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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OHIO
WESTERN DIVISION

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Mary A.: Dendinger, et al.,)
Plaintiffs.)
v.)
Chrysler Plastic Products)
Corp. et al.,)
Defendants.)

Case No. C87-7117

DEPOSITION upon oral examination of
PROFESSOR SIR RICHARD DOLL taken on behalf of the
Defendants before Christine Mary Armstrong, Accredited
Court Reporter, commencing at 11am at Green College,
Oxford, England on the 26th day of July, 1988.

JRL 11:40

A P P E A R A N C E S

For the Plaintiffs:

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For the Defendants:

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I N D E X

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PROFESSOR SIR RICHARD DOLL, sworn

Examined by MR BUNDA	7
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E X H I B I T S

<u>No.</u>	<u>Description</u>	<u>Page</u>
Defendant 1	Curriculum vitae	Marked for identification
Defendant 2	Review by Dr. Doll published 1988	prior to the commencement of the deposition

Plaintiffs' exhibits were marked by counsel and not released to the reporter.

Plaintiffs' exhibits subsequently supplied and attached to transcript.

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11.10am

4

1 MR BUNDA: My name is Robert Bunda. I am attorney for
2 the Defendants in the case of Mary A. Dendinger et al v.
3 Chrysler Plastic Products Corporation et al, a case arising
4 in the United States District Court for the Northern District
5 of Ohio, Western Division.

6 MR DELLI BOVI: I am Kirk Delli Bovi, representing the
7 Plaintiffs, Mary A. Dendinger and Etta Wallace.

8 MR BUNDA: (To the Reporter) Would you swear the
9 witness?

10 PROFESSOR SIR RICHARD DOLL, having been duly sworn,
11 testified and gave evidence as follows:

12 MR DELLI BOVI: Before we begin Dr Doll's testimony,
13 I would like to make an objection for the purposes of the
14 record to both the place and the time of the taking of
15 Dr Doll's deposition. The taking of Dr Doll's testimony
16 in Oxford, England, has imposed a great financial burden
17 on the Plaintiffs in this case. There has been no showing
18 by the Defendants that Dr Doll could not have been produced
19 in the United States to give testimony which would have been
20 far more cost-saving in terms of time and money both for
21 the Plaintiffs and their counsel. Second, I want to
22 register an objection to the time of the deposition. On
23 July 19 I corresponded with you and requested that I be
24 provided on July 25th with all the articles and other infor-
25 mation upon which Dr Doll will base his expert opinions

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1 today. Because of plane mis-connections in Pittsburgh,
2 instead of arriving in London at 8.30 yesterday morning,
3 I arrived in London at 8.50 yesterday afternoon. Yesterday
4 morning, I had my secretary contact you here in Oxford and
5 request that the documents that I had requested from you
6 on July 19 be made available at my hotel so that I could
7 review them upon my arrival. At my hotel, which incidentally
8 is located within a mile of Dr Doll's office and your hotel
9 room here in Oxford, upon arriving in at the hotel, none
10 of the documents were there. I immediately contacted you,
11 you indicated that the documents could not and would not
12 be made available to me until 9 o'clock this morning. When
13 I arrived here at 9 o'clock this morning I did receive some
14 of the documents that Dr Doll is going to be relying on and
15 some of the documents I requested that he had authored and
16 were in his curriculum vitae. However, I did not receive
17 this morning a number of unpublished papers that are listed
18 in the references to Dr Doll's report and accordingly, I
19 have not had an opportunity to review those. I have not
20 had an opportunity to thoroughly review the hundreds of
21 pages of documents first presented to me at 9 o'clock this
22 morning and accordingly we object to the time of the taking
23 of Dr Doll's deposition this morning.

24 MR BUNDA: For the record in response, my understanding
25 is that you arrived in Oxford at midnight last night. The

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1 information was of waiting for you all day on the 25th.
2 The unpublished documents which serve as the basis for
3 Dr Doll's review were requested by him to remain in his
4 office and under his control, to which request I acceded
5 and I so informed your secretary when she called. We also
6 made available to you this morning, the 26th July, at approxi-
7 mately 10 o'clock, an opportunity to review those documents.
8 You were also provided with an opportunity to take a
9 discovery deposition of Dr Doll which request you declined
10 - - let me finish. I have asked Dr Doll to provide you with
11 those articles which you requested from me which had been
12 listed in his curriculum vitae, many of which are published.
13 He brought with him those he had in his possession, this
14 morning, which documents were made available to you between
15 10 and 11 o'clock.

16 THE WITNESS: May I interject. All the ones I was
17 asked to produce were produced, with the exception of one
18 Canadian article which I have used in my evidence which has
19 been in the public domain for several years.

20 MR BUNDA: Which were you not produced?

21 MR DELLI BOVI: The ones I listed as references in
22 Dr Doll's report are the following unpublished articles:
23 Bar, 1981; Bennett, 1986; Barnes, 1987; Downes, 1977,
24 and Equitable Environmental Health, 1978---

25 MR BUNDA: For the record, to my knowledge those were

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1 never requested. The request I understand you made was for
2 the four primary articles which serve as the basis for his
3 opinion. Three of those four were provided and the fourth,
4 as Dr Doll has indicated, is in the public domain as having
5 been published.

6 MR DELLI BOVI: For the purposes of the record and we
7 can mark this as Plaintiffs Exhibit 1, is a copy of my
8 correspondence to you dated July 19, 1988 in which I
9 requested: "All of the articles and other information upon
10 which Dr Doll will base his expert opinions."

11 THE WITNESS: For the record, I do not think I shall
12 base any opinion on any of the articles to which Mr Delli
13 Bovi referred.

14 EXAMINATION

15 BY MR BUNDA:

16 Q Dr Doll, would you please state your name and age, for
17 the record?

18 A My name is Richard Doll. I was born in 1912 so I am
19 75.

20 Q Doctor, what is your profession?

21 A I am a medical practitioner and have, for some years
22 now, been a professional research worker. I then became a
23 university professor and I am now working on cancer research in
24 an honorary capacity.

25 Q Doctor, where are you employed presently?

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1 A In the Radcliffe Infirmary in the Gibson laboratory
2 for the Imperial Cancer Research Fund.

3 Q Where is physically that Cancer Research fund located?

4 A The Head Office is in London but they have a number
5 of independent units and at the moment I am an honorary member
6 of their unit in Oxford, acting temporarily as the Director of
7 that unit - - as the recent Director has just resigned and the
8 new Director cannot yet take up his post.

9 Q That is Oxford, England?

10 A Oxford, England, yes.

11 Q You indicated you were a medical practitioner. Is that
12 the same as a medical doctor?

13 A Yes.

14 Q Where did you get your medical degree?

15 A In the University of London, St. Thomas's Hospital.

16 Q In what year?

17 A I got the degree in 1937.

18 Q Have you received a Doctor of Science degree?

19 A Yes.

20 Q When was that?

21 A The first one I got from the University of London, I
22 cannot remember precisely, late 1950s, early 1960s, I am not sure.

23 Q Let me hand you Defendants Exhibit 1. (Document handed
24 to the witness) Could you identify that for us, please?

25 A D.Sc., 1958.

URL 11547

1 Q Yes, the document itself, is that your curriculum vitae?

2 A Yes.

3 Q It also has attached to it a list of your publications,
4 is that correct?

5 A Yes.

6 Q Have you received subsequent degrees since that time?

7 A I have received several honorary degrees, yes.

8 MR DELLI BOVI: For the purposes of the record, and
9 I believe there is a local court rule that pertains to this,
10 we will stipulate to the qualifications of Dr Doll. It is
11 my understanding that you have in fact offered his curricu-
12 lum vitae into evidence and we will stipulate as to his
13 qualifications also to render expert opinions in the areas
14 in which you choose to enquire.

15 BY MR BUNDA:

16 Q There are certain items listed in the curriculum vitae
17 not familiar to an American jury so I would like to go through
18 your qualifications, if I could?

19 A Yes, sir.

20 Q What were the honorary degrees?

21 A I was given an honorary D.Sc. in the Universities of
22 Newcastle, Belfast, Reading, England. Newfoundland in Canada,
23 the degree in Tasmania of Doctor of Medicine and honorary degrees
24 of science in two universities in the United States, the New York
25 State University and Harvard.

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1 Q Those last two are not listed on your curriculum vitae
2 they are new awards?

3 A No, I was awarded those this year.

4 Q What professional awards have you received?

5 A It is difficult to remember.

6 Q You can refer to your curriculum vitae.

7 A May I?

8 Q Yes.

9 A Are you referring to prizes and that sort of award for
10 cancer research and that sort of thing?

11 Q No, sir. If I could see your curriculum vitae for a
12 second - (document handed to counsel) - you have listed on there
13 professional awards immediately beneath Honorary Degrees and

14
15 what those are. (Document handed to the witness)

16 A These are either examinations I have taken to qualify

17

18

19 Fellow of the Royal College of Practitioners and Fellowship of
20 the Faculty of Community Medicine; Fellowship of the Faculty of
21 Occupational Medicine of the Royal College of Physicians. I also
22 have the Fellowship of our Royal Society in England which is,
23 I suppose, the nearest equivalent of the Academy of Sciences in
24 the States.

25 Q Below that on your listing of Honours, you have Kt

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1 listed. What is that?

2 A Oh, that is an English peculiarity. It stands for
3 Knight. It is an old custom to award this title to some people
4 in this country, twice a year on the Queen's Birthday and also
5 on the 1st of the year.

6 Q And you have been awarded that honour, sir?

7 A Yes.

8 Q I have heard you referred to as Sir Richard Doll. Is
9 that as a result of the Knighthood, sir?

10 A Yes.

11 Q How do your colleagues refer to you, as Dr Doll or
12 Sir Richard?

13 A If they do not know me very well, as Sir Richard. If
14 they know me well, just as Richard.

15 Q Sir, what is the purpose of the knighthood. Do you
16 know why you were knighted?

17 A No, they do not tell you, it just says "For public
18 services", and I presume this was for the results of our research.

19 Q Which research?

20 A Primarily, I imagine, our research into the causes of
21 lung cancer, particularly the effects of smoking, but also into
22 the effects of ionizing radiation and their relation to production
23 of cancer and other studies of national concern like the effects
24 of oral contraceptives and the effect of asbestos. These were
25 all early studies which I imagine influenced whoever it was that

URL 11550

1 made the recommendation that I should be given this honour.

2 Q Now, sir, you also have listed an award, the OBE. What
3 do those initials stand for?

4 A Order of the British Empire.

5 Q What is that?

6 A That is a decoration which is given by the Queen on
7 the Prime Minister's recommendation. I do know what this was
8 for. It was for our early work on demonstrating the relationship
9 between ionizing radiations and production of leukemia and the
10 first estimate of the amount of leukemia that might be produced
11 by a given dose of radiation.

12 Q Did you serve in the World War II in Europe and the
13 Middle East?

14 A Yes.

15 Q Sir, if you would for the jury, could you outline some
16 of the medical posts which you have held leading up to your present
17 position?

18 A Yes. I started as an internal physician and, of course,
19 the war came shortly after I qualified. I was first of all a
20 medical officer to a battalion. Then I became a medical specia-
21 list in a hospital but I immediately after the war ended, I
22 started research and I have been doing research ever since,
23 employed by the Medical Research Council until I was appointed
24 to be Regius Professor of Medicine in Oxford in 1969 when I
25 continued with the research but also had some academic and

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1 administrative responsibilities. For the first twenty years or
2 so after the war I also continued with some clinical medicine,
3 with the care of patients suffering from gastrointestinal diseases
4 because I was doing, at that time, clinical research into the
5 methods of benefits of different sorts of treatment for gastric
6 and duodenal ulcers, but I have not done any clinical work since
7 1969.

8 Q Sir Richard, you have also listed on your curriculum
9 vitae that you are a warden of Green College. What is that?

10 A Well, that title, warden, means the Head of the College
11 and we have some 35 colleges in Oxford. When I retired from the
12 professorship I was made Head of this new college, Green College,
13 which has a special interest in clinical medicine.

14 Q Could I see your curriculum vitae, please? (Document
15 handed to counsel and returned to the witness) Can you confirm
16 for the jury, sir, that you have been honoured with the following
17 awards: The William Julius Mickle Fellow Award from the
18 University of London in 1955?

19 A Yes.

20 Q The David Anderson Berry Prize from the Royal Society
21 of Edinburgh in 1958?

22 A Yes.

23 Q The Bisset Hawkins Medal from the Royal College of
24 Physicians in 1952?

25 A Yes.

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1 Q The United Nations Award for Cancer Research in 1962?

2 A Yes.

3 MR DELLI BOVI: Excuse me for interrupting. This time
4 I would like to renew our objection to at this point
5 reading from Dr Doll's curriculum vitae. That document
6 presumably will be in evidence. At this point it speaks
7 for itself and again I believe there is a local rule that
8 governs qualifying the witness.

9 MR BUNDA: Again I believe that the Awards need
10 explanation.

11 MR DELLI BOVI: May we show a continuing objection?

12 MR BUNDA: Yes.

13 BY MR BUNDA:

14 Q The Awards I mentioned, are they for specific work or
15 is that a general award for the work you have done until that
16 time?

17 A They usually referred to specific items of work,
18 principally the effects of smoking, the effects of ionizing
19 radiation and the effects of asbestos.

20 Q The Gairdner Award, Toronto, 1970.

21 A Yes.

22 Q The Buchanan Medal of the Royal Society in 1972. Did
23 you receive that Award?

24 A Yes.

25 Q What was that for?

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1 A For epidemiological work.

2 Q In 1973, did you receive the Nuffield Medal? —

3 A Which, I am sorry?

4 Q Nuffield Medal?

5 A There must be a misprint. Oh, Nuffield. I cannot
6 remember what that was for.

7 Q You have had so many. The Presidential Award, New
8 York Academy of Sciences in 1974. Do you recall that you
9 received that?

10 A Yes, for general epidemiological research.

11 Q This is a French word now, Prix Griffuel, in Paris in
12 1975.

13 A For cancer research.

14 Q John Snow Award, Epidemiological Section, American
15 Public Health Association in 1976. Did you receive that?

16 A Yes.

17 Q What was that for?

18 A Epidemiological research in general.

19 Q And the Gold Medal, Royal Institute of Public Health
20 in 1977, did you receive that?

21 A Yes.

22 Q What was that for?

23 A I cannot remember.

24 Q The Charles S. Mott Prize for Cancer Research, in New
25 York in 1979. Did you receive that?

JPL 11554

1 A Yes.

2 Q That was for cancer research?

3 A Yes, that specifically mentioned the work on smoking,
4 ionizing radiation and asbestos.

5 Q And you received the Gold Medal of the British Medical
6 Association in 1983?

7 A Yes.

8 Q Do you recall what that was for?

9 A General medical research and helping other people in
10 their research, I think.

11 Q The Wilhelm Conrad Rontgen Prize. You received that
12 in Rome in 1984?

13 A Yes.

14 Q What was that for?

15 A I do not know what was specified for that.

16 Q There was another that appears to be a German or
17 Austrian prize awarded in Hannover in 1985. The Johann-Georg-
18 Zimmermann Preise?

19 A Yes, for cancer research.

20 Q And the Founders' Award from the Chemical Industry
21 Institute of Toxicology in 1986, do you recall that?

22 A I expect that was for the book I wrote with Mr Peto.
23 on the causes of cancer.

24 Q The Royal Medal from the Royal Society in 1986. Do
25 you recall that?

URL 11555

1 A Yes, that was for epidemiological research in general.

2 Q Which Royal Society?

3 A The British Royal Society which I think is the equivalent of the American Academy of Sciences insofar as there is any
4 equivalent.
5

6 Q I would ask you also to review the committees on which
7 you have served or which you are presently serving and indicate
8 whether those listings are accurate. (Pause)

9 A Yes, they are accurate.

10 Q Sir Richard, attached to your curriculum vitae is a
11 list of publications. Is that right?

12 A Yes.

13 Q Is that a list of the articles which you had published
14 in your career?

15 A Yes.

16 Q Are there additions to that list?

17 A None of any importance, no.

18 Q There is at least one article not listed on there, a
19 recent publication of yours regarding the effects of exposure
20 to vinyl chloride?

21 A Yes, that only appeared in April this year and I forgot
22 I had not brought the list up to date.

23 Q Well, I remembered for you. Could you identify Exhibit
24 2 for me please? (Document handed to the witness)

25 A Yes, that is the article.

URL 11556

1 Q Doctor, of your 345 articles approximately, what per-
2 centage of these deal with cancer?

3 A Oh, at a guess I would say about three-quarters.

4 Q What are some of the carcinogens you have studied in
5 your career?

6 A Apart from tobacco smoke, ionizing radiation and
7 asbestos, nickel compounds, chrome compounds, mustard gas, vinyl
8 chloride - - oh dear. Combustion of fossil fuels, urban smoke
9 and the fuels from combustion of coal gas retort houses. I
10 cannot remember if there are any more.

11 Q This body of literature you have produced, do these
12 articles deal with the causes of cancer?

13 A Yes, mostly.

14 Q And has the Office of Technology Assessment of the
15 United States Congress ever asked you to publish any study?

16 A Yes, my colleague Richard Peto and I were asked to
17 write a report on the causes of cancer in the United States and
18 of the proportion that might be avoidable by different means.
19 We were asked to do that several years ago and that was the
20 reason we wrote our book on the causes of cancer.

21 Q Do you recall from that study, sir, what percentage
22 of cancers approximately can be attributed to occupational
23 sources?

24 A Yes, we made an estimate that approximately 4 per cent
25 might be. It is very difficult to give a precise figure but that

JRL 11557

1 seems a reasonable estimate of the proportion of fatal cancers.

2 Q Doctor, I would now like to discuss with you the field
3 of epidemiology. Sir Richard, are you an epidemiologist?

4 A Yes.

5 Q How would you describe your role in the development
6 of the modern field of epidemiology as it relates to known
7 infections, diseases?

8 A I was very fortunate when I came out of the Army after
9 the war. I worked for the Medical Research Council with Doctor
10 Avery Jones on the causes of gastric and duodenal ulcers and the
11 occupational causes in particular and in the course of doing that,
12 I met Professor Bradford Hill at the London School of Hygiene
13 and he asked me to work for him and from 1948 until he retired
14 in 1961, I worked with him and he really was the man, the father
15 of modern epidemiology. I think I can say in the world. Up
16 until then epidemiology had been principally a science studying
17 the causes of infectious diseases and as infectious diseases
18 became controlled, it became of less general interest, but
19 since that period, the period of the war, the techniques of
20 epidemiology have been applied to known infectious diseases such
21 as peptic ulcers, coronary heart disease, as well as cancer and
22 Professor Bradford Hill was really the person who developed the
23 techniques for deciding whether or not a particular factor was
24 a cause of a known infectious disease by epidemiological means.
25 I was fortunate enough to work with him at that time and so I

UPL 11558

1 helped him develop some of these techniques in the very early
2 days of the subject.

3 Q Doctor, can you explain for our jury what epidemiology
4 is?

5 A Yes. Epidemiology is a study on variation in the
6 instance of disease in different groups of human beings. By
7 studying the way the incidence varies in different environments
8 and with people who behave in different ways, we can discover
9 what are the causes of the diseases from which they suffer.

10 Q Doctor, are you familiar with the field of medicine
11 called occupational medicine?

12 A Yes.

13 Q How does the work that an epidemiologist such as your-
14 self does, differ from what an occupational physician does?

15 A An occupational physician will have clinical care of
16 people working in the industry, but the greater part of his
17 research will be epidemiological research. The majority of
18 occupational health researchers nowadays use epidemiological
19 techniques so it is very much a part of epidemiology.

20 Q How long have you been doing work in the field of
21 epidemiology?

22 A Since 1946.

23 Q And in the area of epidemiology of cancer causation?

24 A Since 1948.

25 Q Have you taught epidemiology?

URL 11559

1 A Yes.

2 Q When and where?

3 A Mostly post graduate teaching which I have done ever
4 since 1949 or 1950. Once I knew something about the subject.
5 A little bit of under graduate teaching in Oxford and elsewhere,
6 but mostly post graduate teaching.

7 Q Where did this occur?

8 A All over the world really. At the London School of
9 Hygiene in England, in Oxford University, but in universities
10 all over England and in many parts of the world as well.

11 Q Have you consulted with researchers in epidemiology
12 from different countries?

13 A Yes.

14 Q I would like you to explain to the jury a few terms
15 which they may have already encountered in this trial or may
16 encounter later. What is a case report?

17 A A case report is an account of the development of the
18 disease in an individual. It is a clinical description of a
19 disease in an individual.

20 Q Is it necessarily concerned with determining the cause
21 of the disease in the individual?

22 A Well, it can help to suggest causes if a number of
23 case reports all point to the same type of behaviour in the
24 individual or the same type of exposure and, in very rare cases,
25 even one case reported in the light of knowledge generally, can

URL 11560

1 lead to the discovery of a cause, but this is quite exceptional
2 if the type of disease produced is a disease which is extremely
3 rare normally. I will give you an example in which two cases,
4 two case reports led to a discovery of a cause when a GP in
5 South Wales had two patients with cancer of the ethmoid sinus
6 of the nose present in his practice, both of whom were working
7 in the same plant and he knew from his teaching as a student that
8 it was unlikely he would see one such case in the whole of his
9 practising life and he was able to draw the conclusion that
10 almost certainly their cancer was due to their work.

11 Q Generally, does medical science use case reports to
12 describe cause and effect in an occupational sense?

13 A Oh no. They are of very little value in relation to
14 common diseases.

15 Q Is a case report the same as an epidemiologic study?

16 A No, it is quite different.

17 Q What is an epidemiologic study. How do you go about
18 doing it?

19 A Well, an epidemiologic study requires two things. It
20 requires the determination of the number of cases of a particular
21 disease or condition and also the determination of the population
22 in whom those diseases occurred because we very seldom have a
23 situation in medicine in which a person is exposed to a cause
24 and automatically gets the disease. 100 per cent exposed get
25 the disease. When that happens it is very easy to discover the

URL 11561

1 cause. For most of the chronic diseases, exposure to a cause
2 only gives rise to a risk. 1 in 100 people may get the disease.
3 1 in 1,000, 1 in 10,000 even and epidemiology requires con-
4 structing the relationship between the development of the
5 disease and the population of people who were exposed to the
6 cause of that disease.

7 Q I have heard the term cohort used. What is that?

8 A Cohort is a technical term which was introduced to
9 describe a group of people who are defined and who are then
10 followed forward over a period of time to see what happens to
11 them. It was introduced in the first place to describe a group
12 of people born in a certain period. You would speak of the cohort
13 born before the First World War or the cohort born in the 1930s.
14 That would define a group of people and you could see how their
15 experience, their medical experience differed from those born
16 before or afterwards, but you commonly now use it to describe
17 all the employees of a particular factory. That would be a
18 cohort. I have been studying a cohort of doctors who gave me
19 their smoking habits in 1951 and I have been following them ever
20 since as a matter of fact, or rather the survivors.

21 Q You observe them over time to determine what is
22 happening to them?

23 A Find out if they are still alive at a given date later.
24 If they are not, if you cannot find out if they are alive, you
25 discover if they have died or if they have perhaps left the

URL 11562

1 country or what has happened to them. You may not, you are not
2 always concerned with whether they are alive or dead, you may
3 want to discover the diseases they have developed in the course
4 of the period. That is a more complicated study than one which
5 just requires you to find out the causes of their death.

6 Q Are there different types of epidemiologic studies that
7 are done?

8 A Oh yes, quite a number of different types.

9 Q Have you heard of proportionate mortality study?

10 A Yes.

11 Q What is that?.

12 A That is one in which you just record the causes of
13 death of a defined group of people, let us say, people working
14 in a particular industry and then you compare the proportions
15 of death from different causes in that group with the proportions
16 that you might expect from some other standard population, usually
17 the population of the whole country. It does not require you
18 to know precisely the number of people that you had originally
19 in which these deaths occurred. You just require a list of all
20 the deaths you can get hold of. Let us say the deaths of all
21 the people actually working in a plant over a given number of
22 years in which you do not have to find out what has happened to
23 all the people who have left there, as in a cohort study, you
24 will find out what has happened to everybody. In a proportionate
25 mortality study you are merely concerned with the deaths that

JRL 11563

1 you know about and you have not got any details of the whole
2 group in whom these deaths occurred.

3 Q What is it used for. Why is it done?

4 A Well, it is commonly called a quick and dirty study.
5 You can get this information quite easily very often and can
6 get it quickly and by looking at the distribution of deaths, the
7 different causes of deaths in this list of deaths that you have,
8 you can get an idea as to whether there is any excess or gross
9 excess of a particular disease and this will then provide you
10 with a hypothesis which you will then want to test by doing a
11 full scale cohort study or by doing another type of epidemiologic
12 study known as a case control study.

13 Q Are proportionate mortality studies used for cause and
14 effect of particular occupational disease?

15 A Not in general, no. In an extreme case you might say
16 the evidence obtained from a proportionate mortality study was
17 sufficient to give you pretty strong indications about a cause,
18 but normally speaking they are regarded as hypothesis-forming,
19 the basis for a full scale scientific study.

20 Q Are there weaknesses associated with the proportionate
21 mortality study?

22 A It is a question of the data. The data are fine, but
23 you may get an increased number of deaths from some causes, or
24 it appears to be an increased number of deaths because you have
25 a deficiency of deaths from other causes. You have a group of

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1 people who have very few accidents, let us say, or who have been
2 selected in such a way that they have very little chronic
3 respiratory disease. Automatically, the deaths that occur in
4 this group will be disproportionately due to other causes, so
5 you cannot say there is an excess of one group of causes in
6 these workers because the alternative explanation may be there
7 is a deficiency of other causes.

8 Q I believe you have already described, but are there
9 other types of epidemiologic studies that are more accurate or
10 are more valuable to you?

11 A From the point of view of assessing cause and effect,
12 yes. There is another whole group of studies which we call case
13 control studies in which you start from the diagnosis of a
14 particular condition, let us say cancer of the lung. You get
15 a list, if you can, of all the patients admitted to a number of
16 hospitals with cancer of the lung and then you interview them
17 to find out what their past lives have been like, what chemicals
18 they have been exposed to in the past, if that is what you are
19 interested in and then you take a group of people who have not
20 got cancer of the lung and find out what exposure they have in
21 their past lives, how they behave and compare the two and see
22 if there is any peculiar characteristic of the people who
23 develop the disease you are interested in. That can give very
24 important information about potential disease, but, of course,
25 to say that something is the cause of a disease, that is only

UHL 11565

1 done on the basis of the totality of the evidence of all sorts
2 and you have to take into account all the evidence that you can
3 obtain from many different sources, including, for example, the
4 extent to which a new agent has been introduced into society,
5 the variation in the prevalence of it from one country to another
6 and how this correlates with the prevalence of the disease. All
7 sorts of evidence like that has to be taken into account before
8 you can conclude that something is the cause of a particular
9 disease.

10 Q Is epidemiology usually used to prescribe a particular
11 cause of a disease in a particular person?

12 A No, very seldom. It is used to discover the cause of
13 a risk to which a group of people - - of which a group of people
14 suffer. It can on occasions, epidemiological evidence will be
15 so strong that you can conclude that a particular individual has
16 developed a disease because of exposure to a particular cause,
17 but that is unusual.

18 Q Sir Richard, I have heard of a term used called the
19 power of an epidemiologic study. What is that?

20 A Well, that is a complex concept. If you start from
21 the assumption that a particular mode of behaviour or exposure
22 to a particular chemical is going to cause a certain risk, let
23 us say a risk of someone developing a particular cancer, of 1
24 in 100 in the course of five years, then the power of the study,
25 what it means by the power of the study is the extent to which

UPL 11566

1 you will be able to be precise about the actual risk that people
2 in that group suffered. Your postulate was that 1 in 100 might
3 develop it in five years. You may say, well the power of this
4 study is only such that we will be able to exclude 5 per cent
5 of people developing it in five years because there are not - -
6 or the power of the study is such we will only be able to say
7 that not more than 5 per cent of the people will develop the
8 disease in five years. On the other hand, if you have a very
9 powerful study you might say, well we can boil down our con-
10 clusions to a very fine limit. We can say that the risk in this
11 group must have been something between $\frac{1}{2}$ per cent and $1\frac{1}{2}$ per
12 cent to developing the disease in five years. Then you would
13 say that is a pretty powerful study.

14 Q So it refers to the accuracy of the conclusions and
15 the ability to be accurate in those conclusions?

16 A It refers to the precision of the conclusion you can
17 draw, not to the qualitative conclusion, but to the quantitative
18 conclusion.

19 Q What does the term standardized mortality ratio mean?

20 A This is a term we used to show we have taken account
21 of the peculiar age distribution of the population we are studying.
22 Many, many diseases vary in instance with age of the individual,
23 particularly diseases like coronary heart disease or cancer, they
24 tend to become much commoner as people get older. Therefore,
25 if you are comparing two population groups, you must compare

URL 11587

1 people of the same ages. Obviously, also of the same sexes and
2 a standardized mortality ratio is a figure which you obtain from
3 your study, taking into account the peculiar age distribution
4 of the population you are studying.

5 Q When you are studying two populations and trying to
6 determine the causes of cancer, what is the difference between
7 those two populations?

8 A I am afraid I do not quite follow.

9 Q Say you are studying something like vinyl chloride and
10 you are trying to discover what effect it has and you have two
11 populations, one population would be exposed to vinyl chloride
12 and one would not?

13 A That is right.

14 Q Would you expect to see cancer in the group that was
15 not?

16 A It depends on the type of cancer. Most cancers occur
17 for reasons which we do not know, throughout the whole world.
18 There is a background incidence of all types of cancer. Some
19 cancers are really quite common as a result of background factors
20 that are affecting the whole population. Others, on the other
21 hand, are extremely rare. So, when you are looking at your group
22 of workers, for example, exposed to vinyl chloride, the importance
23 of the background incidence will vary with the type of cancer
24 you are studying. If you are studying cancer of the lung which
25 is very common in the population for other reasons, then it will

URL 11568

1 be quite difficult to tell whether vinyl chloride is causing
2 cancer of the lung in that population. On the other hand, if
3 you are looking at an extremely rare disease like angiosarcoma
4 of the liver, a disease which only affects 1 in 10m people a
5 year, then if you find two or three cases in a group of 200 men,
6 you do not need any other evidence to indicate you have found
7 something pretty extraordinary. The conclusions you draw depends
8 very much on the type of disease you are studying and its
9 general incidence.

10 Q What does the term statistical significance mean?

11 A This is a term we use purely arbitrarily to indicate
12 the probability that your observation may have occurred by chance
13 and not be in any way due to the peculiarities of the group you
14 have been studying. Quite arbitrarily we take a probability of
15 1 in 20 as being something that we would not normally accept as
16 something that is likely to turn up, so if we find an excess of
17 a particular disease which would only have occurred by chance
18 once in thirty times in that group, then you call that statisti-
19 cally significant and you think you have probably got some
20 peculiarity about the group, but it is only a guide. Statistical
21 significance does not tell you definitely whether a disease is
22 due to a particular environment or particular type of behaviour.
23 It just helps you draw a conclusion as to whether it is likely
24 to be due to the peculiarities of the group or whether it is
25 something that could be purely chance event because, after all,

JPL 11569

1 not only 1 in 30, but 1 in 100 chances turn up every now and
2 again or otherwise no one would ever buy a lottery ticket?

3 Q Sir Richard, are you familiar with animal studies which
4 are used in cancer research?

5 A To some extent, yes. I am not a specialist in that
6 field but I have to take account of them in determining epidemio-
7 logical observations.

8 Q What are the advantages and disadvantages of an
9 epidemiologic study versus an animal study?

10 A Well, an epidemiological study, the great value of that
11 refers to the animal whose disease that you are trying to prevent
12 and you know that your findings are relevant to human beings.
13 The difficulty with it is that you usually cannot do an experiment.
14 You cannot do an experiment to produce disease in man so your
15 interpretation of epidemiological evidence is often open to
16 question. You can only take into account all the evidence and
17 eventually you may be able to say it is sufficiently strong to
18 prove that a particular agent is a cause of a disease. With
19 animals you can actually do an experiment. You can cause disease
20 in animals and so you can be confident about what the factor is
21 that has produced the increased incidence of disease in a par-
22 ticular group of animals. What you do not know of course, is
23 whether humans will react in the same way as animals. You have
24 to extrapolate from one species to another and that is always
25 risky. By and large we can get good indications of what is

UPL 11570

1 likely to happen to man from studying different animal species,
2 but there is always the doubt in one's mind, perhaps a man may
3 not behave like a rat in this particular case. Perhaps he may
4 behave more like a guinea pig, in which case the reaction would
5 be quite different.

6 Q Do animals, different animals react differently from
7 time to time?

8 A Yes, they do.

9 Q I would like to change the subject. Are you familiar
10 with some of your colleagues in the field of cancer research and
11 epidemiology in the United States?

12 A Yes.

13 Q Have you heard of a gentleman called Richard Monson?

14 A Yes.

15 Q Have you heard of Leonard Chiazze?

16 A Yes.

17 Q Also have you heard of an Italian researcher by the
18 name of Dr Maltoni?

19 A Yes.

20 Q Have you heard of an occupational physician from
21 Cincinnati by the name of R. Michael Kelly?

22 A No.

23 Q Now I would like again to change gear. If we can go
24 and discuss a little bit the specific matter involved in this
25 case, vinyl chloride. Have you done any research involving

URL 11571

1 vinyl chloride?

2 A Yes.

3 Q Would you describe that for me?

4 A Yes. It was not a very important piece of research,
5 we just used the information that had been collected by the
6 chemical industries in this country on the number of cases of
7 angiosarcoma of the liver, a particular cancer which is charac-
8 teristically produced by vinyl chloride and we use the infor-
9 mation collected from factories, industries throughout the world
10 where vinyl chloride had been used to try to get an estimate of
11 the amount of liver cancer because this disease, angiosarcoma
12 of the liver is commonly described as a liver cancer. We used
13 this information to try to predict how many more cases might be
14 expected to occur in industry. That was all this particular
15 piece of research was aimed at doing.

16 Q Since that time have you recently done a review of the
17 literature or epidemiologic work of others on vinyl chloride?

18 A Yes, I have done a review of the diseases produced by
19 vinyl chloride.

20 Q And that has resulted in the paper that has been
21 marked as Exhibit 2?

22 A This was published in the Scandinavian journal, "Work,
23 Environment and Health" in April this year.

24 Q Can you explain briefly what vinyl chloride is?

25 A Vinyl Chloride is a gas, a molecule, very important

URL 11572

1 A I gathered a great deal of information about the health
2 of the workers exposed to large doses of vinyl chloride.

3 Q Did you do a comprehensive survey of the medical
4 literature? :

5 A Yes.

6 Q How did you go about doing that?

7 A I was provided with a list of publications by the
8 chemical industry, to which, of course, I then sought to add by
9 asking medical libraries to find out if there were any additional
10 articles that were relevant. I had to get some of the foreign
11 ones translated and I read them all, decided which of them were
12 giving important information and then tried to summarise that
13 information and then when I had summarised all the information,
14 tried to make up my mind what it all meant.

15 Q Is this an area where the epidemiologic research has
16 been fairly extensive. Are there a lot of studies?

17 A There are quite a lot. There have been more studies
18 on some other compounds but there have been quite a lot of
19 studies on vinyl chloride.

20 Q Did you do this research before I ever contacted you
21 regarding working and testifying in this case?

22 A Oh yes, I was asked to do this, I cannot remember how
23 many years ago, about five years ago. I could not do it initially,
24 I could not fit it into my timetable, but I effectively did it
25 in 1986 and finished the report in 1987.

URL 11573

1 Q And the results of that research have been recently
2 published?

3 A Yes, I made it a condition of doing the report that
4 I should be free to publish the results.

5 Q Was there any review of the results or change of the
6 results before they were published, not by editors but by the
7 CMA?

8 A Not of necessity. I did, in fact, send it to a
9 colleague of mine who worked in the industry to read through and
10 he suggested there were two points he thought I had not made
11 clear and I tried to improve in that respect and I then sent it
12 to the industry but there was no review from them after that.

13 Q In your opinion, was there any censorship or portions
14 of the article that they found unfavourable, that they asked you
15 not to publish?

16 A No, there was no such thing and indeed I made it a
17 condition of doing the review that I would publish exactly what
18 I thought. There was no possibility of any censorship.

19 Q Where was that published?

20 A In the Scandinavian journal "Work, Environment and
21 Health".

22 Q Is that a juried publication?

23 A Yes.

24 Q What does that mean?

25 A That is not a phrase we use in England. We say.

URL 11574

1 refereed. But yes certainly, that is a refereed journal.

2 Q What does that term mean?

3 A That means the editor does not publish articles unless
4 he has sought opinions of other people in the field that it is
5 a reliable paper that deserves publication.

6 Q And this was done with your article?

7 A Yes.

8 Q What were the general conclusions you reached in this
9 study?

10 A I concluded that intense concentrations of vinyl
11 chloride such the people in the industry were exposed to before
12 the mid-60s in the United States and in England would produce
13 a normally very rare disease, angiosarcoma of the liver, a type
14 of cancer of the liver, that vinyl chloride might possibly
15 produce a small hazard of lung cancer. I could not be quite sure
16 about that, the evidence was not conclusive, but suggestive.
17 But, I thought that the evidence did not really suggest that
18 vinyl chloride caused any other type of cancer in humans. Two
19 or three other types of cancer had been suggested as being likely
20 to be caused by individual studies, but if you looked at the
21 totality of the evidence, you really did not find that there was
22 enough to bear this out. I would like to see some more work done
23 to check that there is not an excess of cancer of the brain and
24 cancers of the lymphatic system. On the whole I do not think
25 there is, but I think it would be important to confirm this

JRL 11575

1 negative conclusion by further observations.

2 Q Doctor, from the research that you have done, do you
3 have a general idea about the level of exposure to vinyl chloride
4 which existed and exists today in the vinyl chloride and poly-
5 vinyl chloride manufacturing facilities?

6 A Yes. When vinyl chloride was first used in industry
7 it was not thought to be likely to be a hazardous agent and
8 people were exposed to very high concentrations of it of the
9 order of thousands of parts per million in the air, but it became
10 clear it did have a number of toxic effects, acute effects on
11 individuals. It was poisonous at that level and the levels were
12 reduced in the early 1960s, mid 1960s by ten-fold to something
13 of the order of several hundred parts per million, but it was
14 not until these cancers turned up that people realised that the
15 amounts that workers had been exposed to were still hazardous
16 and the levels were then quickly reduced to something of the
17 order of ten or five parts per million and then Government
18 agencies came in and said: "That is not low enough." I know
19 the industry really at first thought they could not get it much
20 lower but they have it down now so that no one is exposed to more
21 than one part per million. Very much lower than they used to.
22 be exposed to when the risk of cancer was produced.

23 Q Do you have a general idea about the amount of vinyl
24 chloride exposure which existed in those factories where poly-
25 vinyl chloride resin was used to make plastic products?

URL 11576

1 A I have not much knowledge of that. I decided in my
2 review not to study those plants, the workers in those plants,
3 because my understanding was that they really were not exposed
4 to levels of more than ten or twenty parts per million or even
5 less and so it did not seem relevant. I wanted to find out what
6 vinyl chloride could produce and, therefore, I wanted to look
7 at groups of people who had been exposed to hundreds of parts
8 per million and I did not cover the people that used polyvinyl
9 chloride and who might be exposed to small amounts of vinyl
10 chloride in my review.

11 MR DELLI BOVI: I am going to object to Dr Doll's last
12 answer dealing with levels of vinyl chloride monomer, for
13 lack of proper foundation.

14 BY MR BUNDA:

15 Q I provided you, Doctor, with documents relevant to the
16 levels of vinyl chloride exposures that existed in the Ohio plant
17 that Mr Dendinger and Mr Wallace worked in, have I not?

18 A Yes.

19 Q What is your general understanding of what those levels
20 were as to what you have said before?

21 A My understanding is that those levels were low but not
22 as low as we like to see them now.

23 Q Sir Richard, have you come across any statistics which
24 are important to you with regard to the decrease and level of
25 exposure. I am speaking now of statistics involving those who

URL 11577

1 have incurred angiosarcoma of the liver?

2 A Yes. Well, the angiosarcoma of the liver we take as
3 the marker of exposure to substantial amounts of vinyl chloride.
4 My understanding from studying the register of angiosarcoma cases
5 which is maintained by Imperial Chemical Industries in England
6 and they send me copies of this up-dated register every year,
7 my understanding is that there has not yet been a case of angio-
8 sarcoma recorded in anybody who was first exposed after 1969.
9 That was someone, a case that developed in Germany. I think I
10 am right in saying that no cases have been recorded in American
11 workers who were first exposed after 1964.

12 Q What is the significance of that statistic to you?

13 A Well, it is suggestive, but it is not conclusive. It
14 is suggestive that the reductions in level in concentration that
15 took place in the mid 1960s had reduced the exposure of vinyl
16 chloride workers in the developed countries to levels at which
17 the risk of developing angiosarcoma of the liver is so low that
18 you may not see any more cases. I cannot say you will not see
19 any but you would only see one in a very large number of people.
20 I have to qualify that though to some extent because cancers
21 take some time to be produced after individuals are first exposed
22 and this particular disease tends to occur only fifteen, twenty
23 years or more after first exposure. We had had one case occur,
24 I think nine years after, is the shortest, but we are just coming
25 up to a time now in which it is becoming really interesting that

UPL 11578

1 no new cases are being recorded that have occurred as a result
2 of exposure limited to the period after the mid 1960s because
3 we are getting twenty, twenty-five years after first exposure,
4 but it will still take another five years, I would say, before
5 we can be confident that the reductions that took place in that
6 period were really adequate to eliminate or, if not eliminate,
7 nearly eliminate the risk of the disease.

8 Q Doctor, I would now like to address the specific
9 gentlemen involved in this case, Mr Dendinger and Mr Wallace and
10 the facts surrounding them. I provided you certain materials
11 regarding these two gentlemen?

12 A Yes.

13 Q You have seen certain medical records regarding their
14 cancers?

15 A Yes.

16 Q You understand that Mr Dendinger died of a colon cancer
17 and Mr Wallace died of a mucoepidermoid of the parotid gland?

18 A Yes.

19 Q Do you have an opinion to a reasonable degree of
20 medical certainty about what is known by medical science about
21 these two types of cancers?

22 A I wish I could tell you what the causes of those two
23 types of cancers are. Cancer of the parotid gland is cancer of
24 the group of glands, the salivary glands and we really do not
25 know any causes of these particular types of tumours. They are

URL 11579

1 a little more common among Canadian Indians than any other
2 population. That may be a clue, but I do not know what Canadian
3 Indians do that would produce these diseases. They also occur
4 in families that have a high incidence of cancer of the breast.
5 These types of cancer sometimes occur in families with a genetic
6 susceptibility to cancer of the breast but I know of no cause
7 of cancer of the salivary glands and there is nothing to suggest
8 that vinyl chloride would cause that disease. Cancer of the
9 colon is a different matter. This is a common disease in
10 developed countries. There is quite a good deal of evidence to
11 suggest that most of the cases are determined by the diet of
12 developed countries, particularly the high content of fat and
13 the relative lack of fibre in the diet, but the evidence is not
14 conclusive. I think it is strongly suggestive that both these
15 two factors contribute to the development of the disease but I
16 do not think any epidemiologist would wish to say he thought it
17 was proved that those factors were important. It is something
18 to do with conditions of life of the developed world throughout
19 Europe and North America and Australasia that leads to the pro-
20 duction of these diseases but I cannot put my hand on my heart
21 and say what it is. I am confident that vinyl chloride does not
22 produce this disease.

23 Q Sir Richard, could you explain to the jury what is
24 known by medical science about the types of cancers which are
25 caused by vinyl chloride?

UPL 11580

1 A Yes. We must divide this into two categories of
2 animals and humans. In animals vinyl chloride produces the
3 angiosarcoma of the liver as it does in humans. It also produces
4 squamous sarcoma of the zinnal gland in rats. It possibly
5 produces a few other cancers of the lungs. There was a belief
6 that it produced cancer of the haematopoietic system and lymphatic
7 system originally but this I think is differently interpreted.

8 Q Let us focus on humans.

9 A In humans it produces a particular type of cancer of
10 the liver and I frequently referred to angiosarcoma of the liver
11 intentionally. Cancer of the liver is rare in North America and
12 England but those cancers that do arise in the liver are usually
13 haepatomas, liver cancer cell tumours, but there is this very
14 rare type of cancer of the liver which arises from another type
15 of cell in the liver called an angiosarcoma and this is charac-
16 teristically produced by vinyl chloride. I think there is
17 reason to suspect that it may also cause cancer of the lung to
18 a small extent but that is not proven. I do not think it causes
19 any other cancer in humans.

20 Q Sir Richard, does the fact that as you have indicated,
21 there is research which indicates that vinyl chloride causes
22 cancer in one part of the body, the liver, mean that it can be
23 said that if there is cancer in another part of the body of some-
24 one exposed to vinyl chloride, that vinyl chloride is the cause
25 of that cancer?

URL 11581

1 A No, it certainly does not mean that. From what we
 2 know of the causes of cancer and we know now quite a lot, I
 3 could give you a list of about fifty agents which cause cancer
 4 in humans and with one exception of ionizing radiations which
 5 will cause cancer in practically every tissue, these are all
 6 site specific. They cause cancer in one or perhaps two or three
 7 associated organs but none in more. Tobacco smoke might be
 8 regarded as an exception. That causes cancer in about seven or
 9 eight organs. I am not sure of the recent count, but that is
 10 hardly relevant to your question because tobacco smoke contains
 11 3,000 chemicals and at least 25 different carcinogens. So, the
 12 fact that produces cancer in so many organs is irrelevant to
 13 your question. A specific chemical so far as human experience
 14 goes, produces cancer usually or pretty well always in a very
 15 limited number of organs. The only exception I can think of is
 16 ionizing radiation which will produce cancer in practically
 17 every organ.

18 Q Doctor Doll, I would ask that you base your answer now
 19 and give us an answer to this to a reasonable degree of medical
 20 certainty because that is what the American Courts require. My
 21 question to you is this: Based upon your training, experience
 22 and knowledge in the field of medicine and epidemiology and
 23 based on your research into the area of cancer, specifically as
 24 it relates to vinyl chloride, do you have an opinion to a
 25 reasonable degree of medical certainty as to whether vinyl

UFL 11582

1 chloride was a contributing cause of the parotid gland cancer
2 of Mr Wallace?

3 A Yes I do have.

4 Q What is your opinion?

5 A That it did not cause that cancer.

6 Q What is the basis of that opinion?

7 A The basis of that opinion is that of the workers who
8 have been studied, that had been exposed to very large amounts
9 of vinyl chloride, there has been no excess of tumours of that
10 sort and it is not produced in animal experiments either.

11 Q Mr Wallace was exposed, you indicated, to a lower dose?

12 A I have only the data that you presented me with of the
13 report of the industrial hygienist and that certainly implied
14 it was a much lower dose.

15 Q Does that have any relevance to your conclusion?

16 A Well, it just strengthens the conclusion because one
17 would not expect doses of 1,000 parts per million to produce that
18 type of cancer.

19 Q What did your review of the literature indicate? Are
20 there any indications that that type of cancer was caused by
21 higher levels?

22 A No, no indications at all.

23 Q Based on your training, experience and knowledge in
24 the fields of medicine and epidemiology and your research and
25 review of the medical literature in the area of cancer,

URL 11583

1 specifically as it relates to vinyl chloride, do you have an
2 opinion to a reasonable degree of medical certainty as to whether
3 vinyl chloride was a contributing cause to the colon cancer in
4 Mr Dendinger?

5 A Yes, I do have.

6 Q What is your opinion?

7 A That it was not such a contributory cause.

8 Q What is the basis of your opinion?

9 A Studying these statistics of men exposed to very high
10 doses of vinyl chloride and comparing the risk of colon cancer
11 in those men compared with the risk of developing colon cancer
12 of people in the country at large who were not exposed to vinyl
13 chloride.

14 Q Are these conclusions of yours borne out or indicated
15 in the article you recently published?

16 A Yes.

17 Q Sir Richard, are you familiar with the 1981 study done
18 by an epidemiologist by the name of Leonard Chiazze?

19 A Yes.

20 Q This was done of workers developing cancer using poly-
21 vinyl chloride resins?

22 A Yes.

23 Q These were in areas like Mr Dendinger and Mr Wallace?

24 A My understanding is that that is correct.

25 Q What type of study was that?

JRL 11584

1 A That was a proportionate mortality ratio study.

2 Q And we have already discussed the purpose of that?

3 A Yes.

4 Q Can you remind the jury what that study is used for?

5 A It is used as hypothesis-forming to see if there is
6 any suggestion there might be a specific hazard among a particu-
7 lar group of people investigated.

8 Q Do you recall in that particular study there was a
9 suggestion or a hypothesis that perhaps digestive cancer showed
10 some increase in this group?

11 A Yes, there was indeed.

12 Q How do you resolve that study with the results of your
13 study?

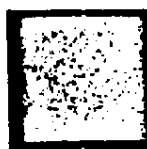
14 A This, as we have said, was a proportionate mortality
15 ratio study and the relatively high proportion of deaths due to
16 cancer of the colon on that study in comparison with deaths of
17 people of the same sex and age in the United States as a whole,
18 was influenced by the fact that the people investigated had a
19 very low proportion of deaths from other diseases, some other
20 diseases, particularly accidents and respiratory disease and this
21 low proportion automatically results in there being a high
22 proportion of some other cause of death, particularly cancers
23 and the proportion of deaths due to cancer as a whole was in-
24 creased in that study. Now, many people - I am surprised
25 Dr Chiazze did not do this - prefer to use what we call a cancer

URL 11585

1 proportional mortality ratio study in which you just look at the
2 proportion of different cancers attributable to cancers in
3 different sites. This is a better indication of a possible risk
4 because cancer as a whole is not really influenced by the
5 selection of workers into a particular industry as the risk of
6 developing cancer as a whole has been shown in many studies
7 where there is no special hazard, to be much the same as in the
8 general population. So, if you look at the distribution of
9 different types of cancer within all the cancers you are much
10 more confident you have something odd if you find that one of
11 those cancers, one type of cancer, shows a higher ratio. I
12 cannot do precisely a proper cancer proportional mortality study
13 on the basis of the published data, but I can make an approximate
14 estimate. If you do that, if you examine the different types
15 of cancer that have caused death, then the excess - and there
16 is some excess from colon cancer - ceases to be what we call
17 technically significant. It is not quite significant. Mind you,
18 if it was significant it would not lead to the conclusion that
19 the work had caused cancer of the colon because if you look at
20 some twelve or fifteen types of cancer, the chances are that you
21 will find that one is unexpectedly common. After all, a 1 in
22 20 chance turns up 1 in 20 times. The statistical test is only
23 a guide to one's thought, that my assessment of the data is that
24 if you look within the different types of cancer there is not
25 really any surprising excess numbers of deaths from cancer of

URL 11586

UPL 11587



1 the colon.

2 Q Of the other studies that you have reviewed, have you
3 found any that have concluded that there is an increased risk
4 of incurring cancer of the colon from vinyl chloride?

5 A I have to qualify my answer to that. My principal
6 studies that I thought gave the best indications of hazards
7 unrelated to vinyl chloride which was 49 plants in the United
8 States, England, Canada and Italy, they actually gave rise to
9 a smaller number of deaths from cancer of the colon than would
10 be expected from the general population. I think it was 30
11 deaths whereas you might have expected 43. This is not a sur-
12 prising deficiency, it is quite within reasonable chance variation.
13 Then I looked at another 7 studies that I called subsidiary
14 studies which, for a variety of reasons did not give such good
15 evidence. The latent periods were not long enough. Various
16 other reasons. There was a small excess, I think 39 against 35
17 expected, but even if you added those into what I call the
18 principal studies, you still find a deficiency of deaths from
19 cancer of the colon. I am not suggesting vinyl chloride protects
20 against developing cancer of the colon, this deficiency is just
21 the sort you would expect quite easily by chance in a study of
22 this size, but looking at the evidence as a whole I am quite
23 confident that there is no suggestion at all of any excess of
24 cancer of the colon on people exposed to high doses of vinyl
25 chloride.

URL 11588

1 Q We talked about the power of studies before. The study
2 which you recently published based upon a review of the other
3 studies that you looked at, the subsidiary studies and the four
4 main studies, how does the power of your study compare to that
5 of Dr Chiazze?

6 A Well, it is qualitatively entirely different. The
7 studies I reviewed give firm evidence. Dr Chiazze's study does
8 nothing more than throw up a hypothesis for testing. Nobody with
9 any experience of epidemiology could draw a conclusion about the
10 cause of disease from the results of Dr Chiazze's study.

11 Q Dr Chiazze's study calls for further investigation?

12 A Yes.

13 Q Was your study the type of further investigation that
14 was called for?

15 A My review was of vinyl chloride workers specifically
16 exposed to the gas itself or the manufacture of polyvinyl chloride.
17 I think Dr Chiazze would say that he was calling for a study of
18 people working with polyvinyl chloride because after all, there are
19 other chemicals to which those people are exposed and the fact
20 that we do not see anything in these diseases that he hypothesized
21 might be produced by vinyl chloride, the fact that we do not see
22 them appear in people that were intensively exposed to it, does
23 not mean to say there was not something in that industry that
24 caused a risk of colon cancer. That, I think, needs investigation,
25 but that is a working hypothesis, nothing more.

URL 11589

1 Q In your opinion, again to a reasonable degree of medical
2 and scientific certainty, is there any scientific basis for
3 claiming either of these two cancers were due to the exposure
4 to vinyl chloride?

5 A There is no reason for concluding that at all.

6 MR BUNDA: Thank you very much, that is all the
7 questions I have.

8 (Whereupon there followed a discussion off the record)

9 (Whereupon there followed the luncheon adjournment)

10 CROSS EXAMINATION

11 BY MR DELLI BOVI:

12 Q My name is Kirk Delli Bovi, we have been introduced
13 before. I represent the Plaintiffs in this case and I have a
14 few quesitons I would like to ask you this afternoon. Is it
15 your understanding that Mr Dendinger and Mr Wallace were employed
16 not in the vinyl chloride industry or in the polyvinyl chloride
17 producing industry, but in the PVC fabrication industry?

18 A Yes.

19 Q Can you tell me what epidemiological or other studies
20 you are aware of that pertain to workers in the industry in which
21 Mr Dendinger and Mr Wallace worked, that is the PVC fabrication
22 industry?

23 A There is one by Dr Chiazze and a colleague. There is
24 a Swedish study, I am afraid I forget the names of the authors
25 and there has been a recent study, I think unpublished, by a

DRL 11590

1 doctor of the particular industry in which Mr Wallace and
2 Mr Dendinger worked. Those are the only three that I can recall
3 at the moment.

4 Q In terms of your opinions in this case, have you relied
5 upon any of the three studies that you have just cited, per-
6 taining to workers in the PVC fabrication industry?

7 A I have not specifically studied the PVC fabrication
8 industry. I have studied the effects of exposure to vinyl
9 chloride and the evidence I have given has been in relation to
10 exposure to vinyl chloride.

11 Q In the paper that you wrote for the Scandinavian
12 journal "Work, Environment and Health", you indicated, did you
13 not, that in formulating opinions concerning the aetiology of
14 cancer, it is important to look at all of the evidence?

15 A Yes, whether I said it in the paper I do not know, but
16 I certainly believe it.

17 Q Now, when you prepared your paper for that Scandinavian
18 journal, did you include ^{at} the end of it a list of the references
19 that you consulted in preparation of that work?

20 A Yes.

21 Q And there are a list of some fifty references that you
22 consulted that you relied on in whole or in part or to a limited
23 extent in preparing that work?

24 A Yes. I did not read one of them actually, it was a
25 Russian one. I only quoted it on the basis of somebody else's

LRL 11591

1 analysis of it.

2 Q Did you rely to any extent on Dr Chiazze's study in
3 authoring your paper entitled "Effects of exposure to vinyl
4 chloride -- an assessment of the evidence"?

5 A No, I did not. I read the paper but I specifically
6 excluded it. As you will see, I stated in that paper that I did
7 not include in my review, reports of polyvinyl chloride fabri-
8 cators as it was my understanding that the amount of vinyl
9 chloride which people in that industry would have been exposed
10 to was substantially less than people were exposed to in the
11 PVC manufacturing industry and my specific concern was with
12 vinyl chloride, not with the effects of any other chemicals that
13 might be found in the fabricating industry.

14 Q What was the source of your assumption or your under-
15 standing that the levels of worker exposure in the PVC fabri-
16 cating industry were lower than those in the PVC resin producing
17 industry?

18 A Two items of information. One, the information that
19 I was given by medical officers in Imperial Chemical Industries
20 with whom I am on professional terms and the other was the
21 absence at that time of reports of angiosarcoma of the liver
22 which I regard as an indicator of vinyl chloride exposure in
23 people in industries other than the vinyl chloride monomer of
24 polyvinyl chloride manufacturing industries.

25 Q Have you ever seen any data from any plants in the

URL 11592

1 United States comparing levels of vinyl chloride in the work-
2 place atmospheres in fabrication plants as opposed to resin
3 manufacturing plants?

4 A I have no direct knowledge of levels in American
5 fabrication plants other than the information provided to me by
6 the investigators at the particular plant in which Messrs Wallace
7 and Dendinger were employed, but as to the rest of the industry
8 I have no personal knowledge of it.

9 Q When you were presented with the data from the Chrysler
10 facility where Mr Dendinger and Mr Wallace were employed, were
11 you given any understanding as to the time frame encompassed by
12 that data?

13 A Yes. I am speaking from memory now. I would like to
14 check it, but I think the observations were made around the
15 middle 1970s but if I am wrong, please tell me.

16 Q Are you aware that the observations all the data that
17 was furnished to you regarding vinyl chloride levels in the work-
18 place atmospheres in that plant were all subsequent to the public
19 announcement of the Goodrich nagiosarcoma deaths?

20 A I think they must have been, yes. I am assuming they
21 were.

22 Q Is it your understanding, based upon your knowledge
23 of the industry, that the workplace levels of vinyl chloride
24 would have been higher prior to the public announcement of the
25 Goodrich angiosarcoma deaths?

URL 11593

1 A The levels in the manufacturing industry were certainly
2 higher before that but whether they could have been higher in
3 the PVC fabrication industry I do not know because I do not know
4 how much vinyl chloride could have been released from manufac-
5 tured PVC. I would be guessing. It does not necessarily follow
6 that they were higher, but they could have been higher.

7 Q Do you have any knowledge as to the mechanism by
8 which workers in a PVC fabrication plant would become exposed
9 to vinyl chloride?

10 A No intimate knowledge, no.

11 Q Have you been provided with any information by the
12 PVC manufacturers as to the method by which PVC fabrication
13 workers can be exposed to vinyl chloride?

14 A Not that I would call any serious account, no.

15 Q I am going to hand you what I have marked as Plaintiffs
16 Exhibit Doll 2. Could you identify that, sir, as the work of
17 Dr Chiazze that appeared in the scientific journal in the United
18 States in 1981. (Document handed to the witness)

19 A Yes.

20 Q In terms of the size of that study, looking at the
21 number of deaths Dr Chiazze analysed, how does the size of
22 Dr Chiazze's study compare to the size of all the studies that
23 you considered in preparing your Scandinavian journal?

24 A Insofar as it relates to exposure to vinyl chloride,
25 I cannot say, because Dr Chiazze's study does not say what

JRL 11594

1 proportion of the 17,000 odd workers that were probably involved
 2 were exposed to vinyl chloride, though he does say somewhere that
 3 the proportion - at least if my memory is correct - that it was
 4 only a relatively small proportion so I cannot answer that lev
 5 question except to say to the best of my belief it is a somewhat
 6 smaller total number of people exposed to vinyl chloride than
 7 in the studies which I reviewed.

8 Q My question, Dr Doll, dealt with the number of worker
 9 deaths that Dr Chiazze analysed compared to the total number of
 10 deaths analysed in the review that you did.

11 A The total number is slightly less than the total number
 12 in the review that I did.

13 Q Dr Chiazze's study involved the deaths of 3,847 workers?

14 A So I believe, yes. I think my studies covered some
 15 5,000 workers, if I remember correctly, but I would need to
 16 check. Some 5,000 deaths, I mean.

17 Q Why don't we take a look at that if we could. Could you
 18 have a copy of your report handy? Could you indicate to me, Dr
 19 Doll, the total number of deaths that were analysed by you
 20 in your review?

21 A Yes, I am just trying to check. It must have been less.
 22 (Pause) No, I am sorry, my memory was at fault. I was thinking
 23 of another review I have just done on formaldehyde. The total
 24 number is nearer 2,000, not 5,000.

25 Q Could we break that down please for the individual

URL 11595

1 studies you analysed. How many deaths were involved in the
2 United States?

3 A 1,136.

4 Q And in the United Kingdom study?

5 A 780.

6 Q Canadian?

7 A 59.

8 Q And the Italian study?

9 A 66.

10 Q So in terms of the total number of deaths encompassed
11 by the studies, the Chiazze study looked at substantially more
12 deaths than all of the studies covered by your review?

13 A Yes, that is true.

14 Q As a result---

15 A Just a minute, let me see what the subsidiary studies
16 were. Where are we now? We will have to add these up. (Pause)
17 Yes, I think the total of the subsidiary studies still probably
18 come to somewhat less than the total reported by Dr Chiazze.

19 Q Now in terms of the conclusions that Dr Chiazze drew
20 from his proportional mortality ratio study, he determined that
21 there were statistically significant increases in cancers of the
22 large intestine in both the male and female deaths, did he not?

23 A No, he did not. His sort of study can tell you nothing
24 about the incidence and consequently the increase in the amount
25 of cancer. What he showed was that if the distribution of deaths

JRL 11596

1 were to be expected to be the same as the distribution of deaths
2 in the American population of people of the same sex and the same
3 age, then the sort of distribution that he observed was unlikely
4 to have been obtained by chance, but that says nothing about an
5 increase or decrease in them because that is a purely proportional
6 distribution and a high proportion of one cause of death may be
7 due to a low proportion of another type of death, so you can
8 draw no conclusions about the actual incidence of the disease,
9 of mortality from the disease as Dr Chiazze is careful to point
10 out in his study.

11 Q Let me read to you, doctor, one of the sentences from
12 Dr Chiazze's conclusion and ask you whether you agree or disagree
13 with his statement: "PMRs are significantly different from unity
14 for all cancers and for cancers of the digestive system among
15 both white males and white females".

16 A Yes, that is what I have just been saying. It is in
17 a different form, but essentially what I say.

18 Q So, in terms of comparing PVC fabrication employees
19 to the general population, Dr Chiazze found statistically signifi-
20 cant increases in the proportion of large intestine cancers in
21 both the male and female PVC fabrication workers?

22 A No, I do not think you could say significant increases.
23 He would say significant differences in the distribution and
24 this may have been due to significant decreases in the other
25 causes. So, a proportional mortality study of the sort he did

JAL 11597

1 is not capable, as Dr Chiazze points out in his article, of
2 telling you whether there is an increase or not. He is showing
3 that the distribution is different and now we have to assess and
4 try to determine why the proportion is different.

5 Q One of the limitations you indicated in your direct
6 examination on Dr Chiazze's study, was that the increases in the
7 large intestine cancers may have been attributable to correspond-
8 ing decreases in other causes of death, for example, accidental
9 death, suicides, heart disease, things of that nature?

10 A Yes.

11 Q And you indicated in your direct examination that a
12 cancer proportionate mortality ratio study would have been a
13 better indication of the possible risk and that if that calcu-
14 lation had been done, you would have been much more confident
15 that something odd had occurred?

16 A Yes, it would have been a better basis for producing
17 a hypothesis.

18 Q Dr Doll, since reviewing Dr Chiazze's work, have you
19 made any effort to take Dr Chiazze's data and determine the
20 cancer proportionate mortality ratios for the total number of
21 cancers and for the large intestine cancers?

22 A Yes.

23 Q Have you brought any of those calculations with you?

24 A No, I have not brought them with me on paper, I have
25 brought them in my head.

UPL 11598

1 Q Your opinion was that if Dr Chiazze's PMR calculations
2 for total cancers and large intestine cancers were converted to
3 CPMRs, that the increased proportions of total cancer deaths and
4 large intestine cancer deaths would not be statistically signifi-
5 cant?

6 A I must qualify that statement as I did earlier by
7 saying I could only make an approximate calculation on the basis
8 of the data available to me and the approximate calculation I
9 made suggested they were not statistically significant but I
10 would not exclude the possibility that if a proper cancer
11 proportionate mortality ratio was done, they would just be on
12 the other side of the 1 in 20 significance level which we usually
13 use, purely arbitrarily, to decide what is significant or not.
14 I think only Dr Chiazze could make such calculations, as you need
15 to have the basic data by broken down small age groups and
16 different calendar years.

17 Q So, it is your belief then that if Dr Chiazze's PMR
18 figures were converted to CPMR figures, that they would still
19 show an elevation in the incidence of large intestine cancers?

20 A I am sure they would show an elevation in comparison
21 with the proportion of deaths normally attributed to cancer of
22 the large bowel in the American population, but I am not at all
23 sure that that elevation would be such that one would regard it
24 as being a particularly unusual event.

25 Q Do you attach any significance to the fact that in his

URL 11539

1 PMR study, Dr Chiazze found increases in the proportion of large
2 intestine cancers of statistical significance for both males and
3 females?

4 A Not particularly, no. I suppose insofar as it implies
5 anything, if it were to be regarded as implying an occupational
6 hazard, it would weigh against it as women would be unlikely to
7 be employed on the same type of occupation as men.

8 Q Was there any indication in Dr Chiazze's study that
9 the women employees that he surveyed were performing different
10 jobs than the male employees?

11 A I cannot remember.

12 Q Would you like to take a look at his study and see if
13 it draws any such distinction?

14 A I am afraid it might take me five minutes to read it.

15 Q Certainly. Would you like to go off the record?

16 A Yes please.

17 (Off the record)

18 BY THE WITNESS:

19 A Yes, I have read the paper and there is a strong
20 implication that there is different exposures for men and women
21 but no specific statement to that effect. I have drawn that
22 conclusion from ordinary experience of factories and the fact
23 that 72% of the women had no exposure to vinyl chloride and 12.6%
24 had improbable exposure and that a proportion of the workers were
25 office and clerical workers. So, it seems to me the ordinary

JPL 11600

1 conclusion to be drawn from that was that the women did different
2 jobs from the men but Dr Chiazze does not state that in his paper.

3 BY MR. DELLI BOVI:

4 Q That is an implication you have drawn from his work?

5 A Yes an implication I have drawn from his paper.

6 Q In his study, Dr Chiazze found statistically different
7 increases in the proportion of total cancers, large intestine
8 cancers and others and unspecified cancers in both males and
9 females, did he not?

10 A Would you mind repeating that, I missed the first part
11 of the question?

12 Q In his study, Dr Chiazze reported statistically signifi-
13 cant increases in the proportion of all cancers, large intestine
14 cancers and other and unspecified cancers in both males and
15 females?

16 A No, I do not think he reported significant increases
17 in the proportion of cancers due to large intestines. He reported
18 significant differences in the proportion of total deaths due
19 to large bowel cancers. We pointed out earlier that a cancer
20 proportionate mortality study probably did not show a significant
21 increase in the proportion of cancer deaths due to large bowel
22 cancer.

23 Q I would like you to take a look, if you would, at either
24 Table 3 of Table 4 from Dr Chiazze's study, which ever one you
25 prefer to work with.

URL 11601

1 A This is the second publication, is it not?

2 Q Yes, it is. The first one reports it in terms of
3 United States mortality. You do not mind if I look over your
4 shoulder, I did not bring another copy. Table 3 reports using
5 U.S. mortality up to 1968. Table 4 shows U.S. mortality figures
6 for individual years between 1964 and 1973. Would you feel more
7 comfortable using the individual years?

8 A It is not that I would feel more comfortable, the data
9 for the individual years are the data that are remotely relevant.
10 The data for using the single year for comparison was something
11 to provide a further indication of what the results might be but
12 neither Dr Chiazze nor myself would attach any significance to
13 the data in Table 3 when we have the data in Table 4 available.

14 Q Let us use Table 4 then. In terms of all cancer among
15 male PVC fabrication employees, what was the PMR that Dr Chiazze
16 calculated?

17 A For what?

18 Q All cancers among male PVC fabrication employees.

19 A 1.1567.

20 Q Did Dr Chiazze determine that that figure was statisti-
21 cally significant?

22 A Yes, he showed it was significantly different from the
23 proportion to be expected from the distribution of the deaths
24 in the U.S. population at the same period.

25 Q Can you determine by what percentage the figure

JRL 11602

1 represented an increase over that expected in the general
2 population?

3 A I do not think that necessarily indicated any increase
4 in cancer mortality in the general population at all. It is
5 reflecting the fact that there were relatively few deaths from
6 accidents in this population and very few from diseases of the
7 respiratory system and cirrhosis of the liver.

8 Q And the decrease in those deaths is largely attribu-
9 table to what has been called a healthy worker effect?

10 A Healthy worker effect is a very complex phenomenon
11 which has two or three components in it. In this case it reflects
12 what is a common - - it partly reflects what is a common
13 experience of any employed workers compared with the national
14 expectation, that is a reduction in the mortality of a number
15 of important diseases but, of course, in some industries the
16 accident rate may be a good deal higher than in the population
17 at large. Here we have an industry with a relatively low accident
18 rate. I would not call that a healthy worker effect. That is
19 an effect of a well run industry or an industry with very little
20 hazards. The healthy worker effect is composed of several
21 components, one of which is the effect of observing a mortality
22 in a group of people who are healthy enough to start employment
23 when you begin and the first few years of any follow up study
24 invariably shows a low mortality for the first few years because
25 you have, by definition, included only people who were healthy

UPL 11603

1 to be in employment at the beginning, but then this wears off
2 with the passage of time. Then there is a second aspect of the
3 healthy worker effect which is that people with certain chronic
4 diseases that are liable to give rise to high death rate, do not
5 get employed in industry, so that they are a selected population
6 and this often gives rise to low mortality, for example, from
7 chronic respiratory disease or from cirrhosis of the liver.

8 Q Before you finish your answer, the Court Reporter has
9 indicated we are about to run out of video tape so why don't we
10 change the tape.

11 (Whereupon there followed a discussion off the record)

12 (Whereupon there followed a short adjournment)

13 BY MR DELLI BOVI:

14 Q Dr Doll, have you concluded your answer?

15 A Yes.

16 Q With that answer in mind, can you tell me whether or
17 not the lower reported death rates/^{that}were proportionately lower
18 death rates in Dr Chiazze's studies for causes other than cancer,
19 are attributable to a significant extent to the healthy worker
20 effect?

21 A I cannot say for certain, I would expect they were.

22 Q Going back to the male fabrication employees and all
23 cancers and the PMR of 1.1567 that Dr Chiazze reported, what does
24 that indicate in terms of the proportion of male employees who
25 died of cancer versus the proportion of people in the general

URL 11604

1 population that died of cancer as opposed to some other cause
2 of death?

3 A I am not sure. I should have to do a calculation.
4 Of course, another factor which has to be taken into account is
5 this comparison is a comparison with the whole of the United
6 States and not with a comparison with the people of Ohio which
7 would, of course, again alter the proportions, but I am afraid
8 I cannot answer your question without some calculations.

9 Q Let me ask it another way. If male PVC fabrication
10 workers were dying of cancer as a proportion of the total deaths,
11 at the same rate as the general population was, would the PMR
12 be 1.00?

13 A I think I will have to ask you to repeat that question.

14 Q Sure.

15 A Would you take it at dictation speed so I can get it
16 down?

17 Q Certainly.

18 A Or perhaps the simplest thing would be to ask the
19 Court Reporter to read it to me.

20 Q Whatever your preference is. (To the Reporter) Would
21 you read the question back, please?

22 (The Reporter read back the relevant passage)

23 BY THE WITNESS:

24 A Yes, well I have got that question now and I am afraid
25 it is a nonsense question because it is confusing proportions

URL 11605

1 and rates so there is no possible way in which I can answer it.

2 BY MR DELLI BOVI:

3 Q How would you like the question phrased so you can
4 answer it in order to tell me why Dr Chiazze concluded that his
5 figure of 1.1567 for the male PVC fabrication cancer employee
6 deaths was statistically significant?

7 A That is quite simple. That is a different question
8 altogether. What he was testing was the comparison of the dis-
9 tribution of the causes of death as recorded in the deaths that
10 he knew about with the distribution of the causes of death as
11 recorded nationally at the same time and what he was able to
12 conclude was - and I would agree with him in this - that the
13 proportion of deaths in this group was a different proportion
14 from that recorded in the general population and that the fact
15 that it was different was unlikely, though not impossible,
16 unlikely to be due to chance, though it might be, but I would
17 agree with him that it probably was not.

18 Q That it was not due to chance?

19 A I would agree with him that it was probably not due
20 to chance because I can think of a lot of better reasons, but,
21 of course, it could be.

22 Q The probability that it was due to chance as opposed
23 to some other factor was less than 20%?

24 A I think you mean less than 5%.

25 Q Less than ---

JPL 11606

1 A Well again, you cannot answer that question. That is
2 not what the statistic says. That statistic does not tell you
3 what the probability is that it was a particular figure. What
4 it tells you is that if the distribution had been the same as
5 that of the national population over the same period, in only
6 1 in 20 comparable studies would the PMR have been as great as
7 that found, or greater.

8 Q So, the odds are 1 in 20 that that particular finding
9 was a chance finding?

10 A This could have occurred by chance once in twenty times
11 or actually he says the probability is less than 1 in 20. I do
12 not know how much. Something between 1 in 20 and 1 in a hundred.

13 Q Can we fairly say then that he was confident to the
14 95% level that his finding was due to something other than chance?

15 A No, that is deduction which no statistician would make.
16 You cannot have levels of confidence. You might be 100% con-
17 fident it was due to chance even though it was, it appeared on
18 paper to be a very improbable thing. For example, if I took a
19 dice out of my pocket and threw it six times and it came up six
20 every time, I would not be 95% confident that was not due to
21 chance. I would be 100% confident it was due to chance although
22 it was a very improbable event, so you cannot draw any conclusions
23 about the confidence with which you draw a conclusion about the
24 meaning of the findings. That is based on a whole lot of other
25 evidence.

URL 11607

1 Q In terms of the male PVC fabrication employees' cancer
2 deaths, the proportion of deaths among those workers was different
3 to a statistically significant level from the proportion of
4 deaths in the general population?

5 A In the United States over the same period, yes.

6 Q And Dr Chiazze came to an identical result and identi-
7 cal finding with respect to the female PVC workers?

8 A Yes.

9 Q Again, as with the male, the odds of that finding in
10 the female PVC fabrication workers was 1 in 20?

11 A Less than.

12 Q Less than 1 in 20?

13 A Yes.

14 Q And Dr Chiazze came to a similar conclusion with
15 respect to the proportion of large intestine cancer deaths among
16 male PVC fabrication employees?

17 A Yes.

18 Q And also with respect to the female employees in that
19 category?

20 A Yes.

21 Q Then with respect to the other and unspecified cancers,
22 Dr Chiazze again came to a statistically significant finding,
23 did he not?

24 A Yes.

25 Q Both with regard to the male employees and with regard

JRL 11608

1 to the female employees?

2 A Yes.

3 Q Have you reviewed at all, Dr Doll, in preparation for
4 your testimony today, the 1976 study of Baxter and Fox?

5 A No.

6 Q Do you know whether or not in their study they reported
7 an increase in mortality due to stomach cancers?

8 A I am afraid you will have to remind me of this study,
9 I forget it.

10 Q Baxter and Fox Angiosarcoma of the Liver in PVC
11 Fabricators, an article that appeared in the Lancet at page 245
12 in 1976. Have you reviewed that study of PVC fabricator employees
13 prior to testifying here today?

14 A No. I am sorry, I will have to look at the paper.
15 I do not think I have.

16 Q I did not bring the paper with me. All I have is the
17 reference to the paper.

18 A Can you remind me of the reference again?

19 Q Baxter and Fox, Angiosarcoma of the Liver in PVC
20 Fabricators, an article that appeared in the Lancet on page 245
21 in 1976.

22 A I cannot recall having reviewed that. Why I am hesi-
23 tating is because I am not sure whether those workers were sub-
24 sumed subsequently into the study done by Jones of all vinyl
25 chloride workers in this country. I am not sure if they were

URL 11609

1 subsumed into this.

2 Q Well, the Baxter and Fox could not be subsumed in Jones'
3 work because Baxter and Fox dealt with PVC fabrications while
4 Jones dealt with PVC manufacturing employees and vinyl chloride
5 manufacturing employees.

6 A If it was purely PVC fabrication and did not involve
7 the manufacture of vinyl chloride or polyvinyl chloride in the
8 same plant, then I have not reviewed it and I have specifically
9 stated that I excluded such data from my review.

10 MR BUNDA: I am going to object to the characterization
11 of counsel of the Baxter and Fox study presented to the
12 witness for his review.

13 BY MR DELLI BOVI:

14 Q Let me refer you, Dr Doll, to an article entitled:
15 "Occupational hazards in the PVC industry", written by William
16 Nicholson. You know Dr Nicholson?

17 A Yes, I do.

18 Q In which he states at page 170: "Interestingly, an
19 excess of stomach cancer was seen in the proportional mortality study of Baxter and Fox."
20 The last sentence. Do I quote accurately from Dr Nicholson's
21 article?

22 A Yes.

23 MR BUNDA: What page was that?

24 MR DELLI BOVI: 170.
25

URL 11610

1 BY MR DELLI BOVI:

2 Q In addition to the Baxter and Fox article that you did
3 not review and the Chiazze article which you did not rely on,
4 you referred to a Swedish study and you forgot the name of the
5 author of that study?

6 A Is that Molina?

7 Q Yes.

8 A I specifically excluded that for a number of reasons.

9 Q What I would like to ask you, Dr Doll, is in your
10 paper that you wrote in 1988, you did refer to two studies done
11 in Sweden at page 66, the top of the right-hand column?

12 A Yes.

13 Q The Swedish study that you relied on that covered two
14 plants was done by Byren and others in 1976?

15 A Yes.

16 Q And that involved workers in plants producing vinyl
17 chloride and polyvinyl chloride?

18 A Yes.

19 Q It did not include PVC fabrication workers?

20 A No.

21 Q So for purposes of your article and the opinions you
22 have given here today, you have relied on a 1976 Swedish study
23 of vinyl chloride and PVC manufacturing employees, but not the
24 1981 Swedish study of PVC fabrication workers?

25 A I read the one on PVC fabrication workers and decided

URL 11611