UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF INDIANA
INDIANAPOLIS DIVISION

COPY

CITY OF BLOOMINGTON, INDIANA; THE UTILITIES SERVICE BOARD OF BLOOMINGTON, INDIANA; and MONROE COUNTY, INDIANA, Plaintiffs,	)	
-vs-	)	CIVIL ACTION NO. IP 83-9-C
WESTINGHOUSE ELECTRIC CORPORATION, a Pennsylvania Corp.; and MONSANTO COMPANY, a Delaware Corp. Defendants.	)	

The deposition upon oral examination of ROBERT GEORGE KALEY II, PhD, a witness produced and sworn before me, Patricia A. Cline, a Notary Public in and for the County of Marion, State of Indiana, taken on behalf of the Plaintiffs at the law offices of Barnes & Thornburg, 1313 Merchants Bank Building, Indianapolis, Marion County, Indiana, on the 25th of May, 1988, commencing at the hour of 9:00 a.m. pursuant to the Federal Rules of Trial Procedure with Notice.

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A P P E A R A N C E S

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I N D E X O F E X A M I N A T I O N

I N D E X O F E X H I B I T S

ROBERT GEORGE KALEY II, having been first duly sworn to tell the truth, the whole truth and nothing but the truth relating to said matter, was examined and testified further as follows:

DIRECT EXAMINATION,

QUESTIONS BY MR. JOE KARAGANIS:

Q Mr. Kaley, would you state your full name for the record, please?

A Yes, Robert George Kaley II.

MR. KARAGANIS: Let the record show that that this is the deposition pursuant to agreement of Robert George Kaley who's been identified as a prospective expert witness at the upcoming trial of this cause.

(Bloomington Deposition Exhibit 617 was marked for identification.)

Q Mr. Kaley, I show you what has been marked as Deposition Exhibit, Bloomington Deposition Exhibit 617, which purports to be a curriculum vitae of yourself; is that correct?

A Yes, sir.

Q Deposition Exhibit 617, does that correctly state

your educational background?

A Yes, it does.

Q And since would it be correct to say upon receiving your PhD you joined Monsanto?

A Yes, in fact I joined Monsanto, actually before the degree was awarded but after I completed all the requirements for the degree.

Q Would it be fair to say since receiving your PhD degree that you have been employed by Monsanto ever since?

A That's correct.

Q And you became employed by Monsanto in December of '73?

A That's correct.

Q You have a PhD in analytical chemistry. Is analytical chemistry the specialty within chemistry that we would talk about if we would say what is your specialty?

A That's correct, yes.

Q What was your first contact with PCBs?

A Well, actually when I joined the company on December of '73, I came into the group whose primary responsibility at that time was investigating the

environmental properties of PCBs and so immediately upon my employment I began doing PCB analytical work.

Q What group was that?

A It was in the applied sciences section of what was at that time the Monsanto Industrial Chemicals Company.

Q And who was in charge of the applied sciences section?

A Robert Keller, K-e-l-l-e-r.

Q Who else was in it? I mean how big a group was it?

A The total group was probably about I would guess about 50 people.

Q How many people working on PCBs?

A With significant involvement at the time I would say there were probably 7 or 8.

Q Who were they?

A The group leader was Scott Tucker, myself.

The other names that come to mind are Vic Saeger Orville Hicks, Bill Mees.

How many am I up to?

I think there was a guy, one of the technicians, Hector Yepez.

Those are the names I think of who were in the specific group I was in at the time.

Q What were your duties upon joining the applied science section?

A I joined as an analytical chemist and my duties revolved around doing analyses of samples containing a variety of materials including PCBs and devising more appropriate and more accurate and precise ways of doing those analyses.

Q By more accurate or precise ways, in defining the quantities of PCBs or determining the particular chemical composition of the PCB?

A Primarily the quantity. We did some work on compositional type analyses, but not nearly as much as quantitative analysis.

Q Would that be a proper characterization of your work from '73 to 78, as a senior research chemist?

A Probably for about the first 2 to 2 and a half years of that period of time I was most deeply involved in working with PCBs.

In '75 or '76 I transferred to another group working for a gentleman named Martin Dietrich and began to do gas chromatography/mass spectrometry. At that point I still had some support involvement with PCB work but my area of expertise broadened

considerably and was not nearly as dedicated to PCB work.

Q When you say you became involved in gas chromatography/mass spectrometry, weren't you doing that in your earlier work on analyses?

A No, it was primarily just gas chromatography. Mass spectrometry work had been done by other people.

Q Why don't, if you would be patient with me?

A Oh, I am.

Q Would you state what it is that gas chromatograph does, then what mass spectrometer does in dealing with the analysis for, for example, PCB?

A Gas chromatography is basically a technique which separates mixtures of compounds into their component parts.

So that for instance, since we're talking about PCB, if we talk about PCBs, if you look at a bottle marked PCBs, there is a fluid in it, looks homogenous, like a nice clear oil. In fact that material is not made up of a single chemical compound but is a mixture of many chemical compounds.

If you inject, using a syringe inject such a mixture into a gas chromatograph and look at that

time at the output of that you get peaks coming off as an output of that instrument and each of those peaks represents one or more of those compounds contained in the PCB.

So it allows us to separate a mixture with some hope then of either identifying what is in there or more accurately measuring what is in there.

Q When you say it separates out the compound, how does it do that physically?

A It passes through a what is called a column. There are several types of columns but most of the work was done with what is called a packed column. There was a glass column. A tube which contains a very finely divided clay-like or diatomaceous earth-like material onto which is coated a very thick organic compound.

The materials passing through a chromatograph interact with the coating on this solid support and by a variety of either chemical or physical interactions are separated. Each compound is going to interact a little differently with that coating on the solid support and if it interacts a great deal, it will be held up on the column and will take it a long time to get through the column.

If it doesn't interact with the support, it zips right through the column, comes out very quickly so at the end of the column some sort of measurement device which allows you to sense when a chemical compound is exiting the column. That device then is connected to a recorder which gives you the chromatographic output. The chromatograph peaks on it so it basically interfaces with the material in the column.

Q So that the packed column media separates out the chemical components of the chemical that your testing; is that correct?

A Basically true.

Q Now then, what is the monitoring device or reading device at the end of the column?

A There are several. And their choice is determined on what exactly you want to measure.

There's, for instance, one of the simple ones called a flane ionization detector. It's basically what it sounds like. There's a little flame burning at the end of the column and any time a carbon-containing compound passes through that flame it generates an electrical signal which is recorded.

This is a very, this type of detector, as I said, will measure any kind of carbon containing compound.

In the area of PCB analytical chemistry the detector most often used is something called an electron capture detector.

At the end of the column in this particular case there is a radioactive foil which generates a stream of electrons. When materials that have not only carbon but also, for instance, chlorine in the molecule pass through this stream of electrons, the electrons are absorbed because of the chemical nature of chlorine and this also generates a signal which can then be recorded.

Q And the electronic signal is subject to graphing; is that right?

A That's correct. It goes through an amplifier and then is connected to a chart recorder which records the intensity of the electrical signal.

Q And the intensity of the electrical signal generates as graphs peaks and valleys; is that correct?

A That's correct.

Q And the peaks and valleys, how do you know what is the chemical composition?

A Well, in total reality you don't. Basically what you do in any type of analyses where you're looking for particular compound is to run a standard material through your chromatographic procedures. So, for instance, if we were interested in a PCB mixture, we would have a standard that we knew to be that PCB mixture, we would run it through chromatograph. Record the pattern of its peaks and then compare the pattern of peaks of our unknown sample to that pattern generated by the standard.

In a more simple case if you have a single compound you're analyzing, then you will get a single peak on the output when you run the standard. If you get a peak in your sample which corresponds in time to the standard peak, then that gives you some measure of qualitative or identity type analysis of that material.

Q Now when you say standard material, who supplies the standard material for chemists?

A That depends. The best, most reliable and most supportable standards are supplied for instance by the National Bureau of Standards and the best analyses would be based on a standard obtained from

the National Bureau of Standards.

In reality the standards are obtained from whatever source is available. There are several companies in the United States which supply standards of various materials for purchase. In the case of an industrial concern like Monsanto, the standards are often supplied from the plant or from the research laboratory which has generated that particular material for investigation. So there are actually several sources.

Q Who supplies standards for PCBs?

THE WITNESS: Today?

MR. KARAGANIS: Today.

A There's, the Analabs Corporation, which is a division of the Foxborough Company is one company. Ultra Scientific I think is another. There are several companies today which supply for purchase. There are also some standards available from the United States EPA.

Q Are those standards with respect to PCBs, are those by product line or the particular description that Monsanto used for a given Aroclor like 1016?

A Some of them are available as Monsanto,

representative of Monsanto products. Some of them are available as single congeners of PCB; in other words, one particular PCB compound.

Q Let's talk about what you mean by congeners and isomers.

A All right.

Q What is a congener?

A Again let's use PCB as an example.

MR. KARAGANIS: All right.

A PCBs are as a generic term for a large group of materials consisting of a chlorine, one or more chlorine atoms on a biphenyl molecule.

In the case of PCBs there are 209 possible ways to put 1 to 10 chlorine atoms on the biphenyl molecule. Each of these individual compounds is termed a congener. So there are 209 PCB congeners.

The next step of classification is to look at how many chlorines are on the given molecule so we can talk about a monochlorobiphenyl containing one chlorine atom on the biphenyl molecule. Skipping up to say 5 we talk about pentachlorobiphenyls as those congeners which have 5 chlorine atoms on the molecule. This type of grouping where we're looking

at chlorine content either one, 2, 3 up to 10 chlorines per molecule are called variously homologs or congener classes.

Within each of these homologs or congener classes, there are a number of different congeners. For instance, in the simplest case if we look at monochlorobiphenyl there are 3 possible ways to put one chlorine on the biphenyl molecule and obtain unique compounds. So each of those ways of putting a single chlorine on the biphenyl molecule would represent one of the isomers. So there are 3 isomers of monochlorobiphenyl.

Q Let me just stop at step 2. The groups or classes that characterize how many chlorines can be on the molecule, on the biphenyl molecule, you indicated those are called either homologs or congener classes?

A That's correct.

Q How many homologs are there?

A For PCB there are 10.

Q So meaning that there can be up to 10 chlorine atoms; is that right?

A That's correct.

Q So within the category of 1 through 10 then as you

indicated a monochlorobiphenyl?

A Monochlorobiphenyl.

Q For monochlorobiphenyl, there are 3 possible variations of monochlorobiphenyl in terms of the position of the chlorine atom; is that right?

A That's right.

Q And those 3 variations are called isomers?

A That's correct.

Q How many possible isomers are there?

A Well, that depends on how many chlorines there are on the ring. There are 3 possible isomers of monochlorobiphenyl. I think it skips up to 12 possible combinations for trichlorobiphenyl

Q Of the total 10 homologs how many total isomers?

A There are 209. But it's not an appropriate term to talk about 209 isomers of PCB.

You can only talk about isomers of the various congener classes. I try to be picky on this and I'm probably overly picky, but there are 209 congeners which are the sum of all the isomers of all the congener classes. I'm sorry about that. But, to get it straight makes it easier in the long run.

Q With respect to a PCB compound such as Aroclor 1242,

would one speak of that compound being made up of a number of different isomers or a number of different congeners or both?

A You could speak of it either way.

Q So how would you describe that, would it be fair to say 1242 has different percentages of the various homologs?

A It has, yes, it has different percentages of the various homologs or the various congeners or the various isomers depending on what you want to focus on.

Q In layman's terms I think I can understand the description of various homologs like trichlorobiphenyl or pentachlorobiphenyl.

A All right.

Q How would you describe differentially the issue of congeners or isomers?

A Well, congeners are basically the simplest term. A congener is simply one of the 209 possible compounds that could be called or are called a PCB. So it's just if we're talking about a single polychlorinated biphenyl with a given number of chlorobiphenyls on the ring that is a single congener. Each PCB

mixture, for example Aroclor 1242, would contain a given amount of that single given congener.

Q All right.

A All right. That congener is then a member of a homolog or a congener class depending on how many atoms, chlorine atoms are on the biphenyl ring. It also represents a single isomer of the possible arrangement of that number of chlorines on the ring.

Let's take a very simple but probably doesn't occur case. Let's look at a pentachlorobiphenyl which has all 5 chlorines on a single ring. That would be called 2, 3, 4, 5, 6 pentachlorobiphenyl. So we're looking at a biphenyl molecule which has 5 chlorines all in one of the biphenyl rings.

Okay, that is one of the possible congeners of the total class of PCBs. It is also one of the, I think there are 46, possible pentachlorobiphenyl isomers. It is a pentachlorobiphenyl, so it belongs to that congener class or that homolog, and it is one of 46 possible ways to put 5 chlorines on those 2 rings.

Q Would it be fair to say then as a layman that the term isomer is used within the homolog class?

A Yes, that is strictly correct.
Q Whereas the term congener is used across the entire spectrum?
A That is exactly right.
Q I'm just trying to get the family straight, that's all.
A That's right. The next guy will tell you something different.
Q You mentioned that your work for the first 2 and a half years was refining or making more precise the quantification of PCBs?
A That's correct.
Q How does one use the gas chromatograph to determine quantity?
A Well, as we look at the output, the actual chromatogram as the output of gas chromatograph, we can look at various measures of the sizes of the peaks. We can look at the height of the peak or the area under the peak. And both of those to a very high degree represent a quantitative measure of the amount of that material which has been detected.
Q So that would it be fair to say the output from the chromatograph, the diagram, the shape of the diagram,

the shape of the plot gives you the identity of the compound; and the area under the peak be it either in height or in area gives you an estimation of the quantity?

A That's correct.

Q With respect to that, what work did you do on making quantification more precise, what was the --

A Well, the actual final step of the measurement is in fact the simplest of the many steps that go into doing a PCB analysis.

If you start with a sample for instance of water, you cannot take the water and take a sample of that water and inject it into the chromatograph. There are several reasons for that. Number one, water is not particularly compatible with the instrumentation.

The second reason is that in general in a water sample the concentration of PCBs as they exist in that water sample is much too small to be detected by the detector on the instrument. And there are also likely to be a wide variety of other chemical compounds in that water sample which would interfere or cause a spurious signal in the analysis for the

PCBs.

So the steps in doing an analysis, the first step is to get the PCBs into a form which is compatible with the gas chromatograph and get them in a more concentrated form so they can in fact be detected by the instrument and to do whatever is necessary to remove these other interfering compounds.

In fact these steps are the most important in any PCB analysis. So this is where a large part of the research is done is in how to make the PCBs the only compound that the instrument is looking at at a particular time, so you're more confident in both your quantitative and your quantitative results.

Q What do you do when you prepare a water sample?

A First step is generally, let's assume it's a dirty water, a very murky cloudy muddy water sample. You might for instance filter the sample to remove particulate material.

The next step would be to extract the water sample. This is done by adding some sort of organic solvent to the water, material which is not soluble in water and will form 2 phases with the water. This

type, a good analogy is an oil and vinegar salad dressing. If you will look at that salad dressing that has set in the refrigerator for several days, there are 2 separate phases there's a liquid, the vinegar phase, and the vegetable oil phase.

If you shake it up, you get what looks to be a homogenous mixture. And if you let then it settle in the refrigerator for a couple hours, you will be back to two phases.

We do the same thing with a water sample. We take the water sample, we add an organic solvent, for instance hexane is often used. You get 2 phases. You shake the sample vigorously for some period of time. The PCBs being organic molecules themselves would prefer to be dissolved in hexane rather than water. So they essentially transfer themselves from the water phase to the oil phase.

You let the sample settle. You get your upper and lower layer. You throw away the water phase which no longer contains the PCBs. Take the hexane phase and typically concentrate that sample by evaporation.

There are several ways to do this. But

basically just you reduce the volume of the organic or the hexane phase to a very small amount. For instance, you might start with a liter of water which is about a quart. Shake that up with probably a tenth of a quart or tenth of a liter of hexane and then evaporate that hexane to say, for instance, one milliliter.

So in effect you have not only removed the PCBs from the water and put them in a solvent they like but you have concentrated the PCB by a factor of one thousand. So if you started out with a sample containing one part per billion PCB, you now have the hexane solution containing a thousand parts per billion PCBs.

Q How do you prevent the PCBs from volatilizing?

A The PCBs compared to the hexane are very non-volatile and you use relatively gentle evaporation conditions. You don't just stick it under a flame and boil it as fast as you can. You use very gentle evaporation conditions.

Q Having concentrated, what's the next step?

A After that typically we go through some sort of clean up phase. There are several available. The choice

is often dependent on the particular sample. But some of the choices are, for instance, to run this hexane solution of PCBs through a column containing, for instance, activated silica, which is a very sandy like material. It has on its surface sites which adsorbed different kinds of chemical compounds, but they will not typically adsorb PCBs.

So we could run the PCBs through the silica column which would remove materials like phenols which have some sort of active site on the molecule. If we know there's a lot of organic material present, we may shake the hexane up with something like sulfuric acid which would destroy a great number of organic molecules but will not destroy PCBs. Those are the types of things we do. We often run it through a material which removes the little bit of water that's in the hexane, leaving it a more pure hexane solution of PCBs.

Q These's the purpose of that is to destroy or remove interfering chemicals?

A That's correct.

Q How does this chemical interfere when they get on the gas chromatograph?

A He you can imagine there are millions of chemical compounds. There are certainly thousands or tens of thousands of materials which would respond to an electron capture detector and pass through a GC. If you look at a typical GC trace, it may represent 20 minutes of elution and there are hundreds or thousands of materials which would come through the chromatograph in the same time period that the PCBs would.

So that in fact instead of seeing peaks only representing PCBs in your chromatogram you would get peaks from a wide variety of different materials that are similar enough to PCBs that they would respond to the detector.

Q So you might get a false positive?

A That's correct. Absolutely. Some of the pesticides, for instance DDT are very similar to PCBs on a first approximation basis and they would elute under the same conditions as the PCBs.

Q What do you use to clean up the pesticides, for example?

A The large silica column that I talked about does retain compounds in a similar way to a gas

chromatograph but it's actually in the liquid phase so that you can by carefully monitoring of how much material you're collecting at the bottom of the column separate PCBs from things like pesticides.

Q So having cleaned up the sample, then what do you do?

A Then typically, you reconcentrate it. Usually most of these types of clean up you have added more hexane to the system for one reason or another.

The next phase would be to concentrate it back to whatever your target level was, typically one milliliter or whatever you decided you needed to concentrate the sample so that you now have a known volume of a hexane solution of your sample.

Q Why would you have added more hexane?

A Well, PCBs tend to adsorb to glass rather than -- especially in water, but even from a hexane solution. So typically if you were doing this in a glass system, you would want to take a little bit of hexane and wash the glass after you were done with your clean up to be sure all the PCBs were transferred to the next step.

Going through the silica column, you put the PCBs on top of the column and elute them through

column with more hexane so the hexane or whatever solvent you're using is being continually added in small amounts throughout the process.

Q To make sure it comes off the silica, the PCBs?

A That's right.

Q So you end --

A So then you go through a final concentration stage, then it's ready for gas chromatography.

Q And then that final concentration if we started out with a quart sample you indicated or a liter sample, what is the concentration typically fed into the gas chromatograph?

A Well, it depends on the detector. Usually if your using an electron capture detector, which is one, you would like to have a final concentration in the solution of about a part per million give or take 10. So you like to have a final solution which contains a tenth to 10 parts per million of PCBs.

Q How do you know you have that?

A In general, if you're starting out blind, you do not know. In fact in many cases you will inject a sample and you will either find that you have no signal whatsoever that represents PCBs, in which case you

would have to concentrate the sample more or you may find you have peaks that are so large that they go off the scale of the chromatograph and you have to dilute the sample or add more hexane back to it to get it into the range you want to analyze.

Q So if you have a blind sample, you essentially do a trial and error method to get the right influent concentration?

A That's right. It's seldom you have no prior knowledge; but if you had no prior knowledge, it is a trial and error.

Q Then how do you deal with quantity?

A Okay. The quantity goes back to the standard we talked about earlier. The simplest way and easiest to see way to do the quantitation is to run a series of standards containing different amounts of the polychlorinated biphenyls.

So, for instance, you might run a standard containing a tenth of a part per million, 5 tenths of a part per million, one part per million and 5 parts per million. You would then measure the response generated by each of those standards and plot a graph of signal intensity on the vertical axis versus

concentration in the standard on the horizontal axis and generate what is called a working curve. So that you then have a plot of response versus concentration.

You would then run your sample, by its intensity determine where it falls on the curve and at that intersection drop a perpendicular down to give you a concentration in your final extract. Then that concentration then would have to be adjusted for any concentration or dilution you have done to the original sample in order to get back to the concentration of the original sample.

Q Now how do you deal with soil?

A Soil you would do typically the same type of procedure. The main difference is in the first step obviously although you can just shake a soil up with organic solvent, the PCBs tend to be so tightly adherent to the soil that you have to use some sort of physical force to help the PCBs break away from their soil matrix and be extracted into the hexane.

There are several ways to do this. One is to use a ultrasonic instrument which is essentially a grinder which uses ultrasound to generate a very high

vibratory field in the sample so that PCBs are forced to break away from the soil.

There's also another technique which is called a Soxhlet extractor with the soil put in a little cup and the solvent, again usually hexane or something similar, is boiled and trickles down through the cup for a period of 1 to 2 days slowly extracting the PCBs from the soil. But it goes over such a long period that you can do a fairly good job of extracting the PCBs from the soil.

So typically just shaking the soil up with a hexane solvent will not extract quantitative or a high amount of PCB, you need to go to one of these other techniques. After the PCBs have been exstracted from the soil, the rest of the techniques, the clean up and the analysis are the same.

Q How do you know you have gotten all the PCBs off the soil?

A Part of any good analytical technique is to do what we call method development or method validation. So in fact whether you're doing soil or water, you would take what you hope to be a clean sample of soil or clean sample, actually put PCBs into that sample by

some means, and then perform your analysis and measure how much you got out. So by comparing the known amount that you put into the sample with the amount you got out, you get a measure of how well your technique is in fact recovering PCBs from the matrix that you're interested in.

Q When you do a water sample, you say you filter it. How do you filter it?

A If you decide you want to do a filtering, you basically pour the sample through a funnel which has a piece of filter paper or have what we call fritted glass, a very fine glass, like mesh, to remove the solid particles. It's a physical process much as making coffee.

Q But the way you indicated, you have to do that in order to run the gas chromatograph anyway, don't you?

A Well, no. Basically you would only use the filters if you wanted to be sure you were only looking at the water concentration versus any concentration of PCBs or whatever analyte on the particles that might be in that water. By the time you go through the extraction and the clean up stages, that would remove any particulates that might be there. In fact the

extraction would generally remove all particulates in and of itself.

Q The extraction being the shaking up?

A The shaking up with hexane.

Q When you say it will remove, it will bring in the hexane phase?

A No. It leave it in the water phase. When you discard the water phase, any of that particulate matter will go.

Q When you're doing a water sample, how do you know what's in the particulate matter with regard to PCBs?

A You don't unless you analyze the particulate matter also, and typically that might be done if you're interested in what percentage of PCBs were in the water or in the particulate. You would filter it through filter paper, collect the water for analysis. Collect what was trapped on the filter paper for analysis and do separate analyses on those the two things.

Q If you didn't catch the filter paper, didn't catch the solid on the water phase after do you the hexane extraction, you would be only catching part of the PCBs; is that right?

A Yes. Clearly.

Q If you have this particulate matter on the filter sample or in the settled material in the water phase, you would go about testing for PCBs in the way described for soil?

A Yes.

Q Now you mentioned that your first 2 years were involved primarily in gas chromatography. Is that a fair statement?

A Yes

Q Then you moved on to mass spectrometry?

A That's correct.

Q Would you describe mass spectrometry?

A Mass spectrometry is an analytical technique which is most used for identifying chemical compounds, telling what their chemical formula is and what their structure is.

Basically it is a technique in which a chemical compound is evaporated or put into the gas phase in an instrument. These molecules are then struck by a beam of electrons, more an energetic beam of electrons, which essentially causes the molecule to fly apart. It breaks it up. It's like hitting a

clay pigeon with a bullet. It just shatters the molecule. This shattering is very reproducible under given instrumental conditions.

If you then cause these particles which are charged and have electrical charge put on them in the shattering process to go through either an electric or a magnetic field, they are separated according to their mass, actually their mass to charge ratio. But in a first approximation they're separated according to the mass of each fragment.

After they are separated, they are detected either -- nowadays they're always detected electrically. But in the earlier days they were detected on photographic plates and either the photographic or electrical pattern of these fragments gives the identity of the molecule. Because, as I said, under a given set of conditions the fragmentation is consistent. So that you get what is often called a fingerprint of a chemical compound, which is its mass spectrum. A trained chemist by looking at mass spectrum of a compound can identify that compound as to its component, as to its make up. It can often tell its actual chemical structure.

Q Would it be fair to say the mass spectrometry uses a standard similar, same kind of standard you talked about with respect to gas chromatography?

A Yes. In mass spectrometry you would run a standard first and compare the material you were looking for to the standard.

Now that is not strictly true because mass spectrometry can be what we call a priori identification technique where if you know anything about the chemical compound, don't have a standard available, you can still make some prediction of structure by looking at the mass spectrum because there are ways, compounds, fragmentation in a mass spectrometry, there are certain rules that are generally followed so can you actually do a priori structure identification from an unknown compound.

But in the types of analyses that we're interested in here basically you were comparing the mass spectrum of a known material to the mass spectrum of the unknown material.

Q Why would you do mass spectrometry with respect to PCBs as opposed to gas chromatography?

A The reason is that, as I said, the mass spectrum is

essentially a fingerprint of a given chemical compound. So that if you get a fingerprint which matches, for instance, a trichlorobiphenyl, you know you have a trichlorobiphenyl and not something like like DDT or another pesticide or another chlorinated material; it gives you a more positive identification that the material that you're in fact analyzing is a PCB. So it reduces the possibility for interferences.

Q Now just as a matter, does this mean that you would always recommend mass spectrometry and essentially discard chromatography or is this --

A Let's backup one step. One of the important developments in analytical chemistry during the early and middle 70's has been the combination of gas chromatography with mass spectrometry. So in fact you use the mass spectrometer as a detector for the gas chromatograph.

That then gives you a very powerful technique for separating a mixture and identifying each component of that mixture. PCBs as they were manufactured were fairly consistent manufactured products. In other words, every batch of Aroclor

1242 looked pretty much the same if you did gas chromatography. So if you had a reasonably fresh sample of an Aroclor 1242 and ran a chromatograph, a trained analytical chemist would recognize a chromatogram of an Aroclor 1242 as that particular material.

However, if Aroclor 1242 were for whatever reason discharged in the environment and were allowed to sit in that environment for some period of time, its chromatographic pattern would change because of the effects of the environment on the components of Aroclor 1242.

It may no longer resemble Aroclor 1242 if you look at a chromatogram. And so that you would be then required to use mass spectrometry to make an identification of that material.

Q What would it resemble?

A It's hard to say. I mean there's no easy answer to that. The earlier components would tend to have disappeared, so you would see a relative elevation of the peak heights of the later eluting components. But you cannot predict exactly what it's going to look like.

Q So you're saying that basically that for every environmental sample of Aroclor, that is Aroclors that have been released into the environments that you ought to use mass spectrometry instead of gas chromatography?

A I don't think would I go that far. I think the best technology would be to use GC mass spectrometry. I don't know and honestly don't believe that that would necessarily be required.

If a laboratory were experienced and capable of doing a lot of PCB analyses and had a lot of experience I think could probably do very well with gas chromatography with an electron capture detection. But, in the best of all possible world you would use GC mass spectrometry.

Q So it would be fair to say in layman's terms that gas chromatography for environmentally occurring PCBs is sufficient but isn't ideal?

A In most cases it would be sufficient. I wouldn't say that its sufficient in all cases.

Q But in most cases?

A In some cases.

Q Now mass spectrometry you indicated that gas

chromatography actually gives you in our terminology for PCBs, it's really giving you the -- if we're looking at our standard, it's giving you the curve or the peak for a mixture of homologs; isn't that right?

A It's given you a series of peaks. If you look at, for instance, Aroclor 1242, you don't get a single peak, you get what we call an envelope of peaks or a mountain range of peaks representing that particular material.

Q Now does each peak represent a given homolog?

A No.

Q It just happens to be the characteristic series of peaks or what?

A Right. The peaks are generated by their interaction with this phase, this liquid phase in the GC column, and so each peak depending on how you do your analyses could represent for instance 5 or 6 congeners which could be of different homologs. For instance, you could get a peak which contained a trichlorobiphenyl and 2 tetrachlorobiphenyls under a single peak in what we call packed column chromatography.

From the middle 70's developing even to this day

there is a new or a definitive technique called capillary column chromatography which does a much better job of separating the congeners of, for instance, PCBs. So that in a packed column you may see 10 to 15 peaks from Aroclor 1242. On a capillary column might see 50 or 60 peaks, representing the components of Aroclor 1242.

Obviously you have done a much better job of separating the components. Your chance of having a single congener represented by each one of those peaks is much better. But in fact even in the best columns today you cannot separate all of the congeners.

A single very sharp peak which looks like a single congener may still contain 2 or 3 or 4 or more PCBs congeners. They may be of different homolog classes. They may be tetrachlorobiphenyl, pentachlorobiphenyl that acts the same time under the best conditions today. So it's a very complicated and still evolving field.

Q The mass spectrometry spectrum that you get is that again of multiple congeners?

A The mass spectrum when attached to a gas

chromatograph is essentially looking at a time cut of the chromatography. So if there are 2 congeners or 2 representatives of 2 homolog classes coming out of the gas chromatograph at the same time, the mass spectrum will be a mixture of the mass spectra of those 2 materials.

Q So let me go back a minute. The mass spectrometer is used on the output from the column of the gas chromatograph?

A Yes. It's looking at what is coming out of of the column.

Q So it's not looking at the raw material, it's looking at the effluent from the column?

A Yes.

Q Over a time series?

A That's correct.

Q You mentioned that you then moved into a group dealing with mass spectrometry. Was that also involving PCB?

A We did some PCB work, yes. The original group I was in continued to do the environmental studies. But did not have the access to the mass spectrometer. So if there were samples which required mass

spectrometry, I would do those samples.

Q So the original group was continuing in examining environmental samples of PCBs using gas chromatography exclusively; is that right?

A That's correct.

Q How long were you in this group that dealt with mass spectrometry?

A Till 1978.

Q Was this group, you were not focusing on PCBs in this group, you were just periodically providing a service to the PCB group; is that right?

A That's correct. Exactly correct.

Q And then from '78 to '81 you're listed as research group leader, environmental analysis.

What does that mean?

A At that point the simplest way to look at it is the group that was original doing the PCB analyses and Applied Sciences was split off into a separate section call Environmental Sciences.

So we now had 2 large groups, an Applied Sciences and an Environmental Sciences group.

When the Environmental Sciences group was formed, I became a group leader in the Environmental

Analysis section of that group.

Q And what were your duties?

A Primarily we were doing analytical chemistry relating to environmental studies of a wide variety of compounds. By this time Monsanto had been out of the PCB business about 2 years. So we had less and less interest in PCBs, but there was still some PCB work involved.

Q What was the work that you did on PCBs in that group?

A Well, most of it was involved in what was at that time a newly evolving area of concern which was called incidental generation of PCBs. Cases where PCBs were made in chemical processes where they were not expected to be made.

And so we undertook a wide program to check all of the Monsanto process and products which under any possible conceivable mechanism PCBs could be formed to see if in fact we measured PCBs in those products.

We also occasionally looked at some environmental samples to see if PCBs were present. Samples from plants or something like that where they were concerned about the presence of PCBs. In an oil sample or something like that.

Those were the 2 main areas, spot checks of a variety of samples for PCBs and involvement in the incidental problem.

Q Then from '81 to '85 you were senior research specialist in mass spectrometry; is that correct?

A That's correct.

Q What does that mean. What does those duties involve?

A Well, that was a move to our corporate analytical group. And in that group I did exclusively mass spectrometry on anything within the company that involved a mass spectrometry question.

In fact I had essentially no involvement with PCBs during this time as far as actual analyses were concerned.

Q It says from May of '85 to September of '86 you became Product and Environmental Safety Manager.

A That's correct.

Q Would you describe what that means?

A Well, in about 1980 a person was identified within Monsanto to act as a focal point for questions that were coming into Monsanto relating primary to PCBs. This person had functioned as a single unit for a period of approximately 4 to 5 years. And there was

enough questions still coming into Monsanto, concerns about PCBs that they decided that person could use some help. And I was identified as the person to help them.

Q So, who was this person?

A John Craddock.

Q You were assigned as his assistant?

A That's basically correct.

Q You have the title of product and environmental safety manager?

A That's correct.

Q What was his title?

A Probably product and environmental safety director? Makes sense, right?

Q How long did you serve in that role?

A Till September of '86. So this would have been about a year and a half.

Q Was he director of product and environmental safety throughout that period?

A Yes.

Q And then since September of '86?

A Right. I have taken a job as manager of environmental technical support, which is

essentially, I manage a group within the same area that John Craddock is actually, but I have a little more wide involvement with chemicals besides PCBs. And basically we serve as a resource within the corporation for technical information on chemicals that are of concern for one reason or another.

Q When you worked for Craddock, what department is Craddock in?

A Part of the environmental policy staff, corporate environmental policy staff.

Q And how is that organized? If we were to look at flow chart of Monsanto organization, how is Monsanto currently organized and how does the corporate environmental staff fit into the scheme?

A In the broadest cut Monsanto is divided into operating companies. We have a chemical company. We have agricultural products company. We have an electronic materials company.

There are other smaller groups. Searle Pharmaceuticals is kind of off to the side as a wholly owned subsidiary. But each of those companies then has responsibility for their own operations.

There are certain concerns which are company

wide and those are organized under a corporate envelope. We operate under that corporate envelope. And so we are part of a corporate staff function actually.

Q Let's just deal with the corporate envelope meaning the parent company?

A Well, yes. I guess that's basically one way to look at it. It's not really, it's not operated as the separate company. It's just kind of, as I say, a cover all for functions which require a corporate wide focus. For instance environmental policy, accounting, the law department, most of that is a corporate department. A typical corporation, finance and things like that.

Q Let's deal with that. When you stay typical corporation, at corporate headquarters is this where you're located?

A Yes, I am.

Q Who is the head of the corporate environmental staff?

A Okay. I guess the head is Mr. Corbett, Hal Corbett.

Q Harold is that?

A I think it is.

Q C-o-r-b-e-t-t?

A Correct.

He's like, he's corporate vice-president or executive vice-president under something. And I assume you're interested in my organization. So going down --

Q Down under him?

A Under him is a guy named Mr. Jim Senger.

Q What's his title?

A He's vice-president of the EPS, Environmental Policy Staff.

Q All right.

A Then reporting to him are several regulatory affairs directors. There are actually 3 of them. They have responsibility in managing specific functions or specific interactions with the environmental laws on a federal level.

Do you want their names?

MR. KARAGANIS: Yes.

A Ron Condray has responsible for TSCA. And Charles Malloch has responsibility for air and water issues.

Q Okay.

A And Dennis Reddington, that's a good question. RCRA concerns. Also representing or reporting to Mr.

Senger are the head of the medical department, Barry Freidlander.

Q Who else?

A Okay. And then the other one is my supervisor which is Bill McCarville.

Q And he heads what group?

A Environmental Affairs.

Q And within Environmental Affairs how many people are we talking about?

A Okay. We have me, and John Craddock, and Jim Wilson.

Q Anybody else?

A And Sherwin Malt.

Q Sherwin Mald?

A Malt, M-a-l-t. Those are the people I --

Q Is Craddock still involved with PCBs?

A Yes, he is.

Q And you provide as you indicated technical support across the corporation?

A That's correct.

Q What does Wilson do?

A Basically he's got a P.R. type job. He's director of technical communications or something. Represents us on several industry wide committees.

Q How about Malt?
A Malt is an M.D. who basically provides a medical outlook on some of the questions that our group becomes involved with.
Q When you worked with Craddock and currently in Craddock's office, how are the files maintained for PCBs?
A Which files? I mean John obviously has files. He does a lot of things. I mean John has a personal set of files.
Q And did you have a personal set of files when you were --
A When I was working for John, we used a joint set.
Q So kind of an office set?
A Yes.
Q How extensive were the files?
A It was about, I guess 2 or 3 file cabinets.
Q Going up the line, you mentioned that you report to McCarville. How do you spell that?
A M-c-C-a-r-v-i-l-l-e.
Q And then he reports to Senger. S-e-n-g-e-r?
A Correct.
Q Who reports to Corbett?

A Correct.
Q And who does Corbett report to?
A I really don't know the answer to that. I would guess either to Harbison or Mahoney. Harbison is the COO and Mahoney is the CEO. I don't know which one he directly reports to, but I guess he reports to one of them.

MR. KARAGANIS: Would you mark this document as 618.

(Bloomington Deposition Exhibit 618 was marked for identification.)

Q Doctor Kaley, directing your attention to what has been marked as Bloomington exhibit 618, which purports to be a document entitled Monsanto's Second Supplemental Response to Plaintiffs' Interrogatory As To Expert Witnesses.

Are you familiar with that document?
A Yes, I have seen it.
Q Did you assist in its preparation?
A Yes, I did.
Q Doctor, before we get into that, you mentioned that in '73 to 75 you were doing gas chromatography on PCBs?

A Correct.
Q And you had occasion to give a paper on the characterization of PCBs at a conference in Chicago?
A I was coauthor on the paper. I did not deliver the paper.
Q Who delivered it?
A Jim Mieure.
Q What were the circumstances, factual circumstances on preparation of that paper? What do you remember about, what was the --
A Well, basically I think the EPA, I believe, was organizing a conference in Chicago to describe what was known about PCBs in that time period. Jim Mieure or somebody within Monsanto was asked to give basically what was an introductory paper describing what Monsanto knew about PCBs at the time, their physical properties, their environmental behavior and things like that.

Jim Mieure had primary responsibility for writing and delivering that paper. My name was on it basically because I had done a significant portion of the work that went into generating the tables and things like that.

Q When you came in '73, what was the position of Monsanto with respect to the continued sale and distribution of PCBs?

A When I came, Monsanto I guess 3 to 4 years before had become aware of the environmental persistence of some components of PCBs.

Prior to my arriving there they had discontinued several applications and several product lines for PCBs in areas where they thought that they had a good chance of being discharged into the environment. They had limited sales to what they termed closed systems, basically electrical uses. There was an active program to develop environmentally compatible PCB products to replace some of those which had some undesirable characteristics in the environment.

Q So would it be fair to say that as to some applications they stopped selling because they feared that PCBs when used would get out into the environment?

A Well, to be perfectly honest, by the time I got there they had realized that some applications for which PCBs were being used were getting into the environment.

Q So they stopped those sales to those applications?
A That's correct.
Q Then there were other applications for which they felt, you called them closed systems where PCBs would not get out into the environment?
A Where they felt systems would be controlled such that environmental discharges would be minimized at least.
Q And how did they proceed to control them?
THE WITNESS: To control the --
MR. KARAGANIS: Environmental discharges.
A Well, as far as I know, you know, the extent of my knowledge is they limited sales to essentially electrical manufacturers for capacitors and transformers.
Q And how did they make sure that the electrical capacitor manufacturers minimized discharges at their facilities?
A I have no idea. You know, I know there was some interaction with some of our customers in a variety of ways, but I have no knowledge of the specific actions that were taken with the customers particularly.
Q What do you know with respect to --

A Basically what I know is the outgrowth of my work as an analytical chemist. I interacted with analytical chemists, for instance, from both Westinghouse and General Electric, working with them to try to bring their analytical capabilities up to the level that ours were. We felt we had a very good analytical lab for PCB analyses and were willing to work with those customers with their analytical chemists to bring their labs up to the ability to do more accurate analysis.

Q I'm asking you a more specific question. If Monsanto was continuing to sell to General Electric and Westinghouse, how did Monsanto assure itself that General Electric and Westinghouse weren't dumping the PCBs?

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

Q What precipitated the decision, to your knowledge, to stop selling PCBs?

THE WITNESS: To my knowledge -- to stop selling PCBs altogether?

MR. KARAGANIS: Yes.

A Basically the fact that there was clearly regulatory pressure developing. And the fact that in spite of

our best efforts, it did the not appear that PCBs were a viable product because of environmental problems.

Q So despite the fact Monsanto was exercising its best efforts PCBs were still getting out into the environment; is that right?

A I don't know if they were still getting out into the environment, but there was still regulatory pressure to reduce their presence in the environment.

Q Would it be fair to say Monsanto's goal up until the decision to stop selling PCBs was to restrict their release into the environment?

A I think that was one of the purposes of the program. I think there was a 2 phase was to restrict the release to the environment and to develop more environmental compatible products.

Q Until more environmentally compatible products were developed --

A Well, including more environmental compatible PCBs, not excluding PCBs from the development of more environmentally compatible products.

Q It says on exhibit 618 that you're expected to testify as to the composition and physical properties

of the Aroclor mixtures of PCBs.

What is it you expect to testify as to that topic?

A Basically what is known both from Monsanto work and from the literature on primarily the homolog or congener class composition of the materials, how they differed in their gross chemical make up.

Q Please describe what it is you will testify to on that subject.

A Well, basically that the Aroclor series of products were formed by the direct chlorination of biphenyl in the process at our plant. The number following the Aroclor trademark designation designated in general the percentage of chlorine by weight in those compounds.

So, for example, Aroclor 1221 contained 21 percent chlorine by weight. Aroclor 1242 contained 42 percent chlorine by weight, et cetera.

An exception to this was Aroclor 1016, which although given the Aroclor trade name, that 1016 number actually came from a research number given that compound when it was under experimental development. It actually contains about 41 percent

chlorine by weight. And as the weight of the chlorine content of the materials came up, that by implication that means there were more chlorines on the average on a given biphenyl molecule; 1221 was primary made up of monochlorobiphenyls, biphenyls with 1 or 2 chlorines on the molecule. Aroclor 1242 was primarily tri- and tetrachlorobiphenyl. Aroclor 1254 was primarily pentachlorobiphenyls and hexachlorobiphenyls. And that many of the characteristics of each of those separate products is in fact determined by not only the average chlorine content but by the specific congener make up of those materials.

Q Actually when you have been using the words tetra and tri's, you have been referring to the terminology homologs; is that correct?

A That's correct.

MR. FRUEHWALD: He used congener classes to be the same as homologs. So I think he's been saying congener classes.

Q Just so I get my terminology --

A I like congener classes. Everybody else likes homologs and I don't. So I --

Q When you say congener classes, you mean homologs; is that right?

A I mean congener classes. Other people call them homologs.

MR. KARAGANIS: Okay.

MR. FRUEHWALD: I think in terms of the specific testimony to be given here, basically we're probably going to have with him a chart similar to the one that appears here which will define the percentage breakdown of the various products and so to be more specific to what he said generally. But this type of a chart would presumably be presented or at least selections from it to explain the distribution.

MR. KARAGANIS: Let's mark that as an exhibit. Would you mark has 619, please.

(Bloomington Deposition Exhibit 619 was marked for identification.)

Q Doctor Kaley, I show you was has been marked as Deposition Exhibit 619, which is a chart showing I take it the molecular composition; is that right?

A Yes, the approximate molecular composition.

Q Of the Aroclor. Where is that chart from?

A It's from a volume one of a series of books called PCBs and The Environment.
Q And who is that series published by?
A It's published by CRC Chemical Rubber Company.
Q Did you have a hand in putting that chart together?
A Not in its present form, no. Although some of the data in it is Monsanto data, none of which I probably had a direct hand in putting together. Some of the data is the same as that presented in the Mieure paper we discussed earlier presented at the Chicago conference.
Q With other material did you bring with you today? Are those exhibits that your planning on using?
A No, sir. These are materials which were reviewed primarily relating to soil and biodegradation studies of PCB.
Q May I examine those?
A Certainly.
Q Okay, we'll mark these later. Now you've mentioned as to the composition the fact that you will be testifying as to molecular composition, the percentage of chlorine, which congener classes various products contain; is that correct?

A That's correct.
Q Is there anything else about the composition and physical properties that you will be testifying to?
A Well, physical properties certainly, depending on what my actual testimony is required to do. We will be prepared to talk about such things as the solubility of the various Aroclor products and how that relates to their environmental behavior.
Q Well, tell me what you mean by the solubility of the various products.
A Okay. Solubility basically is a measure of the tendency of the material to dissolve in water, specifically water.

As it turns out polychlorinated biphenyls are quite insoluble in water. Aroclor 1242, for instance, appears to have a solubility of approximately 200 parts per billion in a water solution. This ability to dissolve in water will have some effect on how the PCBs behave in the environment.

Q If I have got, let's ask about 1242 in its pure state. Is it a liquid or solid?
A It's a liquid.

Q And is what you're saying to me is if I pour a vial of liquid PCBs into a glass of water that only 200 parts per billion of the PCBs will dissolve in water?

A If you perform the experiment in the way you describe it, a significantly lower amount of PCBs than you describe, than 200 parts per billion, will dissolve.

The 200 parts per billion represents a number which is a concerted attempt to get the most PCBs possible to dissolve and involves a long-term shaking process, things like that.

Just putting PCBs and water together, I don't know what the number would be, but it would be a lot lower than 200 parts per billion.

Q Do you have any experimental data as to what it is?

A No.

Q In terms of the relation of things, 200 parts per billion is the maximum is what you're saying of PCBs that can dissolve in water; is this right?

A That's the number which is given for that maximum typically.

Q Is that based on test data?

A I have done some of that testing. It's also based on other literature that's available.

Q What happens to the rest of the PCBs in our little experiment?
A In your little experiments they would sink to the bottom of the glass and sit there.
Q In a liquid phase?
A In a liquid, yes.
Q What do you call that phase? It's liquid, but it's not water. What do you call that, is there a term given?
A It's basically a 2 phase system.
Q Both phases are liquid; are they not?
A Yes. It's back to the oil and vinegar scenario.
Q Now is there a difference solubility for 1016 than for 1242?
A The numbers reported are very, very close. You would not expect a very large difference. And the experimental error in the experiments is probably greater than the actual difference. You would expect about a 200 parts per billion. It may be just in actuality a teensy bit higher because of the lower amounts of the higher chlorinated congeners in 1016, but I would not expect a very large difference at all.

Q Anything other than solubility as to physical properties?
A Well, potentially questions could arise that would relate to the vapor pressure, their ability to evaporate from a system.
Q What is their ability to evaporate?
A Basically they do not evaporate very rapidly. But over a long period of time they would be expected to, lower chlorinated materials might be expected to evaporate into the atmosphere.
Q Is that true for materials that are on the surface or would this also be true of materials that are say covered by soil?
A No, that would be strictly surface effects primarily.
Q Any other physical properties?
A As far as strictly physical properties, I don't believe so. Well, yeah, I guess so. I guess soil adsorption would be considered a physical property. So that would be another.
Q What do you mean by absorption?
A Adsorption.
Q A-d?
A Ad. That's basically looking at their tendency to

adsorb or adhere to particulate matter under whatever conditions of experiment or environment you're looking at.

Q And what is that tendency?

A Well, basically because PCBs are water insoluble and not very volatile they will in fact tend to associate with any particulate matter that is present in certainly an aqueous system, a system containing water, but probably also in a system which contains very little water.

Q By associate they will attach themselves?

A Yes.

Q And they attach at a molecule level; is that right?

A Yes.

Q So the molecules of PCBs have a tendency to adhere to soil?

A That's correct.

Q If I had a column of soil, and again using an experiment, poured a vial of 1242 or 1016 into that soil, would all of the molecules adhere to the soil?

A Well, obviously there's going to be some quantity or capacity of that soil to adsorb PCBs. I think in fact if you poured a bottle of pure PCB, depending on

the length of the soil column, they may very well all adhere. If there's enough soil capacity there to hold all of them.

Q If there isn't enough soil capacity ?

A If there isn't enough, I suppose they would eventually leach from the bottom of that soil column

Q Let's see if we can describe the process here. If I have a soil column that's a hundred feet deep, a hundred feet high --

A Okay.

Q -- and I pour PCBs down that column such that all of them are adsorbed, all the molecules are adsorbed --

A Okay.

Q -- is there any phenomenon which will over time release any molecules of PCBs? I mean are they permanently locked onto the soil?

A In general, that's probably true. I think if you look, the literature says if you in fact took another organic solvent, for instance, if you took hexane and poured it over that soil column, I think that the some of the PCBs would tend to dissolve in the hexane and move on through column with that hexane as the hexane moved through.

Q Let's assume, let's hypothesize now if we have a soil column and PCBs are leaching from it, one of the possible causes of the leaching would be as you indicated that the soil does not have the capacity to adsorb all of the molecules; is that right?

A Yes. But in the experiment you described all the molecules adsorbed.

Q But if we find at the bottom of a column of soil that we have PCBs coming through, one possible explanation for that is that the PCB, the capacity of the soil to adsorb all of the PCBs was either exhausted or have limited capabilities?

A One possibility, I would agree with that, yes.

Q Another possibility -- and that would be true independent of whether any solvents were present, isn't that right?

I mean if you found it there it means, if no solvents were present, the soil couldn't absorb all the PCBs?

A That would be one possible explanation, correct.

Q Another possible explanation might be that the presence of other solvents were causing the PCBs to release from the soil, was that right?

A Yes.
Q So that if another solvent comes into contact with the PCBs, that solvent can actually break the adsorptive bond; is that right?
A To some degree or another, That's correct.
Q Do you have any quantitive estimate as to what that capability is?
A It's going to depend on the solvent, the soil and the and a whole variety of different parameters.
Q Do you have any quantitative estimate or quantitative capability to say independent of solvents that a given column of soil or given column of materials will adsorb a given amount of PCBs?
A I certainly don't have that information today. I don't know whether such a calculation could be made from what's available in the literature or not.
Q So in our situation where we're finding PCBs leaking from the bottom of a soil column, we know that one possible cause is the lack of soil capacity to adsorb all the molecules; is that right?
A That's correct.
Q Another possibility might be the presence of solvents which are causing the break up of the adsorptive

bond; is that right?

A That's correct.

Q Any other causes?

A Not that I can think of. You know, in the situation we described.

Q So the only two ways that PCBs are going to get through the bottom of a soil column are either lack of adsorptive capacity of the soil or some other solvent causing the adsorptive bond to break; is that right?

A Those are two ways we have discussed today. I hesitate to say those are the only two ways.

Q But to your knowledge those are the only two ways; is that recollection?

A As I sit here today, that's correct.

Q Now is it at all possible for the, what's the term used to characterize the non-water phase of liquid PCBs? Is there any terminology used? Is the term miscible ever used or immiscible?

A Well, miscible basically means mixable. And immiscible means not mixable.

I mean if you had a water system and it had another liquid phase, you would say the other liquid

phase was immiscible with water or two phases were immiscible, they weren't mixable. They would just mutually dissolve each other.

Q As to the use of solvents to break the bond, if solvents were breaking the bond, PCBs could be released both as in a soluble form, ie., in water up to the limits of solubility as well as the non-soluble portion isn't that right?

A I'm not sure I understand the question.

Q You indicated that if you poured liquid PCBs into a jar of water that 2 phases would develop.

A That's correct.

Q One would be the soluble phase in the water and the other would be the non-water liquid phase of PCBs?

A Okay. Correct.

Q And I'm asking you if solvents were used, hexane or whatever in soils, would the released PCBs be both that which is soluble in water and that portion, some of that portion which is non-soluble in water?

THE WITNESS: You're asking 2 questions. Are you asking about leaching by water are are you asking questions about leaching by solvent?

Q Let's deal with the leaching by solvent situation?

A Okay.

Q Leaching by solvent situation in the environment for, let's say hexane were to come into contact with the soils. You indicated that in terms of the water phase the maximum amount that could get into the water and out from the soil column would be 200 parts per billion; is that right?

A That would be the maximum, right.

Q Could there also be PCBs in the non-water phase also released in the environment?

A A material like hexane essentially the solubility, PCBs are probably soluble in hexane from anywhere to a hundred percent. So if you leach hexane through a soil column, certain amount of the PCBs may very well dissolve in that hexane and travel down the soil column with the hexane.

Now I don't think it would travel down as quickly because there's going to be a continuing interaction of the PCBs between the solvent and between the soil. There is a relative tendency for the PCBs to either be dissolved in the hexane or be adhered to the soil. So you're not going to put in the hexane, it's going to shoot down the hexane.

It's going to adhere to solvent and redissolve into hexane.

But you really don't, you don't have an aqueous phase. You don't have a 3 phase system. Okay. You have got an oil phase, I mean you have a hexane phase which may or my not contain some dissolved PCBs, and you're going to have a soil solid phase, which will have PCBs adhering to it.

I don't think you're going to have -- if I understand your question, you're asking me are you also going to have free globules of PCBs floating down through that system. My answer to that question is no if there's what you're asking.

Q Let's go back a minute. Let's take the system. You indicated there's going to be some degree of elution into the hexane; is that right?

A Yes.

Q And is that term elution e-l-u-t-i-o-n. Am I using the right term?

A I think the term is dissolution, d-i-s.

Q So when it desorbs, it desorbs into the hexane, there will be a hexane phase?

A That's correct.

Q You indicated that could be substantially above 200 part per billion, indeed all the way up to a hundred percent of the PCBs theoretically?
A Theoretically I would say those 2 were completely mixable at any --
Q And depending on whether a solvent other than hexane was being used, other solvents would have different degrees of solubility in the PCBs, is this correct?
A That's right.
Q But certainly all of the solvents have a higher capacity for mixing or dissolving PCBs than water; isn't that right?
A Using a general term for solvent I would say generally they're going to be higher than water, yes.
Q For example, toluene?
A Yes, that would be higher than water.
Q Then you indicated there would still be material in the soil phase?
A That's correct.
Q And if there were water present, would there also be material, PCBs in the water phase?
THE WITNESS: Along with the hexane and the soil?

MR. KARAGANIS: Yes.

A There would probably be extremely, extremely small amounts present, yes.

Q Theoretically up to 200 parts per billion?

A Not in the phase you're -- no, there's no way it would approach the water, no, because otherwise our analytical experiments wouldn't work.

No, if you have water competing with soil and hexane for PCBs, there's no --

Q Who's going to win?

A The water will lose clearly and it will lose at a much lower level than the 200 parts per billion of maximum solubility.

Q Do you know what the level is?

A I sure don't.

Q Now let's take the process of water independent of solvents.

A Okay.

Q Will water cause desorption over time?

A I hesitate to say absolutely no. But it will certainly not desorb very much, very quickly. And in fact what environmental evidence there is in the literature says that PCBs do not move under water

leaching conditions.

Q They do not move at all?

A That's what the literature says. Within the uncertainties of the measurements that's basically true.

Q So if we were to find it moving, it would be because of either solvents present or an incapacity of the soil to adsorb; is that right?

A Well, I mean that's where we're coming from, yes. Basically as I sit here today those are the processes I'm thinking would be available, yes.

Q Are you familiar with the Bloomington, Indiana situation?

A In outline form, yes.

Q Have you looked at the data from Bloomington?

A I probably have in the past couple years. I don't have any specific recollection of it.

Q And you do not intend to give any opinions as to Bloomington in this case, do you?

A As far as I know, other than how PCBs, their physical properties would be expected. As far as I know I'm not to comment on the actual data.

Q So you can't say whether PCBs are leaking from either

the landfills or from any other locations; is that right?

A Not as I sit here today.

Q Based on your characterization of PCBs and their ability to adhere to soil and not move in a water situation, would it be fair to say as long as you keep PCBs away from solvents that putting them in a landfill is not a bad idea from an environmental standpoint?

A Let me back off a little bit, okay?

First of all, PCBs obviously since they have a limited solubility in water will dissolve to a limited extent in water. I don't know what that extent is. So to say there's absolutely zero leaching with water is incorrect. There is certainly going to be some trace amount. Okay?

Q You don't know what that is, but it's theoretically up to 200 parts per billion, right?

A I would guess in actuality it's much lower than that.

Q But you don't know what it is?

A Not a given number. Okay?

MR. KARAGANIS: All right.

A I think as I sit here today that in a well designed

and well controlled landfill that disposal of PCBs in such a landfill probably is appropriate.

Q What is a well designed and well controlled landfill?

A Well, I guess looking at it from a 1988 perspective it would be a landfill in a geologically secure area where you wouldn't expect earthquakes to occur. An area probably with some sort of clay liner. Probably some sort of artificial plastic or some interliner to maintain the integrity of the clay liner.

Q Would you put it in an area that had fractured limestone?

A I don't have a clear picture of what fractured limestone actually would mean. I don't know the answer to that.

Q If the subsurface conditions underneath the land were in fact fractured limestone, would you put it there?

THE WITNESS: Would I put it there with my knowledge today?

MR. KARAGANIS: Yes.

A Probably not.

Q Would you put it in an area that had sink holes, in a landfill that had sink holes?

A Probably not with my knowledge today.

Q And why is that?
A Well, if we're talking about designing a well controlled landfill from whatever material is put in there, it's put in there with the intent to stay in there, I think the conditions you described you would expect that there would be some potential at least for whatever material you put in there to move from the landfill. Or given conditions over a given period of time.
Q How would it move?
A I think in cases where there's actually voids in the system where there are no, there's no soil, I think it would just move by essentially a channeling type phenomenon.
Q If it moved by a channel type phenomenon, could it move in the water phase?
A At a very small amount I suppose it could. I don't think that would be a major transport mechanism.
Q Could it move in the liquid phase that isn't in water?
MR. FRUEHWALD: Let me interpose, Bob's answering in terms of whatever substance you put in there. I detect maybe your questions are PCBs. But

his answers are more general, but you're now back to PCBs.

Q Well, when you referred to substances, you would not put PCBs in a landfill over fractured limestone, would you?

A With the state of knowledge I have today, no.

Q And you wouldn't put PCBs in a landfill over sink holes, would you?

A With the state of knowledge I have today, probably not.

Q And with respect to the mechanisms for movement you indicated in voids, PCBs would move essentially in a channeling effect, isn't that right?

A That potential certainly exists, yes.

Q I asked you now with respect to its movement, PCBs movement in voids, would that move in a water phase?

A Probably not to a significant extent in a water phase, no.

Q Would it move in the non-water liquid phase?

A Very well could slowly, yes.

Q And could it also move in a solid phase, attached to particles?

A Yes.

Q So the 3 methods of movement, the 3 possible options that we have or 4 would be, one to move as water or move in water, dissolved?
A That's one of the options.
Q Two, to move as in a form of particulate in water?
A Okay. That's an option.
Q Three is to move in its non-water liquid phase?
A Okay.
Q And four would be if we had a solvent present to move in a solvent phase; is that right?
A That's correct.
Q Any other phases that I missed or any other possibilities?
A I don't believe so.
(A recess was taken.)
Q Doctor Kaley, is there anything else about the physical properties?
We mentioned solubility. We mentioned soil adsorption. Anything else about the physical properties of Aroclor mixtures that you're going to testify about?
A Not that I can think of right now.
Q What do you know about the medical effects of PCBs or

the toxicological effects of PCBs?

A I have a general understanding of what is in the literature. I'm certainly not trained to interpret what's in the literature.

Q Would it be fair to say that at least there's a significant body of literature whether you agree or disagree with it that says that PCBs in certain concentrations are toxic?

A Well, yes.

Q Would it be fair to say that without getting into the debate over whether they are carcinogens or not carcinogens that PCB as an industrial chemical have been known to have toxic potential for sometime?

A I would say that PCBs as a general chemical compound, as any general chemical compound have some properties which would require some sort of hygienic procedures to minimize exposure to those materials.

Q By hygienic procedures you mean keeping them away from human contact?

A I would say keeping them away from excessive human contact.

Q Would it be fair to say again without getting into concentration levels that it's been known at least as

early as the 40's and early 50's that you didn't expose people to pure PCBs if you could avoid it?

A It's hard to avoid concentration effects when your talking about pure PCBs. I'm not sure I would agree with that, no.

Q Well, there were recommended hygienic levels for PCBs in the 40's and 50's, were there not, for air exposure, for example?

A I believe there were air exposure levels.

Q So there was recognition above certain levels of air exposure there was potential for toxic effects, isn't that right?

A I would say that's true. Potential was certainly there.

Q How did they determine that potential? Do you recall how they established those air standards?

A As I recall they were basically based on animal tests.

Q Is that a typical way of determining potential toxicity?

A If there is no human evidence available, I think there is a tendency to extrapolate from animal studies.

Q As a matter of fact Monsanto has used animal studies in a number of areas to evaluate potential toxicity, have they not?
A Certainly.
Q It's a standard toxicological approach, is it not?
A Yes
Q Your next topic which is the history of the development of technology and methodology for detection and quantification of low levels of PCBs in various media.

What are you going to testify to about that?

A Basically just outline what kinds of techniques were available and how the analytical chemistry of PCBs has evolved since about the mid 60's to the prior day or whatever.
Q What was their availability in the mid 60's?
A Well, basically the technology that really allowed PCBs to be measured in the environmental samples at the levels, the low levels they were found to be occurring was the development of the electron capture detector. And that really wasn't developed until the early 60's, was not in wide usage until really the late 1960's.

Q That's the device that is at the end of the gas chromatograph?

A That's correct. That technology continued to evolve through the mid and late 70's, the early detectors were not very sensitive. They were very temperamental, very difficult to use, were not widely available.

That technology has continued to improve. The ability to connect a gas chromatographic to a mass spectrometer really didn't develop until the late 1960's. Again that technology continued to improve. I would say by about the mid to late 1970's, that technology was well established and you could do much more precise, much more certain PCB analyses with the mass spectrometer than the early days

I think the development of the capillary column to do better separations of the PCBs in a gas chromatograph, the technology was available in a rudimentary state in the early 1970's but really not until about 1980 was that commonly available.

And again all those developments will have some effect on what levels were able to be measured in what mafrices and determines to a certain extent the

degree of criticality that you need to observe analytical data.

Q What do you mean by that?

A Well, I mean basically that if you look at a body of data, this was generated in 1970's, which purports to measure a part per trillion of PCBs in water, for instance. I think you need to be very critical and look at this data very critically with a historical knowledge of the fact that in reality the ability to do that analysis was not possible. I would say a report of a part per trillion, maybe even a part per billion in water in 1960 probably doesn't have the reliability it would have today.

Q Let's talk about gas chromatography. What would you say the reliability levels of detection were for the 60's?

A For the 1960's I would say in the -- certainly, of course, we're talking in the late 1960's now because the technology wasn't even available till the mid 1960's.

I would say that probably in water maybe a tenth of a part per million, a hundred parts per billion would be a good measure of quantitation. I think in

soil an order of magnitude more than that, a part per million or 2 or 10 parts per million in soil.

Q That's in the late 60's?

A Right.

Q Let's to go the 70's.

A Okay. Again it's going to be a continual development, but starting from those numbers I think by '75 we could drop it down to low parts per billion in water fairly reliably.

Q By low parts per billion?

A One to ten parts per billion would be fairly reliable, maybe even a little lower than that. Soil probably 10 to a hundred parts per billion.

Q All right. And then from '75 to '80?

A Probably slight improvements by '80. I guess we would probably be able to measure 10 to 100 parts per trillion in water. Maybe 100 parts per trillion to 1 parts per billion in soil for it to be reliable.

Q A hundred to one, one to a hundred you mean?

A Okay, I think I said one to 10 parts per trillion in water. And a hundred parts per billion -- no, 10 to a hundred parts per billion -- no, I'm sorry, hold it, stop. One to ten parts per billion in soil.

Q And then from '80 to '88?
A Okay, I don't think things, as far as actual detection limits I would say things haven't developed too much.

I think what has developed in that time period is the ability to look at specific single congeners of PCBs and worry about what is happening to an individual, one of the 209 individual compounds rather than looking at the manufactured mixtures. There's probably been some slight improvements in detection limits and things like that, but probably not significant.

Q What's the significance from the standpoint of environmental contamination and prevention of contamination? What's the significance of the fact that increasing levels of sophistication have developed?
A Well, I think there are two things. I think it's allowed us to have a better understanding of what is really happening to PCBs in the environment. It's allowed us if we talk about single congeners we can begin to worry about are the materials that are found found in the environment, are they in fact the ones

that have for whatever reason been shown to have some toxicity in animals. So we can say if congener X turns out not to be toxic to animals, do we need to worry about congener X in the environment or conversely congener Y is toxic in animals, maybe we should have a little bit more concern about that presence in the environment. I think that that's clearly the way that PCB analysis and toxicity studies and to some extent even regulatory pressure is starting to look at the PCB problem. Not so much about is there Aroclor 1242 there but is congener X there, congener Y.

Q When you say regulatory pressure --

A Well, the regulatory agencies continue to be concerned about the presence of PCB in the environment. And the recognition is there that PCBs are not necessarily all the same. That there are within that 209 compounds, there are some we need to be more concerned about than others. And there is some movement within the regulatory community to begin to look at those specific congeners.

Q What movement is that?

A Well, I mean just the way the EPA for instance is

looking at the regulation of PCB. Perhaps in drinking water. They're now looking at techniques of measuring specific congeners in drinking water rather than looking to see whether there is an Aroclor product in drink water.

Q They have proposed a drinking water standard, have they not?

A Yes, I think that's true.

Q Do they separate out the different kinds of congener?

A There are discussions, that is my understanding is that drinking water standard has been proposed and there are discussions on whether that drinking water standard ought to be, the measurements required to meet that standard ought to be done on single congeners or a group of particular congeners versus total PCB content, yes.

Q And what is the theory of that that certain congeners --

A Well --

Q -- are toxic?

A Yes.

Q What congeners?

A The list is in the literature. I don't know which

offhand. Basically they're looking at pentachlorinated and hexachlorinated congeners with certain patterns of chlorine substitution.

Q Do you know of any toxicologists that have tested toxicology of certain congeners?

A Certainly Steve Safe of Texas A & M has made a career.

Q Studying the toxicology of individual congeners?

A That's right.

There are other people doing it, too.

Q But we don't have pure congeners in the environmental mixtures, do we? I mean in the sense --

A Well, sure you do. Each peak from a of GC is a pure congener. I mean obviously the PCBs that are in the environment are not, I mean there isn't one congener in the environment to the exclusion of all others. They're there because the products that are manufactured that escaped to the environment were mixtures. But they contain some number of these congeners.

And, as I said, the feeling is or the science is today that we need not worry about all of those congeners. That there are certain of the ones that

we need to worry about and maybe not worry about the other ones so much.

Q You're not a toxicologist, are you?

A No, I'm not.

Q And with respect to the toxic effect. Potential toxic effect of the 1242 or 1016, you're not prepared to give expert testimony on their potential for toxic impact, are you?

A No, I'm not.

Q Now let me ask you a practical question. You have mentioned the increasing sophistication of the technology and methodology for detection of quantification. I'd like you to go back to the 50's and early 60's.

A Okay.

Q Does the fact that the technology was not there to detect parts per trillion levels of PCBs in water or soil, would that have been a justification for dumping PCBs down a sewer because you couldn't detect them?

A Because you couldn't detect them, no. The answer to that is no.

Q Based on what you know now or if you were in the 50's

and 60's would it have been sound environmental practice to dump PCBs down the sewer?

THE WITNESS: Based on what I know now?

MR. KARAGANIS: Yes.

A No.

Q Based on what was known about PCBs as an industrial chemical then, would it have been a sound environmental practice to dump PCBs down a sewer?

A I think there could be some justification for that.

Q By what was known then?

A By what was known in the 50's and 60's.

Q Was that a Monsanto recommendation at that time?

A Was at Monsanto recommendation? I don't know the answer to that. I doubt it.

Q Did Monsanto have a position whether it was a good idea to dump PCBs down the sewer?

A I have no idea.

Q Based on what was known in the 50's and 60's would it have been good sound environmental practice to dump PCBs into landfills built on fractured limestone or sink holes?

THE WITNESS: I'm sorry, am I basing my answer on what I know now or what was known then?

Q Known in the 50's or 60's would it have been a good environmental practice to dump PCBs in landfills built on limestone, fractured limestone or sink holes?

A Well, since I was less than ten years old at the time, I really don't know the answer to that.

I would say that it would have been probably standard practice to dispose of industrial materials in landfills near the site they were used and that's really all I can say. I don't know, I do not in my mind know what the standards were were for siting of the landfills the 50s and 60's, I clearly don't.

Q Let's talk about common sense. Had we made such strides in science that we know scientifically something we didn't know then which was that we didn't know in the 50's that it was a bad thing to place contaminants in landfills based on fractured limestone?

MR. FRUEHWALD: In other words you --

A I think those concerns were not addressed to the same extent in the 50's. The concerns we have today were not addressed to the same extent that they were. They are not addressed today, excuse me, let me start

over.

The concerns that we have today were not uppermost in people's minds in the 50's and 60's concerning siting of landfills and what to do with waste.

Q Now let's go back a minute. Let's take today. You agreed, did you not, earlier that it would not be a good idea knowing what you know today to dump PCBs down sewers?

A Yes.

Q And you agreed, did you not, that knowing what you know today it would not be a good idea to place, to deposit PCBs in landfills based on fractured limestone or sink holes?

A Yes.

MR. FRUEHWALD: That could be anything, it could be fill in the blank, PCBs or a lot of other substances. It could be fill in the blank, not just PCB.

MR. KARAGANIS: I want to be specific on PCB.

MR. FRUEHWALD: I know.

MR. KARAGANIS: If you want to talk about

other industrial, Mike, that will be --

MR. FRUEHWALD: They could be generically as to industrial chemicals generally.

Q We're talking about PCBs.

A Okay.

Q And your answer I take it would be the same on both of those points if you talked about industrial chemicals?

A In general, yes.

Q Now from the standpoint of scientific knowledge, isn't it a fact that there has been nothing from a standpoint of scientific knowledge that we have learned about sink holes, fractured limestone or sewers between today and the 50's and 60's which would change that opinion?

A I think that's putting an unfair cast on the situation, because I think our knowledge of the toxicity of industrial chemicals and our concerns about environmental effects of industrial chemicals has progressed greatly since the time period that your describing.

I think in fact did we know in 1950 that if we poured something in a hole, it was going to go the

bottom of the hole? Probably not. I mean certainly we knew that in the 50's. If you take in the 50's and pour something in the hole, it's going to go the bottom of the hole.

But I think clearly our concerns about what happened after it gets to the bottom of the hole has progressed greatly since the 50's and 60's. I'm not even sure I would agree with the first part of that. I think since hydrogeology has probably progressed greatly. What happens to material in hole, how long does it take the material to get to ground level, how long does it take it to get into a stream from a given point, I think clearly the science has progressed greatly.

Q Let's talk about methods and rates of degradation of various Aroclor mixtures.

What is your testimony going to be on methods and rates of degradation?

A I think basically since scientists out there say that in spite of the "conventional" knowledge, conventional in quotes, PCB are non-biodegradable, in fact PCBs containing up to 4 chlorines per molecule are in most cases quite biodegradable.

A material such as 1221 which has 2, 1 or 2 chlorines per molecule is almost totally degradable in laboratory tests and to a certain extent that has been shown in the environment. As we go up in chlorine content the biodegradability of the mixture as a whole tends to decrease. When we get as high in chlorine content as Aroclors 1254, we see a material which probably 10 percent or less degradable over a given period of time in a given test system. But clearly certain of the PCBs are biodegradable.

It turns out that these have been studies in a variety of systems. In fact there's research going on now which says even some of the higher chlorine materials are biodegradable in a different kind of system than was studied earlier.

So I think as we interpret what is the significance of PCBs in the environment we need to look at biodegradation results that are out there and consider what is happening to these materials in natural systems or sewage treatment systems.

Q Let's talk about either a natural system or sewage treatment systems. If we have a given concentration of 1242 or 1016 in sewage sludge, you indicate that

according to summary of grounds in Deposition Exhibit 618, you say 1242 and 1016 degrade at a rate of approximately 30 percent in 48 hours.

A That's correct.

Q If I have got a given concentration of 1242 or 1016 in my sewage sludge, how long do I need to wait before it's gone, before the 1016 and 1242 are totally degraded?

THE WITNESS: What's your definition of gone?

MR. KARAGANIS: I can't measure it.

A You can't measure it? I think you would probably have to wait a significant period of time.

We tend to talk about half-lives of these materials. Certainly in the case of 1242 there are going to be a certain level of pentachlorobiphenyls in there that are probably going stick around for months to years.

Q What do you mean months to years, how long?

A I don't know the exact number. It depends on your system.

Q How long do pentachlorobiphenyls take to degrade in the environment before they're gone?

THE WITNESS: In what environment?

MR. KARAGANIS: Well, let's talk sewage sludge.

A Which treatment plant? It depends on the treatment plant. It depends on the concentration. You're giving me a bunch of assumptions which --

Q Let's talk worst case.

THE WITNESS: Worst case?

Q Yes. How long?

A Certainly components maybe five to ten years.

Q Five to ten years?

A In a sewage treatmeant plant.

Q So that's the worst case. After ten years --

A That's my guess as a worst case.

Q After ten years there shouldn't be anymore; is that right?

A As long as you're not putting anymore in there.

Q So if I have got a sewage lagoon containing sludge I haven't put any in in ten years, I should be able to test that and find none?

A If the bugs in the lagoon are acclimated to PCBs and are in fact degrading PCBs I, would say that's a reasonable assumption.

Q And if I per chance were to find that the material still contains high concentrations of PCBs, that would be because the bugs aren't acclimated or are not degrading; is that right?
A I would say that's true, yes.
Q And there can be indeed situations with such lack of degradation occur; is that right?
A I would guess that there are, yes.
Q You're not in any position to predict when and if the PCBs in the Bloomington sewage lagoon would degrade to non-detection levels are you?
A I don't have any specific information about their system, so I don't know.
Q You don't know whether there is biological degradation taking place; and if any at what rate, is that right?
A I would assume there's some. I certainly don't know at what rate.
Q It's possible that conditions that were not conducive to degradation might exist in such a lagoon; is that right?
A Conceivable.
Q Basically let me get this straight. If I were to

find under your hypothesis, I just want to make sure your testimony is clear on this, if I have a sewage lagoon contaminated with PCBs say in the order of 1242, several thousand pounds per million?

A Can we step back because the first assumption was a sewage treatment plant, which I in my mind consider as an active plant with ongoing inputs of sewage and an ongoing influent/effluent system in active plant.

If you're talking about a lagoon which is just sitting there after ten years and there's no input, there's no output, there's no active treatment, there's no trickle filters or stuff like that, you know, that's different.

Q Well, you have just identified characteristics that might be classified for Bloomington sewage lagoon.

THE WITNESS: Which one, the fact it's just sitting there?

Q It's just sitting there.

A Okay. With no stirring.

Q No stirring.

A Okay. Well, I mean part of biodegradation is the fact that you have a system where you have oxygen inflow for instance.

Q No.
A I'm not asking a question. I say to have biodegradation of PCB under the common system you need oxygen. I mean that's the first step is adding oxygen. If you have an oxygen poor system, if you're not controlling pH, I mean there are lots of things in a lagoon which could stop biodegradation clearly.
Q If we're not adding oxygen, we're not stirring the system, we have just got 7 acres of sludge, how long could that take before it broke down?
A If there's no biodegradation, no other process, I mean it could be tens of years. I really don't know.
Q Could it be hundreds of years?
A Could it be hundreds of years? I don't know the answer to that.
Q So, you do not have --
A I would not say that it was not impossible after a hundred years there would be detectable PCB in there.
Q So it is possible that after a hundred years --
A If there's no process to change those PCBs going on in that lagoon, clearly yes.
Q And you're not in a position to say that there are certain process or not at the Bloomington lagoon?

A No, I'm not.
Q But if there weren't oxygen and stirring and other activities going on, such activities are necessary for biodegradation?
A You clearly need a viable micro-organism.
Q And oxygen and stirring, do you not?
A Certainly oxygen. I think stirring would help. otherwise you're going to get the materials settled into the bottom and covered up and unavailable.
Q Unavailable to the bugs?
A To the bugs that require oxygen.

Now as I have said, there is some new research coming out of General Electric which says that there are processes which even in the absence of oxygen can degrade PCBs. Those have been shown primarily in the Hudson River. But basically what those processes generate are lower chlorinated PCBs and there would then be stirring required to get those chlorinated PCBs up to the level where oxygen were available.

Q Now how about landfill conditions if I put 1242 or 1016 in landfills?
A Yes.
Q How long does at that time to degrade so it won't be

detected?

A I don't have any idea.

Q Could it also be hundreds of years or in excess of a hundred years?

A I would say that potential is there.

Q And your experience here on 1242 and 1016 of degrading 30 percent in 48 hours is an active sludge sewage treatment plant?

A It's in a laboratory system which simulates secondary sewage treatment.

Q So you have got active bug population, you have got aeration?

A That's correct.

Q And that was in a lab experiment?

A That's correct.

Q Did you ever follow on to see how much degradation occurred for the remaining 70 percent?

A There have been experiments done to do that. I think there are experiments in the literature and in fact one of our European labs looked at long-term and found for Aroclor 1016 over 90 percent degradation again in a laboratory system over a period of I think it was a hundred days or something like that.

Q Has Monsanto ever done any experimentation on degradation in the field?

THE WITNESS: Actually in the field?

MR. KARAGANIS: Yes.

A Not to my knowledge.

Q In preparation for this deposition or in preparation for your testimony do you intend to examine any Bloomington data?

A I haven't been asked to. If I'm asked to, I will.

MR. KARAGANIS: Mike, this is a 26B4?

MR. FRUEHWALD: That's right. I'm not purporting to have anymore than these principles as being his testimony. Now, he was supplied the Peoples paper which described the system there, the sewage treatment plant system. But that was just for general background as to what he was here.

But I don't intend to give him a lot of data and have him spout opinions on those. Just as many of your witnesses experts deny the ability to. So this is a similar situation.

MR. KARAGANIS: We do have an expert testifying about Bloomington.

MR. FRUEHWALD: But many of your experts

say they're not going to state opinions on that and likewise I'm not expecting to ask Bob to do so either.

Q Doctor Kaley, have you been asked to review any data with regard to what has been collected in the Bloomington area with regard to PCBs to determine its accuracy or to evaluate the methodology used to analyze the data?

A I don't believe so.

(Bloomington Deposition Exhibits 620 through 630 were marked for identification.)

Q We talked about soil. We talked about water. How do you analyze for PCBs in animal tissue?

A Well, basically the first step is what's different. If you're talking about animal fat, basically you have to mascerate the fat for instance with a ultrasonic generator or ultrasonic nebulizer to get it in the very small particles so that the solvent can extract the PCBs from the fatty tissue.

In the case of fat there's a real problem because the fat is also soluble in the solvents used to extract PCBs, so you have to go through a secondary, usually a column treatment to remove the

PCBs from the fat by traveling through a column. After that procedure is done, then the procedure is the same.

Q How about tissue, non-fat tissue?

A Well, that would be basically the procedure for any tissue except blood. Blood you have to go through several steps to breakdown the protein matter in the blood and again remove the PCBs from the fat component of the blood and things like that.

Q You have mentioned in exhibit 618 your proposed testimony under rule 26B4 that the lower chlorinated congeners degrade more rapidly. If you're doing gas chromatography, you indicated that you work off of a standard?

A That's correct.

Q And I take it the standards if you're looking at 1242 are either, there's a 1016 standard and a 1242 standard and a 1254 standard; is that correct?

A That's correct.

Q If the lower chlorinated congeners degrade more rapidly that would indicate that the remaining material, let's say it was 1242, would have a higher percentage of the higher chlorinated congeners?

A That's correct.
Q So that when we talk about the percentages in exhibit 619, when we talk about the various congeners in 619, a degraded 1242 would have a higher percentage of the higher chlorinated congeners, would it not?
A That's correct.
Q And analytically would that mean that the material might start looking like one of the higher chlorinated PCB compounds such as 1254?
A Without being cute the answer to your question is basically yes. It doesn't become another Aroclor. But the analytical gas chromatogram more closely resembles an Aroclor 1248 or 1254 than it does the original 1242.
Q And again I'm just trying to use layman's terms. If I had say 2 gallons of 1242 that has been subject to degradation in the soil, after a certain period of time I might have something that's akin to say one gallon of 1248?
A I would guess it would be lower than that. But --
Q Lower in quantity?
A Right. It may be a half gallon of 1248 or something.
Q But the remaining half gallon would be like 1248?

A It would like -- it would look like it analytically.
Q From a chemical standpoint it would be somewhat similar, would it not?
A To a first approximation, yes. Maybe. But I mean those kinds of arguments get you into mighty shaky ground down the road, which is why I'm being hesitant.
Q Can you explain?
A Yes. They don't become Aroclor 1248 because there are components of Aroclor 1248 that probably would not be present in that residue of Aroclor 1242. So it doesn't really become that material.

Analytically it looks like that material and is often reported as that material by an analytical chemist. But it isn't the same mixture.

Q While it doesn't have some of the components of 1248, its relative percentages of higher chlorinated homologs are closer to 1248 than they are to the original 1242; are they not? The ones that are in both? Because some of them are in 1248, right?
A To a first approximation, that's probably true.
Q So what we have got with respect to the -- let me just direct your attention to 619 here. Would you

read off the -- would you explain what tables 2 and table 3 mean?

A Okay. We really haven't relied on table 3 particularly yet. But we can talk about it.

THE WITNESS: Do you want me to just read the whole table?

MR. KARAGANIS: Yes.

MR. FRUEHWALD: No, just explain it.

MR. KARAGANIS: Just explain it.

A Explain it. Okay. Table 2 is entitled Approximate Molecular Composition of Aroclor.

Basically this is looking at the congener class composition of the materials of increasing chlorine content. And the general trend of the table is that as the materials increase in Aroclor number, they also increase in the percentage of higher chlorinated congener classes that occur in that material.

So, for instance, if we would look at Aroclor 1242, the table said that approximately half or 49 percent of that material is a trichlorobiphenyl congener class. If we would step up to 1254 for instance, approximately 50 percent, 48 percent of that material is pentachlorobiphenyl.

So that if we look at half of the material in each of the cases, half of Aroclor 1242 is trichloro-. Half 1254 is pentachloro-.

Q Now after degradation over a period of time would it be fair to say that the percentages change, the tables shown in Bloomington exhibit 619, table 2, that if one were to look at 1242 after a period of degradation, a percentage of tri and, I'm sorry, pentachlorobiphenyl is listed there?

A Yes, it is.

Q The percentage of pentachlorobiphenyl would increase?

A That's correct. On a relative base, that is correct.

Q And so would the percentage concentration of tetra?

A Probably to a certain extent, although the tetras are biodegradable. I would expect the biggest increases in the penta and hexachlor and higher congener classes.

Q So the hexa 1242 had what, one percent?

A One percent.

Q In its --

A Original form.

Q -- original formulation?

A Yes.

Q And over time what do these percentages of the hexa and penta grow to?
A I don't know those numbers offhand. I think in the literature there is some date on that, but I don't know the numbers offhand.
Q Would it be fair to say their percentages increase significantly?
A On a relative base, yes, it would.
Q So I guess from the standpoint of over time if one were exposed to an environmentally degraded sample of 1242, one would be exposed to perhaps a lesser total amount of the material but an amount which had a higher concentration of hexa and pentachlorobiphenyls; is that right?
A That's correct.
Q Just parenthetically did that experiment that you mentioned of the sewage treatment, was that a 30 percent degradation of all of the congeners or just the lower?
A That was an average.
Q That was a --
A It was an average of all congeners, yes.
Q So that would it be be fair to say that the

pentachloro and hexachlorobiphenyls degrade if at all substantially slower?

A That's correct.

Q I'd like to read into the record, you came this morning with a group of documents that you indicated you reviewed; is that correct?

A That's correct.

Q Were these provided by counsel or did you gather these documents?

A I gathered them.

MR. FRUEHWALD: I think the Peoples memo or article was among those. So that's one I did supply.

THE WITNESS: Right.

MR. FRUEHWALD: But the rest, if it's there --

Q For purposes of identification for the record Bloomington Deposition Exhibit 620 is entitled Reviews of Environmental Contamination and Toxicology.

Directing your attention to Bloomington Deposition Exhibit 620, can you tell me what publication that's from?

A Okay. What you have already read into the record is the publication. The Reviews Of Environmental Contamination and Toxicology is the publication.

Q And then was there a particular article in that publication?

A Yes.

Q What is that article?

A The article is entitled Attenuation of Polychlorinated Biphenyls in Soils.

Q Directing your attention to exhibit 621, it's entitled A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBs) 3. PCB Sorption and Retardation in Soil Underlying the Site; is that correct?

A Yes, it is. Yes, that's correct.

Q And 622 is an article by Chou and Griffin entitled Solubility and Soil Mobility of PCBs; is that correct?

A That's correct.

Q 623, I'll just read it for the record. I will then hand you the document. If I incorrectly characterize it, please correct me.

623 is a Follow-Up Study of the Distribution and

Fate of Polychlorinated Biphenyls and Benzenes in Soil and Ground Water Samples After an Accidental Spill of Transformer Fluid. U. S. EPA, Atlanta, Georgia, 1976.

624 is Kinetics of Biphenyl and Polychlorinated Biphenyl Metabolism in Soil.

625 is entitled Microbial Degradation of Polychlorinated Biphenyls in Soil.

626 is entitled The Degradation of Polychlorinated Biphenyls by Micro-Organisms by Baxter, Gilbert, Lidgett, Mainprize and Vodden.

627 is Movement of PCBs And Other Persistent Compounds Through Soil.

628 is Polychlorinated Biphenyl Dechlorination in Aquatic Sediments.

Exhibit 629 is entitled Distribution Of Polychlorinated Biphenyls In A Municipal Wastewater Treatment Plant and Environs by Bergh and Peoples.

A That was the article that was supplied by counsel.

Q 630 is Attenuation of Water-Soluble Polychlorinated Biphenyls by Earth Materials, publication by EPA dated May 1980.

And then exhibit 631 is a publication entitled

Attenuation of Polychlorinated Biphenyls in Soils: Literature Review by EPRI, Electric Power Research Institute.

For exhibits 620 through exhibit 631 you have indicated earlier in your testimony that you reviewed these materials in preparation for your testimony?

A That's correct.

Q Dealing with 1242 and/or 1016, what is the rate of degradation that can be expected in landfills in the Bloomington area?

A I have no idea.

Q You indicated you have no basis for calculating what the degradation could be but under a variety of conditions there could be materials, PCB materials in such landfills after a hundred years; is that correct?

A I said that was conceivable.

Q That's possible, is it not?

A I would think it's possible.

Q You have no quantitative basis of saying that it's not possible, isn't that right?

A That's correct.

Q You have no quantitative basis of saying that

degradation will occur prior to a hundred years in these those landfills; is that correct?

A I have no knowledge of what kind of bacterial action is going on in the landfills at all.

Q And that is also true with respect to the sewage treatment facilities at Bloomington; isn't that correct?

A Well, by the very fact that it's a sewage treatment facility I would have to assume that there is some degradation going on.

I don't know what the rate would be nor do I know what the long-term retention of the PCBs in that system would be. I think by the very fact it's an active microbial system in the sewage plant there would be some degradation going.

Q You would assume it's an active plant?

A I'm assuming it's an active plant.

Q I'm going to ask you and suggest to you that it is not an active plant, that it's a plant that is not processing sewage at this time.

A Okay.

Q And that the plant has been closed, indeed the sewage lagoon and sludge drying beds have been inactive for

many years.

Can you state what the rate of degradation, biological degradation is likely to be?

A Under those conditions, no.

Q Isn't it a fact that if there is not an active biological degradation process in the sewage sludge that PCB could exist in that material in excess of a hundred years?

A My testimony has been that it's conceivable, yes.

Q And it's possible, is it not?

A Yes.

Q And you have no basis for any quantitative statement or qualitative statement that it's going to be less than that?

A That's correct.

Q With respect to the mobility of PCBs at the Bloomington sites, be they the landfill or the sewage treatment plant, you have no quantitative basis for saying that the soils will retard the movement of PCBs at a given rate; isn't that correct?

A I think they will retard them. I don't know what that retardation rate will be.

Q When you say retard, that is leaving open the

possibility that some portion of the PCBs that reach the soils can move through those soils, isn't that correct?

A There are conditions as we have discussed under which that movement could be possible, that's correct.

Q Have you been given any facts with regard to the 2 sites at issue in this litigation, the Lemon Lane landfill and the Winston-Thomas treatment plant as to their current status?

A I can't say that Mike hasn't said something about their status now, I don't really have any specific recollection of what was said.

Q I would ask you to assume that the Lemon Lane landfill is built upon fractured limestone and contains a number of sink holes and that an unknown but significant quantity of PCBs was deposited in the landfill from over a period of many years.

I would ask you to assume further that there is evidence that the landfill, that PCBs from the landfill are reaching the ground water below the landfill.

Given your position as manager, environmental technical support, would it be your position that it

would be appropriate to leave the PCB contaminated material in their present position?

MR. FRUEHWALD: Let me interpose an objection and I will instruct the witness not to answer. He is here speaking as an expert witness in his capacity as an analytical chemist. He is not here in a position as a Monsanto employee in that position to state positions in this litigation. So I'm going to instruct the witness not to answer that question.

MR. KARAGANIS: Well, he is here giving opinions that are purportedly relevant to whether it's a good idea or not to leave the things where they are?

MR. FRUEHWALD: No, he's not. He's given the opinions I state it in interrogatory answer and not other opinions.

MR. KARAGANIS: Well, I will reserve the right to seek sanctions and as well to ask this question on cross-examination when you put him on.

Q Doctor Kaley, would it be fair to say that you're being asked to give the opinions that are set forth in Deposition Exhibit 618 as they relate to the

current litigation regarding the City of Bloomington and its landfill and sewage treatment plant?

MR. FRUEHWALD: Let me interpose an objection. His being asked to give the opinions show no evidence they relate to the specific facts of that situation. And as a result your question is ambiguous in the sense in which it relates to. It's in that case, but the opinions do not relate to the specifics.

Q I'm asking Doctor Kaley, and he's being put on the stand as a witness, whether given what he knows that these facts are available and applicable to a jury in deciding whether or not it was good idea to removed the waste?

MR. FRUEHWALD: That's not his decision to make. That is mine and the Judge's decision. He's answering questions about opinions. And whether they're relevant or not the Judge will decide and you may object or whatever. That's not his bailiwick. I object to that question and instruct him not to answer it.

Q Doctor, again on 618 you have a statement here that based on physical properties PCBs would not be

expected to percolate through soils, especially clay, in the groundwater.

Is that statement made that no amount of PCBs will percolate through soils?

A No. I think basically the results in the literature show that there is minimal and in some cases barely measurable but barely measurable levels of percolation in laboratory systems. I think there is some evidence in field testing that such migration is also in fact non-measurable.

Q Is not measurable usually?

A That's correct.

Q Is it your statement that in the field you could not measure the PCBs that would go through a landfill?

A No, no, no. What I said was the literature, among some of which is in the literature that has been marked, states that in certain field conditions that it has been shown that PCBs do not migrate.

The literature does not necessarily relate to, it wasn't a landfill. It was a spill site.

Q Are you aware of literature conditions or real world conditions where PCBs have left landfills, have percolated through landfills?

A I don't have any specific recollections.
Q Did you ever have any discussions with any people at Westinghouse as to whether or not PCBs had percolated through landfills?
A No.
Q Based on our previous discussions you did indicate agreement with the fact there are circumstances where PCBs placed in a soil environment with either fractures or voids could be released into the environment; isn't that right?
A Well, they would move downward through those fractures and voids. I don't agree with released into the environment necessarily.
Q It's referenced in here and I didn't bring it with me, that the summary of grounds for your degradation testimony is Monsanto document 1874, the published research?
A Yes.
Q Which documents are we referring to?
MR. FRUEHWALD: That's not an extra copy. If you want to make it a copy, I'll make a copy.
MR. KARAGANIS: Yes.
MR. FRUEHWALD: Are you going to do the

same thing with the other one?

MR. KARAGANIS: Yes, let's do them.

MR. FRUEHWALD: It's on migration. Mine has some markings on it.

MR. KARAGANIS: I promise not to read the markings.

MR. FRUEHWALD: No, I just underlined various portions if you don't mind that.

MR. KARAGANIS: No, we don't mind at all.

(Bloomington Deposition Exhibit 632 and 633 were marked for identification.)

Q Directing your attention to what has been marked as Bloomington Deposition Exhibit 632 a paper entitled Biodegradation by Tucker, et al. Is that the document you referred to in support of your opinion on degradation on page four of exhibit 618?

A Yes.

Q Direct your attention to what has been marked as Bloomington Exhibit 633 Migration of Polychlorinated Biphenyls in Soil Induced by Percolating Water by Tucker, et al. Is that the document that you referred to in support of your opinion on percolation under subparagraph D of exhibit 618?

A Yes.
Q Going back to our earlier discussion, absent voids and fractures, you indicated at one point that simply in a soil column the adsorptive capacity of that soil column could be overloaded by the amount of PCBs that are put there resulting in the discharge of PCBs at the bottom of the column; is that correct?
A Yes, I think that would be possible. Depending on if you're talking about an experiment, talking about an experimental setting.
Q We also talked about if we find PCBs coming out of the bottom of a landfill which is a soil column, is it not?
A Yes.
Q That one of the causes would be that the adsorptive capacity of the soil had been exhausted?
A It was one of the causes we discussed, yes, possible explanations we discussed.
Q Do you have any information on the solubility of the individual congeners?
A That information is in the literature. I don't have it with me. I don't recall it particularly.
Q When you say 1016 or 1264 having a solubility of 200

ppb, that's an average?
A That's correct.
Q Is that also true on the adsorption?
A Yes.
Q Due to different congeners have different adsorption?
A Yes, they do.
Q Is there anything about the opinions in testimony you intend to present at trial that we haven't covered?
A I don't believe so, no.
Q Why don't you we take subparagraph d of 618?
A Okay.
Q I'm doing this because we may finish early and I want to make sure I have covered the ground. What is it you're going to testify with regard to subparagraph d, the opinions in subparagraph d?
A Basically that the fact that the solubility of Aroclor 1242 has been measured in water. It's approximately 200 parts per billion.

These measurements are done under conditions which will maximize the solubility of the particular PCB mixture in the water. In other words, PCBs in the liquid states are added to water. They are shaken for a period of time, up to 24, possibly even

longer hours so that the maximum amount of PCBs do solubilize.

The materials that actually go into the water solution tend to be the lower chlorinated materials. So that in fact if you look at a chromatogram of the water phase of such an experimental system, the percent composition of the lower chlorinated compound will be increased relative to the more chlorinated compounds.

This basically has an implication in the environment that if there is any kind of leaching at all it will tend to be the more water soluble materials, that is lower chlorinated materials, which will leach.

Those tend then to be the more biodegradable as we have discussed earlier.

Again, based on what I have seen, the water solubility of the Aroclor 1016 is about the same as that of Aroclor 1242.

Q Now when you say leaching, that the materials that will leach have a higher percentage of the lower chlorinated congeners; is that correct?

A Yes.

Q That's true if we're talking about the water phase?
A That's correct.
(A discussion was held off the record.)
Q Back on record. The concept of the lower chlorinated congeners being more water soluble and thus being more biodegradable relates to the water phase leaching, doesn't it?
A Right.
Q To the extent there is the non-water phase liquid leaching, that would not be the case; isn't that right?
A Well, yes. I mean we're talking about a leaching situation now with the higher chlorinated materials. Those materials which are less soluble in water are also the ones that more tightly adhere to soil or more tightly "adsorb" to soil. You would expect them to stay in the soil phase of a leaching type system.
Q But that assumes that the soil has the capability of, enough adsorptive capability to handle a total load?
A Right. It's going to be competitive among the phenomena we talked about before, the capacity of the soil, the retentivity or the retention capability of the soil, a variety of things.

Q Would you state what you're testimony will be on subparagraph C?

A I think we have discussed this previously. Basically the testimony will be that components or certain of the polychlorinated biphenyls do degrade biologically both in soil and in activated sludge type systems.

The materials which do degrade tend to be lower chlorinated materials up to and including tetrachlorinated biphenyls.

The higher chlorinated materials do not degrade at measurement rates or basically at measurable rates in the system. So that has been looked at. And that the rates measured for Aroclor 1242 and 1016 have been approximately 30 percent in 48 hours. Those tend to be lower chlorinated components of those mixtures.

Q Let's deal with the tri and tetra chlorinated congeners?

A All right.

Q Do you have any idea what the degradation rates in a sludge lagoon such as the one I described at Winston-Thomas in Bloomington would be?

A Well, if we rely on the literature that we have

available to us, since Aroclor 1242 and 1016 are primary tri and tetra chlorinated materials, you would expect rates of ten percent. Now these --

Q Rates of ten percent?

A 10 to 20 percent.

Q Per what?

A Per 48 hours. But now this is what the literature is saying. Now we have to keep in mind that these are acclimated sludges and they're used to having PCBs as a food source.

So in the real world the rate would be slower than that and I don't have the information to specify what the actual rate would be in an active sewage treatment plant.

Q What would be the real world rate in a non-active sewage treatment plant?

A That's going to depend on what independent kind of bugs were left over and what's going on there. I would expect it to be somewhat slower as we have discussed. If you have an oxygen depleted system or a bug depleted system, you would expect the rates to become very slow actually.

Q And in soils, what would you expect the rate to be

for 1242 and 1016?

A I don't know. I don't really have specific recollections of the actual soil rates. I think they're quite low.

I'm not sure I have even seen data on the soil -- well, I obviously have. I don't recall the data that was on there.

I think the rates are lower although they are still significant. I think some of them are reporting actual disappearances of materials or 90 percent disappearances over periods of hundreds of days.

Q And if we were to find significant quantities of PCBs over tens of years, that would be an indication that the rate of degradation is a lot slower than what has been reported; isn't that right?

A That's true, in a particular situation.

Q And that could exist in a particular situation; isn't that right?

A Certainly.

Q What are you going to testify about subparagraph b?

A I think basically as again I think we've covered this quite thoroughly earlier that the analytical

chemistry of PCBs has tended to improve in the period since it was really first developed in late 1960's through current day.

I think this relates to the ability to actually detect and measure PCBs in a variety of environmental or other type of media actually. And the long-term implication is that earlier data and some of even the later data needs to be looked at very critically and not accepted on face value.

Q What do you mean looked at very critically and not accepted on face value?

A I think we need to look at what kind of method validation was done to determine whether the methods were actually measuring the PCBs accurately.

We need to look at sampling methods to be sure that the samples were taken in such a way that wouldn't introduce PCBs.

We need to look at quality assurance data to be sure there wasn't cross contamination in the laboratories.

There are a whole variety of effects surrounding the analytical chemistry of PCBs which could lead to erroneous effects.

Q Would that be -- I'm going to throw some lawyers' language at you. Would these defects go to the weight that you might give such data?
A Yes, certainly.
Q Whatever the data is, you would look at it and discount it or accept it in varying degrees depending on these various infirmities; is that correct?
A That's correct. Well, yes, you have to look at the data and make an expert judgment on the reliability of that data and how much weight should be put on it.

In some cases it may turn out to be perfectly acceptable. In certain cases it may have to be thrown out altogether and have no reliability.

MR. KARAGANIS: Just so we have no confusion on this, Mike, is there any of the data sets that we have looked at, the Bloomington data, the State data, EPA data, Blasland and Bouck, Westinghouse data, is any that's going to be subject to admissibility challenge on this basis?

MR. FRUEHWALD: Well, I don't know. I'm not prepared at this time to commit myself on that till we get around as we have said so many times to showing me what data we're actually talking about

there.

So, I suspect not. But I can't come in and give you a blank check that all the data that's floating around, particularly some of the data that goes way back is going to be accepted without some qualification. But once we see what the data is, believe me I'm not going to raise questions that are not --

MR. KARAGANIS: You have seen all the Bloomington data that goes way back into the 70's. You have seen the Westinghouse data that goes way back into the 70's.

MR. FRUEHWALD: I have seen some of it, yes. I think I have seen all of it.

MR. KARAGANIS: I mean is there any that's particularly suspect or that's been --

MR. FRUEHWALD: I have some suspicions about certain samples, yes.

MR. KARAGANIS: Which ones?

MR. FRUEHWALD: Well, certainly the first round of sampling at Lemon Lane. Groundwater sample. But I mean that's a matter beyond Bob's thing. But there are problems I think with some of them.

MR. KARAGANIS: Let's find that out today. I mean you're talking about --

MR. FRUEHWALD: Like I said, we were proposing at some point in time for you to supply me with the data you wanted to admit and I would analyze it and give you a response in time to respond it to. You haven't done that yet; and rather than doing not gross, I'm not going to do it today.

(A discussion was held off the record.)

MR. KARAGANIS: Subject to being limited to the opinions that have been set forth in deposition 617 I have no further questions at this time of this witness.

MR. FRUEHWALD: I have none.

AND FURTHER DEPONENT SAITH NOT

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ROBERT GEORGE KALEY II, PhD

STATE OF INDIANA)
)
COUNTY OF MARION)

I, Patricia A. Cline, a Notary Public in and for the County of Marion, State of Indiana at large, do hereby certify that ROBERT GEORGE KALEY II, PhD, the deponent herein, was by me first duly sworn to tell the truth, the whole truth, and nothing but the truth in the aforementioned matter;

That the foregoing deposition was taken on behalf of plaintiffs at the law offices of Barnes & Thornburg, 1313 Merchants Bank Building, Indianapolis, Marion County, Indiana, on the 25th day of May, 1988, commencing at 9:00 a.m. pursuant to the Federal Rules of Trial Procedure;

That said deposition was taken down in stenograph notes and afterwards reduced to typewriting under my direction, and that the typewritten transcript is a true record of the testimony given by the said deponent; and thereafter presented to said deponent for his signature;

That the parties were represented by their counsel as aforementioned.

I do further certify that I am a disinterested

person in this cause of action; that I am not a relative or attorney of either party, or otherwise interested in the event of this action, and am not in the employ of the attorneys for either party.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal on this 7th day of June, 1988.

_____

N O T A R Y P U B L I C

My Commission Expires:
November 12, 1990
County of Residence:
Marion County