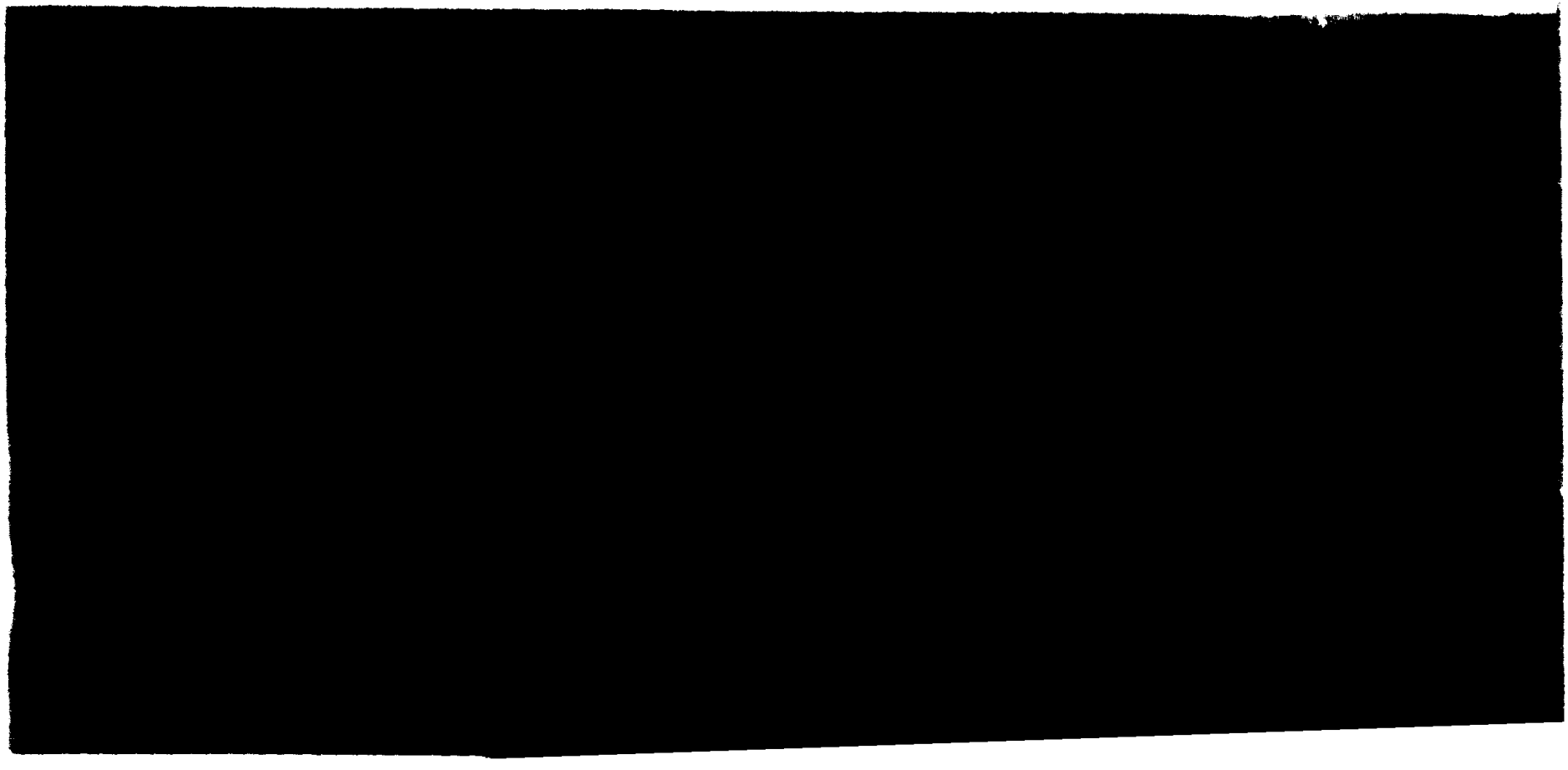
LANGER, ARTHUR PH.D.

CONWED CORPORATION V. UNION CARBIDE

DEPO: 9/16/98 (W/EXHIBITS)



UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF PENNSYLVANIA

CONWED CORPORATION,
Plaintiff,
vs.
UNION CARBIDE CORPORATION,
Defendant/Third Party Plaintiff
vs.
OWENS-CORNING FIBERGLAS CORPORATION, ET AL.,
Third-Party Defendants.

COPY

DEPOSITION OF DR. ARTHUR M. LANGER

New York, New York

Wednesday, September 16, 1998

Reported by:
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September 16, 1998

10:20 a.m.

Deposition of DR. ARTHUR M. LANGER, held at the offices of Kelley Drye & Warren, 101 Park Avenue, New York, New York, pursuant to notice, before Francine Sky-Orr, a Court Reporter and Notary Public of the State of New York.

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DR. ARTHUR M. LANGER called as a witness, having been duly sworn by a Notary Public, was examined and testified as follows:

EXAMINATION BY

MR. WILL:

Q. State your name, please.

A. Arthur M. Langer.

Q. You're a Ph.D.; is that correct?

A. That's correct.

Q. Dr. Langer, my name is Trevor Will, we met previously in this case. For your deposition today I would like to remind you of just a couple of ground rules, if I might.

One: Please wait until I am finished with the question before you begin speaking, all right?

A. Yes.

Q. And No. 2: Please use yes or no where appropriate, rather than um-hum or uh-uh; those are difficult for the reporter to transcribe, all right?

A. Yes.

Q. Third, if I ask you a question that is

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ambiguous or doesn't make sense, let me know and I will rephrase it or repeat it, all right?

A. Yes.

Q. I want to show you what we will mark as Exhibit 1.

(Langer Exhibit 1, document entitled "Report on Morphology: Size Distribution and Fiber Concentrations of a Chrysotile Asbestos Aerosol," marked for identification, as of this date.)

Q. Exhibit 1 to your deposition today is a document entitled, "Report on Morphology: Size Distribution and Fiber Concentrations of a Chrysotile Asbestos Aerosol"; is that right?

A. Yes.

Q. The authors of that document are shown as you and R.P. Nolan.

A. Yes.

Q. Dated August 20, 1998.

A. Yes.

Q. Would I be correct that August 20th of 1998 is the day this was actually written in final form?

A. Yes.

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Langer

Q. When was the experiment that's described in this paper performed?

A. The experiment was conducted possibly several years ago.

Q. So the actual work that's reported in here, was what, more than four years ago?

A. I don't know that.

Q. Well, let me back up. Would I be correct that the work described in Exhibit 1 was performed more than one year ago?

A. Probably, yes.

Q. Let me back up just a second.

Has there been any previous publication of the data that's included in Exhibit 1?

A. I don't believe so.

Q. So, would I be correct, then, that the experiment was done at some point in the past and the data was just collected, but was essentially sitting in a file somewhere?

A. No. That's not correct.

Q. Why don't you tell me what happened, how Exhibit 1 came to be generated.

A. Our laboratory was interested in

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several reports, which became part of the documentation in this particular litigation. And those reports focused on aerosols generated with chrysotile fiber from Union Carbide's -- fiber originating from Union Carbide's New Idria deposit. We wished to reproduce some of their work and at the same time we were interested in determining the relative sensitivity and accuracy of our methods. A dust generator similar to generators described in the literature was made on our campus by the campus chief glassblower, who services the department of chemistry. And based on samples which we had collected and were available in our laboratory, we performed the experiment.

Q. Now, you said the actual work was done several years ago?

A. I believe so.

Q. What was done with the data that was generated from the experiment prior to August 20th of 1998?

A. I'm not sure I understand your question. Do you mean once the data -- once data are generated in our laboratory what happens to

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it?

Q. Right.

A. Normally, it's put in a file and when sufficient data are collected, perhaps a publication results. If the data are of interest and are new and will enhance and forward some field.

Q. Well, for example, Exhibit 1 discusses certain photographic negatives that were taken?

A. Right.

Q. Physically, where were those negatives kept between the time that the photographs were taken and August 20th of 1998?

A. I believe Dr. Nolan filed them in a data file somewhere.

Q. So, for example, in June of 1998, if I had asked you about the data on this experiment, you would have said talk to Bob Nolan, he's got it?

A. I would say the data are -- I would have said the following: I would have said that I could not recall the details of the data, other than the fact aerosols were generated of significant levels, by any standard.

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And that the specific data sets were kept in a file by Dr. Nolan.

Q. If we wanted to know when the experiment was actually done, would Dr. Nolan have information that would establish that?

A. The information would probably come from a photographic plate number -- assuming, of course, it's part of a log somewhere.

Q. Is there any kind of laboratory log or notebook or record that would show when this work was actually done?

A. Probably the photographic plate log.

Q. Did someone commission the experiment or was it something you did on your own?

A. I believe Mr. Brownson requested that we undertake such a study.

Q. You understood, at the time of Mr. Brownson's study, that there was litigation going on between Conwed and Union Carbide?

A. Yes.

Q. It was your understanding the study was to be used for the litigation?

A. Possibly.

Q. Depending on what it showed?

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A. I don't think that fairly represents my thoughts.

Q. Okay.

A. I think that the problem with our laboratory is that we do a lot of different things and very often we engage in some project for which there's no terrible constraint of time. And it goes from a front burner to a back burner. And data may languish in a file. But there's no intent to prevent data from being scrutinized. We are not consciously obstructing any process. This is just the nature of a very busy laboratory.

Q. Doctor, I didn't mean to imply -- I hope you didn't infer I was suggesting --

A. I did.

Q. Okay. Please don't. I just wanted to clear that up.

How much did it cost to run this experiment?

A. I don't know. But I would assume it was a modest amount.

Q. And whatever that cost was, it was billed to Mr. Brownson?

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A. Yes.

Q. And, as you understood it, what was the purpose of doing the experiment? In other words, why did Mr. Brownson want the experiment done? What did he want to see?

A. I think you should ask Mr. Brownson that.

Q. I would like to, I probably can't.

A. Oh, you can't.

Q. All I can ask is what you understood.

A. What is my understanding?

Q. Right.

A. That if I recommended that this project be undertaken, what would be my thoughts and my rationale; that's your question?

Q. No. I will back up a second.

At a point in the past when this experiment was commissioned or authorized by Mr. Brownson, you had some discussions with him about it, correct?

A. Yes.

Q. And before actually going out and doing the experiment, I assume you discussed with him what it is that you were contemplating doing?

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A. Let me see if I can answer your question. The issues involved in the present litigation involve chrysotile asbestos, as one of the fibers of interest. Mr. Brownson visited me in New York, visited my laboratory. In my laboratory I have literally hundreds and hundreds of specimens of asbestos fibers, and I showed Mr. Brownson some of the Union Carbide commercially available pellets of asbestos. And I believe at that time we discussed the rationale for producing pellets. We discussed what the outcome would be if these pellets were crushed, whether this would generate a dust; what would the characteristic of that dust be; would the fibers generated be of such concentration that they would exceed the various regulatory statutes. And at that time I believe I suggested that we could crush pellets, generate an aerosol and we could actually measure the amount of fiber generated. And at that time, I believe Mr. Brownson suggested that he -- there were some documents that showed that this had already been done at Union Carbide. And I believe he agreed to have this experiment undertaken and he sent us

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these materials.

Q. By "these materials," you mean the copies of the experiments study?

A. The plenum study at Union Carbide.

Q. The reason for doing this experiment was to see what sort of dust concentrations you would generate when crushing these Union Carbide pellets?

A. No. It was not in the process of crushing. These pellets are processed and occasionally the containers which carry these pellets are inadvertently damaged during shipment and these pellets become pulverized by various mechanical forces. Based on the amount of material -- based on the materials that are produced, if an air stream were to move over this material, would it generate an aerosol. These are the basic questions that were raised.

Q. In order to try to answer this question you did this experiment that's described in the paper?

A. Yes. I am presenting to you the general elements of a discussion concerning pelletized chrysotile and some circumstances

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under which it would generate an aerosol.

Q. Now, one of the things you said you discussed with Mr. Brownson was the rationale for pellets.

A. Yes.

Q. What did you understand the rationale for pellets to be?

A. Pelletization in an industrial process is an extra process. It is not undertaken because of some cosmetic effect. It is undertaken as a means of handling a material which is otherwise difficult to handle and a material which is dusted. Pelletization is carried out by the Union Carbide process because this chrysotile material is extraordinarily dusty and pelletization is carried out, for example, in iron ore processing. Or an iron ore powder is difficult to get to a -- difficult to bring to a mill because it is just a powder. It's just difficult to handle.

Q. So, as you understand it, pelletization reduces the amount of dust that the asbestos would give off?

A. Yes.

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Q. Have you done any experiments to attempt to measure how much of a difference there is in dustiness with the pelletized versus unpelletized in an industrial setting?

A. No.

Q. Who actually, physically did the experimental work?

A. You mean, who put the material in this particular aerosol chamber?

Q. Yes.

A. Dr. Nolan.

Q. Were you present when that work was done?

A. Yes.

Q. Why don't you tell me what the first step in the process is.

A. The first step was to put pellets in a blade mill and break the pellets down, which occurred in a matter of one second, two seconds.

Q. How many pellets were put into the blend?

A. I didn't count them. I would imagine that the final material could have been a gram or two.

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Langer

Q. Then the blade mill pulverized the pellets?

A. Yes. Did you say "pulverize"? It actually opens the pellets. When you say pulverize -- okay, let's use the general term, pulverize.

Q. After the blade mill ran for one or two seconds, when you looked into the enclosure, did you see any remnants of pellets or was it all a powder?

A. Without describing the specifics of the powder and its particle size distribution, were there still several fragments of pellet? Yes.

Q. Then, how did you determine how long to run the blade mill?

A. I just wanted the form of the pellet to be obliterated.

Q. So you could have run this longer and made it more uniform in consistency?

A. Yes.

Q. Then after you had run the blade mill for a couple of seconds, what was the next thing done with the material?

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Langer

A. The material was -- well, an aliquot was removed, just to examine, to take a look at the nature of this pulverized material.

Q. Let me interrupt you to make sure we are talking about the same thing. What do you mean by that?

A. An aliquot is a sample of a material.

Q. Is there any particular weight taken --

A. No.

Q. -- in the aliquot?

A. No.

Q. Just a portion of it?

A. Yes.

Q. What was done with that aliquot that was removed?

A. Examined by polarized microscopy.

Q. How was the sample prepared for examination by PCM?

A. How is it done?

Q. Yes, how is it done?

A. A portion of the asbestos material is placed on a clean glass slide immersed in an oil with a known refractive index with the edge of a

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different glass slide dispersed in the oil and the cover slip is placed on top of that preparation. It's placed on the stage of a polarized microscope and examined.

Q. Was there any kind of filtering or washing or any other process done to the aliquot between the blade mill and the glass microscope slide?

A. No.

Q. That was just moved by, what, a spoon or -- a laboratory tool, basically?

A. Yes.

Q. Then what was done with the remainder of the sample?

A. It was placed inside of the aerosol generator.

Q. And then am I correct that the generator was run for about 16 minutes?

A. Correct.

Q. This was the glass chamber that had been blown?

A. Yes.

Q. By the campus glass person?

A. Right.

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Q. And you describe in Exhibit 1 the generator that you used and the amount of the airflow; is that correct?

A. Yes.

Q. It says -- at page 3 of Exhibit 1, approximately ten milligrams of the open chrysotile was placed in the bottom of the aerosol generator.

And it references fig. 1.

A. Right.

Q. There is no fig. 1 attached to this report.

A. You're correct.

Q. What is fig. 1?

A. Fig. 1 is a figure of the aerosol generator.

Q. Where is fig. 1?

A. It's not here.

Q. I know. That's evident. Where is it?

A. It's out at the laboratory somewhere. I will see if I can get it to you. Maybe we can have it Xeroxed and sent over or faxed over. It's a photographic plate.

Q. Well, I would ask actually the same

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question about figs. 2 through 6; they're referenced later on in the report. Obviously they're not attached, either. Are they also photographic plates?

A. Yes.

RQ MR. WILL: I would request that we be given copies of figs. 1 through 6.

Can Bob take care of that?

MR. BROWNSON: We can give them to you. We need to be clear what we are talking about. I am not sure I can make photographs. We can run off a Xerox with some time. We could probably, you know, have some negatives made, or whatever, make photos.

THE WITNESS: We will have to do this differently. I have to interrupt.

A. One of these is a photo montage.

Q. Right.

A. And a photo montage is about twice the size of that painting on the wall. I'm looking at a painting that's about two feet by three feet.

Q. At least as to the other five

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figures -- the photo montage is fig. 6, right?

A. Yes.

Q. At least for figs. 1 through 5 they are more 8 and a half by 11 size, or can be?

A. Well, they're more manageable, let's put it that way.

Q. Fair enough. If approximately ten milligrams was put into the aerosol generator, do you know approximately how much was used for the polarized light micropscopy slides?

A. About five milligrams.

Q. After the asbestos was put into the aerosol generator, the fibers were blown up into the air; is that correct?

A. Not really, no.

Q. Inside --

A. No.

Q. Okay.

A. No. This -- the air stream moved above the material.

Q. Okay.

A. And as the air moves above the material, it lofts any loose dust which is associated with the specimen, so that the amount

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of material that's actually lofted is small mass-wise, in relation to the specimen in the aerosol generator.

Q. If you were looking at the aerosol generator during the 16 minutes when the air was running, would you be able to see the asbestos sitting where it had been placed originally?

A. Yes.

Q. The ten milligrams. If you watched it for 16 minutes, to the eye would it appear to change in volume?

A. No.

Q. Or remain the same. The rate of five liters per minute was the air stream; is that right?

A. Yes.

Q. How does that correlate, if at all, to air streams that one would find out in the real world?

A. This particular generator and this particular experimental protocol is that which is recommended by the health and safety executive in Great Britain. This particular design and protocol was recommended in their study of

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silica, so we wanted to use this particular published method rather than introduce our own concept of what generates an aerosol.

Q. My question was a little different, though. How would the rate of five liters per minute compare to what you would find in the real world; for example, would a person walking through a room, which had ten milligrams of asbestos sitting on the floor, generate an airflow of five liters per minute over that material?

A. I don't know if I could answer that. I'm thinking to myself, looking at the dimensions of this room and the volume of the room, and I can feel the air-conditioning system working. I feel air movement. We could calculate the number of liters of the air that changes in this room per hour. And I don't believe that it would be less than five liters -- five liter airflow per minute; I think it would be considerably greater than that. So, I'm not sure of the design, for example, of the facility in Cloquet, Minnesota; although I would think an industrial setting, such as that, with machinery in operation, would

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certainly move air at greater velocities. So this velocity of five liters per minute in that volume chamber is not -- I don't think that this is terribly out of the ordinary that you would find under most circumstances.

Q. What's the volume of the chamber?

A. It could be -- I'm thinking about the liter.

Q. So, for the experiment, then, where the asbestos had been placed, the air was being changed about five times per minute?

A. Could be correct, yes.

Q. How that rate relates at all to what went on in Cloquet you don't really know; is that fair?

A. That's fair.

Q. Now, do I understand correctly that there was this carboxyl methyl cellulose ethyl filter --

A. Yes.

Q. -- on the end of the chamber?

A. Yes.

Q. And the air that was going through the chamber then passed through the filter?

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A. Yes. Correct.

Q. What kind of filter was there on the chamber on the way in to make certain that the air being passed through the chamber didn't bring its own contaminants in?

A. I don't want to mislead you. I think it also was filtered air that went into the chamber. And I had to -- I had to stop for a minute. Of the values generated, is it possible that our laboratory is so contaminated that it would contribute? I don't think so. But I believe it was also filtered in the inlet in this particular -- in this particular hood.

Q. And do you recall specifically that it was or you just think it was?

A. No. I'm drawing a blank on it. But I'm -- I would vouch, we've done a lot of experimental work in that area of the laboratory and we have -- when we do background determinations of fibers and air, we've never found any.

Q. Then once the 16-minute period was over, you took the filter that was at the outflow or outlet of the chamber; is that right?

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A. Yes.

Q. What did you do to prepare that, then, for examination?

A. Well, the first technique is a rather standard technique, as outlined in the NIOSH 7400 method, which is the preparation of the filter, one quarter of the filter for examination by phase contrast microscopy in which the filter is rendered transparent and a cover slip placed on the top of this preparation and 100 fields examined and the fibers which are coming into view are counted according to the counting protocol.

Q. And is that a preparation where you use the oil?

A. It is a material which renders the carboxymethyl cellulose ethyl filter transparent to light. And the objects which remain in -- which may be visualized are those that are inorganic.

It's like an immersion oil technique.

Q. I may have misspoken earlier when we were talking about the polarized light microscopy.

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To prepare those slides you used the oil, correct?

A. Yes.

Q. Now, for the phase contrast microscopy, you used a quarter of the CME filter?

A. Yes.

Q. This other material that renders it --

A. Correct.

Q. -- visible?

A. Translucent.

Q. Translucent?

A. Yeah. It acts like an immersion oil.

Q. What is that material called?

A. Oh, God, I've done this a thousand times and I am blocking on it. It will come to me. I am just blocking on it.

Q. What was done with the other three-quarters of the CME filter?

A. That portion of the filter is carbon coated.

Q. How is that done?

A. It's placed in a carbon evaporator. And it's called a high temperature evaporator. It is a chamber which is rendered a vacuum

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through a series of pumps, then a carbon rod is -- a high current is passed through a carbon rod and it sublimates carbon, atomic carbon. This coats a sample. This sample is then cut with a scalpel into various three by three millimeter pieces. It is placed on an electron grid substrate. These substrates are sitting inside of a petri dish on a screen, like a wire screen. Acetone is added to the bottom of this particular petri dish. Sometimes there's a sponge to keep it wet. This is covered. The acetone destroys the carboxymethyl cellulose filter.

Q. The CME filter?

A. Yeah. Let's just call it the filter. The graphite carbon holds the particles in place and you end with a grid upon which is a carbon film with particles impregnated in it, particles which had previously come to rest on that filter surface.

Q. In the carbon coating phase, when you're in that chamber --

A. Right.

Q. -- is the filter just sitting at the

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bottom of the chamber or is it on any kind of mechanical device?

A. Well, we have a new carbon coater, and that device rotates slightly. So you get a very even -- a very even coating of carbon.

Q. Did you have that coater --

A. I think we did.

Q. -- when you did this experiment?

A. Yeah, I think we did.

Q. So it rotates slightly as the current is being passed through --

A. Yes. It's a more homogeneous distribution. It's a more homogeneous coating. It's more important for other kinds of preparations.

Q. Now, you indicate that you used a support grid of 200 mesh nickel?

A. Yes.

Q. And the 200 describes the diameter of the mesh?

A. No -- yes. Yes. It describes the size of the openings. More or less.

Q. Well, the report says that the mesh openings were about 110 microns.

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A. Right.

Q. Is that correct?

A. Yes.

Q. So the 200 mesh equates to 110 microns?

A. Well, that's the edge dimension. It could be 109. Sometimes certain grids are a little less, 106 microns. But about 110. That's a figure to use. That's a figure to use. But a little more. But 110 microns squared.

Q. After using the acetone and dissolving CME filter, what you're left with on this grid are the fibers and the carbon film?

A. Whatever was on that filter, in that carbon film; that's correct.

Q. That filter preparation then is a grid preparation?

A. Right.

Q. Should we call it the grid, would that be the appropriate term?

A. Why not.

Q. It's looked at under TEM?

A. Yes. It could be looked at under light microscopy as well. In fact, it was.

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Q. Who actually looked at the specimens under the various microscopes?

A. I did some of the work on the light microscopy determination. Dr. Nolan did some of that work, and Dr. Nolan prepared the final montage under the TEM, with the transmission electron microscope.

Q. Who did the fiber counting that's reported in Exhibit 1?

A. By which method?

Q. Let's start with the light microscopy.

A. Light microscopy, I believe that Dr. Nolan was doing that technique and I was in the laboratory with him. Because there are several determinations that require, well, two people to look at it. Does this conform with the definition of a fiber and so on and so forth.

Q. Did you recount the number of fibers, then, at each magnification?

A. Yes. Oh, yes.

Q. Were you involved in doing that as well?

A. I was involved in the evaluation of

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the final data sets when the data was brought into the laboratory, and we would look at it together.

Q. Does that mean you actually sat down with the negatives and counted fibers?

A. No.

Q. Okay. Who did that?

A. No. We counted on the photographic plates. We don't count on the negatives.

Q. Did you actually count on the photographic plate?

A. I was in the laboratory and I participated in that part of the exercise.

Q. How is that different, then -- I mean, is that the same thing as counting on the plates or is that something different?

A. Well, maybe it's a little sloppy in language, but if you have a photographic plate, from that plate you make a print. Some of the counts are made on the prints rather than on the plates. Occasionally the nomenclature is interchanged, but it's not correct.

Q. You do the counting from the prints that are made from the photographic plates?

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A. Yes.

Q. Were you the person actually doing the counting on the prints?

A. I did part of that.

Q. Dr. Nolan did part of it?

A. Yes.

Q. Did anybody else do any of it?

A. I don't want to mislead you. I think there may have been a student working in the lab over the summer who may have participated in some of that. I'm not sure.

Q. Do you recall how much time it took to do the actual counting?

A. You mean this one specimen, looking at the same field, at different magnifications and making the photo montage, not counting the actual photographic development -- the development of the prints or the actual construction of the -- I would say this exercise took several weeks.

Q. Eight hours a day, 40 hours a week?

A. No. I think you have to understand laboratory work. You can --

Q. Maybe I can --

A. You can pulverize a specimen in the

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morning and look at the specimen by polarized light microscopy in the morning and then, sometime in the afternoon, transfer part of that specimen into a chamber, then set up a chamber and walk out and let it run for 15 minutes or whatever the time period is, and then come back and shut off the air pumps and then remove the filter. And then, the next day, because you're busy doing something else, you can come in and remove a quarter of a filter and then examine a quarter of the filter and do a fiber count. And then, later in the afternoon, begin to -- begin to subject a filter to digestion techniques or carbon coat --

Q. Excuse me. Let me interrupt you. I think I do understand that. Let me refine my question. I wanted to know how much time was actually spent looking at the prints and counting fibers.

A. You're asking me how much time I spent looking at the prints? Me?

Q. Right.

A. Maybe a few hours.

Q. How about Dr. Nolan? Do you know how

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much time he spent?

A. I don't.

Q. How about this lab assistant?

A. I don't. I would think it was minor. That's my recollection.

Q. When you gave me before a couple of weeks, that was for the entire project, from beginning to end?

A. Yes. Maybe it took a month; maybe it took longer. I don't want to mislead you. Because we were using someone's darkroom. We used a photographer who does other things. When we wanted a photo montage, it generally takes more time. Then the photos have to be assembled, and so on and so forth. Maybe it took a month or six weeks. It's not continuous time.

Q. In terms of counting fibers, the definition of what is a fiber is key, obviously.

A. Right.

Q. And you used a definition of something that has an aspect ratio of three to one or greater?

A. That's part of the definition.

Q. And your definition also involved a

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diameter component?

A. Yes.

Q. What was that?

A. By which method are we speaking? Are we talking about -- we are talking about the single grid opening, the single field?

Q. Yes.

A. And the single field had X number of fibers -- 60 or 70 fibers, whatever. These 60, 70 fibers were examined at different magnifications on these photo montages. So there is an examination direct and then there are a series of examinations of the same grid opening photographed at 490 and then photographically enlarged and then the same grid opening photographed on a transmission electron microscope and the photo montage generated there.

Q. That's right.

A. So the same fibers are examined, and as this magnification changed, obviously, the so-called "dimension" of the fibers changed, and their ability to be resolved either improved or degraded.

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Q. Maybe I asked an unclear question here.

In terms of determining whether something was a fiber, you indicate on page 5 that in order to be considered a fiber it had to have a width of less than three microns?

A. Right.

Q. Why did you use that characteristic?

A. That's generally considered to be the cutoff point for a fiber in terms of respirability.

Q. How about in terms of a minimum length?

A. Five microns.

Q. So you only counted things longer than five microns?

A. Yes.

Q. Were things shorter than five microns with an aspect ratio of three to one?

A. I don't understand that question. Please repeat it.

Q. When you were looking at this initial grid opening --

A. Right.

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Q. -- did you find particles that had an aspect ratio or a length to width ratio of greater than three to one --

A. Yes.

Q. -- but were shorter than five microns in length?

A. Yes.

Q. Do you know how many particles that fit in that category there were?

A. No.

Q. Why did you use five microns as the lower level cutoff for counting fibers?

A. Is this a trick question?

Q. No.

A. As you know, according to standard OSHA, NIOSH counting rules, those fibers which are considered to be important are those which are greater than five microns in length. The five micron fiber length is basically a -- part of a counting strategy, although there are discussions as to the biological potential associated with fibers less than five microns in length. But the five micron length is the standard length of -- incorporated into the

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counting strategy.

Q. To comply with OSHA regulations?

A. Basically, yes.

Q. That's why you used that definition?

A. Of course, yes.

Q. At least as you understand, is that five micron length based on the assumption that it is the fibers that are five microns in length and longer that are of biological significance?

[redacted]

Q. Maybe we'll come back to that.

A. Sure.

Q. I'll make a little note. Given that you weren't counting fibers shorter than five microns in length, why is there one such fiber that's actually reported in table 1?

A. Because it was found on review of the photographic plates that this fiber did not -- or was not five microns, it was overlaying some other fiber. It looked as if it was longer, but

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it wasn't. So it was dropped. Not dropped, but it was -- it was counted as a short fiber. The one fiber, short fiber.

Q. Now, the grid that was used for the TEM examination had how many openings on it?

A. Well, hundreds.

Q. I only looked at one; is that right?

A. Yes.

Q. Do you still have the grid somewhere?

A. Probably.

Q. How was the grid opening that was examined selected?

A. It was in the center of the grid.

Q. When the filter was placed on the grid, in the petri dish -- how was that done?

A. You mean, how is it physically placed?

Q. Right.

A. The sections of the carbon coated filter are cut with a scalpel, by means of a forceps, placed filter side down on top of the grid; so, you don't prepare one grid, you prepare lots and lots of grids. Then you select one. A grid with a homogeneous distribution, you select

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one field in all of the operations. If you compare techniques, you want to make sure you look at the same field. One field was selected and that field was then photographed. And the operation carried out.

Q. The actual grid itself, how big is it? What are the outside dimensions?

A. It's three millimeters in diameter.

Q. Within that three millimeters in diameter, there are these various openings?

A. Yes.

Q. About 110 by 110 microns?

A. Right.

Q. So you take a scalpel and cut away a piece of the CME filter?

A. Right.

Q. And then about three millimeters in diameter?

A. Edge and edge.

Q. Edge and edge?

A. Yes.

Q. That's placed right on top of the grid?

A. Yes.

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Q. You have to cut out basically a circle out of the filter?

A. No.

Q. Some of it sort of spills over the edges?

A. That's right. That's right.

Q. Then the acetate just dissolves the --

A. Acetone.

Q. Acetone, I'm sorry. Dissolves the fiber?

A. Yes.

Q. You're left with carbon covered particles?

A. The carbon impregnates the particles and holds them in this carbon film.

Q. Is it the carbon film that keeps some of these fibers from falling through the opening?

A. That's it's job. That's right.

Q. How many different grids did you make as part of this experiment?

A. Normally you make anywhere from six to a dozen.

Q. And then how do you determine, from the six to a dozen grids, which one you're

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actually going to look at for the TEM study?

A. The first thing you do is look at the fiber to see whether the particles are homogeneously distributed.

If you're satisfied in examining this preparation by light microscopy that you're dealing with a relatively homogeneous distribution, then any sub-aliquot you selected, you assume, also is homogeneously distributed.

Q. In this instance, did you believe, based on the light microscopy, that the fibers were homogeneously distributed?

A. Yes.

Q. Do I understand correctly, then, that you took this one grid and you looked at the same opening in that grid under both phase contrast light microscopy and with transmission electron microscopy?

A. Yes.

Q. Starting with the phase contrast optical microscopy, you took a photograph of what you saw?

A. Yes.

Q. Is that correct?

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A. Yes.

Q. It had a magnification of 40 times?

A. No. Wait a minute. Do you mean did we photograph the grid or did we --

Q. I am looking at page 4.

A. Right.

Q. The first bullet point there. The field was photographed with a 40 times phase objective.

A. Yes. It says the negative was photographically enlarged to 490 X. So, it was photographed, but that 40 times objective you have a camera back and a lens in the camera back that increases the magnification.

Q. To 490?

A. Yes. That was the -- that was the final magnification which approximates the OSHA requirements. That is what you would see if you followed through the large filter.

Q. Let me see -- I want to make sure what actually happened here.

You take the phase contrast light microscopy?

A. Right. We used a Zeiss inverted 35,

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IM 35 with phase contrast optics.

Q. When you first put the slide on there, if you came up to look through the microscope, it would have a magnification power of 40 times; is that right?

A. No. I apologize for this -- for the report. What it means is the following: A 40 times objective, and normally the total magnification of a light optical system is the product of the magnification of the ocular and the magnification of the objective lens. So it's merely if you had a 40 times objective and a ten times ocular, your final magnification would be 400 X.

However, in a system with a camera, the image is projected onto a film, and normally, given the geometry of the system, it's slightly enlarged. So, normally one puts a stage micrometer -- uses a stage micrometer and photographs a field with this micrometer, so that when you actually develop the print, you can see the dimensions from the micrometer. That tells you what the magnification is, for example.

If I have a one millimeter stage

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micrometer and the final image on the photographic plate is ten millimeters long, that means this represents a magnification of ten times.

Now, it's higher a hundred times, 400 times, 500 times. What was done here was a 40 times objective. We should have just indicated in this report that the final magnification was 490 times on the photographic plate.

Q. Okay. And to get to the 490 is this produced by a combination of the phase objective --

A. By the whole system, which includes the camera back, the negative. And we say photographically enlarged. It means the magnification was slightly smaller but it was photographically enlarged to 490 X. And then that was enlarged further to almost 2,000 X -- 1909 times, almost 2,000 X. Now we have an experiment in which we look at a field and we look at a field visually. We photograph the field. We look at the photographic print. Then we look at the same field enlarged by about five times larger, and then the same field, the same

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grid is put into a transmission electron microscope, which rephotographs the same field at a still higher magnification. So part of this exercise was to see whether or not these techniques were reconcilable, whether they were yielding the same kind of information. So, in addition to generating the aerosol, we were interested in the experiment, what is it that we actually see?

Q. Well, you took a picture through the light microscope and the first one that you took had a magnification of 490 times; is that correct?

A. No.

Q. All right.

A. The field -- as indicated here, the field was photographed with a 40 times phase objective. This negative was photographically enlarged to 490 times. That magnification in which the field was focused was less than 490, since it was photographically enlarged to 490.

Q. What I am trying to find out here -- let me see if I can ask a little bit differently.

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The camera that was actually hooked up to --

A. Right.

Q. -- the microscope?

A. Part of the microscope.

Q. Part of the microscope.

You take the first picture, get your first negative. Now, is that negative 490 times or do you -- is that negative 40 times and then you do something to that negative to enlarge it to 490?

A. I don't know what the final magnification was. I would have to look at the original negatives. But it was -- it was -- it was photographically enlarged to a final magnification of 490. So, it could have been 400 and then using the enlarger you enlarge it to 490, increasing the field 23 percent or something like that. But I would have to look at the actual negative. I'm sorry I can't give you that information.

Q. I am trying to figure out whether the magnification occurs when the camera is still hooked up to the microscope or whether the

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magnification is taking place in the darkroom or with an enlarger somewhere removed from the microscope.

A. That's part of the process. Once you take a photographic plate and make a print, that enlargement is part of the process. Removed from the microscope.

Q. Removed from the microscope?

A. Yes.

Q. For example, when you go from -- fig. 2, which has an enlargement of 490 times, and fig. 3 has an enlargement of 1909?

A. Correct.

Q. To get to from 490 to 1909 --

A. Right.

Q. -- do you go back to the microscope and put a different camera and a different lens on?

A. No.

Q. You go into the darkroom?

A. You just enlarge it.

Q. You just enlarge it?

A. Right.

Q. When we talk now about the TEM

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examination of this grid, the first plate was done at 900 times; is that correct?

A. Yes.

Q. And then that negative, taken at 900 times, was enlarged in the darkroom?

A. Right.

Q. Up to about just over 2300 times?

A. Right. It's standard.

Q. Then you went back and again photographed the grid opening at 4800 times?

A. Yes.

Q. And the negatives taken at 4800 direct magnification were then enlarged photographically to 12,000 times magnification?

A. Right.

Q. And that's what was put together to give you the photo montage?

A. That's correct.

Q. I notice that the photograph taken at 4800 times is not referenced to a figure number. There's no figure given?

A. Yes. It says fig. 6. That's the photo montage.

Q. That's after it was photographically

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enlarged, correct?

A. Yes.

Q. Somewhere there's also a negative just taken at 4800 times?

A. Well, they're all taken at 4800 times. All of these negatives form the prints from which you construct a photo montage. That's correct.

Q. Doctor, I want to make sure I am understanding this.

When you were using the TEM microscope, you took a photograph at 4800 times magnification?

A. A series of photographs.

Q. A series?

A. Yes.

Q. From that we got a series of negatives?

A. Yes.

Q. And those negatives were taken and each one was enlarged photographically two and a half times?

A. Yes.

Q. And those enlargements were what was

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used to compile the photo montage?

A. That's correct.

Q. Could you have taken a photograph of the grid opening directly at 12,000 times magnification?

A. Sure.

Q. Likewise, on the light microscope could you take a photograph directly at about 2,000 times magnification?

A. Oh, wow. You mean, with an oil immersion lens and with a very small optical system? I guess so.

Q. But you begin to have problems getting enough light?

A. Well, that's only one of the problems. Let's say we were to look at a screen and we were to magnify -- we were to generate a montage at 12,000 -- let's make it simple, let's say 10,000 times magnification.

Q. This is on light microscopy?

A. I am thinking on electron microscopy, how many plates you would have to -- to photograph one field. Let's say you're looking at -- you have -- let's call it a hundred

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microns. A hundred microns at 10,000 times. Just a rough calculation, you would need several hundred plates in order to photograph one field. And I went through this exercise with fiber and tissues and there I think the final number was 545 negatives, which is -- can be done today with digital cameras; otherwise, it is costly, time-consuming, and laboratories simply don't have the resources to do that.

Q. Now, on page 5 you start talking about actually determining the fiber morphology and the size distribution?

A. Right.

Q. Working off the 12,000 time magnification photo montage, the mean diameter was found to be .44 microns; is that correct?

A. Yes.

Q. With a standard deviation plus or minus 20 microns?

A. Right.

Q. And the range went from 16 microns to 1.08 microns?

A. .16 microns.

Q. .16, I'm sorry.

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A. Yes.

Q. When you compare those numbers with the 490 phase contrast optical microscope print, you got slightly different numbers; is that correct?

A. Yes.

Q. And, again, with the 1909 times PCOM you've got slightly different numbers?

A. Yes.

Q. Did you ever do the sizing, if you will, from the 4800 times TEM negatives?

A. Yes. The mean and standard deviation, the 4800 times, is represented by the 12,000 times photo montage. So, those values presented are given for that particular photo montage and represent the photographic plates obtained at 4800 times magnification.

Q. Why doesn't the -- now I am confused. Let me back up a second.

The counting that was done from the 490 times print and from the 1909 times print are from the same negative, aren't they?

A. Yes.

Q. But even though you're working from

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the same negative, you get different numbers, depending on the magnification that you used?

A. Well, when you say different numbers, statistically they are identical. The fiber size at 490 times magnification have a mean and standard deviation of 0.59, plus or minus 0.24 microns; whereas, the same fibers sized on the magnification of 1909 times were found to represent a distribution of 0.63 microns, plus or minus 0.17 microns.

If one compares these populations, statistically with a standard student t-test, these numbers are statistically the same.

Q. But when you look at them, and count them, these are the same fibers we are looking at?

A. Yes. Same fibers.

Q. Same original negative, just magnified to different sizes?

A. Right.

Q. When you look at them, for example, at a magnification of 1909, the largest diameter was found to be 1.26?

A. Right.

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Q. Microns. Whereas, if you look at it with a magnification of 490, the largest diameter was found to be 1.63?

A. Correct.

Q. A difference of, what, 37 microns?

A. .37.

Q. .37, I'm sorry.

Does that difference have any significance to you?

A. What it means to me is that, using phase contrast microscopy, there is a scattering of light along the edge of an image. And that although it is visualized and the approximate diameter appears to be a certain dimension, that a more detailed examination shows the edge to be an optical fringe rather than the edge of the particle. One has to look at a whole population of fibers to come to some reasonable understanding. Length is more easily determined than diameter. And, of course, the TEM points this up as well.

Q. I was going to say, is that why when you get into the TEM photograph the diameter gets small?

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A. The resolution is better. Yes.

Q. You can tell exactly where the edge of the material is?

A. Pretty well, yes.

Q. Now, on page 6 you talk about the fiber concentrations. And you say the value that you found was consistent with those reported earlier by Union Carbide scientists in their simulation plenum test; is that right?

A. Yes.

Q. Do these concentrations that you generated in this plenum experiment bear any relationship to the concentrations that actually existed in the real world out at Cloquet?

A. My understanding is that there are no -- there were no measurements taken in that plant during its operation.

Q. Okay.

A. It is my understanding that is the one of the purposes of simulation tests, to generate what could be representative aerosols of materials handled in a plant.

Q. Well, are you suggesting that this concentration that you obtained in your study

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here is representative of the concentrations that existed at the Cloquet plant during actual operations?

A. I am representing to you that there are circumstances under which pelletized chrysotile of this nature is manipulated and physically manipulated and there are conditions that will generate an aerosol of this particular concentration. So manipulations may generate less of an aerosol, some maybe more.

Q. My question is: Are you saying that this manipulation that you did is representative of what actually happened at the Cloquet plant?

A. I never represented that, counsel. What I am saying is that this was an experiment to determine if a pulverized pellet -- I am using your word -- could, under some circumstances, generate an aerosol. And if the aerosol is generated, what is the magnitude of the aerosol according to the standard OSHA, NIOSH counting procedures. Which are the fibers that are regulated.

Q. And if you changed the parameters of the experiment, you could get far different fiber

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concentrations, couldn't you?

A. I would assume so, yes.

Q. Tables 1, 2, and 3 contain some of the actual dimensions of the fibers; is that correct?

A. Right.

Q. Over on page 10, the table 3 is entitled "diameters of the five diameters." Is that a mistake?

A. Sure is.

Q. What's that supposed to say?

A. Diameters of the five fibers that were found to be greater than that, the resolution of the light optical. They happened to be of a size, of a diameter which conforms to the resolution of the optical system. So you're not relying on the scattering of light at the edge, but, rather, you can actually see the object, you can resolve the object.

Q. Does that mean on a light microscope you cannot observe fibers that are less than .85 micron in diameter?

A. No. What it means is that you can see an object and you can see its morphology and you can determine its length with very good

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resolution, but its diameter is more problematic. And the diameter, you see a scattering of light. You're actually looking at some artifact of the light, rather than the actual diameter. And this exercise on page 10, because of the resolution of the system, these are the numbers of fibers whose diameters were greater than that particular limit of resolution. And when you look at the actual numbers by the various techniques, statistically, they are identical.

So, it shows that if you have a good optical system with a good limit of resolution, you will see those particular fibers, at least those fibers greater than the resolution of the system. That was another part of the exercise.

Q. I take it your conclusion from this experiment is that it is possible to generate an aerosol from a crushed or pulverized pellet?

A. Yes.

Q. Under the experimental conditions?

A. Under the experimental conditions, yes.

Q. Did you reach any other conclusions,

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as a result of this experiment?

A. Well, I've discussed this with Mr. Brownson. I think there are a number of other experiments that could have been done. I think that the only problem was that Union Carbide did a lot of experiments and we were going to reproduce them, so we didn't pursue this.

Q. Is that don't bother?

A. Don't bother. Because we actually, I think, demonstrated that, yes, there are conditions and you can generate dust.

Q. But what were some of the other experiments that you were interested in doing?

A. Well, we could have used -- there are different -- there are different ways of grinding this material. We could have taken a pellet and banged it with various devices. People break up bags, and so on and so forth. We could have broken open a bag and actually used space suits to step on them and track them, and so on and so forth. But there's a limit, and I understand this very, very well. We could have done a major study on this. There are finite resources, I

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suppose.

Q. So you were talking about experiments that would more closely approximate actual working conditions?

A. In a sense, I suppose.

Q. Did you ever do any experiments where you put the calidria pellets into water to see what would happen to the size distribution of the fibers?

A. I may have, but when you put chrysotile in water it tends to form a gelatinous material. It's depending on fiber length. But did I do it with calidria? I'm not sure I ever did that with calidria.

Q. Specifically, what I want to know is whether you've done any experimental work to see whether putting calidria in water has any impact on the fiber lengths as a result.

A. Fiber length?

Q. Yes.

A. No. Most of the experiments with water pertain to dust suppression. Fiber length? No.

Q. Now, this report was written up in

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August of 1998; is that right?

A. Right.

Q. Did Mr. Brownson request that it be written up at that point?

A. I think he did.

Q. Did he explain to you why he wanted it?

A. Well, I think the answer is quite obvious. We had data languishing somewhere and Mr. Brownson considered these data important. We had validated a series of, or whatever the plenum tests were, and the data were available. This is a litigation which pertains to dust generated by this product. It seems rather appropriate.

Q. Do you remember when it was that he asked to you write this up?

A. During that time period. It could have been on August 18th or 19th or whatever.

Q. About a month?

A. The 17th.

Q. About a month ago?

A. Well, what's today's date?

Q. 16th of September.

A. Time goes fast. Yeah. Could be about

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a month ago.

Q. And how did he ask you to do it? Was it by letter, by telephone, in person?

A. I think he -- I think I asked him to say please and pretty please. But, other than that, what do you mean how did he ask me?

Q. Did he call you on the phone? Did he send you a letter? Did he bump into you at the airport and say, oh... how did he ask you? In what form?

A. I believe Mr. Brownson was in New York for someone's deposition and we met and discussed my forthcoming deposition. And at that time the existence of these data were made known to Mr. Brownson. He forgot about them and I forgot about them, of course. He asked me to write them up, and I said yes.

Q. Did he say anything to you about why he would like them written up?

A. I think it's fairly obvious.

Q. My question is did he say anything to you, I would like these written up because I would like to do this or that with them?

A. No.

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Q. So your assumption about why he wanted them written up is just an inference. It may be a logical inference, but it's just your inference?

A. Well, I think there are certain obvious reasons.

Q. Okay.

A. It is my understanding, as an example, that the witness that Mr. Brownson was deposing -- is under the impression that this material consists of submicroscopic fibers, less than five microns in length. And I said, no. This is a commercially short fiber and we have data to support that. And then, of course, we thought about this and I said we have data in the files that we've never used. We just discussed it and forgotten about it.

Q. Let me ask you that. Is calidria considered a commercially short fiber?

A. Oh, certainly.

Q. In terms of Exhibit 1, your report here, your report does not talk about the extent to which these pellets produced fibers less than five microns in length, does it?

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A. No, it doesn't.

Q. It doesn't, for example, attempt to give a percentage of fibers greater than five microns versus the percentage less than five microns?

A. No, I didn't think that was important. I have published on that.

Q. I am not asking whether it's important. I want to make sure. It doesn't attempt to say what percentage of the aerosol was greater than five?

A. No. No. This report attempted to show that with a number of techniques and with a number of magnifications you get reasonably reproducible results, in terms of fiber number. I would not, personally, recommend it to do a size distribution, if you're interested in fiber diameters, because of the resolution of the light optical method.

Q. Why was Mr. Brownson interested in fiber diameter?

A. Here he is.

Q. I can't ask him. As you understood it, what was the significance of fiber diameter?

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A. You want me to interpret?

Q. Right.

A. This is my interpretation, which may or may not be true.

Q. Right.

A. I think, very often in environmental assay, depending on the technique, there are objects of biological importance which escape the attention of the microscopist; the question is, how much and how frequently. Now, the calidria asbestos deposit is an example of a commercially short material and disaggregated material of -- fibers may escape detection based on these properties. Properties of the state of aggregation. This was explored as well.

Q. You say they would escape detection because their diameter is difficult to determine from --

A. It's the diameter which determines visibility in an environmental assay, not length.

Q. When you talk about environmental assay, what are you talking about?

A. Workplace assay.

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Q. So, to put it in simpler terms: If we are looking at fibers taken from a personal air monitoring device, worn by somebody in the workplace, you're saying that fibers on that filter with a diameter less than .85 microns may be difficult to see?

A. No. You will have, depending on the resolution of the system, difficulties determining the actual size of the diameter of the particle. But you will see an object "light up," put that in quotes, "light up." And you will not be able to resolve it with any definition, no definitive resolution.

Q. So you could see that there is something there that is, say, six microns long?

A. Right.

Q. You wouldn't be able to tell precisely how wide it was?

A. Correct.

Q. Could you identify such a structure as a chrysotile fiber?

A. Specifically? The phase contrast operational microscope provides no identity of the particle.

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Q. You would have to use some other method to determine?

A. Correct.

Q. Were you suggesting, then, that people who were doing environmental assays failed to count calidria fibers that were on the filters because they couldn't resolve them?

A. This issue is raised in chrysotile textile plants where long, thin fibers beyond the resolution of the light optical method are thought to be responsible for the pulmonary diseases.

Q. When you say "long, thin," what are we

thin.

Q. When you say "thin," what diameter, what measurement?

A. Less than the resolution of the light optical microscope, perhaps less than 0.2 microns in diameter.

Q. What sort of length are we talking about?

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A. Anything over five microns.

Q. Now, would a fiber that had a diameter of .2 microns and was, say, seven microns in length, would that be observable under phase contrast microscopy at 490 times magnification?

A. It depends.

Q. On?

A. It depends on the microscopist and it depends on the optical system. It might be seen.

Q. Or it might not be?

A. Or it might not be.

Q. To get this back to calidria for just a minute. Have you seen any of the environmental dust counts done in workplaces where calidria was being used or being processed?

A. I believe I've seen data from Union Carbide.

Q. From their own mine and mill?

A. Well, they also went to other workplaces where the material was being manipulated.

Q. And are you offering any opinions in this case on whether those dust counts are

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inaccurate because the microscopist failed to see or count some of these calidria fibers?

A. I would have to review the data to offer an opinion.

Q. At least, sitting here today, you're not in a position to give an opinion?

A. I have no recollection of the specifics of the data sets.

Q. Now, I want you to assume with me that some of the dust counts that were done in facilities where calidria asbestos was being used as an ingredient in the production process came back showing less than five fibers per -- well, let me back up.

Off the record.

(Discussion off the record.)

Q. Assume that they show less than five fibers per cc; again, a fiber being something with three to one length/width ratio and longer than five microns.

A. Right.

Q. Would that suggest to you that the microscopist just missed the process?

A. It doesn't suggest anything.

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Q. How about if the numbers were less than two fibers per cc?

A. Again, one has to look at the details and the specifics of the assay, the protocol, the technique and the actual microscopist who did it.

Q. So, simply because Union Carbide's test showed fiber concentrations that were lower than the ones you generated in your experiment here in Exhibit 1, it would not suggest to you that microscopists were necessarily missing or failing to count fibers, would it?

A. Not necessarily. It wouldn't be -- it wouldn't necessarily mean that.

Q. Do you have any plans to do anything with this data in Exhibit 1 in terms of any publication or presentation outside of this litigation?

A. I don't know. I mean, it may find it's way into some paper at some time.

Q. At the present time, do you have any plans or intentions for this data?

A. No.

Q. Beyond this litigation?

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A. No.

Q. You mentioned this was done under the protocol of the health and safety executive from Great Britain?

A. That's right.

Q. That protocol was used, initially, for silica?

A. Silica dust. Silica-containing dust, that's right.

Q. Are you familiar with any other types of -- excuse me, any other protocols for this type of study?

A. I don't understand the question.

Q. All right. Has the United States government, for example, come up with a protocol for trying to measure whether you can aerosolize fibers or materials?

A. I don't think so. No.

Q. As far as you know, the only one in the world is the Great Britain protocol?

A. No. That's not fair. There is tremendous literature on experimental pathology studies in which inhalation chambers are used and animals are exposed to various dust, through

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inhalation as a route of administration.

There are a number of designs of different devices used to generate aerosols.

There is tremendous literature here and I believe that simulation studies are conducted by a number of laboratories based on some of these principles. But I think your question was does the US federal government have any protocol.

Q. Right?

A. I don't believe so. Other than the inhalation facilities at the NIEHS.

Q. By "protocol," what I was trying to get at was for experiments designed to measure whether it was possible to aerosolize various materials.

A. Oh, then I misspoke. Because when one does experimental pathology, one generates a dust level which is a maximum tolerated dose to an animal. There a dust is generated which is the most possible. So if we were to simulate the same kind of experiment, rather than five liters of air, we would just blow the hell out of this particular dust in the chamber.

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Q. Let me back up a second, Doctor. I have a feeling we may be talking a little past each other.

The health and safety executive devised this protocol, as I understood it, to see whether or not you could create silica dust?

A. Yes.

Q. With this amount of airflow?

A. Right.

Q. And you used that protocol for the same purpose to see whether you could aerosolize asbestos fibers from a crushed calidria pellet?

A. Yes.

Q. And that was the question. Are you familiar with any protocols, other than the great Britain protocol, for determining whether one can create an aerosol out of a particular material?

A. The answer is no.

Q. If you had kept the pellets in the blade mill for longer than about two seconds, do you think that would have had any impact on the results of the experiment?

A. Yes.

Q. What would it have done, in your

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opinion?

A. It would have formed a size distribution that would have been smaller and the potential for fiber release much greater.

Q. So, am I correct you believe it would have reduced the number of fibers longer than five microns?

A. No, I think it would have increased the number.

Q. And why is that?

A. Because the first property of the material to be affected by the blade mill is diameter. It disaggregates the fiber bundles. In fact, we showed that. We published that in a paper.

Q. Which paper is that?

A. That was the paper on the experimental work with the human alveolar microphages.

Q. Yaeger, et al.?

A. Yaeger, et al.

Q. If you ran the blade mill longer, you would end with smaller diameter fibers?

A. First smaller diameters. If you wanted shorter diameters, you would use a ball

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mill.

Q. And would running the blade mill longer give you just more total fibers, both longer and shorter than five microns?

A. Yes. Can we take about five minutes?

MR. WILL: Sure.

(Recess taken.)

MR. WILL: Mark this as Exhibit 2.

(Langer Exhibit 2, document titled "Tissue Burden Studies, Conwed Cases," with attachment, marked for identification, as of this date.)

Q. Dr. Langer, I am showing you or giving you what we marked as Exhibit 2, which is a two-page document. The first page says "tissue burden studies, Conwed cases." Then the second page talks about instrumentation; is that correct?

A. Yes.

Q. Can you tell me, starting with Mr. Maki, when it was that you did the tissue analysis for him?

A. I don't remember.

Q. Was it more than a year ago?

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A. I can't recall.

Q. How about Mr. DeRusha, do you remember when that was?

A. He, as well, I don't remember the precise dates for any of these four.

Q. Can you tell me whether any of the four were done within the last year?

A. I think Dahl was done within the last few months, but I can't recall the others. Maybe Banister as well.

Q. These were done at different times?

A. Yes.

Q. Just a general matter, without reference to these specific individuals, how often does your lab do tissue analysis for asbestos fibers?

A. I do tissue burden studies approximately once or twice a month. Dr. Nolan may do them an equal number of times. But he will have to speak for himself.

Q. Is that work generally in connection with litigation?

A. Generally.

Q. You've also done some tissue burden

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analysis in connection with your scientific writings?

A. Sure.

Q. Would I be correct that all four of these individuals had their tissue examined, as you understood it, in connection with litigation?

A. Yes.

Q. And was it Mr. Brownson, or someone from his office, that requested that these four individuals' tissue be examined?

A. Yes.

Q. Now, when you say you do tissue analysis one or two times a month, how much of the work do you actually do and how much is done by somebody else, a lab technician or someone else?

A. That's a fair question. When I do a tissue burden study, I receive the tissues myself. I examine the tissues myself. If the available tissue is mounted in a paraffin block, I will request slides to determine if the tissues are lung tissues or if they are other kinds of tissue or tumor tissue. I will personally remove the tissues from the blocks. I will personally

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divest the tissues in appropriate glassware. I will personally prepare the tissues, EM grids, and I will personally examine the tissues.

Q. So when you do it, you do all of it, basically?

A. I do all of it. I will not develop photographic plates and I will not print the photographs. I will interpret the data myself.

Now, occasionally a piece of equipment is down and an assay must be done in some expeditious fashion, in which case I might prepare the tissues myself and hand them to some other laboratory to do the assay, or have the tissues prepared at some other laboratory and the materials returned to me for an assay in my laboratory; or, if the instrument in our laboratory is also unavailable, I might have someone else do the assay. And I interpret the data. So there are variations to this.

Q. Right.

A. Particular --

Q. Those are the exceptional situations where a piece of equipment isn't available?

A. It's not the norm.

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Q. In the case of Mr. Maki, did you do the analysis?

A. I believe I did Maki and DeRusha and I believe Dr. Nolan did Banister and Dahl. That's my belief. I don't want to mislead you.

Q. Now, when Dr. Nolan does a tissue analysis, do you know what his practice is regarding how much of the work he does and regarding how much someone else does?

A. I think it's very similar to what I do. That's a question that should be reserved.

Q. For Dr. Nolan?

A. Of course.

Q. Do you have any kind of file on Mr. Maki and Mr. DeRusha -- you, personally?

A. I have files for the tissues that I do, yes.

Q. So, assuming you did Maki and DeRusha, you would have a file on those?

A. Yes. I'm assuming that I would have those files.

Q. And what about Dr. Nolan, is it his practice to keep a file on the individuals where he does a tissue analysis?

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A. Yes.

Q. So presumably, if we were looking for Banister and Dahl material, we would go to him?

A. I think so. I think it would be available in our laboratory.

Q. Have you brought anything with you today that relates to any of these four gentlemen?

A. I have brought the materials that you have outlined. Actually, it's the cover sheet and I have the analytical -- the instrumentation outline. Then I have tissue analysis for inorganic particles, Clarence Maki, dated June 28, 1994. Joint photo of microns of tissues. There are data from Banister and DeRusha and from Dahl. Why don't you take a look at those.

Q. Well, I was looking at them from across the table as you paged through them. I believe those are the same materials that Mr. Brownson provided to me --

A. Good.

Q. -- earlier.

A. Good.

Q. Now, is there another file back at

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your office or your lab somewhere that has some additional material about Clarence Maki in it?

A. I can't state that with certainty, other than the fact that there may be a Federal Express shipping label with the date on it. Or a cover letter which indicates the time and the transmission of a specimen to my laboratory.

Q. For example, where would the original photographic negatives or plates be?

A. They should be in a laboratory as well.

Q. When you do fiber counting, do you take notes or do anything like that?

A. I do, yes.

Q. Do you save the notes that you take while you're looking through?

A. Yes.

Q. Would those, likewise, be in the file?

A. Yes.

Q. To your knowledge, has any search been made of the laboratory files and Dr. Nolan's files for material relating to Maki, DeRusha, Banister and/or Dahl?

A. Could you please ask that question

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again.

Q. Within the last, say, two to three months, did anybody make an effort to go through your files, Dr. Nolan's files, the laboratory's files, and find materials that related to Maki, DeRusha, Banister and/or Dahl?

A. No one asked me for them. But I speak for myself, of course.

Q. I take it that's something that could be done if anybody asked to do it?

A. Sure.

Q. Now, I want to skip over to page 2 of Exhibit 2 for a moment. There you set out the instrumentation that you used for these analyses, correct?

A. Correct.

Q. I notice that a different electron microscope was used for Mr. Maki than was used for the other three?

A. Right.

Q. Why was that?

A. Because Maki's assay was performed before we had our instrument installed in our laboratory. We used the one at Mount Sinai in

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their department of pathology.

Q. Maki was done at Mount Sinai?

A. Yes.

Q. The other three were in your lab?

A. Yes.

Q. Where is your lab?

A. At the Brooklyn College campus.

Q. In terms of the two different microscopes, is there anything that one offers that the other doesn't?

A. Well, sure. Yes.

Q. What are the differences between them?

A. The 2010 is an electron microscope with greater resolving capabilities and control of the electron beam, which permits acquisition of data on very small areas of an object. We call that convergent beam microscopy.

We have a windowless -- a thin window detector on our X-ray detector, which permits acquisition of data of smaller concentrations of elements and light elements. We have a digital camera, which virtually eliminates the necessity for obtaining images on a photographic plate. We can image molecules at this particular instrument

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which is beyond the resolving capabilities of the 100 CX. It's a better instrument. It's a quantum jump in technical design.

Q. If you were to reanalyze Maki's tissue on your 2010 microscope, do you think that would alter the results that you reported here?

A. Probably not.

Q. Now, at the bottom of page 2, under definition of asbestos fibers used for count, you say all asbestos fibers present were counted.

A. I beg your pardon?

Q. I am looking at page 2 of Exhibit 2. At the very bottom of the page, in bold, there's a heading of "definition of asbestos fibers used for count." Do you see that?

A. Yes.

Q. And the document then says, all asbestos fibers present were counted, right?

A. That's what it says, yes.

Q. Now, first question is: Can you tell, just looking through an electron microscope, whether something is an asbestos fiber or not?

A. I hope so.

Q. Just by its appearance, visual

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appearance?

A. No, of course not.

Q. What else do you need to do?

A. There are three diagnostics used in the enumeration of objects that you call asbestos fibers.

One, there is morphological information, and depending on the asbestos fiber type, this includes a range of properties, of characteristics. With chrysotile it's a central capillary, and the fact that focusing the condenser lens on the object, which is called a chrysotile fiber, causes the fiber to undergo certain deformational characteristics.

And one can change the geometry of the system and --

I said there's something about you can -- with the morphological characteristics, there are morphological characteristics you find with amphibole asbestos fibers, which contain twin structures and defect structures and other morphological variations.

Then there is the second diagnostic, which is a structural characterization of the

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particle by a diffraction technique -- which, of course, helps you distinguish chrysotile from everything else in the universe and helps you determine whether or not you are examining an amphibole fiber or not. Depending on the nature of the stage of the electron microscope, you can reorient the particle and bring to observation a certain structural zone of the crystallographic structure of the mineral which we call a principal Laue, that's the name of someone, zone.

And the final diagnostic is the chemistry, which is obtained by a standard probe technique in which an energy dispersive X-ray spectrometry system is used rather than crystal. You have morphology structure and chemistry in which an object which is long and thin, which morphologically resembles some asbestiform fiber may be analyzed, and definitively analyzed.

Q. When you are doing an asbestos count with an electron microscope, the morphology you do by looking at it; is that correct?

A. Yes.

Q. Do you run the structural analysis and the chemical analysis on every fiber you see?

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A. I don't.

Q. Do you have somebody do that?

A. No. No. No. There's a certain experience that you bring to all of this. And if you have a single isolated particle, that is 0.03 microns in diameter, that's 300 Angstrom units in diameter with a central capillary, which is 20 microns in length, with a diffraction pattern which is characteristic of chrysotile. The assay could stop right there. You may find a hundred of these objects and you may drop the beam, focus the beam on ten of them and generate an X-ray single, just to confirm what you're looking at. The same is true of amosite fibers, in the sense that you might characterize -- if you have a large number of the objects, you may characterize a proportion of them and assume that those objects with similar morphological characteristics, such as twining and defects, that these are also amosite fibers.

Q. Is there a length below which you cannot perceive the asbestos fiber with the electron microscope?

A. There actually isn't. I normally

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count fibers greater than one micron in length.

Q. In terms of the results reported on the first page of Exhibit 2, do we know what the length of any of these fibers are?

A. For Maki, that would be greater than one micron in length.

Q. And if you did DeRusha, that would also be greater than one micron?

A. Yes.

Q. How about Dr. Nolan, do you know what cutoff he uses?

A. I think he uses one micron. I'm not sure.

Q. How about if I were interested in how many of these fibers were longer than five microns; is there any way to tell that?

A. Not by these data.

Q. Do you have the data anywhere to tell that?

A. You have to look at the original data sets.

Q. Which are, presumably, back at the lab?

A. In the file.

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Langer

Q. You earlier, when you were talking about fiber length, you indicated that calidria was a commercially short fiber?

A. That's right. Yes.

Q. And in terms of reference to a commercial short fiber, what does that refer to in terms of length?

A. The fibers of -- for example, chrysotile, from Canada, are subjected to a sizing procedure before they enter commerce. And that sizing procedure is called a Quebec screening technique. And it consists of a design of a series of four boxes of -- screens. Physical screens. And the fiber, the raw -- a pound, one pound, 16 ounces of raw fiber are dropped at the top on the uppermost screen. And this screen, set with a catcher at the bottom, is moved in a certain manner. It's shaken back and forth and rotated slightly, and so on and so forth, and the fibers, after a prescribed period of time, this material, these fibers, this one pound of fibers falls through these screens. And then on each of the screens the material is removed and it's weighed, literally weighed, and

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the nearest ounce given. So, if you have an extraordinarily -- you have four sizes. Screen 1, screen 2, screen 3 and the bottom catcher, which catches all the fine materials that are not caught on the uppermost screens.

The longest fiber is 16 ounces on the top. So it's 16-0-0-0.

In a cement fiber, a 4T fiber -- that's group 4, grade T -- that may be something on the order of 4-8-3-1. That would be a cement fiber. Something like that.

Q. Commercially short is not necessarily directly related to the short in the sense of --

A. Of being biologically short.

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Q. Is that fair?

A. That would be very fair.

Q. In terms of biologically short, what length cutoff do you refer to?

A. Well, it depends on who you read.

If it is Merle Stanton and his S fibers that had the greatest mesotheliomagenic potential, they were greater than eight microns. And fibers less than eight microns had less of a mesotheliomagenic potential and their ability to induce this tumor in a laboratory animal decreased.

Q. So, Stanton would say eight microns is the --

A. Most active. He never said a biological threshold. He said most active.

Q. What are some other definitions of "biologically short," if you will?

A. Well, there was an interesting paper written by Frederick Pott on the biological potential of fibers, which appeared about 20 years ago in the literature. And he thought that the gradient dropped off below five microns and reached a vanishing point, a zero point at about

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one and a half microns.

So the shorter the fiber below five microns, the less biological potential it exhibited.

Q. The gradient that you were talking about is the gradient for causing biological change?

A. I'm sorry to tell you this, Counselor, I was distracted. You have to repeat the question.

Q. You said that Pott's article reports that the gradient drops off at about five microns and vanishes at about one and a half microns?

A. I don't think I said that.

I said that there is a biological gradient and the biological gradient, the highest tumor-producing potential was a fiber of about 20 microns in length, 10 microns in length. And it decreased as the length decreased from that point. And below five microns it decreased, and the vanishing point where there were no tumors, he thought, was about one and a half microns or something.

Q. Do I gather that the decrease is more

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marked and dramatic below five microns than it is above five microns?

A. I don't think it is. I think it drops off and the curve then becomes more shallow below that point. But -- if I interpret your question correctly, you are suggesting that the slope changes below five microns.

Q. Right.

A. And decreases in biological activity more so below five microns. I don't believe that curve shows that, no.

Q. Basically. We should look at Pott's --

A. Sure. I agree.

MR. WILL: Why don't we stop at this point and take our lunch break.

(Recess taken.)

(Luncheon recess: 12:30 p.m.)

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AFTERNOON SESSION

(Time noted: 1:30 p.m.)

ARTHUR M. LANGER resumed and testified as follows:

EXAMINATION (Cont'd.)

BY MR. WILL:

Q. Before we took a break for lunch, we were talking about Exhibit 1. Down at the bottom -- excuse me, Exhibit 2. Down at the first page of Exhibit 2 there's a note there that says "definitions, tissue preparation as given in Nolan, et al., 1994 environmental health prospect." I assume that's to be "prospectives"?

A. It is.

Q. 102, 245, 250; is that correct?

A. Yes.

Q. That's what it says?

A. That's what it says.

Q. Does that mean, then, that these tissue specimens were prepared in accordance with the procedure that's outlined in that article?

A. Yes.

Q. And the title of that article is the "Lung Content Analysis of Cases Occupationally

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Exposed to Chrysotile Asbestos"; is that correct?

A. I think it is. Yes.

Q. The authors are R.P. Nolan, A.M. Langer and J. Addison; is that right?

A. Yes. Yes. May I look at it for a moment?

Q. Sure. Go ahead. Just so the record is clear, I have a copy of the article here.

Have you had a chance to briefly look at it?

A. Yes.

Q. Did you look at the section in the article that talks about preparation of lung tissue specimens?

A. Yes.

Q. Were all four of the tissue specimens we are talking about here, given to you, affixed in paraffin?

A. No.

Q. Which ones were not?

A. The two specimens which have quantities of tissue one gram or greater are those that are obviously wet tissues. I say "obviously" because most blocks contain less

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than one gram of tissue.

Q. So the DeRusha and Dahl tissue specimens came in paraffin blocks, the Maki and Banister was wet tissue?

A. Yes. Certainly for Banister, of course.

Q. And then for DeRusha and Dahl the first step was to use xylene to remove the paraffin?

A. Yes.

Q. What about for Maki and Banister, what was the first step with the wet tissue?

A. My procedure is slightly different than the one described in the 1994 article. I remove tissue from its container. Normally these bulk tissues are transmitted to my laboratory in formalin, which is a fixative agent. The tissues are removed from the formalin, and an aliquot of tissue is removed from the specimen with a scalpel. If there is tumor associated with the tissue, the tumor tissue is avoided. That tissue is then dried on a towel, which is nothing more than paper towel, and placed in a weighing boat and weighed. And that particular weight, once it

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is dabbed -- once the tissue is dabbed of excess formalin, I record as wet weight. My conversion to dry wet is move to -- move the decimal point after the final assay.

Q. You use a factor of ten?

A. Yes. That's correct.

Q. You said that your procedure was slightly different than the procedure outlined in the article, correct?

A. Right.

Q. Did you actually write Exhibit 2 or did somebody else write that?

A. I believe that table was written by Dr. Nolan.

Q. How about the note down at the bottom that says: "definitions tissue preparation as given in Nolan, et al.," was that written by him as well?

A. I believe it was.

Q. At least as far as the work that you did, that's not 100 percent accurate?

A. That's not 100 percent accurate.

Q. In terms of the final results one gets, do you think there's any distinction

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between the method that Dr. Nolan follows and the one that you follow?

A. No.

Q. If the tissue comes to you not in formalin but in paraffin, then what do you do?

A. Then the specimen -- assuming, of course, it's lung tissue, the specimen is removed physically from a paraffin block with a scalpel. The specimen is then placed in a 200 milliliter beaker. The specimen is immersed in approximately 100 milliliters of xylene. It's allowed to sit in the xylene for a period of time, it could be a half hour it could be one hour.

It's stirred with steel implements. It is removed from this particular xylene bath. It is placed in another xylene bath, fresh xylene. It's allowed to sit in the fresh xylene for approximately one half hour. After that period of time it is removed from the xylene bath and placed in ethyl alcohol, approximately 100 milliliters of ethyl alcohol. The ethyl alcohol loosens the xylene -- the partially dissolved paraffin. It is then physically -- any remaining

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paraffin which can be physically removed is removed, since it's loosened from the tissue. It is then placed in a distilled water bath and then placed on a towel, absorbent towel, and the procedure followed is exactly the same procedure as removing a tissue from formalin.

Q. So you go from the absorbent towel, then, to the weighing mechanism?

A. Yes. Placed in a weighing dish, weighing boat.

Q. Then after the weighing, what -- from then on, are the procedures the same?

A. Yes. They're basically the same. There's the centrifuge tube. The tissue is placed in a thick wall centrifuge tube, covered in approximately 30 milliliters of 5 percent potassium reagent. This is placed in a hot water bath. It's allowed to digest in the bath until there's no remaining tissue visible in the tube. The preparation is then subjected to a number of cycles involving centrifugation, decantation of broken down tissue materials and reagent. Redispersion in distilled water until the supernatant over the specimen is clear.

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That generally is achieved after five or six or seven cycles of washing.

Then the pellet, which represents the materials which have been recovered from the pulmonary tissues, that pellet is dispersed with a short time sonic burst, perhaps a second or two at approximately 60 watts of power. And that suspension is then transferred to appropriate TEM substrates.

After drying, it is examined by TEM.

Q. Now, is the potassium hydroxide designed to digest the lung tissue or the organic tissue?

A. Yes.

Q. Theoretically, what you're left with is only the inorganic materials that were in the lung?

A. Yes.

Q. You said that you do this digestion of the organic materials through, in part, a centrifuge?

A. No. The centrifuge is used to collect the particles.

Q. I'm sorry. It collects what has

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been --

A. Liberated.

Q. Liberated?

A. Yes. Or recovered, if you like.

Q. How does the centrifuge form a pellet out of those recovery materials?

A. The force of the centrifuge is adjusted so that the smallest particles are pulled through the medium and allowed to collect below the supernatant, which means the supernatant can be discarded just through decantation and the particles will remain at the bottom in a pellet form.

Q. When you say a pellet, I mean, is it actually a pellet that has some adhesion or consistency to it? Could you pick it up with a tweezer and it remains as a pellet or is it a lump of material?

A. It's a lump of material. Sometimes it can form what you described as a pellet. Occasionally. Not all the time.

Q. Under what circumstances does it form a pellet that has some cohesion to it?

A. There are times that we have -- I have

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analyzed lung tissues with clay minerals, and clay minerals tend to form pellets. They adhere -- they self-adhere very easily.

Q. Do you recall, in these particular studies that you did here, which would be Maki and DeRusha, whether you found any clay materials?

A. I didn't look for it.

Q. Do you recall whether the recovered material formed a pellet that actually adhered or not?

A. No.

Q. You don't recall, one way or the other?

A. I don't recall.

Q. After you have this pellet or lump, if you will, of recovered material --

A. Call it a concentrate.

Q. A concentrate -- then, you're going to prepare the grid for TEM analysis?

A. Right.

Q. Take me through the steps. What do you do once we have this pellet?

A. Once you have the pellet, you have the

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materials concentrated from some volume of tissue. This material must be transferred to an appropriate EM substrate which will permit you to study the parts which have been recovered.

Q. By "EM," you mean electron microscope?

A. Yes.

Q. How do you go about transferring that material to an appropriate EM substrate?

A. I will speak for the technique I use. There are others. My own technique involves the pipetting of an aliquot of suspension onto a grid. One must determine -- and there are different ways of doing this. We use volumetric glassware and we use volumetric pipettes. We do this in the following manner: We subject the concentrate to a short sonic burst in a known volume of distilled water. We withdraw, we micropipette, volumetrically, ten microliters of that suspension onto an EM grid, and a ten microliter fits on a three millimeter grid. That's allowed to evaporate to dryness. When it is dry, one can examine these grid preparations. Of course the grids are formvar, substrate grids upon which carbon has been deposited, and the

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microdrop is placed on top of the carbon. So these particles are sitting on top of a carbon substrate, which is then thermally and electronically stable, when examined with an electron beam.

Q. Are these the same grids that we were talking about this morning that you used --

A. Yes. We generally use 200 mesh grids. Occasionally we may run out of some grids and order them and they are not available, so we will use 180 mesh grids or 150 mesh grids or something like that. But we've stopped using nickel grids altogether.

Q. Why is that?

A. Because the new electron microscope has a design of its imaging device, the pull pieces that are very sensitive to magnetic fields. Nickel grids do generate a small magnetic field they distort the image you're looking at. We've gone back to copper grids. Of course the problem with the copper grid is the resolution with the sodium signal. We have such a superb high resolution energy dispersive system, we can resolve a copper line from a

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sodium line, so it's noninterfering.

Q. In terms of our studies at issue here, was Maki done on a nickel grid?

A. Yes.

Q. How about Dahl, was this done within the last six or seven months?

A. I think the other three were on copper grids.

Q. Copper grids?

A. Yes.

Q. So, that's another instance where the description in the article --

A. May not fit exactly. Correct.

Q. Back when you were using the nickel mesh --

A. Right.

Q. -- would you coat the nickel grid with carbon in that carbon chamber --

A. Yes.

Q. -- as you described this morning?

A. Yes.

Q. When you do that coating of the grid, there is nothing else in the chamber other than the grid at that point?

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A. That's correct. Yes.

Q. Then you take the coated grid and you pipette the solution onto that?

A. Suspension.

Q. The suspension?

A. Yes.

Q. What is the known volume of distilled water into which you place the pellet?

A. There is no standard volume of dilution. Sometimes there's so many particles recovered you want a dilution in 30 ml's distilled water. Other times there are fewer particles and you may dilute in only five ml's or even less.

Q. So it depends on the amount of recovered material?

A. That's correct.

Q. Assuming we are done with the centrifuging process and we have this pellet --

A. Right.

Q. -- do you ever divide the pellet in half and say we'll put half of it into ten milliliters and the other half in 25 so we have two different concentrations?

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A. Are you asking me have I done it in these cases or ever?

Q. Have you done it for these cases?

A. No.

Q. Have you ever done it?

A. Yes.

Q. What's the advantage of doing it in two different concentrations?

A. This is very similar to the experiment carried out with the microscopes in which you're looking at the very same object. You look at it differently at different magnifications and different techniques and come up with answers that allow you to arrive at an understanding as to how good certain data sets or how good someone else's data set is.

Q. Okay.

A. There were -- in fact, this, again, is like great unpublished data. I have file cabinets full of unpublished data. One of the data sets involves a factory in New Jersey which made insulation for warships, naval warships in the Second World War. The chief fiber used in this plant was amosite. In cases of asbestosis,

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to determine how dilution influenced outcome, particle number, I ran through a series of experiments in which a standard aliquot was halved and halved again and halved again, so on and so forth, and determined whether or not these numbers fell on -- with any linear relationship. The results were quite good. Which led me to conclude that, when diluting samples, one did not alter the final number that you could back calculate to what it actually was.

Q. Regardless of which dilution you used?

A. Correct.

Q. So in the case of these four, you have no way of knowing from the materials available to you today what the dilution was at the point?

A. No. But I would state probably they all had different dilutions. I mean, depending on the nature of the material that was recovered.

Q. That dilution factor has to be taken into account when doing your final fiber calculation?

A. Most certainly.

Q. Is that dilution information set out

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anywhere in the information we've got with us today?

A. No.

Q. Would that dilution information be available back in the lab files?

A. Probably.

Q. When you do the calculation in the actual fibrous per gram of dry weight, does somebody prepare -- for want of a better term -- a scratch sheet or work paper that has that calculation?

A. Only the person doing the calculation.

Q. Is that generally kept in the file, then?

A. Generally, so.

Q. Again, that actual calculation is not set out here, is it?

A. No.

Q. In these materials?

A. No. No.

Q. You mentioned that you set this material on a towel before you weigh it?

A. Yes.

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Langer

Q. What kind of towel or absorbent material do you use? Is it just a paper towel?

A. Yes.

Q. Is it whatever happens to be handy in the lab or do you have a special brand that you use?

A. Does this constitute a legal endorsement? You mean, like a Charmin paper towel? Just a paper towel.

Q. What I am getting at is: Are there any steps taken to insure that there isn't some contamination picked up from the --

A. You mean some cellulose?

Q. Yes.

A. I would think the potassium hydroxide would take care of cellulose.

Q. How about an asbestos fiber that might be on the towel?

A. It would be incorporated in the assay, if it adhered to the tissue.

Q. In the procedure you described, if we are talking about tissue that's fixed in paraffin, is 100 percent of the paraffin removed prior to weighing?

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A. Generally so. However, I believe the question you're asking is are there instances when some paraffin remains. Yes. Occasionally.

Q. What happens to the paraffin that remains?

A. Well, what happens is the following: If there is some paraffin that remains because of the structure of the tissue, there's some anatomical structure which prevents the paraffin from coming into contact with xylene or ethyl alcohol, it may still adhere to the tissue.

When that tissue is placed in KOH and digested, the paraffin is also liberated.

Now, when that preparation is centrifuged and the force generated, something like 10,000 gravities, the force is so high and that paraffin has a different surface character than the rest of the material. It becomes terribly hydrophobic, which means it doesn't mix well. In fact, you can work very hard to pull it down through this centrifugation process. It will not go. It will tend to remain on top. In fact, it forms a paraffin cap. And when you allow this preparation to reach room temperature,

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that paraffin cap hardens. And you can take a pair of forceps and remove the paraffin cap and then you -- with that famous paper towel I was talking about, you pat it dry and you weigh it and you subtract that from the wet weight of the tissue. That's the extra paraffin that comes out.

Q. So if there is any extra paraffin, it's identified in the centrifuging process?

A. Yes. It's separated in the centrifuging process. It's weighed and removed from the weight of the specimen.

Q. Are you familiar with reports of some paraffin that has asbestos fibers in it?

A. Yes.

Q. And if any of the paraffin blocks involved here were contaminated with asbestos fibers, would those fibers have been included in the specimen and in the count?

A. That's possible. If contaminated with asbestos in the manner described in the paper of which you speak, yes.

Q. Have you ever done any testing or experimentation to determine how often one gets

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asbestos-contaminated paraffin blocks and to what extent that contamination exists?

A. Our laboratory did a very detailed study of this many years ago, on the problem which focused on the contamination of Lake Superior with amphibole gangue minerals.

One of the issues that we were concerned about was whether or not tissue preparation included the inadvertent introduction of these adventitious fibers. And we studied the formalins, we studied the water and studied the paraffin used in the makeup of the formalins, used in some local hospitals. We did not find any. That's the extent of my --

Q. Experience?

A. Experience in this particular matter.

Q. Okay.

How about the grids themselves, is there any testing done to see whether they have any asbestos fibers on them before you start the process?

A. Sure. I think the place where you might have introduced fiber would be the formvar preparation. And there, quite easily, when we

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examine grids or grid batches, we place a grid in the electron microscope and just scan a few fields to see if there's any adventitious material present.

This seems to satisfy the requirement. The only serious place where asbestos might be introduced is the use of nuclear pore filters, which were previously identified with chrysolite asbestos.

Q. The formvar preparation, is that another word for putting the carbon on the grid?

A. No.

Q. What is that?

A. Formvar is a substance which is a -- an organic resin. It is admixed with a chlorinated compound. The ratio is approximately 2 percent formvar resin with 98 percent -- or, let's say, a gram of resin to a hundred grams or 150 grams or 200 grams of carbon -- I am blocking on this. It's a chlorinated hydrocarbon in liquid form. This is mixed and forms a syrupy slurry. This is placed in a coping dish. And glass slides are immersed in the coping dish and then withdrawn and you have the material that

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dries as a film on the surface of the glass and then this film is then transferred and floated onto distilled water and then EM grids are dropped on top of the surface of the film floating on the water. It's fished out with a filter paper and you have grids with a film. This chlorinated film.

Q. In terms of the --

A. I just thought of something. Never mind. Okay. I thought of something very interesting.

Q. What was that?

A. Oh, no, I can't tell you. This is really interesting. This is really interesting.

Q. About contamination?

A. Yes. About whether or not chrysotile fibers with a chlorine signal resulted from vinyl floor tiles or not.

I just got a good idea. All right. I'm glad you asked me that question.

Q. Good, I guess. To get back where we were. I want to understand how the grids are prepared. When you get them from the manufacturer --

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A. Right.

Q. -- they're just essentially a nickel grid; is that correct?

A. You get -- from the manufacturer you get a small vial. It is approximately two centimeters in length and approximately five milliliters in diameter. The vial will be marked with the metal, Cu (for copper), and then a mesh number on it. Each one of the vials contains approximately 100 grids. And the grid design is the grid design you have requested. Is it a straight grid or does it have a key mark in the center? Some people like grids that have notations of line A, B, C, D and has other notations across the width, so that you're in field A, but line 3, so on and so forth. Before automated stages -- which, incidentally, our 2010 has, so we can go back to the identical place on the grid by just punching in numbers on the computer.

Q. You can keep finding the same spot?

A. Absolutely.

Q. So in the case of the grids that you used, you used just a straight grid?

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A. Yes. No. We used marker grids called locator grids.

Q. That's so you could go back and find the opening?

A. Yes.

Q. Then you get the grid out of the vial?

A. Right.

Q. Is the next thing you do to put the formvar on it?

A. You don't put the formvar on it. You put it on the formvar. Yes.

Q. Then after the formvar is?

A. On the grid. Right.

Q. Then the next --

A. Yes. You have a filter paper with an outline of the glass slide and you can see the outline of a film and all of the grids lying on that film.

Then you take that preparation. You have it on a filter paper. You put the filter paper inside the carbon evaporator. You have the fiber paper, you have the film and the carbon side. Now the question is, whether you want to coat side A or side B. Some people like to coat

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side A and others coat side B.

Q. Which do you prefer?

A. Side A. I like the carbon sitting on top of the formvar.

Q. So, after the carbon has been applied, then what? You take the grid out of the carbon chamber?

A. Right.

Q. We now have a material that has the original grid on it, or consists of the original grid; is that correct and it has the --

A. Yes.

Q. With the formvar on it?

A. Yes.

Q. And it also has the carbon covering?

A. Yes.

Q. Is the filter paper still there?

A. No. No. No.

Q. And the glass slide isn't part of this either?

A. No. You may use it as a substrate inside the carbon evaporator.

Q. But when it comes time to applying the material from the pipette --

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A. The grids are removed. The grids are -- generally, the carbon-coated formvar support grids are sitting in a petri dish. After you have done this whole practice, you generally like to remove several of the grids and look at them under the light microscope just to see the conditions of the field. Sometimes the formvar tears a little bit or there are holes in the formvar which could be advantageous in certain kinds of assays. Then you want to assay the integrity and homogeneity of the carbon. When these meet your own requirements and standards, then five or six or seven grids are placed a paraffin -- placed in a paraffin dish; this is hardened paraffin wax with the carbon side up. And the micropipetting takes place on top of those grids. And the grids with carbon side up contain the suspension drop. This is allowed to come to dryness. Then the grids are transferred into a grid case. And you walk into an EM room with grids in a grid case and you select one of the grids, or two of the grids, or three of the grids, depending on what you're interested in doing.

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Q. Then, within the grids, you go to the particular opening or openings?

A. You could. If you have a specific opening as being of interest.

(Langer Exhibit 4, six-page document, marked for identification, as of this date.)

Q. In the instance of these particular studies --

A. Which studies are you referring to?

Q. The four individual studies: Maki, DeRusha, Banister and Dahl.

A. Fine.

Q. Would I be correct that the material was sufficiently homogenous that it didn't make any difference into which grid opening one looked?

A. Well, you ask a very interesting question.

I think that -- are they homogeneous is the question?

Q. Right.

A. You assume two things: You assume, one, that it is homogeneously distributed. You also assume that it is randomly distributed. So

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that you could apply certain statistics later on, if you wish. If you say it's homogenous but random, that means it's a Poissonian distribution. In order to prove that it is homogeneously distributed, you don't have to look at every grid -- I mean, a full grid.

Q. There are how many openings per grid?

A. A lot.

Q. Too many to look at?

A. Too many. It's a major commitment of resources.

Q. Now, for example: For Mr. Maki, then, it was your assumption that you had this homogeneous random distribution, as opposed to checking; is that correct?

A. It's a combination of both, actually. One puts a grid in an electron microscope and then turns on the beam and scans at low magnification just to look at fields to see the relative density of particles, the number of particles in a grid opening. You have a visual inspection and you could look at five or ten or 20 or 50 fields at low magnification. There's nothing to it. Then, after one determines that

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this is a reasonable preparation to look at, because these large particles are homogeneously -- there's no clumping, that these are reasonably homogeneous -- then one drops the beam on one specific field and increases the magnification so that, I think one of the notations is a magnification on the console of 10,000 times. It means on the viewing screen, slightly less than that. The photographic imaging takes place below the screen. The image enlarges with depth, just like the camera back. So you may be looking at maybe 8,000, 8,500 times magnification. It's a certain percentage difference.

Then one scans looking for fibers and then goes through the various diagnostics to confirm the presence of a certain fiber type.

Q. You mentioned this morning that when you count the fibers, you only count fibers that are one micron or more in length?

A. That's right.

Q. How is it you determine that a fiber you're seeing is at least one micron in length?

A. Well, it's a judgment call. And for

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one micron fiber if you crank up the magnification to, let's say, 10,000 times, one micron becomes 10,000 microns or ten millimeters. So one micron fiber would be one centimeter in length on the screen. But it should be -- because of the nature of the magnification, it should be a little bit smaller, maybe eight millimeters in size, something like that. Or you can crank it up to 20,000 times and use the same visual estimation.

Q. At 10,000 or 20,000 magnification, there's an appreciable visual difference between something that is a half micron long and something that is a micron long; is that right?

A. There's a difference. You need a little experience. Because on the viewing screen there's an area which marks out the edges of a photographic plate. And, therefore, if you know the dimensions of those marks on the screen, you judge as to the approximate length of the object at the certain magnification.

Q. For somebody who is trained and has some experience?

A. It's not magic. It's a

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straightforward kind of thing.

Q. It's easy to tell the difference between half a micron and a micron?

A. It depends on the magnification and it depends on the experience.

Q. If you get the magnification high enough and you have sufficient experience, you can tell the difference?

A. Yes. I think I am more interested in whether an object is one micron or five microns.

Q. The reason I ask this question is because at page 248 of the article it says that the method that was used for the article was to count fibers that were -- the length had to be greater than .5 microns.

A. Right.

Q. Which is obviously different than one micron.

A. Sure enough.

Q. So that the method you used -- you personally used for Maki and Banister -- excuse me, DeRusha -- was, again, slightly different than what's set up here.

A. Slightly different.

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Langer

Q. If Dr. Nolan also used the one micron cutoff for Dahl and Banister, again, he was slightly different than what was in the article?

A. If he did that, that's correct.

Q. If one were to go back and look at the same grids and use a cutoff of half micron, would that change the numbers?

A. I don't know.

Q. It would just depend on what was seen within the fields?

A. It depends on the size of the fibers in the tissue, sure.

Q. It might, though?

A. It might.

Q. You don't think Dr. Nolan was trying to mislead anybody by this --

A. No. I think Dr. Nolan was using -- the half micron size is the one that's favored by the US EPA when they look at indoor air. And the half micron is used by some others. I prefer to use the one micron, based on my data and information, which are published, incidentally. Of the fibers in the general population, short chrysotile is prevalent; therefore, I don't like

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to count particles, fibers of chrysotile less than one micron. The same may be said of the publication by Ian Stewart on the contamination of paraffin. They found short chrysotile less than one micron. I've stated, in several recent papers, my rationale in not using -- not counting fibers less than one micron; they occur in the general population and it dilutes whatever these numbers are. It's found there's a contamination problem.

Q. I was going to ask you to define. You said chrysotile is present in the general population?

A. Prevalent.

Q. Prevalent?

A. It's present as well.

Q. It's both present and prevalent in the general population?

A. Yes.

Q. By "short," in that context, you mean less than one micron?

A. One micron or less, yes.

Q. If Dr. Nolan was doing Banister and Dahl using a half micron cutoff point, and you

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were doing Maki and DeRusha using a one micron cutoff point, that might mean that your results were not strictly comparable?

A. Well, it might and it might not.

I think we have photographic documentation of fibers greater than five microns in those tissues. That shorter stuff is present and may be -- may have originated from other sources. That's one of my concerns and that's why I eliminate them from assay. You're asking me questions about could it change the assay, that depends on the size distribution of the fibers in these particular tissues; however, since we do find fibers greater than five microns, it may not be terribly important.

Q. In terms of calculating an overall number of fibers per dry --

A. Gram.

Q. -- gram?

A. Right.

Q. It is important whether you're counting the fibers between .5, or it may be?

A. It may be.

Q. And because you may not have used

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exactly the same counting criteria, maybe your results are not strictly comparable?

A. If we use slightly different counting criteria, the chances are that they're probably not identical, no. I would agree with that.

Q. You said that you didn't find fibers longer than five microns?

A. Yes.

Q. But we don't know exactly what percentage of these fibers were longer than five, correct?

A. I would look at the number of chrysotiles identified in each of those cases. See how many photographs we have greater than five, and you can calculate that: 20 percent, 40, 60, 80, whatever.

Q. We don't have the data to do that here with us today, do we?

A. I have some of the plates.

Q. Do you know whether those are all of the plates of the ones created?

A. I don't remember. I can only -- for Maki -- I don't think so.

Q. What we may have is an example of one

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rather than --

A. You're correct. Right.

Q. -- rather than all of them?

A. Yes.

[redacted]

Q. Sure.

A. All right. There are a number of asbestos diseases which concern us. Some of these diseases are malignant, and one major one is not. Each of these diseases involve different cell types and different mechanisms. Well, probably different mechanisms.

[redacted]

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mechanism. So, you ask the question do short fibers matter and I've come back and said it depends. What disease are you talking about? How much dust is there?

If you're dealing with asbestosis, a lot of dust short fiber, less than five microns, maybe less than one micron, sufficient dust, choking off microphages, stimulating cytokine signalling of fibroblasts may be important

Q. The way you gave that answer led me to believe that this was still evolving thinking on

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UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF PENNSYLVANIA

CONWED CORPORATION,

Plaintiff,

vs.

UNION CARBIDE CORPORATION,

Defendant/Third Party Plaintiff

vs.

OWENS-CORNING FIBERGLAS CORPORATION, ET AL.,
Third-Party Defendants.

COPY

DEPOSITION OF DR. ARTHUR M. LANGER

New York, New York

Wednesday, September 16, 1998

Reported by:
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September 16, 1998

10:20 a.m.

Deposition of DR. ARTHUR M. LANGER, held at the offices of Kelley Drye & Warren, 101 Park Avenue, New York, New York, pursuant to notice, before Francine Sky-Orr, a Court Reporter and Notary Public of the State of New York.

THE CORBY GROUP 1-800-255-5040 LASER STOCK FORM B

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D R. A R T H U R M. L A N G E R called as a witness, having been duly sworn by a Notary Public, was examined and testified as follows:

EXAMINATION BY

MR. WILL:

Q. State your name, please.

A. Arthur M. Langer.

Q. You're a Ph.D.; is that correct?

A. That's correct.

Q. Dr. Langer, my name is Trevor Will, we met previously in this case. For your deposition today I would like to remind you of just a couple of ground rules, if I might.

One: Please wait until I am finished with the question before you begin speaking, all right?

A. Yes.

Q. And No. 2: Please use yes or no where appropriate, rather than um-hum or uh-uh; those are difficult for the reporter to transcribe, all right?

A. Yes.

Q. Third, if I ask you a question that is

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ambiguous or doesn't make sense, let me know and I will rephrase it or repeat it, all right?

A. Yes.

Q. I want to show you what we will mark as Exhibit 1.

(Langer Exhibit 1, document entitled "Report on Morphology: Size Distribution and Fiber Concentrations of a Chrysotile Asbestos Aerosol," marked for identification, as of this date.)

Q. Exhibit 1 to your deposition today is a document entitled, "Report on Morphology: Size Distribution and Fiber Concentrations of a Chrysotile Asbestos Aerosol"; is that right?

A. Yes.

Q. The authors of that document are shown as you and R.P. Nolan.

A. Yes.

Q. Dated August 20, 1998.

A. Yes.

Q. Would I be correct that August 20th of 1998 is the day this was actually written in final form?

A. Yes.

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Q. When was the experiment that's described in this paper performed?

A. The experiment was conducted possibly several years ago.

Q. So the actual work that's reported in here, was what, more than four years ago?

A. I don't know that.

Q. Well, let me back up. Would I be correct that the work described in Exhibit 1 was performed more than one year ago?

A. Probably, yes.

Q. Let me back up just a second.

Has there been any previous publication of the data that's included in Exhibit 1?

A. I don't believe so.

Q. So, would I be correct, then, that the experiment was done at some point in the past and the data was just collected, but was essentially sitting in a file somewhere?

A. No. That's not correct.

Q. Why don't you tell me what happened, how Exhibit 1 came to be generated.

A. Our laboratory was interested in

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several reports, which became part of the documentation in this particular litigation. And those reports focused on aerosols generated with chrysotile fiber from Union Carbide's -- fiber originating from Union Carbide's New Idria deposit. We wished to reproduce some of their work and at the same time we were interested in determining the relative sensitivity and accuracy of our methods. A dust generator similar to generators described in the literature was made on our campus by the campus chief glassblower, who services the department of chemistry. And based on samples which we had collected and were available in our laboratory, we performed the experiment.

Q. Now, you said the actual work was done several years ago?

A. I believe so.

Q. What was done with the data that was generated from the experiment prior to August 20th of 1998?

A. I'm not sure I understand your question. Do you mean once the data -- once data are generated in our laboratory what happens to

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it?

Q. Right.

A. Normally, it's put in a file and when sufficient data are collected, perhaps a publication results. If the data are of interest and are new and will enhance and forward some field.

Q. Well, for example, Exhibit 1 discusses certain photographic negatives that were taken?

A. Right.

Q. Physically, where were those negatives kept between the time that the photographs were taken and August 20th of 1998?

A. I believe Dr. Nolan filed them in a data file somewhere.

Q. So, for example, in June of 1998, if I had asked you about the data on this experiment, you would have said talk to Bob Nolan, he's got it?

A. I would say the data are -- I would have said the following: I would have said that I could not recall the details of the data, other than the fact aerosols were generated of significant levels, by any standard.

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And that the specific data sets were kept in a file by Dr. Nolan.

Q. If we wanted to know when the experiment was actually done, would Dr. Nolan have information that would establish that?

A. The information would probably come from a photographic plate number -- assuming, of course, it's part of a log somewhere.

Q. Is there any kind of laboratory log or notebook or record that would show when this work was actually done?

A. Probably the photographic plate log.

Q. Did someone commission the experiment or was it something you did on your own?

A. I believe Mr. Brownson requested that we undertake such a study.

Q. You understood, at the time of Mr. Brownson's study, that there was litigation going on between Conwed and Union Carbide?

A. Yes.

Q. It was your understanding the study was to be used for the litigation?

A. Possibly.

Q. Depending on what it showed?

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A. I don't think that fairly represents my thoughts.

Q. Okay.

A. I think that the problem with our laboratory is that we do a lot of different things and very often we engage in some project for which there's no terrible constraint of time. And it goes from a front burner to a back burner. And data may languish in a file. But there's no intent to prevent data from being scrutinized. We are not consciously obstructing any process. This is just the nature of a very busy laboratory.

Q. Doctor, I didn't mean to imply -- I hope you didn't infer I was suggesting --

A. I did.

Q. Okay. Please don't. I just wanted to clear that up.

How much did it cost to run this experiment?

A. I don't know. But I would assume it was a modest amount.

Q. And whatever that cost was, it was billed to Mr. Brownson?

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A. Yes.

Q. And, as you understood it, what was the purpose of doing the experiment? In other words, why did Mr. Brownson want the experiment done? What did he want to see?

A. I think you should ask Mr. Brownson that.

Q. I would like to, I probably can't.

A. Oh, you can't.

Q. All I can ask is what you understood.

A. What is my understanding?

Q. Right.

A. That if I recommended that this project be undertaken, what would be my thoughts and my rationale; that's your question?

Q. No. I will back up a second.

At a point in the past when this experiment was commissioned or authorized by Mr. Brownson, you had some discussions with him about it, correct?

A. Yes.

Q. And before actually going out and doing the experiment, I assume you discussed with him what it is that you were contemplating doing?

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A. Let me see if I can answer your question. The issues involved in the present litigation involve chrysotile asbestos, as one of the fibers of interest. Mr. Brownson visited me in New York, visited my laboratory. In my laboratory I have literally hundreds and hundreds of specimens of asbestos fibers, and I showed Mr. Brownson some of the Union Carbide commercially available pellets of asbestos. And I believe at that time we discussed the rationale for producing pellets. We discussed what the outcome would be if these pellets were crushed, whether this would generate a dust; what would the characteristic of that dust be; would the fibers generated be of such concentration that they would exceed the various regulatory statutes. And at that time I believe I suggested that we could crush pellets, generate an aerosol and we could actually measure the amount of fiber generated. And at that time, I believe Mr. Brownson suggested that he -- there were some documents that showed that this had already been done at Union Carbide. And I believe he agreed to have this experiment undertaken and he sent us

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these materials.

Q. By "these materials," you mean the copies of the experiments study?

A. The plenum study at Union Carbide.

Q. The reason for doing this experiment was to see what sort of dust concentrations you would generate when crushing these Union Carbide pellets?

A. No. It was not in the process of crushing. These pellets are processed and occasionally the containers which carry these pellets are inadvertently damaged during shipment and these pellets become pulverized by various mechanical forces. Based on the amount of material -- based on the materials that are produced, if an air stream were to move over this material, would it generate an aerosol. These are the basic questions that were raised.

Q. In order to try to answer this question you did this experiment that's described in the paper?

A. Yes. I am presenting to you the general elements of a discussion concerning pelletized chrysotile and some circumstances

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under which it would generate an aerosol.

Q. Now, one of the things you said you discussed with Mr. Brownson was the rationale for pellets.

A. Yes.

Q. What did you understand the rationale for pellets to be?

A. Pelletization in an industrial process is an extra process. It is not undertaken because of some cosmetic effect. It is undertaken as a means of handling a material which is otherwise difficult to handle and a material which is dusted. Pelletization is carried out by the Union Carbide process because this chrysotile material is extraordinarily dusty and pelletization is carried out, for example, in iron ore processing. Or an iron ore powder is difficult to get to a -- difficult to bring to a mill because it is just a powder. It's just difficult to handle.

Q. So, as you understand it, pelletization reduces the amount of dust that the asbestos would give off?

A. Yes.

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Q. Have you done any experiments to attempt to measure how much of a difference there is in dustiness with the pelletized versus unpelletized in an industrial setting?

A. No.

Q. Who actually, physically did the experimental work?

A. You mean, who put the material in this particular aerosol chamber?

Q. Yes.

A. Dr. Nolan.

Q. Were you present when that work was done?

A. Yes.

Q. Why don't you tell me what the first step in the process is.

A. The first step was to put pellets in a blade mill and break the pellets down, which occurred in a matter of one second, two seconds.

Q. How many pellets were put into the blend?

A. I didn't count them. I would imagine that the final material could have been a gram or two.

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Q. Then the blade mill pulverized the pellets?

A. Yes. Did you say "pulverize"? It actually opens the pellets. When you say pulverize -- okay, let's use the general term, pulverize.

Q. After the blade mill ran for one or two seconds, when you looked into the enclosure, did you see any remnants of pellets or was it all a powder?

A. Without describing the specifics of the powder and its particle size distribution, were there still several fragments of pellet? Yes.

Q. Then, how did you determine how long to run the blade mill?

A. I just wanted the form of the pellet to be obliterated.

Q. So you could have run this longer and made it more uniform in consistency?

A. Yes.

Q. Then after you had run the blade mill for a couple of seconds, what was the next thing done with the material?

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Langer

A. The material was -- well, an aliquot was removed, just to examine, to take a look at the nature of this pulverized material.

Q. Let me interrupt you to make sure we are talking about the same thing. What do you mean by that?

A. An aliquot is a sample of a material.

Q. Is there any particular weight taken --

A. No.

Q. -- in the aliquot?

A. No.

Q. Just a portion of it?

A. Yes.

Q. What was done with that aliquot that was removed?

A. Examined by polarized microscopy.

Q. How was the sample prepared for examination by PCM?

A. How is it done?

Q. Yes, how is it done?

A. A portion of the asbestos material is placed on a clean glass slide immersed in an oil with a known refractive index with the edge of a

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different glass slide dispersed in the oil and the cover slip is placed on top of that preparation. It's placed on the stage of a polarized microscope and examined.

Q. Was there any kind of filtering or washing or any other process done to the aliquot between the blade mill and the glass microscope slide?

A. No.

Q. That was just moved by, what, a spoon or -- a laboratory tool, basically?

A. Yes.

Q. Then what was done with the remainder of the sample?

A. It was placed inside of the aerosol generator.

Q. And then am I correct that the generator was run for about 16 minutes?

A. Correct.

Q. This was the glass chamber that had been blown?

A. Yes.

Q. By the campus glass person?

A. Right.

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Q. And you describe in Exhibit 1 the generator that you used and the amount of the airflow; is that correct?

A. Yes.

Q. It says -- at page 3 of Exhibit 1, approximately ten milligrams of the open chrysotile was placed in the bottom of the aerosol generator.

And it references fig. 1.

A. Right.

Q. There is no fig. 1 attached to this report.

A. You're correct.

Q. What is fig. 1?

A. Fig. 1 is a figure of the aerosol generator.

Q. Where is fig. 1?

A. It's not here.

Q. I know. That's evident. Where is it?

A. It's out at the laboratory somewhere. I will see if I can get it to you. Maybe we can have it Xeroxed and sent over or faxed over. It's a photographic plate.

Q. Well, I would ask actually the same

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question about figs. 2 through 6; they're referenced later on in the report. Obviously they're not attached, either. Are they also photographic plates?

A. Yes.

RQ MR. WILL: I would request that we be given copies of figs. 1 through 6.

Can Bob take care of that?

MR. BROWNSON: We can give them to you. We need to be clear what we are talking about. I am not sure I can make photographs. We can run off a Xerox with some time. We could probably, you know, have some negatives made, or whatever, make photos.

THE WITNESS: We will have to do this differently. I have to interrupt.

A. One of these is a photo montage.

Q. Right.

A. And a photo montage is about twice the size of that painting on the wall. I'm looking at a painting that's about two feet by three feet.

Q. At least as to the other five

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figures -- the photo montage is fig. 6, right?

A. Yes.

Q. At least for figs. 1 through 5 they are more 8 and a half by 11 size, or can be?

A. Well, they're more manageable, let's put it that way.

Q. Fair enough. If approximately ten milligrams was put into the aerosol generator, do you know approximately how much was used for the polarized light micropscopy slides?

A. About five milligrams.

Q. After the asbestos was put into the aerosol generator, the fibers were blown up into the air; is that correct?

A. Not really, no.

Q. Inside --

A. No.

Q. Okay.

A. No. This -- the air stream moved above the material.

Q. Okay.

A. And as the air moves above the material, it lofts any loose dust which is associated with the specimen, so that the amount

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of material that's actually lofted is small mass-wise, in relation to the specimen in the aerosol generator.

Q. If you were looking at the aerosol generator during the 16 minutes when the air was running, would you be able to see the asbestos sitting where it had been placed originally?

A. Yes.

Q. The ten milligrams. If you watched it for 16 minutes, to the eye would it appear to change in volume?

A. No.

Q. Or remain the same. The rate of five liters per minute was the air stream; is that right?

A. Yes.

Q. How does that correlate, if at all, to air streams that one would find out in the real world?

A. This particular generator and this particular experimental protocol is that which is recommended by the health and safety executive in Great Britain. This particular design and protocol was recommended in their study of

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silica, so we wanted to use this particular published method rather than introduce our own concept of what generates an aerosol.

Q. My question was a little different, though. How would the rate of five liters per minute compare to what you would find in the real world; for example, would a person walking through a room, which had ten milligrams of asbestos sitting on the floor, generate an airflow of five liters per minute over that material?

A. I don't know if I could answer that. I'm thinking to myself, looking at the dimensions of this room and the volume of the room, and I can feel the air-conditioning system working. I feel air movement. We could calculate the number of liters of the air that changes in this room per hour. And I don't believe that it would be less than five liters -- five liter airflow per minute; I think it would be considerably greater than that. So, I'm not sure of the design, for example, of the facility in Cloquet, Minnesota; although I would think an industrial setting, such as that, with machinery in operation, would

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certainly move air at greater velocities. So this velocity of five liters per minute in that volume chamber is not -- I don't think that this is terribly out of the ordinary that you would find under most circumstances.

Q. What's the volume of the chamber?

A. It could be -- I'm thinking about the liter.

Q. So, for the experiment, then, where the asbestos had been placed, the air was being changed about five times per minute?

A. Could be correct, yes.

Q. How that rate relates at all to what went on in Cloquet you don't really know; is that fair?

A. That's fair.

Q. Now, do I understand correctly that there was this carboxyl methyl cellulose ethyl filter --

A. Yes.

Q. -- on the end of the chamber?

A. Yes.

Q. And the air that was going through the chamber then passed through the filter?

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A. Yes. Correct.

Q. What kind of filter was there on the chamber on the way in to make certain that the air being passed through the chamber didn't bring its own contaminants in?

A. I don't want to mislead you. I think it also was filtered air that went into the chamber. And I had to -- I had to stop for a minute. Of the values generated, is it possible that our laboratory is so contaminated that it would contribute? I don't think so. But I believe it was also filtered in the inlet in this particular -- in this particular hood.

Q. And do you recall specifically that it was or you just think it was?

A. No. I'm drawing a blank on it. But I'm -- I would vouch, we've done a lot of experimental work in that area of the laboratory and we have -- when we do background determinations of fibers and air, we've never found any.

Q. Then once the 16-minute period was over, you took the filter that was at the outflow or outlet of the chamber; is that right?

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A. Yes.

Q. What did you do to prepare that, then, for examination?

A. Well, the first technique is a rather standard technique, as outlined in the NIOSH 7400 method, which is the preparation of the filter, one quarter of the filter for examination by phase contrast microscopy in which the filter is rendered transparent and a cover slip placed on the top of this preparation and 100 fields examined and the fibers which are coming into view are counted according to the counting protocol.

Q. And is that a preparation where you use the oil?

A. It is a material which renders the carboxymethyl cellulose ethyl filter transparent to light. And the objects which remain in -- which may be visualized are those that are inorganic.

It's like an immersion oil technique.

Q. I may have misspoken earlier when we were talking about the polarized light microscopy.

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Langer

To prepare those slides you used the oil, correct?

A. Yes.

Q. Now, for the phase contrast microscopy, you used a quarter of the CME filter?

A. Yes.

Q. This other material that renders it --

A. Correct.

Q. -- visible?

A. Translucent.

Q. Translucent?

A. Yeah. It acts like an immersion oil.

Q. What is that material called?

A. Oh, God, I've done this a thousand times and I am blocking on it. It will come to me. I am just blocking on it.

Q. What was done with the other three-quarters of the CME filter?

A. That portion of the filter is carbon coated.

Q. How is that done?

A. It's placed in a carbon evaporator. And it's called a high temperature evaporator. It is a chamber which is rendered a vacuum

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through a series of pumps, then a carbon rod is -- a high current is passed through a carbon rod and it sublimates carbon, atomic carbon. This coats a sample. This sample is then cut with a scalpel into various three by three millimeter pieces. It is placed on an electron grid substrate. These substrates are sitting inside of a petri dish on a screen, like a wire screen. Acetone is added to the bottom of this particular petri dish. Sometimes there's a sponge to keep it wet. This is covered. The acetone destroys the carboxymethyl cellulose filter.

Q. The CME filter?

A. Yeah. Let's just call it the filter. The graphite carbon holds the particles in place and you end with a grid upon which is a carbon film with particles impregnated in it, particles which had previously come to rest on that filter surface.

Q. In the carbon coating phase, when you're in that chamber --

A. Right.

Q. -- is the filter just sitting at the

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bottom of the chamber or is it on any kind of mechanical device?

A. Well, we have a new carbon coater, and that device rotates slightly. So you get a very even -- a very even coating of carbon.

Q. Did you have that coater --

A. I think we did.

Q. -- when you did this experiment?

A. Yeah, I think we did.

Q. So it rotates slightly as the current is being passed through --

A. Yes. It's a more homogeneous distribution. It's a more homogeneous coating. It's more important for other kinds of preparations.

Q. Now, you indicate that you used a support grid of 200 mesh nickel?

A. Yes.

Q. And the 200 describes the diameter of the mesh?

A. No -- yes. Yes. It describes the size of the openings. More or less.

Q. Well, the report says that the mesh openings were about 110 microns.

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A. Right.

Q. Is that correct?

A. Yes.

Q. So the 200 mesh equates to 110 microns?

A. Well, that's the edge dimension. It could be 109. Sometimes certain grids are a little less, 106 microns. But about 110. That's a figure to use. That's a figure to use. But a little more. But 110 microns squared.

Q. After using the acetone and dissolving CME filter, what you're left with on this grid are the fibers and the carbon film?

A. Whatever was on that filter, in that carbon film; that's correct.

Q. That filter preparation then is a grid preparation?

A. Right.

Q. Should we call it the grid, would that be the appropriate term?

A. Why not.

Q. It's looked at under TEM?

A. Yes. It could be looked at under light microscopy as well. In fact, it was.

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Langer

Q. Who actually looked at the specimens under the various microscopes?

A. I did some of the work on the light microscopy determination. Dr. Nolan did some of that work, and Dr. Nolan prepared the final montage under the TEM, with the transmission electron microscope.

Q. Who did the fiber counting that's reported in Exhibit 1?

A. By which method?

Q. Let's start with the light microscopy.

A. Light microscopy, I believe that Dr. Nolan was doing that technique and I was in the laboratory with him. Because there are several determinations that require, well, two people to look at it. Does this conform with the definition of a fiber and so on and so forth.

Q. Did you recount the number of fibers, then, at each magnification?

A. Yes. Oh, yes.

Q. Were you involved in doing that as well?

A. I was involved in the evaluation of

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the final data sets when the data was brought into the laboratory, and we would look at it together.

Q. Does that mean you actually sat down with the negatives and counted fibers?

A. No.

Q. Okay. Who did that?

A. No. We counted on the photographic plates. We don't count on the negatives.

Q. Did you actually count on the photographic plate?

A. I was in the laboratory and I participated in that part of the exercise.

Q. How is that different, then -- I mean, is that the same thing as counting on the plates or is that something different?

A. Well, maybe it's a little sloppy in language, but if you have a photographic plate, from that plate you make a print. Some of the counts are made on the prints rather than on the plates. Occasionally the nomenclature is interchanged, but it's not correct.

Q. You do the counting from the prints that are made from the photographic plates?

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A. Yes.

Q. Were you the person actually doing the counting on the prints?

A. I did part of that.

Q. Dr. Nolan did part of it?

A. Yes.

Q. Did anybody else do any of it?

A. I don't want to mislead you. I think there may have been a student working in the lab over the summer who may have participated in some of that. I'm not sure.

Q. Do you recall how much time it took to do the actual counting?

A. You mean this one specimen, looking at the same field, at different magnifications and making the photo montage, not counting the actual photographic development -- the development of the prints or the actual construction of the -- I would say this exercise took several weeks.

Q. Eight hours a day, 40 hours a week?

A. No. I think you have to understand laboratory work. You can --

Q. Maybe I can --

A. You can pulverize a specimen in the

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morning and look at the specimen by polarized light microscopy in the morning and then, sometime in the afternoon, transfer part of that specimen into a chamber, then set up a chamber and walk out and let it run for 15 minutes or whatever the time period is, and then come back and shut off the air pumps and then remove the filter. And then, the next day, because you're busy doing something else, you can come in and remove a quarter of a filter and then examine a quarter of the filter and do a fiber count. And then, later in the afternoon, begin to -- begin to subject a filter to digestion techniques or carbon coat --

Q. Excuse me. Let me interrupt you. I think I do understand that. Let me refine my question. I wanted to know how much time was actually spent looking at the prints and counting fibers.

A. You're asking me how much time I spent looking at the prints? Me?

Q. Right.

A. Maybe a few hours.

Q. How about Dr. Nolan? Do you know how

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much time he spent?

A. I don't.

Q. How about this lab assistant?

A. I don't. I would think it was minor. That's my recollection.

Q. When you gave me before a couple of weeks, that was for the entire project, from beginning to end?

A. Yes. Maybe it took a month; maybe it took longer. I don't want to mislead you. Because we were using someone's darkroom. We used a photographer who does other things. When we wanted a photo montage, it generally takes more time. Then the photos have to be assembled, and so on and so forth. Maybe it took a month or six weeks. It's not continuous time.

Q. In terms of counting fibers, the definition of what is a fiber is key, obviously.

A. Right.

Q. And you used a definition of something that has an aspect ratio of three to one or greater?

A. That's part of the definition.

Q. And your definition also involved a

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diameter component?

A. Yes.

Q. What was that?

A. By which method are we speaking? Are we talking about -- we are talking about the single grid opening, the single field?

Q. Yes.

A. And the single field had X number of fibers -- 60 or 70 fibers, whatever. These 60, 70 fibers were examined at different magnifications on these photo montages. So there is an examination direct and then there are a series of examinations of the same grid opening photographed at 490 and then photographically enlarged and then the same grid opening photographed on a transmission electron microscope and the photo montage generated there.

Q. That's right.

A. So the same fibers are examined, and as this magnification changed, obviously, the so-called "dimension" of the fibers changed, and their ability to be resolved either improved or degraded.

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Q. Maybe I asked an unclear question here.

In terms of determining whether something was a fiber, you indicate on page 5 that in order to be considered a fiber it had to have a width of less than three microns?

A. Right.

Q. Why did you use that characteristic?

A. That's generally considered to be the cutoff point for a fiber in terms of respirability.

Q. How about in terms of a minimum length?

A. Five microns.

Q. So you only counted things longer than five microns?

A. Yes.

Q. Were things shorter than five microns with an aspect ratio of three to one?

A. I don't understand that question. Please repeat it.

Q. When you were looking at this initial grid opening --

A. Right.

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Q. -- did you find particles that had an aspect ratio or a length to width ratio of greater than three to one --

A. Yes.

Q. -- but were shorter than five microns in length?

A. Yes.

Q. Do you know how many particles that fit in that category there were?

A. No.

Q. Why did you use five microns as the lower level cutoff for counting fibers?

A. Is this a trick question?

Q. No.

A. As you know, according to standard OSHA, NIOSH counting rules, those fibers which are considered to be important are those which are greater than five microns in length. The five micron fiber length is basically a -- part of a counting strategy, although there are discussions as to the biological potential associated with fibers less than five microns in length. But the five micron length is the standard length of -- incorporated into the

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counting strategy.

Q. To comply with OSHA regulations?

A. Basically, yes.

Q. That's why you used that definition?

A. Of course, yes.

Q. At least as you understand, is that five micron length based on the assumption that it is the fibers that are five microns in length and longer that are of biological significance?

A. That is widely held to be true.

Q. Do you hold that to be true?

A. I hold it to be oversimplified. But do you really want to go to this area? Or are we...

Q. Maybe we'll come back to that.

A. Sure.

Q. I'll make a little note. Given that you weren't counting fibers shorter than five microns in length, why is there one such fiber that's actually reported in table 1?

A. Because it was found on review of the photographic plates that this fiber did not -- or was not five microns, it was overlaying some other fiber. It looked as if it was longer, but

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it wasn't. So it was dropped. Not dropped, but it was -- it was counted as a short fiber. The one fiber, short fiber.

Q. Now, the grid that was used for the TEM examination had how many openings on it?

A. Well, hundreds.

Q. I only looked at one; is that right?

A. Yes.

Q. Do you still have the grid somewhere?

A. Probably.

Q. How was the grid opening that was examined selected?

A. It was in the center of the grid.

Q. When the filter was placed on the grid, in the petri dish -- how was that done?

A. You mean, how is it physically placed?

Q. Right.

A. The sections of the carbon coated filter are cut with a scalpel, by means of a forceps, placed filter side down on top of the grid; so, you don't prepare one grid, you prepare lots and lots of grids. Then you select one. A grid with a homogeneous distribution, you select

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one field in all of the operations. If you compare techniques, you want to make sure you look at the same field. One field was selected and that field was then photographed. And the operation carried out.

Q. The actual grid itself, how big is it? What are the outside dimensions?

A. It's three millimeters in diameter.

Q. Within that three millimeters in diameter, there are these various openings?

A. Yes.

Q. About 110 by 110 microns?

A. Right.

Q. So you take a scalpel and cut away a piece of the CME filter?

A. Right.

Q. And then about three millimeters in diameter?

A. Edge and edge.

Q. Edge and edge?

A. Yes.

Q. That's placed right on top of the grid?

A. Yes.

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Q. You have to cut out basically a circle out of the filter?

A. No.

Q. Some of it sort of spills over the edges?

A. That's right. That's right.

Q. Then the acetate just dissolves the --

A. Acetone.

Q. Acetone, I'm sorry. Dissolves the fiber?

A. Yes.

Q. You're left with carbon covered particles?

A. The carbon impregnates the particles and holds them in this carbon film.

Q. Is it the carbon film that keeps some of these fibers from falling through the opening?

A. That's it's job. That's right.

Q. How many different grids did you make as part of this experiment?

A. Normally you make anywhere from six to a dozen.

Q. And then how do you determine, from the six to a dozen grids, which one you're

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actually going to look at for the TEM study?

A. The first thing you do is look at the fiber to see whether the particles are homogeneously distributed.

If you're satisfied in examining this preparation by light microscopy that you're dealing with a relatively homogeneous distribution, then any sub-aliquot you selected, you assume, also is homogeneously distributed.

Q. In this instance, did you believe, based on the light microscopy, that the fibers were homogeneously distributed?

A. Yes.

Q. Do I understand correctly, then, that you took this one grid and you looked at the same opening in that grid under both phase contrast light microscopy and with transmission electron microscopy?

A. Yes.

Q. Starting with the phase contrast optical microscopy, you took a photograph of what you saw?

A. Yes.

Q. Is that correct?

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A. Yes.

Q. It had a magnification of 40 times?

A. No. Wait a minute. Do you mean did we photograph the grid or did we --

Q. I am looking at page 4.

A. Right.

Q. The first bullet point there. The field was photographed with a 40 times phase objective.

A. Yes. It says the negative was photographically enlarged to 490 X. So, it was photographed, but that 40 times objective you have a camera back and a lens in the camera back that increases the magnification.

Q. To 490?

A. Yes. That was the -- that was the final magnification which approximates the OSHA requirements. That is what you would see if you followed through the large filter.

Q. Let me see -- I want to make sure what actually happened here.

You take the phase contrast light microscopy?

A. Right. We used a Zeiss inverted 35,

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IM 35 with phase contrast optics.

Q. When you first put the slide on there, if you came up to look through the microscope, it would have a magnification power of 40 times; is that right?

A. No. I apologize for this -- for the report. What it means is the following: A 40 times objective, and normally the total magnification of a light optical system is the product of the magnification of the ocular and the magnification of the objective lens. So it's merely if you had a 40 times objective and a ten times ocular, your final magnification would be 400 X.

However, in a system with a camera, the image is projected onto a film, and normally, given the geometry of the system, it's slightly enlarged. So, normally one puts a stage micrometer -- uses a stage micrometer and photographs a field with this micrometer, so that when you actually develop the print, you can see the dimensions from the micrometer. That tells you what the magnification is, for example.

If I have a one millimeter stage

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micrometer and the final image on the photographic plate is ten millimeters long, that means this represents a magnification of ten times.

Now, it's higher a hundred times, 400 times, 500 times. What was done here was a 40 times objective. We should have just indicated in this report that the final magnification was 490 times on the photographic plate.

Q. Okay. And to get to the 490 is this produced by a combination of the phase objective --

A. By the whole system, which includes the camera back, the negative. And we say photographically enlarged. It means the magnification was slightly smaller but it was photographically enlarged to 490 X. And then that was enlarged further to almost 2,000 X -- 1909 times, almost 2,000 X. Now we have an experiment in which we look at a field and we look at a field visually. We photograph the field. We look at the photographic print. Then we look at the same field enlarged by about five times larger, and then the same field, the same

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grid is put into a transmission electron microscope, which rephotographs the same field at a still higher magnification. So part of this exercise was to see whether or not these techniques were reconcilable, whether they were yielding the same kind of information. So, in addition to generating the aerosol, we were interested in the experiment, what is it that we actually see?

Q. Well, you took a picture through the light microscope and the first one that you took had a magnification of 490 times; is that correct?

A. No.

Q. All right.

A. The field -- as indicated here, the field was photographed with a 40 times phase objective. This negative was photographically enlarged to 490 times. That magnification in which the field was focused was less than 490, since it was photographically enlarged to 490.

Q. What I am trying to find out here -- let me see if I can ask a little bit differently.

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Langer

The camera that was actually hooked up to --

A. Right.

Q. -- the microscope?

A. Part of the microscope.

Q. Part of the microscope.

You take the first picture, get your first negative. Now, is that negative 490 times or do you -- is that negative 40 times and then you do something to that negative to enlarge it to 490?

A. I don't know what the final magnification was. I would have to look at the original negatives. But it was -- it was -- it was photographically enlarged to a final magnification of 490. So, it could have been 400 and then using the enlarger you enlarge it to 490, increasing the field 23 percent or something like that. But I would have to look at the actual negative. I'm sorry I can't give you that information.

Q. I am trying to figure out whether the magnification occurs when the camera is still hooked up to the microscope or whether the

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magnification is taking place in the darkroom or with an enlarger somewhere removed from the microscope.

A. That's part of the process. Once you take a photographic plate and make a print, that enlargement is part of the process. Removed from the microscope.

Q. Removed from the microscope?

A. Yes.

Q. For example, when you go from -- fig. 2, which has an enlargement of 490 times, and fig. 3 has an enlargement of 1909?

A. Correct.

Q. To get to from 490 to 1909 --

A. Right.

Q. -- do you go back to the microscope and put a different camera and a different lens on?

A. No.

Q. You go into the darkroom?

A. You just enlarge it.

Q. You just enlarge it?

A. Right.

Q. When we talk now about the TEM

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examination of this grid, the first plate was done at 900 times; is that correct?

A. Yes.

Q. And then that negative, taken at 900 times, was enlarged in the darkroom?

A. Right.

Q. Up to about just over 2300 times?

A. Right. It's standard.

Q. Then you went back and again photographed the grid opening at 4800 times?

A. Yes.

Q. And the negatives taken at 4800 direct magnification were then enlarged photographically to 12,000 times magnification?

A. Right.

Q. And that's what was put together to give you the photo montage?

A. That's correct.

Q. I notice that the photograph taken at 4800 times is not referenced to a figure number. There's no figure given?

A. Yes. It says fig. 6. That's the photo montage.

Q. That's after it was photographically

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enlarged, correct?

A. Yes.

Q. Somewhere there's also a negative just taken at 4800 times?

A. Well, they're all taken at 4800 times. All of these negatives form the prints from which you construct a photo montage. That's correct.

Q. Doctor, I want to make sure I am understanding this.

When you were using the TEM microscope, you took a photograph at 4800 times magnification?

A. A series of photographs.

Q. A series?

A. Yes.

Q. From that we got a series of negatives?

A. Yes.

Q. And those negatives were taken and each one was enlarged photographically two and a half times?

A. Yes.

Q. And those enlargements were what was

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used to compile the photo montage?

A. That's correct.

Q. Could you have taken a photograph of the grid opening directly at 12,000 times magnification?

A. Sure.

Q. Likewise, on the light microscope could you take a photograph directly at about 2,000 times magnification?

A. Oh, wow. You mean, with an oil immersion lens and with a very small optical system? I guess so.

Q. But you begin to have problems getting enough light?

A. Well, that's only one of the problems. Let's say we were to look at a screen and we were to magnify -- we were to generate a montage at 12,000 -- let's make it simple, let's say 10,000 times magnification.

Q. This is on light microscopy?

A. I am thinking on electron microscopy, how many plates you would have to -- to photograph one field. Let's say you're looking at -- you have -- let's call it a hundred

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microns. A hundred microns at 10,000 times. Just a rough calculation, you would need several hundred plates in order to photograph one field. And I went through this exercise with fiber and tissues and there I think the final number was 545 negatives, which is -- can be done today with digital cameras; otherwise, it is costly, time-consuming, and laboratories simply don't have the resources to do that.

Q. Now, on page 5 you start talking about actually determining the fiber morphology and the size distribution?

A. Right.

Q. Working off the 12,000 time magnification photo montage, the mean diameter was found to be .44 microns; is that correct?

A. Yes.

Q. With a standard deviation plus or minus 20 microns?

A. Right.

Q. And the range went from 16 microns to 1.08 microns?

A. .16 microns.

Q. .16, I'm sorry.

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A. Yes.

Q. When you compare those numbers with the 490 phase contrast optical microscope print, you got slightly different numbers; is that correct?

A. Yes.

Q. And, again, with the 1909 times PCOM you've got slightly different numbers?

A. Yes.

Q. Did you ever do the sizing, if you will, from the 4800 times TEM negatives?

A. Yes. The mean and standard deviation, the 4800 times, is represented by the 12,000 times photo montage. So, those values presented are given for that particular photo montage and represent the photographic plates obtained at 4800 times magnification.

Q. Why doesn't the -- now I am confused. Let me back up a second.

The counting that was done from the 490 times print and from the 1909 times print are from the same negative, aren't they?

A. Yes.

Q. But even though you're working from

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the same negative, you get different numbers, depending on the magnification that you used?

A. Well, when you say different numbers, statistically they are identical. The fiber size at 490 times magnification have a mean and standard deviation of 0.59, plus or minus 0.24 microns; whereas, the same fibers sized on the magnification of 1909 times were found to represent a distribution of 0.63 microns, plus or minus 0.17 microns.

If one compares these populations, statistically with a standard student t-test, these numbers are statistically the same.

Q. But when you look at them, and count them, these are the same fibers we are looking at?

A. Yes. Same fibers.

Q. Same original negative, just magnified to different sizes?

A. Right.

Q. When you look at them, for example, at a magnification of 1909, the largest diameter was found to be 1.26?

A. Right.

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Q. Microns. Whereas, if you look at it with a magnification of 490, the largest diameter was found to be 1.63?

A. Correct.

Q. A difference of, what, 37 microns?

A. .37.

Q. .37, I'm sorry.

Does that difference have any significance to you?

A. What it means to me is that, using phase contrast microscopy, there is a scattering of light along the edge of an image. And that although it is visualized and the approximate diameter appears to be a certain dimension, that a more detailed examination shows the edge to be an optical fringe rather than the edge of the particle. One has to look at a whole population of fibers to come to some reasonable understanding. Length is more easily determined than diameter. And, of course, the TEM points this up as well.

Q. I was going to say, is that why when you get into the TEM photograph the diameter gets small?

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A. The resolution is better. Yes.

Q. You can tell exactly where the edge of the material is?

A. Pretty well, yes.

Q. Now, on page 6 you talk about the fiber concentrations. And you say the value that you found was consistent with those reported earlier by Union Carbide scientists in their simulation plenum test; is that right?

A. Yes.

Q. Do these concentrations that you generated in this plenum experiment bear any relationship to the concentrations that actually existed in the real world out at Cloquet?

A. My understanding is that there are no -- there were no measurements taken in that plant during its operation.

Q. Okay.

A. It is my understanding that is the one of the purposes of simulation tests, to generate what could be representative aerosols of materials handled in a plant.

Q. Well, are you suggesting that this concentration that you obtained in your study

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here is representative of the concentrations that existed at the Cloquet plant during actual operations?

A. I am representing to you that there are circumstances under which pelletized chrysotile of this nature is manipulated and physically manipulated and there are conditions that will generate an aerosol of this particular concentration. So manipulations may generate less of an aerosol, some maybe more.

Q. My question is: Are you saying that this manipulation that you did is representative of what actually happened at the Cloquet plant?

A. I never represented that, counsel. What I am saying is that this was an experiment to determine if a pulverized pellet -- I am using your word -- could, under some circumstances, generate an aerosol. And if the aerosol is generated, what is the magnitude of the aerosol according to the standard OSHA, NIOSH counting procedures. Which are the fibers that are regulated.

Q. And if you changed the parameters of the experiment, you could get far different fiber

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concentrations, couldn't you?

A. I would assume so, yes.

Q. Tables 1, 2, and 3 contain some of the actual dimensions of the fibers; is that correct?

A. Right.

Q. Over on page 10, the table 3 is entitled "diameters of the five diameters." Is that a mistake?

A. Sure is.

Q. What's that supposed to say?

A. Diameters of the five fibers that were found to be greater than that, the resolution of the light optical. They happened to be of a size, of a diameter which conforms to the resolution of the optical system. So you're not relying on the scattering of light at the edge, but, rather, you can actually see the object, you can resolve the object.

Q. Does that mean on a light microscope you cannot observe fibers that are less than .85 micron in diameter?

A. No. What it means is that you can see an object and you can see its morphology and you can determine its length with very good

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resolution, but its diameter is more problematic. And the diameter, you see a scattering of light. You're actually looking at some artifact of the light, rather than the actual diameter. And this exercise on page 10, because of the resolution of the system, these are the numbers of fibers whose diameters were greater than that particular limit of resolution. And when you look at the actual numbers by the various techniques, statistically, they are identical.

So, it shows that if you have a good optical system with a good limit of resolution, you will see those particular fibers, at least those fibers greater than the resolution of the system. That was another part of the exercise.

Q. I take it your conclusion from this experiment is that it is possible to generate an aerosol from a crushed or pulverized pellet?

A. Yes.

Q. Under the experimental conditions?

A. Under the experimental conditions, yes.

Q. Did you reach any other conclusions,

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as a result of this experiment?

A. Well, I've discussed this with Mr. Brownson. I think there are a number of other experiments that could have been done. I think that the only problem was that Union Carbide did a lot of experiments and we were going to reproduce them, so we didn't pursue this.

Q. Is that don't bother?

A. Don't bother. Because we actually, I think, demonstrated that, yes, there are conditions and you can generate dust.

Q. But what were some of the other experiments that you were interested in doing?

A. Well, we could have used -- there are different -- there are different ways of grinding this material. We could have taken a pellet and banged it with various devices. People break up bags, and so on and so forth. We could have broken open a bag and actually used space suits to step on them and track them, and so on and so forth. But there's a limit, and I understand this very, very well. We could have done a major study on this. There are finite resources, I

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suppose.

Q. So you were talking about experiments that would more closely approximate actual working conditions?

A. In a sense, I suppose.

Q. Did you ever do any experiments where you put the calidria pellets into water to see what would happen to the size distribution of the fibers?

A. I may have, but when you put chrysotile in water it tends to form a gelatinous material. It's depending on fiber length. But did I do it with calidria? I'm not sure I ever did that with calidria.

Q. Specifically, what I want to know is whether you've done any experimental work to see whether putting calidria in water has any impact on the fiber lengths as a result.

A. Fiber length?

Q. Yes.

A. No. Most of the experiments with water pertain to dust suppression. Fiber length? No.

Q. Now, this report was written up in

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August of 1998; is that right?

A. Right.

Q. Did Mr. Brownson request that it be written up at that point?

A. I think he did.

Q. Did he explain to you why he wanted it?

A. Well, I think the answer is quite obvious. We had data languishing somewhere and Mr. Brownson considered these data important. We had validated a series of, or whatever the plenum tests were, and the data were available. This is a litigation which pertains to dust generated by this product. It seems rather appropriate.

Q. Do you remember when it was that he asked to you write this up?

A. During that time period. It could have been on August 18th or 19th or whatever.

Q. About a month?

A. The 17th.

Q. About a month ago?

A. Well, what's today's date?

Q. 16th of September.

A. Time goes fast. Yeah. Could be about

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a month ago.

Q. And how did he ask you to do it? Was it by letter, by telephone, in person?

A. I think he -- I think I asked him to say please and pretty please. But, other than that, what do you mean how did he ask me?

Q. Did he call you on the phone? Did he send you a letter? Did he bump into you at the airport and say, oh... how did he ask you? In what form?

A. I believe Mr. Brownson was in New York for someone's deposition and we met and discussed my forthcoming deposition. And at that time the existence of these data were made known to Mr. Brownson. He forgot about them and I forgot about them, of course. He asked me to write them up, and I said yes.

Q. Did he say anything to you about why he would like them written up?

A. I think it's fairly obvious.

Q. My question is did he say anything to you, I would like these written up because I would like to do this or that with them?

A. No.

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Q. So your assumption about why he wanted them written up is just an inference. It may be a logical inference, but it's just your inference?

A. Well, I think there are certain obvious reasons.

Q. Okay.

A. It is my understanding, as an example, that the witness that Mr. Brownson was deposing -- is under the impression that this material consists of submicroscopic fibers, less than five microns in length. And I said, no. This is a commercially short fiber and we have data to support that. And then, of course, we thought about this and I said we have data in the files that we've never used. We just discussed it and forgotten about it.

Q. Let me ask you that. Is calidria considered a commercially short fiber?

A. Oh, certainly.

Q. In terms of Exhibit 1, your report here, your report does not talk about the extent to which these pellets produced fibers less than five microns in length, does it?

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A. No, it doesn't.

Q. It doesn't, for example, attempt to give a percentage of fibers greater than five microns versus the percentage less than five microns?

A. No, I didn't think that was important. I have published on that.

Q. I am not asking whether it's important. I want to make sure. It doesn't attempt to say what percentage of the aerosol was greater than five?

A. No. No. This report attempted to show that with a number of techniques and with a number of magnifications you get reasonably reproducible results, in terms of fiber number. I would not, personally, recommend it to do a size distribution, if you're interested in fiber diameters, because of the resolution of the light optical method.

Q. Why was Mr. Brownson interested in fiber diameter?

A. Here he is.

Q. I can't ask him. As you understood it, what was the significance of fiber diameter?

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A. You want me to interpret?

Q. Right.

A. This is my interpretation, which may or may not be true.

Q. Right.

A. I think, very often in environmental assay, depending on the technique, there are objects of biological importance which escape the attention of the microscopist; the question is, how much and how frequently. Now, the calidria asbestos deposit is an example of a commercially short material and disaggregated material of -- fibers may escape detection based on these properties. Properties of the state of aggregation. This was explored as well.

Q. You say they would escape detection because their diameter is difficult to determine from --

A. It's the diameter which determines visibility in an environmental assay, not length.

Q. When you talk about environmental assay, what are you talking about?

A. Workplace assay.

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Q. So, to put it in simpler terms: If we are looking at fibers taken from a personal air monitoring device, worn by somebody in the workplace, you're saying that fibers on that filter with a diameter less than .85 microns may be difficult to see?

A. No. You will have, depending on the resolution of the system, difficulties determining the actual size of the diameter of the particle. But you will see an object "light up," put that in quotes, "light up." And you will not be able to resolve it with any definition, no definitive resolution.

Q. So you could see that there is something there that is, say, six microns long?

A. Right.

Q. You wouldn't be able to tell precisely how wide it was?

A. Correct.

Q. Could you identify such a structure as a chrysotile fiber?

A. Specifically? The phase contrast operational microscope provides no identity of the particle.

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Q. You would have to use some other method to determine?

A. Correct.

Q. Were you suggesting, then, that people who were doing environmental assays failed to count calidria fibers that were on the filters because they couldn't resolve them?

A. This issue is raised in chrysotile textile plants where long, thin fibers beyond the resolution of the light optical method are thought to be responsible for the pulmonary diseases.

Q. When you say "long, thin," what are we talking about, in terms of length?

A. Well, textile fibers, spinning grade fibers tend to form "motes," which are long and thin.

Q. When you say "thin," what diameter, what measurement?

A. Less than the resolution of the light optical microscope, perhaps less than 0.2 microns in diameter.

Q. What sort of length are we talking about?

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A. Anything over five microns.

Q. Now, would a fiber that had a diameter of .2 microns and was, say, seven microns in length, would that be observable under phase contrast microscopy at 490 times magnification?

A. It depends.

Q. On?

A. It depends on the microscopist and it depends on the optical system. It might be seen.

Q. Or it might not be?

A. Or it might not be.

Q. To get this back to calidria for just a minute. Have you seen any of the environmental dust counts done in workplaces where calidria was being used or being processed?

A. I believe I've seen data from Union Carbide.

Q. From their own mine and mill?

A. Well, they also went to other workplaces where the material was being manipulated.

Q. And are you offering any opinions in this case on whether those dust counts are

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inaccurate because the microscopist failed to see or count some of these calidria fibers?

A. I would have to review the data to offer an opinion.

Q. At least, sitting here today, you're not in a position to give an opinion?

A. I have no recollection of the specifics of the data sets.

Q. Now, I want you to assume with me that some of the dust counts that were done in facilities where calidria asbestos was being used as an ingredient in the production process came back showing less than five fibers per -- well, let me back up.

Off the record.

(Discussion off the record.)

Q. Assume that they show less than five fibers per cc; again, a fiber being something with three to one length/width ratio and longer than five microns.

A. Right.

Q. Would that suggest to you that the microscopist just missed the process?

A. It doesn't suggest anything.

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Q. How about if the numbers were less than two fibers per cc?

A. Again, one has to look at the details and the specifics of the assay, the protocol, the technique and the actual microscopist who did it.

Q. So, simply because Union Carbide's test showed fiber concentrations that were lower than the ones you generated in your experiment here in Exhibit 1, it would not suggest to you that microscopists were necessarily missing or failing to count fibers, would it?

A. Not necessarily. It wouldn't be -- it wouldn't necessarily mean that.

Q. Do you have any plans to do anything with this data in Exhibit 1 in terms of any publication or presentation outside of this litigation?

A. I don't know. I mean, it may find it's way into some paper at some time.

Q. At the present time, do you have any plans or intentions for this data?

A. No.

Q. Beyond this litigation?

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A. No.

Q. You mentioned this was done under the protocol of the health and safety executive from Great Britain?

A. That's right.

Q. That protocol was used, initially, for silica?

A. Silica dust. Silica-containing dust, that's right.

Q. Are you familiar with any other types of -- excuse me, any other protocols for this type of study?

A. I don't understand the question.

Q. All right. Has the United States government, for example, come up with a protocol for trying to measure whether you can aerosolize fibers or materials?

A. I don't think so. No.

Q. As far as you know, the only one in the world is the Great Britain protocol?

A. No. That's not fair. There is tremendous literature on experimental pathology studies in which inhalation chambers are used and animals are exposed to various dust, through

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inhalation as a route of administration.

There are a number of designs of different devices used to generate aerosols.

There is tremendous literature here and I believe that simulation studies are conducted by a number of laboratories based on some of these principles. But I think your question was does the US federal government have any protocol.

Q. Right?

A. I don't believe so. Other than the inhalation facilities at the NIEHS.

Q. By "protocol," what I was trying to get at was for experiments designed to measure whether it was possible to aerosolize various materials.

A. Oh, then I misspoke. Because when one does experimental pathology, one generates a dust level which is a maximum tolerated dose to an animal. There a dust is generated which is the most possible. So if we were to simulate the same kind of experiment, rather than five liters of air, we would just blow the hell out of this particular dust in the chamber.

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Q. Let me back up a second, Doctor. I have a feeling we may be talking a little past each other.

The health and safety executive devised this protocol, as I understood it, to see whether or not you could create silica dust?

A. Yes.

Q. With this amount of airflow?

A. Right.

Q. And you used that protocol for the same purpose to see whether you could aerosolize asbestos fibers from a crushed calidria pellet?

A. Yes.

Q. And that was the question. Are you familiar with any protocols, other than the great Britain protocol, for determining whether one can create an aerosol out of a particular material?

A. The answer is no.

Q. If you had kept the pellets in the blade mill for longer than about two seconds, do you think that would have had any impact on the results of the experiment?

A. Yes.

Q. What would it have done, in your

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opinion?

A. It would have formed a size distribution that would have been smaller and the potential for fiber release much greater.

Q. So, am I correct you believe it would have reduced the number of fibers longer than five microns?

A. No, I think it would have increased the number.

Q. And why is that?

A. Because the first property of the material to be affected by the blade mill is diameter. It disaggregates the fiber bundles. In fact, we showed that. We published that in a paper.

Q. Which paper is that?

A. That was the paper on the experimental work with the human alveolar microphages.

Q. Yaeger, et al.?

A. Yaeger, et al.

Q. If you ran the blade mill longer, you would end with smaller diameter fibers?

A. First smaller diameters. If you wanted shorter diameters, you would use a ball

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mill.

Q. And would running the blade mill longer give you just more total fibers, both longer and shorter than five microns?

A. Yes. Can we take about five minutes?

MR. WILL: Sure.

(Recess taken.)

MR. WILL: Mark this as Exhibit 2.

(Langer Exhibit 2, document titled "Tissue Burden Studies, Conwed Cases," with attachment, marked for identification, as of this date.)

Q. Dr. Langer, I am showing you or giving you what we marked as Exhibit 2, which is a two-page document. The first page says "tissue burden studies, Conwed cases." Then the second page talks about instrumentation; is that correct?

A. Yes.

Q. Can you tell me, starting with Mr. Maki, when it was that you did the tissue analysis for him?

A. I don't remember.

Q. Was it more than a year ago?

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A. I can't recall.

Q. How about Mr. DeRusha, do you remember when that was?

A. He, as well, I don't remember the precise dates for any of these four.

Q. Can you tell me whether any of the four were done within the last year?

A. I think Dahl was done within the last few months, but I can't recall the others. Maybe Banister as well.

Q. These were done at different times?

A. Yes.

Q. Just a general matter, without reference to these specific individuals, how often does your lab do tissue analysis for asbestos fibers?

A. I do tissue burden studies approximately once or twice a month. Dr. Nolan may do them an equal number of times. But he will have to speak for himself.

Q. Is that work generally in connection with litigation?

A. Generally.

Q. You've also done some tissue burden

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analysis in connection with your scientific writings?

A. Sure.

Q. Would I be correct that all four of these individuals had their tissue examined, as you understood it, in connection with litigation?

A. Yes.

Q. And was it Mr. Brownson, or someone from his office, that requested that these four individuals' tissue be examined?

A. Yes.

Q. Now, when you say you do tissue analysis one or two times a month, how much of the work do you actually do and how much is done by somebody else, a lab technician or someone else?

A. That's a fair question. When I do a tissue burden study, I receive the tissues myself. I examine the tissues myself. If the available tissue is mounted in a paraffin block, I will request slides to determine if the tissues are lung tissues or if they are other kinds of tissue or tumor tissue. I will personally remove the tissues from the blocks. I will personally

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divest the tissues in appropriate glassware. I will personally prepare the tissues, EM grids, and I will personally examine the tissues.

Q. So when you do it, you do all of it, basically?

A. I do all of it. I will not develop photographic plates and I will not print the photographs. I will interpret the data myself.

Now, occasionally a piece of equipment is down and an assay must be done in some expeditious fashion, in which case I might prepare the tissues myself and hand them to some other laboratory to do the assay, or have the tissues prepared at some other laboratory and the materials returned to me for an assay in my laboratory; or, if the instrument in our laboratory is also unavailable, I might have someone else do the assay. And I interpret the data. So there are variations to this.

Q. Right.

A. Particular --

Q. Those are the exceptional situations where a piece of equipment isn't available?

A. It's not the norm.

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Q. In the case of Mr. Maki, did you do the analysis?

A. I believe I did Maki and DeRusha and I believe Dr. Nolan did Banister and Dahl. That's my belief. I don't want to mislead you.

Q. Now, when Dr. Nolan does a tissue analysis, do you know what his practice is regarding how much of the work he does and regarding how much someone else does?

A. I think it's very similar to what I do. That's a question that should be reserved.

Q. For Dr. Nolan?

A. Of course.

Q. Do you have any kind of file on Mr. Maki and Mr. DeRusha -- you, personally?

A. I have files for the tissues that I do, yes.

Q. So, assuming you did Maki and DeRusha, you would have a file on those?

A. Yes. I'm assuming that I would have those files.

Q. And what about Dr. Nolan, is it his practice to keep a file on the individuals where he does a tissue analysis?

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A. Yes.

Q. So presumably, if we were looking for Banister and Dahl material, we would go to him?

A. I think so. I think it would be available in our laboratory.

Q. Have you brought anything with you today that relates to any of these four gentlemen?

A. I have brought the materials that you have outlined. Actually, it's the cover sheet and I have the analytical -- the instrumentation outline. Then I have tissue analysis for inorganic particles, Clarence Maki, dated June 28, 1994. Joint photo of microns of tissues. There are data from Banister and DeRusha and from Dahl. Why don't you take a look at those.

Q. Well, I was looking at them from across the table as you paged through them. I believe those are the same materials that Mr. Brownson provided to me --

A. Good.

Q. -- earlier.

A. Good.

Q. Now, is there another file back at

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your office or your lab somewhere that has some additional material about Clarence Maki in it?

A. I can't state that with certainty, other than the fact that there may be a Federal Express shipping label with the date on it. Or a cover letter which indicates the time and the transmission of a specimen to my laboratory.

Q. For example, where would the original photographic negatives or plates be?

A. They should be in a laboratory as well.

Q. When you do fiber counting, do you take notes or do anything like that?

A. I do, yes.

Q. Do you save the notes that you take while you're looking through?

A. Yes.

Q. Would those, likewise, be in the file?

A. Yes.

Q. To your knowledge, has any search been made of the laboratory files and Dr. Nolan's files for material relating to Maki, DeRusha, Banister and/or Dahl?

A. Could you please ask that question

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again.

Q. Within the last, say, two to three months, did anybody make an effort to go through your files, Dr. Nolan's files, the laboratory's files, and find materials that related to Maki, DeRusha, Banister and/or Dahl?

A. No one asked me for them. But I speak for myself, of course.

Q. I take it that's something that could be done if anybody asked to do it?

A. Sure.

Q. Now, I want to skip over to page 2 of Exhibit 2 for a moment. There you set out the instrumentation that you used for these analyses, correct?

A. Correct.

Q. I notice that a different electron microscope was used for Mr. Maki than was used for the other three?

A. Right.

Q. Why was that?

A. Because Maki's assay was performed before we had our instrument installed in our laboratory. We used the one at Mount Sinai in

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their department of pathology.

Q. Maki was done at Mount Sinai?

A. Yes.

Q. The other three were in your lab?

A. Yes.

Q. Where is your lab?

A. At the Brooklyn College campus.

Q. In terms of the two different microscopes, is there anything that one offers that the other doesn't?

A. Well, sure. Yes.

Q. What are the differences between them?

A. The 2010 is an electron microscope with greater resolving capabilities and control of the electron beam, which permits acquisition of data on very small areas of an object. We call that convergent beam microscopy.

We have a windowless -- a thin window detector on our X-ray detector, which permits acquisition of data of smaller concentrations of elements and light elements. We have a digital camera, which virtually eliminates the necessity for obtaining images on a photographic plate. We can image molecules at this particular instrument

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which is beyond the resolving capabilities of the 100 CX. It's a better instrument. It's a quantum jump in technical design.

Q. If you were to reanalyze Maki's tissue on your 2010 microscope, do you think that would alter the results that you reported here?

A. Probably not.

Q. Now, at the bottom of page 2, under definition of asbestos fibers used for count, you say all asbestos fibers present were counted.

A. I beg your pardon?

Q. I am looking at page 2 of Exhibit 2. At the very bottom of the page, in bold, there's a heading of "definition of asbestos fibers used for count." Do you see that?

A. Yes.

Q. And the document then says, all asbestos fibers present were counted, right?

A. That's what it says, yes.

Q. Now, first question is: Can you tell, just looking through an electron microscope, whether something is an asbestos fiber or not?

A. I hope so.

Q. Just by its appearance, visual

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appearance?

A. No, of course not.

Q. What else do you need to do?

A. There are three diagnostics used in the enumeration of objects that you call asbestos fibers.

One, there is morphological information, and depending on the asbestos fiber type, this includes a range of properties, of characteristics. With chrysotile it's a central capillary, and the fact that focusing the condenser lens on the object, which is called a chrysotile fiber, causes the fiber to undergo certain deformational characteristics.

And one can change the geometry of the system and --

I said there's something about you can -- with the morphological characteristics, there are morphological characteristics you find with amphibole asbestos fibers, which contain twin structures and defect structures and other morphological variations.

Then there is the second diagnostic, which is a structural characterization of the

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particle by a diffraction technique -- which, of course, helps you distinguish chrysotile from everything else in the universe and helps you determine whether or not you are examining an amphibole fiber or not. Depending on the nature of the stage of the electron microscope, you can reorient the particle and bring to observation a certain structural zone of the crystallographic structure of the mineral which we call a principal Laue, that's the name of someone, zone.

And the final diagnostic is the chemistry, which is obtained by a standard probe technique in which an energy dispersive X-ray spectrometry system is used rather than crystal. You have morphology structure and chemistry in which an object which is long and thin, which morphologically resembles some asbestiform fiber may be analyzed, and definitively analyzed.

Q. When you are doing an asbestos count with an electron microscope, the morphology you do by looking at it; is that correct?

A. Yes.

Q. Do you run the structural analysis and the chemical analysis on every fiber you see?

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A. I don't.

Q. Do you have somebody do that?

A. No. No. No. There's a certain experience that you bring to all of this. And if you have a single isolated particle, that is 0.03 microns in diameter, that's 300 Angstrom units in diameter with a central capillary, which is 20 microns in length, with a diffraction pattern which is characteristic of chrysotile. The assay could stop right there. You may find a hundred of these objects and you may drop the beam, focus the beam on ten of them and generate an X-ray single, just to confirm what you're looking at. The same is true of amosite fibers, in the sense that you might characterize -- if you have a large number of the objects, you may characterize a proportion of them and assume that those objects with similar morphological characteristics, such as twining and defects, that these are also amosite fibers.

Q. Is there a length below which you cannot perceive the asbestos fiber with the electron microscope?

A. There actually isn't. I normally

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count fibers greater than one micron in length.

Q. In terms of the results reported on the first page of Exhibit 2, do we know what the length of any of these fibers are?

A. For Maki, that would be greater than one micron in length.

Q. And if you did DeRusha, that would also be greater than one micron?

A. Yes.

Q. How about Dr. Nolan, do you know what cutoff he uses?

A. I think he uses one micron. I'm not sure.

Q. How about if I were interested in how many of these fibers were longer than five microns; is there any way to tell that?

A. Not by these data.

Q. Do you have the data anywhere to tell that?

A. You have to look at the original data sets.

Q. Which are, presumably, back at the lab?

A. In the file.

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Q. You earlier, when you were talking about fiber length, you indicated that calidria was a commercially short fiber?

A. That's right. Yes.

Q. And in terms of reference to a commercial short fiber, what does that refer to in terms of length?

A. The fibers of -- for example, chrysotile, from Canada, are subjected to a sizing procedure before they enter commerce. And that sizing procedure is called a Quebec screening technique. And it consists of a design of a series of four boxes of -- screens. Physical screens. And the fiber, the raw -- a pound, one pound, 16 ounces of raw fiber are dropped at the top on the uppermost screen. And this screen, set with a catcher at the bottom, is moved in a certain manner. It's shaken back and forth and rotated slightly, and so on and so forth, and the fibers, after a prescribed period of time, this material, these fibers, this one pound of fibers falls through these screens. And then on each of the screens the material is removed and it's weighed, literally weighed, and

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the nearest ounce given. So, if you have an extraordinarily -- you have four sizes. Screen 1, screen 2, screen 3 and the bottom catcher, which catches all the fine materials that are not caught on the uppermost screens.

The longest fiber is 16 ounces on the top. So it's 16-0-0-0.

In a cement fiber, a 4T fiber -- that's group 4, grade T -- that may be something on the order of 4-8-3-1. That would be a cement fiber. Something like that.

If you were to take a calidria fiber and put it on top, you would have a 0-0-0-16.

Now, the important area here is what is the dimension of the smallest screen that permits this to drop through. Well, if you convert the inches to microns it's about 1150 microns. So it means all of the fibers are less than 1150 microns. Now, that's commercially short, but that would be packing a terrific biological wallop. So...

Q. Commercially short is not necessarily directly related to the short in the sense of --

A. Of being biologically short.

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Q. Is that fair?

A. That would be very fair.

Q. In terms of biologically short, what length cutoff do you refer to?

A. Well, it depends on who you read.

If it is Merle Stanton and his S fibers that had the greatest mesotheliomagenic potential, they were greater than eight microns. And fibers less than eight microns had less of a mesotheliomagenic potential and their ability to induce this tumor in a laboratory animal decreased.

Q. So, Stanton would say eight microns is the --

A. Most active. He never said a biological threshold. He said most active.

Q. What are some other definitions of "biologically short," if you will?

A. Well, there was an interesting paper written by Frederick Pott on the biological potential of fibers, which appeared about 20 years ago in the literature. And he thought that the gradient dropped off below five microns and reached a vanishing point, a zero point at about

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one and a half microns.

So the shorter the fiber below five microns, the less biological potential it exhibited.

Q. The gradient that you were talking about is the gradient for causing biological change?

A. I'm sorry to tell you this, Counselor, I was distracted. You have to repeat the question.

Q. You said that Pott's article reports that the gradient drops off at about five microns and vanishes at about one and a half microns?

A. I don't think I said that.

I said that there is a biological gradient and the biological gradient, the highest tumor-producing potential was a fiber of about 20 microns in length, 10 microns in length. And it decreased as the length decreased from that point. And below five microns it decreased, and the vanishing point where there were no tumors, he thought, was about one and a half microns or something.

Q. Do I gather that the decrease is more

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marked and dramatic below five microns than it is above five microns?

A. I don't think it is. I think it drops off and the curve then becomes more shallow below that point. But -- if I interpret your question correctly, you are suggesting that the slope changes below five microns.

Q. Right.

A. And decreases in biological activity more so below five microns. I don't believe that curve shows that, no.

Q. Basically. We should look at Pott's --

A. Sure. I agree.

MR. WILL: Why don't we stop at this point and take our lunch break.

(Recess taken.)

(Luncheon recess: 12:30 p.m.)

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AFTERNOON SESSION

(Time noted: 1:30 p.m.)

ARTHUR M. LANGER resumed and testified as follows:

EXAMINATION (Cont'd.)

BY MR. WILL:

Q. Before we took a break for lunch, we were talking about Exhibit 1. Down at the bottom -- excuse me, Exhibit 2. Down at the first page of Exhibit 2 there's a note there that says "definitions, tissue preparation as given in Nolan, et al., 1994 environmental health prospect." I assume that's to be "prospectives"?

A. It is.

Q. 102, 245, 250; is that correct?

A. Yes.

Q. That's what it says?

A. That's what it says.

Q. Does that mean, then, that these tissue specimens were prepared in accordance with the procedure that's outlined in that article?

A. Yes.

Q. And the title of that article is the "Lung Content Analysis of Cases Occupationally

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Exposed to Chrysotile Asbestos"; is that correct?

A. I think it is. Yes.

Q. The authors are R.P. Nolan, A.M. Langer and J. Addison; is that right?

A. Yes. Yes. May I look at it for a moment?

Q. Sure. Go ahead. Just so the record is clear, I have a copy of the article here.

Have you had a chance to briefly look at it?

A. Yes.

Q. Did you look at the section in the article that talks about preparation of lung tissue specimens?

A. Yes.

Q. Were all four of the tissue specimens we are talking about here, given to you, affixed in paraffin?

A. No.

Q. Which ones were not?

A. The two specimens which have quantities of tissue one gram or greater are those that are obviously wet tissues. I say "obviously" because most blocks contain less

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than one gram of tissue.

Q. So the DeRusha and Dahl tissue specimens came in paraffin blocks, the Maki and Banister was wet tissue?

A. Yes. Certainly for Banister, of course.

Q. And then for DeRusha and Dahl the first step was to use xylene to remove the paraffin?

A. Yes.

Q. What about for Maki and Banister, what was the first step with the wet tissue?

A. My procedure is slightly different than the one described in the 1994 article. I remove tissue from its container. Normally these bulk tissues are transmitted to my laboratory in formalin, which is a fixative agent. The tissues are removed from the formalin, and an aliquot of tissue is removed from the specimen with a scalpel. If there is tumor associated with the tissue, the tumor tissue is avoided. That tissue is then dried on a towel, which is nothing more than paper towel, and placed in a weighing boat and weighed. And that particular weight, once it

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is dabbed -- once the tissue is dabbed of excess formalin, I record as wet weight. My conversion to dry wet is move to -- move the decimal point after the final assay.

Q. You use a factor of ten?

A. Yes. That's correct.

Q. You said that your procedure was slightly different than the procedure outlined in the article, correct?

A. Right.

Q. Did you actually write Exhibit 2 or did somebody else write that?

A. I believe that table was written by Dr. Nolan.

Q. How about the note down at the bottom that says: "definitions tissue preparation as given in Nolan, et al.," was that written by him as well?

A. I believe it was.

Q. At least as far as the work that you did, that's not 100 percent accurate?

A. That's not 100 percent accurate.

Q. In terms of the final results one gets, do you think there's any distinction

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between the method that Dr. Nolan follows and the one that you follow?

A. No.

Q. If the tissue comes to you not in formalin but in paraffin, then what do you do?

A. Then the specimen -- assuming, of course, it's lung tissue, the specimen is removed physically from a paraffin block with a scalpel. The specimen is then placed in a 200 milliliter beaker. The specimen is immersed in approximately 100 milliliters of xylene. It's allowed to sit in the xylene for a period of time, it could be a half hour it could be one hour.

It's stirred with steel implements. It is removed from this particular xylene bath. It is placed in another xylene bath, fresh xylene. It's allowed to sit in the fresh xylene for approximately one half hour. After that period of time it is removed from the xylene bath and placed in ethyl alcohol, approximately 100 milliliters of ethyl alcohol. The ethyl alcohol loosens the xylene -- the partially dissolved paraffin. It is then physically -- any remaining

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paraffin which can be physically removed is removed, since it's loosened from the tissue. It is then placed in a distilled water bath and then placed on a towel, absorbent towel, and the procedure followed is exactly the same procedure as removing a tissue from formalin.

Q. So you go from the absorbent towel, then, to the weighing mechanism?

A. Yes. Placed in a weighing dish, weighing boat.

Q. Then after the weighing, what -- from then on, are the procedures the same?

A. Yes. They're basically the same. There's the centrifuge tube. The tissue is placed in a thick wall centrifuge tube, covered in approximately 30 milliliters of 5 percent potassium reagent. This is placed in a hot water bath. It's allowed to digest in the bath until there's no remaining tissue visible in the tube. The preparation is then subjected to a number of cycles involving centrifugation, decantation of broken down tissue materials and reagent. Redispersion in distilled water until the supernatant over the specimen is clear.

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That generally is achieved after five or six or seven cycles of washing.

Then the pellet, which represents the materials which have been recovered from the pulmonary tissues, that pellet is dispersed with a short time sonic burst, perhaps a second or two at approximately 60 watts of power. And that suspension is then transferred to appropriate TEM substrates.

After drying, it is examined by TEM.

Q. Now, is the potassium hydroxide designed to digest the lung tissue or the organic tissue?

A. Yes.

Q. Theoretically, what you're left with is only the inorganic materials that were in the lung?

A. Yes.

Q. You said that you do this digestion of the organic materials through, in part, a centrifuge?

A. No. The centrifuge is used to collect the particles.

Q. I'm sorry. It collects what has

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been --

A. Liberated.

Q. Liberated?

A. Yes. Or recovered, if you like.

Q. How does the centrifuge form a pellet out of those recovery materials?

A. The force of the centrifuge is adjusted so that the smallest particles are pulled through the medium and allowed to collect below the supernatant, which means the supernatant can be discarded just through decantation and the particles will remain at the bottom in a pellet form.

Q. When you say a pellet, I mean, is it actually a pellet that has some adhesion or consistency to it? Could you pick it up with a tweezer and it remains as a pellet or is it a lump of material?

A. It's a lump of material. Sometimes it can form what you described as a pellet. Occasionally. Not all the time.

Q. Under what circumstances does it form a pellet that has some cohesion to it?

A. There are times that we have -- I have

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analyzed lung tissues with clay minerals, and clay minerals tend to form pellets. They adhere -- they self-adhere very easily.

Q. Do you recall, in these particular studies that you did here, which would be Maki and DeRusha, whether you found any clay materials?

A. I didn't look for it.

Q. Do you recall whether the recovered material formed a pellet that actually adhered or not?

A. No.

Q. You don't recall, one way or the other?

A. I don't recall.

Q. After you have this pellet or lump, if you will, of recovered material --

A. Call it a concentrate.

Q. A concentrate -- then, you're going to prepare the grid for TEM analysis?

A. Right.

Q. Take me through the steps. What do you do once we have this pellet?

A. Once you have the pellet, you have the

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materials concentrated from some volume of tissue. This material must be transferred to an appropriate EM substrate which will permit you to study the parts which have been recovered.

Q. By "EM," you mean electron microscope?

A. Yes.

Q. How do you go about transferring that material to an appropriate EM substrate?

A. I will speak for the technique I use. There are others. My own technique involves the pipetting of an aliquot of suspension onto a grid. One must determine -- and there are different ways of doing this. We use volumetric glassware and we use volumetric pipettes. We do this in the following manner: We subject the concentrate to a short sonic burst in a known volume of distilled water. We withdraw, we micropipette, volumetrically, ten microliters of that suspension onto an EM grid, and a ten microliter fits on a three millimeter grid. That's allowed to evaporate to dryness. When it is dry, one can examine these grid preparations. Of course the grids are formvar, substrate grids upon which carbon has been deposited, and the

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microdrop is placed on top of the carbon. So these particles are sitting on top of a carbon substrate, which is then thermally and electronically stable, when examined with an electron beam.

Q. Are these the same grids that we were talking about this morning that you used --

A. Yes. We generally use 200 mesh grids. Occasionally we may run out of some grids and order them and they are not available, so we will use 180 mesh grids or 150 mesh grids or something like that. But we've stopped using nickel grids altogether.

Q. Why is that?

A. Because the new electron microscope has a design of its imaging device, the pull pieces that are very sensitive to magnetic fields. Nickel grids do generate a small magnetic field they distort the image you're looking at. We've gone back to copper grids. Of course the problem with the copper grid is the resolution with the sodium signal. We have such a superb high resolution energy dispersive system, we can resolve a copper line from a

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sodium line, so it's noninterfering.

Q. In terms of our studies at issue here, was Maki done on a nickel grid?

A. Yes.

Q. How about Dahl, was this done within the last six or seven months?

A. I think the other three were on copper grids.

Q. Copper grids?

A. Yes.

Q. So, that's another instance where the description in the article --

A. May not fit exactly. Correct.

Q. Back when you were using the nickel mesh --

A. Right.

Q. -- would you coat the nickel grid with carbon in that carbon chamber --

A. Yes.

Q. -- as you described this morning?

A. Yes.

Q. When you do that coating of the grid, there is nothing else in the chamber other than the grid at that point?

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A. That's correct. Yes.

Q. Then you take the coated grid and you pipette the solution onto that?

A. Suspension.

Q. The suspension?

A. Yes.

Q. What is the known volume of distilled water into which you place the pellet?

A. There is no standard volume of dilution. Sometimes there's so many particles recovered you want a dilution in 30 ml's distilled water. Other times there are fewer particles and you may dilute in only five ml's or even less.

Q. So it depends on the amount of recovered material?

A. That's correct.

Q. Assuming we are done with the centrifuging process and we have this pellet --

A. Right.

Q. -- do you ever divide the pellet in half and say we'll put half of it into ten milliliters and the other half in 25 so we have two different concentrations?

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A. Are you asking me have I done it in these cases or ever?

Q. Have you done it for these cases?

A. No.

Q. Have you ever done it?

A. Yes.

Q. What's the advantage of doing it in two different concentrations?

A. This is very similar to the experiment carried out with the microscopes in which you're looking at the very same object. You look at it differently at different magnifications and different techniques and come up with answers that allow you to arrive at an understanding as to how good certain data sets or how good someone else's data set is.

Q. Okay.

A. There were -- in fact, this, again, is like great unpublished data. I have file cabinets full of unpublished data. One of the data sets involves a factory in New Jersey which made insulation for warships, naval warships in the Second World War. The chief fiber used in this plant was amosite. In cases of asbestosis,

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to determine how dilution influenced outcome, particle number, I ran through a series of experiments in which a standard aliquot was halved and halved again and halved again, so on and so forth, and determined whether or not these numbers fell on -- with any linear relationship. The results were quite good. Which led me to conclude that, when diluting samples, one did not alter the final number that you could back calculate to what it actually was.

Q. Regardless of which dilution you used?

A. Correct.

Q. So in the case of these four, you have no way of knowing from the materials available to you today what the dilution was at the point?

A. No. But I would state probably they all had different dilutions. I mean, depending on the nature of the material that was recovered.

Q. That dilution factor has to be taken into account when doing your final fiber calculation?

A. Most certainly.

Q. Is that dilution information set out

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anywhere in the information we've got with us today?

A. No.

Q. Would that dilution information be available back in the lab files?

A. Probably.

Q. When you do the calculation in the actual fibrous per gram of dry weight, does somebody prepare -- for want of a better term -- a scratch sheet or work paper that has that calculation?

A. Only the person doing the calculation.

Q. Is that generally kept in the file, then?

A. Generally, so.

Q. Again, that actual calculation is not set out here, is it?

A. No.

Q. In these materials?

A. No. No.

Q. You mentioned that you set this material on a towel before you weigh it?

A. Yes.

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Q. What kind of towel or absorbent material do you use? Is it just a paper towel?

A. Yes.

Q. Is it whatever happens to be handy in the lab or do you have a special brand that you use?

A. Does this constitute a legal endorsement? You mean, like a Charmin paper towel? Just a paper towel.

Q. What I am getting at is: Are there any steps taken to insure that there isn't some contamination picked up from the --

A. You mean some cellulose?

Q. Yes.

A. I would think the potassium hydroxide would take care of cellulose.

Q. How about an asbestos fiber that might be on the towel?

A. It would be incorporated in the assay, if it adhered to the tissue.

Q. In the procedure you described, if we are talking about tissue that's fixed in paraffin, is 100 percent of the paraffin removed prior to weighing?

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A. Generally so. However, I believe the question you're asking is are there instances when some paraffin remains. Yes. Occasionally.

Q. What happens to the paraffin that remains?

A. Well, what happens is the following: If there is some paraffin that remains because of the structure of the tissue, there's some anatomical structure which prevents the paraffin from coming into contact with xylene or ethyl alcohol, it may still adhere to the tissue.

When that tissue is placed in KOH and digested, the paraffin is also liberated.

Now, when that preparation is centrifuged and the force generated, something like 10,000 gravities, the force is so high and that paraffin has a different surface character than the rest of the material. It becomes terribly hydrophobic, which means it doesn't mix well. In fact, you can work very hard to pull it down through this centrifugation process. It will not go. It will tend to remain on top. In fact, it forms a paraffin cap. And when you allow this preparation to reach room temperature,

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that paraffin cap hardens. And you can take a pair of forceps and remove the paraffin cap and then you -- with that famous paper towel I was talking about, you pat it dry and you weigh it and you subtract that from the wet weight of the tissue. That's the extra paraffin that comes out.

Q. So if there is any extra paraffin, it's identified in the centrifuging process?

A. Yes. It's separated in the centrifuging process. It's weighed and removed from the weight of the specimen.

Q. Are you familiar with reports of some paraffin that has asbestos fibers in it?

A. Yes.

Q. And if any of the paraffin blocks involved here were contaminated with asbestos fibers, would those fibers have been included in the specimen and in the count?

A. That's possible. If contaminated with asbestos in the manner described in the paper of which you speak, yes.

Q. Have you ever done any testing or experimentation to determine how often one gets

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asbestos-contaminated paraffin blocks and to what extent that contamination exists?

A. Our laboratory did a very detailed study of this many years ago, on the problem which focused on the contamination of Lake Superior with amphibole gangue minerals.

One of the issues that we were concerned about was whether or not tissue preparation included the inadvertent introduction of these adventitious fibers. And we studied the formalins, we studied the water and studied the paraffin used in the makeup of the formalins, used in some local hospitals. We did not find any. That's the extent of my --

Q. Experience?

A. Experience in this particular matter.

Q. Okay.

How about the grids themselves, is there any testing done to see whether they have any asbestos fibers on them before you start the process?

A. Sure. I think the place where you might have introduced fiber would be the formvar preparation. And there, quite easily, when we

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examine grids or grid batches, we place a grid in the electron microscope and just scan a few fields to see if there's any adventitious material present.

This seems to satisfy the requirement. The only serious place where asbestos might be introduced is the use of nuclear pore filters, which were previously identified with chrysolite asbestos.

Q. The formvar preparation, is that another word for putting the carbon on the grid?

A. No.

Q. What is that?

A. Formvar is a substance which is a -- an organic resin. It is admixed with a chlorinated compound. The ratio is approximately 2 percent formvar resin with 98 percent -- or, let's say, a gram of resin to a hundred grams or 150 grams or 200 grams of carbon -- I am blocking on this. It's a chlorinated hydrocarbon in liquid form. This is mixed and forms a syrupy slurry. This is placed in a coping dish. And glass slides are immersed in the coping dish and then withdrawn and you have the material that

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dries as a film on the surface of the glass and then this film is then transferred and floated onto distilled water and then EM grids are dropped on top of the surface of the film floating on the water. It's fished out with a filter paper and you have grids with a film. This chlorinated film.

Q. In terms of the --

A. I just thought of something. Never mind. Okay. I thought of something very interesting.

Q. What was that?

A. Oh, no, I can't tell you. This is really interesting. This is really interesting.

Q. About contamination?

A. Yes. About whether or not chrysotile fibers with a chlorine signal resulted from vinyl floor tiles or not.

I just got a good idea. All right. I'm glad you asked me that question.

Q. Good, I guess. To get back where we were. I want to understand how the grids are prepared. When you get them from the manufacturer --

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A. Right.

Q. -- they're just essentially a nickel grid; is that correct?

A. You get -- from the manufacturer you get a small vial. It is approximately two centimeters in length and approximately five milliliters in diameter. The vial will be marked with the metal, Cu (for copper), and then a mesh number on it. Each one of the vials contains approximately 100 grids. And the grid design is the grid design you have requested. Is it a straight grid or does it have a key mark in the center? Some people like grids that have notations of line A, B, C, D and has other notations across the width, so that you're in field A, but line 3, so on and so forth. Before automated stages -- which, incidentally, our 2010 has, so we can go back to the identical place on the grid by just punching in numbers on the computer.

Q. You can keep finding the same spot?

A. Absolutely.

Q. So in the case of the grids that you used, you used just a straight grid?

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A. Yes. No. We used marker grids called locator grids.

Q. That's so you could go back and find the opening?

A. Yes.

Q. Then you get the grid out of the vial?

A. Right.

Q. Is the next thing you do to put the formvar on it?

A. You don't put the formvar on it. You put it on the formvar. Yes.

Q. Then after the formvar is?

A. On the grid. Right.

Q. Then the next --

A. Yes. You have a filter paper with an outline of the glass slide and you can see the outline of a film and all of the grids lying on that film.

Then you take that preparation. You have it on a filter paper. You put the filter paper inside the carbon evaporator. You have the fiber paper, you have the film and the carbon side. Now the question is, whether you want to coat side A or side B. Some people like to coat

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side A and others coat side B.

Q. Which do you prefer?

A. Side A. I like the carbon sitting on top of the formvar.

Q. So, after the carbon has been applied, then what? You take the grid out of the carbon chamber?

A. Right.

Q. We now have a material that has the original grid on it, or consists of the original grid; is that correct and it has the --

A. Yes.

Q. With the formvar on it?

A. Yes.

Q. And it also has the carbon covering?

A. Yes.

Q. Is the filter paper still there?

A. No. No. No.

Q. And the glass slide isn't part of this either?

A. No. You may use it as a substrate inside the carbon evaporator.

Q. But when it comes time to applying the material from the pipette --

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Langer

A. The grids are removed. The grids are -- generally, the carbon-coated formvar support grids are sitting in a petri dish. After you have done this whole practice, you generally like to remove several of the grids and look at them under the light microscope just to see the conditions of the field. Sometimes the formvar tears a little bit or there are holes in the formvar which could be advantageous in certain kinds of assays. Then you want to assay the integrity and homogeneity of the carbon. When these meet your own requirements and standards, then five or six or seven grids are placed a paraffin -- placed in a paraffin dish; this is hardened paraffin wax with the carbon side up. And the micropipetting takes place on top of those grids. And the grids with carbon side up contain the suspension drop. This is allowed to come to dryness. Then the grids are transferred into a grid case. And you walk into an EM room with grids in a grid case and you select one of the grids, or two of the grids, or three of the grids, depending on what you're interested in doing.

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Q. Then, within the grids, you go to the particular opening or openings?

A. You could. If you have a specific opening as being of interest.

(Langer Exhibit 4, six-page document, marked for identification, as of this date.)

Q. In the instance of these particular studies --

A. Which studies are you referring to?

Q. The four individual studies: Maki, DeRusha, Banister and Dahl.

A. Fine.

Q. Would I be correct that the material was sufficiently homogenous that it didn't make any difference into which grid opening one looked?

A. Well, you ask a very interesting question.

I think that -- are they homogeneous is the question?

Q. Right.

A. You assume two things: You assume, one, that it is homogeneously distributed. You also assume that it is randomly distributed. So

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that you could apply certain statistics later on, if you wish. If you say it's homogenous but random, that means it's a Poissonian distribution. In order to prove that it is homogeneously distributed, you don't have to look at every grid -- I mean, a full grid.

Q. There are how many openings per grid?

A. A lot.

Q. Too many to look at?

A. Too many. It's a major commitment of resources.

Q. Now, for example: For Mr. Maki, then, it was your assumption that you had this homogeneous random distribution, as opposed to checking; is that correct?

A. It's a combination of both, actually. One puts a grid in an electron microscope and then turns on the beam and scans at low magnification just to look at fields to see the relative density of particles, the number of particles in a grid opening. You have a visual inspection and you could look at five or ten or 20 or 50 fields at low magnification. There's nothing to it. Then, after one determines that

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this is a reasonable preparation to look at, because these large particles are homogeneously -- there's no clumping, that these are reasonably homogeneous -- then one drops the beam on one specific field and increases the magnification so that, I think one of the notations is a magnification on the console of 10,000 times. It means on the viewing screen, slightly less than that. The photographic imaging takes place below the screen. The image enlarges with depth, just like the camera back. So you may be looking at maybe 8,000, 8,500 times magnification. It's a certain percentage difference.

Then one scans looking for fibers and then goes through the various diagnostics to confirm the presence of a certain fiber type.

Q. You mentioned this morning that when you count the fibers, you only count fibers that are one micron or more in length?

A. That's right.

Q. How is it you determine that a fiber you're seeing is at least one micron in length?

A. Well, it's a judgment call. And for

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one micron fiber if you crank up the magnification to, let's say, 10,000 times, one micron becomes 10,000 microns or ten millimeters. So one micron fiber would be one centimeter in length on the screen. But it should be -- because of the nature of the magnification, it should be a little bit smaller, maybe eight millimeters in size, something like that. Or you can crank it up to 20,000 times and use the same visual estimation.

Q. At 10,000 or 20,000 magnification, there's an appreciable visual difference between something that is a half micron long and something that is a micron long; is that right?

A. There's a difference. You need a little experience. Because on the viewing screen there's an area which marks out the edges of a photographic plate. And, therefore, if you know the dimensions of those marks on the screen, you judge as to the approximate length of the object at the certain magnification.

Q. For somebody who is trained and has some experience?

A. It's not magic. It's a

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straightforward kind of thing.

Q. It's easy to tell the difference between half a micron and a micron?

A. It depends on the magnification and it depends on the experience.

Q. If you get the magnification high enough and you have sufficient experience, you can tell the difference?

A. Yes. I think I am more interested in whether an object is one micron or five microns.

Q. The reason I ask this question is because at page 248 of the article it says that the method that was used for the article was to count fibers that were -- the length had to be greater than .5 microns.

A. Right.

Q. Which is obviously different than one micron.

A. Sure enough.

Q. So that the method you used -- you personally used for Maki and Banister -- excuse me, DeRusha -- was, again, slightly different than what's set up here.

A. Slightly different.

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Q. If Dr. Nolan also used the one micron cutoff for Dahl and Banister, again, he was slightly different than what was in the article?

A. If he did that, that's correct.

Q. If one were to go back and look at the same grids and use a cutoff of half micron, would that change the numbers?

A. I don't know.

Q. It would just depend on what was seen within the fields?

A. It depends on the size of the fibers in the tissue, sure.

Q. It might, though?

A. It might.

Q. You don't think Dr. Nolan was trying to mislead anybody by this --

A. No. I think Dr. Nolan was using -- the half micron size is the one that's favored by the US EPA when they look at indoor air. And the half micron is used by some others. I prefer to use the one micron, based on my data and information, which are published, incidentally. Of the fibers in the general population, short chrysotile is prevalent; therefore, I don't like

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to count particles, fibers of chrysotile less than one micron. The same may be said of the publication by Ian Stewart on the contamination of paraffin. They found short chrysotile less than one micron. I've stated, in several recent papers, my rationale in not using -- not counting fibers less than one micron; they occur in the general population and it dilutes whatever these numbers are. It's found there's a contamination problem.

Q. I was going to ask you to define. You said chrysotile is present in the general population?

A. Prevalent.

Q. Prevalent?

A. It's present as well.

Q. It's both present and prevalent in the general population?

A. Yes.

Q. By "short," in that context, you mean less than one micron?

A. One micron or less, yes.

Q. If Dr. Nolan was doing Banister and Dahl using a half micron cutoff point, and you

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were doing Maki and DeRusha using a one micron cutoff point, that might mean that your results were not strictly comparable?

A. Well, it might and it might not.

I think we have photographic documentation of fibers greater than five microns in those tissues. That shorter stuff is present and may be -- may have originated from other sources. That's one of my concerns and that's why I eliminate them from assay. You're asking me questions about could it change the assay, that depends on the size distribution of the fibers in these particular tissues; however, since we do find fibers greater than five microns, it may not be terribly important.

Q. In terms of calculating an overall number of fibers per dry --

A. Gram.

Q. -- gram?

A. Right.

Q. It is important whether you're counting the fibers between .5, or it may be?

A. It may be.

Q. And because you may not have used

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exactly the same counting criteria, maybe your results are not strictly comparable?

A. If we use slightly different counting criteria, the chances are that they're probably not identical, no. I would agree with that.

Q. You said that you didn't find fibers longer than five microns?

A. Yes.

Q. But we don't know exactly what percentage of these fibers were longer than five, correct?

A. I would look at the number of chrysotiles identified in each of those cases. See how many photographs we have greater than five, and you can calculate that: 20 percent, 40, 60, 80, whatever.

Q. We don't have the data to do that here with us today, do we?

A. I have some of the plates.

Q. Do you know whether those are all of the plates of the ones created?

A. I don't remember. I can only -- for Maki -- I don't think so.

Q. What we may have is an example of one

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rather than --

A. You're correct. Right.

Q. -- rather than all of them?

A. Yes.

Q. In your opinion, are the fibers one micron and shorter biologically insignificant?

A. Wow. I believe that -- do you want to hear the whole thing?

Q. Sure.

A. All right. There are a number of asbestos diseases which concern us. Some of these diseases are malignant, and one major one is not. Each of these diseases involve different cell types and different mechanisms. Well, probably different mechanisms.

There is a very new theory raised concerning dust and its effect on cells. One of these new theories is called pulmonary overload or macrophage overload.

And it states: If you overload a macrophage with a lot of dust, this macrophage responds. And with asbestos, fiber length may not be important. As a matter of fact, Morton Lippmann published a paper a few years ago in

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which he thought that surface area of the dust was more important, in total aggregate, to asbestosis than fiber length. And one of our colleagues from Rochester, Dr. Oberdostter -- O-B-E-R-D-O-S-T-T-E-R, I'm pretty sure that's how he spells it -- believes that dose may determine mechanism. So, you ask the question do short fibers matter and I've come back and said it depends. What disease are you talking about? How much dust is there?

If you're dealing with asbestosis, a lot of dust short fiber, less than five microns, maybe less than one micron, sufficient dust, choking off microphages, stimulating cytokine signalling of fibroblasts may be important. Short fiber at the pleura may be important for mesothelioma, and short fiber for lung cancer may not be terribly important. So basically there are a constellation -- there exists a constellation of factors in the production of disease, and a simple yes or no answer would be misleading; in fact, it would be wrong.

Q. The way you gave that answer led me to believe that this was still evolving thinking on

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