

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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1 R O B E R T G E O R G E K A L E Y I I, having been
2 first duly sworn to tell the truth, the whole truth
3 and nothing but the truth relating to said matter,
4 was examined and testified further as follows:

5
6 DIRECT EXAMINATION,

7 QUESTIONS BY MR. JOE KARAGANIS:

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

10 A Yes, Robert George Kaley II.

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

16 (Bloomington Deposition Exhibit 617 was marked
17 for identification.)

18 Q Mr. Kaley, I show you what has been marked as
19 Deposition Exhibit, Bloomington Deposition Exhibit
20 617, which purports to be a curriculum vitae of
21 yourself; is that correct?

22 A Yes, sir.

23 Q Deposition Exhibit 617, does that correctly state

1 your educational background?

2 A Yes, it does.

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

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

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

11 A That's correct.

12 Q And you became employed by Monsanto in December of
13 '73?

14 A That's correct.

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

19 A That's correct, yes.

20 Q What was your first contact with PCBs?

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

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

3 Q What group was that?

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

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

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

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

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

12 Q How many people working on PCBs?

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

15 Q Who were they?

16 A The group leader was Scott Tucker, myself.

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

19 How many am I up to?

20 I think there was a guy, one of the technicians,
21 Hector Yopez.

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

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

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

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

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

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

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

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

1 considerably and was not nearly as dedicated to PCB
2 work.

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

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

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

9 A Oh, I am.

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

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

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

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

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

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

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

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

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

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

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

13 A Basically true.

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

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

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

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

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

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

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

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

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

21 A That's correct.

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

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

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

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

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

1 the National Bureau of Standards.

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

11 Q Who supplies standards for PCBs?

12 THE WITNESS: Today?

13 MR. KARAGANIS: Today.

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

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

23 A Some of them are available as Monsanto,

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

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

6 A All right.

7 Q What is a congener?

8 A Again let's use PCB as an example.

9 MR. KARAGANIS: All right.

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

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

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

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

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

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

17 A That's correct.

18 Q How many homologs are there?

19 A For PCB there are 10.

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

22 A That's correct.

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

1 indicated a monochlorobiphenyl?

2 A Monochlorobiphenyl.

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

6 A That's right.

7 Q And those 3 variations are called isomers?

8 A That's correct.

9 Q How many possible isomers are there?

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

14 Q Of the total 10 homologs how many total isomers?

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

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

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

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

4 A You could speak of it either way.

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

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

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

15 A All right.

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

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

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

3 Q All right.

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

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

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

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

1 A Yes, that is strictly correct.

2 Q Whereas the term congener is used across the entire
3 spectrum?

4 A That is exactly right.

5 Q I'm just trying to get the family straight, that's
6 all.

7 A That's right. The next guy will tell you something
8 different.

9 Q You mentioned that your work for the first 2 and a
10 half years was refining or making more precise the
11 quantification of PCBs?

12 A That's correct.

13 Q How does one use the gas chromatograph to determine
14 quantity?

15 A Well, as we look at the output, the actual
16 chromatogram as the output of gas chromatograph, we
17 can look at various measures of the sizes of the
18 peaks. We can look at the height of the peak or the
19 area under the peak. And both of those to a very
20 high degree represent a quantitative measure of the
21 amount of that material which has been detected.

22 Q So that would it be fair to say the output from the
23 chromatograph, the diagram, the shape of the diagram,

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

5 A That's correct.

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

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

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

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

1 PCBs.

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

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

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

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

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

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

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

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

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

23 There are several ways to do this. But

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

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

15 Q How do you prevent the PCBs from volatilizing?

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

21 Q Having concentrated, what's the next step?

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

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

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

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

21 A That's correct.

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

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

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

15 Q So you might get a false positive?

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

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

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

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

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

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

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

14 Q Why would you have added more hexane?

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

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

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

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

5 A That's right.

6 Q So you end --

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

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

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

19 Q How do you know you have that?

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

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

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

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

12 Q Then how do you deal with quantity?

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

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

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

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

13 Q Now how do you deal with soil?

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

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

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

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

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

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

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

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

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

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

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

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

1 extraction would generally remove all particulates in
2 and of itself.

3 Q The extraction being the shaking up?

4 A The shaking up with hexane.

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

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

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

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

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

1 A Yes. Clearly.

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

6 A Yes.

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

10 A Yes

11 Q Then you moved on to mass spectrometry?

12 A That's correct.

13 Q Would you describe mass spectrometry?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 1242 looked pretty much the same if you did gas
2 chromatography. So if you had a reasonably fresh
3 sample of an Aroclor 1242 and ran a chromatograph, a
4 trained analytical chemist would recognize a
5 chromatogram of an Aroclor 1242 as that particular
6 material.

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

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

17 Q What would it resemble?

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

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

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

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

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

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

21 Q But in most cases?

22 A In some cases.

23 Q Now mass spectrometry you indicated that gas

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

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

10 Q Now does each peak represent a given homolog?

11 A No.

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

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

23 From the middle 70's developing even to this day

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

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

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

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

23 A The mass spectrum when attached to a gas

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

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

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

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

14 A Yes.

15 Q Over a time series?

16 A That's correct.

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

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

1 spectrometry, I would do those samples.

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

5 A That's correct.

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

8 A Till 1978.

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

12 A That's correct. Exactly correct.

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

15 What does that mean?

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

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

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

1 Analysis section of that group.

2 Q And what were your duties?

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

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

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

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

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

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

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

6 A That's correct.

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

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

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

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

17 A That's correct.

18 Q Would you describe what that means?

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

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

5 Q So, who was this person?

6 A John Craddock.

7 Q You were assigned as his assistant?

8 A That's basically correct.

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

11 A That's correct.

12 Q What was his title?

13 A Probably product and environmental safety director?

14 Makes sense, right?

15 Q How long did you serve in that role?

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

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

20 A Yes.

21 Q And then since September of '86?

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

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

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

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

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

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

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

23 There are certain concerns which are company

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

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

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

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

18 A Yes, I am.

19 Q Who is the head of the corporate environmental staff?

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

21 Q Harold is that?

22 A I think it is.

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

1 A Correct.

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

6 Q Down under him?

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

8 Q What's his title?

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

11 Q All right.

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

17 Do you want their names?

18 MR. KARAGANIS: Yes.

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

21 Q Okay.

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

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

3 Q Who else?

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

6 Q And he heads what group?

7 A Environmental Affairs.

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

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

11 Q Anybody else?

12 A And Sherwin Malt.

13 Q Sherwin Mald?

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

15 Q Is Craddock still involved with PCBs?

16 A Yes, he is.

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

19 A That's correct.

20 Q What does Wilson do?

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

1 Q How about Malt?

2 A Malt is an M.D. who basically provides a medical
3 outlook on some of the questions that our group
4 becomes involved with.

5 Q When you worked with Craddock and currently in
6 Craddock's office, how are the files maintained for
7 PCBs?

8 A Which files? I mean John obviously has files. He
9 does a lot of things. I mean John has a personal set
10 of files.

11 Q And did you have a personal set of files when you
12 were --

13 A When I was working for John, we used a joint set.

14 Q So kind of an office set?

15 A Yes.

16 Q How extensive were the files?

17 A It was about, I guess 2 or 3 file cabinets.

18 Q Going up the line, you mentioned that you report to
19 McCarville. How do you spell that?

20 A M-c-C-a-r-v-i-l-l-e.

21 Q And then he reports to Senger. S-e-n-g-e-r?

22 A Correct.

23 Q Who reports to Corbett?

1 A Correct.

2 Q And who does Corbett report to?

3 A I really don't know the answer to that. I would
4 guess either to Harbison or Mahoney. Harbison is the
5 COO and Mahoney is the CEO. I don't know which one
6 he directly reports to, but I guess he reports to one
7 of them.

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

10 (Bloomington Deposition Exhibit 618 was marked
11 for identification.)

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

17 Are you familiar with that document?

18 A Yes, I have seen it.

19 Q Did you assist in its preparation?

20 A Yes, I did.

21 Q Doctor, before we get into that, you mentioned that
22 in '73 to 75 you were doing gas chromatography on
23 PCBs?

1 A Correct.

2 Q And you had occasion to give a paper on the
3 characterization of PCBs at a conference in Chicago?

4 A I was coauthor on the paper. I did not deliver the
5 paper.

6 Q Who delivered it?

7 A Jim Mieuse.

8 Q What were the circumstances, factual circumstances on
9 preparation of that paper? What do you remember
10 about, what was the --

11 A Well, basically I think the EPA, I believe, was
12 organizing a conference in Chicago to describe what
13 was known about PCBs in that time period. Jim Mieuse
14 or somebody within Monsanto was asked to give
15 basically what was an introductory paper describing
16 what Monsanto knew about PCBs at the time, their
17 physical properties, their environmental behavior and
18 things like that.

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

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

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

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

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

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

1 Q So they stopped those sales to those applications?

2 A That's correct.

3 Q Then there were other applications for which they
4 felt, you called them closed systems where PCBs would
5 not get out into the environment?

6 A Where they felt systems would be controlled such that
7 environmental discharges would be minimized at least.

8 Q And how did they proceed to control them?

9 THE WITNESS: To control the --

10 MR. KARAGANIS: Environmental discharges.

11 A Well, as far as I know, you know, the extent of my
12 knowledge is they limited sales to essentially
13 electrical manufacturers for capacitors and
14 transformers.

15 Q And how did they make sure that the electrical
16 capacitor manufacturers minimized discharges at their
17 facilities?

18 A I have no idea. You know, I know there was some
19 interaction with some of our customers in a variety
20 of ways, but I have no knowledge of the specific
21 actions that were taken with the customers
22 particularly.

23 Q What do you know with respect to --

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

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

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

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

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

21 MR. KARAGANIS: Yes.

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

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

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

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

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

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

17 Q Until more environmentally compatible products were
18 developed --

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

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

1 of the Aroclor mixtures of PCBs.

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

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

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

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

16 So, for example, Aroclor 1221 contained 21
17 percent chlorine by weight. Aroclor 1242 contained
18 42 percent chlorine by weight, et cetera.

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

1 chlorine by weight. And as the weight of the
2 chlorine content of the materials came up, that by
3 implication that means there were more chlorines on
4 the average on a given biphenyl molecule; 1221 was
5 primary made up of monochlorobiphenyls, biphenyls
6 with 1 or 2 chlorines on the molecule. Aroclor 1242
7 was primarily tri- and tetrachlorobiphenyl. Aroclor
8 1254 was primarily pentachlorobiphenyls and
9 hexachlorobiphenyls. And that many of the
10 characteristics of each of those separate products is
11 in fact determined by not only the average chlorine
12 content but by the specific congener make up of those
13 materials.

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

17 A That's correct.

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

21 Q Just so I get my terminology --

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

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

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

5 MR. KARAGANIS: Okay.

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

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

17 (Bloomington Deposition Exhibit 619 was marked
18 for identification.)

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

22 A Yes, the approximate molecular composition.

23 Q Of the Aroclor. Where is that chart from?

1 A It's from a volume one of a series of books called
2 PCBs and The Environment.

3 Q And who is that series published by?

4 A It's published by CRC Chemical Rubber Company.

5 Q Did you have a hand in putting that chart together?

6 A Not in its present form, no. Although some of the
7 data in it is Monsanto data, none of which I probably
8 had a direct hand in putting together. Some of the
9 data is the same as that presented in the Mieure
10 paper we discussed earlier presented at the Chicago
11 conference.

12 Q With other material did you bring with you today?
13 Are those exhibits that your planning on using?

14 A No, sir. These are materials which were reviewed
15 primarily relating to soil and biodegradation studies
16 of PCB.

17 Q May I examine those?

18 A Certainly.

19 Q Okay, we'll mark these later. Now you've mentioned
20 as to the composition the fact that you will be
21 testifying as to molecular composition, the
22 percentage of chlorine, which congener classes
23 various products contain; is that correct?

1 A That's correct.

2 Q Is there anything else about the composition and
3 physical properties that you will be testifying to?

4 A Well, physical properties certainly, depending on
5 what my actual testimony is required to do. We will
6 be prepared to talk about such things as the
7 solubility of the various Aroclor products and how
8 that relates to their environmental behavior.

9 Q Well, tell me what you mean by the solubility of the
10 various products.

11 A Okay. Solubility basically is a measure of the
12 tendency of the material to dissolve in water,
13 specifically water.

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

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

23 A It's a liquid.

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

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

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

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

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

15 A No.

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

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

21 Q Is that based on test data?

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

1 Q What happens to the rest of the PCBs in our little
2 experiment?

3 A In your little experiments they would sink to the
4 bottom of the glass and sit there.

5 Q In a liquid phase?

6 A In a liquid, yes.

7 Q What do you call that phase? It's liquid, but it's
8 not water. What do you call that, is there a term
9 given?

10 A It's basically a 2 phase system.

11 Q Both phases are liquid; are they not?

12 A Yes. It's back to the oil and vinegar scenario.

13 Q Now is there a difference solubility for 1016 than
14 for 1242?

15 A The numbers reported are very, very close. You would
16 not expect a very large difference. And the
17 experimental error in the experiments is probably
18 greater than the actual difference. You would expect
19 about a 200 parts per billion. It may be just in
20 actuality a teensy bit higher because of the lower
21 amounts of the higher chlorinated congeners in 1016,
22 but I would not expect a very large difference at
23 all.

1 Q Anything other than solubility as to physical
2 properties?

3 A Well, potentially questions could arise that would
4 relate to the vapor pressure, their ability to
5 evaporate from a system.

6 Q What is their ability to evaporate?

7 A Basically they do not evaporate very rapidly. But
8 over a long period of time they would be expected to,
9 lower chlorinated materials might be expected to
10 evaporate into the atmosphere.

11 Q Is that true for materials that are on the surface or
12 would this also be true of materials that are say
13 covered by soil?

14 A No, that would be strictly surface effects primarily.

15 Q Any other physical properties?

16 A As far as strictly physical properties, I don't
17 believe so. Well, yeah, I guess so. I guess soil
18 adsorption would be considered a physical property.
19 So that would be another.

20 Q What do you mean by absorption?

21 A Adsorption.

22 Q A-d?

23 A Ad. That's basically looking at their tendency to

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

4 Q And what is that tendency?

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

11 Q By associate they will attach themselves?

12 A Yes.

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

14 A Yes.

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

17 A That's correct.

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

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

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

4 Q If there isn't enough soil capacity ?

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

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

10 A Okay.

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

13 A Okay.

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

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

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

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

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

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

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

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

20 A That would be one possible explanation, correct.

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

1 A Yes.

2 Q So that if another solvent comes into contact with
3 the PCBs, that solvent can actually break the
4 adsorptive bond; is that right?

5 A To some degree or another, That's correct.

6 Q Do you have any quantitative estimate as to what that
7 capability is?

8 A It's going to depend on the solvent, the soil and the
9 and a whole variety of different parameters.

10 Q Do you have any quantitative estimate or quantitative
11 capability to say independent of solvents that a
12 given column of soil or given column of materials
13 will adsorb a given amount of PCBs?

14 A I certainly don't have that information today. I
15 don't know whether such a calculation could be made
16 from what's available in the literature or not.

17 Q So in our situation where we're finding PCBs leaking
18 from the bottom of a soil column, we know that one
19 possible cause is the lack of soil capacity to adsorb
20 all the molecules; is that right?

21 A That's correct.

22 Q Another possibility might be the presence of solvents
23 which are causing the break up of the adsorptive

1 bond; is that right?

2 A That's correct.

3 Q Any other causes?

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

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

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

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

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

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

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

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

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

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

9 A I'm not sure I understand the question.

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

12 A That's correct.

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

15 A Okay. Correct.

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

20 THE WITNESS: You're asking 2 questions.

21 Are you asking about leaching by water are are you
22 asking questions about leaching by solvent?

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

1 A Okay.

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

8 A That would be the maximum, right.

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

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

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

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

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

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

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

17 A Yes.

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

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

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

23 A That's correct.

1 Q You indicated that could be substantially above 200
2 part per billion, indeed all the way up to a hundred
3 percent of the PCBs theoretically?

4 A Theoretically I would say those 2 were completely
5 mixable at any --

6 Q And depending on whether a solvent other than hexane
7 was being used, other solvents would have different
8 degrees of solubility in the PCBs, is this correct?

9 A That's right.

10 Q But certainly all of the solvents have a higher
11 capacity for mixing or dissolving PCBs than water;
12 isn't that right?

13 A Using a general term for solvent I would say
14 generally they're going to be higher than water, yes.

15 Q For example, toluene?

16 A Yes, that would be higher than water.

17 Q Then you indicated there would still be material in
18 the soil phase?

19 A That's correct.

20 Q And if there were water present, would there also be
21 material, PCBs in the water phase?

22 THE WITNESS: Along with the hexane and
23 the soil?

1 MR. KARAGANIS: Yes.

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

4 Q Theoretically up to 200 parts per billion?

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

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

10 Q Who's going to win?

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

14 Q Do you know what the level is?

15 A I sure don't.

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

18 A Okay.

19 Q Will water cause desorption over time?

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

1 leaching conditions.

2 Q They do not move at all?

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

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

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

12 Q Are you familiar with the Bloomington, Indiana
13 situation?

14 A In outline form, yes.

15 Q Have you looked at the data from Bloomington?

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

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

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

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

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

3 A Not as I sit here today.

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

10 A Let me back off a little bit, okay?

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

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

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

20 Q But you don't know what it is?

21 A Not a given number. Okay?

22 MR. KARAGANIS: All right.

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

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

3 Q What is a well designed and well controlled landfill?

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

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

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

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

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

19 MR. KARAGANIS: Yes.

20 A Probably not.

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

23 A Probably not with my knowledge today.

1 Q And why is that?

2 A Well, if we're talking about designing a well
3 controlled landfill from whatever material is put in
4 there, it's put in there with the intent to stay in
5 there, I think the conditions you described you would
6 expect that there would be some potential at least
7 for whatever material you put in there to move from
8 the landfill. Or given conditions over a given
9 period of time.

10 Q How would it move?

11 A I think in cases where there's actually voids in the
12 system where there are no, there's no soil, I think
13 it would just move by essentially a channeling type
14 phenomenon.

15 Q If it moved by a channel type phenomenon, could it
16 move in the water phase?

17 A At a very small amount I suppose it could. I don't
18 think that would be a major transport mechanism.

19 Q Could it move in the liquid phase that isn't in
20 water?

21 MR. FRUEHWALD: Let me interpose, Bob's
22 answering in terms of whatever substance you put in
23 there. I detect maybe your questions are PCBs. But

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

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

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

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

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

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

14 A That potential certainly exists, yes.

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

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

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

20 A Very well could slowly, yes.

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

23 A Yes.

1 Q So the 3 methods of movement, the 3 possible options
2 that we have or 4 would be, one to move as water or
3 move in water, dissolved?

4 A That's one of the options.

5 Q Two, to move as in a form of particulate in water?

6 A Okay. That's an option.

7 Q Three is to move in its non-water liquid phase?

8 A Okay.

9 Q And four would be if we had a solvent present to move
10 in a solvent phase; is that right?

11 A That's correct.

12 Q Any other phases that I missed or any other
13 possibilities?

14 A I don't believe so.

15 (A recess was taken.)

16 Q Doctor Kaley, is there anything else about the
17 physical properties?

18 We mentioned solubility. We mentioned soil
19 adsorption. Anything else about the physical
20 properties of Aroclor mixtures that you're going to
21 testify about?

22 A Not that I can think of right now.

23 Q What do you know about the medical effects of PCBs or

1 the toxicological effects of PCBs?

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

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

9 A Well, yes.

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

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

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

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

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

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

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

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

9 A I believe there were air exposure levels.

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

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

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

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

19 Q Is that a typical way of determining potential
20 toxicity?

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

1 Q As a matter of fact Monsanto has used animal studies
2 in a number of areas to evaluate potential toxicity,
3 have they not?

4 A Certainly.

5 Q It's a standard toxicological approach, is it not?

6 A Yes

7 Q Your next topic which is the history of the
8 development of technology and methodology for
9 detection and quantification of low levels of PCBs in
10 various media.

11 What are you going to testify to about that?

12 A Basically just outline what kinds of techniques were
13 available and how the analytical chemistry of PCBs
14 has evolved since about the mid 60's to the prior day
15 or whatever.

16 Q What was their availability in the mid 60's?

17 A Well, basically the technology that really allowed
18 PCBs to be measured in the environmental samples at
19 the levels, the low levels they were found to be
20 occurring was the development of the electron capture
21 detector. And that really wasn't developed until the
22 early 60's, was not in wide usage until really the
23 late 1960's.

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

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

8 That technology has continued to improve. The
9 ability to connect a gas chromatographic to a mass
10 spectrometer really didn't develop until the late
11 1960's. Again that technology continued to improve.
12 I would say by about the mid to late 1970's, that
13 technology was well established and you could do much
14 more precise, much more certain PCB analyses with the
15 mass spectrometer than the early days

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

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

1 degree of criticality that you need to observe
2 analytical data.

3 Q What do you mean by that?

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

14 Q Let's talk about gas chromatography. What would you
15 say the reliability levels of detection were for the
16 60's?

17 A For the 1960's I would say in the -- certainly, of
18 course, we're talking in the late 1960's now because
19 the technology wasn't even available till the mid
20 1960's.

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

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

3 Q That's in the late 60's?

4 A Right.

5 Q Let's to go the 70's.

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

10 Q By low parts per billion?

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

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

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

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

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

1 Q And then from '80 to '88?

2 A Okay, I don't think things, as far as actual
3 detection limits I would say things haven't developed
4 too much.

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

13 Q What's the significance from the standpoint of
14 environmental contamination and prevention of
15 contamination? What's the significance of the fact
16 that increasing levels of sophistication have
17 developed?

18 A Well, I think there are two things. I think it's
19 allowed us to have a better understanding of what is
20 really happening to PCBs in the environment. It's
21 allowed us if we talk about single congeners we can
22 begin to worry about are the materials that are found
23 found in the environment, are they in fact the ones

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

13 Q When you say regulatory pressure --

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

22 Q What movement is that?

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

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

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

8 A Yes, I think that's true.

9 Q Do they separate out the different kinds of congener?

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

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

19 A Well --

20 Q -- are toxic?

21 A Yes.

22 Q What congeners?

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

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

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

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

8 Q Studying the toxicology of individual congeners?

9 A That's right.

10 There are other people doing it, too.

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

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

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

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

3 Q You're not a toxicologist, are you?

4 A No, I'm not.

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

9 A No, I'm not.

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

15 A Okay.

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

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

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

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

3 THE WITNESS: Based on what I know now?

4 MR. KARAGANIS: Yes.

5 A No.

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

9 A I think there could be some justification for that.

10 Q By what was known then?

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

12 Q Was that a Monsanto recommendation at that time?

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

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

17 A I have no idea.

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

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

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

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

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

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

19 MR. FRUEHWALD: In other words you --

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

1 over.

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

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

10 A Yes.

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

15 A Yes.

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

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

22 MR. FRUEHWALD: I know.

23 MR. KARAGANIS: If you want to talk about

1 other industrial, Mike, that will be --

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

4 Q We're talking about PCBs.

5 A Okay.

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

9 A In general, yes.

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

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

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

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

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

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

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

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

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

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

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

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

1 according to summary of grounds in Deposition Exhibit
2 618, you say 1242 and 1016 degrade at a rate of
3 approximately 30 percent in 48 hours.

4 A That's correct.

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

9 THE WITNESS: What's your definition of
10 gone?

11 MR. KARAGANIS: I can't measure it.

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

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

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

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

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

1 THE WITNESS: In what environment?

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

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

7 Q Let's talk worst case.

8 THE WITNESS: Worst case?

9 Q Yes. How long?

10 A Certainly components maybe five to ten years.

11 Q Five to ten years?

12 A In a sewage treatment plant.

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

14 A That's my guess as a worst case.

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

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

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

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

1 Q And if I per chance were to find that the material
2 still contains high concentrations of PCBs, that
3 would be because the bugs aren't acclimated or are
4 not degrading; is that right?

5 A I would say that's true, yes.

6 Q And there can be indeed situations with such lack of
7 degradation occur; is that right?

8 A I would guess that there are, yes.

9 Q You're not in any position to predict when and if the
10 PCBs in the Bloomington sewage lagoon would degrade
11 to non-detection levels are you?

12 A I don't have any specific information about their
13 system, so I don't know.

14 Q You don't know whether there is biological
15 degradation taking place; and if any at what rate, is
16 that right?

17 A I would assume there's some. I certainly don't know
18 at what rate.

19 Q It's possible that conditions that were not conducive
20 to degradation might exist in such a lagoon; is that
21 right?

22 A Conceivable.

23 Q Basically let me get this straight. If I were to

1 find under your hypothesis, I just want to make sure
2 your testimony is clear on this, if I have a sewage
3 lagoon contaminated with PCBs say in the order of
4 1242, several thousand pounds per million?

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

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

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

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

18 Q It's just sitting there.

19 A Okay. With no stirring.

20 Q No stirring.

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

1 Q No.

2 A I'm not asking a question. I say to have
3 biodegradation of PCB under the common system you
4 need oxygen. I mean that's the first step is adding
5 oxygen. If you have an oxygen poor system, if you're
6 not controlling pH, I mean there are lots of things
7 in a lagoon which could stop biodegradation clearly.

8 Q If we're not adding oxygen, we're not stirring the
9 system, we have just got 7 acres of sludge, how long
10 could that take before it broke down?

11 A If there's no biodegradation, no other process, I
12 mean it could be tens of years. I really don't know.

13 Q Could it be hundreds of years?

14 A Could it be hundreds of years? I don't know the
15 answer to that.

16 Q So, you do not have --

17 A I would not say that it was not impossible after a
18 hundred years there would be detectable PCB in there.

19 Q So it is possible that after a hundred years --

20 A If there's no process to change those PCBs going on
21 in that lagoon, clearly yes.

22 Q And you're not in a position to say that there are
23 certain process or not at the Bloomington lagoon?

1 A No, I'm not.

2 Q But if there weren't oxygen and stirring and other
3 activities going on, such activities are necessary
4 for biodegradation?

5 A You clearly need a viable micro-organism.

6 Q And oxygen and stirring, do you not?

7 A Certainly oxygen. I think stirring would help.
8 otherwise you're going to get the materials settled
9 into the bottom and covered up and unavailable.

10 Q Unavailable to the bugs?

11 A To the bugs that require oxygen.

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

20 Q Now how about landfill conditions if I put 1242 or
21 1016 in landfills?

22 A Yes.

23 Q How long does it take at that time to degrade so it won't be

1 detected?

2 A I don't have any idea.

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

5 A I would say that potential is there.

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

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

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

13 A That's correct.

14 Q And that was in a lab experiment?

15 A That's correct.

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

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

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

3 THE WITNESS: Actually in the field?

4 MR. KARAGANIS: Yes.

5 A Not to my knowledge.

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

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

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

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

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

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

23 MR. FRUEHWALD: But many of your experts

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

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

9 A I don't believe so.

10 (Bloomington Deposition Exhibits 620 through
11 630 were marked for identification.)

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

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

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

1 PCBs from the fat by traveling through a column.

2 After that procedure is done, then the procedure is
3 the same.

4 Q How about tissue, non-fat tissue?

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

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

15 A That's correct.

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

19 A That's correct.

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

1 A That's correct.

2 Q So that when we talk about the percentages in exhibit
3 619, when we talk about the various congeners in 619,
4 a degraded 1242 would have a higher percentage of the
5 higher chlorinated congeners, would it not?

6 A That's correct.

7 Q And analytically would that mean that the material
8 might start looking like one of the higher
9 chlorinated PCB compounds such as 1254?

10 A Without being cute the answer to your question is
11 basically yes. It doesn't become another Aroclor.
12 But the analytical gas chromatogram more closely
13 resembles an Aroclor 1248 or 1254 than it does the
14 original 1242.

15 Q And again I'm just trying to use layman's terms. If
16 I had say 2 gallons of 1242 that has been subject to
17 degradation in the soil, after a certain period of
18 time I might have something that's akin to say one
19 gallon of 1248?

20 A I would guess it would be lower than that. But --

21 Q Lower in quantity?

22 A Right. It may be a half gallon of 1248 or something.

23 Q But the remaining half gallon would be like 1248?

1 A It would like -- it would look like it analytically.

2 Q From a chemical standpoint it would be somewhat
3 similar, would it not?

4 A To a first approximation, yes. Maybe. But I mean
5 those kinds of arguments get you into mighty shaky
6 ground down the road, which is why I'm being
7 hesitant.

8 Q Can you explain?

9 A Yes. They don't become Aroclor 1248 because there
10 are components of Aroclor 1248 that probably would
11 not be present in that residue of Aroclor 1242. So
12 it doesn't really become that material.

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

16 Q While it doesn't have some of the components of 1248,
17 its relative percentages of higher chlorinated
18 homologs are closer to 1248 than they are to the
19 original 1242; are they not? The ones that are in
20 both? Because some of them are in 1248, right?

21 A To a first approximation, that's probably true.

22 Q So what we have got with respect to the -- let me
23 just direct your attention to 619 here. Would you

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

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

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

7 MR. KARAGANIS: Yes.

8 MR. FRUEHWALD: No, just explain it.

9 MR. KARAGANIS: Just explain it.

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

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

18 So, for instance, if we would look at Aroclor
19 1242, the table said that approximately half or 49
20 percent of that material is a trichlorobiphenyl
21 congener class. If we would step up to 1254 for
22 instance, approximately 50 percent, 48 percent of
23 that material is pentachlorobiphenyl.

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

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

10 A Yes, it is.

11 Q The percentage of pentachlorobiphenyl would increase?

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

13 Q And so would the percentage concentration of tetra?

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

18 Q So the hexa 1242 had what, one percent?

19 A One percent.

20 Q In its --

21 A Original form.

22 Q -- original formulation?

23 A Yes.

1 Q And over time what do these percentages of the hexa
2 and penta grow to?

3 A I don't know those numbers offhand. I think in the
4 literature there is some data on that, but I don't
5 know the numbers offhand.

6 Q Would it be fair to say their percentages increase
7 significantly?

8 A On a relative base, yes, it would.

9 Q So I guess from the standpoint of over time if one
10 were exposed to an environmentally degraded sample of
11 1242, one would be exposed to perhaps a lesser total
12 amount of the material but an amount which had a
13 higher concentration of hexa and
14 pentachlorobiphenyls; is that right?

15 A That's correct.

16 Q Just parenthetically did that experiment that you
17 mentioned of the sewage treatment, was that a 30
18 percent degradation of all of the congeners or just
19 the lower?

20 A That was an average.

21 Q That was a --

22 A It was an average of all congeners, yes.

23 Q So that would it be fair to say that the

1 pentachloro and hexachlorobiphenyls degrade if at all
2 substantially slower?

3 A That's correct.

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

7 A That's correct.

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

10 A I gathered them.

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

14 THE WITNESS: Right.

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

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

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

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

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

6 A Yes.

7 Q What is that article?

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

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

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

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

19 A That's correct.

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

23 623 is a Follow-Up Study of the Distribution and

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

5 624 is Kinetics of Biphenyl and Polychlorinated
6 Biphenyl Metabolism in Soil.

7 625 is entitled Microbial Degradation of
8 Polychlorinated Biphenyls in Soil.

9 626 is entitled The Degradation of
10 Polychlorinated Biphenyls by Micro-Organisms by
11 Baxter, Gilbert, Lidgett, Mainprize and Vodden.

12 627 is Movement of PCBs And Other Persistent
13 Compounds Through Soil.

14 628 is Polychlorinated Biphenyl Dechlorination
15 in Aquatic Sediments.

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

19 A That was the article that was supplied by counsel.

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

23 And then exhibit 631 is a publication entitled

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

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

7 A That's correct.

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

11 A I have no idea.

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

17 A I said that was conceivable.

18 Q That's possible, is it not?

19 A I would think it's possible.

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

22 A That's correct.

23 Q You have no quantitative basis of saying that

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

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

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

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

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

16 Q You would assume it's an active plant?

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

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

21 A Okay.

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

1 many years.

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

4 A Under those conditions, no.

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

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

10 Q And it's possible, is it not?

11 A Yes.

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

15 A That's correct.

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

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

23 Q When you say retard, that is leaving open the

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

11 Q Is not measurable usually?

12 A That's correct.

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

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

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

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

1 A I don't have any specific recollections.

2 Q Did you ever have any discussions with any people at
3 Westinghouse as to whether or not PCBs had percolated
4 through landfills?

5 A No.

6 Q Based on our previous discussions you did indicate
7 agreement with the fact there are circumstances where
8 PCBs placed in a soil environment with either
9 fractures or voids could be released into the
10 environment; isn't that right?

11 A Well, they would move downward through those
12 fractures and voids. I don't agree with released
13 into the environment necessarily.

14 Q It's referenced in here and I didn't bring it with
15 me, that the summary of grounds for your degradation
16 testimony is Monsanto document 1874, the published
17 research?

18 A Yes.

19 Q Which documents are we referring to?

20 MR. FRUEHWALD: That's not an extra copy.
21 If you want to make it a copy, I'll make a copy.

22 MR. KARAGANIS: Yes.

23 MR. FRUEHWALD: Are you going to do the

1 same thing with the other one?

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

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

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

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

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

10 (Bloomington Deposition Exhibit 632 and
11 633 were marked for identification.)

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

17 A Yes.

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

1 A Yes.

2 Q Going back to our earlier discussion, absent voids
3 and fractures, you indicated at one point that simply
4 in a soil column the adsorptive capacity of that soil
5 column could be overloaded by the amount of PCBs that
6 are put there resulting in the discharge of PCBs at
7 the bottom of the column; is that correct?

8 A Yes, I think that would be possible. Depending on if
9 you're talking about an experiment, talking about an
10 experimental setting.

11 Q We also talked about if we find PCBs coming out of
12 the bottom of a landfill which is a soil column, is
13 it not?

14 A Yes.

15 Q That one of the causes would be that the adsorptive
16 capacity of the soil had been exhausted?

17 A It was one of the causes we discussed, yes, possible
18 explanations we discussed.

19 Q Do you have any information on the solubility of the
20 individual congeners?

21 A That information is in the literature. I don't have
22 it with me. I don't recall it particularly.

23 Q When you say 1016 or 1264 having a solubility of 200

- 1 ppb, that's an average?
- 2 A That's correct.
- 3 Q Is that also true on the adsorption?
- 4 A Yes.
- 5 Q Due to different congeners have different adsorption?
- 6 A Yes, they do.
- 7 Q Is there anything about the opinions in testimony you
8 intend to present at trial that we haven't covered?
- 9 A I don't believe so, no.
- 10 Q Why don't you we take subparagraph d of 618?
- 11 A Okay.
- 12 Q I'm doing this because we may finish early and I want
13 to make sure I have covered the ground. What is it
14 you're going to testify with regard to subparagraph
15 d, the opinions in subparagraph d?
- 16 A Basically that the fact that the solubility of
17 Aroclor 1242 has been measured in water. It's
18 approximately 200 parts per billion.
- 19 These measurements are done under conditions
20 which will maximize the solubility of the particular
21 PCB mixture in the water. In other words, PCBs in
22 the liquid states are added to water. They are
23 shaken for a period of time, up to 24, possibly even

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

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

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

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

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

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

23 A Yes.

1 Q That's true if we're talking about the water phase?

2 A That's correct.

3 (A discussion was held off the record.)

4 Q Back on record. The concept of the lower chlorinated
5 congeners being more water soluble and thus being
6 more biodegradable relates to the water phase
7 leaching, doesn't it?

8 A Right.

9 Q To the extent there is the non-water phase liquid
10 leaching, that would not be the case; isn't that
11 right?

12 A Well, yes. I mean we're talking about a leaching
13 situation now with the higher chlorinated materials.
14 Those materials which are less soluble in water are
15 also the ones that more tightly adhere to soil or
16 more tightly "adsorb" to soil. You would expect them
17 to stay in the soil phase of a leaching type system.

18 Q But that assumes that the soil has the capability of,
19 enough adsorptive capability to handle a total load?

20 A Right. It's going to be competitive among the
21 phenomena we talked about before, the capacity of the
22 soil, the retentivity or the retention capability of
23 the soil, a variety of things.

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

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

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

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

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

19 A All right.

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

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

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

4 Q Rates of ten percent?

5 A 10 to 20 percent.

6 Q Per what?

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

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

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

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

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

1 for 1242 and 1016?

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

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

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

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

17 A That's true, in a particular situation.

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

20 A Certainly.

21 Q What are you going to testify about subparagraph b?

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

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

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

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

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

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

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

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

1 Q Would that be -- I'm going to throw some lawyers'
2 language at you. Would these defects go to the
3 weight that you might give such data?

4 A Yes, certainly.

5 Q Whatever the data is, you would look at it and
6 discount it or accept it in varying degrees depending
7 on these various infirmities; is that correct?

8 A That's correct. Well, yes, you have to look at the
9 data and make an expert judgment on the reliability
10 of that data and how much weight should be put on it.

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

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

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

1 there.

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

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

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

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

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

19 MR. KARAGANIS: Which ones?

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

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

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

9 (A discussion was held off the record.)

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

14 MR. FRUEHWALD: I have none.

15 AND FURTHER DEPONENT SAITH NOT

16

17 _____
ROBERT GEORGE KALEY II, PhD

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1 STATE OF INDIANA)
)
2 COUNTY OF MARION)

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

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

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

21 That the parties were represented by their
22 counsel as aforementioned.

23 I do further certify that I am a disinterested

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

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

8
9
10
11 NOTARY PUBLIC

12
13 My Commission Expires:

14 November 12, 1990

15 County of Residence:

16 Marion County
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