UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

BEFORE THE HONORABLE VINCE CHHABRIA

IN RE: ROUNDUP PRODUCTS LIABILITY LITIGATION,	)	No. M-16-2741 VC
	)	San Francisco, California
	)	Wednesday
		April 4, 2018.

TRANSCRIPT OF PROCEEDINGS

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ALSO PRESENT: The Honorable Ioana Petrou

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Wednesday - April 4, 2018 **10:05 a.m.**

P R O C E E D I N G S

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THE CLERK: Calling Case No. 16-MD-2741, In Re Roundup Products Liability Litigation.

Counsel, please state your appearances for the record.

MS. WAGSTAFF: Good morning, Your Honors. Nice to see you both again. Aimee Wagstaff for the plaintiffs.

And with me I have Robin Greenwald, David Wool, Brent Wisner and Kathryn Forgie.

MS. FORGIE: Good morning, Your Honor.

MS. GREENWALD: Good morning.

THE COURT: Hello.

MR. LASKER: Yes, your Honor. Eric Lasker for Monsanto. And I have Heather Pigman and Grant Hollingsworth.

THE COURT: Hello.

MR. HOLLINGSWORTH: Good morning.

THE COURT: Okay. So this is the day to continue hearing from Dr. Ritz. As I think I mentioned to you-all when I got you on the phone recently, I wanted to start with my own follow-up questions of Dr. Ritz and any questions of course that Judge Petrou has, but after that, happy to give both sides an opportunity to, you know, follow up with her as well.

Who do you-all think should go first -- or go second after me?

MS. WAGSTAFF: Your Honor, we were sort of thinking that plaintiffs would go second.

THE COURT: Okay. That's fine.

MR. LASKER: I'm not sure I understand. Second after the judge or second after us?

MS. WAGSTAFF: I assume -- we were thinking that it would go judge, judge; judge, judge, judge; and then plaintiffs.

MR. LASKER: That's fine.

THE COURT: Okay. That sounds good. And we'll try not to disappoint you. And we'll take -- we'll take as much as time as we need with Dr. Ritz.

I think one of the problems, you know, one of the problems is that Dr. Ritz went first, and I personally did not -- you know, I was -- I was not in as good a position to ask her questions as I would have had she testified on Friday at the end. And I think also everybody was a little rushed because of the time constraints that we had.

On reflection I think, you know, we -- we did not schedule enough time during that week to talk to the experts, and so that's why I wanted to have a couple more days.

So anyway, with that, why don't we go ahead and have Dr. Ritz take the stand.

BEATE RITZ,

called as a witness for the Plaintiff, having been duly sworn, testified as follows:

THE WITNESS: I do.

THE CLERK: Thank you. Please be seated.

THE COURT: Welcome back.

THE CLERK: Judge, can I get --

THE COURT: You're going to go ahead and get her name and spelling?

THE CLERK: Yes.

THE COURT: Thank you.

THE CLERK: For the record, please state your first and last name and please spell both.

THE WITNESS: Beate Ritz. B-E-A-T-E, R-I-T-Z.

THE CLERK: Thank you.

THE COURT: Thank you for coming back. I know you were in Europe until very recently, so I hope you're not too jet lagged.

THE WITNESS: It's all right. But if I start speaking German, you'll remind me.

THE COURT: So one of the big concerns I have still after hearing all the testimony the other week is about the issue of latency. And it seems to me that all of the numbers that the plaintiffs are relying on, all of the numbers that the plaintiffs view as favorable to them come from these, you know,

pools of people in the United States and in Canada. I guess particularly the pool -- I'm concerned about the pools from the United States. Come from pools of people who were diagnosed with NHL in the late '70s, early '80s, maybe spanning til the mid-'80s. And glyphosate was only introduced onto the market in '75 or '76, something like that. I don't remember --

THE WITNESS: '75 I think.

THE COURT: '75. And so their initial exposure to glyphosate in many, many of those cases was less than ten years before being diagnosed with NHL. I think in a number of cases less than eight years, less than seven years.

And as I said, that appears -- it appears that all of the numbers that the plaintiffs rely on to support their argument that glyphosate is causing NHL come from those pools of people, or primarily from those pools of people. And that strikes me as a significant concern about the reliability of those numbers.

And so that's the first issue that I -- I'd love for you to address. And keep in mind -- I mean, give me as long and as detailed an answer as you want with as much background as you want, keeping in mind I'm a layperson. I'm not a scientist.

So go ahead.

THE WITNESS: Yeah. So latency is interesting, as you said. Generally when we do an epidemiologic study, we would like to follow people for cancer for a very long time.

However, when I say that, that's usually a study designed -- we call it cohort study design. We start with people who are exposed and unexposed, and we are actually excluding everyone who has the disease at baseline. We even exclude people who would get the disease one or two years after baseline --

THE COURT: You're talking about in a cohort.

THE WITNESS: In a cohort, right.

MS. FORGIE: Doctor, just to interrupt for a second. Could you speak a little bit slower for the court reporter and a little louder, please? Thank you.

THE WITNESS: And -- and that is for exactly that reason that we are assessing exposure at baseline. And what we are knowing about it at baseline is probably not reflecting the causative type of exposure in the first year or what already -- I mean, the cancers that we are harvesting at baseline or in the first two or three or sometimes five years.

So in a case-control study, that's why in a cohort we definitely want to make sure that we have a minimum of five years of follow-up, because we are very concerned about, you know, do we have the timing right and have we waited long enough to actually see an increase in cancer.

THE COURT: But, I mean, I was -- my primary concern is about --

THE WITNESS: The case control.

THE COURT: -- the case control studies. But since you bring up the cohort studies, let's take a quick detour and let me ask you about the cohort studies.

I mean, let's say we start following these people in year one, right, and we follow them for five years.

I understand why that would be a problem if we are only looking at what they are being exposed to beginning in year one, but if we start following people in year one and we have information about their exposure the last 10 or 20 years, why is it a problem that we're only following them for five years?

THE WITNESS: It is a problem if we don't see anything, because it could mean that what they reported at baseline is not really a good reflection of the exposure. Because what we are after is the best exposure contrast we can get.

And the further these people have to remember backward -- and remember, they have no reason to really, you know, want to remember or make a big effort. They are just being asked: Hey, do you want to be in the study? And, you know: Here is a questionnaire, please fill it out. Then we are quite concerned when that time period goes too long backward that they are not making that effort.

So I'm -- I'm probably not comfortable about what they are reporting for the last few years and for a long time period back. So that's one reason.

The other reason is that I really would be concerned about the timing. Sometimes cancers take a little bit of -- longer to be diagnosed, depending on the patient really picking up on symptoms. So you may be picking up some that, you know, in the first few years that really are -- have already a longer history, but you -- it took awhile to come to diagnose. So the temporality is really not all that clear as to when the exposure first started.

Of course, if it's 10 years or 20 years ago, that's not a problem. But if it's really in that last five years, then it's a little bit more wishy-washy. So it's more cleaner if we have a follow-up in a cohort study, we generally agree on that.

Some cohorts actually make rules of, well, the first five years we really don't count anyone and then after the five years we start because we have a clean slate. So that's the cohort.

But in a case-control study we go the other way around. We accumulate the cases and at the time when the case occurs, we then go out and find controls from the population and we ask them about their exposures.

So in this case if you have an exposure that only reaches, let's say, five to seven years back -- and that was, I think, the time in one of the studies, was five to seven years, and the other 8 to 11 years maximum, 11 years -- then my worry is that depending on when the exposure actually happened, but also

how long it took for the cancer to develop. I'm only seeing the early birds of the cancers.

So those would be the cases where the exposure was either strong enough to have initiated a -- a cancer event or the cases that were the most aggressive.

So I'm actually harvesting the most aggressive cases in the very early period and exposures that are maybe more moderate but cumulative over time wouldn't have had a chance yet to show the cases that come later. So I think the concern with the early studies is that assuming that, you know, I did my job right with the exposure assessment, those were probably the most aggressive cases.

Does that make sense for these early studies? It could be if we think about how farmers at the time used pesticides and what they were used to. They were used to pesticides that were quite toxic. The pesticides in the 1960s, a lot of them were quite toxic and they were warned, or they had slight symptoms of fever or of any flu-like symptoms when they exposed themselves, these organophosphates. And then glyphosate came along and they were not considered to be really very toxic to human beings.

So we could see that, you know, these farmers were possibly not taking the same precautions as they should have. And so what it might mean, these early studies, is that we have a lot more not protected exposure in people who did not -- who

did not really think about glyphosate being very harmful.

JUDGE PETROU: Dr. Ritz, would it be fair to say then that it's your opinion that NHL could develop within the 5- to 11-year time frame in these studies --

THE WITNESS: Yes.

JUDGE PETROU: -- based on your assumption, presumption, you tell me what it is, that the workers were using glyphosate in an unprotected manner?

THE WITNESS: Absolutely. We generally -- I mean for -- for solid cancers, I would pause. But for blood-related cancers, we know that two years might be enough. Five years might be enough. And I did a radiation worker study. For the leukemias and lymphomas we could go back to 2- and 5-year latency. We would not go to 10 years. But for the solid tumors you would pause and say, well, maybe ten years. But, really, for blood-related cancers they are faster.

THE COURT: Well, so if I could -- if I could ask you a follow-up question on that point, Dr. Ritz.

I'm looking at your expert report, your report that you submitted, and I -- I have to say that it seems like you said a number of things in that report that contradict what you're saying now about the issue of latency.

I'm looking at -- do you have your report in front of you?

THE WITNESS: Which one? Yes.

THE COURT: Your original expert report.

THE WITNESS: Yes.

MR. WISNER: Exhibit 1.

It's also in the binders if you want a hard copy, Your Honor.

THE WITNESS: What page?

THE COURT: Start on Page 17.

THE WITNESS: Yes.

Oh, I have a deposition here. Exhibit 1, yes. Sorry.

MS. FORGIE: Do you need help finding it?

THE WITNESS: No, I've got it.

JUDGE PETROU: Just a side note, though, because I am looking at the binder. It says Exhibit 1 is the expert report, but then Exhibit 1 does appear to be the deposition transcript, as Dr. Ritz just noted.

MR. WISNER: In the tab it should say Exhibit 1 after --

JUDGE PETROU: I see how you did it.

THE WITNESS: I got it.

MR. WISNER: The deposition transcripts are technically not exhibits.

MS. FORGIE: Is that clarified enough? Thank you.

THE COURT: So I'm looking at the middle of Page 17, and in this report of your report you're talking about the Eriksson study; right?

THE WITNESS: Yes.

THE COURT: And you're talking about the part of the Eriksson study that analyzed -- that focused on people who were diagnosed more than ten years after they started using glyphosate; right?

THE WITNESS: Yes.

THE COURT: You say:

"These results are more convincing due to biological plausibility; in the group in which less than ten years had elapsed since exposure, the effect estimate was much lower, as would be expected since these exposures are less likely to contribute to disease onset."

And then if you go to the bottom of Page 18, when you're talking about the Cantor study. And the Cantor study, that's the cases in Iowa and Minnesota; is that right?

THE WITNESS: Yes.

THE COURT: You -- you say that:

"Less informative for the current evaluation is the Cantor study because, although it was carefully conducted, cases were included that were diagnosed 1980 to 1983. Hence, only six to ten years could have elapsed between a potential first glyphosate exposure and NHL diagnosis, which for cancer epidemiologic studies is considered an inadequate latency period and one would want to see at least the median latency

period of ten years."

And then you say:

"Again, for an individual the latency period may vary (one year to many decades), but on average for a study one would prefer a minimum latency period of on average ten years."

So it -- it seems to me at least as a lay person that what you are now saying about latency is different from what you said in your report. If that's true, can you explain why you're changing; and if it's not true, explain to me why it's not, not true?

THE WITNESS: You asked me to explain why I say this here. Well, I'm generally a conservative human being and this report I consider the conservative way.

So the Cantor study wasn't what I base my opinion on, and I wanted to make that very clear. And so I'm -- I'm phrasing here very carefully what usually would be expected in cancer studies. And I apologize if I didn't qualify that for blood-related cancers. I thought I did, but I guess I didn't.

But my saying that for any individual it could be one year or 20 years or 50, whatever I said, is actually true. We want the average latency to be covered by the study. If the average latency is really ten years, then what I'm saying is Cantor actually underestimates. It's not the best study to base this on.

However, I wouldn't be too concerned because they are actually seeing something. But if we want to be conservative, we would actually want to do these studies later.

THE COURT: But, so I -- so a question about that last point. You say they are seeing something.

THE WITNESS: Right.

THE COURT: Right? And I guess -- I don't yet understand whether they really are seeing something.

In other words, these studies, depending on how you look at the numbers, show a -- potentially show a statistically significant association between NHL and glyphosate use.

THE WITNESS: Right.

THE COURT: But the question is that -- we're trying to answer is whether it's merely an association or there is causation.

THE WITNESS: Correct.

THE COURT: Right?

THE WITNESS: Uh-huh.

THE COURT: And I think the concern with the latency issue, right, is that when somebody has NHL -- or if somebody is diagnosed with NHL and they only began being exposed to glyphosate five years prior, the sort of automatic question we all would ask, I think, given what we've been told by you and others about latency, is that -- is, well, is something else causing the NHL? Is -- is something that these people were

exposed to more than ten years ago causing the NHL?

And so my question is: How do we know that it wasn't something else that was causing the NHL that the people in these groups were being exposed to before they started being exposed to glyphosate given particularly that we know that farmers have always had elevated cases of NHL?

THE WITNESS: Right. I would be completely of your opinion if I would base my opinion on Cantor. I wouldn't know.

However, Anneclaire De Roos did something very beautiful. She combined these studies. And by combining these early studies she was then able to do a lot of analyses, including a 47 pesticide adjusted analysis that still found a significant and a multiply adjusted significant result.

None of the early studies could have done that because of the number of cases exposed to glyphosate. They did not -- it wasn't enough in any one of the studies to actually properly adjust for other pesticides. So that question could not be solved or answered in the early studies.

So the -- the De Roos study is really so beautiful because it allows us this pooling of data and then it allows us to do exactly that.

So I would be completely with you if it was just Cantor. And that's what I also was trying to say in my expert report. I would dismiss it. But after De Roos, pooling all of this data and then being able to adjust for all of these different

pesticides and still finding an increased risk and multiply adjusted increased risk, I find that convincing.

THE COURT: Okay. And so I think you may have answered this, but I'll -- let me just make sure.

So by adjusting for other pesticide use, that addresses the concern that I am expressing about latency. That is to say, the -- the adjusting for other pesticide use in this context tells us, okay, you don't have to worry about whether this association that we're seeing between glyphosate use and NHL is actually attributable to these farmers' use of MCPA, you know, 15 years prior or whatever; is that right?

THE WITNESS: That is correct. Because you would assume that if really it was just an indicator, glyphosate was just an indicator of prior MCPA use, then putting that variable into the model would have taken care of it.

And that would not have been possible in the Cantor study because of the numbers, but it was possible in De Roos. And, therefore, because you have now a lot more cases and a lot more exposed cases, but you also have a lot more controls. So you're filling up these cells in a way that you're actually now allowing your model to work for adjustment.

When you have any one of these studies, you can't do it without generating, pooling or having zero cells or your model collapses. It basically collapses. So you're stuck with not being able to adjust.

Or if you adjust, what can also happen -- and that's actually one thing I was trying to do with my visual recommendation, one of them on Hardell, the early Hardell study. We can see that we generate something called sparse data bias, meaning we have so few cases and we throw so many variables into the model that I know there must be a lot of zero cells, so the model misbehaves.

And then you actually have a bias introduced that increases the risk. And it looks like glyphosate has a five-fold risk when the univariant model only shows you 2.3 fold. And I would then go with the 2.3 fold because I know this model must have not behaved.

That's not the case in De Roos. De Roos was actually able to have enough numbers to do the proper adjustment.

THE COURT: Another thing I'm curious about, this may be a dumb question, but we have these case-controlled studies and they are on -- all look at people -- McDuffie was later.

THE WITNESS: Yes, '92.

THE COURT: McDuffie looked at people who were diagnosed with NHL in the early 90's.

THE WITNESS: Early 90's, uh-huh.

THE COURT: But these other North American pools are looking at people who were diagnosed with NHL late '70s, early 80's, mid-80's.

Sorry. Were you going to...

THE WITNESS: They were actually -- there was only one study that started in 1979. The others were '80 through '86.

THE COURT: Okay. And we're now in 2018; right?

And we have had many papers written about these studies of people who were diagnosed with NHL in the 80's and people are crunching the numbers and re-crunching the numbers and re-crunching the numbers.

But why have there not been any -- why have there not been any case-controlled studies of people who were diagnosed with NHL in the late 90's or in 2005 or 2010 or whatever?

THE WITNESS: I can venture some guesses. One was the Hardell study in 1993, and everybody thought that would give us the answer. So it's actually NIH. One, they invest in one study that they believe is the Cadillac. Reviewers are very reluctant to spend more money on something that they consider may be inferior, which is a case-controlled study; right? And I disagree with those reviewers.

There was also -- when I started as a young professor in 1995, there was almost no money in occupational and environmental epidemiology. And the Hardell study was funded within NIH, but for external funds. There was no money. And I struggled for four years to get money, and I finally got the State of California to give me my first cancer study in 1999.

So it was really hard to convince reviewers at NIH that

occupational and environmental exposures were important. And, unfortunately, I have to say it didn't change much. It was the genomic era and it was the nutrition era and everybody wanted to study just that. And when you came with a proposal saying: Oh, I want to study pesticides, you really had an uphill battle. And on top of it, you had the Hardell study that everybody was pointing to saying: They will answer it. Right? We just have to wait.

Yeah, I wish that hadn't happened, but that's how research is, unfortunately, funded.

THE COURT: There are currently no case-controlled studies being done on the link between glyphosate and various cancers?

THE WITNESS: I would doubt it. For the U.S. I don't know. Of course, the Swedes then started up, so there might be other countries who are now investigating this; right? Yes. And definitely the Scandinavian countries are forerunners of this kind of research. So I hope they will put out more research.

THE COURT: Speaking of which, that reminds me of some testimony you gave when you were last here on the Ericksson study. And let me see if I can remember the concept you were articulating, but I think maybe you didn't have enough time to fully explain.

You have had a criticism of the Ericksson study and the

criticism, if I recall correctly, was that the Ericksson study compared people who were exposed to glyphosate and other pesticides to people who were not exposed to any pesticides at all. And you explained -- it seems rather obvious why that's a real problem, and you explained to us that that's a problem.

And then you said during your testimony that you were able to adjust for that and still extract some value from the Ericksson study and -- but that part of your testimony was pretty quick and I don't think you had enough of a chance to explain what you did and why what you did resulted in helpful numbers.

THE WITNESS: I totally agree. That wasn't clear. So what you can do is when you -- when the authors actually provide you with some raw data, which is the numbers exposed and unexposed, you can actually reconstruct the number of unexposed that you should have who were also exposed to other pesticides from those tables.

So I was able to reconstruct that number --

THE COURT: Let me stop you right there and ask a clarification question.

So you're saying that in the pool of people that Ericksson looked at, there were -- there were cases. Those people were exposed to glyphosate and other pesticides. There were controls, and some of the controls were not exposed to any pesticides and other of the controls were exposed to other

pesticides?

THE WITNESS: Correct.

THE COURT: So what Ericksson did in the paper was to remove the controls who were not exposed to glyphosate, but exposed to other pesticides?

THE WITNESS: Yes, exactly. And so they had a group of controls that had no other pesticide exposure. It may sound like a good idea. I think that's why they tried it. But when you -- when you do a formal analysis in --

THE COURT: I don't understand why that would ever sound like a good idea to anybody.

THE WITNESS: That's good. I agree. I totally agree.

But sometimes clinical colleagues think it's a cleaner control group if they are not exposed to other pesticides. And these arguments, I've seen them being made, that that's a cleaner control group; right? They have no other pesticide exposures.

So we're really only comparing the glyphosate exposure in the controls to the glyphosate exposure in the cases, and we'll ignore that the cases have maybe also some other pesticide exposure; right?

It's not a good idea, but I was able to reconstruct the control numbers with other types of pesticide exposure. So, and then to calculate what we call a crude odds rate ratio,

which is just a cross product. And that crude odds rate ratio was about ten percent different from the one that they reported. That could be because I couldn't adjust for age because I didn't have the raw data, and I couldn't adjust for sex and province, all the variables they adjusted for.

But when I did this -- and we were too fast last time. You remember that visual representation that we call forest plot, but I don't want to call it forest plot? At the bottom there were all these other subtypes of NHL listed. And that -- I did that for a purpose, because actually the Ericksson subtypes -- and when you read that paper carefully, it says in those analyses he used all controls. So they don't have that problem, these subgroup analyses. And they are adjusted for. Age and sex and everything else he adjusted for.

So when you then kind of scan along and you look at the largest group, which I think was B-cells, and it was 800 out of the 900 about, then you can actually see that that estimate is also about 1.8 something, 1.9. And it is the largest group of NHL. And so that would really then weigh the heaviest in the overall estimate.

So I was quite comfortable with my crude estimate being very close to an adjusted estimate when you're including every single control and not just the ones who -- or excluded the ones who had any other pesticide exposure.

THE COURT: Is there -- do you recall, is there any

explanation of the numbers you came up with or the estimate you came up with in your reports?

THE WITNESS: An explanation on the Ericksson study?

THE COURT: Yeah.

THE WITNESS: An explanation in this way?

THE COURT: Yeah. An explanation of how you addressed the problem of Ericksson deciding to use only the controls who hadn't been exposed to other pesticides and how I think you said that, you know, the numbers -- your estimate is that they were within ten percent of the numbers. Is there anything sort of laying out --

THE WITNESS: I'm not sure I was as explicit because it becomes very technical and -- to explain this. And then you could say: Well, you didn't adjust for age, and that's a problem.

So I could have hesitated to really do that, but I convinced myself that the numbers that Ericksson reports are not too far off the truth. If they are within ten percent, epidemiologists are generally happy. That's kind of the rule of thumb.

So it might be that I haven't really explained how I got to that -- how I convinced myself that that's correct, but I do remember that one reason I put in this visual graph, I put all those numbers was because I then found that they had actually used the full cohort set and not a subgroup. So that bias

could not have been in the subgroup.

THE COURT: For the subtypes.

THE WITNESS: Yes.

THE COURT: Before I ask you a follow-up question about the subtypes, for the overall number where you sort of put the -- put the controls back in, who had been exposed to pesticides and then sort of did your -- did your estimate where you were unable to adjust for age and gender and things like that, were those -- was all that stuff adjusted for other pesticide use or were these the numbers that were not adjusted for other pesticide use?

THE WITNESS: They don't report -- oh, they report the multi-variant analysis as well. So I couldn't do that; right? I didn't have age. I also didn't have -- and so that's why I hesitated; right? That is a problem.

However, you remember that when you're adjusting, what you're actually trying to do is simulate a clinical trial where you are taking care of confounding by randomizing. Meaning, you're assigning the treatment to the two groups in a random way.

And the reason why we do this in medicine, randomly assigning treatment, is because then confounding in the long run is actually taken care of because you are distributing all risk factors across the treated and untreated group or the exposed and unexposed group fairly.

So you still have other risk facts that are causing the outcome, but they are kind of distributed randomly so they can not influence the outcome in one group more than in the other.

So what we are trying to do with adjusting for confounding is recreate this kind of evenness in all other risk factors except for the exposure. So that's -- that's really what we're after.

THE COURT: And so on the -- on these numbers up here on the screen, the break it down by subtypes, you say that these -- these numbers are based on all of the controls?

THE WITNESS: Yes.

THE COURT: Not just the controls who were unexposed to other pesticides?

THE WITNESS: Correct.

THE COURT: But these numbers are also not adjusted for exposure to other pesticides; correct?

THE WITNESS: They couldn't do that because of the number game. Again, they would have run --

THE COURT: In other words, the pool -- the pool of people in each subtype is too small --

THE WITNESS: Yes.

THE COURT: -- to adjust for other pesticide use.

THE WITNESS: Right; right.

THE COURT: Okay.

Does this -- I mean, discussion about Ericksson, does that

leave you feeling that, you know, the De Roos 2003 study is much more useful study than Ericksson?

THE WITNESS: I find De Roos very, very useful. Definitely I would prefer her.

However, I think there is a lot to Ericksson. There really is a lot to Ericksson. It's a large study. It's one outside the U.S. And it's otherwise quite well done because they have such wonderful data, cancer data, as well as the way they do their studies is very solid. I wish they had tried to adjust more.

However, I think they present their results in that multi-variant model very fairly, fair and square. And I am still okay with the 1.5, a 50 percent increased risk after adjustment. I'm fine with that. Especially since they then later also did the ten days per year analysis and, you know -- and that kind of confirmed it for me.

THE COURT: That reminds me of another question I have about Ericksson. But first Kristen has asked that we take a break because of a technical issue.

To give you extra time, why don't we take an extra break and come back in at five minutes to 11:00.

(Whereupon there was a recess in the proceedings from 10:44 a.m. until 11:06 a.m.)

THE COURT: Okay. Let me ask you a couple other questions about latency maybe and then we can -- we can move

on.

By the way, was there anything that you wanted -- that we've discussed so far that you wanted to clarify or elaborate on or anything?

THE WITNESS: Actually, while I was sitting here, I realized that I hadn't made it very clear what latency means in terms of biology.

So when we think about latency, it is not only a question of when the exposure happened, but at what age the exposure happened. And we now know that there are actually periods that are much more sensitive.

So, for example, it could be very different if I expose a 55- or 60-year-old farmer than a 35- or 40-year-old. And in a case-controlled study that is kind of a given.

So if I only have five to ten years of latency, it means the exposure actually happened in the five to ten years prior to the onset of the disease, which naturally, because all of these individuals are older, means they were exposed at an older age.

In a cohort studies that is not -- and I presume -- I do elderly studies --

THE COURT: So when you say because all these people are older --

THE WITNESS: On average.

THE COURT: -- you mean in the case-controlled

studies, because we are looking at people who have already been diagnosed with NHL --

THE WITNESS: Yes.

THE COURT: -- by -- by definition or by logic, they are going to be older --

THE WITNESS: Yes.

THE COURT: -- than people we're looking at in a cohort study.

THE WITNESS: Correct. Because in a cohort study we actually are enrolling everyone; right? So sometimes we set a limit and say they have to be 25 or 35, especially when I want to see cancer. Because we all know, even though the people may be exposed at 35, we have to wait until 60 on average to see the cancer.

So the latency actually depends on how -- whether that person reaches 60 or above. So for lung cancer we know that, you know, it's around 62, and for NHL, too, is the peak of the cancer incidents. So even though the exposure may have happened at age 35, your immune system was able to keep it in check.

And then with the weakening, we think now, with the weakening of the immune system surveillance with aging, that's what then brings it all on.

So I know when I do a study where I enroll 25-year-olds, I probably should wait 30 years before I see something really

happening.

In the early years all I see are the very aggressive young age cases that are unusual; right? So in a case-controlled study I don't have that problem because everybody who would become a case already is a case. And so if I only go five or ten years back, then I know that was the exposure prior to that event happening and probably during a lifespan that was more susceptible or sensible.

THE COURT: And so in the -- in the -- for the people who De Roos looked at, do we know what the average or median age was of the cases and the controls?

THE WITNESS: Yes. That is actually usually in Table 1. She may not have represented, but I just looked back at one of them and it was about 62.

THE COURT: Was the average --

THE WITNESS: The average age.

THE COURT: -- average or median?

THE WITNESS: That's the average age. It was reported as the average age.

THE COURT: For the cases?

THE WITNESS: Cases. And the controls are usually matched by age, so they are about the same.

THE COURT: Okay. And then since we -- since we bounced back to De Roos, let me ask you one more question about that. And this is sort of a more general question to make sure

I understand the effect of adjusting for other pesticide exposure, okay?

So what that means for De Roos, for example, is when we have these numbers showing an association between NHL and glyphosate exposure, the fact that adjustments were made for MCPA and other pesticides can give us confidence that the exposure to the other pesticides is not responsible for this association that we're seeing in the numbers for -- for NHL and glyphosate.

THE WITNESS: Correct.

THE COURT: We still are left to wonder whether something else might have -- might be responsible for this association, such as exposure to diesel fumes or excess exposure to the sun or something like that; right?

THE WITNESS: Yes. We are left with everything that we haven't adjusted for, assuming that those were similarly distributed among the exposed and non-exposed.

So if I can come up with a reason why that's not the case, and really every farmer who used glyphosate took sun baths every day, and the ones who did something and used other pesticides, you know, wore sunscreen or didn't go out in the middle of the day, then that suspicion has a grounding in reality.

So that's actually the job of the investigator, to think about all the potential other risk factors that not only are

risk factors for the outcome, but also different among the exposed and the unexposed and would, therefore, explain that pattern that I see for glyphosate.

And I didn't read that the investigators thought that any of that would be the problem. What we usually hope is that it -- yeah, there are all these other risk factors, but they are kind of evenly distributed among the exposed and the unexposed, unless I can come up with a true reason that that's not the case. Like, they did not allow smoking on the farms that used glyphosate, or -- that's a bad example, but it's actually true for woodworkers; right?

Woodworkers can't go and smoke in the wood shop. So they are likely not smokers and, you know, they have dust exposure, but they have less smoking. So there -- there a kind of reason. Even if I don't have smoking data, I should be worried because the distribution would be different. But if I can come up with a reason why that would be the case, then I'm not so concerned.

JUDGE PETROU: I just want to go back one moment to a make sure that I understand your testimony regarding age of exposure and latency, since you raised that issue.

So is your point or one of your points that the age of exposure is relevant in the sense that people who were using glyphosate would be more susceptible to its potentially deleterious impacts if they were older because of a weakened

immune system over time?

THE WITNESS: It's actually both. You caught that right.

So one thing I -- I suppose could be that we say, yes, with aging we know the immune system ages and the immune system has issues in aging; right? We see all of the herpes zoster outbreaks in the elderly for good reason, because the immune system can't check it anymore.

So yes, definitely when I am exposed at an older age, my system may not be capable of coping with it. And we call that a susceptible group in terms of age of exposure.

But the other factor is really also the distinction between the case control and the cohort studies, where in the cohort studies I have a mixture of ages and for only the small group that is close enough to the peak age of NHL can I expect within a short period of follow up to see the cancers. For the others, even though they might have that cancer cell already sitting somewhere, I might have to wait 20 years to see it emerge, or 30 years.

JUDGE PETROU: And the -- the individuals that we commonly think that -- potentially being particularly susceptible, such as in utero, infancy, puberty, periods of time, right, when your body is going through very quick cellular change in growth, those are not groups that we have at issue here, because of the -- because of the item at issue

basically.

THE WITNESS: Correct. Correct. Because it's occupational exposure.

Yeah, I wish somebody had done a study on children who help on farms.

THE COURT: The one other question I had about the Ericksson study that I was mentioning before the break, can you talk to me in a little bit more detail the significance of Ericksson's conclusion about people who were exposed for greater than ten years or longer than ten years before diagnosis?

And then there was also some discussion you had in your previous testimony about people, I believe -- I may be misremembering this, but people who were exposed even longer, like greater than 20 years, and how numbers dropped off for that.

THE WITNESS: Yes, yes.

THE COURT: And I didn't -- I think that was, again, another example of something that was gone through pretty quickly in your prior testimony, and so I wanted to hear more about that.

THE WITNESS: Right. So in Ericksson it seems that a lot of the farmers they actually enrolled in the studies had actually stopped farming. So I don't think they really had the exposures close to the onset of their -- their disease.

So they must have stopped when they were 60 and maybe gotten the disease at 65. So that's at least five years. Some got the disease at 70.

So that they saw most of the effect between 10 and 20 years, I think, was probably a reflection of them -- it taking them a little longer to get to the disease because they may have stopped farming earlier.

And I'm saying that because it looked from the patterns of, you know, when they last farmed, et cetera, it seemed to make sense that a lot of the --

THE COURT: So they had -- sorry. Let me interrupt real quick.

THE WITNESS: Yeah.

THE COURT: So they had data about when they last farmed?

THE WITNESS: Yes, yes.

THE COURT: Okay.

THE WITNESS: I think so. That's what -- I think they asked them actually when they had used and the years they had used. And so that's the only way they can actually look at latency.

They didn't explicitly say it, I think, but the only way they could have actually constructed these variables was by asking them; right?

And so 20 years-plus is probably harder for Ericksson to

get to because people used other pesticides, and I think the -- the glyphosate use came in vogue in Sweden in the '80s, more in the mid-'80s. So we kind of have that span of 20 years where glyphosate exposure could have had happened.

So just because of that data structure, it is unlikely that you find a lot of people who have more than 20 years' latency just because the exposure couldn't have happened so early.

You're restricted in your data. I mean, you want to really estimate this as good as you can, but you're restricted by real-world situations where, okay, when did the exposure happen? How long did I follow these people? When did they get sick? At what age were they exposed? And you kind of deal with it by looking at your data in different ways. And I thought they actually did a pretty good job of doing that.

THE COURT: I'm kind of ready to turn away from the issue of latency. Is there anything else that you wanted to say about that?

THE WITNESS: I think we covered it. Yeah.

THE COURT: Okay. Now, this -- this is an issue we've talked about a little bit today and we've talked a little bit about during your last testimony, but I want to explore it further.

In the opinions that you provide in your reports and in your testimony, you -- you place very heavy emphasis on numbers

that are not adjusted for other pesticide use. And I wanted to ask you sort of a methodological question, I guess, which is: Is it okay in, you know, forming an opinion like this to place such heavy emphasis on numbers that are not adjusted for other pesticide use when you have numbers that are adjusted for other pesticide use that you could be emphasizing instead?

THE COURT: I'm actually a little shocked that you say that because I didn't feel that I did that. And I feel very misunderstood if that's what you read.

Definitely, I want to look at adjusted estimates. I looked at adjusted estimates. But for the early studies, as I said, I would be just as worried about that sparse data bias which you throw everything in to the model. And sometimes with the multiply adjusted estimates, I'm a little worried about them putting things in there that they shouldn't be putting in there.

So if my critique came across as if I'm not -- I'm asking not to adjust for other pesticides, that's not what I meant. I just -- what I tried to convey is that even though we are generally having a knee-jerk reaction of, oh, just put everything into the model, that is probably the wrong approach. You have to think about which of the pesticides are risk factors, are associated with glyphosate. The number issue. Can I adjust without introducing bias? And all of that goes into my evaluation.

And, yes, if I'm able to adjust for as much as I want to, I definitely want to see those numbers, and I think that the De Roos paper did a really good job in that.

So if it came across like I didn't look at those, that's not what I intended.

THE COURT: If you were asked to look only at numbers that are adjusted for other pesticide use, and kind of assume for the sake of argument that numbers that are not adjusted for other pesticide use are not particularly useful, would that change your conclusion about glyphosate causing non-Hodgkin's lymphoma?

THE WITNESS: Actually, I did put a plot together where I just put the adjusted ones on. And I still have all of the estimates except for the AHS study on the right side of that graph, that one. Some of the confidence levels straddle the one or go across.

However, those are the plain numbers that I could extract where they did not do dose-response analyses, for example, or where they didn't exclude the occasional users.

So as a scientist, I want to put that into the perspective of what also happens if I try to exclude the occasional users and only use the heavy users or if I try to get at a dose-response like Ericksson actually did. And if I put all of that together, then, yes, I still believe that what I said is correct; that even after fully adjusting, or maybe even

over-adjusting in my book, I would see that there is a risk increase, except for the Andreotti study and the AHS.

THE COURT: But is that -- but the numbers become less stark when you adjust for other pesticide use. And so the question is, you know, you see an association, you query to what extent it's statistically significant; right?

THE WITNESS: Right.

THE COURT: Is that enough, you know, when -- if you combined it with the animal studies and the mechanistic data, is that enough to conclude that glyphosate is currently causing NHL in human beings?

THE WITNESS: Well, when I put it all together, it was enough. And I have done a lot of pesticide studies and I know what happens when you put a lot of pesticides in the same model. The estimates always shrink because farmers don't just use one agent; right? We wish we could do those studies. We really wish, but they don't exist.

So in human populations I just have to deal with the reality of what's out there. And sometimes, yes, they use two carcinogens. Sometimes one uses one and the other uses the other. And my -- my model can only do what it does. And I know what it does when I put two very highly colinear or collated variables into the same model. The estimates will shrink towards the one. That's just -- that's how it works. So that doesn't concern me too much.

What really concerns me is is there a systematic bias I can figure out that would explain all of these increased estimates, and that I did not see.

And the other thing I also didn't see was reversals of trends or, you know, something that all of a sudden didn't make sense anymore and jump around. The whole picture was still quite consistent.

THE COURT: I guess another way to get at this question is to put it in the context of the Bradford Hill analysis; right? And what we're talking about here is strength of association, I guess.

THE WITNESS: Right.

THE COURT: And as I understand, I don't remember whether you said this or other witnesses, but I -- I think everybody agreed that strength of association is a very important factor in the Bradford Hill analysis.

THE WITNESS: It is one criterium or one guideline.

THE COURT: And the -- and so -- sorry to interrupt, but so -- so it -- I mean, obviously -- I mean, I think in your report you already -- I can't remember what you said. I'll pull it up.

Let me get out of the Ericksson study here. One moment.

(Brief pause.)

THE COURT: You talk about the strength criterion in your report on Page 23, and you refer to it as having been

partially met and you describe a weak to moderate size association.

THE WITNESS: Yes, but that's for the ever/never. So the weak to moderate size is really the ever/never. And I consider that the worst analysis or the weakest analysis you can do.

So I -- I then continued to say that, you know, for the studies that actually looked at heavy exposure, you see odds ratios of 2 and 3, and that was what convinced me.

THE COURT: But those are -- those numbers that you are giving are numbers that were not adjusted for other pesticide use, correct?

THE WITNESS: That is correct.

THE COURT: And so my question is: How does -- you know, if you're being asked to place heavy emphasis on the numbers that are adjusted for pesticide use -- for other pesticide use, as opposed to the numbers that are not adjusted for other pesticide use, how does that affect your assessment of that -- that Bradford Hill criterion, the strength of association?

THE WITNESS: First of all, I think a 50 percent increase, we call it moderate, is actually quite a warning sign in occupational and environmental epidemiology because we know that we are underestimating due to exposure assessment issues all the time. So 50 percent is really a warning sign.

If I then go to the dose-response -- and, yes, I wish that some of them had been adjusting for other pesticides, but I can see how the estimates behave. And generally when we break up from ever/never into different categories, you can kind of see how these estimates become either unreasonable or if you would combine them, they would give you back the adjusted estimate. And that's how I assessed it.

And I -- I did not see anything totally unreasonable happening. It was as I, from what I know about data analysis -- and I've done a lot -- it was very reasonable and it was something that I would expect.

THE COURT: Can you talk to me a little more about how one sort -- sort of mechanically how you adjust for other pesticide use?

THE WITNESS: Yes. So there are two ways. One is you stratify, but that's -- or standardize. That's not what's done here.

What they -- what most of these analysts are doing is they use a regression model. So they use a regression model and they add these variables into the regression. So they are making assumptions about the association that these variables have with the outcome, and that is what we are usually calling adjustment, is adding these variables into the regression model.

THE COURT: Is there any issue with -- let's say --

let's take De Roos, for example. Is there any issue with how the adjustment for other pesticide use is done? I haven't -- I haven't seen any criticism of -- I haven't seen anything like that; right? Well, this study adjusted for other pesticide use, but they didn't do in it a --

THE WITNESS: In the proper way.

THE COURT: -- proper way.

I mean, the one thing I recall is your -- your discussion of adjusting for all 47 other pesticides. And maybe that's not particularly reliable, but other than that, I don't recall any criticism of any of the studies for the way in which they adjusted for other pesticide use. Is that an issue in the -- with these studies at all?

THE WITNESS: It is always an issue, how well you measure everything. And the better you measure covariates -- we call them covariates -- the higher your chance to actually adjust properly.

But, I mean, reality again hits you in the face. I mean, how many variables in how many different ways can you put in? And I think what they mostly did is say yes or no exposed or high or medium exposed. And that's how far it went.

Because even for glyphosate, that's mostly what they did; right? They used a ever/never. So most of these studies probably used ever/never for the covariate adjustments in the same way.

THE COURT: On the issue -- since you raised dose-response, on that issue, talking about the NAPP data, I -- I recall you -- I believe it was you who focused on the -- the numbers associated with people who used -- who exposed -- were exposed to glyphosate more than two days per year.

THE WITNESS: Correct.

THE COURT: And you referred to those folks as routine users.

THE WITNESS: Uh-huh.

THE COURT: And as I recall, the -- the odds ratio for people who were exposed to glyphosate more than two days per year was either statistically significant or barely not statistically significant, depending on which slides you're looking at; right?

THE WITNESS: Yeah.

THE COURT: But, in any event, noteworthy odds ratios.

THE WITNESS: Correct.

THE COURT: And then, if I recall, there was also a category of users, and it was people who -- who were exposed to glyphosate more than seven days in their lifetime? Do you recall that?

THE WITNESS: I think it was -- I think it was a multiplication of years and days. Could that be?

THE COURT: Yeah, that sounds right. I'm looking at

this -- I'm looking at -- here, maybe I'll hand you this. This is a chart. I don't remember who testified about it. I think you probably did. But it's Exhibit 1278.

Kristen, do you want to hand this down?

(Whereupon document was tendered to the witness.)

THE COURT: So I don't remember exactly where this came from, but this is the -- this is the chart that delineates between proxy and self-respondents; right?

THE WITNESS: Right.

THE COURT: And it has these different categories. And one of the categories is called Lifetime Days.

THE WITNESS: Right.

THE COURT: And they are looking at people -- people who had between zero and seven lifetime days of exposure and greater than seven.

So I wanted -- my question for you is, I guess, first, can you explain what this Lifetime Days category means?

And, second, can you explain why you think the previous category that we just discussed, greater than two days per year, is a more illuminating category than this one?

THE WITNESS: Right. So, actually, what you want to do is also look at duration, number of years. And you can see that there is absolutely no increase in the -- by duration, right, by those two categories, between zero and 3.5 years and then greater than 3.5 years.

And so I'm not surprised to see that the lifetime number of years times days per year, greater than seven, also show no great increase at all. And what that tells you when you then compare to it frequency of days per year, more than two, that this is about intensity and not duration of exposure.

So I've seen this before for silica, where you can where you can find lung cancers in silica-exposed workers for peak exposure per day in fibers, but you don't see it for duration of exposure or average or cumulative fibers over a lifetime.

In the silica we know it's a biologic principle that our lungs, the cilia of the bronchial system, can actually clear dust when it's not overwhelming them. So if you have fibers under a certain threshold, your lungs take care of it. If you overwhelm them, then, you know, you get inflammation and you get the process of cancer going.

And so what this suggests, we should really look at intensity of exposure and not at duration because it seems like your body can handle it if you get exposed here and there. It's actually nice to -- to look at. I mean, it's interesting to look at, but if you overwhelm your system, you use it day after day after day and the system has no way to recover, that's maybe where we should be looking.

THE COURT: What do we know about the range of days per year that this group covers?

THE WITNESS: All they are telling us here is more

than two.

THE COURT: But do we know -- I mean, looking at the data, do we know anything about --

THE WITNESS: They -- the NAPP study didn't tell us that. But we could ask the authors, yeah. They would have the data. It's not published yet and there is only a draft, a draft manuscript, and it's not explained.

THE COURT: This may be a weird question, but I want to give you a hypothetical.

So let's say you have four case-controlled studies. Take it out of the realm of glyphosate and NHL. Let's say you have four case-controlled studies. One of the things that is clear from all of the testimony we've heard in this case is that there are always going to be concerns, problems, potential problems with studies, case-controlled studies, cohort studies, epidemiological studies; always concerns about ways in which the studies might err or the numbers might be off; right?

THE WITNESS: Right.

THE COURT: Just hypothetically let's say you have four case-controlled studies and you have about the same level of confidence in their reliability; right? You have -- there are questions about all of them. There are concerns about all of them.

But let's say you think they are within the range of reliability and they are all about the same in that regard.

And two of the studies show a slightly statistically significant odds ratio, and two of them are close to the null. All right?

What do you -- what conclusion do you draw from that about -- I mean, is that -- will you -- do you conclude that we don't have enough information to know whether this particular substance causes this particular disease?

THE WITNESS: This is not how I look at studies, really. I -- I rarely would rank every study the same. And I really would want to look at dose-response patterns, at, you know, latency, at exposure assessment, at, you know, everything they did. And sometimes one well-done study can convince me that there is something, and nine other studies that didn't see something, I know exactly why they wouldn't see it. And then that one study makes me want to go out there and do more studies and, you know -- and show with additional studies. And I wish somebody had done that, but we don't often have second and third chances.

And then all we have to do is use the data that we have in front of us and say: Well, you know, are these weighing heavily enough in my scientific assessment together with the animal data, together with the mechanistic data, and I can wish as I want for better studies in humans. I won't get them, but I have to make a decision. And that's how I do it.

And, yes, I might be frustrated with the process. I often

are -- am, and wish I had better data. We all wish. My students always try to conclude at the end, and future studies should.

I say: There might not be a future study. Could you maybe conclude something from yours? They have a hard time doing that. It's amazing. Because we teach them so well to be skeptical. One thing we teach in epidemiology is to be really skeptical. And sometimes a bit too much because they then have a hard time concluding. But we have to, as -- you know, as public health people, we have to conclude something.

THE COURT: I think this is probably a relatively minor issue, but one of the issues that Monsanto brings up is the issue of publication bias. And they -- and as I understand it -- and maybe I'm not understanding it correctly, but as I understand the argument, you know, your study is more likely to be published if you show an association, and your study is less likely to be published if you don't -- if it doesn't show an association. Because people are more interested in reading about associations than non-associations.

Is -- do you think that that could be a concern in this case? And why or why not?

THE WITNESS: I really doubt it. Because I don't think -- especially the 1980s studies. They didn't go out there to investigate glyphosate. They were worried about farmers and what farmers were using. And they published no

matter what they saw. And they usually found at least one pesticide causing something; right?

So in this case when they find glyphosate, if they found another pesticide causing NHL, they would still put the glyphosate data in there. So we would have accrued a lot of null glyphosate results if that was the case and other pesticides were causing NHL. Because I get my study published whether it's MCPA, 2,4-D, malathion or glyphosate.

And I always tell my students: Well, you only get this chance, so please put all your data in there. And that's how we do it.

And we're actually asked by the reviewers as well. You know: Didn't you have these other pesticides? What's the result for them? Because they also know about publication bias.

So we say -- nowadays we can say, well, there is a lengthy appendix. We put all that data in the appendix, like we saw in Andreotti. So I wouldn't be as worried -- in the realm of pesticide research that I'm familiar with, I wouldn't be worried about that.

THE COURT: And then another sort of general question, what do we know about, you know, the association or lack of association between glyphosate and other types of cancer, and does that knowledge affect your view of the link between glyphosate and NHL?

THE WITNESS: It affects my view and so far, as I can exclude, recall bias.

And I think Dr. Weisenburger was one of the them who explained that very nicely; that if really all farmers believed that glyphosate was causing cancer, they would all report it for every cancer; right? So it relieves me of that worry.

On the other hand --

THE COURT: Tell me more about that. Remind me --

THE WITNESS: Of the discussion? Yeah. It was the first day, I know.

THE COURT: Background information behind what you just said.

THE WITNESS: Right. So if there is the general knowledge among farmers that they are handling a carcinogen, then no matter what the cancer is they will suspect that agent to have caused it.

And recall bias would be if the farmers would say: Ahh, I used a carcinogen. I know that -- my suspicion is it must be glyphosate because somebody told me it's a carcinogen; right? And the people who developed the cancer would, therefore, report it much more accurately or just recall it more than people who don't have cancer.

And that seems to not be the case, because if all the other cancers didn't show that result, it didn't -- it means that farmers, at least the farmers who developed other cancers,

didn't think that glyphosate was a carcinogen and, therefore, reported, it more heavily. So that -- that worry I don't have.

On the other hand --

THE COURT: So are these -- just a clarification question on that. Are these in the same studies that we have been talking about or are these in different case-controlled studies about other cancers?

THE WITNESS: Other cancers, but in the same areas. Like, for example, the same -- I mean, these researchers are not just interested in NHL; right? They do the -- I mean, the ALGA health study would not have been funded if they had looked at all cancers.

So these same authors, actually I know, have a lot of other case-controlled studies going on that they do in the same way for other cancers and they do them in the same regions for the same reasons. Because they are regions where farmers were using pesticide. So if I want to learn about pesticides, that's where I'm going; right?

And I do all of my cancer studies in those areas about the same time periods, about the same questionnaires; right? I use what I learned works, so I use it in all of my studies. And that's why I'm saying that.

THE COURT: And so --

THE WITNESS: But they are definitely different studies.

THE COURT: They are different studies. And so -- but what -- what people are saying, what farmers or the people who have these other cancers in these other studies are saying about their glyphosate exposure is not resulting in increased odds ratios for glyphosate and these other cancers, is that --

THE WITNESS: Correct. Absolutely right, yes.

THE COURT: Okay. And so the -- so is it right to say that the only utility of that information is that it causes you to be much less worried about recall bias in the NHL studies? I get the point.

THE WITNESS: Yeah, yeah.

THE COURT: I understand. And, in fact, I think Dr. Mucci eventually agreed that recall bias is not a real concern here with these case-controlled studies; right?

THE WITNESS: Correct.

THE COURT: So I get that point. But is that the only utility of these conclusions in these other studies --

THE WITNESS: Actually, there is another one, and that's specificity. And that's a Bradford Hill criteria.

So if we have an agent that causes all cancers, I'm much more suspicious. Of course, we know that smoking causes a lot of different cancers; right? And now we know -- we start to understand the biology of that as well. It causes cervical cancer and, you know, who would think so. But the biology is there.

But, actually, the fact that it causes one cancer and not all of the others --

THE COURT: The fact that there is an association between studies in cancer and not this one.

THE WITNESS: Right. So presumed causation in that -- from those studies. In that case I would say: Well, there must be something about the immune system and what we really need to do is study what is happening in a human immune system that's aging.

And, yeah, for me that's -- that's another specificity issue that these studies point to.

THE COURT: The rest of my questions I think are probably kind of less significant, but I'm going to ask them anyway since I have you here.

You talked about -- at one point in your testimony when you were last here you talked about collider bias. And I think you were discussing that in the context of the Ericksson study.

THE WITNESS: Right.

THE COURT: And I couldn't figure out when I was looking back over your testimony what collider bias is and what its significance may or may not be in this case.

THE WITNESS: It's just a fancy word for what we already described. What happens when you are excluding the other people, the people with other pesticide exposure from the control group. That's what we call a collider bias. And it

is --

THE COURT: Say that one more time.

THE WITNESS: It is exactly the -- we also call it selection bias, collider or selection bias. It is exactly what we did when we selected out from the control group the individuals with other pesticide exposure.

And why we call it "collider" is because we draw these nice little graphs and then two arrows go into one variable selection by that factor. That's all. And so these arrows collide on that variable. That's all. It's technical.

THE COURT: Okay.

(Brief pause.)

THE COURT: There was another part of your testimony that Monsanto criticized you for and I wanted to point to it and give you a chance to address it. And this is -- I don't know. You have your testimony there, yeah?

THE WITNESS: Yes.

THE COURT: This is on Page 27.

THE WITNESS: Is that the expert --

THE COURT: No, the --

THE WITNESS: Rebuttal?

THE COURT: Your testimony here in court.

THE WITNESS: In court.

THE COURT: Do you have that in your binder?

MR. WISNER: Yes. It says *"Daubert* Day One."

May I approach, Your Honor?

THE COURT: Sure.

(Whereupon document was shown to the witness.)

THE WITNESS: Got it.

THE COURT: Page 27?

THE WITNESS: Yes.

THE COURT: You were talking about adjusting for MCPA?

THE WITNESS: Yes.

THE COURT: And let me also go back -- take a second to go back over it, and I'm going to do the same.

I think you were saying here, and I may be wrong, and this is why I want -- wanted to give you a chance to address it. I think you may have been saying that it's -- it would not be a good idea to adjust for MCPA use, and you said that you didn't see any literature that told you that MCPA was truly an NHL risk factor.

THE WITNESS: Yes.

THE COURT: So it may be that I'm misstating your testimony, but Monsanto was criticizing you for saying that and so I thought I would ask you to address it.

THE WITNESS: Right. That brings back this issue of how do I select confounders. And confounders are -- first of all, have to be risk factors for the outcome. So I have to convince myself -- and they have to be strong risk factors for

the outcome. And then they have to be strong --

THE COURT: Sorry to interrupt, but I just want to ask one clarification question about that.

I'm not sure that I understand the concept that you need to know that something is a risk factor before you adjust for it.

I mean, I would think that you would -- if something is a possible risk factor or if there is a -- you know, if there is a reasonable -- if there is a reasonable possibility that this might be a risk factor, that we would just for it to see what happens.

THE WITNESS: That's the second point.

So we -- we don't always have the data. So, for example, we might have forgotten to ask about MCPA in my study; right? Could have happened. So that doesn't excuse me if it -- if it's truly known to be a risk factor.

And so the first thing that we teach is, you have to know the literature. Go to the literature and see whether anybody established risk factors for this disease. If they have, please plan your study accordingly and measure those; right?

But if we are not sure that something is a risk factor, then we have a second tool. And the second tool is I measure it and I look whether it's distributed between the exposed and non-exposed, the exposure of interest, in a way that is differential; meaning, everybody who is exposed to glyphosate

is also exposed to MCPA. Nobody who is not exposed to glyphosate is exposed to MCPA.

Then I have 100 percent colinearity. If I now put MCPA into my model, what happens is something that we formerly call -- or technically call splitting of the variants, because both predict -- both are predictors of each other; right? They are 100 percent correlated. So they must -- if one of them is truly a risk factor, the other one will be as well. It's the breath mint -- if we say breath mints are only taken by people who smoke, and I measure breath mint chewing and I measure smoking, both will explain NHL or lung cancer in this case.

So at that point my data doesn't help me anymore. So I have to go back and actually decide: Is that truly a risk factor and should I truly adjust for it, or is it just a breath mint? That's it.

And that's why, you know, we go back and forth. We play with our data and we test things in our data, our hypothesis. But we also need to put it back into the context of what we know about biology and what we know about other studies and what we know about the real world. And that's where we go back and forth and back and forth. And that's where this comment comes from.

THE COURT: But -- but you seem to -- seem to be saying in this testimony that -- and, again, it's quite possible that I'm misunderstanding it, but you seem to be

saying that it's not a good idea to adjust for MCPA use.

THE WITNESS: At least if you do it, be aware. And the aware is, you can say: Well, I wanted to be absolutely conservative. I believe MCPA is causing NHL, and all I want to do is estimate glyphosate adjusting for MCPA, but you have to then really say my assumption. You have to state that very clearly, is that MCPA is a true confounder. If I say that, then it means it's a true risk factor for NHL.

I'm not excused -- I'm not excused by my data because the data doesn't tell you the truth. The data just tells you there is a high colinearity. It does not help you distinguish between it being truly a risk or a cause for NHL or being just an indicator of glyphosate use. That is something we have to decide how we look at it.

However, when we put them both in the model and there's still an effect for glyphosate, then I would say: Hmm, okay. No matter what, even if MCPA is a true risk factor for NHL, it doesn't remove all of the effect of glyphosate.

THE COURT: But you adjust for the MCPA use?

THE WITNESS: Yes. Yes.

THE COURT: I guess maybe what I should ask you now is: Should one adjust for MCPA use in these studies?

THE WITNESS: I would try it and see what happens. And as long as the estimate that I get for glyphosate is then not going to one, I would still be concerned.

THE COURT: So were you saying -- I mean, if you want to take time to look at the transcript, you should feel free, but I thought you were saying here that one shouldn't -- that it was not a good idea to adjust for MCPA use, partly because you didn't see any literature that told you that MCPA was truly an NHL risk factor.

So if I'm misunderstanding your prior testimony, please take your time and look at it and tell me.

THE WITNESS: Yes. From what I know, I would think MCPA has not convincingly been shown to be an NHL risk factor. So if I go by my rules, I really shouldn't put it into the model.

However, if I want to be careful and say maybe we don't know enough about MCPA yet, then I would do what I just said, which is test it in my model and put it in and see what happens to the effect estimate for glyphosate. And if that is still -- but do it very consciously because I know what I'm doing. I'm putting two very highly colinear variables into the same model. So I expect both estimates to reduce towards the null. The MCPA one, if there is one, as well as glyphosate.

And that's actually what Ericksson showed. They had a MCPA estimate of 2.6, and I think it went to 1.8. And the glyphosate one went from 2.1 or something like that to 1.5.

THE COURT: But if you adjust for breath mint use, it shouldn't affect your number for cigarette use.

THE WITNESS: It will.

THE COURT: It will?

THE WITNESS: Yes.

THE COURT: There is something I'm missing.

THE WITNESS: It will. Absolutely.

THE COURT: Explain that to me.

THE WITNESS: So if you had a -- for heavy smokers, let's say, an odds ratio of 5 for lung cancer, and if truly everybody who smokes -- or 80 percent of the smokers also always use breath mints and maybe only 20 percent of the non-smokers do, because they have bad breath, then that high correlation with smoking guarantees you that the estimate for cigarettes will reduce to the -- towards the one. Because they are positively associated.

If -- if the breath mint was negatively associated, then something else would happen. But if they are positively associated, I can guarantee you that that 5 would end up being maybe a 2.5. And you would also see an odds ratio of about 2 or 2.5 for breath mints.

So both would kind of look like they are predictors of the outcome.

(Brief pause.)

THE COURT: Last topic, at least for metrics I think. I can't guarantee.

THE WITNESS: That's fine.

THE COURT: Non-differential exposure misclassification.

THE WITNESS: Good one.

THE COURT: So we have these AHS numbers, right, that sort of -- regardless of which sort of quartile exposure you're looking at, the numbers -- the odds ratio comes out in the eights, usually; right? .8 -- .83, .87, somewhere around there; right?

THE WITNESS: Right. Uh-huh.

THE COURT: And, you know, we have this statement that everybody intones that non-differential exposure misclassification will bias you towards the null; right?

In other words, if there is something else -- if there is an association or if there is causation, it's going to be concealed by non-differential exposure misclassification; right?

THE WITNESS: By making the exposed and unexposed more similar.

THE COURT: Right. And it's always going to -- what everybody intones is it's always going to bias you towards the null.

THE WITNESS: Correct.

THE COURT: And so the -- you know, one of the points Monsanto seems to be trying to make is that if you have the .87 number and you have non-differential exposure

misclassification, that's going to bias you towards one, and it's not going to -- it's not actually, like, concealing any true odds ratio that might be 1.5 or 1.7 or something like that. That -- that is a concept I think that primarily came up after you testified.

Is that something that you would like to address?

THE WITNESS: Yes. It's actually very important to understand. And I -- yeah, I thank you for bringing it up.

We are always taking biases out of context. And I teach it that way too. I'm guilty as -- as charged.

When I start teaching about biases, I start confounding, most important, exposure misclassification; really important, disease misclassification, et cetera, et cetera. And we are using examples to show how this works. And what I then in the end tell my students: But this only works this way as long as we assume no other biases. In the real world, that's a wrong assumption.

So while it is true that most of the time, in just about, you know, all examples you can -- but also theoretically, if you do the numbers, non-differential exposure misclassification biases towards the null. So you are getting something very close to the null. It wouldn't necessarily bring you on the other side of the null.

So if we are saying that, well, we are coming from the other side, we, first of all, have to assume that's actually

true. So we would be reducing the risk of NHL by exposing farmers to glyphosate. And under that scenario, we would move that the estimate closer to the one, but then the true one would be .6, .5; 50 percent reduction in NHL due to glyphosate use. I truly don't believe that.

What I believe is that more than one bias is actually happening here. First of all, there is also randomness, a little bit is randomness.

But, most importantly, we have an additional bias. And the additional bias comes probably from the way that they are comparing the AHS, the people with glyphosate exposure in categories to people that have never used glyphosate. That's one group that seems to be consistently used in Andreotti, but hasn't been used by De Roos.

When you look back at the De Roos 2005 study, she gives you the numbers for the people who never -- it's a smaller group, something like 9,000 people I think, who reported never using glyphosate. And then she has a low and a high exposure group. And when she does her comparisons, her dose-response, she actually compares to the lowest exposed group. She never compares to the never users. And that gave me an ah-ha, when I saw what she did. And I realized why she did it.

The only reason an investigator would do that is because they believe the counterfactual is not met; meaning, that the comparison group is truly giving you the rate you would see if

the others weren't exposed to glyphosate; meaning every other risk factor is the same in that group except for glyphosate use.

So these -- and actually that has been discussed in the AHS. The group who never used glyphosate had a lot of other characteristics that were different from the people who were using. And so my guess is there is residual confounding by other risk factors for NHL that they couldn't control for. And the only way to do that is what Anneclaire De Roos did, is by: Let's ignore the people who never used, and let's just look at the spectrum of users and use the lowest exposed group.

THE COURT: And that reminds me of another question I had, not about non-differential exposure misclassification, but about the De Roos study. And you -- you said that she was comparing low-dose users to higher-dose users. And what was her definition of lower dose and higher dose there?

THE WITNESS: Yeah. She used -- remember that I explained this very complex algorithm that Dosemeci came up with?

THE COURT: No. Sorry.

THE WITNESS: So what she did is -- or better, Dosemeci, who is a very, very good exposure assessor, he -- he used that one question that they ask farmers in the questionnaire about. After they asked them about 22 pesticides, they asked: How did you apply it? Did you use

personal protective equipment? Did you clean your clothes. When you used it, did you use a cab that was, you know, pressurized? Et cetera.

And that -- and then they constructed a very complex algorithm from that one variable to come to intensity of exposure. And they used that intensity to weigh the exposures, all of the exposures, the day of exposures that the farmers reported using. And from that they -- they categorized low and high exposure.

And that's really my problem with the study, is that this --

THE COURT: The study you're talking about --

THE WITNESS: Is the AHS.

THE COURT: -- is the AHS study.

THE WITNESS: Right.

THE COURT: Okay.

THE WITNESS: And so the problem I have with that is that they did not ask after every pesticide. They asked after 22, what did you do. So it was left to the farmer to decide on what pesticide to report or on what practice to report. And my guess was that they probably reported the most inclusive or the most average they did. They didn't necessarily report what they were doing for glyphosate.

And, therefore, by definition you would actually introduce a lot of misclassification by using this algorithm for a

pesticide that farmers at baseline in the '90s still didn't believe was very toxic.

So they probably reported their, you know, use of equipment, their use of washing -- their washing of hands and their suiting up and their whatever, repairing equipment for a lot of pesticides that were a lot more toxic than glyphosate.

So what they really did when they sprayed glyphosate, I don't know, but it was presumed it was the same as if they, you know, applied malathion or anything else.

THE COURT: Okay. Let's see. It's a little bit after 12:00. We can turn to your presentation or we can take a lunch break. Maybe would now be a good time to take a lunch break?

MS. FORGIE: That's fine.

MR. LASKER: If I could just ask, how long do we have Your Honor for today?

THE COURT: Til midnight if you want.

MR. LASKER: That's fine.

MS. WAGSTAFF: Do not say that.

THE COURT: Why don't we take a lunch break and we'll return at 1:00 o'clock?

MS. FORGIE: Thank you, your Honor.

THE WITNESS: Thank you.

THE CLERK: Court is in recess.

(Whereupon at 12:10 p.m. until 1:09 p.m. proceedings

were adjourned for noon recess.)

THE COURT: I mentioned we were available until midnight.

THE CLERK: One of us is.

THE COURT: I forgot to consult with Judge Petrou about this. She has to leave at 2:45.

JUDGE PETROU: I'm going to leave at 2:45, which is not an issue at all, because everything is being recorded. I will have an opportunity to do it. I wanted you to know I was on Court Call when the oral argument took place, so I did have an opportunity to hear that as well.

THE COURT: We don't have to stop at 2:45 p.m., but we will take a break at that time -- if we're still going, we will take a break around that time to let Judge Petrou go.

MS. FORGIE: Thank you, your Honor.

Dr. Ritz actually has a flight, too, that she has to catch. I'll try to be pretty fast and pretty limited.

THE COURT: I think you should take as much time as you think you need to flesh everything out.

MS. FORGIE: Thank you, your Honor.

MS. WAGSTAFF: I didn't know if Judge Petrou if any questions or not.

JUDGE PETROU: No.

DIRECT EXAMINATION

BY MS. FORGIE

Q. Dr. Ritz, the first think I wanted to do, please, is just clarify a couple of things that you were asked about.

One is, you keep mentioning, or at least I kept hearing you say, convince yourself, convince yourself. Can you explain what you mean by that?

A. Yeah. Since I am a teacher, and I just come out of teaching my big methods class at UCLA, it's actually some -- it's a teaching tool that I use to professionalize epidemiologists in the way that we are thinking critically about our subject matter. So it's really the method. So applying the method of epidemiology in a critical way to -- and come to a conclusion.

So convincing myself doesn't mean myself, but, you know, it means be critical. Look at all the evidence. Look at it from different angles. And when you're then convinced that the study is valuable, then come to a conclusion.

Q. Okay. Thank you.

And you were asked some questions about latency with regard to the 2003 De Roos study. Do you remember those questions?

A. Yes.

Q. And notwithstanding the relatively short latency in De Roos 2003 study, do you believe that the NHLs that were

observed with glyphosate use could, from a biologically plausible perspective, have been caused by exposure to glyphosate?

A. Yes, I do.

Q. Okay. And your concerns about latency in De Roos are -- apply equally to all the studies, even the so-called positive studies; is that correct?

A. Yes.

Q. Okay. And would you expect to see even stronger associations in De Roos 2003 if latency were longer?

A. I would guess, yes. I mean, when I say "guess," I mean, I would expect -- I would expect stronger effects.

Q. And can you explain why that is?

A. Because we are really harvesting the earliest cases in De Roos. And if we -- if we think that we did not hit the peak onset in terms of age, as well as timing of the exposures, then the longer we are waiting, the more we are actually inclusive in terms of the kind of cases that occur. So right now we are probably just seeing the tip of the iceberg.

Q. Okay. And I want to go back a little bit to some -- just some basics on confounding and adjustment and proper adjustment. So could you explain briefly what confounding actually means?

A. Right. So confounding is a principle in which we are first assessing whether a factor is a true risk factor for the

outcome. Because all true risk factors for the outcome, we have to consider if and only if they also are related to the exposure, meaning -- related means are these risk factors distributed in the same way in the exposed and non-exposed or are, for example, the unexposed exposed to everything else and the exposed only exposed to the factor I'm investigating. Clearly, if the unexposed are only exposed -- are exposed to everything else, then their risk would be higher due to all the other exposures.

And then I'm comparing exposed to exposed, right? So what I'm hoping to get is an equal distribution of all the other risk factors for the outcome among the exposed and non-exposed, but, really, only for the risk factors for the outcome that actually influence the risk of disease.

Q. Okay. And I'd like you to please --

MS. FORGIE: Mr. Wisner, could you please pull up a new exhibit --

A. I'm not seeing anything on this.

BY MS. FORGIE

Q. We're just pulling it up.

MS. FORGIE: Exhibit 460, please.

THE WITNESS: It's not up.

MS. FORGIE: It's up on ours.

MR. WISNER: May I approach, Your Honor?

THE COURT: Sure.

(Brief pause.)

MS. FORGIE: Would that be okay? We'll give her a hard copy?

THE COURT: Of course.

(Whereupon document was tendered to the witness.)

BY MS. FORGIE

Q. Turn to the chart.

A. Uh-huh.

(Witness complied.)

Q. Do you have it, Doctor?

A. Yes.

Q. Okay. Can you explain what is the difference between -- well, how do you define "properly adjusted"?

A. So properly adjusted means I'm identifying the actual confounders, meaning the risk factors for the outcome that also are associated with the exposure of interest. And then I'm -- I am putting those and only those in the model.

And I'm not putting proxies for the exposure in the model. I'm not putting intermediates in the model. I'm actually just putting true risk factors for the outcome in that are related to the exposure.

Q. Okay. And can you tell me what this chart on Exhibit 460, what it shows you and explain what is the top part, and then afterwards what is the bottom part please?

A. Right. So this is another plot, a visualization of data

in which we see on the -- on first the upper part the ever/never exposed, not adjusted for other pesticides. And below we have the ever/never exposed -- in addition -- I mean, the ones on the top are adjusted. They are not crude ratios. They are justed for age and sex and some of them medical history, et cetera, but the ones on the bottom are also adjusted for other pesticides.

Q. Okay. I'd like you to look at the -- let's talk about the Hardell study. Okay?

At one point --

THE COURT: I'm sorry. Could I ask a quick question? On this slide, where did this come from?

THE WITNESS: I made that.

THE COURT: You mean in anticipation of today?

THE WITNESS: Yes, yes.

THE COURT: Okay. Thank you.

MS. FORGIE: After so many questions from the *Daubert* hearing about adjusted and not adjusted.

THE COURT: Got it.

BY MS. FORGIE

Q. So with regard to the Hardell odds ratios, at one point is there a very high odds ratio in Hardell?

A. Yes, it's extremely high. You can see that the point estimate approaches 6. The confidence intervals are quite wide. They also straddle the one. And you can see from the

whole graph that this odds ratio seems like an outlier, and it truly is an outlier.

And the reason why that is is if you compare it to the not adjusted for other pesticides, you can see that that odds ratio was around 2.3. Also, wide confidence intervals.

But what happens now when you're putting all the other pesticides, and Hardell had a lot of other phenoxies, but also some others in there, into the model, exactly what I tried to explain at the beginning happens, and that is we have now sparse data bias.

So the fully or the most adjusted estimate is actually the wrong estimate, or better the improper adjusted estimate. We cannot adjust in Hardell for these other pesticides without introducing this kind of sparse data bias.

Q. Okay. Let me break it down a little bit slower for me, for a layman. You see this odds ratio that's almost 6; correct?

A. Right.

Q. And that was adjusted for other pesticides; is that correct?

A. That is correct.

Q. So can you explain -- and would you call this a fully adjusted for other pesticides odds ratio?

A. Absolutely, yes.

Q. Okay. And so can you explain how sometimes you add in

what might be confounding factors and then you take them out? And can you explain why you do that and how you make that decision?

And then after you do that in a general sense, we'll do it specifically with Hardell.

A. Yes. So -- so that was one way if you're not convinced or if you -- if you are thinking, well, maybe this pesticide also causes NHL, so I better take care of it. Right? I better adjust for it so that I get the true causal odds ratio for glyphosate after adjusting.

And in this case Hardell did that. They knew that phenoxyherbicides are suspected at the time. Now we know some of them are actually causing NHL. So we should be adjusting for pesticides. And then they throw all of these pesticides into the model. And what happens is what we call it explodes the model.

So the data was not sufficient to do this kind of adjustment. And you can see that it actually creates a bias away from the null. And this is very well known. It's called sparse data bias. And it's something I -- I warn my students against. You cannot just throw everything in a model and expect to know the truth or to -- you can't expect that that kind of fully adjustment is proper adjustment. It's really not.

Q. And, in fact, Dr. Rider agreed with you with regard to

this particular issue in terms of throwing in the kitchen sink and everything else for adjustment; is that correct?

A. That is correct.

Q. Okay. So in the --

MS. FORGIE: And can we just put up that one section up from Dr. Rider's deposition?

(Document displayed)

BY MS. FORGIE

Q. Is it -- you don't have a screen. Hold on. Let me get you a hard copy.

(Brief pause.)

MR. WISNER: Don't have a hard copy.

BY MS. FORGIE

Q. Okay. Well, in any event, you're familiar with the deposition testimony of Dr. Rider; correct? And you're aware after having read that deposition testimony that she agrees with your position on that; correct?

A. Yes.

Q. And, in fact, in Hardell, what happened was you put in -- you adjust for all these other pesticides. The odds ratio goes up very high; is that correct?

A. Correct.

Q. And then you make a determination as to whether or not you should leave in all those adjusting for pesticides or take it out; is that correct?

A. That is correct. Actually, when you read the Hardell study, you see that the univariate analysis, meaning where just one pesticide at a time is in the model, is represented in a table. This estimate of 5.8, you can find in the text, but the authors never refer to it again.

They do it because reviewers ask for it. They ask for a fully adjusted odds ratio, but they also interpret the univariate as the most reliable one.

Q. Okay. So in other words, it was fully adjusted for other pesticides. And then they removed those because of the reasons you just explained; correct?

A. Correct.

Q. So in that case -- in that sense Hardell actually is fully adjusted; correct?

A. Yes.

Q. It's just not referred to that way because they actually ended up taking out the pesticides after they determined it wasn't appropriate to throw in the kitchen sink; is that correct?

A. Right. Otherwise we would believe it's a six-fold risk increase; right?

Q. Right.

A. And they did not want to believe that. They said, well, 2.3 is -- is scary enough and it's probably the better model.

Q. And do you agree with the Hardell authors and co-authors

that it's appropriate -- that the almost 6 odds ratio is inappropriate and that it was appropriate to take out the pesticides; is that correct?

A. Absolutely.

Q. Okay. And then turning to the McDuffie study briefly, which is Exhibit No. 21. Can you please turn to that? I believe it's in your book. I'll wait until everyone gets there.

And I'd like you to turn to Page 1160, and looking at Tables 6 and 7.

A. Right.

Q. Are you there?

A. Yes.

Q. And you see the -- they are not really footnotes, but the explanations right in between the actual table and where it says Table 6 and Table 7. Do you see that?

A. Yes.

Q. Can you tell me what exactly they mean when they say -- for example on Table 7 it says:

"Among individual pesticides, carbaryl, lindane, DDT and malathion insecticides and captan fungicide user/nonuser were included in the initial multivariate model and found not to contribute significantly to the risk of NHL."

Do you see that?

A. Yes.

Q. Can you explain what that means and ultimately what they did in the McDuffie study in terms of the univariate model and removal of pesticides?

A. Yeah. What they do is describe the mechanics of fitting models. And in this case it's a regression model again. And so they are watching the estimates of the exposure of interest and then putting other pesticides into the same model. And they see all of these pesticides in the multivariate model are not significantly contributing to NHL, which then justifies removing them from the model.

So if they are not risk factors for NHL, then they are not -- then they are not subclassing one criterion for being actually a confounder, but they go beyond that. They don't just say: Oh, they are not confounders because in our models they are not predicting NHL. But they actually tested it out and that's what we usually do.

We first think about: Is it a risk factor? Is it related to the exposure? But then we go the next step and put a variable in. Put the pesticide in. If it doesn't change anything, we can take it out.

And then the appropriately adjusted model is the one without control for the other pesticide.

Q. So in that sense McDuffie, as it's ultimately published, isn't adjusted for other pesticides, but, in fact, it is

because they put it in and then took it out; is that correct?
A. That's correct.
Q. Would it be fair to say, for example, if you have other pesticides -- for example, malathion, just because that's one that was used in Table 7. If both the cases and the controls are using malathion -- which is often the case; correct, as they are farmers?
A. Correct.
Q. -- then it's fair to take it out because you know it's not affecting the outcome because they are both -- cases and controls are using it, just as an example; is that correct?
A. Actually, what -- what you're saying is that in my study it's not a risk factor for NHL, but more importantly, it is not related to glyphosate exposure.

So whether or not you're exposed to glyphosate, you may or may not be co-exposed to malathion, but not in a way that is different in terms of exposure. So the exposed to glyphosate and the exposed -- the unexposed to glyphosate may have malathion exposure, but kind of at a comparable rate.
Q. And so in that sense, McDuffie is also adjusted for other pesticides; is that correct?
A. Yeah, appropriately adjusted.
Q. And we've already talked about De Roos and that being adjusted; is that correct?
A. In the same manner.

Q. So McDuffie, Hardell, De Roos and NAPP are all adjusted for other pesticides; is that correct?

A. They all went through this procedure, yes.

Q. Okay. And then one of the things that was talked about a fair amount in the *Daubert* argument, which you weren't present for, but you actually read the transcript of that hearing; is that correct?

A. Yes.

Q. And there was some discussion in there about what you call a visual representation and what others have called the forest plot. Do you remember that discussion?

A. Yes.

Q. Okay. And, in fact, on Page 153 of your original deposition --

MS. FORGIE: Which I'd like you to pull up, please.

(Document displayed)

MR. LASKER: Just a second. Where is that?

THE WITNESS: The September one, right?

MS. FORGIE: Let me know when you've got it.

MR. LASKER: I'm asking where it is.

MS. FORGIE: Oh, 153 of the original.

MR. WISNER: It says "Deposition of September 17."

THE COURT: The depositions are not in the index.

MR. LASKER: What page?

MS. FORGIE: Oh, 153. It's okay. There's lot of

documents flying around.

THE COURT: So it's in the binder?

MS. FORGIE: Yes.

THE COURT: What tab is it?

THE WITNESS: Second tab.

MS. FORGIE: Exhibit --

MR. WISNER: It's not --

MS. FORGIE: Oh, it's not in there.

MR. WISNER: It just says "Depo."

MS. FORGIE: It's the first one, where it says --

MR. WISNER: No, second one.

MS. FORGIE: It says "Deposition September 17."

Everybody have it? Okay.

BY MS. FORGIE

Q. On Page 153 of the deposition, do you see where you were asked about whether or not it was a -- you were asked questions about the forest plot. And then on Line 4 through 6 can you read what you said there?

A. Yes. My answer was:

"ANSWER: You can call it a forest plot. I would just call it a visual representation of results from different studies."

Q. Okay. And can you explain -- I mean, that's just not semantics, calling it a visual representation versus calling it a forest plot; is that correct?

A. That is very much correct, yes.

Q. Okay. And can you explain -- let's start with first explaining what a forest plot is.

A. So technically we use forest plots in meta-analyses. And what meta-analyses strive to do is summarize estimates across studies. In order to be able to do that, we have to pull out of every study the odds ratios or rate ratios that are most similar to each other; meaning, the lowest common denominator odds ratio is being pulled out. So we're striving for similarity, right? We want the estimate that are most comparable.

In fact, a forest plot often on the side has something called a measure of heterogeneity that actually indicates how much these individual estimates differ from each other. And we hope that that's not statistically significant, because if they really are heterogeneous, we shouldn't be summarizing them. Okay?

And then at the bottom you see a summary estimate. And that is the one that summarizes all of these -- these individual study estimates with weights to one common estimate. And that's a meta-analytic tool that strives to represent the most common denominator you can pull out of studies. That's not what I did with my visual representation.

Q. Okay. Can you explain what was the purpose of your visual representation, please?

A. Yes. I actually used it as a reminder for myself to talk about the individual studies and estimates that I was taking from these studies as making points about the validity of the study.

For example, is the 5.8 a valid estimate or should I take the 2.3 instead from Hardell? And I wanted to remind myself that that's an issue. I wanted to remind myself that Lee actually distinguished between asthmatics and non-asthmatics and that both estimates are kind of the same.

I also wanted to show that individual studies that later were summarized by other studies showed estimates that were quite comparable to the study that then summarized these estimates, but used slightly different methods. Or better, if, in the smaller studies, you couldn't adjust for other pesticides, see what happens when De Roos actually summarized them into one study. She was able to adjust for other pesticides. She did it and the result was still positive and it was statistically significant and it was in the range, of course, of the other studies, but now it was fully adjusted.

Q. So would it be fair to say that the purpose of your visual representation was actually to remind you of some of the differences between the various studies and, also, some of the high points of the different studies?

A. Indeed.

Q. And was there anything else about your visual

representation that you were trying to assist yourself with in creating that graph?

A. I definitely didn't intend it to be a tool for a meta-analysis. It really was a tool to remind myself to talk about these different studies in a certain way, critical way, but also a way of comparing results against each other and reminding myself what I thought was most important about these studies.

Q. Is there any reason why -- it might have been simpler if you had just told everyone at the hearing that it wasn't a forest plot. Is there any reason you didn't tell us that at the time?

A. Well, it wasn't my first time and I was told to just answer questions. And I thought that a memory tool would not make such a big splash.

Q. Anything else?

A. That's it.

THE COURT: So when you called it a forest plot in your expert report, you made a mistake?

THE WITNESS: I used that word and I might not -- I should probably not have used it. It was really a -- did I call it a forest plot? Then, yeah, that was a mistake.

THE COURT: Okay.

MS. FORGIE: Go ahead.

THE COURT: Okay.

BY MS. FORGIE

Q. So then a couple other questions from your earlier testimony today.

You were asked questions about ever/never use in some of the studies and heavy exposure, particularly with regard to the De Roos study. Do you remember that?

Let me see if I can rephrase it. You look confused. Let's turn to Page 23 of your expert report.

A. Where is it? Oh, my expert report, yes.

Q. Which I believe is --

MR. WISNER: Exhibit 1.

BY MS. FORGIE

Q. -- Exhibit 1 in your book.

A. Yes.

Q. On Page 23 you mention that it's a weak to moderate association with regard to ever/never use. Do you remember -- oh, I'll wait till you find it.

A. 23. Yes, I see it.

Q. Okay. And you mention there that it's a weak to moderate association for ever/never use with regard to De Roos; is that correct?

A. Yes.

Q. Okay. And when you look at odds ratios for more heavy exposure, what do you find there?

A. Well, we see that whenever I get rid of the occasional

users and are able to look at data that actually distinguishes occasional and heavy users, the odds ratios behave in the way that you would expect if there was a causal association; meaning, that the heavier users are showing the effect, which is generally above 2, while the occasional users don't or show less effect.

Q. Okay. And I think you were asked earlier whether or not those adjusted -- I mean, whether or not those numbers, those odds ratios, for example, in the De Roos study were adjusted or not. And I think you said that they weren't adjusted, but let me -- let's just clear that up.

With regard to De Roos, are the numbers adjusted for other pesticides?

A. De Roos 2003, yes, they are adjusted.

Q. And as we just discussed, the same is true for McDuffie, Ericksson and Hardell; is that correct?

A. That's correct.

THE COURT: Yeah, but -- if I could just follow up on that. That sentence that says:

"However, the effect estimates for longer or more extensive use in several studies were larger, i.e., between 2 and 3, and this can be considered a stronger endorsement of a causal relation."

You told me that that -- those numbers were not adjusted for pesticide use. Did you misspeak?

THE WITNESS: The Hardell one, as far as I know, is not adjusted.

THE COURT: Let me ask --

THE WITNESS: But the De Roos one is.

THE COURT: Let me ask the question this way. When you wrote that sentence -- or when that sentence was written, was it -- what were -- what is the -- what are those numbers referring to? "The several studies being larger, i.e., between 2 and 3."

THE WITNESS: McDuffie and Hardell and De Roos. And NAPP, actually.

THE COURT: Okay. So -- and which of those numbers are -- that are between 2 and 3 are adjusted for other pesticide use?

THE WITNESS: So in the sense that McDuffie actually tried to adjust and found that, you know, it didn't matter, we can consider that the most appropriately adjusted estimate. De Roos is definitely an appropriately adjusted estimate.

THE COURT: But where is the number from De Roos that's between 2 and 3?

THE WITNESS: Which De Roos -- we are talking 2003?

THE COURT: Yeah.

THE WITNESS: Can we look at it?

THE COURT: Sure. What exhibit is it?

MS. FORGIE: It's 21 -- no, no, no. It's 15. Sorry.

(Brief pause.)

A. I have the De Roos wrong. It's the 2005. But that's not -- that's not appropriate.

BY MS. FORGIE

Q. And -- well, I'll wait until your -- let me know when you're finished, please.

(Brief pause.)

A. So the adjusted one in De Roos is actually the overall one.

Q. And do you -- can you give us a reference of the page and number, please?

A. It is on Page 5.

Q. And then also with regard to the NAPP --

THE COURT: Wait. Hold on.

MS. FORGIE: I'm sorry.

THE COURT: I'm trying to understand what we're looking at on Page 5 of De Roos.

MS. FORGIE: I'm sorry, Your Honor.

THE COURT: Where are you pointing us to?

THE WITNESS: Where are we? We're looking at glyphosate. That's a 2.1.

THE COURT: Okay.

THE WITNESS: With a 1.1 to 4 confidence interval in the logistic regression.

THE COURT: And you said that is the overall number?

THE WITNESS: Yes, that's the overall one, exactly.

THE COURT: Okay. And then where is the number for longer or more extensive use?

THE WITNESS: She did not do this. She just counted pesticides after that. So we do not have it for specific glyphosate. She just counts pesticides and she has all the potentially carcinogenic ones, and she explains in the text how she categorized those. And you can see that we get a very strong increase with the number of those pesticides.

So 25.9, I wouldn't believe that one. But it goes from 1.6 to 2.7 to 25.9. That's a dose-response, but it includes all of -- potentially carcinogenic pesticides, which she defines in her text. That was her attempt at getting at dosage. But it wasn't specific to glyphosate. But the one that's specific to glyphosate is a 2.1, and it's fully adjusted.

THE COURT: Okay. And then the ones -- so this sentence:

"However, the effect estimates for longer or more extensive use in several studies were larger."

THE WITNESS: That is McDuffie and Ericksson and the NAPP.

THE COURT: Okay. And so -- and those are -- just to make clear, are those numbers that you are referring to adjusted for use of other pesticides?

THE WITNESS: As we discussed before, that was actually -- they tried these pesticides in the models and then took them out again.

So I consider that appropriate, but they didn't do what De Roos did in her ever/never analysis, which is keep them all in there. De Roos could do it because she had enough data to do it, and that's why she did it.

THE COURT: And which were the -- for McDuffie, which were the pesticides that they -- the other pesticides that they looked at? Did they look at --

THE WITNESS: Malathion, DDT. Yeah, they list them in that table, 6 and 7.

THE COURT: And what about, like, 2,4-D and dicamba?

THE WITNESS: Let's look. Where is it? They list them.

MS. FORGIE: It's Page 1160.

THE COURT: Which tab is --

MS. FORGIE: I'm getting it right now.

THE WITNESS: They actually did two different things --

MS. FORGIE: Hold on. It's -- let's get there. It's Exhibit 21, Your Honor.

THE WITNESS: In Table 6 they use phenoxyherbicides --

BY MS. FORGIE

Q. Hold on. Let's make sure everybody is there.

A. They use phenoxyherbicides as a group. So they say any of these. Or carbamates as a group. Or organophosphate insecticides as a group. Fungicides as a group. And then also, added carbon tetrachloride.

And then in Table 7 they say they also tried this kind of adjustment with individual pesticides. So not just doing groups, but then using carbaryl, lindane, DDT, malathion, captan.

Q. On 2,4-D is an phenoxyherbicide; correct?

A. It's an phenoxyherbicide. So it's under that group.

Q. Correct. Because I think the judge was asking about that one.

THE COURT: Okay.

BY MS. FORGIE

Q. And then, Doctor, just to be clear, you believed to a reasonable degree of scientific certain that the epidemiology as a whole provides evidence that glyphosate exposure causes non-Hodgkin's lymphoma even based on the numbers that are fully adjusted to exposures to other pesticides; is that correct?

A. Yes.

Q. Okay. And then to be clear, I think -- I think we covered that, but the NAPP study is also fully adjusted and -- is that correct?

A. That is correct.

Q. Okay.

A. That's why they pooled it. They wanted to be able to adjust.

Q. Exactly. Okay. And then, Doctor, I would like you to -- I want to show you some things about your testimony that were also discussed in the *Daubert* argument.

MS. FORGIE: So, Mr. Wisner, can you please pull up Page 20 from the transcript of the hearing? And the exhibit number for that -- oh, no. It's not an exhibit number.

THE WITNESS: Which one?

JUDGE PETROU: It is simply entitled *"Daubert* Argument."

MS. FORGIE: Thank you.

THE WITNESS: Got it.

BY MS. FORGIE

Q. And go to Page 20, please.

A. Yes.

Q. Okay. Let me know when you're there, please.

A. I'm there.

Q. Okay. In looking at Lines 9 through 21, talking about the Ericksson study. Do you see that?

A. Yes.

Q. And do you see where Mr. Lasker says:

"And everyone, at least in this record, including

IARC, including plaintiff's other experts, you asked Dr. Weisenburger about this at Page 181, 182. The study, itself, states that the analysis was cumulative days. Dr. Ritz -- and this is the first time she offered this opinion. I didn't have any -- she never offered this opinion before -- all of a sudden starts, argues that it's days per year. Again, this is minor. But there are various places in the testimony where she just sort of changes things. And I can point to others, sort of a litany of situations like that, where things all of a sudden just change a little bit, with no basis in the actual study language or in the data, and that can give one pause."

Do you see that?

A. Yes.

Q. Doctor, I'd like to have Mr. Wisner pull up your original deposition testimony, which is --

A. September?

MR. WISNER: September 2017.

BY MS. FORGIE

Q. It just says Ritz depo, 9-17-17. And I would like you to look at Page 340, please.

(Witness complied.)

A. I have it.

Q. Okay. Hold on. I'm getting there.

All right. And please look at --

MS. FORGIE: Is the Court there as well?

BY MS. FORGIE

Q. All right. Please look at Lines 9 through 19. And do you see where Mr. Lasker asked:

"QUESTION: The two data points we have from Ericksson, it was ten days -- more than ten days or less than ten days; correct?"

And then you answered:

"ANSWER: Yes, but I'm not sure that it was ten days per year or ten days cumulative."

And then Mr. Lasker asked you:

"QUESTION: Okay. I'll represent, and if I'm wrong, the Court will know and everybody will know that it was ten days cumulative?"

Do you see that?

A. Yes.

Q. Okay. And do you know whether the Ericksson study is ten days cumulative or ten days per year?

A. Ten days per year.

Q. And how do you know that?

A. Well, I went back to the study and looked at the statistics section, and where it talks about exposure assessment they say days per year.

Q. So Mr. Lasker's representation to you that the Ericksson

study was based on ten days cumulative is not correct, is it?

A. No.

Q. And then I'd like you to go back to the *Daubert* proceedings again and look again back to Page 20. The one we were just looking at.

Let me know when you're there.

A. Yes.

Q. On Line 9, again, Mr. Lasker says:

"And everyone, at least in this record, including IARC, including plaintiff's other experts, the study itself states the analysis was cumulative days."

Do you see that?

A. Yes.

Q. And is that representation correct?

A. No, it's not.

Q. And with regard to IARC, do you know -- are you familiar with what IARC says about Ericksson and whether it's cumulative or days per year?

A. Yes. It says days per year. There is clearly a table in IARC where they are specifying the methods. And in that table they clearly state days per year.

MS. FORGIE: Okay. Mr. Wisner, can you pull that table up, please?

And it is, I believe Exhibit 57. 57 in your books, Your Honor. And then Page 23, I believe.

BY MS. FORGIE

Q. Are you there, Doctor?

A. Yes, I am.

Q. And can you just identify for the record where the IARC states that it's ten days?

A. The first column is labeled exposure category or level. And it says one -- the less equal to ten days per year and greater than ten days per year in, like, the fifth or sixth line.

Q. Okay. And so, Dr. Ritz, just to be clear, was it ten days per year or ten days cumulative with regard to the Ericksson study?

A. According to the authors and according to IARC it's ten days per year.

Q. And you didn't testify anywhere that it was ten days cumulative with regard to the Ericksson study, did you?

A. No, no.

Q. Okay. Now, I'd also like you to look at something else again from the *Daubert* testimony. And -- or *Daubert* argument.

MS. FORGIE: And I'd like you, Mr. Wisner, to please pull up Page 45 of those proceedings.

And those are marked, so please let me know when everybody is there. Page 45 of the *Daubert* proceedings.

THE WITNESS: Oh, that's the argument.

MR. WISNER: That's correct.

BY MS. FORGIE

Q. That's correct. If you've got the *Daubert* argument, that's correct.

A. 45.

Q. Page 45.

A. Yes.

Q. Okay. And I'd like you to look, please, at Lines 4 through 15. Do you see that?

A. Yes.

Q. Or 5 through 15. It says:

"But the issue again is plaintiffs have the burden of proof here. And what Dr. Ritz is relying upon is something that she acknowledges is not likely as a basis for dismissing the Ag Health study, and not only that it's unlikely, but she then doesn't consider all of the validation studies, all of the sensitivity analyses. And, you know, in her deposition she said: I'd give it no weight whatsoever. And it's again -- that's not" --

And then the Court says:

"That's pretty -- I mean, to give weight to the Ericksson study and not to the AHS is pretty amazing."

Do you see that testimony, Doctor?

A. Yes, I do.

Q. Okay. Now, I would like you to look, please, at your

deposition, your original deposition --

MR. WISNER: January.

MS. FORGIE: I'm sorry, your January deposition.

Nice to have somebody that's on top of it.

BY MS. FORGIE

Q. On page -- hmm.

The January deposition was the deposition that was all about the Agricultural Health Study; correct?

A. Yes.

Q. Okay. Let me just find the page number here.

(Brief pause.)

MR. WISNER: Page 160.

MS. FORGIE: Hold on. I've got it.

I guess you beat me to it.

BY MS. FORGIE

Q. It's 160 through 162.

A. Yeah, I got it.

MS. WAGSTAFF: January 2018 deposition, first tab.

MR. WISNER: I believe it says "Depo January 2018" on the tab.

I apologize. This is so confusing.

(Brief pause.)

MS. FORGIE: Are you there?

MR. LASKER: Yeah.

MS. FORGIE: Okay.

BY MS. FORGIE

Q. So on Page 160 at the bottom, starting with Line 24, do you see where it says:

> **"QUESTION:** Okay. You were also asked a question about what weight you would give the AHS study, the 2018 AHS publication with regard to your opinions in this case? Do you remember that question?"
>
> And you answered:
>
> **"ANSWER:** Yes."
>
> And then you were asked:
>
> **"QUESTION:** Can you clarify or expand upon what weight exactly you would give the 2018 AHS study?"

Do you see that?

A. Yes.

Q. Because you had previously been asked questions about weight to give the AHS study, and this whole deposition was about the AHS study; is that correct?

A. Correct.

Q. Can you just read your answer please?

A. Yeah. So I said:

> **"ANSWER:** It definitely has to be reviewed, and it definitely needs to be considered. However, I tried to explain there is some weight to every study. Some studies have a larger weight than others. The way I determine that is by looking at the potential biases

that these studies may have as well as the size of the study and sensitivity analyses that do help me or don't helpful me to determine whether these biases have been taken care of. And overall I feel these sensitivity analyses done in this 2018 publication -- let's call it 2018 -- all make a lot of assumptions under which I wouldn't -- under which I wouldn't agree with. Each of the sensitivity analyses make another assumption that would only give you a piece of the puzzle. It never considers the whole realm of biases that you have to actually consider."

Q. Okay. So actually you did give some weight to the AHS study; is that correct?

A. Yes.

Q. And you still give some weight to the AHS study; is that correct?

A. Absolutely, yes.

Q. And then Mr. Lasker, as we just read on Page 45 of the *Daubert* argument, also stated that you didn't consider the -- all of the validation studies and all of the sensitivity analyses. Do you remember that section that I just read you?

A. Yes.

Q. Did you actually look at the validation studies?

A. Extensively.

Q. And just to refresh everybody's understanding, what are

the validation studies and what did you look at?

A. Well, I looked at Dr. Blair's study. That was the study where he repeated the questionnaire assessments in some of the participants.

I looked at lots of studies that I'm not sure conducted in the field with urine sampling. I looked at the Heltshe study. And I looked at Monsanto's own study of glyphosate, urine levels and questionnaire data.

Q. And on Page -- let me just find this.

Going to your original deposition, which is tabbed in your book. It's the first tab, where it says "Ritz Depo, January 18th, 2018."

A. Yes.

Q. Okay. Turning to Page 74, please.

MS. WAGSTAFF: That's not her original deposition.

MS. FORGIE: I'm sorry, you're right. It's the second one, second tab dated 9/17/17.

A. Got it.

BY MS. FORGIE

Q. Turning to Page 74, please.

A. Uh-huh.

Q. And you see Lines 16 through 22?

A. Yes.

Q. Do you see that? And can you just -- and you see where you talk about the sensitivity analyses in that; correct?

A. I might have the wrong one.

Q. Okay. It should be -- I'm sorry. That's my fault. Your original -- it's January 19th.

A. Yes.

Q. So it is the first tab, but I gave you the wrong date. I'm so sorry. So go to the first tab.

A. Yes.

Q. And go to Page 74?

A. Yeah, I got it.

Q. And look at Lines 16 through 22.

A. Uh-huh.

Q. Do you see that?

A. Uh-huh.

Q. And you said that this is discussed on Page 4 of the paper, a number of sensitivity analyses. Do you see that?

THE COURT: She didn't say that. That's Mr. Lasker's question.

MS. FORGIE: I'm sorry. I'm befuddled here. Let me rephrase this.

"QUESTION: Now the investigators then -- and this is discussed on Page 4 of the paper -- do a number of sensitivity analyses. I want to walk through them and make sure we have a common understanding of what was done. So we'll mark this -- this is now 30-12."

Do you see that?

A. Yes, I do.

BY MS. FORGIE

Q. Okay. And so you talked about sensitivity analyses there, and later you talked about validation studies; is that correct?

A. That's correct. I actually remember Mr. Lasker having made these charts, where he explicitly walked with me through the different sensitivity analyses on the chart. And I think we also discussed it the first day I testified in court so you should have those charts.

Q. Okay. Can you explain briefly about validation, what you mean by validation reports and validation analysis?

A. Yes. So validation analysis is a sub-analysis in a larger study in which I try to assess how valid my exposure assessment has been. Of course this has to be taken with a grain of salt because I'm doing this in realtime now, but I'm trying to estimate exposures in the past.

So I'm trying to evaluate whether what I'm learning from field trials where I'm watching farmers applying pesticides and then go and collect their urine and make them fill out the same questionnaire that the AHS -- the Agricultural Health Study made them fill out, comparing the urine level with the self-reported use of protective equipment, use of equipment, et cetera and then say: Well, my algorithm of generating this exposure, this exposure measure is actually valid because I now have a golden standard, which is the urinalysis. And I watched

these farmers doing the applications.

However, I make a lot of assumptions when I do this kind of validation. I'm assuming that what the farmers did under observation on that day represents what they have done for the last 20 years or they reported to me. That's a large assumption to make.

Q. Okay. And then, finally, could you turn please to Exhibit 301.

(Witness complied.)

Q. And there is a section there at the bottom -- let me know when you're at 301.

A. Yes.

Q. And then at the bottom you see some numbers. MONGLY, do you see those?

A. MONGLY, yes.

Q. If you go to 494.

A. Yeah.

Q. Okay. Just a quick question. This is a presentation in the NAPP study; correct?

A. That's correct.

Q. And I just want to ask you: Does this show that for more than two days of use that the -- that this was adjusted for other pesticides?

A. Yes. Actually the odds ratio has a little star. And it refers to the footnote in which they actually say it was

adjusted for. And you can see that it was actually adjusted for a lot of different variables, including 2,4-D, dicamba and malathion.

Q. And what is the odds ratio?

A. The odds ratio --

Q. The adjusted odds ratio.

A. The odds ratio is 1.98 with a confidence interval 1.16 to 3.4, for the overall NHL.

MS. FORGIE: Okay. I don't have anything else, Your Honor.

(Brief pause.)

THE COURT: It's being suggested that we take a five-minute break to see if we can fix the witness's screen.

MR. LASKER: Thank you.

(Whereupon there was a recess in the proceedings from 2:03 p.m. until 2:08 p.m.)

CROSS EXAMINATION

BY MR. LASKER

Q. Good afternoon, Dr. Ritz.

MR. LASKER: Could we put up Exhibit 460 again? That was the exhibit that we showed which was the new --

MR. WISNER: Are you talking to me?

MR. LASKER: Yes. One of you.

MR. WISNER: I'm not set up.

MR. LASKER: Exhibit 46 is the new depiction of

forest plot.

MS. WAGSTAFF: Hold on. He has to turn it on.

MR. WISNER: I didn't know you needed my help.

(Brief pause.)

MR. WISNER: What page?

MR. LASKER: Second page. Thank you.

BY MR. LASKER

Q. And I just want to make sure that I understand what we're looking at here. You have depicted in this forest plot, first you have Hardell 1999 and you also have Hardell 2002; correct?

A. That's correct.

Q. And Hardell 1999 was pooled into Hardell 2002; correct?

A. Not that I -- Hardell -- it was -- wasn't it in Ericksson? No, no. 2002, yes. Right. Yes.

Q. So the Hardell data from 1999 is part of Hardell 2002; correct?

A. Yes.

Q. You also have listed here separately McDuffie and De Roos 2003. That data is pooled into NAPP; correct?

A. Part of that data.

Q. The -- you have the two versions of NAPP. You have the version from Canada and that was in June. And then you have the version from Brazil that was in August; correct?

A. Right.

Q. So you have both of those in there as well.

And you also have the first AHS study, De Roos 2005. And then you have the Andreotti 2018 study in there; correct?

A. That's correct.

Q. Okay. And so we went through this, a similar analysis of the prior visual aid that you had for us. But if we were to take out the -- the studies that are sub-studies of pooled analyses and only look at the pooled data and the most recent data, then we would have Hardell 2002, which only had eight cases, right?

A. Eight cases of what?

Q. Well, either non-Hodgkin's lymphoma or hairy cell leukemia; is that correct?

A. There were more than eight cases in Hardell 2002.

Q. Okay. Well, let's take this a little bit -- in terms --

A. That was, what was it, several hundred cases.

Q. I'm sorry, exposed to glyphosate.

A. I would have to look that up.

Q. Okay. If you want to do that, it's in your scientific binder.

THE COURT: You don't have the smaller binder there, Dr. Ritz?

MR. LASKER: They are right over there.

THE CLERK: You don't have another copy for the Law Clerk?

MR. LASKER: Oh, I'm sorry.

JUDGE PETROU: Counsel, since there is no index on this one, which exhibit number is it?

MR. LASKER: If we're doing the scientific binder, it's Tab 9.

(Whereupon binder was tendered to the witness.)

BY MR. LASKER

Q. And I can direct you if you want to Page 1044, that's Table 1, where it presents the glyphosate data. It's the fourth row on the table. Glyphosate number of exposed cases, eight.

A. Yes, the number of exposed cases and exposed controls is eight, too.

Q. Okay. All right. And then -- so going back to your plot here. Then we would also have the NAPP study as the most recent pooled analysis. We would have Andreotti 2018. We would have Orsi and we would have Ericksson; correct?

A. Yes.

Q. And you provided some testimony in response to questions from plaintiff's counsel about the Hardell study and the impact, the problem that that study had for -- in adjusting for exposures to other pesticides. You talked about sparse data. Do you recall that testimony?

A. Yes.

Q. And the Hardell 1999 study only had four exposed glyphosate cases with three controls; correct?

A. That's correct.
Q. And that was why there was a problem of sparse data, because the numbers were so, so small in that study; correct?
A. They were too small to adjust for these other pesticides, yes.
Q. And with our other studies, certainly with the NAPP, we have much other larger numbers of exposed cases and controls; correct?
A. That's why we pool, yes.
Q. Let me ask you a bit about -- about latency. And I want to -- you discussed a lot of this with Judge Chhabria so I don't want to repeat all of that discussion, but I would like to turn you to Page 25 of your expert report. And that is Tab 1 -- not in our science binder, but in our -- I think we're done with the science binder.

Tab 1 in the binder we provided you.

THE COURT: Page 25 of her original expert report?

MR. LASKER: That's it.

THE WITNESS: The big one?

BY MR. LASKER

Q. Not -- I'm sorry. It's going to be that one. I'm sorry.

(Whereupon binder was tendered to the witness.)

MR. WISNER: Your Honor, can I approach to get the big one off --

THE COURT: Feel free. You don't need to ask

permission.

(Brief pause.)

BY MR. LASKER

Q. Are you in Tab 1?

A. Uh-huh.

Q. So Page 21.

And the very -- right before the final paragraph in your report, the last sentence in the first paragraph of your conclusion, you state:

> "Studies that assess those also generally found a higher level of exposure associated with increased risk, and importantly in the one study that did assess the importance of having been exposed more than ten years prior to a diagnosis of cancer, the results clearly pointed to those exposures as the relevant one as compared to more recent exposures within ten years increasing the plausibility of associations greatly."

Correct?

A. Uh-huh.

Q. Do you see that?

A. Yes.

Q. And that's still your opinion today; correct?

A. It is one argument, yes, for plausibility.

Q. And that is your opinion today; correct?

A. I don't understand.

Q. You stated that it's one argument. I just want to make sure that that's still your opinion today.

THE COURT: What is still the opinion? The sentence that is written in that -- in that -- that you just read? Is that what you're asking?

MR. LASKER: Yeah. The sentence that says that exposures -- that the findings -- I assume you're referring to the Ericksson study here; correct?

A. I would have to read through this to make sure.

BY MR. LASKER

Q. Okay. Well, let me just ask this question, and if you can't answer it, we can move on.

But is it your opinion that the exposures that took place more than ten years prior to the diagnosis of cancer as compared to more recent exposures are the relevant ones?

A. This is taken out of context. I'm making an argument for validity across studies looking at them in different ways. In one of the ways is to look at the recency or non-recency of exposure.

Q. Okay. And with regard to the De Roos study, and I -- I think -- I asked you this question in your deposition and I think you gave a similar answer, but I want to just confirm.

Is one of your -- one of the issues that you believe may be at play in the De Roos study the fact that the individuals who were the first users of glyphosate may have been heavier

users of glyphosate?

A. Are you referring to what I said today?

Q. Well, I'm asking you -- we can go to your deposition, because I asked you that in your deposition; do you recall?

A. No, I don't.

Q. Okay. So then let's go to your deposition. It's Tab 2. It's Page 209, Line 9 through Page 210 -- Page 210, Line 6.

And for context, and you can read before and after, we're talking during this part of the deposition about the De Roos 2003 study and the issue of latency.

And you can read the question and answer yourself, but as I understand it, and correct me if I'm wrong, one of the arguments you were making was that the latency might not be an issue because the early users of glyphosate may have been using it more heavily.

Am I understanding that correctly? Or if I'm not, maybe I misunderstood this.

A. Well, that would be one argument you might want to make. However, as I said this morning --

THE COURT: Well, let's -- if I can direct you?

THE WITNESS: Yeah.

THE COURT: Maybe we can just take a little time to look at the deposition testimony.

And I think Mr. Lasker is first trying to establish that you were testifying to a certain point; that you made a certain

point in your deposition and he is characterizing the point that you -- that he says you were making.

But I want you to look at it, and you should agree or disagree with him about what point you were making in the deposition.

THE WITNESS: So which page would you like me to --

BY MR. LASKER

Q. Again, we're on 209 Line 9 through 210, Line 6. And my question -- I guess my first question --

THE COURT: Why don't you let her read through it and then you can ask the question?

MR. LASKER: Okay.

(Brief pause.)

A. Okay.

BY MR. LASKER

Q. And my question to you is: Am I understanding, at least your testimony at your deposition correctly, that one of the issues you raised with respect to latency and the De Roos 2003 study was that the individuals in that study who first used glyphosate may have been heavy users of glyphosate and, therefore, latency would not be as much of a problem?

A. That's not what this is about. It's not about De Roos.

This is about one study or two studies that had cases in the very early -- end '79 and early '80s, and when I read through this, I mean, that's what you have been asking me

about, to talk about the latency with respect to 1974 or '-5 out to the studies that looked at cases in 1979 through '86. Right?

But De Roos actually included a lot -- included all of them and had, therefore, a median latency that was much longer, on average.

So it was just not five years, is that what you're saying?

Q. No. We may be miscommunicating.

My question was -- and I think we've already established what years the NHL diagnosis were in De Roos 2003.

My question is: Is it your testimony or is it your opinion -- and we can ask it now. If it's not, we will move on.

Is it your opinion that the issue of latency in those North American studies might not be a problem because the early users of glyphosate were very heavy users of glyphosate?

A. Actually, I'm saying in my testimony here it might be the case, but I don't know. I did not investigate that.

JUDGE PETROU: Counsel -- finish your answer and then I'd like to jump in.

THE WITNESS: What was that? Sorry.

Yeah, yeah. I had proposed that that could be a possibility. However, I said here clearly I don't know. I did not investigate that.

JUDGE PETROU: All right. So this morning you were

answering some questions along the same lines, and I thought we had established that you, in fact, said that the cases that showed input that 6- to 11-year time period after 1975 were due most likely to either heavy use --

THE WITNESS: Yes.

JUDGE PETROU: -- and/or use without adequate safety precautions; is that correct?

THE WITNESS: Yes. Those were two hypotheses that we can have.

And the third one was that it was really in a vulnerable period of their life because these individuals, of course, got their NHL in their 60s. So they were clearly exposed at a later age.

JUDGE PETROU: And did you also have another theory that was not discussed this morning, but which I seem to see here in the deposition transcript around Page 208, that there were users, potentially, of glyphosate prior to it being approved?

THE WITNESS: Correct, yes.

JUDGE PETROU: So you have four different theories?

THE WITNESS: Yes.

JUDGE PETROU: And am I correct that we don't actually have evidence as to these four different theories. We don't know, was it heavy usage? Were they not using safety equipment? Were they using it pre-approval?

THE WITNESS: Correct. We don't know this. However, we see increases in risk. So some of this must be the case.

JUDGE PETROU: Okay. So of the four theories, the one that we have some actual concrete information about, has to do with the age at time of exposure.

THE WITNESS: That's correct.

JUDGE PETROU: All right. Thank you.

BY MR. LASKER

Q. And with respect to the level of use during that time period in the early years, in your rebuttal expert report you actually did address that question about when there was heavy use of glyphosate during -- over the time period that glyphosate has been approved. Do you recall that in your expert report?

A. Would you mind showing me?

Q. Sure. It's Tab 8. It's your rebuttal report at Page 3.

A. Yes.

Q. And if you can look about seven lines from the top, you talk about the usage of glyphosate during these first 13 years of approval; correct?

A. Yes.

Q. And you talk about the fact that during that period there was only about 6 to 8 million pounds applied by farmers and ranchers as of 1987; correct?

A. That's correct.

Q. And you note that during those first 13 years, glyphosate was approved only for -- well, glyphosate was only used to kill weeds before planting of crops or spraying for weed control in pastures and non-crop areas; correct?

A. That's correct.

Q. And that's because this was prior to the adoption, development of Roundup Ready crops; correct?

A. That's correct.

Q. And you make the point that the usage of glyphosate actually became far greater in later years after the approval of Roundup Ready crops; correct?

A. Yes. And I mean it's reflected in all of the studies. The exposure problems and controls was about 5 percent or less in the early years, and it was 85 percent and more in the AHS.

Q. Okay. And with respect to the De Roos 2003 study and these early North American case-controlled studies, these were population-based studies; correct?

A. Yes, population-based case-controlled studies.

Q. So as people came into the hospital and they had NHL, they would identify them and they would then become the cases in the study; correct?

A. No, that's not exactly how they do it. They actually have cancer registries and they use the cancer registries. It's not hospital based.

Q. Unlike the AHS study, though, this is not a study limited

to farmers. It is a population-based study; correct?

A. It is a population-based study in areas that were heavily farming. So if you go to Cantor, you actually see the 60 percent of these individuals were farmers.

Q. And when Judge Chhabria was asking you questions about other exposures, such as diesel or sun, with respect to these individuals, there have been studies and there have been studies in, for example, with the AHS, that found that farmers are at an increased risk of NHL because of -- or at least associated with diesel and sun and I think also certain types of farming; correct?

A. There are some diesel studies on farmers, but there are a lot more diesel studies on other types of workers that are part of a population-based study.

Q. And you would agree -- well, let me ask you if you agree.

Dr. Weisenburger testified last month that 70 percent of NHL cases have no known cause. Do you agree with that?

A. I wouldn't venture in that direction.

Q. Okay. Do you have an opinion one way or the other on that?

A. No.

Q. Let's talk about the Ericksson study. And if I'm -- I want to go back to this issue of days per year in the Ericksson study.

MR. LASKER: What tab is that, Grant?

MR. HOLLINGSWORTH: Tab 23.

BY MR. LASKER

Q. Tab 23. So it's the last tab. And -- I'll wait until you're there. I'm sorry.

(Brief pause.)

Q. Are you there?

A. Yeah.

Q. Okay. And you mentioned that the authors in the Statistical Analyses section of this paper state -- first of all -- well, they state that their exposure assessment is in days per year. Do you recall that testimony?

A. Yes.

Q. Can you point me to that statement in this study?

A. Under assessment of exposure, middle paragraph.

Q. Yes.

A. (As read):

"For all pesticides, not only number of years and number of days per year, but also maximum lengths of exposure per day was questioned."

Q. Okay. Is there anything necessarily in this study that you're relying upon in support of your view that the exposure assessment was in days per year?

A. IARC concluded that it was days per year.

Q. Okay. I'm ask in this study. Is there any other language anywhere in this publication that you rely upon for your

opinion that the analysis that's presented in the tables is in days per year?

A. This is what I relied upon.

Q. And all of the studies, I believe, that we have been talking about, including the NAPP, including the AHS studies, they all ask for information about exposure for a number of years and also days per year; correct?

A. You're saying all studies?

Q. All of the glyphosate studies that we're dealing with in this case.

A. No. Cantor didn't. And there were some others who didn't, who didn't specify this.

Q. How is it your understanding that cumulative days of exposure was calculated in the NAPP?

A. They did not calculate cumulative days.

Q. In the NAPP. Remember, we have seven days. We had the number of years --

A. That was number of years times days per -- days per year.

Q. Okay. And Cantor is pulled into the NAPP; correct?

A. But not for those analyses because they wouldn't have had the data.

Q. Is it your understanding that they don't have days per year of data in Cantor?

A. They only use those analyses for the studies where they must have had those numbers.

Q. Let me -- let me ask you to look at Tables 2 and Tables 4 in the Ericksson study.

A. Where is it?

Q. We're still in Ericksson.

A. Okay.

Q. And, again, this is a population-based study; correct?

A. Ericksson, yes.

Q. So there would be some farmers and some not farmers in this study; correct?

A. That's correct.

Q. Is it your understanding then that the median exposure in this study for this -- this population-based study for phenoxyacetic acids was 45 days per year?

A. It says 45 days.

Q. I understand. But this is the same table where we have glyphosate as ten days.

A. Right. But they don't specify so I wouldn't know.

Q. Okay. So you don't know if phenoxyacetic acids are days per year or cumulative days?

A. Well, all they give us here is days. It doesn't say cumulative.

Q. Okay. But for glyphosate, which is on the same table, that you believe is days per year?

A. Because I looked at IARC and in IARC it says more than ten days per year, and I imagine when IARC does an evaluation they

actually go back to the original authors and ask them.

Q. Do you have any information to -- upon which to -- you base that opinion --

A. No.

Q. -- that they went back and talked to the original authors?

A. I haven't talked to them.

Q. So you're relying upon IARC for your opinions in this case, at least with respect to the Ericksson study?

A. No. Just to clarify, there are two places where days per year are mentioned. One is in Ericksson itself and the other is in the IARC monograph.

Q. Let's talk some more about adjustments for the pesticides. And you testified earlier today that you relied upon, if I could understand you correctly, the adjusted odds ratios in reaching your expert opinion in this case; is that correct?

A. Yes.

Q. Okay. And when I asked you about this issue during your deposition, you testified that you -- you used the unadjusted odds ratios because you believed them to be the most valid data; correct?

A. Can I see that?

Q. Sure. If we could go to your original deposition. And this is Tab 10 in our binder, which is your September 18, 2017 deposition.

MR. HOLLINGSWORTH: Tab 2.

MR. LASKER: I'm sorry, Tab 2. My mistake. Thank you. It says that right there.

BY MR. LASKER

Q. And starting at Page 152, Line 24. This is starting -- just to give you context, this is where we're talking about your -- the slide that you presented in the last hearing with all of the different odds ratios. And we're walking through sort of like we did in your testimony in March.

And I would like to -- I want to just position you because I'm going to take you a little bit further in to Page 157, where we start talking about using adjusted versus unadjusted, but I wanted you to at least have a grounding of what we're talking about here. But I'm then going to ask you to turn to Page 157, starting at Line 20.

A. What did you want me to read now? 53?

Q. So at Page -- if you are situated at Page 157 at Line 20, we're talking about the Hardell study. Do you see that?

A. Yes.

Q. And my question is that you do not present the most adjusted, highly adjusted odds ratios reported by the authors in that study; correct?

A. It says, yes.

Q. And your answer was that you're presenting the odds ratio that you believe has the most validity given what they present in their paper; correct?

A. Yes.

Q. Okay. And just to put this in context, you mentioned that you have done research independent of this litigation where you've published your own studies looking at pesticides and certain cancers or other health outcomes; correct? You've done your own studies?

A. Yes, yes.

Q. In your own studies that you have published, you have presented -- when you've presented your odds ratios, you've presented odds ratios that were adjusted for exposure to other pesticides; correct?

A. We tried to adjust as much as we can, yes.

Q. Okay. So if I could take you, for example -- and this is at Tab 14 in your binder. This is a study that you published with Dr. Clary. And it is entitled "Pancreatic Cancer Mortality and Organochlorine Pesticide Exposure in California," correct?

A. Yes.

Q. And if you turn to Page 309, Table 3 --

A. Yes.

Q. -- you present your odds ratios; correct?

A. Yes.

Q. And there is a footnote on that table, on Page 310 --

A. Right.

Q. -- where you note that all of the odds ratios that you

present, and I think it's all the odds ratios that you present in your study, are adjusted for all 17 pesticides used in this study simultaneously; correct?

A. That's correct.

Q. And you do not present anywhere in your paper actually odds ratios that are not adjusted for exposure to other pesticides; correct?

A. They are not in this paper in the main -- I don't know. Was there a supplement? If not, then --

Q. Not that I'm aware of.

A. If not, then that's all we did.

Q. And you adjusted these odds ratios for other pesticides despite the fact that you did not know whether these other pesticides were, in fact, risk factors for pancreatic cancer; correct?

A. We actually have 640 different pesticides to choose from. We chose 17 because they were considered due to the literature as carcinogenic in some way. And this was an exploratory study. This was not a confirmative study so we wanted to use all possible carcinogens and test them out, and that's what we did.

Q. Okay. And we heard about exploratory studies and -- in connection with Dr. Neugut's testimony last month.

But just so I'm clear, is it your testimony that we know that every other pesticide in this study causes pancreatic

cancer?

A. We don't know this. I said we had 640 agents to choose from and we chose most used -- okay. There might be a carcinogen where only one case or two cases are exposed. I have no way to estimate that odds ratio in a study like this. So we made two distinctions.

We first said what is out there in any study, because this is exploratory. This is not a confirmative study, right? This is hypothesis generating.

So what we're doing is we say we have all this data. We cannot put 640 agents into the model. That won't work. And it won't make any sense to do that. So what we're doing is we are looking at all the literature that suggests that a pesticide might be a carcinogen, and then we're putting those in the model, yes.

Q. Let me ask you to turn to Tab 16. And this is a more recent publication of yours from 2014 entitled "The Association Between Ambient Exposure to Organophosphates and Parkinson's Disease Risk;" correct?

A. Yes.

Q. And if you could turn -- are you there?

A. Yes.

Q. If you could turn to Table 2, and it's at the back of this publication in the appendix. This is the author's manuscript so they put them at the end. It's Pages 16 and 17.

A. Yes.
Q. And here you are presenting your odds ratios for, again, the pesticides that you were looking at --
A. 16, 17?
Q. Yes. You have to -- oh, it goes past the --
A. Oh, pass it. Yeah. Yes.
Q. And for your analysis in this study, again, if you look at the footnote for all the odds ratios that you present in this study they are adjusted for exposure to other pesticides; correct?
A. Well, this is not pesticides, this is OPs. This is just in the class of organophosphate pesticides.
Q. I understand. The footnote, though, the bottom of the table, the asterisk, notes that all of the odds ratios are adjusted for other pesticides; correct?
A. Other pesticides in this table.
Q. Okay. And do we know that all these other pesticides cause Parkinson's disease?
A. We suspect since they are OP pesticides that all of them contribute in the same way because they have the same mechanism, yes. That was actually the part of this exercise, to see whether, you know, all of the OPs have that effect.

We actually showed in another publication that there is a gene environment interaction with OP pesticides. And we have also have methylation data and other data that show that all of

these OPs actually contribute.

Q. If I could take you back now to your testimony with regard to adjusting for the pesticides in this case. And we talked about -- we were talking about your testimony with regard to the Hardell. So if I could take you back again to Tab 2. And this is your September 2017 deposition.

A. I would like to point out these had hundreds of cases exposed, and this is a heavily exposed population in the Central Valley where 60 percent of all cases are actually exposed.

Q. So are you back in your September 2017 deposition, Page 158?

A. Yes.

Q. And at Lines 7 through 21, I asked you about your use of the unadjusted odds ratios from the NAPP. And, again, you explain that you were presenting what you believed to be the most valid model, and that that does not necessarily mean the most fully adjusted model; correct?

A. Yes. Not necessarily.

Q. And then continuing on, at Page 158, Line 23 through Page 159, Line 9, you explain that while IARC had concluded -- or we're discussing about the fact that IARC had concluded that it should look at the most highly adjusted odds ratios in these epidemiologic studies, that was based off their criteria not yours; correct?

A. That's correct.

Q. And then if we continue at 159, Line 11 through 160, Line 2, you testified that you did not consider what IARC had done, which was look at the most adjusted odds ratios as being the most valid approach; correct?

A. Not necessarily. And I think I explained that multiple times, that you can actually create bias by throwing too many pesticides in a model that can't take it.

Q. And we also talked in your deposition, your first deposition about the NAPP, and you testified then that you had validity concerns about the NAPP analysis that adjusted for dicamba, malathion and 2,4-D; correct?

A. Well, indeed, you could argue whether all three should be in the same model. Not because they are or aren't carcinogens, but because you have multi-colinearity and you want to examine what happens when you put even four pesticides that are highly correlated into the same model.

It's different from the analyses that I did in my population because my population wasn't farm workers. It was home and ambient exposure. So the correlations aren't as strong as in farmers.

Q. And, Dr. Ritz, in your initial expert report when you presented data from the NAPP and from Ericksson, from Hardell, you did not mention in your expert report anywhere any of the adjusted odds ratios; correct?

A. Oh, I would -- I would doubt that. That's -- that can't be.

Q. Okay. Well, let's take a look.

Let's go to your expert report. It's Tab 1. And we can start at Page 15 to 16. And this is your discussion of the NAPP data; correct?

A. Yes.

Q. And here you are talking about the June data not the August data; correct?

A. Yes, but this was actually before I had been presented with these tables (indicating).

Q. Okay. So you can -- you'll agree that none of the data that you provided for the NAPP in your initial expert report are adjusted for other pesticides; correct?

A. Let's see. I would have to compare that. So does it quote 2.12?

It's different numbers. Oh, yeah. We have multiple versions. It's different numbers, so I can't confirm that right now.

Q. You don't know one way or the other?

A. I can't confirm that these numbers are from the adjusted or unadjusted. I have to look back at the document.

Q. Let's look at Ericksson. Page 17 of your initial expert report.

A. Yes.

Q. You represent a number of odds ratios in -- on that page for Ericksson; correct?
A. Yes.
Q. And we know that the multivariate adjusted odds ratio is 1.51 for Ericksson; correct?
A. That's what he represented in that model, yes.
Q. And you present in your expert report, I believe it is every odds ratio in the Ericksson study for glyphosate except for that 1.51 number; correct?
A. I'm talking here about subgroups, and I'm making the argument about the subtypes of NHL. And he never -- he never adjusted for any of the pesticides, other pesticides in these subgroup analyses. So on Page 17 you can see that.
Q. I'm sorry, Dr. Ritz, if you look a little bit higher on the page you have about, halfway through the first paragraph:

"Ericksson reported a two-fold increase in NHL risk with glyphosate exposure. OR equals 2.02."

Correct?
A. Yes.
Q. That's the unadjusted ever/never odds ratio; correct?
A. Yes.
Q. And you do not report anywhere on this page or in this expert report or in any of your expert reports the 1.51 odds ratio that was adjusted for other pesticides; correct?
A. This comparison is made, because I then go on saying:

"There's evidence for a dose-response, and that more than ten days use has that dose-response."

And I wanted to make those estimates be comparable.

Q. Okay.

A. So you cannot compare 1.53 multiple adjusted that even Ericksson says is probably the wrong way. And you can read the conclusions of Ericksson. It actually says we have multi-colinearity. We shouldn't be adjusting for MCPA and glyphosate at the same time. So they actually recommended to use this odds ratio.

Plus, you cannot compare two differently adjusted odds ratios when you're comparing an ever/never to a dose-response.

So the -- the exercise here I'm making is actually doing exactly that, comparing apples to apples and not to oranges.

Q. Okay. I'll ask it one more time and we can move on.

Do you ever in any of your expert reports in this litigation mention the 1.51 adjusted odds ratio for Ericksson?

A. For Ericksson? I don't know.

Q. Okay.

A. I have to look it up. But I definitely have De Roos in there.

Q. Okay. We're going to talk about De Roos in a second.

But let's talk about the Hardell study, and this is the Hardell study that was two -- two studies that was pooled into a larger study --

A. Yes.
Q. -- that had a multivariate analysis when the data was pooled. You report the 3.04 odds ratio that was statistically significant in the pooled data. And that's at the top of Page 18.
A. Right.
Q. Do you see that?
A. Yes.
Q. There was a multivariate odds ratio in that study that was somewhere around 1.6 or so that was not statistically significant. You put it up earlier today. You don't include that anywhere in your expert report; correct?
A. Again, I am comparing it to an earlier report. And, again, if you want to make those comparisons, you have to use the same kind of estimates.
Q. You mention -- I'm sorry.
A. If you read this it says, likely limitations, et cetera. And then I'm comparing these 3.04 and 3.1 estimates that are similarly adjusted.
Q. And -- skip over to the Cantor study, because you do mention -- you do talk about the Cantor study in your expert report; correct?
A. Yes.
Q. And the Cantor study actually adjusted for the pesticides in their analysis; correct?

A. I believe so.
Q. And if you look at your expert report, and I believe it's at Page 18 and 19, the Cantor study had a 1.1 odds ratio that was not statistically significant, correct, for glyphosate?
A. It's not stated here.
Q. Okay. Well, that was my point. You didn't mention the odds ratio -- the adjusted odds ratio for Cantor anywhere in your expert report; correct?
A. I don't mention any odds ratio because I refer to this study as being very preliminary, and then the Lee study as utilizing Cantor and the Nebraska data and actually doing proper analysis.
Q. And you talked about the McDuffie paper, and I want to go back to that because I -- I thought that we had discussed this previously. But for the glyphosate data in McDuffie, that -- and the odds ratios they present for glyphosate, that was not adjusted for exposures to other pesticides; correct?
A. Well, as we discussed here previously, they actually tried out adjustments and then decided what to adjust for and not. So after seeing that in their study, all these other pesticides did not predict NHL. They kept them out of the model. And they explain that in their -- in their discussion.
Q. Okay. Let's look at that. And this is --
MR. LASKER: What tab are we at? I'm sorry.
MR. HOLLINGSWORTH: 12.

BY MR. LASKER

Q. Tab 12. And -- I'm sorry.

At Page -- you were referring to Page 1160 in your testimony earlier today and the fact that they tried adjusting for other pesticides in these analyses; correct?

A. Well, what they are saying is they are using the groups, and then they are using individual pesticides and see whether or not they are actually associated with NHL to see whether in their data there is a risk increase due to these groups.

Q. What they are looking here at in Table 6 and Table 7 is whether exposure to those other pesticides impacted the odds ratios that are reported in that -- in those tables; correct?

A. No. What this footnote actually says is that they are putting these exposures into the model, and then they are looking -- and they are finding in these multivariate models that they do not contribute significantly to the risk of NHL.

So in multivariate models, these groups phenoxies, carbamates, organophosphates, as well as these individual pesticides, carbaryl, DDT, malathion, captan, are not contributing to NHL.

Q. If we look at Table 8, which is the next page where they present the data on glyphosate, they have a description at the top of that table with respect to the models they used in that analysis; correct?

A. Yes.

Q. They do not state in Table 8 where they present the data for glyphosate anything about other individual pesticides and a multivariate model; correct?

A. What they are saying is:

"Models that included the time variable 'days per year' and stratification for age and province of residence were also assessed for the individual herbicide compounds, bromoxynil 2,4-DB, diallate, MCPA, triallate and treflan. No significant associations were found."

So they tried these out in all of these analyses with days. And they found them not to be significant.

Q. Just to be clear, it's 2,4-DB.

And because of that they didn't present data in Table 8 with respect to those pesticides where they did not find associations; correct?

A. They did what?

Q. They did not report those individual herbicides that they mentioned at the top. What they did by association is they are explaining we did not put them in the table because we did not find associations; correct?

A. That is correct.

Q. There some nothing in Table 8 where the glyphosate data is presented that states that they did any adjustments for exposures to other pesticides; correct?

A. Well, in this table is glyphosate and -- in Table 8. And it has an unexposed group, a more than zero and less than two days per year use, and more than two days per use. And in those analyses they tried out these other pesticides. MCPA is one of them.

Q. And it's your understanding --

A. And it did not change anything according to what they say.

Q. Is your understanding that they did that? Because in Table 6 and Table 7 they say they did that, but in Table 8 they don't say they did that. Is that -- am I understanding your opinion here?

A. That's convoluted. I don't know.

Q. I agree with that.

A. Sorry.

Q. I'm trying to understand where in Table 8 -- and maybe it doesn't say it in Table 8, it says it somewhere else. But where in this study do you see that they adjusted the odds ratio for glyphosate in Table 8 for exposure to other pesticides?

A. Because it states:

> "Models that include the time variable days per year and stratification for age and province were also assessed for the individual herbicides compounds."

So that I read as meaning they put that in the model and it wasn't significant so we don't see it.

Q. And with respect to all the herbicides that are listed in this table then, 2,4-D, mecocrop, glyphosate, dicamba, malathion, going down the list, they didn't adjust for those herbicides?

A. I'm not sure because they are not specific about that.

Q. Let's talk about the De Roos 2003 study.

THE COURT: Should we take a break before we do that? So why don't we return at 10 after 3:00.

THE CLERK: Court is in recess.

(Whereupon there was a recess in the proceedings from 2:59 p.m. until 3:17 p.m.)

THE COURT: Okay. You can resume.

BY MR. LASKER

Q. Dr. Ritz, before we turn to De Roos 2003, I wanted to ask you a bit about the exposure measurements in the NAPP. You talked about that earlier, I think both with Judge Chhabria and with your counsel, and they had years and they had days per year and they had cumulative days. Do you recall that?

A. Yes.

Q. Now, there has been testimony in this case -- and my first question will be whether you're aware of this, but there was testimony in the hearing in March by Dr. Weisenburger, and the record will reflect if I've stated this correctly, but I think something along the lines of that he would expect that it would be about 8.5 years of cumulative exposure of glyphosate, that

glyphosate would be needed before there could be a risk of non-Hodgkin's lymphoma.

My first question to you is: Are you familiar with that testimony?

A. No.

Q. Okay. Do you have any opinion with regard to how many years of cumulative exposure to glyphosate would be necessary, in your opinion, to cause non-Hodgkin's lymphoma?

A. I wouldn't venture to say anything about cumulative exposure.

Q. Let's turn to De Roos 2003. And the De Roos study actually presents two odds ratios. It presents -- and its Tab 6 in your binder.

And if you look at Table 3, De Roos presents two odds ratios for all the pesticides, a logistic regression and a hierarchical regression analysis; correct?

A. That's correct.

Q. And for glyphosate, for the logistic regression analysis it was a 2.1, which was statistically significant; and for the hierarchical regression, it was a 1.6 odds ratios that was not significant; correct?

A. Yeah. The confidence level is .9 to 2.8.

Q. You discussed the hierarchical regression approach generally in your initial expert report; do you recall that?

A. Yes.

Q. So let's turn to that. This is Tab 1, and Page 5 of your expert report.

And you have a section for Hierarchical Regression; correct?

A. Yes.

Q. And you start off your discussion by noting that farmers and pesticide applicators generally have many correlated exposures to different pesticides; correct?

A. Yes.

Q. And you discuss a hypothetical of co-exposure to glyphosate and dicamba, where both of them have odds ratios of 2.0 because they are correlated even if dicamba is not a carcinogen; correct?

A. Yes.

Q. And that theoretically could work the other way, of course; correct? You could have dicamba and glyphosate having odds ratios of 2.0 even though glyphosate is not a carcinogen; correct?

A. Well, if we ignore prior knowledge, yes.

Q. And you then discuss the possibility that both of the pesticides have some effect and that adjusting for co-exposure could lower the odds ratios for each so that you no longer see an association.

I think you were talking with Judge Chhabria about that earlier today; correct?

A. Correct.

Q. And you explain that hierarchal regression is used to tease apart such correlations in order to determine which pesticides are the ones driving the increase in NHL and narrow down the long list of pesticides to find the bad actors which are increasing the risk of NHL; correct?

A. Yes. But I also say that:

"This approach makes a number of assumptions, for example, that either all pesticides considered or pesticides within certain groups have similar effects on the outcome and that these assumptions may be quite incorrect."

Q. And you have used hierarchal regression in your own epidemiologic research outside of this case; correct?

A. Correct.

Q. And let's -- if you could turn to Tab 17 in your binder?

(Witness complied.)

Q. And for the record, this is a study that you published with Drs. Rull and Shaw in 2016 entitled "Neural Tube Defects and Maternal Residential Proximity to Agricultural Pesticide Applications;" correct?

A. Yes.

Q. And you are familiar with this study; correct?

A. Oh, yes.

Q. And if you turn to Page 748 in your publication, in the

statistical --

MR. LASKER: I'm sorry, Your Honor.

THE COURT: You're fine.

BY MR. LASKER

Q. On the left-hand column, the Statistical Analyses section, the second paragraph you state:

"We used hierarchical multi-level logistic regression" -- and then you explain the program you used -- "to reduce the possibility of false-positive results when simultaneously evaluating a large number of pesticides."

Correct?

A. Yes.

Q. And "false-positive" means that a pesticide is reported as being associated with a health outcome when, in fact, it's not associated, correct, or not causally associated?

A. Correct.

Q. And then you cite -- you have Footnotes 30 and 31, and those are citations, if you look at the back, to two papers by Dr. De Roos, the 2003 study that we have been talking about, and then an earlier 2001 study; correct?

A. Yes.

Q. So I want to take a look at earlier 2001 study. It's Tab 18 in your binder.

A. Yes.

Q. And for the record, this is entitled "An Application of Hierarchical Regression in the Investigation of Multiple Paternal Occupational Exposures and Neuroblastoma in Offspring;" correct?

A. Yes.

Q. And if you turn to page -- or if you actually start at the first page of her study at 477, in the Introduction, and starting in that first paragraph and then carrying over to the next page, she's talking about the hierarchical method, methodology that she's using; correct?

A. She's talking about conventional and hierarchal regression, yes.

Q. And she starts off by discussing some of the problems that exist with respect to doing logistic regression analyses; correct?

A. Yes. And I think I explained those already.

Q. Yes. And, in fact, she mentions the same as you did. The third -- the third point she raises is the same point you made, the possibility of false-positives; correct?

A. Right.

Q. And in her next full paragraph on Page 478 in that same column, starting "Hierarchal regression," Dr. De Roos states:

> "Hierarchal regression, also known as multilevel or random-coefficient modeling, is a statistical method that can greatly improve the accuracy of

unstable estimates, especially when studying effects of multiple exposures with limited data."

Correct?

A. Yes.

Q. If we go back to your study, which is Tab 17, you present the results of your analyses in this paper in Table 2, which is Page 746, and carries over to Page 747; correct?

A. Yes.

Q. And for your logistic regression analysis you actually have two models, a single pesticide model and a multiple pesticide model. And that's indicated in the -- at the top of the table; do you see that?

A. Uh-huh.

Q. And in the single pesticide model, and we can -- I'm going to be referring to the abstract, but you can look throughout the entire study. I don't know if that helps.

But if you go to the beginning of the study on 743 and you look in the abstract, you explain the single pesticide model.

A. It's one by one, yes.

Q. So in the abstract at 743 about halfway down you state that:

"In the single pesticide models several pesticides were associated with NTDs after adjustment for study population, maternal ethnicity, educational level, cigarette smoking and vitamin use."

Correct?

A. Yes.

Q. And you did not adjust in the single pesticide model for exposures to other pesticides; correct?

A. That's what a single pesticide model is, yes.

Q. So you can do a logistic regression analysis. That doesn't answer the question whether or not you are adjusting for other pesticides. You can do it either way; correct?

A. Exactly.

Q. And --

A. But it doesn't tell you which model is the better one.

Q. Right. In the conclusion of the your paper -- we're talking about your paper right now -- when you present the results of your study, it's the last paragraph.

A. Uh-huh.

Q. The pesticide that you cite, which is benomyl by name --

A. Benomyl.

Q. Benomyl, I'm sorry.

That is the one pesticide that the came out of your hierarchal regression analysis; correct?

A. It came out of all analyses -- no. Actually, in the hierarchical it's not statistically significant any more.

Q. If you can go to Page 748 in your paper. In the Results section in the second paragraph.

A. Yes.

Q. You in this paper had a different definition that you were using to identify exposures to pesticides that were at least of interest to you, which was an odds ratio of greater than 1.4 with a confidence interval lower limit greater than 0.9; correct?

A. Yes.

Q. And then at page --

A. As possibly associated.

Q. Right. And then at Page 749 the left column, the top, you discuss that the:

> "The hierarchical multiple-pesticide model drew the effect estimate for each pesticide toward the mean of all agents in the category, and only benomyl was still associated with neural tube defects."

Correct?

A. Yes.

Q. And then, again, as we mentioned in the conclusion, your concluding paragraph, the only pesticide you identify, despite the fact that you had a number of pesticides that popped out in the earlier analysis, the only one that you mention in your conclusion is benomyl; correct?

A. Well, I mentioned that because I then put it into the context of teratogenicity for lab animals.

So I'm putting this in the conclusion, back into prior knowledge and in laboratory animal biologic plausibility that

we have for benomyl and not for other agents.

Q. Okay. And you don't identify any of the other agents that came out of your analysis in any of the other models that you used. Benomyl is the only one that comes out in the hierarchal regression analysis and it's the only one that you discuss?

A. As a singular pesticide. However, I make a lot of statements about multiple exposures and exposures in certain categories of pesticides.

Q. Again, this is another study that you published in which you again adjusted for exposures to other pesticides; correct?

A. We did single pesticide models, multiple pesticide models and hierarchical models.

Q. Okay. So let's look back now at De Roos 2003.

A. But, again, these -- all these pesticides were pre-selected.

I can tell you again, we have 640 agents. We did not put 640 agents in here. We used prior knowledge to select classes of pesticides.

Q. Okay. If we can go back to Tab 6, and this is De Roos 2003. Are you there?

A. Yes.

Q. And you testified both here and in the March hearing that both, in your opinion, the logistic regression analysis and the hierarchal regression analysis are adjusted for exposure to other pesticides; correct?

A. Correct.

Q. I'd like to ask you to look at the Statistical Analyses section of the De Roos paper. It's on Page 2.

A. Yes.

Q. And if you look about halfway down that first paragraph in -- under Statistical Analyses there is a line that starts, paren, 75.2 percent. Do you see that?

A. Yes.

Q. The author states:

"We employed two approaches to our analyses; standard logistic regression analysis and hierarchal regression."

Correct?

A. Yes.

Q. And they state that:

"Each model included variables for age and indicator variables for study site."

Correct?

A. Yes.

Q. They then state that:

"Other factors known or suspected to be associated with non-Hodgkin's lymphoma, including first degree relative with haematopoietic cancer, education, and smoking, were evaluated and found not to be important confounders of the associations

between NHL and pesticides."

Correct?

A. Right.

Q. And there is no mention, in this first paragraph at least, about adjusting for potential confounding effects of other -- of exposure to other pesticides; correct?

A. No. Because the next sentence actually gives that away:

"The standard logistic regression model did not assume any prior distribution of pesticide effects, in contrast to the hierarchal regression modeling."

So I am --

Q. Right. And --

A. Yeah.

Q. And then the hierarchal regression model is where they talk about hierarchical regression of multiple pesticide exposures; correct?

THE COURT: Wait. Hold on a second.

Dr. Ritz, you just said the last sentence gives it away.

THE WITNESS: Yes.

THE COURT: I didn't understand what was being given away by the last sentence. Can you explain that?

THE WITNESS: That they are using multiple pesticide models, not singular pesticide models, because they are talking about the assumptions they are making for the pesticide effects.

THE COURT: So in other words, they are not in the logistical regression -- logistic regression analysis, they are not making assumptions about --

THE WITNESS: The distributions, yeah.

In the hierarchical they are making assumptions about that. That's what they are saying.

THE COURT: What does it mean to make assumptions about prior distribution of pesticide effects?

THE WITNESS: That's exactly what hierarchical regression does that logistic regression doesn't do. Logistic regression treats the data as is. Hierarchical regression says, well, what do you think the effects are?

And then you put weights for that belief into your model. And the weights are actually given in Table 1. And you can see it's the carcinogenic probability that they are assigning, and each single pesticide has a probability for causing NHL. And you can see that glyphosate here is among the lower probability agents.

So -- which one is this? There is one with a one. Chlordane, I guess. It's hard to see. But that last -- that last column is Carcinogenic Probability. And when you look at glyphosate, you see that it -- they give it a 30 percent probability .3 is a 30 percent probability to be carcinogenic, which is the lowest -- one of the lowest.

There is one that has even less, and that's bentazon, with

a 10 percent.

But there are lots of agents that they rate much higher in terms of carcinogenicity. And that's the distribution that they are putting across these pesticides.

THE COURT: It says here:

"Carcinogenic probability value is created by combining the classifications from the IARC Monographs Programme and the U.S. EPA Integrated Risk Information System."

THE WITNESS: Right.

THE COURT: So at this time, of course, we don't have the IARC classification.

THE WITNESS: Exactly. Yes. So they are just going with what they have, which is all we can do; right?

Prior knowledge is time dependent. So they are giving a time dependent estimate of what the carcinogenicity is. And they are telling you that they are actually weighing down the carcinogenicity probability for glyphosate considerably when they run the hierarchical model. And that may be wrong and you can dispute.

Now, you know, if they would redo this, they would probably give it a much higher probability. What then happens is, and I've done this before in my other studies, as we have seen, you're actually -- the hierarchical model -- if you give it a one, the hierarchical model will actually give you

probably exactly the same as the logistic.

But when you down weigh these probabilities, these distributions, then you will get less and less influence from what your data tells you and more and more influence from this prior probability. That's all.

So what we're actually doing when we're running hierarchical regressions is arguing with the reviewers all the time about these assumptions, and there are lots of opinions and it's actually why it hasn't caught on.

So the papers that Mr. Lasker is actually citing were from the early 2000s, where we tried to do this and convey the messages by putting this prior information in and it didn't come across very well. The reviewers generally don't like it. They just want to see what the data says.

Q. And if we can, though, go back to the issue we were discussing. This issue of prior covariates is not discussing adjustment for other pesticide exposures. It's a separate -- in fact, there are two steps in the hierarchical regression analysis in this paper; correct?

A. Two steps?

Q. Well, if you look at the hierarchical regression of multiple pesticide exposures, again where we were --

A. Uh-huh.

Q. -- that's hierarchical regression of multiple pesticide exposures; correct?

I'm sorry. Page 2, where you were on the Statistical Analyses.

A. Yes.

Q. And they talk about hierarchical regression of multiple pesticide exposures; correct?

A. Yes.

Q. (As read)

"In the first-level model of the hierarchical regression analysis NHL disease status was regressed simultaneously on the 47 pesticide exposures, age, and study site."

Correct?

A. Yes.

Q. So they are adjusting for all 47 of the other pesticides in this first-level middle for the hierarchical regression; correct?

A. They are estimating, yes, in a multi-pesticide model.

Q. Okay. And then just so we can continue on to the top of the second column, on Page 2 of 9, they talk about, the third line, the second-level model then incorporates these prior covariates; correct?

A. Yes, but you actually -- you can explain it this way, but the model runs together. It doesn't run individually. You get one estimate.

So that's -- it's called hierarchical, but it is really

going back and forth between these two levels.

Q. And just so we are clear then though, at least in the Statistical Analyses section of this paper, they first discuss adjusting for other pesticides in the hierarchical regression analysis?

A. The hierarchical regression analysis automatically adjusts because of the way you set it, the model up.

Q. There is nothing --

A. It's just adding a second level, which is -- and the second level kind of weighs these prior probabilities.

Q. Okay. And with respect to your testimony that the logistic regression analysis adjusts for exposure to other pesticides, first of all, let's take this in steps, that's not stated in the Statistical Analyses section that we just looked at; correct?

A. Well, it's also stated at the -- in the footnote of Table 3.

Q. Yeah, and I want to get there. I do have questions about that, but I first want to find out from you if -- other than that footnote in Table 3, if there is anything in the Statistical Analyses discussion that states that there was adjustments for other pesticide exposures in logistic regression analysis?

THE COURT: She testified that the last sentence of that first paragraph in Statistical Analyses shows that the

logistic regression includes adjustment for the pesticides.

MR. LASKER: Let me go back to that, because I want to make sure I'm clear on that.

BY MR. LASKER

Q. The issue that's being raised in that last sentence talks about prior distribution of pesticide effects, which is Table 1; correct?

A. Okay. There is actually another sentence in Statistical Analyses.

"Because these analyses of multiple pesticides modeled themselves" --

Q. I'm sorry. Where are you?

A. Under Statistical Analyses.

THE COURT: The paragraph immediately under that heading?

THE WITNESS: Yeah.

A. And about the fourth or fifth line.

"Because these analyses of multiple pesticides modeled the pesticides simultaneously, any subject with missing or 'don't know' response for any one of the 47 pesticides of interest was excluded from all analyses."

BY MR. LASKER

Q. Okay. So there were analyses that were of multiple pesticides and there were analyses that were not of multiple

pesticides?

A. No, they were all of multiple pesticides. That's why you actually have to exclude everybody who doesn't have all data. It's a complete data analysis.

Q. I understand that. I'm just trying to figure out what in that sentence you read as stating that all of the models adjusted for multiple pesticides.

I mean, maybe I'm misunderstanding. It seems to read that there were different models --

A. No.

"Analyses of multiple pesticides, modeled the pesticides simultaneously."

That means you're putting them all in the model. When you put them all in the model, you -- your model throws out any person who has a missing value.

So this is a complete subject analysis based on all pesticides simultaneously. That's what this says.

Q. I understand. And they state that because of that they excluded those responses from all analyses.

And my question is: There is other analyses, at least as I'm reading that, that don't adjust for other pesticides. Am I not reading that correctly?

A. No, you don't.

Q. Okay.

A. This is very technical and, you know, this is how we

write. Unfortunately. But my reading of this technical text is exactly what I just said.

They did simultaneous adjustment and because they had to, therefore, use only data for complete -- for all -- I mean, they needed the data for every single pesticide in order to do these analyses, so they had to exclude the people who didn't provide that data for each and every single pesticide. So that's why they reduced the number to these 650 and 1933.

Q. Is there anything else in the text -- I want to turn to Table 3 next, but is there anything else in the text that you rely upon for your opinion that the logistic regression analysis was adjusted for other pesticides?

A. Well, I find that very clear, the explanation.

Q. Is there anything else in the text though, or is that -- that's what you rely upon?

A. When we write these papers, we have very limited space. So we usually become very technical in the Methods section and we don't repeat ourselves because then we have no -- you know, no space to discuss.

Q. Okay.

A. So that's where you usually put this kind of information and that's where I find it.

Q. Let's look to Table 3, because you also mentioned the footnote on the asterisk that appears in Table 3.

MR. LASKER: And that is on Page 5, Your Honor, of

De Roos.

BY MR. LASKER

Q. And this asterisk, which is in the table that presents logistic regression and hierarchical regression, states that:

"Each estimate is adjusted for use of all pesticides listed in Table 3, age, and study site."

Correct?

A. Yes.

Q. And am I correct in my understanding that you interpret this as indicating that the logistic regression odds ratio in this table adjusted for exposure to other pesticides?

(Court reporter clarification.)

Q. Am I correct in my understanding that you rely, in part, on this footnote in Table 3 as evidence that the logistic regression analysis in De Roos 2003 was adjusted for the use of other pesticides?

A. Yes, because it says "each estimate" and the header is for all estimates.

Q. And if I could ask you to turn back to Tab 17, which is your paper, the Rull publication.

And Table 2 presents, as we discussed, a single pesticide model that did not adjust for other pesticides in the logistic regression analysis, a multiple pesticide model that does adjust for other pesticides, and then the hierarchical regression that adjusts for other pesticides; correct?

A. Correct.

Q. And there is a footnote, a very similar footnote asterisk to Table 2 in the title, that goes down to the bottom of Table 2 that states: "Each estimate" -- are you with me, the asterisk?

A. Yes.

Q. (As read)

"Each estimate was adjusted for the other pesticides listed, study population, maternal, education..."

And then they go on to list some other items; correct?

A. Yes.

Q. So at least in this instance that footnote, which likewise says each estimate was adjusted for other pesticides listed, does not mean that all the odds ratios in that table were adjusted for other pesticides; correct?

A. Well, this table is differently structured. It actually has a single pesticide, and that's a very clear description, and a multiple pesticide model.

Q. I understand that, but I'm correct that while there's a footnote that states identical -- very similar to the 2003 De Roos study, while there is a footnote to this table that states "Each estimate was adjusted for the other pesticides listed," at least in this table, in your paper that does not mean that all the odds ratios reported in that table are

adjusted for other pesticides; correct?

A. As I said, this is a different kind of table. It actually lists single pesticide and multiple pesticide models, and they are very carefully labeled.

Q. And let's turn to the issue of --

A. And, by the way, I'm not the first author of this paper. It's my student.

Q. Okay. The last issue I want to talk to you about is non-differential exposure and misclassification. I want to make sure I understood your testimony here this morning. And maybe -- these are, for me at least, to sort of think about the terms we have been using and that IARC used, for example, of "bias," "confounding" and "chance."

And if I understand correctly, you're also looking at all three of those issues with respect to the potential impact or the potential issues in the -- risk ratios in the Andreotti study.

Is that -- in explaining what happened with those odds ratios, to get those odds ratios below one; correct?

A. Well, I generally look at every single study in that way.

Q. Okay. So with respect to non-differential misclassification, that's a bias that biases the rate ratio towards the one; correct?

A. Generally, yes.

Q. But that bias itself, putting for the moment chance and

confounding to the outside, but non-differential misclassification by itself cannot push the rate ratio past one; correct?

A. Well, there could be random fluctuation so you get an estimate slightly under one, but the confidence intervals conclude.

Q. Okay. But that -- maybe I'm misunderstanding, but random is the confidence intervals concluded that's a play of chance; correct?

A. Yes.

Q. Okay. So there is chance and there is confounding, but for the non-differential misclassification, non-differential misclassification biases towards the null but not beyond the null; correct?

A. I explained that the beyond the null must be a different kind of bias. It's not non-differential misclassification. It's a different bias.

Q. Okay. I understand.

A. It's confounding.

Q. Okay. And I want to get to that because there is also -- I want to walk through these just to help me understand.

There is the issue of chance, or random movements. And the play of chance with respect to the Andreotti study is limited because of the size of the study and the tightness of the confidence intervals; correct?

A. We wouldn't be as worried about chance, but we're certainly worried about bias.

Q. I understand that. But, again, I'm trying to take this -- because I'm going to get to the confounding issue, which I know is a separate issue.

But you have the non-differential bias and then you have the play of chance.

And with respect to the play of chance, because of the size of the Andreotti study, that is not going to have as big of an effect to be able to get the odds ratio -- sorry, the relative risk down to that .85 range; correct?

A. I haven't done the analyses, but I would think it's bias, not chance.

Q. And when you say "bias," and I know this is different -- probably the same terminology for epidemiologists, but the bias that you have mentioned is residual confounding. Am I understanding that correctly?

A. That's one of the biases, yes.

Q. Okay. And so with respect to residual confounding, we'll just break this down, the -- and I think you explained in your rebuttal report that just claiming that something is a confounder is not enough; correct?

A. Correct.

Q. And the 2018 Andreotti study in its analysis -- and let's actually -- I'm sorry. Let's pull that up, Tab 3.

And we can actually -- if you could turn to Page 2 of the Andreotti study? We could actually put some slides up here. Slide 62 is where we're going to start.

And we are about two-thirds of the way, three-quarters of the way down the page on the second column in Andreotti 2018; correct?

A. Where are you?

Q. On Page 2, I'm sorry. The second column under Statistical Analyses.

A. Yes.

Q. And if you go down, about three-quarters of the way down you will see a sentence that starts "Continuous variable period," and then "Risk estimates were adjusted."

A. Yes.

Q. So in the Andreotti study first they explain that risk estimates were adjusted for age, cigarette smoking, alcoholic drinks, family history of cancer, state of recruitment, and five pesticides most highly correlated with glyphosate use; correct?

A. Yes.

Q. And then moving down for a few more lines, they have some other adjustments that they looked at which -- where they start -- we can put it up. It's Slide 63, if I recall correctly. I can't see the slides.

It starts:

"We evaluated other potential confounding factors." Do you see that?

A. Yes.

Q. (As read)

"...including body mass index, pack-years of cigarettes smoked."

Correct?

A. Yes.

Q. They also mention that because women and non-whites, because the numbers are small, making it hard to -- making it -- precluding adjustment, they ran sensitivity analyses to assess the risks of men and whites alone; correct?

A. Uh-huh.

Q. And they continue to state:

"For lymphohematopoietic cancers, we additionally adjusted for occupational exposure to solvents, gasoline, x-ray radiation, engine exhaust, and pesticides linked to lymphohematopoietic malignancies."

Correct?

A. Yes.

Q. And then if you look in the Results section on Page 3, when they are talking about, sort of towards the bottom, right towards the end of that second paragraph. Second paragraph talks about:

"Risk ratios for unlagged intensity-weighted lifetime days."

Correct?

A. Where are you?

Q. So on Page 3, the first column on the left -- column on the left. There is only one.

Under Results, and there is the second paragraph that starts:

"Risk ratios for unlagged intensity-weighted lifetime days."

Do you see that?

A. Yes.

Q. And if you go down towards the bottom of that paragraph they state -- and it's about one, two, three, four, five -- six lines from the bottom of the paragraph:

"These findings were unchanged in sensitivity analyses, including further adjustments for additional potential confounders or by exclusion of women and non-whites."

Correct?

A. Yes.

Q. So the Andreotti investigators looked at a large number of potential confounders and ran sensitivity analyses to determine whether those potential confounders impacted their results; correct?

A. Yes. They tried to do what they could.
Q. And they didn't find in their analyses any issue of confounding that would explain their results; correct?
A. They did not have a variable that adjusted for -- we see, for example, high school or less is 70 percent among the never glyphosate users. And the median, the less than median, more than median days, we have 60 and 50 percent less than high school. And we know that less than high school education goes along with a lot of lifestyle factors they probably don't have any information on.
Q. All right. You don't have any information or data of specific confounders that you can point to that would -- that you can show push that relative risk numbers down below one, do you?
A. Well, as I explained, De Roos actually suggests this in her analyses, where she is not using the never glyphosate users for good reason. And the good reason -- unless you want to tell me the true effect as to it should be below one, there has to be confounding.
Q. Well, again, the relative risks here are not statistically significant --
A. Well, but your argument goes into the true risk ratio is below one.
Q. Let me clarify one point on that. With respect to non-differential misclassification of exposure -- I think we

talked about this last time -- if there is, in fact, no association between an exposure and an outcome, non-differential misclassification does not move the rate ratio or odds ratio at all; correct?

A. Does not move it -- I didn't hear that last.

Q. If there is no association or no causal association between an exposure and an outcome, non-differential misclassification --

A. By definition, then it's one.

Q. And non-differential misclassification then does not move the odds ratio in either direction?

A. Below one, no.

Q. And with respect to the De Roos 2005 study, they had a Table 1 that looked at the characteristics of never used and used as of 2005, and they had a comparison?

A. Uh-huh.

Q. And in this study they have different numbers because they are looking at different -- people at different periods of time and different people are exposed and not exposed in the 2018 analysis as compared to the 2005 analysis; correct?

A. But the never users are pretty similar.

Q. And the same authors -- many of the same authors in the 2005 paper are authors in the 2018 paper; correct?

A. Many, but not all.

Q. And let me ask one more time: Do you -- can you point to

any confounder, any specific thing that you believe is a confounder where you have data that shows that that confounding drove the odds ratio lower?

A. I don't have too tell you that, because I don't believe that glyphosate is a healthy agent that we should put into our cereal. So I don't believe the true estimate is below one.

If this study shows an estimate below one, there is bias. And one of the explanations is unmeasured confounding. And De Roos had exactly that suspicion and that's why she did the kind of analyses she did.

MR. LASKER: I have no further questions.

THE COURT: Okay. Any re-whatever-it-is before we -- before we wrap up?

MS. FORGIE: I have three whatever-it-is things, Your Honor.

THE COURT: Okay.

REDIRECT EXAMINATION

BY MS. FORGIE

Q. Can you turn to Exhibit 12, please?

MR. LASKER: This is in your book?

MS. FORGIE: In her book, De Roos.

MR. LASKER: Tab 12.

MS. WAGSTAFF: Yes, our book.

A. Yes. Andreotti?

BY MS. FORGIE

Q. No. De Roos 2003.

(Brief pause.)

MS. FORGIE: I'm sorry. It's Exhibit 15. Somebody else got it wrong besides me.

A. Too many binders.

BY MS. FORGIE

Q. Okay.

A. Okay.

Q. Okay. Dr. Ritz, you were asked several questions by Mr. Lasker about the De Roos 2003 publication. Do you remember some of those questions?

A. Yes.

Q. Okay. And the implication of some of those questions is that De Roos did not adjust for other pesticides; correct?

A. That's what I understood.

Q. Okay.

THE COURT: In the logistic regression.

BY MS. FORGIE

Q. In the logistic regression.

A. Yes.

Q. Thank you.

If you look at Page 7 of the De Roos paper, the authors state that:

"The large number of exposed subjects allow" --

MR. LASKER: Where are you?

MS. FORGIE: Page 7.

THE COURT: Where?

MS. FORGIE: Top of -- first paragraph. First full paragraph, the top. Sorry. "The large number."

THE WITNESS: Yes.

BY MS. FORGIE

Q. So there the authors state that the large number of exposed subjects allow for the use of other pesticides for the adjustment; correct?

A. Yes.

Q. Okay. So at least the authors of the 2003 De Roos study state that they adjusted for other pesticides; is that correct?

A. Obviously, yes. And as far as I know, Anneclaire De Roos, she would never present a single pesticide model and compare that to a hierarchical model and then draw any exclusions from it. That's not what we do.

Q. Okay. And then the epidemiologic studies that we discussed today and two weeks ago are peer-reviewed publications; correct?

A. Yes.

Q. And with regard to the epidemiological methods, it's not considered in epidemiology methodologically sound to rely on peer-reviewed literature; is that correct?

A. That is correct.

Q. And, finally, Dr. Ritz, Mr. Lasker asked you questions about whether you copied various odds ratios into your expert report. Do you remember those questions?

A. Yes.

Q. And just for clarification, did you consider all of the odds ratios, both adjusted and not adjusted, in all of the studies in forming your opinions as you've given them here today and two weeks ago?

A. Yes, I did. That's what I usually do. In order to understand the study, I use every single data point that the study has.

However, when I described the study, especially in a report that shouldn't be 500 pages long, then I just pull out the estimates that makes sense for the argument I'm trying to make and the argument depends on what the argument is.

Is it that there is a dose-response? Then I pull out the overall estimate that most likely reflects the dose-response and, also, an estimate maybe that is comparable, most comparable to those.

Q. Okay. Thank you.

THE COURT: Any follow up?

MR. LASKER: No.

THE COURT: Okay. Congratulations. You're completed your second day. We'll see you again in a couple weeks.

(Laughter.)

THE WITNESS: I really like San Francisco, but...

THE COURT: Thank you.

You can have some more water and then you can step down.

(Witness excused.)

THE COURT: Okay. So we meet again on Friday; right? What time, 10:00?

MR. LASKER: I think 10:00.

THE COURT: 10:00 o'clock.

MS. WAGSTAFF: Your Honor, is there any possible way we could start earlier if it's going to go as long, just because it's a Friday afternoon and people may be wanting to leave? If your schedule and your schedule and your schedule arise?

THE COURT: Yeah. I think that's fine.

MR. LASKER: And Judge Petrou's schedule.

THE COURT: I haven't checked with her, but I think she probably prefers starting earlier as well.

When do you want to start, 9:00?

MS. WAGSTAFF: 9:00 o'clock would be great.

MR. LASKER: 9:00.

THE COURT: Let's plan on starting at 9:00, unless that doesn't work with Judge Petrou, and in which case we will get back to you and tell you we're starting at 10:00. But as of now, plan on starting at 9:00 notation.

MS. GREENWALD: Just so you know, your Honor,

Dr. Portier is available to stay the whole day. He's study not flying ought until Saturday morning.

THE COURT: Oh, that actually reminds me. I mean, I may --

MS. GREENWALD: I understand that it's not --

THE COURT: We may start off on Friday with me -- you know, so it's pronounced Dr. Portier?

MS. GREENWALD: Correct.

THE COURT: I may start off, like we did today, with me asking Dr. Portier questions, but maybe not, because he -- he never -- if I recall correctly, he did not testify at all about the aspect of his opinion that discussed the epidemiology, which is what we want him here for on Friday.

So -- so it -- if I have any questions at the outset, it will probably be far fewer and you can go ahead and jump in and have him present his opinion on the epidemiological studies.

MS. GREENWALD: That's very helpful. Thank you. Appreciate it your Honor.

THE CLERK: Court is adjourned.

(Proceedings adjourned.)

I N D E X

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CERTIFICATE OF REPORTER

I certify that the foregoing is a correct transcript from the record of proceedings in the above-entitled matter.

Debra L. Pas, CSR 11916, CRR, RMR, RPR

Wednesday, April 4, 2018