of multiple myeloma in those studies.
Q. Is it also important to know the expected deaths in the population?
A. Yes, because without it we have nothing to compare to.
Q. And if you know the observed and the expected and the cohort size, can you calculate the SMR?

A. With a simple calculator, yes, I can. Without that, I don't know.
Q. And is it also important to know the confidence level given the size of the studies?
A. Yes. And it's not showing on the screen.
Q. All right. I'm sorry. Can you discuss that, then, with the ladies and gentlemen of the jury with regard to these studies?
A. The very first study I put down there is a study that I published about ten years ago. It's a study of -
MR. CONNOR: Your Honor, I'm going to object. I don't know what he's discussing.
THE COURT: I think he's about to discuss the studies one at a time. But let's take them one at a time and then ask him a question.
MR. RUNYAN: Do you want me to cover up the other ones, Your Honor?
THE COURT: No.
Q. (By Mr. Runyan) The first study is a study that you authored, Dr. Wong?
A. Yes.
Q. In 1987?
A. Yes.
Q. And what were you studying, what type of workers?
A. I studied about 4,000 chemical workers exposed to

benzene.
Q. Okay. And can you go through and explain what you think is significant with regard to that study and your opinions about multiple myeloma and exposure to benzene?
A. In that study we actually observed or recorded three cases, three deaths, due to multiple myeloma. And based on the size of the study, the number of people we had in the study, the age and how long we observed them, remember, we observed them for many, many years, we estimate that based on the general population rates for multiple myeloma, that group would have about 2.58 cases of multiple myeloma. Okay? So basically, we're comparing three observed to 2.58 expected.
Q. Now, the SMR, then, is 1.16?
A. Yes.
Q. And that is above one?
A. The SMR is simply the ratio between three and 2.58.
Q. And that's an elevated risk, is it not?
A. Well, they expect two or three because that's based on a calculation, you can be a fraction of a death. But when people die, they die in whole numbers, so it's either two or three. So when you do the ratio, of course it comes out to 1.16, but what you're saying really is there is no difference between three and 2.58.

Q. Is the confidence level important with regard to the significance of the SMR?
A. Yes, because the 95 percent confidence interval in that study is from about point two to three point something, which includes what? Meaning there is no significant increase. So the first study that I did basically says that people exposed to benzene have the same risk of multiple myeloma as the general population.
Q. Now, the second study has two people listed. Is it Dr. Rinsky?
A. I don't think he has a doctor degree.
Q. Okay. Mr. Rinsky and yourself. Is this the pliofilm study?
A. This is the so-called NIOSH, the National Institute for Occupational Safety and Health, study.
Q. But this is the one study on the pliofilm workers in Ohio?
A. Yes, sir.
Q. Can you discuss with the ladies and gentlemen of the jury the significance of that study to your opinions?
A. That study consists of workers exposed to very high levels of benzene. And in 1987, Robert Rinsky and NIOSH published the result of multiple myeloma. Basically, he reported four cases of multiple myeloma and expected about one case, just a little bit above one case. So the

Rinsky shows about four. And the 95 percent confidence interval is from 1.1 to about 10.5. So the lower limit in this case is actually above one. So based on the result, we say there is a significant increase of multiple myeloma in that study.
Now, that study was based on data through 1981.
Subsequently, the data has been updated by NIOSH through 1987 and I have the data and analyzed the data. .The number of observed multiple myeloma for the updated data, okay, we're talking about 1987 now instead of stopping the observation in 1981, in the updated data I still have only four cases. In other words, there was no new cases of multiple myeloma reported in the study.
But because we extended the observation for another six years and also the group of people aged over the years, of course we expect more cases now. Instead of 1.01, now we expect 1.37 cases. And when I compare 1.37 to four, the risk ratio becomes 2.9 and is no longer statistically significant. Because the 95 percent confidence interval now is from point seven to about seven. So based on the latest data, the updated data, there is no significant increase even in the NIOSH study.
Q. With regard to the four workers who did develop multiple myeloma, was there a dose response to any exposures to benzene?

A. No, there was not. In fact, out of the four multiple myeloma deaths, three of them were short-term workers. One supposedly worked at that place for only four days.
Q. And why is that important?
A. Well, I don't know how long the guy lived, but certainly four days out of his lifetime is not a significant number. We don't know what else he was exposed to.
Q. Of the other three people who died, what were their exposures? Besides the one you talked about before who had four days.
A. I'm not sure I understand your question.
Q. Of the four people at the pliofilm plant who developed multiple myeloma, besides the person who had the four-day exposure, what about the exposures of the other three?
A. Well, I list the three out of the four as shot-term workers. One worked there for nine months, another one worked there for one and a half years. So all of them are really short-term workers. When we do a study, most of the time we will not even include people with less than six months or under one year of exposure.
Q. Now, we're talking about the cohort studies.- And another study that you've listed that you believe supports

your opinion is the Bond study. Can you discuss the Bond study with the ladies and gentlemen of the jury?
A. The Bond study is a study of Dow Chemical workers and their exposure to benzene and other chemicals. It's a rather small study, only about 900 people. And Bond reported one case of multiple myeloma, only one case. And he did not calculate expected. When you read the paper, you cannot find the number expected, he did not report that. But he did say that the one case of multiple myeloma does not represent an excess. So most likely, the expected is around one or something like that. And when you compare one to that number, there is not an increase.
Q. Have you ever called Dr. Bond to see whether or not he made any calculations with regard to expected deaths?
A. No, I have not.
Q. Would that be appropriate, epidemiologically?
A. Well, regardless of whether he calculates it or not when you have only one case, there's not a whole lot you can talk about. So I would not put too much weight on that study, even though Bond said there is no excess.
Q. The next study you have listed is the Decoufle study? .
A. Decoufle.
Q. Can you please tell the ladies and gentlemen of

the jury the significance of that study with regard to your opinions?
A. It's an extremely small study of workers at a Baltimore refinery, later on turned into a chemical plant. And, again, only one death due to multiple myeloma was reported. And Decoufle did not report the expected. So, again, that study does not tell us a whole lot other than that there's only one multiple myeloma.
Q._ The final study that you have listed is the Yin study, correct?
A. Yes.
Q. And that's a study of workers in China?
A. Yes.
Q. Is that the largest study of people who might have been exposed to benzene?
A. In terms of number of people, it certainly is the largest study, yes.
Q. And why is that important to your opinions?
A. Well, it's one of the studies that the exposure is benzene. And we're talking about benzene workers so I included that study.
Q. Now, one thing that I don't know that I understand, so I'm going to ask, you see in your follow-up on the Rinsky study, you have an $HR of 2.91?
A. Right.

Q. And that is in excess of one?
A. Yes.
Q. And if it's in excess of one, that means you did find an increased risk of multiple myeloma in the people that you studied?
A. Yes.
Q. And yet you say that it's not significant and I don't understand that. Can you explain that to the ladies and gentlemen and to me?
A. Because the 95 percent confidence interval ranged from about 0.8 to 7.5, that includes one. What we are saying is based on the sample size, based on the study size and so on, we cannot say that the risk is different from one. Because the 95 percent confidence interval includes one.
Q. You have to remember I became a lawyer for certain reasons and it wasn't because math was my strong suit.
- Save you, Doctor, also done studies yourself or at least done analysis of studies with regard to petrochemical workers and petroleum workers that is important to your opinion with regard to benzene and multiple myeloma? .
A. Yes, I have. The group of studies that we just looked at are what we call chemical workers exposed to

benzene. Another group of studies that we should look at would be petroleum workers who are exposed to gasoline, crude oil and so on, different petrochemicals which consist of benzene.
Q. And have you done something called a meta-analysis with regard to those studies?
A. Yes, I have.
Q. And can you explain to the ladies and gentlemen of the jury what a meta-analysis is?
A. A meta-analysis is just a summary of all the studies, of similar studies, you put them together. One of the things that we talked about is how reliable a study is depends on, and one of the things would be how large the study is When you have a whole bunch of small studies and they state the same thing, then you have to think maybe they are telling me something, somehow I need to be able to combine those little studies to make it a bigger database to say something. So you want to take the consistency of results into the equation.
And meta-analysis does exactly that. When you have a whole bunch of studies on the same kind of people with the same kind of exposure, you combine them in a meta-analysis so that you have more confidence in the combined result.
Q. And it looks like you combined about fourteen

studies?
A. I didn't count. Probably about, yeah, about fifteen to twenty studies over there.
Q. And how many workers in total were included in this meta-analysis?
A. 250,000 workers. So it was a huge, huge database including petroleum workers from the United States, United Kingdom -- what else do I have? -- Canada and Australia.
Q._ -And what did this show once you combined all of this? Just generally what did it show with regard to the incidence of multiple myeloma and petroleum workers?
A. If you can show the next chart?
Q. Did you break it down as per each division of studies, for example, refinery, distribution, et cetera?
A. Yeah, first I combine all the studies of refinery workers in the United States, in the U.K. and Canada and so on. And that is the result. I apologize, you probably cannot see very well.
The first column is the study number, what we call cohort number. The second one, column, is which country the study comes from. And the third column is the number of observed multiple myeloma deaths. And the next column is the number of expected multiple myeloma deaths. And the next column is the risk ratio. Okay. And the last column is the 95 percent confidence interval.

Q. Maybe what I'll do -- well, I guess I can't do it that way. What did you determine with regard to the petroleum workers in the refinery division with regard to the incidence of multiple myeloma? You can come down if you need to.
A. I can't see from here.
Q. I don't know how to make it any bigger.
A. When you look at this column, which is the SMR, the relative risk for different studies, it ranges from anywhere between -- the resolution is not very clear, I'll read from here -- anywhere from 0.77 all the way to about 1.5. So there's some studies below one, some studies slightly above one. But when you combine all of them and give more weight to a large study and less weight to smaller studies, you come up with the bottom line, okay, this number, if I can -- you can all read that. When you combine all the studies, relative risk is 0.92. So that's very close to one. And this 95 percent confidence interval is from 0.77 to 1.09 so it does include one. Actually, the SMR is slightly less than one.
So what we're saying is when we combine all of the refinery studies, refinery workers exposed to gasoline and so on, when we combine all those studies, we don't see an increase in multiple myeloma. And the 95 percent confidence interval is very narrow. That means we have a

fair amount of confidence in the study. Because we're talking about a huge, huge database consisting of 250,000 workers.
Q. Did you also do that for petroleum workers in the distribution division?
A. Yes. Distribution workers are workers who are responsible for the transportation of, for example, gasoline or crude oil from one place to another. And there are four-studies in the area, two U.S. studies, one U.K. study and one Canada study.
I did both U.S. studies. The first one is on what we call land based workers. These are the people that drive the tank trucks from the tank farms to the service stations, loading and unloading gasoline and so on. And the second study is what we call marine workers. These are the people who work on barges and tankers and are exposed to gasoline and crude oil and so on.
Notice they're very similar. In the first study the risk ratio was .87 and the second study on marine workers was 0.7. That's the U.S. study. A similar study 4n the U.K., the risk ratio is 0.92.
Q. Doctor, we're going to have to be quicker because we're running out of time here.
A. And the last one is from Canada, one of the . smaller studies. The risk ratio was 1.8.

But when you combine all of them, the risk ratio is 0.9 and there is no increased risk for people who are responsible for the transportation of gasoline and other petroleum products.
Q. How about in the production and the pipeline division?
A. They're the people responsible for the exploration and most of them would be exposed to crude oil. And there were two studies, one in the U.S. and one in Canada. And when you summarize those two studies, combine those, you have a risk ratio of .6.
Q. Did you also break it down by country?
A. This is really a summary of all my results. If . you look at U.S. refinery, combine all the refinery studies, you have a total of 116 deaths from multiple myeloma and expect 120. So the risk ratio is about 0.97, there is no increased risk.
When you combine all of the refinery studies from the U.S., U.K. and Canada, the observed number goes up to 145 but, at the same time, the expected goes up to 157. so, again, the risk ratio is about 0.9 and there is no increased risk.
Now, for the distribution, we talked about that, the distribution in the U.S., U.K and Canada, we have ;a total of 48 observed deaths and 51 expected. So, again,

the risk ratio is 0.9.
When you combine all this, combine all the
divisions, refining, distribution and pipeline, we have a
, total of 205 multiple myeloma deaths, we observed 205. And
based on 250,000 workers and their age, we expect to see
220. Okay? So actually, .we have a risk ratio slightly
less than one, 0.79.
So based on this huge database, we just don't see
any evidence of an increased risk of multiple myeloma.
Q. Did you also go to certain refineries and break
down the data with regard to certain refineries?
A. Yes. One of the things that we asked ourself was
when we have this huge database, are we missing something,
have we left out something. So what we did was we went
back and looked at each specific study and said, okay, some
of these studies reported an increase of leukemia before
and we know that benzene can cause leukemia. If I single
out those studies which reported an increase of leukemia
before and look at these refineries and see whether they
have an increase of multiple myeloma or not, that would
give me a better answer to the question of benzene exposure
and multiple myeloma. And when we did that, we identified
three refineries which have an increased risk of leukemia:
Okay. In terms of leukemia, the three refineries
give us a total of 43 observed deaths, leukemia deaths, and

the expected is only 22. So the risk ratio is 1.9, close to two, and yet statistically significant because the 95 percent confidence interval rates from 1.3 to 2.5. So, indeed, when we look at the study, we identified three refineries with a significant increase of leukemia. The question is, do the same refineries have an increased risk of multiple myeloma. And when we do that, we observed 29 multiple myeloma deaths and expect 28 point something and the risk ratio is about one.
So based on this analysis, there is absolutely no increase of multiple myeloma even among those who have an increased risk of a leukemia.
Q. Have you also looked -- is your opinion also based on case control studies?
A. I also looked at case control studies. But case control studies are not as good as cohort studies. But regardless, I did look at case control studies. And the results are consistent with what I have.
And here I list a number of case control studies and they range in size from 100 to about 1,000. And sometimes the exposure is not very specific. Sometimes the exposure is benzene, sometimes the exposure is solvents. But when you look at the risk ratio, they range from anywhere from about 0.5 to 1.2 and none of them was statistically significant. So -I I

Q. Let me interrupt you just for a second. We talked about one of these this morning, I think it's the Linet study. And it was represented to the jury that the SMR in that one was 3.7, is that correct? That's different from what you have listed up there.
A. In the Linet study, she reported a risk ratio for different occupations and for different chemicals. I believe that 3.7 refers to petroleum products: But Linet also was .saying a relative risk for benzene specifically. So for benzene exposure, it's actually 1.1.
Q. Based on your review of these and other studies, Doctor, are you prepared to discuss the Bradford Hill criterion and what you believe the studies show with regard to the relationship between benzene and multiple myeloma?
A. Yes. I want to go back and apply the Hill criteria of causation one by one to the data that we have on the multiple myeloma.
Q. Please do so.
A. Make it smaller.
Q. I'm trying.
A. The very first one, strength and significance of association. We have looked at about 30, 35 studies in total and none of the studies reported a significant increase of multiple myeloma. None of the studies. Okay. There was one study, based on the old data, there was a

marginally significant increase.
Q. That's the Rinsky study?
A. That's the Rinsky study. When we updated the
. study, that significance went away. Okay? So the strength
and significance of association, you have to remember there
is no study reporting a significant increase at all.
Now, the second criteria, consistency of
association, it's very consistent. More than thirty
studies pointed at the same direction, except maybe with
the exception of one. And that was the Rinsky study, an
old study. And that one, we know three out of four
multiple myeloma deaths were short-term workers, including
one guy who worked there for four days. So there is no
dose response relationship.
The third criteria, specificity, we've got to use
as specific information as possible in this case. We have
to talk about multiple myeloma and nothing else, no other
disease. In terms of exposure, we need to talk about
benzene and gasoline and so on, people who work in the
petroleum industry. Okay? And not painters, not furniture
workers.
Q. Why shouldn't we talk about painters and
furniture workers? :-.
A. Because painters and furniture workers are
exposed to a whole range of chemicals in addition to or

besides benzene. We don't know what else they're exposed to. If I want to look at someone whose job is a seaman, then we look at people with the same job title, the same industry, the same occupation. That is what we call specificity.
The next criteria is dose response. None of the studies we have demonstrate a positive dose response. In other words, the more gasoline you're exposed to or the more benzene you're exposed to, the higher the risk of multiple myeloma. So we have not seen any of that at all.
And the last one, latency, simply says we need to allow ourselves enough time for the disease to develop. And in all those studies, we have an observation period of more than 30, 40 years, so an adequate latency has been allowed.
So based on all the criteria, my conclusion is there is absolutely no evidence of a causal relationship between benzene exposure or petroleum exposure and multiple myeloma.
Q. We had some studies discussed this morning and they're listed on the board. Are you familiar with these studies?
A: Most of them, I think.
Q. I don't think number six is a study, I think that's a textbook.

MR. CONNOR: I wonder if we could have the doctor testify to this, Your Honor?
THE COURT: Sustained.
Q. (By Mr. Runyan) We've already talked about the Rinsky study. Is there another study that you could discuss with the ladies and gentlemen of the jury and discuss what you believe that study shows?
A. Well, some of those studies are not specifically on benzene or on petroleum products. For example, the study I believe in Sweden, the third study -
Q. Schottenfeld?
A. No, the third study.
Q. Lundberg?
A. Lundberg. That study is based on painters. And like I said, painters are exposed to different chemicals. So I don't think that one is appropriate. If we do want to include a painter study, then we need to include not just one study, we need to look at all the studies of painters.
Q. How about rubber workers, is it appropriate, in your opinion, to include a study on rubber workers?
A. More correctly we should say rubber tire workers.
Q. Are there other studies other than the Delzell study on rubber workers?
A. There must be thirty, forty studies on rubber tire workers. There is a huge, huge study at UNC at Chapel

Hill, the University of North Carolina. And, again, you know, number one, I don't think rubber tire worker studies are appropriate to address the case here because they're exposed to different chemicals. Okay. And even if we allow rubber tire worker studies to be included in the analysis, then we need to include all other forty studies of rubber tire workers, we cannot just selectively include one or two studies.
Q. Is there any other study that you'd like to discuss that's listed up here?
A. Well, number eight is kind of interesting.
Q. That's the Massoudi study?
A. Massoudi. And that's a study on Union Carbide workers in West Virginia. That study is on the entire facility, the study did not address specific chemical exposure. There is another paper published earlier talking about specific exposures of the same group of workers. And in that study, in the more detailed study, they analyze multiple myeloma risk in terms of exposure to different chemicals. For benzene exposure, the relative risk was 1.4, it's not 2.39.
THE COURT: Mr. Runyan, just so you're not surprised, how are you doing?
MR. RUNYAN: We're getting there, Your Honor.
THE COURT: About ten minutes.

MR. RUNYAN: I was looking for Dr. Infante's chart.
Q. (By Mr. Runyan) Are you familiar with the studies, Doctor, that are listed on the left here?
A. These are the same studies that we talked about.
Q. And one of these is a study that you authored, isn't it, in 1987?
A. I authored two of the studies.
Q. Two of the studies. I'm sorry, my mistake.
A. I spent a lot of time on those studies.
Q. I didn't mean to dismiss them, it's just the time.
In your article that was published in 1987, was your expected zero?
A. No, it was 2.58.
Q. I won't cross it out but I'll put it above here.
A. And you know it cannot be zero, because what you're saying, if you take benzene out of this world, then multiple myeloma would disappear. That's what it says, okay? In the comparison group, there is no risk of multiple myeloma. In other words, if there is no benzene, there is no risk of multiple myeloma. That's what it says.
Q. Did you use the general population for that expected or the workers?
A. I used the general population. Because that is

the most stable.
Q. Isn't there a problem using the general population in that you're comparing the general population to the workers and that's an unfair comparison?
A. No, every study uses the general population.
Q. The Rinaky study, the expected in the Rinsky, did they use the general population?
A. Yeah, the Rinsky study used the general population.
Q. Now, the observed is the workers, correct?
A. That's the group that you study, correct.
Q. Why don't you use the unexposed workers in the expected as opposed to the general population?
A. Unless you have a huge, huge group of nonexposed workers, otherwise, the number from that group would not be stable, would not be a good comparison number. So most of the time you use the general population.
Q. Are you familiar with the Decoufle study and what was-expected?
A. The Decoufle study, actually, there's only one multiple myeloma death and not two. You can read the paper and it says one.
Q: How about the expected, how-many were expected?
A. Decoufle did not report the expected. So there is a none, not reported.

Q. So that was the NR in that, not reported?
A. Right. If you read the paper, nowhere can you find the 0.23.
Q. In the Bond study, do you agree with the observed of one?
A. Yes, there was one observed.
Q. Do you agree with the expected of point nine?
A. All Bond said was the one case does not represent an excess. So it can be point nine, it can be 1.1. I don't know what that -- he didn't report an expected.
Q. He did report an expected with regard to acute myeloid leukemia, did he not?
A. I don't remember.
Q. Would it be appropriate to use the expected for acute myeloid leukemia with regard to multiple myeloma?
A. No, because it's a different disease.
Q. With regard to the Yin study, do you agree with the observed of one?
A. The Yin study reported zero, there was no death due to multiple myeloma. And we're talking about mortality, so all these should be deaths.
Q. How about the expected of 2.5?
A: Yin did not report an expected. So we don't know what the expected is. But it should be a fairly large number because we have 7,000 workers in that study.

Q. Now, these have been added together to get an observed and expected and then a relative risk. You didn't do that on your slide?
A. No, I did not. Because, number one, we don't know the expected for these three studies so how can you add them up?
Is this Dr. Infante’s point? Somebody comes up with this number, it's not from the paper. That's all I can say. You cannot find those three numbers from the original study, in the original paper.
But regardless, if you want to add the numbers up, we should have these -- change this to zero, which is what Yin reported, and to one, which is was Decoufle reported. And if you do that, basically you're talking about seven, eight, nine, so you have a total observed of nine. And when you add all these numbers together, one, point seven, plus 2.58, that's a number that I know, okay? And I don't know what we do with these numbers. And if we add them up, I can't do it, but it should be between seven and eight. So again, you're comparing nine observed to an expected of between seven and eight and there is really no increase.
Q. Ms. Pyle will be happy to know that even you couldn't do it, Doctor, without a calculator.
In your opinion, Doctor, can an epidemiologist or

any medical doctor base an opinion that benzene or petroleum products caused multiple myeloma in Mr. Murray, or any other marine worker, based on the studies you have done?
MR. CONNOR: Your Honor, I'm going to object to this; form, foundation.
THE COURT: Overruled.
You may answer.
MR. CONNOR: Also object that this calls for a critique and that's not his function.
Q. (By Mr. Runyan) Do you recall the question, Doctor?
A. No.
THE COURT: Just a minute, I need to rule on the objection. I'll overrule the objection.
Do you want to restate the question?
MR. RUNYAN: If I can read it.
Q. (By Mr. Runyan) In your opinion, Doctor, can an epidemiologist or any medical doctor base an opinion that benzene or petroleum products caused multiple myeloma in Mr. Murray or any other marine worker based on the studies you have done?
THE COURT: Actually, hold on for just a second.
I'm going to sustain the objection with respect to what a medical doctor may or may not be able to do.

Q. (By Mr. Runyan) In your opinion, Doctor, can an epidemiologist base an opinion that benzene or petroleum products caused multiple myeloma in Mr. Murray or other marine workers based on the studies you have done?
MR. CONNOR: Your Honor, this is a hypothetical and it doesn't list all the factors. If he wants to give him all of the background and history and the relevant questions that were responded to.
THE COURT: I'll sustain that objection. And you'll need to take Mr. Murray individually specifically out of the question.
MR. RUNYAN: Your Honor, I'm not going to have a question when you're done with it.
THE COURT: You may or may not. Let's try again.
MR. CONNOR: Your Honor, the objection does not go just to Mr. Murray, it goes to the epidemiologist who is rendering the opinion. He may have other qualifications that would permit him to render such an opinion.
MR. RUNYAN: Well, I'm only asking about a hypothetical epidemiologist.
THE COURT: You may ask that question.
Q. (By Mr. Runyan) In your opinion, can an epidemiologist base on opinion that benzene or petroleum products caused multiple myeloma in a marine worker based on the studies you have done?

A. Yes.
Q. And what is your opinion?
A. My opinion is, based on all the scientific studies, that there is no increased risk of multiple myeloma among people exposed to benzene or other petroleum products, including marine workers.
Q. You're familiar with the studies on the easel right there?
A. Yes.
Q. In your opinion, do those studies support an opinion that multiple myeloma is caused by exposure to benzene?
A. They do not.
Q. And how about the studies we went through, do you want me to hold those up again? How about these studies, do they support an opinion that exposure to benzene causes multiple myeloma?
MR. CONNOR: This is repetitious, Your Honor.
THE COURT: I'll sustain the objection.
MR. RUNYAN: I don't think I asked the question specifically, Your Honor, but -
THE COURT: Are you about to finish up?
MR. RUNYAN: Just let me read this one. I think I'm done. Well, maybe not, Your Honor.
THE COURT: Does this mean, Ms. Pyle, you don't

have questions?
MR. DANIELS: This means we do not have questions.
THE COURT: Okay. Go ahead, then.
Q. (By Mr. Runyan) Have all of the opinions you've expressed today, Doctor, been to a reasonable degree of probability?
A. Yes.
MR. RUNYAN: Okay.
THE COURT: Thank you.
We will take our afternoon recess. Members of the jury, if you would please retire to the jury room, we will be at recess for fifteen minutes.
(Recess.)
THE COURT: Be seated, please.
We will bring the jury in.
(WHEREUPON, the following proceedings continued in the presence of the jury.)
THE COURT: Be seated, please.
Mr. Connor, cross-examination?
MR. CONNOR: Thank you, Your Honor.

CROSS-EXAMINATION
BY MR. CONNOR:
Q. Doctor, I want to touch on one thing before I get ' into your qualifications. I think the last thing you were pointing out was the Chinese study by Dr. Yin. Multiple myeloma is a very, very, very rare disease, is it not, in China, sir?
A. It's much rarer than in Caucasians.
Q. And do you know if Dr. Yin himself indicated that the report should not be taken to indicate anything significant in regard to multiple myeloma?
A. I don't know whether he said that or not.
Q. Do you know indeed, sir, if one of the people in the cohort died of a leukemia that had developed out of multiple myeloma? Are you familiar with that, that that was reported in the study by Yin?
A. There was a report of a case but no death.
Q. A case of what, sir?
A. Of multiple myeloma.
Q. Inasmuch as it was reported, do you think it's improper to list it as one?
A. Because we're talking about mortality studies. And when you do a meta-analysis, we need to make sure that we use the same kind of data. We cannot add deaths together with other cases.

Q. What is the life expectancy for a person with multiple myeloma, if you know?
A. It depends on the stage of diagnosis and so ' forth. I don't have the number.
Q. The Yin study was in 96, was it not?
A. It was in 96, but the study actually ranged over ten, twenty years.
Q. So it was reported in 96 but, indeed, it was referring to people even prior to that time?
A. Yes, sir.
Q. How many multiple myeloma were in the controls?
A. Are we still talking about the Yin study?
Q. Yes. I thought we'd spend some time on that before we got to your qualifications.
A. I don't remember Dr. Yin reporting that.
Q. As a matter of fact, they didn't list it, did they?
A. I don't think they did.
Q. So your answer isn't you don't remember, it's that they didn't list it?
A. I don't think they reported that, sir.
Q. Did they list the expected?
A: No, he did not.
Q. You are an epidemiologist and you work for your firm called Applied Health Sciences?

A. Yes, sir.
Q. And you have indicated that the work you do is for industry?
A. I didn't hear the last.
Q. You have indicated, I believe, that the work you do as an epidemiologist is for industry?
A. Because my special area is in occupational epidemiology, therefore, I work with the industry.
Q. I know what your reason is that you give for why you do, but, in fact, you are an industry epidemiologist, are you not, sir?
A. An occupational epidemiologist.
Q. You have been contracted to perform services by the API, the American Petroleum Institute?
A. Yes.
Q. And you know that Texaco is a member of that organization?
A. Yes.
Q. And, in fact, you have had a number of studies that have been commissioned or funded by the American Petroleum Institute, is that correct?
A. Yes.
Q: One of those would be the Regulatory Toxicology and Pharmacology, by yourself and Gerhard R. Raabe?
A. Are you referring to a paper?

Q. Yes.
A. A paper that I wrote?
Q. That you wrote along with Gerhard Raabe.
A. Dr. Raabe, R-A-A-B-B.
Q. Yes.
A. Yes, Dr. Raabe. And actually, that one was sponsored by Mobile. Jerry Raabe is an employee of Mobile and I wrote the article with Jerry Raabe.
Q. And Mobile is a member of API?
A. Yes, sir.
Q. API also funded a project for you to write some comments on the so-called Chinese benzene study?
A. Yes, sir.
Q. Has that ever been published?
A. Not yet.
Q. Who funded the paper published by the Journal of American Medicine this year, the one that was published in that on the update mortality of workers at the petroleum refinery in Beaumont, Texas?
A. That study was done by Dr. Raabe at Mobile and I was a consultant to him in that process.
Q. Again, that was funded, of course, by Mobile if he was-at Mobile?
A. Yes, and it's a study of Mobile employees.
Q. And the Occupational and Environmental Health in

96, an Updated Cohort Mortality Study of Workers at a Northeastern United States Petroleum Refinery?
A. It's not published in a journal, it's published in the International Archives of Occupational and Environmental Health.
Q. And that was a Mobile study?
A. That was a Mobile study, yes.
Q. The Health Effects of Gasoline Exposure.
I. Exposure Assessment for U.S. Distribution Workers?
A. That study was actually done by Professor Thomas Smith at Harvard University. And I was a co-author of that study. The study was funded by API.
Q. Right, there was Smith and yourself and also a Katharine Hammond. And that study was again funded by API?
A. Yes, sir.
Q. Now, you've indicated that part of the reason why you do articles and, of course, it is important for peer review, is that correct?
A. Yes.
Q. And you indicated, I believe, that there is 122, you thought?
A. About 120 articles.
Q: 120. I think I have 121. But I'm going to go over a few of the more recent ones.
Your study on the Risk of Acute Myeloid Leukaemia

and Multiple Myeloma in Workers Exposed to Benzene, was that submitted to several journals before it was published?
A. No, to give you the history of that -
Q. I'm not asking you for the history, sir. Your answer is sufficient if it's no. Did you submit that to any journal that rejected it in its form?
A. It was submitted to one journal and they thought it was too long.
Q. And it was rejected, sir?
A. Because of the length.
Q. And you had to resubmit that to another journal?
A. I shortened it and submitted it to another journal, yes.
Q. And, let's see, there's one you did with Ragland also. I think it's number 88 in your CV. Was that ever published?
A. I can't remember the number. If you can read the title to me?
Q. Well, did you do more than one with Ragland?
A. I believe so.
Q. Was there one that was not published?
A. I don't know which one you're talking about.- If you can't read the title, I can tell you.
Q. I don't have time, sir.
How about Cooper and Wong,, a Study of Mortality

in the Population of Nickel Miners and Refinery Workers, submitted in 1988?
A. That one was not published because in the middle of all this Dr. Cooper retired.
Q. The paper was completed?
A. It was completed and submitted to the sponsor and was widely circulated.
Q. And never published?
A. No.
Q. Yes. Epidemiology and Toxicology, A Quantitative Risk Assessment and Quantitative Approach. Submitted for publication?
A. Who was the first author on that paper?
Q. You don't recall that paper?
A. I think the first author of the paper was Susan Ostland. And she asked me some questions and she put my name on the paper and I don't know what happened to that paper. I was not the first author, I can tell you that.
Q. Is that how things are done, that they call you up and talk to you, ask to put your name on the paper?
A. They call me up and discuss some of the issues and sometimes they say, "You've given me enough help, do you want your name on the paper?" Sometimes I say yes, sometimes I say no.
Q. How about Wong, Wortharton, Morgan and Gordon,

Specific Mortality and Morbidity Among Paper Mill Employees, was it submitted for publication?
A. I think it was later published.
Q. Later published?
A. Yeah. It was presented at a meeting and then published later on. A paper mill paper, yes.
Q. How about Wong and Foley, Assessment of Lung Cancer Risk by Histologic Category in Workers Exposed to Chlorinated Chemicals?
A. We didn't get enough data. We submitted the paper and they said, "There's not enough data to justify the paper," so we never went back.
Q. How about the next case, Assessment of a Cohort of Landbased Terminal Workers Exposed to Gasoline in the Petroleum Industry? .
A. We did publish some of the results in my 1997 paper on multiple myeloma.
Q. When you say "we," who is that?
A. Myself and Raabe, as published in Regulatory Toxicology and Pharmacology.
Q. When was that published, very recently?
A. 1997, I believe.
Q: Doctor, it is true that when you write one of these papers, the industry pays for it? Is that correct?
MR. RUNYAN: Objection to the form of the

question.
THE COURT: Sustained.
MR. RUNYAN: Improper.
. Q. (By Mr. Connor) Who pays for your time to write all those papers?
A. In terms of writing the paper, actually nobody pays for the time. But the underlying study was sponsored by the companies.
Q. Doctor, have you ever testified for a plaintiff, an injured plaintiff?
A. A few times, yes.
Q. When was that?
A. I can think of two or three times that I testified.
Q. When?
A. The last one was about five years ago.
Q. What was the name of that case?
A. I don't remember the name of the case.
Q. Have you ever said anything different?
A. Said anything different in terms of what?
Q. In terms of not testifying for plaintiffs ever?
A. It depends on what cases you're talking about. I have never testified in a case regarding benzene exposure, that is true. But you asked a very general question, I gave you a very general answer.

Q. All right. Have you ever been funded by a university or college? Have you ever done a research paper for a university or college since you left Georgetown?
A. I don't think universities would fund any studies, per se. They are on the receiving end, they don't give out money for studies.
Q. Well, have you, as a member of a faculty of a university, ever applied for and obtained a grant to do a study?
A. No, I have not.
Q. You indicated that you are on the faculty of Tulane University and you are a visiting professor at one of the medical schools in Taiwan?
A. Yes, sir.
Q. Do they pay you a salary?
A. No, they pay my expenses. I don't get a salary from them.
Q. And by "expenses," you mean they give you travel money?
A. Yes.
Q. So you don't receive what would commonly be understood as a salary?
A: No.
Q. When you travel to a courtroom like this, do they pay your expenses?

A. Pay for my time and expenses, yes.
Q. Who does?
A. Whoever.
Q. Not Tulane University?
A. Not Tulane, no.
Q. Not the Korean or the Taiwan medical school?
A. I have nothing to do with Korea.
Q. Does the medical school in Taiwan pay your expenses?
A. To go there and teach, yes.
Q. No, to go here and testify?
A. Of course not.
Q. What do you charge an hour?
A. $380. an hour.
Q. Where does your general income come from as to Applied Health Sciences?
A. From doing studies, contract research.
Q. For the industries?
A. Mostly for the industries.
Q. Well, who else do you do them for?
A. Well, I also consult to the government. I sit on committees, expert panels for the government.
Q. Yes, you did testify one time before OSHA,, didn't you?
A. I testified many years ago in front of OSHA, yes.

Q. How much did you get for that?
A. I don't remember.
Q. Not very much, was it?
A. No.
Q. What is that last, I think it's your last paper that you published, what's the name of that, again? In 97, how much did Mobile Oil pay you for that?
A. I don't know how many hours I spent on it.
Q. I'm just interested in how much they paid you?
A. I don't remember.
Q. Well, do you recall your previous testimony at your deposition in this case? If I could give that to you and refresh your recollection. Just look up there in the top and you'll see a couple of questions and answers and that should refresh your recollection. It was only a couple months ago.
A. Okay.
Q. How much did they pay you?
A. For doing the study?
Q. Yes.
A. About 25 to 30,000.
Q. You submitted a letter to the Journal of the* National Cancer Institute, Volume 90,-Number 6, on March 18th, 1998, is that correct, sir?
A. Yes.

Q. And that was regarding benzene and the dose-related incidence of hematologic neoplasms in China?
A. Yes.
Q. Is that one of the papers that you were commissioned to do or is that something different?
A. Nobody commissioned that one.
Q. And you've commented on a report by Hayes, "Hayes, et al, reported a nonsignificant relative risk for non-Hodgkin's lymphoma with a NHL of 3.0 among Chinese workers exposed to benzene and other chemicals," is that correct, sir?
A. Well, I didn't really comment on Richard Hayes' article.
Q. And you also commented on a second study consisting of 1,165 men exposed to relatively high levels of benzene, up to several hundred ppm, at two rubber hydrochloride plants in Ohio, is that right, sir?
A. Do you have a citation?
Q. I think I just mentioned the citation. I gave you the journal, the date it was published, it was March 18th, 1998, and I gave you the title. You don't recall this letter?
A: It's the same article you're talking about?
Q. Yes.
A. In that article --

Q. You do recall it?
A. -- I refer to Richard Hayes' comment on my study.
Richard Hayes did a study -
Q. Sir, I'm just asking you if, indeed, you did have a letter that commented upon a report by Mr. Hayes, and also a second study, and did you have such a letter that was published?
A. I have a letter to the editor on the Hayes article but I did not comment on the study that you mentioned.
Q. Well, didn't you indicate that, "Further supporting evidence is that there is no association between benzene exposure and NHL, which comes from case control studies summarized in table one"?
A. You're switching to case control studies now, not the -
Q. I'm just reading from your article.
A. I understand. I understand. But you're changing your, question to another area.
Q. Okay. You said in a cover letter, did you not, which listed your affiliations -
A. Cover letter?
Q: Yes. Did you list your affiliations in that paper?
I'll show you something. Maybe you can identify

and recognize this.
Did you send that in along with the paper?
A. Yes.
Q. And what are your affiliations listed on that document?
A. Well, I mean, I am an epidemiologist at Applied Health Sciences. I also have an appointment at Tulane University.
Q. Do you indicate in any way that you are associated with the industry that has conducted these studies?
A. In the acknowledgment, yes.
Q. What?
A. Not on the cover page. I talked to one of the editors.
Q. You mean you enlarged upon that when you talked to one of the editors?
A. The editors e-mailed to me and asked who paid for the studies and I responded.
Q. This states, "The study described in 2.3 was sponsored by the"
MR. RUNYAN: Your Honor
THE COURT: Just a second.
MR. RUNYAN: I want to object to this. It's improper. I don't see what the relevance is.

THE COURT: I'm going to overrule the objection.
Go ahead.
Q. (By Mr. Connor) "Editor's note. The study described in 2.3 was sponsored by the Chemical Manufacturers Association. The study described in 7 was sponsored by the American. Petroleum Institute. In addition, Dr. Wong has served as paid consultant to the petroleum and chemical industry."
Is that the editor's note?
A. I supplied the information to the editor, yes.
Q. Well, that's highly unusual for an editor's note of that nature, is it not?
MR. RUNYAN: Objection.
Well, go ahead.
MR. CONNOR: You're withdrawing the objection, I take it?
THE COURT: It sounds like it.
Go ahead, you may answer the question.
Q. (By Mr. Connor) Is it highly unusual? And I think you can answer that yes or no, sir.
A. It's not unusual at all.
Q. There was a response also filed in your letter, was there not, sir?
A. A response from Dr. Hayes, yes.
Q. Well, Dr. Hayes, Martha Linet, Mustafa Dosemeci,

and Song-Nian Yin. Wasn't that a joint response filed by all four of them?
A. Those four were among the authors of the original paper, yes.
Q. Yes. Those authors are listed and their affiliations are listed as being with the National Cancer Institute at Bethesda, Maryland, isn't that correct, sir?
A. Yes, sir.
Q. And did they have this to say -
MR. RUNYAN: I'll object, Your Honor.
MR. DANIELS: Objection.
MR. RUNYAN: Totally improper.
THE COURT: Sustained.
Q. (By Mr. Connor) They did have some comments about your evaluation that were negative, is that correct, sir?
A. No, sir. In fact, they agree with my comments. If you read the last paragraph of their conclusion -
MR. CONNOR: Well, Your Honor, under those circumstances, I think I am entitled to go into this.
MR. RUNYAN: I don't understand how that makes it relevant, Your Honor. It opens the door. He asked the question.
MR. CONNOR: He's indicated they agree with him and the body of this letter does not agree with him.

MR. DANIELS: He can't open his own door.
THE COURT: I'm going to sustain the objection.
MR. DANIELS: Thank you.
Q. (By Mr. Connor) Well, as to the last sentence, did they state -
MR. RUNYAN: I'll object, Your Honor. This is improper.
THE COURT: Sustained.
Q. (By Mr. Connor) Sir, you also wrote, along with others, An Industry-Wide Epidemiologic Study of Vinyl Chloride Workers, 1942 to 1982, is that correct, sir?
A. Yes, sir, I published that I believe in 1991, yes, sir.
Q. And you published this along with Donald Wharton, Donna Fullert and David Gregard (phonetic spellings), but you were the lead author?
A. Yes, sir.
Q. This is a 17-page study?
A. I don't remember how many pages.
Q. Well, you don't argue with my count, do you?
A. No, sir.
Q. And in the abstract of that study, did you find that vinyl chloride workers experience a significant mortality excess in angiosarcoma, 15 deaths, cancer of the liver and biliary tract, SMR 641, and cancer of the brain

and other central nervous system, SMR 180? Is that what's in your abstract or in your conclusion?
A. I don't know whether you finished reading the sentence or not, but I remember saying that, yes.
Q. And who was it that had commissioned that paper?
A. The study was sponsored by the Chemical Manufacturers Association. But nobody paid for the time that we actually spent on writing the paper.
Q. As part of your contract, did you have to submit that paper to the association prior to publication?
A. No, I never do.
Q. Did they confront you and allege that you had a duty and a responsibility to submit that paper to them?
A. After the paper got published, somebody from CMA contacted me and raised some questions.
Q. Yes. And, indeed, you were part of a conference call, were you not, on June 5th?
A. I don't remember a conference call, no, but somebody called me regarding my publication.
Q. Well, sir, were you part of a conference call that included members of the chemical board? I can supply you with those names if you feel it might refresh your recollection. Were you part of that conference call?
A. I don't remember that call, I remember a call. I don't know how many people called me.

Q. Was there a Robert Hinderer, part of that board,
that was on that call?
A. I don't even know the person.
Q. One of the things they raised with you is by
failing to submit a draft, you violated the contract?
A. If that's their interpretation, that's too bad.
As a scientist, I reserve the right to publish.
Q. Is that one of the things they raised?
A. I don't remember if they objected to that or not.
Q. Did they ask you to consider making some changes
to that report?
A. No, they subsequently, they submitted a letter to
the editor raising a couple of issues and asked me to
formally respond.
Q. Did they ask you in the telephone conversation,
sir, to make some changes to your paper?
A. No.
Q. Subsequently, a Dr. Shaw did write a paper that
critiqued your study, is that correct, sir?
A. I would not call that a critique; it's a letter
to the editor asking me to explain a couple of findings in
my study.
Q. And who is Dr. Shaw?
A. Dr. Shaw is an employee of CHA.
Q. .And what is his title?

A. I don't know what his title is.
Q. Well, indeed, wasn't he in charge of the committee?
A. He's in charge of some program. I don't know his title.
Q. Okay. Did you talk with Mr. Shaw when you were on the phone?
A. I remember him being in a conversation.
Q. Was he one of the people that was on the conference call?
A. Yes, sir.
Q. And did he indicate to you that there were some problems he thought with your conclusions and asked you to change your paper?
A. No, he raised a number of issues.
MR. RUNYAN: Your Honor, I think I've been fairly patient and lenient with this. I think this is totally irrelevant and I object. I don't think it has anything to do with the issues in this case.
MR. DANIELS: And asked and answered.
THE COURT: Well, that last question was asked and answered. I'm going to sustain the asked and answered objection.
Q. (By Mr. Connor) All right. Did you subsequently publish a letter to the editor that was three pages?

A. I published a response to Dr. Shaw's letter. I don't remember how many pages.
Q. And in that response, did you indeed say, . "Dr. Shaw's letter raises several issues of potential diagnostic bias on the brain cancer and emphysema findings" in your recent paper of vinyl chloride workers?
MR. DANIELS: Objection; reading the substance of the letter, it's improper.
THE COURT: Sustained.
MR. CONNOR: Your Honor, this is a letter that he, himself -
THE COURT: If we're going to go into it further, we can excuse the jury on your time, Mr. Connor.
Q. (By Mr. Connor) Did you, sir, in your paper, state that although you had previously reported a statistically significant increase of brain cancer, that you had reconsidered it in light of Dr. Shaw's concerns and you felt that, indeed, your conclusions in regard to brain carver could not be sustained?
MR. RUNYAN: Object to the form of the question.
MR. DANIELS: Objection.
THE COURT: Overruled.
You may answer that.
A. In my original paper, I never concluded that the excess of brain cancer was related to vinyl chloride

exposure, I simply reported an increase in the workers. We don't know the reason. And in my response, I mention that diagnostic sensitivity is one of the explanations. . On top of that, if you read my response to Dr. Shaw's letter, you will also discover that there was another study done by NIOSH, the National Institute of Occupational Safety and Health. They did a study of two of the largest plants in my study. Those two largest plants would account for maybe 70 percent of all the brain cancer deaths in my study. And their conclusion, this is NIOSH's conclusion now, NIOSH concluded there is no connection between vinyl chloride exposure and brain cancer. And my letter, my response to Dr. Shaw's letter to the editor, partly was based on the NIOSH result.
Q. (By Mr. Connor) Doctor, in your original paper, in your abstract, in the introduction, didn't you say, "The study confirmed that" -
MR. DANIELS: Objection, asked and answered.
MR. CONNOR: -- "that the vinyl chloride workers experienced a significant mortality excess in cancer of the brain and other central nervous system"?
THE COURT: Overruled.
You can answer.
A. Yes, but, sir -
MR. CONNOR: That calls for a yes or no answer.

MR. RUNYAN: Your Honor, he should be allowed to explain his answer.
THE COURT: He's answered. Go ahead, ask your next question.
Q. (By Mr. Connor) If it confirmed a significant excess, isn't that a bit more than saying, "I never drew a conclusion"?
A. I never drew a conclusion on the causation. I didn't say that, indeed, the brain cancer was caused by vinyl chloride exposure. I said there was an increase in the vinyl chloride workers and there can be different -12 reasons and diagnostic sensitivity is one of them. You have to make a distinction -
Q. Well, if you felt that way -
THE COURT: Mr. Connor, he's still answering.
A. You have to make a distinction between causation and simply reporting an observation. Reporting an observation, I agree with you, I did report an increase in brain cancer among vinyl chloride workers. But that is not the same as saying that, indeed, vinyl chloride caused the problem.
Q. (By Mr. Connor) Indeed, sir, that was a 17-page paper, .I think we established that. You could have put that in your original paper, could you not, sir?
MR. DANIELS: Objection.

THE COURT: Overruled.
You may answer.
A. I very clearly say there is an increase but I did not attribute that to the vinyl chloride exposure.
Q. (By Mr. Connor) You didn't deal with the NIOSH paper, did you?
A. The NIOSH paper was published in a proceeding that I was not aware of.
Q _ So you published a 17-page document and you weren't even aware of this other study that was out there?
A. Because it's not in the record journal.
Q. There were, at any rate, some other significant problems with the cohort in your vinyl study, was there not?
MR. DANIELS: Objection on relevance grounds.
We've gone pretty far with this.
MR. CONNOR: Not as far as I'd like to go.
There's considerably more.
THE COURT: Let's go to sidebar.
(WHEREUPON, a sidebar conference was held outside the presence of the jury.),
THE COURT: Okay. Mr. Connor, I don't know if you want to repeat the question?
Q. (By Mr. Connor) Dr. Joseph Wagoner, you are familiar with him, are you not, sir?

A. I know of him.
Q. And he is an epidemiologist with the National Institute for Occupational Safety and Health and the Occupational Safety and Health Administration in the 1970s?
A. I believe so.
Q. And was he one of the first outsiders that I believe spotted what he called a latency bias in your study?
A. - In my study?
Q. Yes.
A. I don't recall.
Q. Well, sir, you were aware of the fact and it was brought to your attention that the oldest vinyl plant in the country, in Charleston, South Carolina, which opened in 1938, gave the CMA contract researchers only records of workers who were still on the payroll or who had left the company during the last six years of the 30-year study period? That was brought to your attention subsequently?
A. No, it was not. Who brought that to my attention?
Q. You were not aware of -- well, let me show you something.
Can you identify, recognize .that, sir?
A. It's a newspaper.
Q. Can you identify and recognize that article?

A. It's an article about -
Q. No, I don't want you to say what it is. Have you seen that before?
A. I have seen that before, yes.
Q. And you know the body of that report, do you not?
A. I read part of it. I didn't read the entire article.
Q. You didn't read the part in that article about Dr. Wagoner?
MR. DANIELS: Objection.
MR. RUNYAN: Objection.
THE COURT: Sustained.
Q. (By Mr. Connor) Did you read the part in this article about Dr. Wagoner?
MR. DANIELS: Objection.
THE COURT: Overruled.
You may answer the question whether you read the portion in the article relating to Dr. Wagoner.
A. Dr. Wagoner made some comments about a study. But I was not aware of that before. Your question was, was I aware of it. No, I was not.
Q. (By Mr. Connor) I didn't say you were aware-of it prior to the time. But subsequent .to your report, you became aware that there was a significant latency bias: in the information you received, isn't that correct?

MR. DANIELS: Object to the form.
THE COURT: Overruled.
A. When you say "subsequent," what do you mean? I became aware of Dr. Wagoner's interest in the study only when I read the newspaper article.
Q. (By Mr. Connor). Well, it did come to your attention, did it not, sir, that the industry had been reporting false data to you?
A. _ Let me explain. That study was started a long time ago by Dr. Taylor Shore and Dr. Cooper. Both of them are retired now. And they gave me the data to do an update. That is the extent of my knowledge of the data.
Q. Doctor, in your recent publication, and there were two of them, I believe the last -- or maybe it's not your last one. Let me read the title on this. The Wong and Raabe, Multiple Myeloma and Benzene Exposure in a Multinational Cohort of More Than 250,000 Petroleum Workers. And this was received June 17th of 97. Drawing your attention to that report, you have made reference to it here, is that correct, sir?
A. Yes.
Q. Did that include any information about any tankers?
A. This is a meta-analysis, the paper, so he includes twenty-some studies, if I remember correctly. And

one of the studies, as I mentioned before, was on U. S. marine workers and some of those workers were on tankers.
Q. How do you know that?
A. I did the study.
Q. So you know that some of the information in that study pertained to merchant mariners on tankers, is that correct, sir?
A. Yes, sir.
Q. And is there any place in this report that you indicate that?
A. I have to look for it. I remember we have tanker workers in the study. I mean, I did the study.
Q. Indeed, there was some reference to tanker and barge workers But you don't know if there were any tanker workers, in fact, in that study, do you, sir?
A. I'm not sure I understand the question.
Q. How many tankers were involved in that study?
A. I don't remember the exact number.
Q. Well, is it published anywhere?
A. The group we called marine workers, which we 4ncluded both barge and tanker workers, would come to about 9,000 something. But if you want to break it down between tankers and barges -
Q. Yes, I do.
A. -- I don't have that breakdown.

Q. Does anybody?
A. Not now. When we do the study, if somebody asked the question, we could have.
Q. Now, in fact, in that study, your third study, that indicates that you included this study of 9,109 and it also stated that an in depth analysis had been done in the previous paper, is that correct, sir?
A. I have to look at what you're reading. When you say "previous paper," I don't know what that refers to.
Q. Before we get to that, as a general basis for comparison, you used the general population, is that correct?
A. Yes.
Q. Do you think that's appropriate?
A. Yes.
Q. Doesn't that bring into effect the healthy worker?
A. Healthy worker is not a real problem for cancer. On stop of that, we also took a lot of internal comparisons, comparing people who worked there thirty years to people who worked there ten years and so on. So to that extent, we have internal comparison, not just relying on outside.
Q. All right. I think you've gone through this exercise before, but if you want, I'll give you this study and you can go through it to see if there's any breakdown

between the two, between barge workers and people that work on tankers. Or are you satisfied there is not?
A. I don't recall any breakdown that I put in the paper.
Q. All right. And this report also refers back to a previous report of yours that is entitled, quickly and deftly, Health Effects of Gasoline Exposure. II. Mortality Patterns of Distribution Workers in the United States. And is that correct, sir, you relied in part upon this paper for some of the data as to the exposure of people in your other paper?
A. I'm sorry, I don't understand the question.
Q. You are familiar with this paper? It was published in 1993.
A. All right. Who are the authors?
Q. Otto Wong, number one, Fran Harris and Thomas J. Smith. I've already read to you the title.
A. That's part two?
Q. Yes.
A. Now I know which paper you're talking about.
Q. Health Effects of Gasoline Exposure II. And you are obviously familiar with this paper?
A. Yes, sir. .,
Q. And is this the paper you took the information from regarding the exposure, allegedly, on marine vessels?

A. No, the exposure was actually found in part one
of the paper.
Q. All right.
A. And the first author is professor Smith.
Q. Health Effects of Gasoline Exposure. I. Exposure
Assessment for U.S. Distribution Workers, is that correct,
sir?
A. Is that the one by Smith?
Q. _ By Thomas Smith, Katharine Hammond and Otto Wong.
A. Yes, sir.
Q. And in this paper, sir, do you refer at any time
to the number of vessels that merchant mariners are on?
A. I don't think we mention it.
Q. Do you refer at any time to the number of
merchant marines that were the part of this study?
A. The first paper was on the exposure, the second
paper was on the health effects.
Q. I know, that's very interesting, but could you
answer my question now?
A. Well, I'm trying to say the first paper does not
concern with people, per se. The second paper deals with
people and we do have tanker workers there, I just don't
have the breakdown.
Q. With regard to the dose indices, you named two?
A. I think there's more than that. Peat exposure is

one, different wastes exposure.
Q. Well, I'm talking about two dose indices for the epidemiologic analysis were calculated for the exposure assessment for truck operations and for marine exposures?
A. Yes.
Q. And, indeed, they were calculated for inland barge operations only, is that correct, sir?
A. Yes, sir.
Q. And why was that, sir?
A. Because we don't have sufficient data to characterize the exposure of tanker workers.
Q. And, in fact, did you state that, "Due to the limited exposure data for seagoing tanker operations, quantitative exposures could not be estimated"?
A. That's what we said.
Q. But you saw fit to put this same cohort into your meta-analysis?
A. Just because we could not quantify that exposure, that-does not mean that, epidemiologically, it is not there.
Q. Well, you also put it into Wong II, did you not?
A. Absolutely, yes.
Q. Well, certainly, exposure was important in that paper, wasn't it?
A. Exposure was important. Exposure can be

expressed in different ways, length of exposure, job titles and so on. One thing we could not do is we could not quantify the exposure in terms of how many parts per million. But that should not stop us from analyzing the epidemiologic data.
Q. Did you state, in fact, sir, under "Discussion" in this study, "Unlike most previous studies in the petroleum industry, quantitative exposure estimates were made. -The exposure assessment component was important to the epidemiologic study for a number of reasons. First, not all employees in the marketing or marine distribution divisions were exposed"?
MR. RUNYAN: Your Honor, if we're going to read the whole article, I'd like Dr. Wong to have a copy in front of him so he can make sure he knows where he's referring. I think that's just courtesy to the witness.
THE COURT: Do we have a copy of the article available?
MR. RUNYAN: Yes. Are you reading from I or II?
MR. CONNOR: I'm reading from II. This is the one in which he indicated the exposure was important. lest. RUNYAN: Objection, Your Honor.
THE COURT: Sustained.
MR. RUNYAN: Do you have a copy for the witness?
MR. CONNOR: No, I do not.

Do you? If you do, I'd appreciate it.
Well, while they're looking for that, I'll go ahead with some other questions.
Q. (By Mr. Connor) Inasmuch as you estimated there was not enough data to estimate seagoing tanker personnel exposure, why was it that you placed this in Wong II, which dealt with exposures?
MR. DANIELS: I'll object to the form. of that. Wong TI doesn't deal with exposures, it deals with epidemiology. Object to the form, vague.
MR. CONNOR: Your Honor, I'm only quoting from him. He used the term Wong II was the one that dealt with exposures.
MR. DANIELS: Your Honor, he's quoting from a multi-author study and I'm not even sure he's established that Dr. Wong is the one that made this observation.
THE COURT: I'm going to. overrule the objections. He can address those concerns in his answer.
A. The study, we did have exposure information. If we had quantified exposure for every study, that would be perfect, but sometimes in the real world we can't do that. And in my study, we were able to quantify exposure for the landbased terminal workers, we were able to quantify it for barge workers, we were -- we did not have sufficient data to quantity the exposure of tanker workers. But that

should not stop us from analyzing the data. Because when we look at the marine workers as a whole, you know, the total group, we do not see an increase of multiple myeloma. Just because we don't have quantitative exposure information on the tanker workers, that does not invalidate the epidemiologic research.
Q. (By Mr. Connor) Indeed, sir, you don't know how many merchant mariners there were, you don't know how many vessels there were and you don't know what their exposure was, so it has no effect at all, does it?
A. No, I know the total number of barge workers and tanker workers. When I do the analysis, I combined them into one group. I do not have the breakdown. The paper was published in 1993. Today, I have not looked at that data for so many years.
You asked me to give you a breakdown between barge workers and tanker workers. I just can't, I don't have the number in my head. But that doesn't invalidate the, study.
Q. Is that number anywhere in any of these reports?
A. No.
Q. And, indeed, in all of these reports, one of the conclusions that is drawn is there is not an adequate number in order to make calculations as to exposure, isn't that correct, sir?

A. Just on the exposure side.
Q. Sir, in the Wong I and Wong II, did you combine the lymphatic malignancies along with the leukemias?
A. Well, whenever you do an analysis in cohort studies, you start with the largest group, which would be all causes of death. And then you break down into cancer and noncancer, and within cancer you break down into the different systems. So that's the way that we do things.
Q. Do I take that to be a yes?
A. That is yes, but I want to explain to you why.
MR. CONNOR: Your Honor, I wonder if you could address the witness and tell him to answer the questions yes or no if he could.
THE COURT: As I indicated before, we will take it a question at a time. But the witness should attempt to answer yes no questions yes or no and then Mr. Runyan may redirect.
Q. (By Mr. Connor) Now, Dr. MacMahan made the recommendation that you split that up, didn't he?
A. Who?
Q. MacMahan.
A. Oh, Dr. MacKahan.
Q. Yes. And didn't he make the recommendation that you split those two out?
A. I don't remember receiving comments from him.

Q. All right. At any rate, you did testify to OSHA and justified the combination and published articles that did combine the various categories, did you not, sir?
A. Hold on for one second. Which study are we talking about? Are we still talking about the 1993?
Q. No. I'm talking about the paper in 87.
A. You didn't say 87. I was confused.
Q. I thought I did, I'm sorry. And Dr. MacKahan made a recommendation that you split out the lymphatic malignancies and the leukemias, is that correct?
A: Yes, that's after the study was done.
Q. And you testified before OSHA, did you not, and indicated that you thought that that was perfectly proper and appropriate the way it was done, and published a paper to that extent also?
A. It depends on what your question is. If you're interested in multiple myeloma, then the grouping that we have is not appropriate. If you're interested in the overall category then, yeah, it's appropriate.
Q. What control group did you use in the Wong I and II?
A. In the 1987 paper?
Q. The 87.
A. In the 1987 paper, we have two control groups, one we call nonexposed workers, which is a very small

group, only 3,000 workers, and then we have the general
population, which is more stable, much larger.
Q. There were 6,000 or 7,000 people in the study?
. A. Including the exposed workers, yes.
Q. And then out of the 7,000 or so, there were 3,000
that were not exposed?
A. Yes, sir.
Q. Did you find leukemia, sir?
A. I find leukemia in the exposed group, yes.
Q. And did you find leukemias in the group that were
not exposed?
A. No, I didn't.
Q. And in making your comparison, did you compare
the leukemias to the 3,000 that were not exposed?
A. I made two comparisons, the internal -
Q. You answered my question, sir. Did you compare
the leukemias to the internal group, the 3,000 that were
not exposed?
A. Yes, I did.
Q. Now, sir, did you find multiple myelomas?
A. Multiple myeloma in the nonexposed group?
Q. In the exposed group.
A. Yes, I did.
Q. And did you find any in the nonexposed group?
A. No, I did not.

Q. Did you compare the multiple myelomas to your internal control, the nonexposed group?
A. No, I did not.
Q. Why was it all right to do that for leukemias but you have testified here that it is not all right to do it for multiple myeloma?
MR. RUNYAN: Objection, Your Honor, that mischaracterizes his testimony.
THE COURT: If you can rephrase the question, you can ask it. Without attempting -- Mr. Connor, I'm just suggesting you don't try summarizing.
Q. (By Mr. Connor) You did testify in regard to that study, did you not, sir, that it was improper to compare the multiple myelomas to that internal group because it was too small and it had zero?
A. That's one of the reasons. Because a small group does not provide you with a stable rate.
Q. Well, why was it all right for the leukemias and not: all right for the multiple myelomas?
A. No, I think you misread my paper. Leukemia is one of the internal classification disease groupings that we use in the program, in the computer program. Whereas multiple myeloma is not an entity by itself. Multiple myeloma is lumped together with non-Hodgkin's lymphoma and other lymphatic cancer in a fourth category, called other

lymphatic cancers. Therefore, it is not analyzed
separately because the group is together with some other
diseases.
It has to do with the international
classification of disease. And I spelled it out in my
paper.
Q. Do you remember the statement that you submitted
to the OSHA benzene hearing in 1986?
A. _I remember making a statement.
Q. And in this, when you were asked to comment on
Dr. MacMahan raising the issue of the lack of leukemia
deaths in the nonexposed group and questioning the validity
of the data, that you in this paper had defended the fact
7.4 that you compared it to the internal group and stated -
and maybe I can have him read along with me.
MR. RUNYAN: Your Honor, I don't think he has to
read along. I object to the question, it's not a question,
it's a statement. It's Counsel's characterization of what
he ,thinks occurred and that's improper.
THE COURT: Ask him whether he made a statement
and refer him to the statement.
Q. (By Mr. Connor) I'll ask you to read the two
paragraphs, the second full paragraph .and the third full
paragraph in your comments to OSHA?
A. "On pages four and five of his October 25, 1983,

comments, Dr. MacMahan raised the issue of the lack of leukemia deaths in the nonexposed group and questioned the validity of the data. Other reviewers also indicate I similar concerns. There might be several possible explanations for this observation."
Q. And what is that, sir? What was the reasons you gave?
A. Okay. First, there might be some unrecognized problems-in the data. As pointed out in the report, the participating company decided to collect data themselves and supplied the data to AHK, meaning the company. However, the data were collected according to the common protocol and subject to very thorough data audit. Which includes a verification of the completeness of the cohorts and a verification of the coding accuracy. Our data audit indicated that the cohort was 99.2 percent complete and the accuracy of coding was 97.4 percent. As such, we did not feel that the data had any major obvious problems.
Q. Now, it's 99 percent accurate for leukemia and -
A. Wait a minute. Ninety-nine percent accurate for?
Q. Isn't that what you're saying there?
A. No, we're saying that the cohort was 99.2 percent complete and the coding itself was 97.4 percent. That has nothing to do with leukemia.
Q. Isn't that why you said you could compare it

Q. Did you say that?
A. I said that.
Q. And did you indicate using internal controls would have certain advantages?
A. If the group is large enough, you have certain advantages.
Q. And if you, indeed, felt that the internal comparisons were ineffective, for lack of a better term, for leukemia, then you would not have published your data, would you?
A. Not necessarily. Because that wasn't the protocol. We publish everything we get as we like it or not, according to the protocol.
Q. So even if you found that it was ineffective or inaccurate, you would have published it?
MR. RUNYAN: Objection, it's argumentative. It also misstates his testimony.
THE COURT: You may answer.
A. We will report that together with any limitations on-the data. We would report it, as well.
Q. (By Mr. Connor) Okay. Can you explain to me how that 87 report failed to find any AMLs?
A. It's a small study and the exposure was not high.
Q. Well, they did find leukemias, did they not?
A. We find seven leukemias and they expect about

six.
Q. And aren't AMLs the largest group of leukemias?
A. That's true, yes.
Q. Doctor, you did make a presentation in Miami on gasoline workers, is that correct?
A. Yes.
Q. What percentage of gasoline is benzene?
A. I would say about two percent. In-the old days, maybe more. In Europe, maybe more.
Q. Well, do you recall stating on December 16th of 1997, that in gasoline we have two to three percent of benzene?
A. Yes.
Q. Is that your testimony today?
A. A couple of percentage, yes.
Q. Is that what epidemiologists do, two or three, it doesn't matter? Or did you say two to three?
MR. DANIELS: Objection, argumentative.
THE COURT: Sustained.
Q. (By Mr. Connor) So what you meant when you said two to three here was a couple?
MR. RUNYAN: Objection.
MR. DANIELS: Asked and answered and argumentative.
TEE COURT: Sustained.

Q. (By Mr. Connor) What was the control group in that study?
A. We have both the general population as well as, when we do dose response, we use people with less exposure as the control.
Q. And you have, in your 1997 Wong paper, cited Interline (phonetic spelling) as being a person that was favorable to the United States population you used as a cohort, is that correct, sir?
Or that is too confusing? I may have confused myself.
MR. RUNYAN: Objection, Your Honor, it's confusing.
THE COURT: To Mr. Connor or to you?
MR. RUNYAN: To me, too.
THE COURT: Try it again.
Q. (By Mr. Connor) Were there criticisms for utilizing the United States as a control group by Dr. Interline, sir?
A. I don't recall. But as I said, we do have internal control using workers with less exposure.
Q. Well, in that study, Dr. Interline, in fact, was looking over your shoulder for three or four years while you were doing the study, was he not?
A. He was one of the outside reviewers.

Q. And you don't recall whether or not he raised a question about the control group being used being the general population?
A. I'm not sure that was his major comment on my study. I mean, we talk a lot about a study, that I don't think being the most important question that he raised.
Q. You remember him raising that question?
A. In any study, you can question the comparison group. He might have. I can't say yes or no.
Q. Well, in your testimony on December 16th, 1997, do you recall giving that testimony? And I think if you look down at the bottom, you'll find reference.
MR. RUNYAN: What testimony are you referring to?
MR: DANIELS: I'm going to object. What testimony?
THE COURT: Well, the testimony in December of 1977 does not -- I don't know, does it mean anything to Counsel at all?
MR. DANIELS: No.
THE COURT: You want to show them, Mr. Connor, what you're referring to?
MR. CONNOR: Yes.
THE COURT: Just show Counsel.
Q. (By Mr. Connor) You've had an opportunity to review that, sir. Does that refresh your recollection?

A. Yes.
Q. And, indeed, he did raise a question about that?
A. I assume that was one of the questions he raised,
. yes.
Q. And there are problems any time you use the
United States population as a control group, are there not,
sir?
A. If that's the only thing we use, I -would say
that's a problem. But that's not the only thing we use.
Q. If you were studying your 100 smokers, you
wouldn't want to use as a control group 100 people from the
general population, would you?
A. We can use nonsmokers, we can use the same
population. But at the same time, if we compare people who
smoke more, compare them to people who smoke less, that's
okay.
Q. You'd have to know what was in that group, in
that general population, out of the 100?
A. Yes.
Q. And if you knew what the percentages were you'd
no longer be talking about the general population?
A. That's true. But I think you're not making a
fair comparison. Because in terms of-smoking, we have a
very sizable population who smoke, but we don't have a
large population in the general population who work on

tankers. That's the difference.
Q. By the way, you never did a study, yourself, on smoking and its relationship to cancer, did you?
A. I think that's before my time.
Q. You did?
A. By the time I got my degree, everything had been done on smoking and lung cancer.
Q. In 72?
A. I don't think the studies would have been in 72. All the major studies were done in the 50s and the 609. I got my degree in 75, by the way.
Q. Well, you got one of them in 72, didn't you?
A. In physics.
Q. And all the studies had been completed by then, there's no controversy.
All right. You did do a study or studies for the cigarette industry, though, didn't you?
A. I've never done any study for the cigarette industry.
Q. You have never done any studies for them?
A. No.
Q. Well, I could be wrong about that. You indicated a number of risk factors here I believe in your testimony, did you not, sir? Do you recall your testimony on direct?

A. Today? Risk factors for what?
Q. Yes. I believe we were talking about, I believe, whether or not there was any other potential causes of benzene? I could be wrong about that.
A. Potential causes of benzene?
Q. Yes.
THE COURT: Try another question.
Q. (By Mr. Connor) Excuse me, multiple myeloma. Do you know of any substance that could be a cause of multiple myeloma?
A. Substances?
Q. Yes.
A. Ionizing radiation, we mentioned before. Certain medical history, we mentioned before. And obviously, age is a risk factor.
Q. How about diesel exhaust?
A. Diesel exhaust? I have not looked at all the studies on diesel exhaust so I am not sure.
Q. There are studies, however, that would show a relationship between diesel exhaust and multiple myeloma, is that correct, sir?
MR. DANIELS: Objection; he just said he hasn't seen the data.
THE COURT: What was the objection?
MR. DANIELS: He just testified he hadn't looked

at the data.
THE COURT: Overruled.
He can answer if he can.
MR. CONNOR: I think he already did.
THE COURT: The court reporter is indicating she didn't get it.
A. I don't remember seeing any studies on diesel exhaust.
Q. (By Mr. Connor) Are you familiar with Dr. Bernard Goldstein?
A. I know of him.
Q. Are you familiar with his work?
A. He's an occupational physician. I'm not sure -
Q. Well, he's a toxicologist, is he not, sir?
A. He may also be a toxicologist. Certainly, I don't know his work in the sense that he does epidemiologic studies.
Q. Is he well known in terms of toxicology related to benzene?
A. I don't know. His name is -- he's chairman of a department, so he's famous.
Q. Well, on December 16th, 1997, when you were asked if you were familiar with his work and-whether you would agree that he is well known in the area of benzene-related diseases, did you state, "He is well known in terms of

toxicology related to benzene"?
A. Yes, a toxicologist. I don't know anything about epidemiology. That's what I'm trying to answer.
. Q. Are you familiar, sir, with his opinion expressed in the printed literature that -
MR. RUNYAN: Your Honor, I'll object.
MR. DANIELS: Objection.
Q. (By Mr. Connor) -- benzene is more commonly -
THE COURT: Mr. Connor? The objection is sustained.
If you wish, Mr. Connor, you may begin by showing him or referring him to a specific article.
MR. CONNOR: I'm sorry, Your Honor?
THE COURT: I said if you wish, you can show him or refer him to a specific article and ask him whether he's familiar with it.
MR. RUNYAN: I think he has to do more than that, Your Honor.
THE COURT: Well, that's a start.
MR. RUNYAN: True.
THE COURT: Mr. Connor, I'm just suggesting before you begin referring or quoting specific portions, you're going to need to do more in the-way of foundation, that's all.
Q. (By Mr. Connor) One of the things that would be

important to you, would it not, sir, in making a study as to whether or not there is a relationship between benzene and multiple myeloma, you would certainly want to consider whether or not there was a biological plausibility, would you not, sir?
A. The biological plausibility is outside my area of expertise. We are talking about something that a hematologist would look at. As an epidemiologist, what we do is study a group of people and find out whether they have a risk or not, and if there is an increase, try to relate it to their exposure levels. That's what we do. In terms of biological mechanism, that's really not our area.
Q. So if they had, in fact, found a biological plausibility, that wouldn't mean anything to you in the conduct of your study?
A. It would, in the sense that if somebody comes up with the theory or the hypothesis that it is biologically possible, then we would like to find out whether, indeed, we observe that in the real world. Anybody can come up with a theory of possibility, the question is can you confirm that.
Q. When you do your meta-analysis and you combined various epidemiological studies, do you review those studies to note whether or not they're of equal value?
A. I combine studies of workers belonging to the

same industry or the same occupation.
Q. And do you take into consideration whether or not they were exposed or were not exposed?
A. They were exposed to the extent they work at a refinery or they work on barges. That's the extent, that's the indication of exposure.
Q. Well, you aren't suggesting that everyone that is in the transportation industry is exposed to benzene?
A. Some are exposed to high levels, some are exposed to the background level, yes.
Q. You mean because they live in the United States, they had some exposure that qualifies?
A. No.
Q. Well, what was the background exposure you're referring to?
A. Background exposure at the facility, not on the street corner.
Q. And what was the background exposure at the facility for transportation workers, in general?
A. It would be less than one ppm.
Q. And what is it in the urban environment?
A. Would be in the ppb range, parts per billion range
Q How many of the transportation workers were in the exposure only level, background exposure?

A. We have to look at a job title. And, for example, we do have quantitative exposure data on the landbased workers. And every one of them was exposed.
. Q. Every one?
A. Some may be exposed for one or two years, some may be exposed for 40 years.
Q. How many were in that background exposure group only?
A. We would have to go back and look at the job titles. And the job title, for example, the loader who put gasoline into the tankhouse, that job title would involve high exposure.
Q. And, in fact, if it was a secretary in the office, it would be low exposure?
A. I'm not sure if it's a secretary in the office.
Q. Well, if they're in the transportation industry, we know no more than what the job title is. You listed them -
A. No, they have to have exposure to the gasoline.
Q. So when you said it was everyone in the transportation industry, you did not mean everyone?
A. The people with job titles that indicate exposure.
Q. And is the same thing true of your meta-analysis, sir?

A. The meta-analysis was based on studies that other people have done. And their definition may be simply employment in a refinery for a year.
Q. And what was the range of exposure in your study of 250,000 workers?
A. Some would be exposed to higher levels, some would be exposed to lower levels.
Q. And what is the high level?
A. I don't have quantitative exposure information for that study.
Q. And what is the low level?
A. I don't have that either.
Q. And we know you don't know how many merchant marines there were, is that correct?
MR. RUNYAN: Your Honor, this is repetitive.
THE COURT: Sustained.
Mr. Connor, you have about a half hour left.
Q. (8y Mr. Connor) What about -- is latency important in those various studies?
A. Yes.
Q. Is it particularly important when you have a younger cohort as opposed to an older cohort? .
A. Not necessarily. Depends on-the timing of the exposure.
Q. It does create somewhat of a problem, .however,

when you combine the studies, because they do use different cut points for latency for exposure, is that correct, in the different studies?
, A. I don't think they use latency as a cut point in any studies at all.
Q. How about length of employment?
A. Length of employment is used as what we call cohort definition. Because we simply want to eliminate people who worked there for an extremely short period of time.
Q. And length of exposure?
A. If you're still talking about the meta-analysis paper, I don't think length of exposure was used as the criteria in those studies. Length of employment was.
Q. And what was your cutoff for length of employment?
A. In what?
Q. In the study we're talking about.
A. In the meta-analysis?
Q. Yes.
A. No. I just include all original studies, whatever definition they use.
Q. So that would be, in some instances, one day?
A. No, we don't have -- I don't believe one day was in there.

Q. Well, do you include it or don't you include it, which way do we go here?
A. I have to look at that paper and see whether they have any study that would include people with one day of employment.
Q. So, then, you don't actually know what you included?
A. There is a distinction between what I remember today sitting here and whether I know or not. I don't think that's a fair question.
Q. I want to go to your 83 paper. Did you find any relationship between benzene in your 83 paper and any disease?
A. You have to tell me what paper that is. Just giving me the year is not sufficient.
Q. Okay. That was another study sponsored by the Chemical Manufacturers Association.
MR. RUNYAN: Object to the form of the question, Your Honor.
THE COURT: Could you maybe give him the title, Mr. Connor?
MR. CONNOR: I'm looking to-see a title.
Q. (By Mr. Connor) Chemical worker study of 1983. Is that enough information?
A. Give me the title or show me the title page.

Q. I can't find it. It would be Wong, and Epidemiological Mortality Study of a Cohort of Chemical Workers Potentially Exposed to Formaldehyde, with a . discussion on SMR and PMR, 1983.
A. Formaldehyde?
Q. Yes.
A. That was not a study sponsored by the Chemical Manufacturers Association.
Q. Who was that sponsored by?
A. It was sponsored by, I believe, Celanese (phonetic spelling), a chemical plant.
Q. In that study -- well, let's skip that one. In the Chinese study, do you find that to be an authoritative study in terms of its methodology?
A. That is a very complicated study and I don't-want to make a blanket statement. There's certain parts I would agree and there's certain parts I do not.
Q. Well. I know it's a large study and it's complex. But judging by our study standards, there are many shortcomings in that report, are there not, sir?
A. Yes, sir.
Q. You've indicated I believe here today that there are certain kinds of leukemia that can-be caused by exposure to benzene, is that correct, sir?
A. Yes, sir.

Q. And what leukemia is that?
A. The type we call acute myeloid leukemia.
Q. And there was a time when you would not accept that acute myeloid leukemia could be caused by benzene, isn't that correct, sir?
A. I'm not sure what you're referring to.
Q. Sir, have you published papers in the past that stated that there was no connection shown epidemiologically between benzene and acute myeloid leukemia, AML?
A. I don't remember that. But, again, you have to look at the timing. Because knowledge changes over time.
Q. Yes, I know it does. And now that everyone accepts that, what would you say is the range of exposure necessary to cause AML?
MR. DANIELS: Objection, relevance to this case.
THE COURT: Overruled.
You may answer.
A. The only study that can provide us with the data would come from the so-called NIOSH pliofilm study. And I have done an analysis on that. In that study, we have a number of exposure estimates. Based on the most conservative exposure estimates, I would say it takes about 200 ppm years in order to have an increased risk of acute myeloid leukemia.
Q. And what is a ppm year?

A. Ppm years is what we call cumulative exposure.
You multiply the concentration of exposure to give you ppm,
the duration that someone was exposed to that level by how
long. It's somewhat similar to pack years, how many packs
you smoke per day for how many years. So it tells you both
the concentration of exposure as well as the length of
exposure.
Q. Do you have any familiarity with the exposure
that Mr. Murray had while serving onboard vessels from 1948
through 1976?
A. Not -
MR. RUNYAN: Exposure to what, Counsel?
MR. CONNOR: Exposure to benzene.
A. Not on himself. I have studies indicating
that -
THE COURT: I think you've answered the question.
Go ahead, Mr. Connor.
Q. (By Mr. Connor) Save you looked at co-worker
depositions in this case?
A. Yes, I have.
Q. Do you know what level of exposure it takes to
create a state of euphoria?
A. I don't remember the number, It would be 50, 60
PPM
Q. Do you know what level of exposure it would take

for someone to become fatigued?
MR. RUNYAN: Your Honor, this is well beyond direct. And with all deference to Dr. Wong and his expertise, I don't know if it's within his expertise.
THE COURT: Mr. Connor?
MR. CONNOR: Your Honor, it seems to me that he has been presented here as an expert in the area of whether or not there is any scientific evidence that would demonstrate that benzene caused or could cause a cancerous condition. If it is within the foreseeable risk, I think that is enough. And I think that all of this information -
THE COURT: All right. That's good. I'm going to sustain the objection. It is beyond the scope of direct.
Q. (By Mr. Connor) Are you familiar with the American Petroleum Institute 1948 paper which established a safe level of exposure as zero?
MR. RUNYAN: Your Honor, I'll object, it's beyond the scope of direct. And, again, with deference, excuse me, to Dr. Wong, it's not relevant to his testimony or his expertise.
- THE COURT: Can I hear the question again, Mr. Connor? I'm sorry.
Q. (By Mr. Connor) Are you familiar with --

MR. RUNYAN: Also, Your Honor, just for the record, I'll object to Counsel's characterization. Because it is a mischaracterization of what the API recommended in 1948.
THE COURT: I apologize, Mr. Runyan, but I do need to hear the question again.
MR. RUNYAN: I know.
Q. (By Mr. Connor) Are you familiar with the 1948 paper from the American Petroleum Institute that indicated that exposure to benzene was unsafe at any level above zero?
THE COURT: All right. I'll sustain the objection. And if you wish, you can rephrase the question.
Q. (By Mr. Connor) Is there any safe level for exposure to benzene?
A. You just talked about in terms of AML. And that is the only disease that is caused by exposure to benzene, based on scientific evidence. And we are talking about we need to have at least 200 ppm years to have increased risk.
Q. By the way, sir, I want to show you questions and answers that you gave on June 2nd, 1998, in a deposition in this case. And this would be at page 74 and goes on to 75.
MR. DANIELS: I'll object. -Is he impeaching him? I don't know what he's doing.
MR. CONNOR: Right now refreshing his

recollection. But you're right, I'll just impeach him.
THE COURT: Well, whichever you're doing, let's start with a question. I haven't heard a question that he doesn't remember an answer to.
Q. (By Mr. Connor) Sir, on June 2nd, 1998, did you indicate that you had done work for the tobacco company?
MR. DANIELS: Objection. He has to ask him a question first.
THE COURT: Actually, I think that question was asked some time ago so I'll allow this question.
Q. (By Mr. Connor) Were you asked on June 2nd, 1998, "Have you ever done any work for any tobacco companies?"
MR. RUNYAN: Your Honor, what's the relevance of this?
THE COURT: If that's an objection, it's overruled. Go ahead.
Q. And did you give this answer?
"I think I might have consulted them once a long time ago on some disease that's generally not known to be tobacco related.
"Question. What disease is that?
"Answer. I forgot. I mean, that's many, many years ago and it was on a very short term basis, very limited.

"Was that lung cancer, by chance?
"Answer. To review a paper. I don't
remember the specifics."
Do you recall, on June 2nd, 1998, being asked
those questions and giving those answers?
MR. DANIELS: I object. That's not impeachment.
The earlier question involved studies, not consultations.
THE COURT: Overruled.
You may answer the question. If you could answer
the question whether or not you gave those answers to those
questions.
A. I recall making a statement that I did
consultation for the tobacco company. But I did not do any
studies for the tobacco industry, which was your question.
Q. (By Mr. Connor) Didn't you indicate to me that
you never did any work for any tobacco company?
A. No, study. You used the word study, sir.
Q. There are a number of studies that do report what
we might call risk factors of multiple myeloma, is that
correct sir?
A. Yes, there are studies.
Q. And one of those studies, it does mention
exhaust, does it not, sir?
MR. RUNYAN: Asked and answered, Your Honor:,
A. It may have, I don't know.

THE COURT: Overruled.
I'm sorry, your answer?
A. It may have.
Q. (By Mr. Connor) Sir, you indicated that you did review the co-workers. Did you attach any significance at all to the testimony that you reviewed?
, A. Not really.
MR. CONNOR: I have nothing more.
THE COURT: Thank you.
Redirect?
MR. RUNYAN: Just a few, Your Honor.
REDIRECT EXAMINATION
BY MR. RUNYAN:
Q. You answered some questions about submitting manuscripts to journals and having comments made about-them and resubmitting. Do you recall that general testimony?
A. Yes.
Q. Is that unusual?
A. Well, if I can talk about the specific example?
Q. Well, are you familiar with the peer review process and how manuscripts are submitted to peer review journals and how they come to publication?
A Yes, I am.
Q. Can you discuss that with the jury?
A. Well, when you submit a manuscript to the

journal, the editor of the journal sends it out to two or three people, so-called peer reviewers.
Q. Is that like what you've done as a reviewer for the journals that we talked about?
A. Yes, sir.
Q. Okay. I'm sorry, go ahead.
A. And it depends on what comments they have. You may or may not agree with the reviewers. And the specific example we talked about earlier on today, I wanted to submit my work as a paper but it had something to do with a previous paper published in a journal. And the editor basically said, "You have to shorten that to a letter to the editor." And I did not want it to appear in that form, my article, so I said, "No," and so I submitted it to another journal.
Q. And I take it you have the ability to do that, as the author?
A. Of course.
Q. You were asked about the healthy worker effect and I believe unexposed populations versus taking the general population in your 1993 study. And you explained but I don't know if the jury understood it, I certainly didn't,-with regard to why that didn't-necessarily apply in cancer. Can you explain that in a little more detail?
A. The healthy worker is an observation that is made

in occupational epidemiologic studies, that the overall mortality risk is slightly lower than the general population. And that's because people with basically cardiovascular diseases would not be able to get a job or may not be able to maintain a job. That's what we call healthy worker effect. .,
In terms of cancer, we are really talking about disease in older ages. So that doesn't apply to the selection for health at the time of hire. Because when you get into an industry, you're already in the younger age group and you don't have any symptoms at that point of cancer. Okay? So it doesn't apply to cancer that much.
But the really important question, the really important issue, is when we do analysis in a study, even though we use the general population as the control group, because it is large, provides us with stable statistics to compare to, we don't just calculate one relative risk, we calculate many, many different statistics, different risk ratios, people who work there for thirty years, people who work there for twenty years, ten years and so on, and compare them to see whether there is any pattern or not. If, indeed, the employment or the exposure can cause the disease, then we should be able to see-an upward trend, the longer you work there, the higher the risk. And that's what we call dose response. And we always have that in any

study.
So even if we use the outside, the external comparison, the general population as comparison, that's okay as long as we do what we call dose response analysis.
Q. You were asked about, and I think, again, it's still your 1983 study, Wong I and II as it was referred to, the fact that you combined various cancers. In fact, you had I think a category of cancer then leukemias and maybe lymphatic cancers. Can you explain why you went about doing it in that manner?
A. Basically, when we do a cohort study we look at all causes of death, every different kind of disease. We start with all causes of death and then break into cancer, non-cancer. Within cancer we have the digestive system, we have the respiratory system and so on.
So within each group, we just subdivide them into the specific group. It depends what question you want to ask. If you want to ask a question on multiple myeloma, then you go to the group. If there is a sufficient group there to compare with multiple myeloma, you don't go to all causes. Okay? When we do a study, all causes of death is always lower than expected. We don't stop at that, we go to specific causes of death.
Q. When you broke it down into cancers, did you include multiple myeloma in cancers?

A. Well, that is one of the problems. Because in the United States, the government does not publish multiple myeloma as a separate group. Multiple myeloma, . non-Hodgkin's lymphoma and some other lymphatic cancers are grouped together in one statistical category. So in a lot of publications, unless you really separate it out, you won't see that as a separate entity.
Q. And one of the things you talked about was specificity of association when you listed the Bradford Hill criterion, correct?
A. Right.
Q. Did you mean to infer that multiple myeloma was the same as other cancers?
A. No. If we are talking about an issue of multiple myeloma, then we need to look at multiple myeloma by itself and not together with non-Hodgkin's lymphoma or with some other disease.
Q. I think this was your 1987 study, and you were asked about the fact that you looked at leukemias in an exposed group, in a nonexposed group, but with regard to multiple myeloma, you didn't make the same comparison. Can you explain to the jury why you didn't?
A. Leukemia is a separate entry. Whereas, as I said, multiple myeloma is not a separate entry.
MR. RUNYAN: They don't have any questions for

me, Your Honor, and I'm out of my questions so that's all I've got. Thank you.
THE COURT: Thank you.
Mr. Connor?
RECROSS-EXAMINATION
BY MR. CONNOR:
Q. I'm not going to go over all of this again, but, sir, you did testify in regard to why you made the comparison for leukemia and why you did not make it for multiple myeloma. And wasn't your answer for multiple myeloma because the control group of 3,000 was too small? I asked you then why did you do it for leukemia, because the control group didn't change?
MR. DANIELS: Which question does he want?
THE COURT: Mr. Connor, you're probably trying to finish but let's stick to one question at a time.
Q. (By Mr. Connor) There are two studies from Sweden. And the first study is by Flodin, I think it's Flodin.
MR. RUNYAN: Your Honor, I asked five questions on redirect and I don't believe, unless I -
THE COURT: Does this relate to something that Mr. Runyan asked?
MR. CONNOR: Well, if I were pressed, I could probably come up with something.

THE COURT: Should I ask whether anybody wants me
to press you on that?
MR. RUNYAN: I've never even been to Sweden, Your
. Honor.
MR. CONNOR: I have nothing further.
THE COURT: Dr Wong, you're excused. You're
free to go.
THE WITNESS: Thank you.
THE COURT: Members of the jury, that will be it
for you for the week. Am I right, this is Thursday?
MR. DANIELS: This is Thursday. It's hard to
tell.
THE COURT: Yes. I need to at some point talk
with Counsel about the schedule, but for now, let's assume
Monday will be a day like our -- I'm trying to look for the
word, because it's not regular. It's not what we started
out with. But in other words, we will go from 9:00 to 4:30
on Monday with an hour and a half lunch. And then if we
need to adjust for the rest of the week to get back to
longer days in order to finish this trial, we may have to
do that. But for now, we will look at a, quote, regular
day ending at 4:30 with a full hour and a half for lunch on
Monday.
If you could return, hopefully all of you after a
three-day break, no later than ten minutes to 9:00 o'clock

Monday morning?
Continue to keep an open mind about the case and
please don't discuss it with anyone.
We will be at recess. And, Counsel, I'll see you
just briefly in chambers.
(Court adjourned at 4:35 p.m.)

C E R T I F I C A T E

I, TARALYNN A. HATES, Certified Shorthand Reporter and Official Court Reporter for the.King County Superior Court, State of Washington, do hereby certify that I reported the court proceedings annexed hereto in the foregoing cause number while acting in my official capacity; I FURTHER CERTIFY that the foregoing transcript is a full, true and correct copy of said proceedings ordered to be transcribed, to the best of my ability, reported stenographically and computer transcribed by me; I FURTHER CERTIFY that I am not related to any of the parties to this cause of action, nor am I interested in the outcome thereof.

WITNESS MY BAND this 18th day of September, 1998.

TARALYNN A. HATES
Official Court Reporter
Ring County, Washington